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POWER OF ATTORNEY and CORRESPONDENCE ADDRESS INDICATION FORM

Application Number	
Filing Date	July 22, 2005
First Named Inventor	Ferguson, et al.
Title	A HUMAN MOVEMENT MEASUREMENT SYSTEM
Art Unit	Not yet known
Examiner Name	Not yet known
Attorney Docket Number	FER1947-002B

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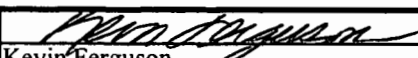
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Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record

Signature		Date	7/21/2005
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PTO/SB/81 (11-04)

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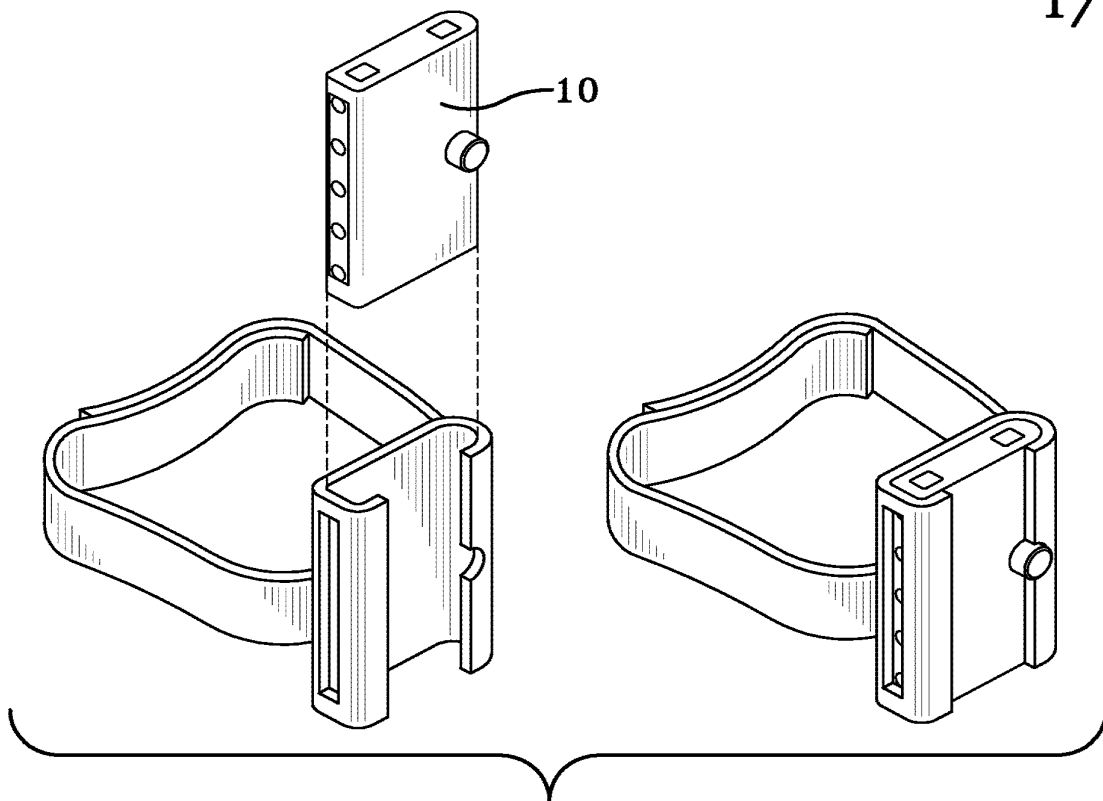


FIG-1A

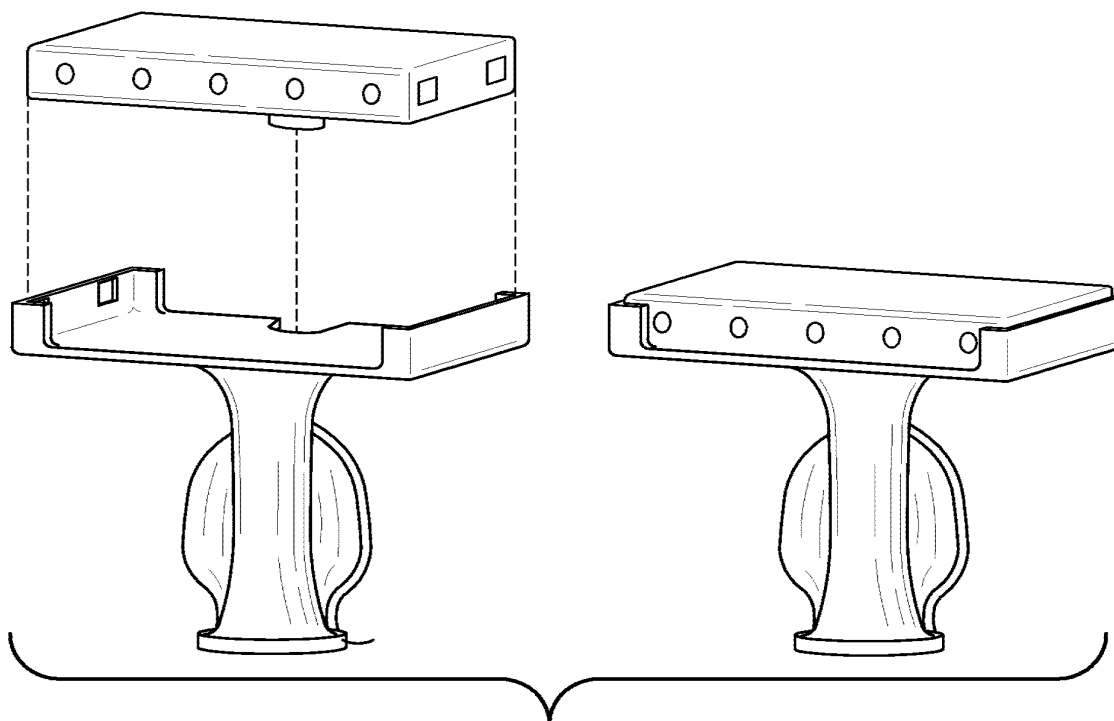


FIG-1B

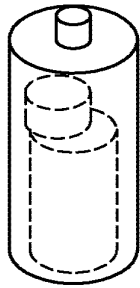


FIG-2A

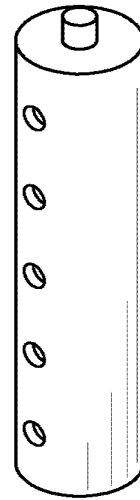


FIG-2B

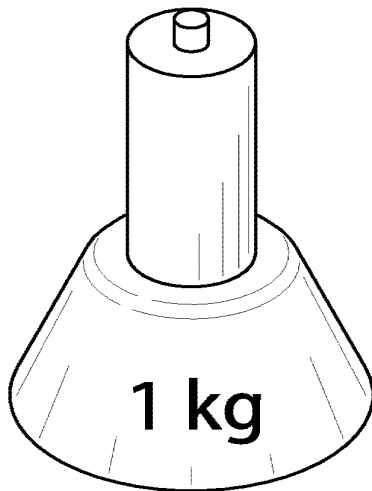


FIG-2C

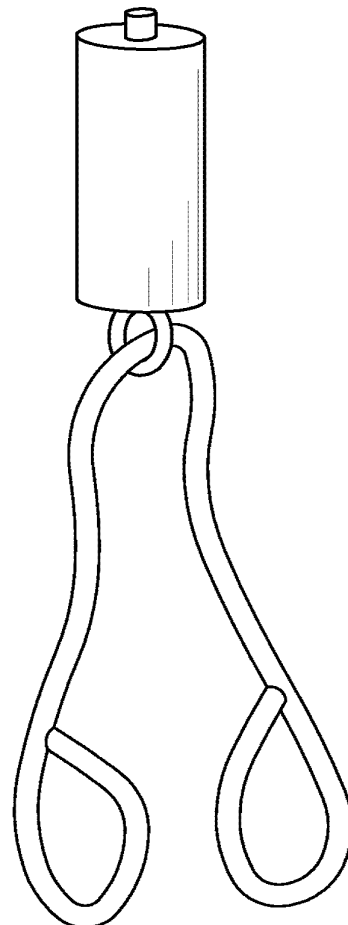


FIG-2D

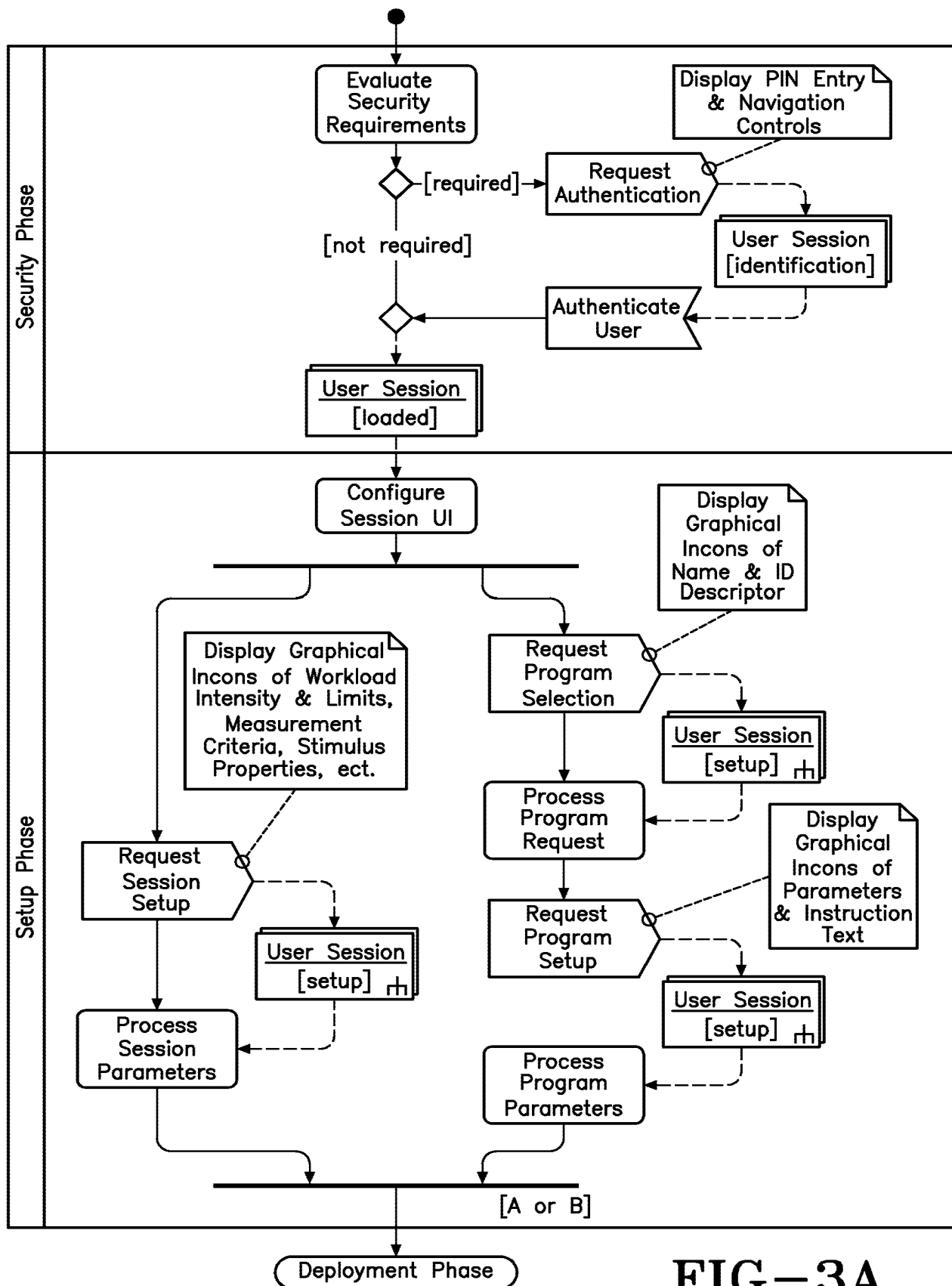
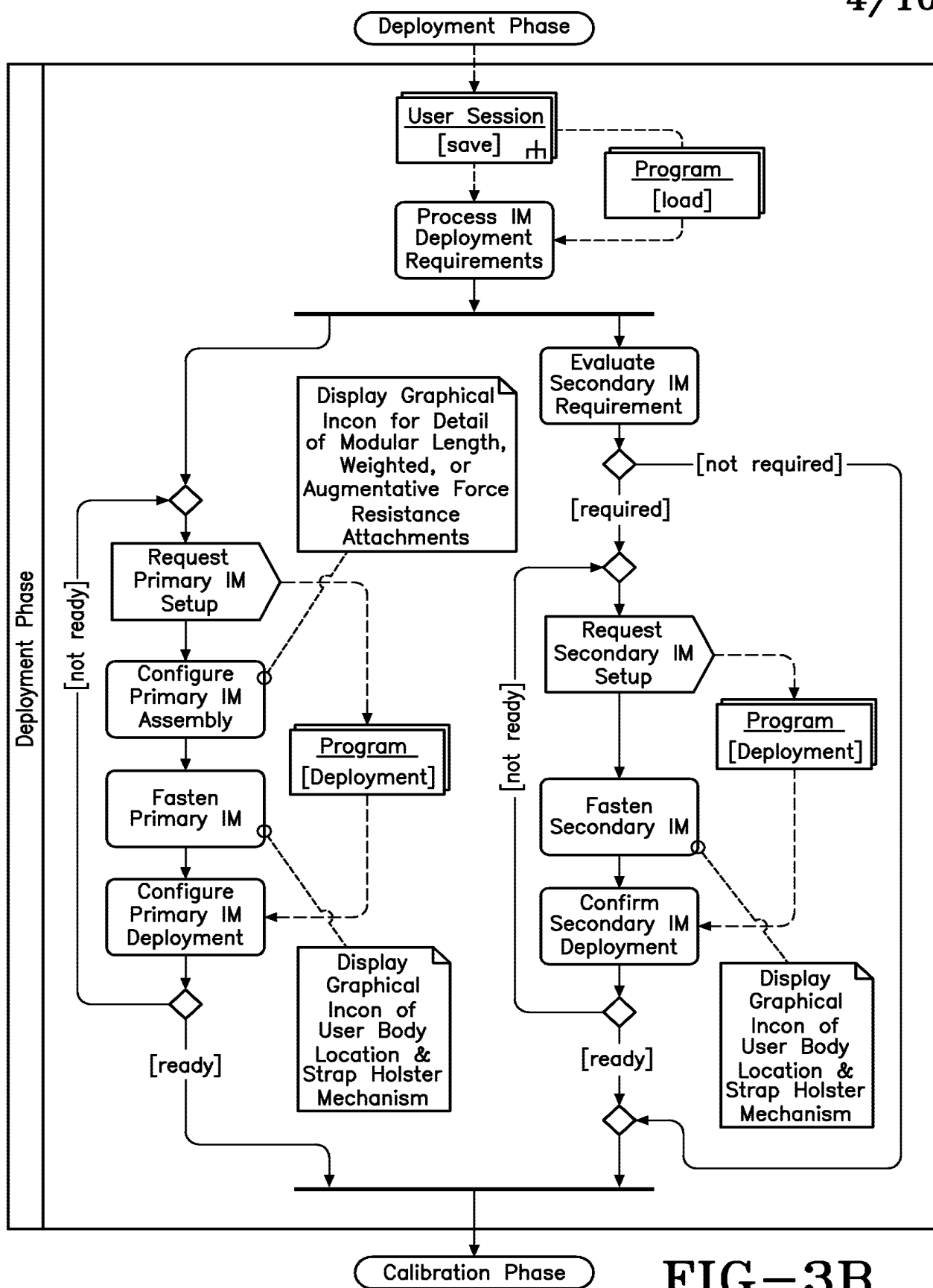
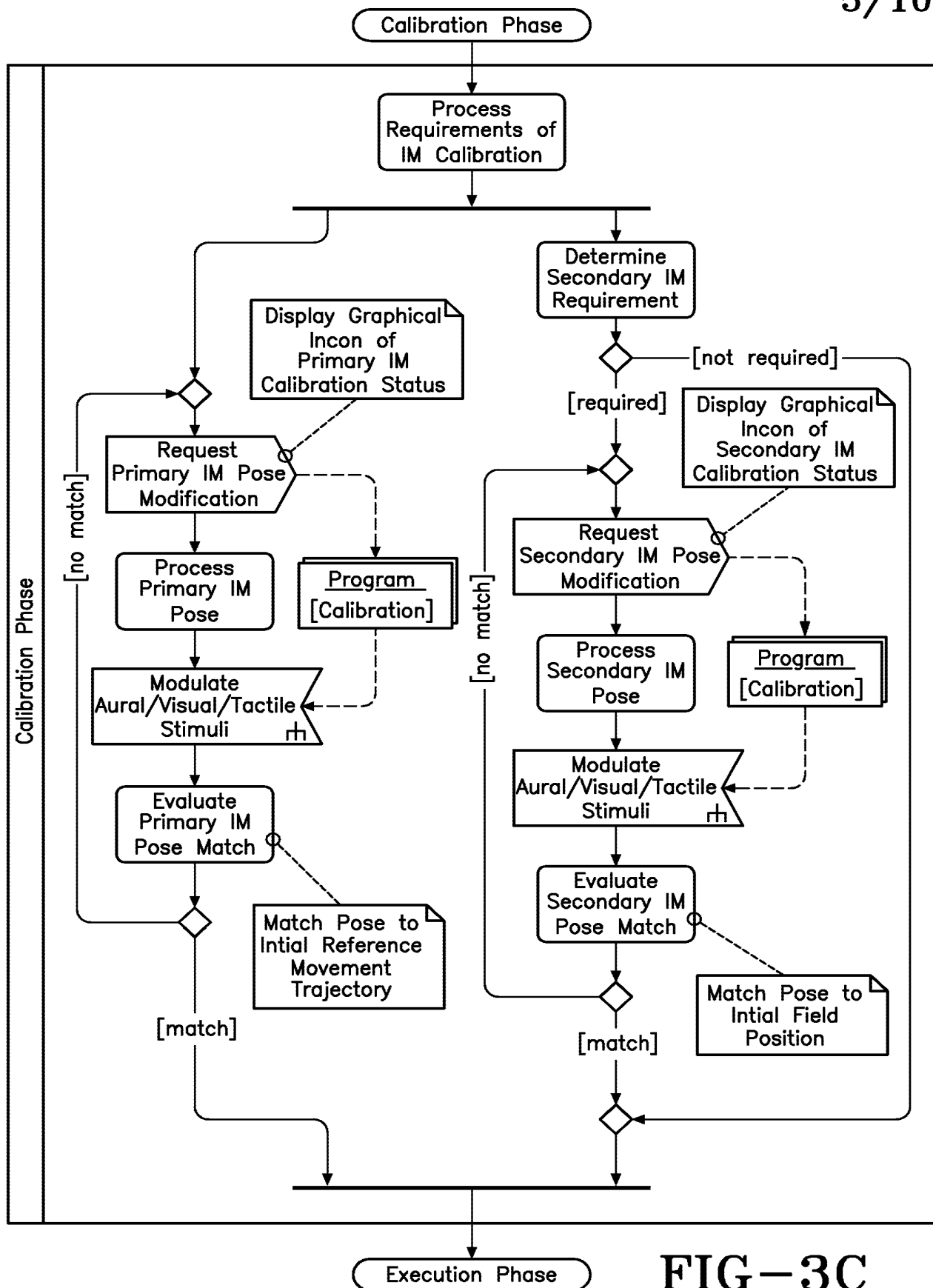
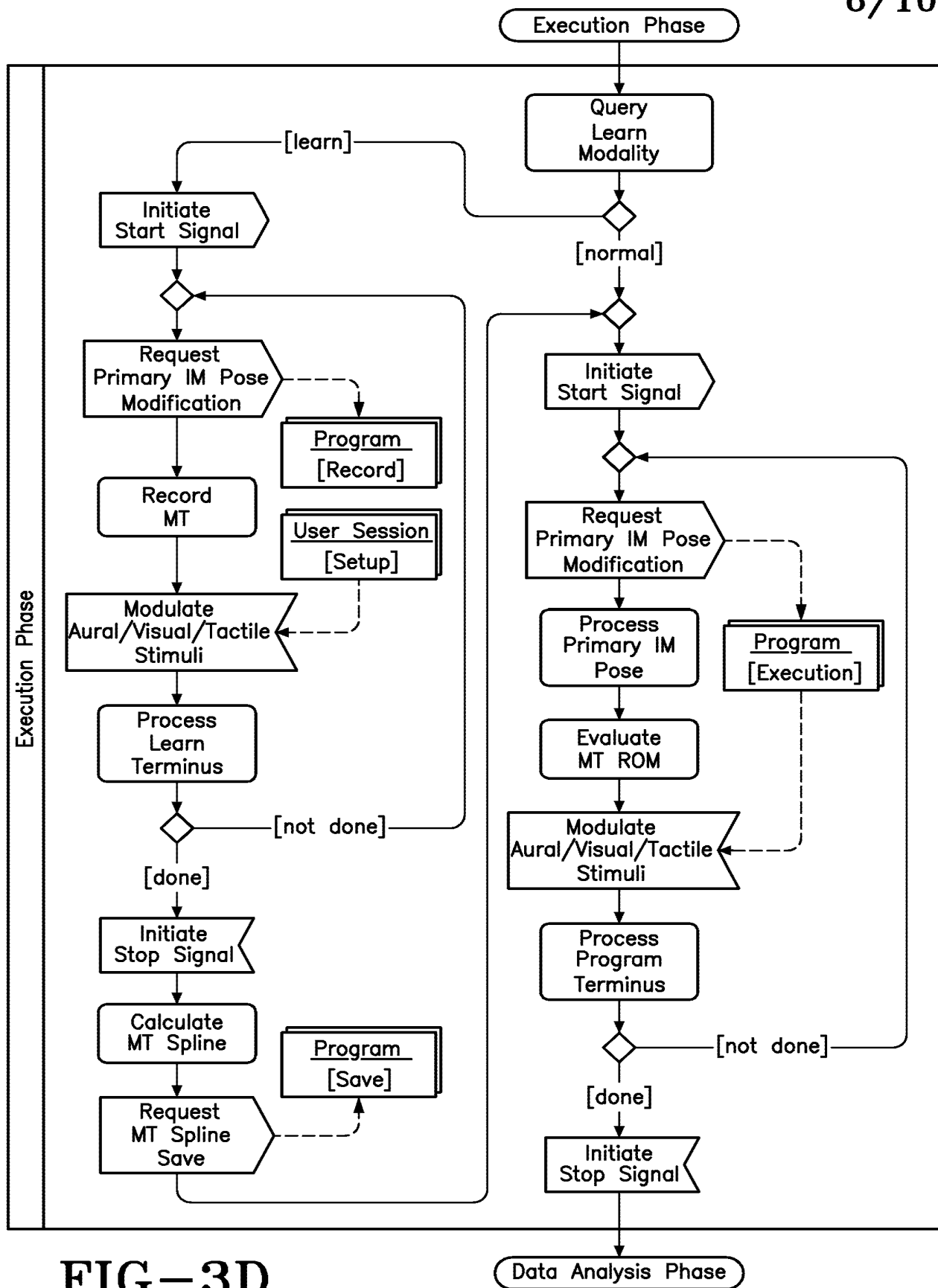


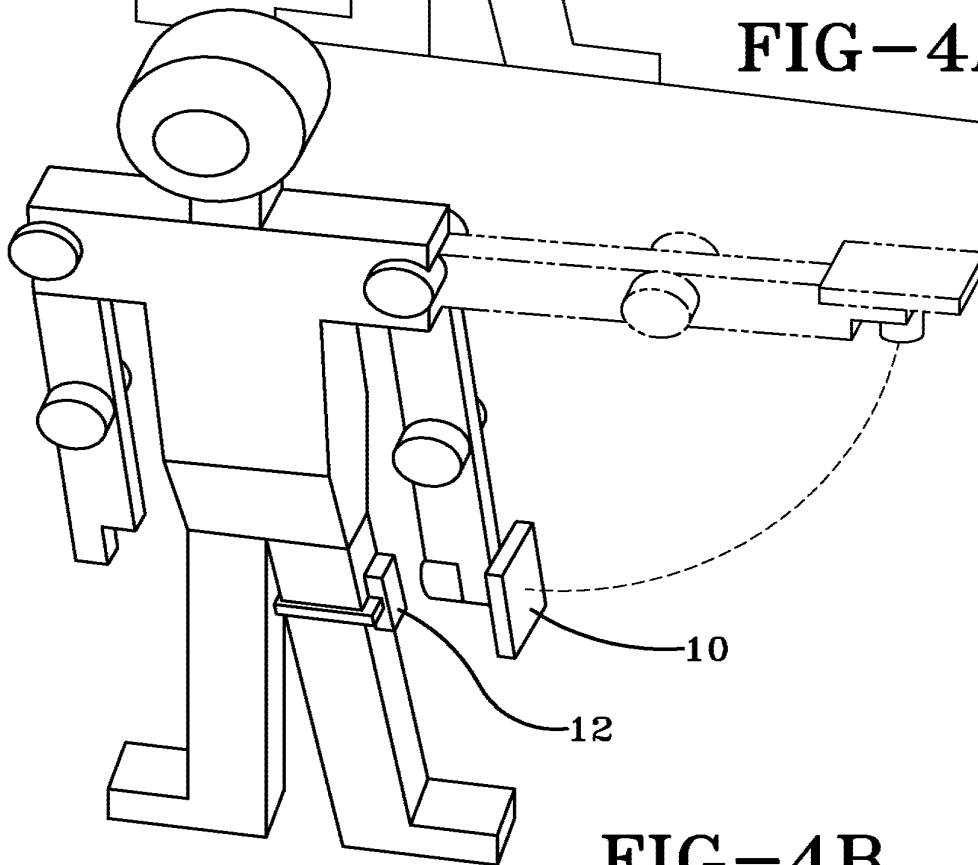
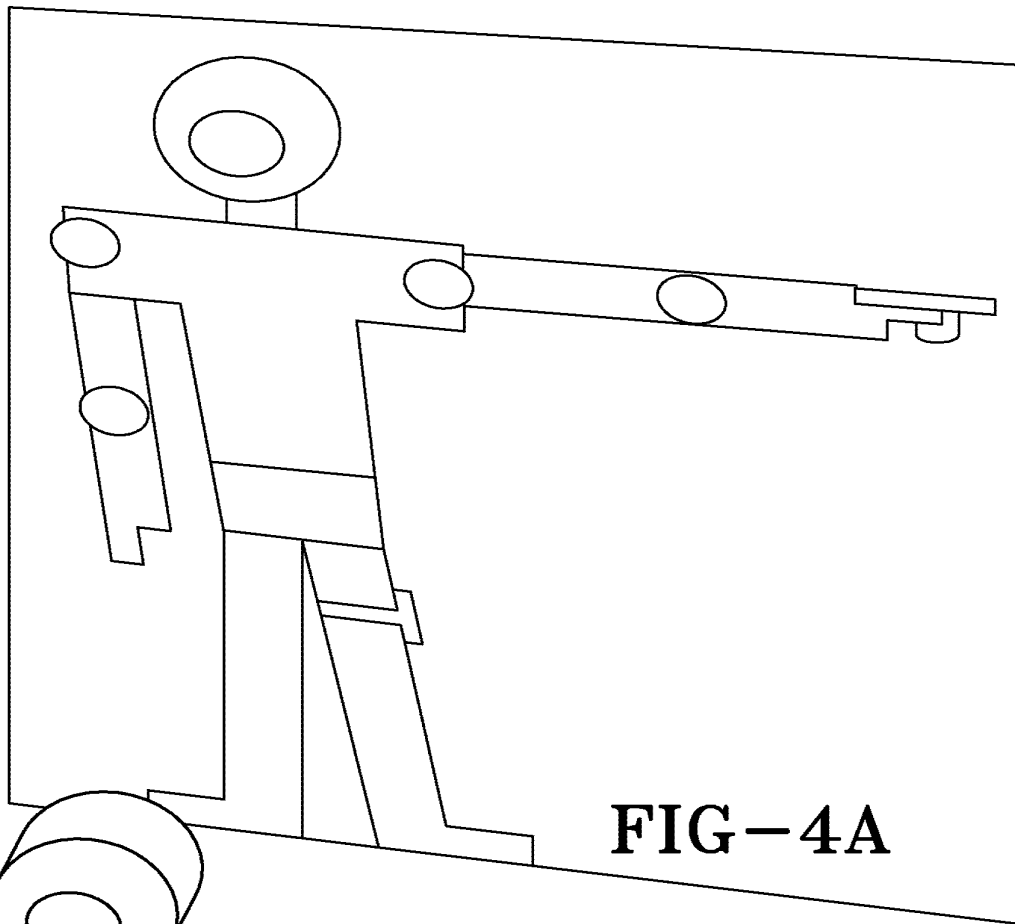
FIG-3A







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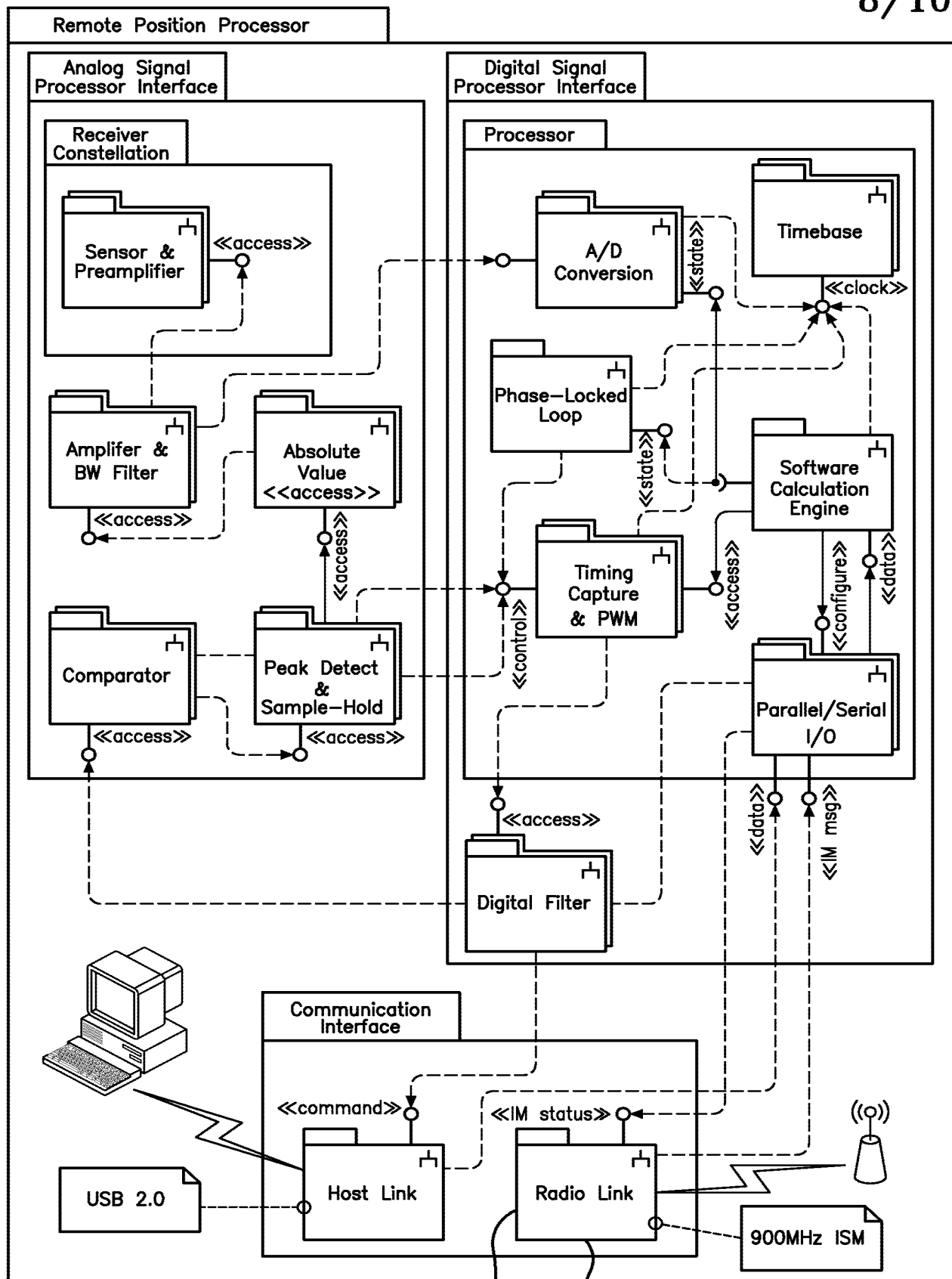


FIG-5

20 30

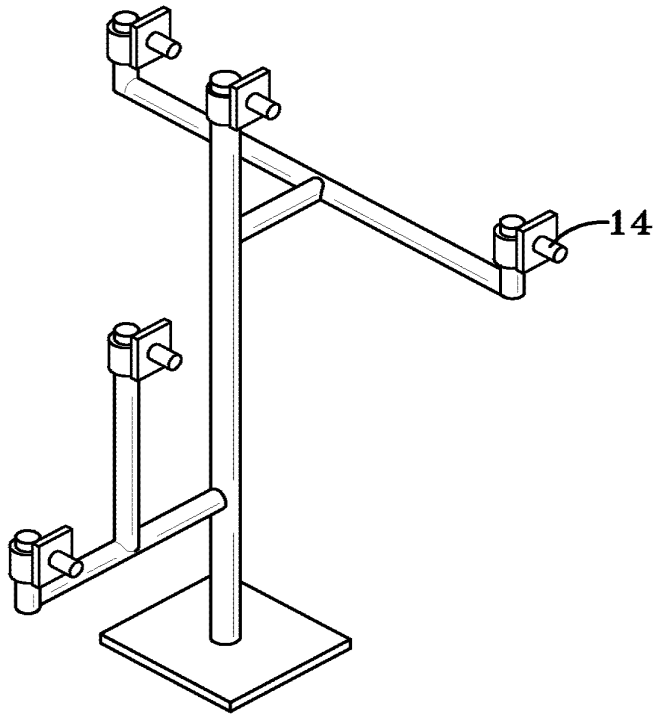


FIG-6A

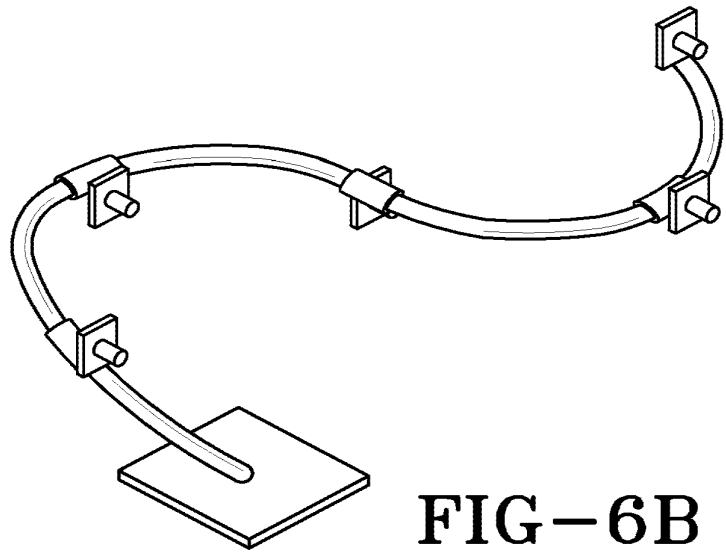


FIG-6B

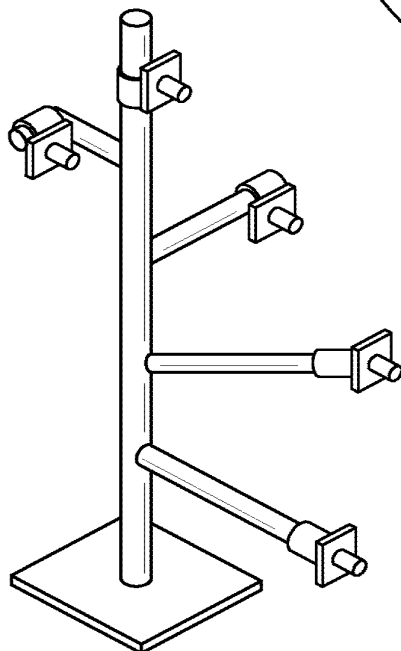
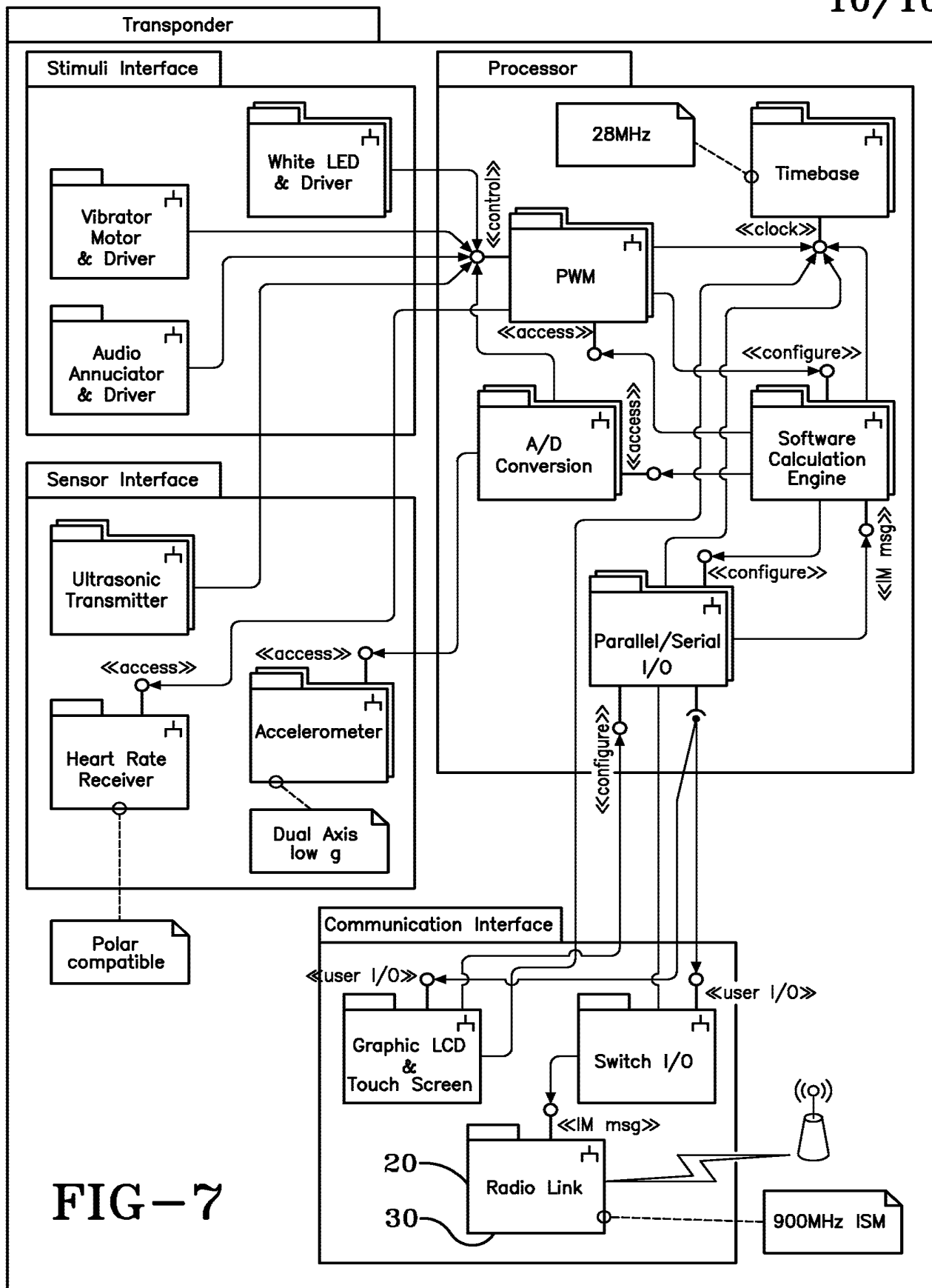


FIG-6C



A HUMAN MOVEMENT MEASUREMENT SYSTEM

[001] This application is a continuation of US 12/371,711, filed 16 February 2009, currently pending, which is in turn a continuation of US 11/935,578 filed 6 November 2007, now US Pat. 7,492,268, issued 17 February 2009, which is in turn a continuation of US 11/187,373 filed 22 July 2005, now US Pat. 7,292,151, issued 6 November 2007, which claims the benefit of US 60/592,092, filed 29 July 2004. Each of these is hereby incorporated by reference as if fully recited herein.

Background of the Art and Summary of the Invention

[002] This invention relates to a system and methods for setup and measuring the position and orientation (pose) of transponders. More specifically, for training the user to manipulate the pose of the transponders through a movement trajectory, while guided by interactive and sensory feedback means, for the purposes of functional movement assessment for exercise, and physical medicine and rehabilitation.

[003] Known are commercial tracking and display systems that employ either singularly, or a hybrid fusion thereof, mechanical, inertial, acoustical or electromagnetic radiation sensors to determine a mobile object's position and orientation, referred to collectively as pose.

[004] The various commercial tracking systems are broadly classified by their relative or absolute position tracking capability, in which system the pose of a mobile object is measured relative to a fixed coordinate system associated with either combination of receiver(s) or passive or active transmitter(s) housing mounted on the user. The tracking system's components may be tethered with obvious inherent movement restrictions, or use wireless communication means to remotely transmit and process the information and allow for greater mobility and range of movement.

[005] Typically these tracking systems are utilized for biomechanics and gait analysis, motion capture, or performance animation and require the sensors to be precisely mounted on the joints. Various means of presenting the tracking information in a visual display are employed, such as Heads-Up Display (HUD), that provide occluded or see-through visibility of the physical world, or Fixed-Surface Display (FSD), such as computer desktop monitors, depending upon the simulation

and immersive quality required for the application. The application may require various degrees of aural, visual, and tactile simulation fidelity and construct direct or composite camera views of the augmented or three dimensional (3D) virtual reality environment to elicit interactive user locomotion and/or object manipulation to enhance the user's performance and perception therein. The tracked object may be represented in the virtual environment in various forms, i.e., as a fully articulated anthropoid or depicted as a less complex graphical primitive. The rendering strategy employed depends upon the degree of photo realism required with consideration to its computational cost and the application's proprioception requirements.

[006] Tracking technologies possess certain inherent strengths and limitations dependent upon technology, human factors, and environment that need consideration when discussing their performance metrics. Regardless of differentiating resolution and accuracy performance benchmarks, many implementations suffer from varying degrees of static and dynamic errors, including spatial distortion, jitter, stability, latency, or overshoot from prediction algorithms. Some human factors include perceptual stability and task performance transparency, which are more subjective in nature. And environmental issues such as line-of-sight, sensor attachment, range, and multiple-object recognition, need to be considered when selecting the optimal technology for the most robust application development. Irrespective of the intrinsic strengths and weaknesses of the tracking technology employed, ultimately the user's satisfaction with the system's utilization and efficacy, including the production of reliable, easily understood, measurable outcomes, will dictate the overall success of the device.

[007] This invention's system and methods facilitates biomechanical tracking and analysis of functional movement. In the preferred embodiment, this invention is low cost, robust, easy to deploy, noninvasive, unobtrusive, and conveys intuitive and succinct information to the user to execute movement properly and provides performance indicators of said movement for feedback purposes. One feature of the present invention provides for an interactive tracking system because the sensor functionality, or referred to herein as active transponders or transponders, is integrated with local user input control, and real-time sensory interfaces on the same device. The transponder is a wireless communication and monitoring device that receives a specific signal and automatically responds with a specific reply. In one embodiment, the invention provides functional movement assessment based upon

the relative measures of limb pose with respect to two positions defined by the transponders. The transponders can operate independently or work in unison to process and share computational tasks and information between the local databases. This decentralized, distributed processing scheme allows the configuration and coordination of the training session, and processing and analysis of the measurements to occur without requiring expensive auxiliary computer and display systems to manage the same, and without relying on costly software development of complex synthetic environments for visualization purposes. Also, the user can manage the applications and performance databases off-line on a remote computer system with Internet connectivity to customize and configure the system parameters in advance of their session.

[008] The present invention is designed to provide such system and methods for high-fidelity tracking or registration of the poses of active transponders and engage the user to purposely manipulate the transponders' pose along a prescribed or choreographed movement trajectory in order to train and assess functional movement capability. In the preferred embodiment, the system is comprised of two subsystems: (1) a subsystem comprised of one or more active transponders, which, in its most sophisticated implementation, responds to periodic requests from another component of the system to radiate or transmit a signal for purposes of absolute position tracking; processes an embedded inertial sensor for relative orientation tracking and absolute tracking refinement; and provides an essentially real-time aural, visual, and tactile sensory interfaces to the user, and (2) a subsystem comprised of a centralized position processor system or unit and receiver constellation unit, collectively referred to as the processor unit, which is essentially a signal processor that synchronizes the transponders' periodicity of radiating signal and other operational states; collectively receives and processes the radiated signal; iteratively calculates the transponders instantaneous pose and convolution, thereof; and continually exchanges this information, and its analysis thereof, with the transponders and/or auxiliary host computer system in essentially real-time via a combined wireless and tethered communication means. This real-time bi-directional exchange of information allows for proper transponder identification, coordination, and the accurate measurement of pose, thereof, and timely actuation of the sensory interfaces for optimal user regulated closed-loop control.

[009] The transponder is broadly classified by its level of hardware and software configuration that define its scope of intelligence, sensory support, and configuration. The degree of intelligence is determined by its capability to locally access, process, and modify the database. Further, either transponder classification can be sub-classified by its manipulative requirements. In one embodiment, where multiple transponders are used, a principle transponder is consciously and deliberately moved along the reference movement trajectory, while a subordinate transponder serves as an anchor or secondary reference point elsewhere on the locomotion system whose kinematics are not necessarily controlled by the user's volition.

[010] An interactive transponder, preferably, has significant intelligence; supports relative and absolute tracking capabilities; provides complete sensory stimuli support; provides for functional enhancement through attachment of modular, extension pieces; and provides a user display and input system to control the training session. In the preferred embodiment, the interactive transponder is primarily held in the hand to facilitate more complex user input and greater sensory intimacy. Conversely, in another embodiment, the fixed transponder has limited intelligence; supports only the absolute pose tracking capability; provides no sensory stimuli support; and is usually mounted to a fixed site on the limb or trunk.

[011] A combination of transponder deployment strategies may be required depending on the training session's objectives, such as two interactive transponders grasped by each hand; or alternatively, an interactive transponder, and a fixed transponder attached to the limb or trunk; or lastly, two fixed transponders attached to the limb(s) and/or trunk.

[012] In one embodiment, this invention proposes to elicit movement strategies based on the deployment of at least two transponders that define the endpoints of a movement vector whose relative translation and rotation is measured and evaluated for the assessment of functional movement capability, including but not limited to, limb range of motion and its control thereof, limb strength conditioning, and overall proprioception and hand-eye coordination skills, and overall body movement. This registration system measures a single movement vector whose endpoints are comprised of an anchor point, i.e. one that is located in a less dynamic frame of reference, e.g., such as the trunk or abdomen, and another more distal location fixed on or held by a limb or extremity, e.g., the hand, arm, or leg. As this movement vector is translated and rotated through space by the act of the user modifying the

pose of the principle transponder in concert with the reference movement trajectory, the vector's length will expand and contract relative to the proximity of principle transponder with respect to the subordinate transponder. The vector's length conveys unique and explicit information regarding the user's movement efficiency and biomechanical leverage. For example, by attaching a fixed subordinate transponder at the hips and a fixed principle transponder on the upper arm, the biomechanics of the act of lifting a box or similar object can be elegantly qualified. If the user assumes a poor lifting technique, i.e. legs locked with the trunk severely flexed with head down and the arms stretched out beyond the basis of support, the vector's length would consistently be measured longer than compared to a good lifting technique, i.e., legs bent at knees with the back straight, head gaze up, and arms close to body. Also, the measurement(s) of higher-order derivatives derived from numerical mathematical processes of a reference point described by the vector would provide additional indication of movement control or smoothness. In summary, one embodiment of the present invention is comprised of:

- a means to create a single movement vector whose endpoints are defined by the locations of at least two transponders, wherein, the expansion and contraction of the vector's length is calculated, analyzed, and reported in essentially real-time;

- a means to create a single movement vector whose endpoints are defined by the locations of two transponders, wherein, a representative point along the vector length is referenced and its higher-order derivatives are computed by mathematical numerical processes, wherein the result is calculated, analyzed, and reported in essentially real-time; and,

- a means to correlate said vector's length and at least one other measure consisting of a higher-order derivative, to the reference movement trajectory, wherein the result is calculated, analyzed, and reported in essentially real-time.

[013] A registration system for practical functional movement applications should clearly convey information to the user regarding his movement quality while he performs the task, without compromising or distracting from said execution by unnecessary head movements or change in eye gaze and normal focus. Poor visualization strategies that distract the user are ineffectual for promoting heads-up, immersive interaction, and the alphanumeric information it imparts often can not be consciously processed fast enough to elicit corrective action. This system provides for both a local, standalone sensory interface as a primary feedback aid, or

alternatively, an interface to a remote fixed-surface display for greater visualization and simulation capabilities. The visual stimulus could be modulated to warn of range violations, or provide signals for purposes of movement cadence and directional cueing. A principle interactive transponder is typically hand-held, which is naturally in close proximity to the user's aural and visual sensory field during most upper extremity movements, or, conversely, the visual stimulus may be viewed through a mirrored or reflective means if not in optimal line-of-sight. A remote fixed-surface display might augment the immersive quality of the user's experience by providing control of a view camera of a simulated computer environment, and display of the transponders and/or interactive objects' static or dynamic poses within the computer display's skewed through-the-window perspective projection.

[014] In summary, one embodiment of the present invention is comprised of:

- a means for modulating an embedded luminescent display organized and oriented into a directional-aiding pattern, by varying its degree of intensity and color, or other physical characteristics, to provide a visual display stimulus. This sensory interface is excited at a rate, repetition, or pattern proportional to the pose error of the transponders' movement trajectory compared to the reference movement trajectory;

- a means to view said visual display stimulus with the aid of a mirror(s) or other reflective means;

- a means for the real-time projection of sound or speech commands through an audio device to provide warning, alarm, instructional, and motivational aid, and/or additional cueing upon encroachment of static and dynamic limit/boundary conditions defined by the reference movement trajectory;

- a means for real-time tactile feedback including, but not limited to, modulation of the rotational properties of a vibrator motor proportional to the pose error of the transponders' movement vector compared to the reference movement trajectory;

- a means for combining the excitation of said stimuli proportional to the pose error of the transponders' movement vector compared to the reference movement trajectory; and,

- a means to coordinate the real-time, periodic parametric update and modulation of the stimuli imparted by the sensory interfaces within the transponders from a processing unit by means of a wireless communication link.

[015] This invention addresses the need for an intuitive, interactive method to instruct, create, and deliver a movement trajectory command without necessarily relying on pre-programmed, regimented movement trajectories. The registration system can be configured via remote setup at the principle transponder to pre-record and choreograph a free-form movement trajectory of the principle transponder with the intent of the user mimicking the same said path. This impromptu learning modality can expedite the session down time between different users and movement scenarios, and accommodate users' high anthropometric variability in range of movement. In summary, one embodiment of the present invention is comprised of:

a means is to provide a movement trajectory learning modality that allows the user to calibrate and create the desired endpoints, midpoints, and/or total reference movement trajectory through user programmer entry of an input device resident on the transponder;

a means to process and save a movement trajectory using a computationally efficient Catmull-Rom spline algorithm or other similar path optimizing algorithms to create control points along key points of the movement trajectory that define the optimally smoothest path intersecting the control points;

a means to provide database management by a processing unit via a wireless communication link or, alternatively, through user data entry of an input device resident on the interactive transponder; and,

a means to access, edit, and store the program and/or databases to nonvolatile memory operably coupled to the principle transponders for the purpose of automating the creation, delivery, storage, and processing of movement trajectories. Customized user programs and databases would be downloaded from a central repository or relevant website in advance of the training session to the transponder from the user's home location via the Internet or other convenient locales having networked Internet access, and transported to the systems remote physical location, and uploaded into the system's memory, and executed as the application program.

[016] This a priori process of remote selection, download, and transfer of programmatic content and database would minimize the user's decision making and input during product utilization by offering only relevant and customized programming material of their choosing targeted for their specific exercise, fitness, or rehabilitation goals. Performance data could be saved indefinitely in the database's nonvolatile memory, until an upload process was performed through the said

network so the database could be transferred to another location for purposes of, but not limited to, registration, processing, archival, and normative performance evaluation, etc.

[017] An exemplary list of specific data structures contributing to or affecting the means for automating the creation, delivery, storage, and processing of movement trajectories described below may be stored within the non-volatile memory of the transponder or position processor which may use high-density serial FLASH, although other types of memory may be used such as SmartMedia, Compact Flash, etc. Additionally, the memory device interface should not be limited to internal, but may include external media devices, such as USB FLASH Key or other portable media means, that may have inter-operability with other computerized devices. The data structures may include:

[018] Modulation & Feedback Thresholds/Triggers Properties – the aural, visual, tactile interfaces require threshold settings which determine their excitation or stimulation characteristics. These settings can be derived from previous performance data or defaults determined from normative data, or modified in real-time, by algorithmic methods including moving averages, standard deviations, interpolation based upon goal-oriented objectives, etc.

[019] Normative Performance – performance data collected over a large population of users through controlled studies, that is distilled down into specific user categories based upon certain demographics that the user may compare and rank his/her results. This data may be initially embedded within the transponders or position processor non-volatile memory and may be augmented or modified automatically or by user volition when connected to the Internet.

[020] Competitive Ranking - applications which have a predominate point goal-oriented purpose would allow access to a global ranking file archive accessed through the Internet or automatically via updated executive files. This ranking file would be created through an analysis of user participation and publishing of his/her results through Internet Web-based services.

[021] Downloadable Executive Programs & Configurations – new software programs, including new features, enhancements, bug fixes, adjustments, etc., could be downloaded to the transponder through an Internet connection. Graphics images would be stored in compressed or uncompressed binary forms, i.e., bitmap, gif, jpeg, etc. This new programs could be transferred to any suitable computerized position

processor unit located at a remote facility via the transponder's wireless link. Therefore, the user's transponder is the node that establishes the portable network capabilities of the system, not necessarily the computerized position processor.

[022] Custom Menu Interfaces – specialized activities may require more advanced (or simplified) interfaces dependent upon the users' cognitive abilities and interactive specificity. This menu may include interactive queries or solicit information regarding the user's daily goals, subjective opinions or overall impression of the activity and ones performance which could be incorporated in the Motivation Index described below.

[023] Report Generation Tools and Templates – XML, HTML or other authoring language used to create documents on the Web that would provide an interactive browser-based user interface to access additional performance data analysis and report generation tools and templates that may not be available or offered with the standard product.

[024] Custom Performance Algorithms – certain application-specific performance analysis may require dynamically linked algorithms that process and calculate non-standard or specialized information, values, units, physical measurements, statistical results, predictive behaviors, filtering, numerical analysis including differentiation and integration, convolution and correlation, linear algebraic matrices operations to compute data pose and scaling transformation, and proprietary types. One example of a proprietary type is Motivation Index, a composite numerical value derived from a weighted average of statistical performance indicators and subjective user input including relative scoring improvements, conformity to ROM pattern, lengthy activity access duration, high access rate, relative skill level improvement, daily goal achievement, etc., that could represent the overall level of enthusiasm and satisfaction, the user has for a particular activity.

[025] Range of Motion (ROM) Pattern Generator – the ROM pattern requires some key control points to be captured along the desired trajectory and stored in order that the algorithm can calculate an optimally smooth path, in real-time, during the comparative analysis phase.

[026] ROM Pattern Capture & Replay – the ROM pattern can be can saved to memory in real-time by discrete position samples versus time depending upon the

resolution desired and memory limitations and later played back on the transponder or remote display for analysis.

[027] Activity Specific Attributes - includes Reps/Sets, Duration, Pause, Heart Rate Limits, intra-activity delay, level, point scalars, energy expenditure, task-oriented triggers, etc., and other parametric data that controls intensity, execution rate and scoring criteria for the activity.

[028] Instructional Information – textual, graphical, or animation-based instruction, advice, coaching, activity description, diagramed transponder deployment and intra-device connectivity, etc. that facilitates the intuitiveness, understanding, and usage of the system. The form of instruction may include music files saved in various formats, including Wave, MP3 or other current or future audio data compression formats, and video files saved in MPEG or other current or future video data compression formats.

[029] Real-time Data Management – proprietary data management protocols that reside above the communication driver layer that manage the real-time, synchronous and asynchronous exchange of data between transponder(s) and position processor. This would provide an essential real-time sharing of activity data, analysis, and feedback stimulus thresholds, or coordination of multiple transponder configurations, or for a collaboration of same or different user requirements to complete a similar activity objective.

[030] This invention addresses the need for adaptability of the registration system to different movement measurement scenarios. In one embodiment, it utilizes a versatile, modular configuration and mounting of the transponders onto the user. The efficient deployment of the transducers between different users' and from task to task requires a universal mounting scheme to provide consistent localization and pose of the transponders at the desired measurement sites on user's body. Also, to compensate for the receivers' finite tracking volume when stationary, the receiver constellation unit may be mechanically modified to optimize its tracking properties by conveniently repositioning it in closer proximity to the expected transponders movement trajectories and line-of-sight, thereof. In summary, one embodiment of the present invention is comprised of:

a means to quickly and efficiently alter the location of the transponders using a fastening system designed to quickly attach and dispose various forms of transponder assemblies;

a means to augment the physical properties, i.e., weight and length, of the principle transponder with adjunct electro-mechanical components that provide variations in biomechanical leverage for isotonic and isometric utilization; and,

a means to allow the user to manually alter the geometry and pose of the receiver constellation unit to facilitate an optimal tracking location based upon collectively maximizing the ultrasonic source's energy received at the transducer interface.

[031] This invention addresses the practicality and robustness of the registration system when used in either indoor or outdoor environments, and especially when the tracking volume likely contains potentially occluding objects, i.e., an uninvolved limbs or clothing, that become potential sources of competing, reflected paths. The preferred embodiment of the registration system utilizes the time of flight (TOF) measurement of ultrasonic acoustic waves due to its immunity from interference from the visible and near-visible electromagnetic spectrum and its superior ability to overcome most multi-path reflections problems by simple gated timing of the initial wave front. Upon command from the processor unit, the transponders produce a few cycles burst of ultrasonic energy and the transducers of the receiver constellation unit are stimulated and mechanically resonate accordingly, upon the wave front arrival. The processor unit's analog signal processing circuits transform the mechanical energy into electrical signals that resemble tapered sinusoidal waveforms, which another electronic circuit triggers upon using an adaptive threshold technique which, in turn, the processor unit detects and calculates TOF timestamps indicating the wave front arrival. In the preferred embodiment, the system overcomes the ultrasonic technology's intrinsic challenge of precisely triggering on same the waveform location and provides consistent unambiguous trigger detection by complementing the adaptive threshold technique with a software timestamp correction algorithm, which includes in part, a digital over-sampling and averaging timestamp algorithm, a relative timestamp correction scheme utilizing a predictive algorithm of higher-order Taylor series based derivatives, and an absolute timestamp correction scheme that minimizes the range error based upon discrete biasing of timestamps.

[032] Further, in the preferred embodiment, the processor unit utilizes the absolute and relative trigger timestamps in a multi-modal trilateration algorithm for the measurement of three-dimensional (3D) translations and rotations of the

transponders. The primary trilateration calculation is derived by an application of Pythagorean theorem involving a point position solution based-upon range measurements from at least three (3) points, versus the well-known triangulation method which uses bearing angles of two cameras of known pose. Additionally, the system's main accuracy limitation is mostly affected by the temperature variability of outdoor environments and its influence on the speed of sound in air value. This algorithm mitigates this problem by mathematically computing the speed of sound every analysis period provided at least five (5) receivers and a transponder synchronizing means are utilized. If the integrity of the synchronizing signal is temporarily compromised, the system automatically employs a variation of the trilateration algorithm that uses the last known speed of sound value.

[033] In the preferred embodiment, the maximum update rate, and hence the major contributor to the latency of the position calculation, is determined by the typical acoustical reverberation, typically between 20 to 100 ms, encountered in an indoor environment. Since the transponders are held or fixed on the user's body and, therefore, are mobile, the TOF measurements will experience an additional latency effect. A Kalman filter is used as a prediction/estimation strategy to minimize and compensate for the latency effect. The prediction algorithm uses a higher-order Taylor series based derivatives and augmentative inertial sensor data. Its predictive refinement is dependent upon predefined models of expected movement conditions. Because functional movement is episodic, having periods of stillness interspersed with bursts of motion activity, a multi-modal filtering strategy is preferably employed to handle the unpredictable jerkiness at the start of motion and relatively predictable, smooth motion afterwards. In summary, the preferred embodiment of the present invention is comprised of:

a means to detect the same carrier wave cycle of ultrasonic energy using a software correction algorithm requiring multiple, consecutive TOF acquisitions as input for the digital over-sampling and averaging algorithm, the calculation of a higher-order numerical differentiation of the past and current TOF information as input for the predictive algorithm of higher-order Taylor series based derivatives used for the relative TOF correction, and a measurement of the intra-pulse time intervals of consecutive TOF acquisitions as input for the absolute TOF correction scheme that minimizes the range error based upon selective biasing of the TOFs;

a means to utilize a dual matrix formulation of the trilateration algorithm, and a calculation strategy thereof, which decision is dependent upon the integrity of the system's communication link, synchronization condition, and the desired measurement accuracy; and,

a means to coordinate the information transfer between transponders and the processor unit so that their contribution to the resultant movement vector calculation can be measured without intra-signal interference.

[034] These goals will be attained by such system and methods that are comprised of the user's interaction described by the following steps as set forth as the preferred embodiment:

- a. Authenticate user access and open user session from a local or remote database;
- b. Setup user training session, i.e., workload limitations, measurement criteria, and audio/visual/tactile stimuli;
- c. Select training program and configure its options;
- d. Deploy the transponders as instructed to predefined locations of users locomotion system to create at least one transponder movement vector;
- e. Calibrate the transponder movement vector to establish its reference pose;
- f. Create a movement trajectory using learn mode, if required;
- g. Initiate the start of session;
- h. Determine the instantaneous pose of transponder movement vector relative to its reference pose from a periodic temporal iteration of this step;
- i. Perform qualitative and quantitative statistical analysis of accumulated measured poses of the transponder movement vector relative to the pattern of instantaneous poses defined by the reference movement trajectory;
- j. Update the major transponders sensory interfaces to modulate said system parameters in a periodic temporal iteration of this step;
- k. End the session once program objectives have been obtained;
- l. Analyze the results by interacting with local and/or remote databases;

- m. Provide numerical, graphical, and/or animated information indicating desired performance measurements.

Brief Description of the Drawings

[035] The disclosed embodiments will be better understood when reference is made to the accompanying drawings, wherein identical parts are identified with identical reference numbers and wherein:

Figure 1A illustrates one example of a deployment apparatus of the present invention;

Figure 1B illustrates one example of hand-held form for the transponder of the present invention;

Figures 2A-2D illustrate example extension pieces for the present invention;

Figures 3A-3D illustrate one example of process flows for the present invention;

Figures 4A and 4B illustrate a sample application of the present invention;

Figure 5 illustrates a block diagram of the remote processing system of the present invention;

Figures 6A-6C illustrate example receiver configurations of the present invention; and

Figure 7 illustrates a block diagram of the components of one embodiment of the transponder of the present invention.

Detailed Description of the Embodiments

[036] The present invention provides a practical, versatile measurement tool for the assessment of the user's manipulation strategy of the transponder 10 or transponders along a reference movement trajectory. Moreover, the system and methods measure and analyze the kinematics of the relative translations and rotations of the limbs or extremities with respect to each other or to a more inertial reference location on or off body as the transponders are manipulated. This information provides useful insight on biomechanical demands and anthropometric factors that influence human movement efficiency and control. Although measurement performance metrics are important design criteria, it's equally important to provide intuitive and motivating program instruction and administration,

and to provide comprehensive analysis and integration of the motion data in a form that is objective and easily interpreted. This system improves upon the practicality and user interactive aspects of setup, deployment, calibration, execution, feedback, and data interpretation of a tracking system designed for function human movement.

[037] Human movement is a response to external environmental forces which requires the accurate coordination of the distal segment(s) to compensate for these forces. Skillful coordination of human movement is dependent upon the cohesive interaction of multiple sensory systems, including visual, vestibular, with the musculoskeletal system. More specifically, the challenges and goals of cognitive spatial mapping, (2) minimization of energy expenditure, (3) maintaining stability, (4) steering and accommodation strategies for various environments, (5) dynamic equilibrium, (6) active propulsion and weight support, and (7) core locomotion pattern should be relationally considered to properly assess human movement. Therefore, it is preferable to engage the interaction of these sensory systems during a training session to promote the desired functional movement outcome. Because many movements persist for 400-500 ms, enough time is allowed for the initiation of the movement and for user correction based upon visual and kinesthetic information acquired during the time of the movement. However, the implemented means of visual feedback should be not be distracting or interfering with the task at hand. In the preferred embodiment, this system engages the sensory systems with non-distracting, intuitive, embedded aural, visual, and tactile stimuli which provide real-time indication of the principle transponder pose error with respect to the reference movement trajectory.

[038] In order to conduct a time efficient training session, this registration system attempts to minimize the encumbering experimental setup and calibration procedures characteristic of more complex and higher cost motion analysis technology. These complementary systems serve important academic or clinical oriented research needs or for motion capture for computer animation purposes and strive for highly accurate measurement of joint motion data in terms of angular displacement. Therefore, the integrity and reliability of their motion data is dependent upon proper sensor setup and calibration.

[039] For instance, single axis goniometer-based systems usually require specially designed harnesses to hold the monitor and are firmly strapped or taped over the joint to avoid relative motion artifacts. Usually these devices are tethered and their

fit, weight, and constraining mechanical linkages can impose limitations on the joint motion and cause discomfort for the user. Most optical or video-based systems require the placement of numerous active or passive markers over landmarks, such as the joints' center of rotation. These systems should guarantee sufficient environmental illumination and contrast between markers and background to function optimally. Also, these systems are severely affected by occluded markers that may disappear for long periods of time due to rotations and line-of-sight limitations. Other video-based systems do not use markers but require the assignment of the body's joints manually or through computerized automation during data analysis, making real-time analysis arduous and real-time feedback virtually impossible.

[040] In the preferred embodiment, the system doesn't require complicated, time consuming sensor setup and calibration by virtue of its minimalist sensor requirements and uncomplicated sensor mounting. Instead, it requires only the deployment of a sensor on the body (in one embodiment a dual sensor group on a combination of limb(s) and or trunk) and doesn't enforce stringent movement protocol, but encourages free-form, unrestrictive movement of the transponders.

[041] The transponder's preferred deployment means, include either insertion into a universal strap and holster apparatus (**Figure 1A**) that secures on the user's limb, extremity, or trunk, including, but not limited to, the hip, ankle, knee, wrist, upper arm, neck, waist or an augmentative mechanical attachment to one or a combination of modular extension pieces shaped into a hand-held form (**Figure 1B**). A strap or torx-like clip and holster design provides a firm, yet light weight and comfortable mounting location away from areas that clothing and or uninvolved limbs may occlude.

[042] The modular extension piece is either an instrumented sensory type designed to support alternative tactile stimulus device or alternative configurations of aural, visual, and tactile feedback types, or non-instrumented, weighted extension pieces as shown in **Figures 2A-2D**. All modular extension pieces may be of various physical dimensions and intrinsic weight, with a captive handle design that preferably requires zero grip strength to grasp. Alternatively, the modular extension piece may be coupled to the transponder through a fixed or flexible, segmented, articulated coupling to accommodate attachment of additional transponders and/or other modular extension pieces. These components would quickly assemble to each other

using a spherical snap joint or twist snap latch, or similar mechanism, to provide quick alteration of form and function when used for different movement trajectory scenarios.

[043] In one embodiment, the weighted extension attachments (**Figure 2A**) are offered in fixed gradations of one (1) kilogram increments or other convenient unit of measure and either be indicated as such with a numerical label, quantitative mark, or color-code feature, or combination thereof. For upper extremity evaluation, the weighted extension piece integrated into a zero-grip handle would enhance the improvement of musculature strength of the limb, while not compromising the user's endurance with a potentially fatiguing hand grasp requirement.

[044] In one embodiment (**Figure 2B**), the tactile type provides force feedback functionality by controlling the rotational speed of an embedded vibrator motor in the shaft. Alternatively, the visual type (**Figure 2C**) may be comprised of a series of light emitting diodes that could be uniformly embedded along the length of the handle or transponder and their intensities variably controlled therein. It should be appreciated that a simple, economical mirrored or reflective surface placed in front of the user's visual field could provide sufficient real-time indication of the user's subjective conformity to the said movement trajectory while allowing non-distracting viewing of this visual stimulus. For example, a program that requires the user to reposition the principle interactive transponder through an arc-like movement trajectory in the midsagittal plane through out a range of motion beginning from the waist upwards until parallel to shoulder height. As the user performs the movement, the visual sensory interface could be proportionally excited if the user moves too quickly, or hesitates too long, or produces shaky or erratic episodic motions, or is beyond the prescribed bounds of the movement arc. The light stimulus is easily viewed in the mirror and would indicate corrective action in his or her movement strategy, while appropriate aural commands may be issued simultaneously to encourage the same correction. Regardless of the sensory interface type, its control and excitation properties will be determined by some statistical aspect of the user's conformity to and progression through the movement trajectory.

[045] The hand-held transponder may include a modular extension piece with an embedded graphic display device and associated input means to allow the user to setup, operate, provide visual feedback, and view performance results of the device usage without additional remote display means. More specifically, a software-

controlled user interface could provide certain visual prompts in a menu oriented presentation, to instruct the user on (1) device setup, i.e., aural, visual, and tactile feedback parameters, types of program start and termination cues, program intensity based on ratio of amount of repetitions, sets, and rest periods or categorical gradation of challenge, learn mode behavior, etc., (2) scrollable program selection with brief descriptions including objective, desired measurement, i.e., range of motion, energy, accuracy, speed, etc., and instructive information, and (3) alphanumeric and/or graphical display of measured performance data and other biophysical data and its analysis thereof, displayed in standard plotted forms including line, bar, and pie charts, etc. It is important to note that the user input process is intuitive and streamlined so as not to detract from the practicality and user friendliness of the system. Only relevant applications and its control thereof will be sequestered from the database and presented to the user.

[046] In one embodiment, two or more transponders and extension pieces, or combinations thereof, may be assembled at their endpoints with a universal spring coupling. The assembled device could be grasped in both hands and bent in various rotational angles about the spring coupling's axis. Isotonic strength conditioning programs can be developed due to the force resistance feedback supplied by the spring. A multi-transponder assembly in the form of a flexible rod or staff could provide an indication of balance of upper extremity strength and proprioceptive function dependent upon the angular closure rate and rotational imbalance and orientation deviation from initial starting position.

[047] Additionally, in the preferred embodiment, the modular extension pieces have provisions for other attachable apparatus (**Figure 2D**) that can augment the program's intensity or difficulty. For example, an eyelet is embedded in the end of the extension piece and is designed to attach an elastomeric band, such as the type manufactured by Theraband®. By securing the other open stirrup end of the band to the user's foot, isotonic strength conditioning programs can be developed due to the force resistance feedback supplied by the elastomeric band. Moving the transponder through a movement trajectory is now made more restrictive and challenging.

Application Examples

[048] An example training session deploying a dual transponder group is now described that may be designed to improve the range of motion, strength, and coordination of shoulder abduction in a user. The training session would primarily serve as an exercise aid that provides essential feedback to the user so that he/she learns to progressively improve the manipulation of the transponder through the reference movement trajectory, while benefiting from increased shoulder range of motion and strength improvement.

[049] In advance of the training session, a software application is operated from a host computer that provides a utility for baseline configuration and management of the system's and transponder's local databases, and/or access to other remote databases, and for the real-time interface to the data flow between the system's components. The application's navigation and selections are presented to the user through a typical graphical user interface like Microsoft Windows® XP operating system. A generalized step-wise procedure requires the administrator or user to (1) select the desired program and features from a menu screen list, and (2) to initiate a communication process that causes the program parameters to be transferred to the processor unit through a standard computer communication protocol, i.e. serial, USB, ethernet, etc., whereupon, (3) the information is subsequently processed and transferred into the transponders local memory via a wireless communication link, and, finally, (4) the transponder's software program accesses this database to manage the device utilization and configuration of the local display means. Alternatively, a Compact FLASH-based memory card, embedded serial FLASH, or a similar nonvolatile memory device provides the user an additional specialized database supporting remote data collection capabilities. This database would be preprogrammed in advance and the resultant performance data retained, even if the device's power is lost, or for extended unsupervised exercise sessions conducted remotely from the host computer system or when the host computer system is unattached or unavailable. After the session is completed, the user would be queried if the results are to be saved for later analysis or would automatically be saved, dependent upon device setup. This data could be retrieved at a later time when the system is once again attached to a host computer system, and the software utility could be commanded to upload the database.

[050] Henceforth, the following procedural description refers to the activity dependencies diagrammed in **Figures 3A-3D** that the user would encounter while operating the system.

[051] During the Security Phase (**Figure 3A**), the user may be requested to provide a security authentication code for validation, which opens access to his/hers custom programs in the training session. Next, during the Setup Phase (**Figure 3A**), the user can configure global options or select the desired program. The global options may include, but are not limited to, workload intensity, measurement criteria, sensory interface properties, and reporting features. A program menu list would indicate name, ID, and a brief description, or alternatively, be represented by a detailed graphical icon. When the program is selected, other program-specific options can be setup.

[052] During the Deployment Phase (**Figure 3B**), and dependent upon the program's objectives, a suitable combination of transponder types will be mounted on the user's body as instructed by the program. This example requires the assembly of a hand-held interactive transponder with graphical display, and a weighted extension piece coupled therein to be grasped by the hand on the same side as the affected shoulder. Another subordinate transponder 12 is placed into a holster assembly strapped around the lower quadriceps on the same side. This setup is shown in **Figure 4**.

[053] During the Calibration Phase (**Figure 3C**), a simple calibration procedure may be requested to evaluate transponder function and specific user range of motion constraints. Typically, this information is determined beforehand and saved in the system's database. Also, practicality of this system is claimed for lack of extensive calibration requirements.

[054] Dependent upon the program's options, a user-defined movement trajectory may be created prior to program start in lieu of executing the predefined version. The learn mode could be utilized to quickly choreograph free-form movement trajectories and save them into the transponder's non-volatile memory for later execution. The learn mode would be accessed through the user interface and instruct the management of the control point assignment by pressing the push button switch at the appropriate junctures of movement discontinuity or, preferably, allowing automated assignment by the software. In the preferred embodiment, a computationally efficient Catmull-Rom spline is used to define a three dimensional

(3D) curve that passes through all the control points along the movement trajectory path. If manually interceding, the user is instructed to press the push button once at each major juncture in the movement trajectory, but, preferably, for no more than a few locations, until the desired end of range of motion is reached as shown in **Figure 4B**. Similarly, the return path may be similarly defined or he/she may elect to use the same forward path in reverse. These control points are registered by the processor unit and transferred and saved to the transponders' memory to serve as the control points for the real-time calculation of a Catmull-Rom spline. The Catmull-Rom spline is calculated in real-time from the desired initial starting point to provide a continuous set of position points representing the "learned" reference movement trajectory.

[055] After the program is selected or the learn mode complete, the user may be instructed to alter the pose of the transponders to satisfy the initial starting conditions of the program. Either one or a combination of sensory interfaces could be excited by the principle transponder to cause the user to direct or steer it towards the desired start point. For instance, the visual sensory interface could sequentially extinguish or dim its peripheral light sources to converge to a central light source as the principle transponder is positioned closer to the desired start point. Alternatively, the aural sensory interface could change its tonality and loudness as the start point is approached. Or alternatively, the tactile sensory interface could be modulated to provide less force feedback as the start point is approached.

[056] During the Execution Phase (**Figure 3D**), the transponders are continually manipulated along the reference movement trajectory to the best of the user's skill and fidelity, within the bounds of the user's physical limitation, until an aural, visual, or tactile response is given that indicates the activity volume has been successfully completed or a sufficient number of conformity violations or failures have been registered. The processor unit calculates the instantaneous pose coordinates of the transponders every analysis interval and periodically communicates this information to the transponders via the wireless communication link. As the principle transponder is moved in mimicry to the reference movement trajectory the conformity error between the actual and reference movement trajectory is calculated periodically in real-time to determine the characteristics of feedback quality to be elicited by the sensory interfaces for the user's closed-loop control to correct his/her manipulation strategy. For example, the conformity error may be calculated from

statistical processes based upon the standard deviation of the least mean squared (LSM) principle transponder's position error compared to the reference movement trajectory, or based upon, or combination thereof, a threshold magnitude of some multi-order numerical differentiation of said movement to indicate a "smoothness" quality of translation and rotation along the movement trajectory path.

[057] Alternatively, a host computer system could provide an auxiliary processing and display means to allow another software program to access the transponder's calculated positional data through an application programmer's interface and use this data to alter the pose of a graphical primitive in proportion to the motions of the transponders within the context of computer generated virtual environment. The dynamic control of objects in the computer generated virtual environment could be used to augment the local sensory interfaces of the transponders through an interactive, goal-oriented video game modality. The video game challenges could be increased over time based upon some scoring criteria of successful manipulation of the principally controlled on-screen graphical object with respect to cueing derived from other secondary static or dynamically moving objects. It is important to note that only primitive forms of video game challenges would be considered, to take into account the user's cognitive awareness and physical limitations, and the economics of software development for photo realistic virtual environments and animation. Also, this auxiliary computer display means would offer an alternative visualization method of interactive and immersive video feedback aid to enhance the application presentation.

[058] Additional examples of how the present invention may be applied are described as follows:

Balance

[059] The body has the ability to maintain balance under both static and dynamic conditions. In static conditions, such as in standing, the body strives to efficiently maintain posture (often referred to as postural stability) with minimal movement. In dynamic conditions such as in walking or sports play, the body strives to maintain balance while performing in an ever changing environment. The ability to maintain balance is a complex process that depends on three major sensory components. The sensory systems include visual, vestibular and proprioception. For example, we rely on our visual system (eyes) to tell us if the environment around us is moving or

still; we rely on our vestibular system (inner ears) to tell us if we are upright or leaning, standing still or moving; and we rely on our proprioceptive system (feet and joints) to tell us if the surface we are standing on is uneven or moving. If balance problems develop, they can cause profound disruptions in your daily life. In addition to increased risk for falls, balance disorders can shorten attention span, disrupt normal sleep patterns, cause excessive fatigue, increase dependence on others and reduce quality of life. It is not uncommon for individuals with a history of balance problems to regain their balance control through accurate diagnosis followed by specific medical treatment and/or rehabilitation exercises.

[060] The present invention described can be used as a testing and training device for balance improvement under both static and dynamic conditions.

[061] One testing and training scenario for postural stability would be to measure frequency and amplitude of body sway in three dimension (3D) space while feet remain in a fixed position. This task can be performed in both a double or single leg stance to test for bilateral symmetry relating to balance. Another modification of the test would be to perform each test with eyes both open and closed to help determine the contribution of the visual component to overall balance ability. Tracking body sway while creating the illusion of motion through proper visual cueing on a display means would be another test to help determine the reliance on specific sensory components of balance. Delivering repetition of protocols with increasing difficult oscillation thresholds with biofeedback of successes and failures of such predetermined goals is one way to train to improve balance.

[062] The transponder can deliver aural, visual, and tactile stimuli to queue the individual to the degree of frequency and amplitude of body oscillations. The aural and tactile components provide the only means of feedback when the testing and training are performed with eyes closed or the visual field is compromised. Examples include, but are not limited to, (1) an audio signal increasing and decreasing in volume proportional to the amplitude of body sway, (2) a vibration action proportional to frequency of body oscillations, and (3) a light source illuminated when both frequency and amplitude goals are achieved. Multiple transponders can be used to evaluate and reinforce proper balance posture by communicating position information of certain body segments in relationship to others. An example would be the comparison of position of the head with respect to

the hips while generating a vibration action if an excessive forward lean of the head as compared to the hips is recognized.

[063] Another test for balance would be to test ones Limits of Stability (LOS). This test refers to ones ability to effectively operate within their sway envelope. The sway envelope or LOS is defined as the maximal angle a person's body can achieve from vertical without losing balance. An individual with healthy balance is capable of leaning (swaying) within a known sway envelope and recover back to a centered position without the need for a secondary maneuver such as a step, excessive bend at the torso or arm swinging. LOS for bilateral stance in normal adults is 8 degrees anterior, 4 degrees posterior and 8 degrees laterally in both directions.

[064] The present invention described can be used as a testing and training device for balance control during movement or perturbations within a desired sway envelope. Through proper visual queuing represented on the display means that defines a normal sway envelope, the amount of body displacement can be measured from vertical stance.

[065] The transponder can deliver aural, visual, and tactile stimuli to queue the individual as to when he or she has achieved the desired range of their sway envelope, then assess the individual's ability to return back to a vertical stance. Examples include, but are not limited to, (1) a vibration action when the user varies (meanders) from the desired movement path, (2) an array of lights change intensity and pattern as the individual successfully approaches the intended target, (3) an audio signal is generated when the individual has maintained a stable position with respect to proper visual queuing represented on the display means for a selected period of time. Multiple transponders can be used to evaluate and reinforce proper balance posture by communicating position information of certain body segments in relationship to others. An example would be the comparison of position of the head with respect to the hips while generating a vibration action if an excessive forward lean of the head as compared to the hips is recognized.

[066] Dynamic balance can be evaluated while having the individual perform coordinated movements which specifically challenge the various components of balance in a dynamic nature. Such movements include, but are not limited to jumping, hopping, and walking. These movements can be performed with eyes both open and closed, during interaction with static or dynamic visual queuing on the display means. The ability to perform these dynamic balance tasks with

comparisons to others of similar sex, age or disability can be assessed. Example measurements may include, but are not limited to, (1) amount of body sway in three dimension (3D) space, (2) time to complete specific task, and (3) effects of fatigue on balance ability.

[067] Balance training in both static and dynamic conditions can be easily achieved by providing specific visual queuing on the display means, which challenge the individual to perform repetitive and progressively more difficult balance drills. Performance reports can be generated to establish a baseline, isolate specific strengths and weaknesses within the specific sensory and motor control aspects of balance, and document progression and improvements.

[068] The transponder can deliver aural, visual, and tactile stimuli to queue the individual as to when he or she has achieved the desired balance task. By example, a vibration action is produced proportional to the frequency of a body segment oscillation after the user lands from a hop test and attempts to stabilize and maintain proper postural balance. When the individual finally stabilizes and achieves correct postural balance, an audio signal indicates the task has successfully completed. Multiple transponders can be used to evaluate and reinforce proper balance posture by communicating position information of certain body segments in relationship to others. An example would be the comparison of position of the head with respect to the hips while generating a vibration action if an excessive forward lean of the head as compared to the hips is recognized.

Range of Motion (ROM)

[069] The present invention described can be used as a testing and training device to determine the range of motion within a joint. Range of Motion is the normal distance and direction through which a joint can move. Limited ROM is a relative term indicating that a specific joint or body part cannot move through its normal and full ROM. Motion may be limited by a mechanical problem within the joint that prevents it from moving beyond a certain point, by swelling of tissue around the joint, by spasticity of the muscles, or by pain. Diseases that prevent a joint from fully extending, over time may produce contracture deformities, causing permanent inability to extend the joint beyond a certain fixed position.

[070] The present invention described can be used to test the starting point and end point which an individual is capable of moving a body part, typically a limb and

associated joint(s). Comparisons to age and sex based normative data can be made. Proper visual queuing can be represented on the display means to instruct and motivate the individual through the proper testing procedure.

[071] The present invention described can be used as a testing and training device for individuals involved in physical rehabilitation or general fitness to improve ROM. Proper visual queuing can be represented on a display means to motivate individuals to extend their range of motion beyond their current capabilities.

[072] The transponder can deliver aural, visual, and tactile feedback that alerts the individual to successes or failures in proper execution of each repetition. An example of tactile feedback would be the transponders are vibrated if the individual's movement trajectory varied from the intended two dimensional (2D) reference movement trajectory by deviation from the planar path into the uninvolved spatial dimension. An array of light sources could increase illumination in intensity and repetition as the ROM goal was approached and an audio tone could signal the individual they have achieved the desired pause time at the proper ROM.

[073] Multiple transponders can be deployed to determine the contribution of each joint or anatomical structure where more than one joint is involved in the ROM movement (example; shoulder and scapular in overhead reaching). The vector sum of each transponder movement in a specific axis can be added together to determine the total ROM. The ROM of one joint in a two joint motion can be subtracted from the total ROM to determine the contribution of a single joint in a two joint movement.

Human Performance Testing and Training

[074] There are many devices that test the strength and speed of isolated joint movements, for example, the leg extension and bicep curl. This information has value in testing both healthy individuals, athletes and individuals whose strength and speed capabilities may be compromised by injury, disease, poor conditioning or simply age. Recently in the field of human performance, it has been recognized that the analysis of the mobility of the isolated joint, although providing some value, does not offer enough information to determine how the body will perform during functional movements. Functional movements are defined as movements equal to those encountered on the athletic field, in the work environment or while performing activities of daily living. Functional movements involve the movement and

coordination of multiple joints and muscle groups acting together to perform a more complex task than a single, isolated joint movement.

[075] The present invention described can be used as a testing and training device for functional movement improvement. By tracking various registration points on the body with respect to each other or to an off-body registration point, performance measurements of functional movements can be assessed, such as jumping, cutting, turning, bounding, hopping, shuttling, etc.

[076] The present invention described can be used as a testing and training device for individuals involved in physical rehabilitation, general fitness or sports performance enhancement to improve their functional movement abilities. Proper visual queuing can be represented on the display means to instruct and motivate individuals to perform specific functional movements.

[077] The transponder can deliver aural, visual, and tactile feedback of proper movement execution. Examples include, but are not limited to, (1) an audio signal alerting the user that the desired performance stance is incorrect, (2) the light sources illuminate when the desired speed is achieved in a first step quickness drill, (3) a vibration action to indicate the limits of tracking range, (4) a vibration action proportional to the magnitude of a biophysical measurement during the interaction with visual queues represented on the display means, (5) a vibration action when the body or limb position does not correlate well to the desired body or limb position of the visual queuing represented on the display means, (6) an audio signal indicating start, stop and pause periods or other controlling events, (7) an audio signal indicating proper body alignment or posture has been compromised, and (8) an audio signal indicating the relationship of desired target heart rate to a desired threshold.

Hardware Description

[078] In the preferred embodiment, the processor unit is comprised principally of a constellation of five (5) ultrasonic transducers and signal processing circuitry, thereof, and a signal processor that interfaces to this receiver group, performs the pose calculations, and interfaces to the transponders and host computer databases. The following interface descriptions for the processor unit are based upon the dependency flow represented by **Figure 5**.

[079] The sensors 14 preferably used for the receiver constellation unit are cylindrically-shaped ultrasonic transducers, for example, the model US40KR-01 40kHz PVDF ultrasonic receivers manufactured by Measurement Specialties Inc., which provide adequate acoustic pressure sensitivity and exhibit 360 degree omnidirectional broad beam response along the horizontal plane. The omnidirectional characteristic, albeit in one plane only, is very desirable to minimize line-of-sight occlusion. Because of its low resonance Q value, the rising and decay times are much faster than conventional ceramic transmitters. This reduces its power requirements since less burst drive duration is needed to achieve sufficient triggering thresholds at the receiver. This transducer type is also utilized similarly in the transponders to provide the potential for the most optimal acoustic coupling.

[080] The receiver constellation unit is preferably mounted on a fixed support base, and has a pivoting and/or swiveling mechanical linkage which provides an adjustable mechanism for configuration of the receiver constellation unit's inertial frame of reference relative to the tracking field. In the preferred embodiment, it is strategically positioned and oriented in proximity to the tracking field in order (1) to minimize line-of-sight degradation with respect to the expected transponder orientation, (2) to optimize registration resolution with respect to field volume size, and (3) to satisfy the mathematical restrictions of performing trilateration calculations based upon the solution of simultaneous linear equations. It should be noted that the trilateration matrices may be solved if the matrices have a rank of five, and are non-singular, i.e., the matrix determinant is non-zero. In the preferred embodiment, the geometric parameters and their coordinate location of the receiver constellation must insure linear independence of the columns of the matrices and to avoid the matrices from becoming singular.

[081] One example geometrical permutation of the receiver constellation unit that satisfies these rules is shown in **Figure 6A**. It occupies a volume of approximately 8 cu. ft. and essentially fixes the transducers in a way that defines two primary orthogonal, bisecting planes defined by three non-collinear points each. Another preferred implementation that occupies nearly the same volume is shown in **Figure 6B** and is characterized by its S-shaped curve and tilted with respect to the horizontal plane. Another preferred implementation that occupies nearly the same volume is shown in **Figure 6C** and is characterized by its helical or logarithmic spiral shape oriented perpendicular to the horizontal plane. Further, as indicated in the

preceding figures, the transducers vertical axes are oriented 90° with respect to the typical vertical axis orientation of the transponder's transmitter to improve acoustic coupling in the vertical plane, a consideration for overhead, upper extremity tracking. Although this causes some reduction in the lateral registration bounds, the compromise provides a more symmetric field about the middle or primary location of tracking interest.

[082] In the preferred embodiment, the overall size of the receiver constellation unit is predicated on a phenomenon referred to as Geometric Dilution of Precision (GDOP). The solution of a unique three-dimensional location based upon trilateration requires the precise resolution of the common intersection of multiple spheres circumscribed by the distance between each transmitter and receiver transducer. Each sphere has an inexact radius due to system noise and measurement resolution. Therefore, the intersection becomes a volume instead of a point and the size of the volume is dependent upon the radii of the intersecting spheres as well as the distance between the spheres' centers. As the radii get larger with respect to the distance between the centers, i.e., the transmitter is farther down range, the spheres begin to appear more and more tangential to one another and the intersection volume increases, although not necessarily symmetrical in all dimensions. Therefore, to minimize position uncertainty, the receiver transducers should be separated from each other as much as practical proportions allow with respect to the confines of the tracking field volume as the above said geometric examples provide.

[083] This receiver constellation unit can be repositioned with respect to the tracking field by a simple mechanical adjustment as shown in the preceding figures. The mechanical adjustment raises and lowers and changes the length and pivot axis of the cantilever arm which is fixed to a ground base support.

[084] Because the receiver constellation unit operates a distance from the processor unit, each receiver preferably has an associated pre-amplifier circuit to convert the high-input impedance piezoelectric signal into a low-level voltage proportional to the acoustic signal energy impinging the transducers sufficient in order to accurately transmit the signals to the processor unit. In one embodiment, a high-input impedance AC amplifier design with 30dB gain can be utilized. The preferred operational amplifier is the OPA373 manufactured by Texas Instruments. It was chosen for its low 1pA input bias current, high 6MHz GBW, and low-voltage

single supply operation. The amplifier is configured as a non-inverting type with the high-pass cutoff frequency set at 1 kHz. The overall circuitry is preferably enclosed in a metal shield to minimize electromagnetic noise coupling into the highly sensitive amplifier inputs. In addition, a local, regulated power supply is included to allow for a wide range of input voltage supply and provide sufficient power supply rejection to compensate for the noise susceptibility of remote power distribution. All the pre-amplifier circuits' power and signal connections preferably originate from the processor unit.

[085] The processor unit subsystem preferably consists of an analog signal processing interface that provides (1) additional voltage amplification and filtering of base band signal from the preamplifiers, (2) absolute value function, (3) peak detection function, and (4) analog-to-digital comparator function to provide support for an adaptive threshold means. The adaptive threshold technique provides robust triggering of the most proximal ultrasonic source at a precise temporal point along the traversing sinusoidal waveform of the electrical signal. Essentially, a new threshold signal is recalculated each analysis period based upon a small percentage reduction of the last peak waveform detected. Therefore, the tracking range is not necessarily restricted due to an arbitrarily high threshold setting and the noise immunity is improved as the threshold tracks the waveform envelope and not transient disturbances. An alternative automatic gain control strategy for the amplification function is unnecessary since the trigger threshold will adjust to the signal level instead. In the preferred embodiment, the threshold faithfully tracks the peak to minimize integer period phase errors, so the amplifier's gain is set to prevent signal saturation from occurring when the receiver constellation unit and transponders are in closest proximity during normal use.

[086] In one embodiment, an amplifier and BW (band width) filter circuit receives the output from the sensor and preamplifier circuit and provides additional amplification and low-pass filtering to condition it for reliable threshold triggering and input to other analog signal processing circuitry. A dual amplifier configuration may be used to provide an additional gain of 40dB, AC coupling to remove DC offsets of the preamplifier outputs and long cable losses, and low-pass filter to reject noise beyond the interest signal's bandwidth. The first stage amplifier may be configured as a non-inverting type with a gain of 20dB. The low-impedance DC input signal is effectively blocked by the coupling capacitor in series at its non-inverting input with a

high-pass frequency cutoff set at 20 kHz. This gain stage feeds a second amplifier configured as low-pass, 2nd order Butterworth MFB filter. This filter type provides smooth pass band response and reduced sensitivity to component tolerances. The second stage low-pass frequency cutoff is set at 80 kHz with a pass band gain of 20dB.

[087] An absolute value circuit receives the output of the amplifier and BW filter circuit and converts the bipolar signal into a unipolar form for magnitude detection. A dual amplifier configuration may be used to provide highly accurate full wave rectification of the millivolt-level signal. The first stage amplifier feedback switches to control the distribution of input current between the two signal paths dependent upon the input signal polarity. For a positive input voltage the input current will be positive which forward biases D1 and reverse biases D2. This configures the 1st stage as an inverter driving the inverting input resistor of the 2nd stage, which is also configured as an inverter because its non-inverting input is held at virtual ground due to the non-conducting path of D2. This effectively creates a combined circuit of two cascaded inverters for an overall gain of +1. For a negative input signal its input current is negative which forward biases D2 and reverse biases D1. This configures the 1st stage as an inverter driving the non-inverting input of the 2nd stage which changes the sign of the circuit gain. In this mode, the input current is shared between two paths to the input of the 2nd stage, where -2/3 of the input current flows around the 1st feedback stage and -1/3 flows in the opposite path around the 2nd stage feedback path for a net gain of -1.

[088] In the preferred embodiment, a peak detect and sample-hold circuit receives the output of the absolute value circuit and registers a peak value that is required to set a magnitude threshold precisely at some percentage of full-scale of the peak. A dual amplifier configuration may be used to provide the highest ratio of high output slew rate to low droop. The first stage is typically in negative saturation until the input voltage rises and exceeds the peak previously stored on the sample capacitor at the inverting input. Now the amplifier acts as a unity gain buffer and the input voltage charges the sample capacitor which faithfully tracks the rising voltage. Once the input voltage diminishes in magnitude, the first blocking diode reverse biases and the sample capacitor holds an accurate replica of the highest voltage attained with minimal droop because of the low input bias current of the amplifier and elimination of leakage altogether in the second blocking diode by bootstrapping its cathode at

the same potential provided by the low-impedance buffer of the second output stage. An electronic switch and bleed resistor allow the voltage across the sample capacitor to be reset by the processor during power up and after the triggering event is recorded so the adaptive threshold value can be refreshed each cycle. A 1st order Butterworth filter may be used at the input to smooth false in-band transients that could disrupt the peak accuracy detection.

[089] In the preferred embodiment, a comparator circuit receives the output from the peak detect and sample-hold circuit to convert the analog signal to digital form for high-speed triggering operation of the processor. The preferred device is the MAX941 which is manufactured by Maxim. A percentage of the peak threshold is used to set the inverting input. When the non-inverting voltage exceeds the inverting voltage, the comparator's output will trip and produce a high-true logic pulse that triggers the processor. A latch control input allows the processor to disable the comparator action to prevent unnecessary triggering during the reverberation phase and to prevent potentially disruptive noisy output chattering near threshold crossover beyond its hysteretic immunity. The percentage of threshold level is predetermined through the scaling resistors to be set low enough to trigger on the rising edge of the signal's first crest at the furthest range of transponder operation, but high enough above the intrinsic system noise level and external noise caused by reverberation and other ultrasonic sources. Once the first crest is registered, subsequent crests may be triggered at their zero-crossing representing the most precise timing registration by momentarily disabling the sample-hold circuit. Because of the longer duration trigger receptivity window, early multiple reflections are mitigated by transducer placement at least 3.5 cm away from adjacent planar surfaces, so the reflected acoustic energy doesn't produce a canceling effect of the direct acoustic energy of the later crests. Once a sufficient number of crests have been registered, then the triggering window is blanked for the remainder of the analysis period by latching the comparator's value.

[090] In the preferred embodiment, a digital signal processing interface is connected to the analog signal processing interface to transform the analog trigger processing into digital position information.

[091] The digital filter circuit receives output from the comparator circuit and preferably consists of a digital low-pass filter implemented in a complex programmable logic device (CPLD) that serves to precondition the comparator

circuit's digital outputs. The preferred device is an AT1504ASVL CPLD which is manufactured by Atmel. Base band system noise or other glitches potentially occurring in the analog signal processor interface, but prior to the actual arrival of the ultrasonic signal, could cause a threshold disruption that registers a "runt" pulse as a false trigger condition. The "runt" pulse would be misinterpreted as the actual TOF trigger and cause serious error in the position calculation. An AND/NOR one-hot state machine design may be used to ignore level transitions that are not stable for at least $\frac{1}{2}$ system clock frequency x 8 states, so only transitions of 4 μ S or greater are passed through. The system clock delays introduced by the digital filter's synchronous state machine affect all channels the same and are, therefore, effectively eliminated by the inherent dependency on relative measurement.

[092] In the preferred embodiment, the processor and digital filter circuits receive the output from the analog processor and provide controlling signals therein. The preferred processor circuit is the MC9S08GB60 which is manufactured by Motorola Inc. It is a low-cost, high-performance 8-bit microcontroller device that provides all the aforementioned hardware circuits integrated into one convenient device. The calculation circuit is abstracted from embedded 60 KB FLASH for program memory with in-circuit programmable capability and 4 KB RAM for data memory. The time base circuit is preferably comprised of an external, high-noise immunity, 4.0 MHz system clock, which multiplies this by the internal frequency-locked loop for a bus clock of 40.0 MHz and single instruction execution time of 25 ns. This clock also provides all the capture and control timing functionality for the other specified circuits. Multiple parallel I/O ports and dedicated asynchronous serial communication signals provide for the digital control of the analog signal processing and communication interfaces, respectively.

[093] The timing capture-control circuit receives the output from the digital filter circuit representing the arrival of the TOF triggers to determine the relative TOF propagation of the ultrasonic acoustic wave as it passes through the receiver constellation unit. More specifically, it is comprised of a five channel 16-bit timer input capture module with programmable interrupt control that provides edge detection and 50 ns timing precision to automatically register the TOF triggers timestamps asynchronously without using inefficient and less accurate software polling means.

[094] The phase-locked loop circuit receives the output from the timing capture-control circuit and is preferably comprised of a three channel, 16-bit timer compare module is implemented as an all-digital phase locked loop (ADPLL), which synchronizes the capture window and blanking functions with respect to the reference input channel. It is comprised primarily of a free-running 16-bit timer configured to periodically interrupt the processor dependent upon a precise convergence of its period and phase to the reference trigger source, by means of an over/under count matching and correction technique.

[095] The A/D conversion circuit receives the output from the amplifier and BW filter circuit and consists of an eight channel 10-bit analog-to-digital converter used to monitor channel offsets and magnitudes for range and polarity errors and correction. This information is utilized by the calculation circuit as input to the TOF software correction algorithm to determine the slope of the waveform crest.

[096] In the preferred embodiment, the serial communication circuit is comprised of two asynchronous serial communication interfaces that are connected between the calculation circuit and host link and radio link circuits of the communication interface. The host link provides a 115K bit per second (baud) bi-directional communication link to an auxiliary host computer system through a Serial-to-Universal Serial Bus bridge. The preferred device is the CP2101 which is manufactured by Silicon Laboratories. It supports the conversion of a fully asynchronous serial data bus protocol, with buffering and handshaking support, to an integrated Universal Serial Bus (USB) Function Controller and Transceiver and internal clock providing USB 2.0 full-speed compliancy. An integrated 512bit EEPROM stores the required USB device descriptors, including the Vendor ID, Product ID, Serial Number, Power Descriptor, Release number and Product Description strings. A host computer may enumerate and access this device utilizing the manufacturer's virtual COM port device drivers using a USB channel.

[097] In the preferred embodiment, the radio link circuit is comprised of a wireless bi-directional communication interface to preferably (1) broadcast a synchronization signal to control the transponders interoperability, (2) to receive other transponder sensor data, including, but not limited to, accelerometer, heart rate, battery, user I/O status, (3) to provide control messages for the transponders' sensory interfaces, and (4) to provide means to configure transponders' local databases. The preferred wireless communication link is based upon the AT86RF211, a highly integrated, low-

power FSK transceiver optimized for license-free ISM band operations from 400 MHz to 950 MHz. and manufactured by Atmel. It supports data rates up to 64 kbps with data clock recovery and no Manchester Encoding required. The device has a three wire microprocessor interface that allows access of read/write registers to setup the frequency selection, transmission mode, power output, etc. or get information about parameters such as battery, PLL lock state, etc. In normal mode, any data entering its input channel is immediately radiated or any desired signal collected by the aerial is demodulated and transferred to the microprocessor as reshaped register bit information. In wake-up mode, the device periodically scans for an expected message sequence and broadcasts an interrupt if a correct message is detected.

[098] In the preferred embodiment, at least three (3) consecutive TOF timestamps are registered for each receiver during the acquisition phase. Preferably, the transponder's transducer emits a multi-cycle ultrasonic acoustic burst of at least ten cycles in duration so that sufficient energization of the receiver transducer is realized and at least three crests of the waveform can be properly registered. At low signal levels when ultrasonic acoustic coupling is poor, this requirement may fail and an invalid tracking status is asserted. Preferably, the reference receiver transducer of the receiver constellation unit is positioned in closest proximity to the acoustic signal source so that it is the first transducer to be affected by the initial wave front. This reference receiver provides the overall system timing and state machine control for the phase-locked loop circuit, so that the processing, calculation, and communication tasks are executed in a deterministic and efficient fashion.

[099] It should be appreciated that a high-resolution ultrasonic acoustic tracking system that depends upon threshold detection means has an inherent uncertain trigger dilemma. This uncertainty arises because of the multi-cycle nature of the transmitted signal's waveform and the associated difficulty detecting the exact temporal location for consecutive analysis periods when the signal's magnitude may vary greatly depending upon the efficiency of the acoustic coupling, the distance between transmitter and receiver, and signal-to-noise ratio of the signal processing techniques. If a threshold is set near one of the minor crests of the waveform during the last analysis period, then it is conceivable a slight reduction of magnitude of the waveform during the next analysis period may fall slightly below the set threshold and actually not be triggered until the next larger excursion of the waveform occurs.

This would create a TOF error proportional to the period of the acoustic waveform or its intra-pulse interval and have a detrimental affect on the measurement accuracy. This analog processing described above establishes trigger thresholds that allow no more than a single intra-pulse interval of uncertainty, but that is still inadequate for high-resolution measurements. Although a technique is known that controls the largest peak profile of the transmitter acoustic signal and claims to provide an absolute trigger condition, this procedure is difficult to reliably tune and control among different transducer types.

[0100] In the preferred embodiment of the invention, no modulation of the acoustic signal is required. Rather, the adaptive threshold method is augmented with a TOF software correction algorithm that unambiguously determines the correct TOF based upon a means to detect the same carrier wave cycle of ultrasonic energy every period. The software correction algorithm requires multiple, consecutive TOF acquisitions as input for the digital over-sampling and averaging algorithm, the calculation of a higher-order numerical differentiation of the past and current TOF information as input for the predictive algorithm of higher-order Taylor series based derivatives used for the relative TOF correction, and a measurement of the intra-pulse time intervals of consecutive TOF acquisitions as input for the absolute TOF correction scheme that minimizes the range error based upon selective biasing of the TOFs.

[0101] The calculation circuit preferably processes multiple, consecutive TOF acquisitions to effectively improve the timing resolution that proportionally affects position accuracy and precision. The digital filter discussed above introduces quantization errors because of its discrete operation. And minor fluctuations in the acoustical coupling produces timing jitter or uncertainty in the triggered zero-crossings of the acoustic sinusoidal. A Gaussian average or mean value of multiple TOF is a simple and effective filter strategy. Due to the possibility of poor acoustic coupling or misalignment, and distant transponder location from the processor unit, the number of detectable triggered zero-crossings may vary for a fixed duration of multi-cycle ultrasonic acoustic burst. The averaging algorithm automatically adjusts to this condition by only including TOFs whose delta changes fall within the expected range of the nominal intra-pulse interval defined by the transmission properties of the acoustic source. The nominal intra-pulse interval is determined and utilized by the following compensation schemes.

[0102] The calculation circuit preferably processes a relative TOF correction algorithm based upon a predictive tuned algorithm that requires higher-order numerical differentiation calculation of the past and current TOFs. This compensates the TOFs that may have registered one intra-pulse interval earlier or later than the nominally expected time due to the trigger dilemma described above. By formulating these derivatives into a truncated 2nd order Taylor series expansion and weighting the terms contribution, an estimate of expected TOF is calculated and compared to the actual TOF through an iterative error minimization calculation. A minimized error that results in a delta time change indicative of a discrete intra-pulse interval increase or decrease due to an early or late TOF, respectively, produces a characteristic value that directs the algorithm to compensate the actual TOF by the intra-pulse interval and restore it to its correct value. In the preferred embodiment, this relative compensation algorithm works most effectively when, (1) the maximally expected inter-period TOF change is less than the discrete intra-pulse interval, (2) the TOF inter-period processing is contiguous, (3) the TOF increase or decrease is no more than a single intra-pulse interval, and (3) the Taylor series terms are suitably weighted in the prediction algorithm.

[0103] The calculation circuit preferably processes an absolute TOF correction algorithm at least once initially, when the phase-locked loop is stable, but may be performed every analysis period depending on computational resources, that determines the initial set of TOF values for the relative correction algorithm. The initial condition that precedes the start of the relative compensation algorithm may be due to the resumption of a stable, locked tracking state after recovery from a fault condition and, therefore, requires computation of a set of reference TOFs producing minimum range error as a starting basis. The algorithm utilizes a wireless synchronization means to determine a reference TOF calculation between the transponder and reference sensor of the receiver constellation. By computing the reference range distance by the product of the reference TOF and speed of sound in air, this reference range may be compared to the range calculated from the matrices solutions described below. By iteratively and sequential increasing and decreasing the TOFs by a single intra-pulse time interval and applying the input to matrices formulations described below, all possible combinations of compensation are permuted and tested, which produces a unique set of TOFs that minimize the error between the calculated range distance with respect to the reference range distance.

This unique set of initial TOFs serves as the starting basis for the relative compensation algorithm. In the preferred, embodiment, this absolute compensation algorithm works most effectively when (1) the wireless synchronization means is tightly coupled to the excitation of the acoustic source, (2) the synchronizing signal's arrival is timed by the same mechanism that times the arrival of the reference transducer's acoustic signal, and (3) the coordinate locations of the sensors of the receiver constellation are established to a high degree of accuracy.

[0104] The calculation circuit preferably employs two software methods of trilateration calculation to estimate transponder position, wherein the particular method used depends upon the availability of a synchronizing signal and the accuracy desired. The first method is based on a relative TOF calculation and the speed of sound is treated as a constant estimated at ambient indoor room temperature. The second method requires calculation of an additional TOF timestamp between the transponder and reference receiver, but calculates the speed of sound as an unknown every analysis period, and thus improves measurement accuracy. The first method eliminates the global system timing variances and delays due to the multiplicity of signal conditioning circuitry and eliminates the need for a controlling signal means synchronized at the generation of the transmission of the ultrasonic acoustic wave. The second method also employs relative TOF calculation but requires an additional synchronization signal from the processor unit to determine the absolute TOF between transponder and reference receiver. Since the absolute TOF is based upon a single channel only, its timing latencies can be readily accounted for and easily corrected. This method computes the speed of sound every analysis period, provided the synchronization signal is detected, without need for additional hardware temperature processing or requiring more than five (5) receivers, and automatically accounts for the system's main accuracy limitation of speed of sound in air as defined by Eq.1.1, if uncorrected, yields a 1.6 mm/m ranging error for every 1°C temperature shift. If the synchronization signal is not detected and, therefore, the second method is not resolvable, the last calculated speed of sound can be utilized within the first method's calculation to minimize error.

$$c \approx 34.6m/s + 0.5813m/s(T_c - 25^{\circ}C) \quad (1.1)$$

[0105] The TOF timestamps and speed of sound values are input into linear independent algebraic equations in a matrix formulation to solve for the unknown transponder(s) position, in a form as shown in Eq.2.1,

$$\mathbf{A} \cdot \mathbf{X} = \mathbf{B} \quad \mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \quad \mathbf{X} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \end{bmatrix} \quad (2.1)$$

[0106] To solve for the unknowns \mathbf{X} , Eq.2.1 is rearranged as shown in Eq.3.1, whereas the inverse of \mathbf{A} requires computation of the cofactor matrix \mathbf{A}^c for the adjoint and determinant calculations for Eq.3.2 and Eq.3.3, respectively,

$$\mathbf{X} = \mathbf{A}^{-1} \cdot \mathbf{B} = \frac{(\mathbf{A}^c)^T}{|\mathbf{A}|} \cdot \mathbf{B} \quad (3.1)$$

$$\left(\mathbf{A}^e\right)^T \equiv \begin{bmatrix} \mathbf{A}_{11} & \mathbf{A}_{21} & \mathbf{A}_{31} & \mathbf{A}_{41} \\ \mathbf{A}_{12} & \mathbf{A}_{22} & \mathbf{A}_{32} & \mathbf{A}_{42} \\ \mathbf{A}_{13} & \mathbf{A}_{23} & \mathbf{A}_{33} & \mathbf{A}_{43} \\ \mathbf{A}_{14} & \mathbf{A}_{24} & \mathbf{A}_{34} & \mathbf{A}_{44} \end{bmatrix} \quad (3.2)$$

$$|\mathbf{A}| \equiv a_{11} \cdot \mathbf{A}_{11} + a_{21} \cdot \mathbf{A}_{21} + a_{31} \cdot \mathbf{A}_{31} + a_{41} \cdot \mathbf{A}_{41} \quad (3.3)$$

[0107] To setup the coefficient matrix \mathbf{A} , the utilization of five (5) receivers produces the following set of relative TOF equations defined by Eqs.4.1-4,

$$\Delta T_{12} \equiv T_2 - T_1 \quad (4.1)$$

$$\Delta T_{13} \equiv T_3 - T_1 \quad (4.2)$$

$$\Delta T_{14} \equiv T_4 - T_1 \quad (4.3)$$

$$\Delta T_{15} \equiv T_5 - T_1 \quad (4.4)$$

[0108] The receiver locations are fixed within the system's inertial reference frame, while the transponder(s) are mobile with respect to the same reference frame and are defined as follows,

$$S(x_i, y_i, z_i) \text{ for } 5 \geq i \geq 1 \Rightarrow \text{fixed receiver locations}$$

$$S(x_0, y_0, z_0) \equiv S(u, v, w) \Rightarrow \text{unknown transponder location}$$

[0109] Since each receiver is fixed at a distance D_i from the transponder as determined by the receiver constellation geometry and because the acoustic waves propagate spherically, by using Pythagorean's theorem the following set of range equations are defined in Eqs.5.1-5,

$$(x_1 - u)^2 + (y_1 - v)^2 + (z_1 - w)^2 = D_1^2 \quad (5.1)$$

$$(x_2 - u)^2 + (y_2 - v)^2 + (z_2 - w)^2 = D_2^2 \quad (5.2)$$

$$(x_3 - u)^2 + (y_3 - v)^2 + (z_3 - w)^2 = D_3^2 \quad (5.3)$$

$$(x_4 - u)^2 + (y_4 - v)^2 + (z_4 - w)^2 = D_4^2 \quad (5.4)$$

$$(x_5 - u)^2 + (y_5 - v)^2 + (z_5 - w)^2 = D_5^2 \quad (5.5)$$

[0110] Equivocally, the four (4) non-reference receivers are preferably located at an incremental distance relative to the reference receiver, so by substitution of the incremental distance defined by Eq.6.1, the following set of relativistic range equations are defined by Eqs.6.2-5,

$$D_i = D_1 + c\Delta T_{1i} \quad \text{for } 5 \geq i \geq 2 \quad (6.1)$$

$$(x_2 - u)^2 + (y_2 - v)^2 + (z_2 - w)^2 = (D_1 + c\Delta T_{12})^2 \quad (6.2)$$

$$(x_3 - u)^2 + (y_3 - v)^2 + (z_3 - w)^2 = (D_1 + c\Delta T_{13})^2 \quad (6.3)$$

$$(x_4 - u)^2 + (y_4 - v)^2 + (z_4 - w)^2 = (D_1 + c\Delta T_{14})^2 \quad (6.4)$$

$$(x_5 - u)^2 + (y_5 - v)^2 + (z_5 - w)^2 = (D_1 + c\Delta T_{15})^2 \quad (6.5)$$

[0111] By expanding and rearranging the terms of Eqs.6.2-5, a set of four linear algebraic equations and four unknowns for the first method algorithm, depicted in the matrix form of Eq.2.1, is defined by Eq.7.1,

$$2 \begin{bmatrix} x_1 - x_2 & y_1 - y_2 & z_1 - z_2 & -c\Delta T_{12} \\ x_1 - x_3 & y_1 - y_3 & z_1 - z_3 & -c\Delta T_{13} \\ x_1 - x_4 & y_1 - y_4 & z_1 - z_4 & -c\Delta T_{14} \\ x_1 - x_5 & y_1 - y_5 & z_1 - z_5 & -c\Delta T_{15} \end{bmatrix} \begin{bmatrix} u \\ v \\ w \\ D_1 \end{bmatrix} = \begin{bmatrix} (c\Delta T_{12})^2 + R_1^2 - R_2^2 \\ (c\Delta T_{13})^2 + R_1^2 - R_3^2 \\ (c\Delta T_{14})^2 + R_1^2 - R_4^2 \\ (c\Delta T_{15})^2 + R_1^2 - R_5^2 \end{bmatrix} \quad (7.1)$$

$$\text{where } R_i^2 = x_i^2 + y_i^2 + z_i^2 \quad \text{for } 5 \geq i \geq 1 \quad (7.2)$$

[0112] Alternatively, if the second method algorithm is used, the unknown range of the reference receiver D_1 can be substituted by Eq.8.1,

$$D_1 \equiv cT_{01}, \Delta T_{01} \Rightarrow \text{time of flight (TOF) from } S(u,v,w) \text{ to } S(x_1,y_1,z_1) \quad (8.1)$$

[0113] And, by rearranging terms, it is depicted in the matrix form defined by Eq.9.1,

$$\text{a.} \quad \begin{bmatrix} x_1 - x_2 & y_1 - y_2 & z_1 - z_2 & -(\Delta T_{01} \Delta T_{12} + 0.5 \Delta T_{12}^2) \\ x_1 - x_3 & y_1 - y_3 & z_1 - z_3 & -(\Delta T_{01} \Delta T_{13} + 0.5 \Delta T_{13}^2) \\ x_1 - x_4 & y_1 - y_4 & z_1 - z_4 & -(\Delta T_{01} \Delta T_{14} + 0.5 \Delta T_{14}^2) \\ x_1 - x_5 & y_1 - y_5 & z_1 - z_5 & -(\Delta T_{01} \Delta T_{15} + 0.5 \Delta T_{15}^2) \end{bmatrix} \begin{bmatrix} u \\ v \\ w \\ c^2 \end{bmatrix} \equiv \begin{bmatrix} R_1^2 \\ R_1^2 \\ R_1^2 \\ R_1^2 \end{bmatrix} \quad (9.1)$$

[0114] Although similar results may be obtained by application of more computational efficient processes such as pivotal condensation or Crout's decomposition, the application of Cramer's rule was used to evaluate the first-order determinant in Eq.3.3 using second-order determinants from Laplace expansion. The final transponder(s) position equations are defined by Eqs.10.1-8.

$$u \equiv \frac{|A_2|}{|A|} \quad (10.1)$$

$$v = \frac{|A_2|}{|A|} \quad (10.2)$$

$$w = \frac{|A_3|}{|A|} \quad (10.3)$$

$$D_1 = \frac{|A_4|}{|A|} \text{ (1st method) or } c = \sqrt{\frac{|A_4|}{|A|}} \text{ (2nd method)} \quad (10.4)$$

$$|A_1| = b_1 \cdot A_{11} + b_2 \cdot A_{21} + b_3 \cdot A_{31} + b_4 \cdot A_{41} \quad (10.5)$$

$$|A_2| = b_1 \cdot A_{12} + b_2 \cdot A_{22} + b_3 \cdot A_{32} + b_4 \cdot A_{42} \quad (10.6)$$

$$|A_3| = b_1 \cdot A_{13} + b_2 \cdot A_{23} + b_3 \cdot A_{33} + b_4 \cdot A_{43} \quad (10.7)$$

$$|A_4| = b_1 \cdot A_{14} + b_2 \cdot A_{24} + b_3 \cdot A_{34} + b_4 \cdot A_{44} \quad (10.8)$$

[0115] If the first method is used, D, the range of the transponder to the reference receiver from Eq.10.4 may be calculated as a redundant confirmation of the Eqs.10.1-3 calculations, provided the frame of reference origin and location of the reference receiver are identical or their offsets accounted for. If the second method is used, C, the speed of sound in air, from Eq.10.4 must be computed every analysis period if its value is anticipated to be used in the first method in the absence of a synchronization signal.

[0116] The orientation of the transponders can be derived from a similar utilization of the above algorithms for a transponder configured with a triad of ultrasonic transmitters. The transducers are preferably arranged in a triangular plane at the transponder of sufficient area for the desired angular resolution. The sequential

excitation of each transducer and subsequent calculation of position by the aforementioned methods provides sufficient information to determine orientation by the inverse kinematic calculations of Eqs.11.1-4, where the analysis is simplified by assuming the origin of rotations occurs about T_1 and T_{123} represents the initial relative position matrix from this origin and T'_{123} is the transformed or forward kinematic position matrix.

$$R_z(\theta)^{-1} T'_{123} = R_x(\theta) R_y(\theta) T_{123} \quad (11.1)$$

$$R_x(\theta) R_y(\theta) T_{123} \equiv \begin{bmatrix} 0 & x_2 \cos \theta_y + z_2 \sin \theta_y & x_3 \cos \theta_y \\ 0 & \sin \theta_x (x_2 \sin \theta_y - z_2 \cos \theta_y) & x_3 \sin \theta_x \sin \theta_y \\ 0 & -\cos \theta_x (x_2 \sin \theta_y - z_2 \cos \theta_y) & -x_3 \cos \theta_x \sin \theta_y \end{bmatrix} \quad (11.2)$$

$$R_z(\theta)^{-1} T'_{123} \equiv \begin{bmatrix} x_1' \cos \theta_z + y_1' \sin \theta_z & x_2' \cos \theta_z + y_2' \sin \theta_z & x_3' \cos \theta_z + y_3' \sin \theta_z \\ -x_1' \sin \theta_z + y_1' \cos \theta_z & -x_2' \sin \theta_z + y_2' \cos \theta_z & -x_3' \sin \theta_z + y_3' \cos \theta_z \\ z_1' & z_2' & z_3' \end{bmatrix} \quad (11.3)$$

$$\therefore x_1' = y_1' = z_1' = 0 \quad \wedge \quad y_2' = 0 \quad \wedge \quad y_3' = z_3' = 0 \text{ for initial orientation} \quad (11.4)$$

[0117] By examination of the matrices element equivalency of Eqs.11.2-3 and manipulation of terms so that the angles may be found using the inverse tangent function, the following rotation equations Eqs.12.1-3 are derived,

$$\theta_x = \text{atan} \left(\frac{x_2' \sin \theta_z - y_2' \cos \theta_z}{z_2'} \right) \quad (12.1)$$

$$\theta_y = \text{atan} \left(\frac{-z_1'}{\cos \theta_x (x_3' \cos \theta_z + y_3' \sin \theta_z)} \right) \quad (12.2)$$

$$\theta_z = \text{atan} \left(\frac{y_3' - \frac{x_3' \sin \theta_x \sin \theta_y}{\cos \theta_{z-1}}}{x_3'} \right) \quad (12.3)$$

$$\cos \theta_{z-1} \equiv \cos \theta_z \text{ from previous iteration} \quad (12.4)$$

$$\theta_z = \text{atan} \left(\frac{y_3'}{x_3'} \right) \text{ for 1st iteration} \quad (12.5)$$

[0118] These calculations are performed through iterative step processes which inherit angular approximations of the preceding steps until the final desired angular accuracy is achieved by assuming the conditions of Eqs.12.4-5. Therefore the rotation θ_z , roll, is first approximated by Eq.12.5; then the rotation θ_x , pitch, is approximated by Eq.12.1; and then the final rotation θ_y , yaw or turn, is approximated by Eq.12.2. The next approximation of θ_z utilizes the previous value of θ_z in Eq.12.3 and the similar steps are preferably repeated until the desired accuracy is achieved. The transcendental functions may be evaluated through a conventional look-up table or by a power series expansion.

[0119] Preferably, the overall analysis period duration is effectively trebled until the three (3) transducers' positions are calculated, which reduces the system's frequency response and imposes an increased latency effect. Typically, robust absolute orientation processing requires more stringent line-of-sight operation and is reserved for more sensitive, less dynamic, and reduced ROM movement trajectories, e.g., balance and sway. Therefore, the latency effect is less noticeable upon the real-time performance of the sensory interfaces.

[0120] In the preferred embodiment, the interactive hand-held transponders support a dual axis inertial sensor, which is operably configured to provide tilt (pitch and roll) orientation in its horizontal mounting plane. The inertial sensor is mounted in the intended operational horizontal plane with respect to the systems inertial frame of reference. Once the sensors signals has been converted to an acceleration value that varies between +/- 1 g the tilt in degrees is calculated as shown in Eqs.13.1-2, for pitch and roll, respectively.

$$\phi = \arcsin(A_x/1g) \quad (13.1)$$

$$\varphi = \arcsin(A_y/1g) \quad (13.2)$$

[0121] This outside-in ultrasonic tracking implementation, where the transponders are mounted on the mobile object, produces inherent temporal delays due to the finite TOF registration and calculation delays after the transponder has already moved into a different position before the measurement is complete. This overall latency period is compensated and minimized through use of a Kalman filter data processing algorithm to estimate the pose of the transponder by optimally and recursively combining past history, new measurements, and a priori models and information. Generally speaking, the Kalman filter is a digital filter with time-varying gains that are optimally determined through a stochastic dynamical model of the motion. The overall goal is to minimize filter lag while providing sufficient smoothing of the motion data.

[0122] An adaptive, multi dynamic model is developed based upon the kinematic quality of the expected movement trajectory. The predictive kinematic model for the Kalman filter is depicted in matrix form utilizing a truncated 2nd order Taylor series expansion as below in Eqs.14.1-2,

$$\begin{bmatrix} r \\ v \end{bmatrix}_{k+1} = \begin{bmatrix} 1 & \Delta t \\ 0 & 1 \end{bmatrix} \begin{bmatrix} r \\ v \end{bmatrix}_k + \begin{bmatrix} 0 \\ w \end{bmatrix} \quad (14.1)$$

$$\begin{bmatrix} r \\ v \\ a \end{bmatrix}_{k+1} = \begin{bmatrix} 1 & \Delta t & 0.5\Delta t^2 \\ 0 & 1 & \Delta t \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} r \\ v \\ a \end{bmatrix}_k + \begin{bmatrix} 0 \\ 0 \\ w \end{bmatrix} \quad (14.2)$$

[0123] The Kalman filter is now described for a single dimension, although it is utilized for prediction and smoothing for all position dimensions. The predictor stages consist of the calculation of the state and the error covariance projection equations. The state projector equation, Eq15.1, utilizes a discrete time-sampled difference equation of r calculated from Eq.15.2. In other words, the numerically derived velocity and acceleration components of motion are linearly combined with the previously a priori position to estimate the new position. The corrector stages consist of sequential computation of the gain, updated state estimate, and updated error covariance equations. The a posteriori state estimate, Eq.15.4, is based on a linear combination of the weighted measurement residual and the last state estimate.

$$\hat{x}_k^- = x_{k-1} + 0.5(x_{k-1} - x_{k-3}) + 0.5(x_{k-1} - 2x_{k-2} + x_{k-3}) \quad (15.1)$$

$$P_k^- = P_{k-1} + Q_k \quad (15.2)$$

$$K_k = \frac{P_k^-}{(P_k^- + R_k)} \quad (15.3)$$

$$\hat{x}_k = \hat{x}_k^- + K_k(z_k - \hat{x}_k^-) \quad (15.4)$$

$$P_k = (1 - K_k)P_k^- \quad (15.5)$$

[0124] The new error covariance projector, Eq.15.2, is it's previously computed value combined with the current process noise covariance, Q_k , which is tuned by an example model derived from the measured motion dynamics shown in Eq.16.1. The gain's measurement noise covariance, R_k , is defined as a small constant and based upon the actual static timing variance empirically measured. The smaller this value the more confidence there exists in the systems' measurement capability.

[0125] In the preferred embodiment, the product of the numerically-derived 1st and 2nd order derivatives of the measured position scaled by a frequency dependent gain provides a computationally practical adaptive dynamic process noise estimate model. The derivative product term increases Q_k proportionally for higher velocity and acceleration components of motion, e.g., quick, abrupt directional changes, which effectively increases the gain and, therefore, means more confidence exists in the measurement rather than the estimate. This provides faithful, low-latency response to high-frequency motions. Conversely, the frequency scaling term decreases the predictive "overshoot" characteristic of lower power, repetitive motion, e.g. slower, cyclic, ROM trajectories, which effectively decreases the gain and, therefore, means more confidence exists in the estimate rather than the measurement. It should be appreciated this filter implementation provides superior tracking fidelity and comparable smoothing characteristics as compared to practical lengths of finite impulse response running-average filters and various low-orders infinite impulse response filters. It achieves enough predictive response to compensate for the inherent TOF and computation latencies, while providing and comparable smoothing properties of other filter types.

$$Q_k \equiv |K_g [(z_{k-1} - z_{k-3})(z_{k-1} - 2z_{k-2} + z_{k-3})\sin(z_{k-1} - z_{k-3})]| \quad (16.1)$$

$$R_k \equiv 0.005 \quad (16.2)$$

[0126] In the preferred embodiment, a three dimensional (3D) piecewise cubic curve interpolates a movement trajectory for smoothing and reduced sample storage for greater memory efficiency. Preferably, four (4) sequential discrete control points of the n-length set of control points, the sample resolution dependent upon the desired movement granularity, and corresponding timestamp are needed to calculate in real-time the interpolated position between any pair of control points. A Catmull-Rom spline algorithm is the preferred method in that the path intersects the control points and would best approximate a movement that may have acute directional changes. The Catmull-Rom spline algorithm is defined by Eqs.17.1-3, where the geometry matrix \mathbf{G}_k represents the matrix of three dimensional (3D) control points.

$$\mathbf{C}_k(\mu) = \mathbf{G}_k \frac{1}{2} \begin{bmatrix} 0 & -1 & 2 & -1 \\ 2 & 0 & -5 & 3 \\ 0 & 1 & 4 & -3 \\ 0 & 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ \mu \\ \mu^2 \\ \mu^3 \end{bmatrix} \quad (17.1)$$

$$\mathbf{C}_k(\mu) = \mathbf{G}_k \begin{bmatrix} -0.5\mu + \mu^2 - 0.5\mu^3 \\ 1 - 2.5\mu^2 + 1.5\mu^3 \\ 0.5\mu + 2\mu^2 - 1.5\mu^3 \\ -0.5\mu^2 + 0.5\mu^3 \end{bmatrix} \quad (17.2)$$

$$\mathbf{G}_k \equiv [\mathbf{P}_{k-1} \quad \mathbf{P}_k \quad \mathbf{P}_{k+1} \quad \mathbf{P}_{k+2}] \quad (17.3)$$

[0127] The μ value is normalized and represents the %value between the 2nd 3rd control points. To calculate the interpolated value between the 1st and 2nd or the n-1th and nth control points, the value of first control point of the pair and the value of the last control point pair are doubly entered into the geometry matrix, respectively. The appropriate $d\mu/dt$ is determined by the desired rate of playback of movement trajectory. To playback at the same rate as the recorded session, and assuming fairly constant velocity, a timestamp should also be saved at each control point registration so that the μ calculation is correctly scaled by the delta time interval. The n-length set of control points would be manually registered by the user pressing a switch or automatically post processed by a sorting method where a control point is registered at the tangents of the trajectory having sufficient magnitude and/or experience sign changes which indicates discontinuous or non-monotonic movement.

[0128] The major functional interfaces of the transponder unit preferably include the sensory interface, transducer interface, processor, and communication interface. The following descriptions of the transponder unit are based upon the dependence flow represented by **Figure 6**.

[0129] The sensor interface refers to the collective support for the ultrasonic transmitter, heart rate receiver, and accelerometer circuits. The ultrasonic transmitter circuit is preferably gated by a pulse-width modulated (PWM) digital signal at nominally 0.8% duty cycle of the 40 kHz resonant frequency, e.g., a single 250 μ s pulse every analysis period, by the processor circuit. The radiated ultrasonic signal strength is controlled by gating a MOSFET transistor switch at a duty cycle which optimally energizes the transducer's series resonant tank circuit for sufficient duration. The resonant circuit's reactive components include an impedance matching inductor, the transducer's intrinsic capacitance, and a small damping resistive load. At resonance, a electrical damped sinusoidal with a potential up to $\sim 400 V_{pk-pk}$ is developed across the transducer to sufficiently drive it at acoustical power levels practical for the system's intended range of operation. Enabling a lower

duty cycle control through means of a software algorithm monitoring the transponders range would effectively lower the transponders power consumption and radiate less ultrasonic acoustic energy for close range operation when signal saturation and clipping is undesirable. Conversely, a higher duty cycle control would radiate greater ultrasonic energy to compensate for less efficient, non-optimal acoustical coupling orientations of the transponder with respect to the receiver constellation. Optionally, two additional transducers may be driven in unison or sequentially from a different transponder assembly to support measurement of absolute rotation about a single or multiple axes, or provide calculated positional redundancy for certain difficult line-of-sight applications.

[0130] The heart rate receiver circuit wirelessly receives a 5 kHz heart rate signal from a POLAR® transmitter belt. The transmitter, worn around the chest, electrically detects the heart beat and starts transmitting a pulse corresponding to each heart beat. The receiver captures the signal and generates a corresponding digital pulse which is received by the timing capture-control circuit of the processor interface. A software algorithm processes the signal with known time-based averaging and an adaptive window filter techniques to remove any extraneous artifact or corruption caused by interfering sources.

[0131] The accelerometer circuit consists of a low cost +/-1.5 g dual axis accelerometer that can measure both dynamic, e.g. vibration, and static, e.g. gravity or tilt, acceleration. If the accelerometer is oriented so both its axes are parallel to the earth's surface it can be used as a two axis tilt sensor with a roll and pitch axis.

[0132] The stimuli interface circuit provides the primary visual sensory interface preferably comprised of a linear array of five (5) bright, white light emitting diodes (LED) and associated drivers. The preferred LED device is a CMD87 manufactured by Chicago Miniature Lamp. These LEDs' intensity is controlled by a white LED driver. The preferred white LED driver device is a MAX1570 manufactured by Maxim. The white LED driver provides a maximum 120mA constant current source to each LED for optimal uniform luminescence. The drive current can be proportionally regulated through external pulse width modulation (PWM) means from the processor circuit to modulate its brightness level. Additionally, an electronic switch is connected in series to each LED drive to individually control its active state. By simultaneously controlling the PWM duty cycle and active state of each LED, the

light strobe can appear to smoothly migrate along the linear array in spite of its discontinuous operation.

[0133] Preferably, the stimuli interface circuit provides the primary aural stimulus by means of a 4 kHz piezo buzzer. The preferred device is SMT-3303-G manufactured by Projects Unlimited. This electro-mechanical buzzer requires an external transistor drive circuit and digital control signal gated at a rate near its resonant frequency. The buzzer inputs are connected to and controlled by PWM means from the processor circuit to provide a gross volume adjustment which is dependent upon the amplitude of the drive signal.

[0134] Additionally, the stimuli interface circuit provides the primary tactile stimulus by means of a vibrator motor. The driver for the vibrator motor enables a 120mA DC current source to excite the motor armature. The preferred driver device is the MAX1748 manufactured by Maxim. The rotational speed of the motor's armature is controlled by PWM means from the processor circuit.

[0135] The processor circuit preferably receives input from the stimuli interface, sensor interface, and the communication interface and provides controlling signals therein. The preferred processor circuit is the MC9S08GB60 which is manufactured by Motorola Inc. It is a low-cost, high-performance 8-bit microcontroller device that integrates the specialized hardware circuits into one convenient device. The software calculation engine circuit operates from an embedded 60 KB FLASH for program memory with in-circuit programmable capability and 4 KB RAM for data memory. The time base circuit is preferably comprised of an external, high-noise immunity, 4.0 MHz system clock, which multiplies this value by the internal frequency-locked loop for a bus clock of 40.0 MHz and single instruction execution time of 25 nS. This clock also provides all the capture and control timing requirements for the other specified circuits. Multiple parallel I/O ports and dedicated asynchronous serial communication signals provide digital control for the circuits of the parallel/serial I/O circuit.

[0136] In the preferred embodiment, the graphic LCD and touch screen circuit is the primary user input device for database management for an interactive transponder configuration. For example, it may be a 128x64 graphical liquid crystal display system (LCD) and associated 4-pin touch screen input device. A preferred LCD device is the 51553 manufactured by Optrex and the preferred touch screen device is the TSG-51 manufactured by Apollo Displays. LCD display information,

configuration commands, and bitmaps images can be loaded through the software calculation engine via a parallel memory interface to emulate a graphical user interface. A touch screen input device is connected to a controller circuit to decode soft key presses at areas over the graphical object. Preferably, the key presses are registered, filtered, decoded, and processed by the controller and then transferred to the software calculation engine via an interrupt driven asynchronous serial communication channel of the I/O interface. A preferred LCD controller is the UR7HCTS manufactured by Semtech.

[0137] The timing capture-control circuit provides controlling means for the stimuli interface and portions of the sensor interface. The stimuli interface is preferably comprised of a five channel 16-bit timer PWM module with programmable interrupt control which provides 250 ns timing resolution to automatically modulate the circuits' drivers through variable duty cycle control.

[0138] In the preferred embodiment, the A/D conversion circuit receives the output from the accelerometer circuit and consists of a two channel 10-bit analog-to-digital converter used determine the rotational angle of roll and pitch in the accelerometer deviates from its horizontal plane orientation. This information is communicated to the signal processor via the radio link.

[0139] In the preferred embodiment, the radio link circuit is comprised of a wireless bi-directional communication interface (with a receiver and transmitter shown generally at **20** and **30**) to (1) receive a synchronization signal for control of the transponders interoperability, (2) to transfer acquired local sensor data, including, but not limited to, accelerometer, heart rate, battery, user I/O status, to processor unit and (3) to provide means to configure its local database from command of processor unit. The preferred wireless communication link is based upon the AT86RF211, a highly integrated, low-power FSK transceiver optimized for license-free ISM band operations from 400 MHz to 950 MHz. and manufactured by Atmel. Its key features are described above.

[0140] In the preferred embodiment, the switch I/O circuit uses a SPST push button switch for user input to control the system's operational states, start and stop program execution, and function as feedback input to the program. A preferred device is the KSS231 SPST pushbutton switch manufactured by ITT Industries.

CLAIMS

What is claimed is:

1. A system for a user to play a video game, comprising:
 - a first hand-held communication device comprising:
 - a transmitter for transmitting signals;
 - a receiver for receiving signals; and
 - an output device;
 - an array of receiving devices remote from the first hand-held communication device for detecting ultrasonic signals emitted by the first hand-held communication device;
 - a processing system, remote from the first hand-held communication device, and in electrical communication with the array of receiving devices, adapted to wirelessly receive the signals transmitted by the transmitter, to determine movement information for the first hand-held communication device, to determine position information for the first hand-held device, and to send data signals to the first hand-held device to provide feedback data to the user;
 - wherein the movement information of the first hand-held communication device controls the movement of at least one object in a computer generated virtual environment; and
 - wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user based on the received data signals and delivered through the output device.
2. The video game system of claim 1, further comprising:

a second hand-held communication device adapted to electrically communicate with the first hand-held communication device, said second hand-held communication device, comprising a transmitter for transmitting signals;

wherein the processing system is adapted to determine movement information of the second hand-held communication device.

3. The video game system of claim 1, wherein the first hand-held communication device is further comprised of:

a tilt sensor for sensing orientation data for the first hand-held communication device, and wherein the first hand-held communication device transmits the orientation data to the processing system.

4. The video game system of claim 3, wherein the orientation data is roll and pitch data.

5. The video game system of claim 2, wherein the feedback data sent to the receiver is derived from the movement information of the first hand-held communication device and the second hand-held communication device.

6. The video game system of claim 5, wherein the output device provides audible stimuli to the user based on the feedback data.

7. The video game system of claim 1, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

8. The video game system of claim 7, wherein the first hand-held communication device is adapted to allow the user to provide configuration data to the system through the touch screen display.

9. The video game system of claim 1, wherein the system is adapted to provide feedback data proportional to an error signal determined by comparing the movement of the user to a reference movement trajectory.
10. The video game system of claim 1, wherein the system is interactive and responds to verbal command input from the user.
11. The video game system of claim 1, wherein the first hand-held communication device is adapted to attach to a modular extension piece.
12. The video game system of claim 11, wherein the modular extension piece is a rod.
13. The video game system of claim 11, wherein the modular extension piece provides force resistive feedback.
14. The video game system of claim 1, wherein the system is adapted to excite the output device based on the movement information for the first hand-held communication device.
15. The video game system of claim 1, wherein the system is adapted to excite the output device to indicate the quality of movement information for the first hand-held communication device.
16. The video game system of claim 1, wherein the system is adapted to proportionally excite the output device based on the movement information for the first hand-held communication device.
17. The video game system of claim 1, wherein the system is adapted to provide feedback data to the output device when the user has completed an activity.
18. The video game system of claim 1, wherein the system is adapted to modulate activity challenges based on scoring criteria.

19. The video game system of claim 1, wherein the system is adapted to visually queue the user to move according to a desired movement trajectory to assess balance control.
20. The video game system of claim 1, wherein the system is adapted to determine range of motion of a user's joint or body segment.
21. The video game system of claim 1, wherein the system is adapted to queue the user to control range of motion within prescribed limits.
22. The video game system of claim 1, wherein the system is adapted to provide feedback data to the output device when the user deviates from a desired movement trajectory.
23. The video game system of claim 1, wherein the system is interactive and responds to verbal command input from the user to modulate an activity.
24. The video game system of claim 1, further comprising:
a second hand-held communication device in electrical communication with the first hand-held communication device, said second hand-held communication device, comprising a transmitter for transmitting signals,
wherein the processing system is adapted to determine movement information of the second hand-held communication device; and
wherein the movement information of the first hand-held communication device and the second hand-held communication device is used to derive performance measurements of functional movements.
25. The video game system of claim 24, wherein functional movements can be measured of gait, jumping, cutting, turning, or shuttling.
26. The video game system of claim 24, wherein the functional movement measured can be balance or stance.

27. The video game system of claim 2, wherein the processing system determines movement information for the first hand-held communication device and the second hand-held device and processes this information to provide feedback data to the user.

28. The video game system of claim 27, wherein the movement information for the first and second hand-held devices is processed to provide feedback data to the user based on the movement of the first hand-held communication device with respect to the second hand-held communication device.

29. The video game system of claim 2, wherein the processing system is adapted to determine position information for the first hand-held communication device and the second hand-held device and process this position information to provide feedback data to the user.

30. The video game system of claim 1, wherein the processing system is adapted to determine the three-dimensional position of the first hand-held communication device and wherein the first hand-held communication device controls a graphical object in a virtual three-dimensional environment.

31. The video game system of claim 2, wherein the processing system is adapted to determine movement and position information for the first and second hand-held communication devices and process this information to provide feedback data to the user.

32. A system for a user to play a video game, comprising:

a first hand-held communication device comprising:

a transmitter for transmitting signals;

a receiver for receiving signals; and

an output device; and

a processing system, remote from the first hand-held communication device for wirelessly receiving the signals transmitted by the transmitter, determining movement information for first hand-held communication device;

a second hand-held communication device, in wireless communication with the processing system said second hand-held communication device, comprising a transmitter for transmitting signals;

wherein the processing system is adapted to determine movement information of the second hand-held communication device and send feedback data to the user based on the movement information of the first and second hand-held communication devices;

wherein the first hand-held communication device is adapted to receive and process the feedback data and generates sensory stimuli for the user based on the received data and delivered through the output device; and

wherein the movement information of the first and second hand-held communication devices are used to control a graphical object on a display screen.

33. The video game system of claim 32, wherein the system is interactive and responds to verbal command input from the user to modulate an activity.

34. The video game system of claim 32, wherein the system is adapted to visually queue the user to move according to a desired movement trajectory to assess balance control.

35. The video game system of claim 32, wherein the system is adapted to determine range of motion of a user's joint or body segment.

36. The video game system of claim 32, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

37. The video game system of claim 36, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.
38. The video game system of claim 36, wherein the system is adapted to provide feedback data to the user through the touch screen display.
39. The video game system of claim 36, wherein the system is adapted to provide performance data to the user through the touch screen display.
40. The video game system of claim 36, wherein the system is adapted to allow system setup through the touch screen display.
41. The video game system of claim 36, wherein the system is adapted to provide a menu oriented interface to the user through the touch screen display.
42. The video game system of claim 36, wherein the system is adapted to allow program selection to the user through the touch screen display.
43. The video game system of claim 36, wherein the system is adapted to biophysical data to the user through the touch screen display.
44. A system according to claim 32, wherein:
the first hand-held communication device is adapted to attach to a modular extension piece.
45. A system according to claim 44, wherein the second hand-held communication device is adapted to attach to the modular extension piece.
46. A system according to claim 44, wherein the first hand-held communication device is connected to the modular extension piece via a flexible coupling.
47. A system according to claim 44, wherein the first hand-held communication device is connected to the modular extension piece via a snap joint.

48. A system according to claim 44, wherein the first hand-held communication device is connected to the modular extension piece via a twist joint.
49. A system for a user to play a video game, comprising:
- a first hand-held communication device comprising:
 - a transmitter for transmitting signals;
 - a receiver for receiving signals; and
 - an output device; and
 - a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitter, to determine movement information for the first hand-held communication device;
 - wherein the movement information of the first hand-held communication device controls the movement of at least one object in a computer generated virtual environment;
 - wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user, based on the received data signals and delivered through the output device; and
 - wherein the processing system is adapted to determine the three-dimensional position of the first hand-held communication device and wherein the object is controlled in a virtual three-dimensional environment.
50. A system for a user to play a video game, comprising:
- a first hand-held communication device comprising:
 - a transmitter for transmitting signals;
 - a receiver for receiving signals; and
 - an output device;

a second hand-held communication device, the second hand-held communication device comprising a transmitter for transmitting signals; and

a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitters of the respective communication devices, to determine movement information for each of the respective communication devices, and to send data signals to the receiver to provide feedback data to the user;

wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user, based on the received data signals and delivered through the output device;

wherein the movement information of the first and second hand-held devices are used to control a graphical object on a display screen; and

wherein the system is interactive and responds to verbal command input from the user.

51. A system according to claim 50, wherein the first hand-held communication device is adapted to attach to a modular extension piece.

52. The system of claim 51, wherein the modular extension piece is a rod.

53. The system of claim 51, wherein the modular extension piece provides force resistive feedback.

54. The system of claim 51, wherein the modular extension piece is a weighted extension.

55. A system according to claim 50, further comprising:

a strap connected to the first hand-held communication device for securing the first hand-held communication device to a user's wrist.

56. A system according to claim 50, wherein:

the first hand-held communication device comprises a user input device adapted for communication with the processing system through the transmitter.

57. A system according to claim 56, wherein:

the user input device is adapted for calibrating the first communication device to establish a reference position.

58. A system according to claim 50, wherein:

the processing system is adapted to determine position information for each of the respective communication devices.

55. The video game system of claim 50, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

56. The video game system of claim 55, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.

57. A system according to claim 50, further comprising:

a coupling attachment to the first hand-held communication device adapted to accept attachment to the second hand-held communication device.

58. A system according to claim 50, further comprising:

a coupling attachment to the first hand-held communication device adapted to accept attachment to a modular extension piece.

59. A system for a user to play a video game, comprising:

a first hand-held communication device comprising:

a transmitter for transmitting signals;

a receiver for receiving signals; and

an output device;

a second hand-held communication device adapted to electrically communicate with the first communication device, and adapted for being attached to, in contact with, or held by the user, the second hand-held communication device comprising a transmitter for transmitting signals;

an array of receiving devices remote from the first hand-held communication device for tracking the movement of the first hand-held communication device;

a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitter of the first hand-held communication device, to determine movement information for each of the respective communication devices, and to send data signals to the receiver to provide feedback data to the user;

wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user, based on the received data signals, the sensory stimuli delivered through the output device;

wherein the first hand-held communication device is further comprised of a user input device adapted for communication with the processing system through the transmitter; and

wherein the user input device is adapted for calibrating the first communication device to establish a reference position.

60. A system according to claim 59, wherein:

the processing system is adapted to determine position information for each of the respective communication devices.

61. A system according to claim 59, wherein:

wherein the output device is a speaker for providing audible stimuli to the user.

62. A system according to claim 59, wherein:
the first hand-held communication device is adapted to attach to a modular extension piece.
63. A system according to claim 62, wherein the second hand-held communication device is adapted to attach to the modular extension piece.
64. A system according to claim 62, wherein the first hand-held communication device is connected to the modular extension piece via a flexible coupling.
65. A system according to claim 62, wherein the first hand-held communication device is connected to the modular extension piece via a snap joint.
66. The video game system of claim 59, wherein the first hand-held communication device is further comprised of:
a touch screen display for accepting input from the user.
67. The video game system of claim 66, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.
68. A system for a user to play a video game, comprising:
a first hand-held communication device comprising:
a transmitter for transmitting signals;
a receiver for receiving signals; and
an output device;
a second hand-held communication device adapted to electrically communicate with the first communication device, and adapted for being attached to, in contact with, or held by the user, the second hand-held communication device comprising a transmitter for transmitting signals; and

a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitter of the first hand-held communication device, and to send data signals to the receiver to provide feedback data to the user;

wherein the first hand-held communication device receives and processes the received data signals and generates sensory stimuli for the user, based on the received data signals and delivered through the output device;

wherein the first hand-held communication device is further comprised of a user input device adapted for communication with the processing system through the transmitter; and

wherein the user input device is adapted for calibrating the first communication device.

69. A system according to claim 68, wherein:

the processing system is adapted to determine movement information for each of the respective communication devices.

70. The video game system of claim 68, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

71. The video game system of claim 70, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.

72. The video game system of claim 70, wherein the system is adapted to provide feedback data to the user through the touch screen display.

73. The video game system of claim 70, wherein the system is adapted to provide performance data to the user through the touch screen display.

74. The video game system of claim 70, wherein the system is adapted to allow system setup through the touch screen display.
75. The video game system of claim 70, wherein the system is adapted to provide a menu oriented interface to the user through the touch screen display.
76. The video game system of claim 70, wherein the system is adapted to allow program selection to the user through the touch screen display.
77. The video game system of claim 70, wherein the system is adapted to biophysical data to the user through the touch screen display.
78. A system according to claim 68, wherein:
the first hand-held communication device is adapted to attach to a modular extension piece.
79. A system according to claim 78, wherein the first hand-held communication device is connected to the modular extension piece via a flexible coupling.
80. A system according to claim 78, wherein the first hand-held communication device is connected to the modular extension piece via a snap joint.

ABSTRACT

A system for use in playing a video game, the system acting to measure the position of transponders for testing and to train the user to manipulate the position of the transponders while being guided by interactive and sensory feedback. A bidirectional communication link to a processing system supporting the video game provides functional movement assessment.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	FER1947-002H
		Application Number	
Title of Invention	HUMAN MOVEMENT MEASUREMENT SYSTEM		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.</p> <p>This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

Secrecy Order 37 CFR 5.2

- ☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1						Remove	
Applicant Authority		<input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117		<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name		Family Name		Suffix	
Mr.	Kevin			Ferguson			
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service							
City	Dublin	State/Province	OH	Country of Residence i		US	
Citizenship under 37 CFR 1.41(b) i		US					
Mailing Address of Applicant:							
Address 1		8156 Campden Lakes Blvd					
Address 2							
City	Dublin	State/Province		OH			
Postal Code	43016	Country i		US			
Applicant 2						Remove	
Applicant Authority		<input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117		<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name		Family Name		Suffix	
Mr.	Donald			Gronachan			
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service							
City	Holtsville	State/Province	NY	Country of Residence i		US	
Citizenship under 37 CFR 1.41(b) i		US					
Mailing Address of Applicant:							
Address 1		4 Spiral Road					
Address 2							
City	Holtsville	State/Province		NY			
Postal Code	11742	Country i		US			
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.							
Add							

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

- ☐ An Address is being provided for the correspondence Information of this application.

IPR2019-01134

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	FER1947-002H	
		Application Number		
Title of Invention	HUMAN MOVEMENT MEASUREMENT SYSTEM			
Customer Number	08698			
Email Address	standleydocketing@standleyllp.com		<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	HUMAN MOVEMENT MEASUREMENT SYSTEM			
Attorney Docket Number	FER1947-002H	Small Entity Status Claimed <input checked="" type="checkbox"/>		
Application Type	Nonprovisional			
Subject Matter	Utility			
Suggested Class (if any)		Sub Class (if any)		
Suggested Technology Center (if any)				
Total Number of Drawing Sheets (if any)	10	Suggested Figure for Publication (if any)		

Publication Information:

<input type="checkbox"/>	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
<input type="checkbox"/>	Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.			
Please Select One:	<input checked="" type="radio"/> Customer Number	<input type="radio"/> US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)
Customer Number	08698		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.			
Prior Application Status	Pending	<input type="button" value="Remove"/>	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	12371711	2009-02-16
Prior Application Status	Patented	<input type="button" value="Remove"/>	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		FER1947-002H	
		Application Number			
Title of Invention		HUMAN MOVEMENT MEASUREMENT SYSTEM			

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12371711	Continuation of	11935578	2007-11-06	7492268	2009-02-17
Prior Application Status		Patented	Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
11935578	Continuation of	11187373	2005-07-22	7292151	2007-11-06
Prior Application Status		Expired	Remove		
Application Number		Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	
11187373		non provisional of	60592092	2004-07-29	
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.					Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).			
			Remove
Application Number	Country ⁱ	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			<input type="radio"/> Yes <input checked="" type="radio"/> No
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.			
Assignee 1			Remove
If the Assignee is an Organization check here. <input checked="" type="checkbox"/>			
Organization Name	MOTIVA LLC		
Mailing Address Information:			
Address 1	8156 Campden Lakes Blvd		
Address 2			
City	Dublin	State/Province	OH
Country ⁱ	US	Postal Code	43016
Phone Number		Fax Number	
Email Address			
Additional Assignee Data may be generated within this form by selecting the Add button.			Add

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.
--

IPR2019-01134

Sony EX1002 Page 84

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		FER1947-002H	
		Application Number			
Title of Invention	HUMAN MOVEMENT MEASUREMENT SYSTEM				
Signature	/James L. Kwak/			Date (YYYY-MM-DD)	2011-04-28
First Name	James L.	Last Name	Kwak	Registration Number	41133

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	A HUMAN MOVEMENT MEASUREMENT SYSTEM			
First Named Inventor/Applicant Name:	Kevin Ferguson			
Filer:	James Lee Kwak/Emily Shultz			
Attorney Docket Number:	FER1947-002H			
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	82	82
Utility Search Fee	2111	1	270	270
Utility Examination Fee	2311	1	110	110
Pages:				
Claims:				
Claims in excess of 20	2202	60	26	1560
Independent claims in excess of 3	2201	3	110	330
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				2352

Electronic Acknowledgement Receipt

EFS ID:	9979705
Application Number:	13096587
International Application Number:	
Confirmation Number:	4852
Title of Invention:	A HUMAN MOVEMENT MEASUREMENT SYSTEM
First Named Inventor/Applicant Name:	Kevin Ferguson
Customer Number:	08698
Filer:	James Lee Kwak/Emily Shultz
Filer Authorized By:	James Lee Kwak
Attorney Docket Number:	FER1947-002H
Receipt Date:	28-APR-2011
Filing Date:	
Time Stamp:	16:39:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$2352
RAM confirmation Number	3474
Deposit Account	194076
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:
Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		POA_DEC.pdf	208596	yes	4
			de54850839c5123f0ec44d6aac81922b363b28dd		
	Multipart Description/PDF files in .zip description				
	Document Description	Start	End		
	Oath or Declaration filed	1	2		
	Power of Attorney	3	4		
Warnings:					
Information:					
2	Drawings-only black and white line drawings	formal_drawings.pdf	629114	no	10
			cfc9588e88e3b7c966e6071b4027294ec5a82f8b		
Warnings:					
Information:					
3		con3_patapp.pdf	978850	yes	69
			397a0de1c7091f3afe48d1e014236c9cc2196d38		
	Multipart Description/PDF files in .zip description				
	Document Description	Start	End		
	Specification	1	54		
	Claims	55	68		
	Abstract	69	69		
Warnings:					
Information:					
4	Application Data Sheet	sb0014_fill.pdf	1031713	no	5
			0a57394cb7e1971b8a75ba93c54283c4b15ce0ff		
Warnings:					
Information:					
5	Fee Worksheet (PTO-875)	fee-info.pdf	38037	no	2
			78b3c1cc81d5d0f5f6320e06f93d46d9d51725c9		
Warnings:					
Information:					
Total Files Size (in bytes):			2886310		
IPR2019-01134					

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)		Attorney Docket Number	FER1947-002B	
		First Named Inventor	Ferguson, et al.	
		COMPLETE IF KNOWN		
<input checked="" type="checkbox"/> Declaration Submitted With Initial Filing	OR	<input type="checkbox"/> Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)	Application Number	
			Filing Date	
			Art Unit	Not yet known
			Examiner Name	Not yet known

I hereby declare that:

Each inventor's residence, mailing address, and citizenship are as stated below next to their name.

I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A HUMAN MOVEMENT MEASUREMENT SYSTEM

(Title of the Invention)

the specification of which

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) [] as United States Application Number or PCT International

Application Number [] and was amended on (MM/DD/YYYY) [] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

(Page 1 of 2)

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 21 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.


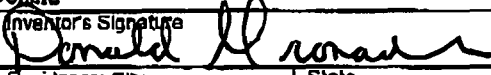
If you need assistance completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/01 (08-04)

Approved for use through 07/31/2006. OMB 0851-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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DECLARATION - Utility or Design Patent Application

Direct all correspondence to:	<input checked="" type="checkbox"/> The address associated with Customer Number:	<div style="border: 1px solid black; padding: 2px;">08698</div>	OR	<input type="checkbox"/> Correspondence address below
Name				
Address				
City		State		ZIP
Country	Telephone		Fax	
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.				
NAME OF SOLE OR FIRST INVENTOR:		<input type="checkbox"/> A petition has been filed for this unsigned inventor		
Given Name (first and middle (if any))		Family Name or Surname		
Kevin		Ferguson		
Inventor's Signature				Date
				7/21/2005
Residence: City	State	Country	Citizenship	
Dublin	Ohio	USA	USA	
Mailing Address				
8156 Campden Lakes Blvd.				
City	State	Zip	Country	
Dublin	Ohio	43016	USA	
NAME OF SECOND INVENTOR:		<input type="checkbox"/> A petition has been filed for this unsigned inventor		
Given Name (first and middle (if any))		Family Name or Surname		
Donald		Gronachan		
Inventor's Signature				Date
				7/20/05
Residence: City	State	Country	Citizenship	
Holtsville	New York	USA	USA	
Mailing Address				
4 Spiral Road				
City	State	Zip	Country	
Holtsville	New York	11742	USA	
<input type="checkbox"/> Additional inventors or a legal representative are being named on the supplemental sheet(s) PTO/SB/02A or 02LR attached hereto.				

(Page 2 of 2)



UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/096,587	04/28/2011	Kevin Ferguson	FER1947-002H

CONFIRMATION NO. 4852

FORMALITIES LETTER

8698
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017



Date Mailed: 05/11/2011

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing.

Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- Additional claim fees of **\$104** as a small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

SUMMARY OF FEES DUE:

Total fee(s) required within **TWO MONTHS** from the date of this Notice is **\$104** for a small entity

- Total additional claim fee(s) for this application is **\$104**
 - **\$104** for **64** total claims over 20.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
<https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html>

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at <http://www.uspto.gov/ebc>.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/tgebre/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/096,587	04/28/2011	Kevin Ferguson	FER1947-002H

CONFIRMATION NO. 4852

POA ACCEPTANCE LETTER

8698
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017



Date Mailed: 05/11/2011

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/28/2011.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/yhailu/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
13/096,587	04/28/2011	2629	2352	FER1947-002H	84	6

CONFIRMATION NO. 4852

8698
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017

FILING RECEIPT



Date Mailed: 05/11/2011

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Kevin Ferguson, Dublin, OH;
Donald Gronachan, Holtsville, NY;

Assignment For Published Patent Application

MOTIVA LLC, Dublin, OH

Power of Attorney: The patent practitioners associated with Customer Number 08698

Domestic Priority data as claimed by applicant

This application is a CON of 12/371,711 02/16/2009 PAT 7,952,483
which is a CON of 11/935,578 11/06/2007 PAT 7,492,268
which is a CON of 11/187,373 07/22/2005 PAT 7,292,151
which claims benefit of 60/592,092 07/29/2004

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.)

If Required, Foreign Filing License Granted: 05/09/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/096,587**

Projected Publication Date: 08/18/2011

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

HUMAN MOVEMENT MEASUREMENT SYSTEM

Preliminary Class

345

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER**Title 35, United States Code, Section 184****Title 37, Code of Federal Regulations, 5.11 & 5.15****GRANTED**

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as

set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 13/096,587				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	82		N/A				
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	270		N/A				
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	110		N/A				
TOTAL CLAIMS (37 CFR 1.16(j))	84	minus 20 = *	64	x 26 =	1664	OR				
INDEPENDENT CLAIMS (37 CFR 1.16(h))	6	minus 3 = *	3	x 110 =	330					
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$270 (\$135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				0.00					
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					0.00					
			TOTAL	2456		TOTAL				
* If the difference in column 1 is less than zero, enter "0" in column 2.										
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.										

Under the paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) FY 2009 <i>(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).)</i>		Docket Number (Optional) FER1947-002H	
Application Number 13096587		Filed 28-APR-2011	
For A HUMAN MOVEMENT MEASUREMENT SYSTEM			
Art Unit 3714		Examiner	
This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application. The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):			
	<u>Fee</u>	<u>Small Entity Fee</u>	
<input checked="" type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$130	\$65	\$ <u>65</u>
<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))	\$490	\$245	\$ _____
<input type="checkbox"/> Three months (37 CFR 1.17(a)(3))	\$1110	\$555	\$ _____
<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$1730	\$865	\$ _____
<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$2350	\$1175	\$ _____
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.			
<input type="checkbox"/> A check in the amount of the fee is enclosed.			
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.			
<input type="checkbox"/> The Director has already been authorized to charge fees in this application to a Deposit Account.			
<input checked="" type="checkbox"/> The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number <u>19-4076</u> .			
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.			
I am the <input type="checkbox"/> applicant/inventor.			
<input type="checkbox"/> assignee of record of the entire interest. See 37 CFR 3.71.			
Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96).			
<input checked="" type="checkbox"/> attorney or agent of record. Registration Number <u>41133</u>			
<input type="checkbox"/> attorney or agent under 37 CFR 1.34.			
Registration number if acting under 37 CFR 1.34 _____			
<u>/James L. Kwak/</u>		<u>July 21, 2011</u>	
Signature		Date	
<u>James L. Kwak</u>		<u>(614) 792-5555</u>	
Typed or printed name		Telephone Number	
NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.			
<input checked="" type="checkbox"/> Total of <u>1</u> forms are submitted.			

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	13096587			
Filing Date:	28-Apr-2011			
Title of Invention:	HUMAN MOVEMENT MEASUREMENT SYSTEM			
First Named Inventor/Applicant Name:	Kevin Ferguson			
Filer:	James Lee Kwak/Kimberly Hefner			
Attorney Docket Number:	FER1947-002H			
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Claims in excess of 20	2202	4	26	104
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

IPR2019-01134

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension - 1 month with \$0 paid	2251	1	65	65
Miscellaneous:				
Total in USD (\$)				169

Electronic Acknowledgement Receipt

EFS ID:	10571445
Application Number:	13096587
International Application Number:	
Confirmation Number:	4852
Title of Invention:	HUMAN MOVEMENT MEASUREMENT SYSTEM
First Named Inventor/Applicant Name:	Kevin Ferguson
Customer Number:	08698
Filer:	James Lee Kwak/Kimberly Hefner
Filer Authorized By:	James Lee Kwak
Attorney Docket Number:	FER1947-002H
Receipt Date:	21-JUL-2011
Filing Date:	28-APR-2011
Time Stamp:	16:27:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 169
RAM confirmation Number	3013
Deposit Account	194076
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digits	Multi Part (if appl.)	Pages (if appl.)
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1	Extension of Time	20110721_Extension.pdf	312288 a7381d05a51b30fdc3194482287e99b8ff943481	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32351 fle1bd044871aa98480672a60a8ee47cc9d11134	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			344639		
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 13/096,587			
APPLICATION AS FILED - PART I									
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY			
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)		
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	82		N/A			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	270		N/A			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	110		N/A			
TOTAL CLAIMS (37 CFR 1.16(j))	84	minus 20 = *	64	x 26 =	1664	OR			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	6	minus 3 = *	3	x 110 =	330				
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$270 (\$135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00					
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00					
				TOTAL	2456	TOTAL			
* If the difference in column 1 is less than zero, enter "0" in column 2.									
APPLICATION AS AMENDED - PART II									
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus **	=	x =	OR	x =		
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =	OR	x =		
	Application Size Fee (37 CFR 1.16(s))					OR			
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					OR			
				TOTAL ADD'L FEE		TOTAL ADD'L FEE			
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus **	=	x =	OR	x =		
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =	OR	x =		
	Application Size Fee (37 CFR 1.16(s))					OR			
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					OR			
				TOTAL ADD'L FEE		TOTAL ADD'L FEE			
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.									



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
13/096,587	04/28/2011	3714	2456	FER1947-002H	84	6

CONFIRMATION NO. 4852

UPDATED FILING RECEIPT

8698
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017



Date Mailed: 08/01/2011

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Kevin Ferguson, Dublin, OH;
Donald Gronachan, Holtsville, NY;

Assignment For Published Patent Application

MOTIVA LLC, Dublin, OH

Power of Attorney: The patent practitioners associated with Customer Number 08698

Domestic Priority data as claimed by applicant

This application is a CON of 12/371,711 02/16/2009 PAT 7,952,483
which is a CON of 11/935,578 11/06/2007 PAT 7,492,268
which is a CON of 11/187,373 07/22/2005 PAT 7,292,151
which claims benefit of 60/592,092 07/29/2004

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.)

If Required, Foreign Filing License Granted: 05/09/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/096,587**

Projected Publication Date: 08/18/2011

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

HUMAN MOVEMENT MEASUREMENT SYSTEM

Preliminary Class

463

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER**Title 35, United States Code, Section 184****Title 37, Code of Federal Regulations, 5.11 & 5.15****GRANTED**

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NOT GRANTED

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/096,587	04/28/2011	Kevin Ferguson	FER1947-002H

CONFIRMATION NO. 4852

PUBLICATION NOTICE



OC000000049394681

8698
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017

Title:HUMAN MOVEMENT MEASUREMENT SYSTEM

Publication No.US-2011-0201428-A1

Publication Date:08/18/2011

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <http://pair.uspto.gov/>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PLUS Search Results for S/N 13096587, Searched Thu Oct 06 09:12:27 EDT 2011

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

5682135 99	6154735 82
7292151 99	
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/096,587	04/28/2011	Kevin Ferguson	FER1947-002H	4852
8698 7590 10/13/2011 STANDLEY LAW GROUP LLP 6300 Riverside Drive Dublin, OH 43017			EXAMINER PHAM, TOAN NGOC	
			ART UNIT 2612	PAPER NUMBER
			MAIL DATE 10/13/2011	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 13/096,587	Applicant(s) FERGUSON ET AL.	
	Examiner TOAN N. PHAM	Art Unit 2612	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 5) ☒ Claim(s) 1-80 is/are pending in the application.
- 5a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 6) ☐ Claim(s) ____ is/are allowed.
- 7) ☒ Claim(s) 1-80 is/are rejected.
- 8) ☐ Claim(s) ____ is/are objected to.
- 9) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 12) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____. |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

Claim Objections

Claims 55-58 are objected to because of the following informalities: There are two sets of claims 55-58 (pages 63-64), one set should be cancelled. Appropriate correction is required.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to

Art Unit: 2612

be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-80 are rejected on the ground of nonstatutory double patenting over claims 1-50 of U. S. Patent No. 7,952,483 since the claims, if allowed, would improperly extend the "right to exclude" already granted in the patent.

The subject matter claimed in the instant application is fully disclosed in the patent and is covered by the patent since the patent and the application are claiming common subject matter, as follows: a first and second hand-held communication device comprising a transmitter for transmitting signals; a receiver for receiving signals; and an output device; a processing system, remote from the first hand-held communication device, and in electrical communication with the array of receiving devices, adapted to wirelessly receive the signals transmitted by the transmitter, to determine movement information for the first hand-held communication device, to determine position information for the first hand-held device, and to send data signals to the first hand-held device to provide feedback data to the user; wherein the movement information of the first hand-held communication device controls the movement of at least one object in a computer generated virtual environment; and wherein the first hand-held communication device is adapted to receive and process the received data signals and

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generate sensory stimuli for the user based on the received data signals and delivered through the output device.

Furthermore, there is no apparent reason why applicant was prevented from presenting claims corresponding to those of the instant application during prosecution of the application which matured into a patent. See *In re Schneller*, 397 F.2d 350, 158 USPQ 210 (CCPA 1968). See also MPEP § 804.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TOAN N. PHAM whose telephone number is (571)272-2967. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin C. Lee can be reached on (571) 272-2963. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2612

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TOAN N PHAM/
Primary Examiner, Art Unit 2612
10/8/11

Notice of References Cited	Application/Control No. 13/096,587	Applicant(s)/Patent Under Reexamination FERGUSON ET AL.	
	Examiner TOAN N. PHAM	Art Unit 2612	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,952,483	05-2011	Ferguson et al.	340/573.1
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			


FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes 	Application/Control No. 13096587	Applicant(s)/Patent Under Reexamination FERGUSON ET AL.
	Examiner TOAN N PHAM	Art Unit 2612

SEARCHED			
Class	Subclass	Date	Examiner
340	573.1, 573.4, 539.12, 539.13, 539.22, 407.1, 825.36, 6.1, 5.61, 825.72	10/5/11	TNP
381	315	10/5/11	TNP
434	112, 114	10/5/11	TNP
463	36, 39, 7, 35, 42	10/5/11	TNP
345	161	10/6/115	TNP

SEARCH NOTES		
Search Notes	Date	Examiner
EAST	10/5/11	TNP
PLUS SEARCH	10/6/115	TNP

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
340	573.1, 407.1	10/5/11	TNP
434	114	10/6/115	TNP

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BIB DATA SHEET

CONFIRMATION NO. 4852

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.		
13/096,587	04/28/2011	340	2612	FER1947-002H		
RULE						
APPLICANTS Kevin Ferguson, Dublin, OH; Donald Gronachan, Holtsville, NY; ** CONTINUING DATA ***** This application is a CON of 12/371,711 02/16/2009 PAT 7,952,483 which is a CON of 11/935,578 11/06/2007 PAT 7,492,268 which is a CON of 11/187,373 07/22/2005 PAT 7,292,151 which claims benefit of 60/592,092 07/29/2004 ** FOREIGN APPLICATIONS ***** ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED *** SMALL ENTITY ** 05/09/2011						
Foreign Priority claimed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No 35 USC 119(a-d) conditions met <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Verified and Acknowledged <u>/TOAN NGOC PHAM/</u> Examiner's Signature		<input type="checkbox"/> Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
			OH	10	84	6
ADDRESS						
STANDLEY LAW GROUP LLP 6300 Riverside Drive Dublin, OH 43017 UNITED STATES						
TITLE						
HUMAN MOVEMENT MEASUREMENT SYSTEM						
FILING FEE RECEIVED 2456	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		<input type="checkbox"/> All Fees			
			<input type="checkbox"/> 1.16 Fees (Filing)			
			<input type="checkbox"/> 1.17 Fees (Processing Ext. of time)			
			<input type="checkbox"/> 1.18 Fees (Issue)			
			<input type="checkbox"/> Other _____			
				<input type="checkbox"/> Credit		

EAST Search History

EAST Search History (Prior Art)


Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	92	("5682135" "7292151" "7492268" "7499985" "7952483" "20050282588" "20060022833" "20060136997" "20080018472" "20080061949" "20090149257" "20110201428" "6847296" "20030076239" "4004460" "4860016" "4897661" "5206626" "5223818" "5273532" "5288291" "5300079" "5305002" "5319354" "5370611" "5406262" "5477225" "5510795" "5584261" "5602538" "5623413" "5671786" "5708423" "5739774" "5794172" "5853327" "5857434" "5890520" "5924653" "5929760" "5936574" "5947423" "6026868" "6049280" "6049279" "6070156" "6073840" "6098879" "6145225" "6154735").pn.	US- PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/06 13:48
S1	4	("7492268" "7292151").pn.	US- PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 13:23
S2	2	("7952483").pn.	US- PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 13:32
S3	727	video with game with wireless with control	US- PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 14:23
S4	94	S3 and transmitter and receiver and movement	US- PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 14:24
S5	25	S4 and (determine\$2 detect\$) and process\$4 and position and (hand adj2 held)	US- PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 14:25
S6	18	340/573.1.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held)	US- PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 17:07

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S9	4	340/539.12.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 17:13
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S15	0	340/825.36.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 17:15
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S21	14	463/36.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 17:17
S22	0	435/161.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 17:18
S23	822	game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:43
S24	423	S23 and virtual and environment	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:44
S25	369	S24 and computer and generated and data and signals	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:44
S26	164	S25 and array and receivers	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:45


S27	10	S26 and (controls adj3 movement)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:45
S28	28	video with game with interactive with movement with control\$3	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	ON	2011/10/05 19:48
S29	10	463/39.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:51
S30	1	463/7.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:52
S31	2	463/35.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:52
S32	13	463/42.ccls. and game and controller and wireless and (motion movement) and (hand adj2 held) and transmitter and receiver and feedback	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 19:52
S33	6	virtual with interactive with wireless with controller	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 20:02
S34	3	interactive with wireless with controller with movement	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	OR	OFF	2011/10/05 20:22

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C:\ Users\ tpham2\ Documents\ EAST\ Workspaces\ user to play video game.wsp

<i>Index of Claims</i> 	Application/Control No. 13096587	Applicant(s)/Patent Under Reexamination FERGUSON ET AL.
	Examiner TOAN N PHAM	Art Unit 2612


✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant		<input type="checkbox"/> CPA		<input type="checkbox"/> T.D.		<input type="checkbox"/> R.1.47			
CLAIM		DATE							
Final	Original	10/08/2011							
	1	✓							
	2	✓							
	3	✓							
	4	✓							
	5	✓							
	6	✓							
	7	✓							
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	35	✓							
	36	✓							

<i>Index of Claims</i> 	Application/Control No. 13096587	Applicant(s)/Patent Under Reexamination FERGUSON ET AL.
	Examiner TOAN N PHAM	Art Unit 2612

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
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<input type="checkbox"/> Claims renumbered in the same order as presented by applicant		<input type="checkbox"/> CPA		<input type="checkbox"/> T.D.		<input type="checkbox"/> R.1.47			
CLAIM		DATE							
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	71	✓							
	72	✓							

<i>Index of Claims</i> 	Application/Control No. 13096587	Applicant(s)/Patent Under Reexamination FERGUSON ET AL.
	Examiner TOAN N PHAM	Art Unit 2612

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant		<input type="checkbox"/> CPA		<input type="checkbox"/> T.D.		<input type="checkbox"/> R.1.47			
CLAIM		DATE							
Final	Original	10/08/2011							
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	74	✓							
	75	✓							
	76	✓							
	77	✓							
	78	✓							
	79	✓							
	80	✓							

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 13/096,587

Inventors: Ferguson, et al

Filed: 28 April 2011

Examiner: Pham, Toan Ngoc

GAU: 2612

Atty Docket: FER1947-002H

**RESPONSE TO
OFFICE ACTION**

Title: A HUMAN MOVEMENT MEASUREMENT SYSTEM

Filed electronically on 16 November 2011

This paper is responsive to the Office Action mailed on 13 October 2011, making a non-final rejection of the claims. **A LISTING OF CLAIMS** begins on page 2 and **REMARKS** begin on page 17.

A terminal disclaimer based on US Pat 7,952,483 is filed herewith and the fee is being paid.

As this response is made within three months after the Office Action, no extension of time is required. No excess claim fees are believed to be due, as there has already been payment on July 11, 2011 for the additional four claims.

Please charge any fee deficiency to Deposit Account 19-4076.

LISTING OF CLAIMS

1. **(original)** A system for a user to play a video game, comprising:
 - a first hand-held communication device comprising:
 - a transmitter for transmitting signals;
 - a receiver for receiving signals; and
 - an output device;
 - an array of receiving devices remote from the first hand-held communication device for detecting ultrasonic signals emitted by the first hand-held communication device;
 - a processing system, remote from the first hand-held communication device, and in electrical communication with the array of receiving devices, adapted to wirelessly receive the signals transmitted by the transmitter, to determine movement information for the first hand-held communication device, to determine position information for the first hand-held device, and to send data signals to the first hand-held device to provide feedback data to the user;
 - wherein the movement information of the first hand-held communication device controls the movement of at least one object in a computer generated virtual environment; and
 - wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user based on the received data signals and delivered through the output device.
2. **(original)** The video game system of claim 1, further comprising:

a second hand-held communication device adapted to electrically communicate with the first hand-held communication device, said second hand-held communication device, comprising a transmitter for transmitting signals;

wherein the processing system is adapted to determine movement information of the second hand-held communication device.

3. **(original)** The video game system of claim 1, wherein the first hand-held communication device is further comprised of:

a tilt sensor for sensing orientation data for the first hand-held communication device, and wherein the first hand-held communication device transmits the orientation data to the processing system.

4. **(original)** The video game system of claim 3, wherein the orientation data is roll and pitch data.

5. **(original)** The video game system of claim 2, wherein the feedback data sent to the receiver is derived from the movement information of the first hand-held communication device and the second hand-held communication device.

6. **(original)** The video game system of claim 5, wherein the output device provides audible stimuli to the user based on the feedback data.

7. **(original)** The video game system of claim 1, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

8. **(original)** The video game system of claim 7, wherein the first hand-held communication device is adapted to allow the user to provide configuration data to the system through the touch screen display.

9. **(original)** The video game system of claim 1, wherein the system is adapted to provide feedback data proportional to an error signal determined by comparing the movement of the user to a reference movement trajectory.
10. **(original)** The video game system of claim 1, wherein the system is interactive and responds to verbal command input from the user.
11. **(original)** The video game system of claim 1, wherein the first hand-held communication device is adapted to attach to a modular extension piece.
12. **(original)** The video game system of claim 11, wherein the modular extension piece is a rod.
13. **(original)** The video game system of claim 11, wherein the modular extension piece provides force resistive feedback.
14. **(original)** The video game system of claim 1, wherein the system is adapted to excite the output device based on the movement information for the first hand-held communication device.
15. **(original)** The video game system of claim 1, wherein the system is adapted to excite the output device to indicate the quality of movement information for the first hand-held communication device.
16. **(original)** The video game system of claim 1, wherein the system is adapted to proportionally excite the output device based on the movement information for the first hand-held communication device.
17. **(original)** The video game system of claim 1, wherein the system is adapted to provide feedback data to the output device when the user has completed an activity.

18. **(original)** The video game system of claim 1, wherein the system is adapted to modulate activity challenges based on scoring criteria.

19. **(original)** The video game system of claim 1, wherein the system is adapted to visually queue the user to move according to a desired movement trajectory to assess balance control.

20. **(original)** The video game system of claim 1, wherein the system is adapted to determine range of motion of a user's joint or body segment.

21. **(original)** The video game system of claim 1, wherein the system is adapted to queue the user to control range of motion within prescribed limits.

22. **(original)** The video game system of claim 1, wherein the system is adapted to provide feedback data to the output device when the user deviates from a desired movement trajectory.

23. **(original)** The video game system of claim 1, wherein the system is interactive and responds to verbal command input from the user to modulate an activity.

24. **(original)** The video game system of claim 1, further comprising:

a second hand-held communication device in electrical communication with the first hand-held communication device, said second hand-held communication device, comprising a transmitter for transmitting signals,

wherein the processing system is adapted to determine movement information of the second hand-held communication device; and

wherein the movement information of the first hand-held communication device and the second hand-held communication device is used to derive performance measurements of functional movements.

25. **(original)** The video game system of claim 24, wherein functional movements can be measured of gait, jumping, cutting, turning, or shuttling.

26. **(original)** The video game system of claim 24, wherein the functional movement measured can be balance or stance.

27. **(original)** The video game system of claim 2, wherein the processing system determines movement information for the first hand-held communication device and the second hand-held device and processes this information to provide feedback data to the user.

28. **(original)** The video game system of claim 27, wherein the movement information for the first and second hand-held devices is processed to provide feedback data to the user based on the movement of the first hand-held communication device with respect to the second hand-held communication device.

29. **(original)** The video game system of claim 2, wherein the processing system is adapted to determine position information for the first hand-held communication device and the second hand-held device and process this position information to provide feedback data to the user.

30. **(original)** The video game system of claim 1, wherein the processing system is adapted to determine the three-dimensional position of the first hand-held communication device and wherein the first hand-held communication device controls a graphical object in a virtual three-dimensional environment.

31. **(original)** The video game system of claim 2, wherein the processing system is adapted to determine movement and position information for the first and second hand-

held communication devices and process this information to provide feedback data to the user.

32. **(original)** A system for a user to play a video game, comprising:

a first hand-held communication device comprising:

a transmitter for transmitting signals;

a receiver for receiving signals; and

an output device; and

a processing system, remote from the first hand-held communication device for wirelessly receiving the signals transmitted by the transmitter, determining movement information for first hand-held communication device;

a second hand-held communication device, in wireless communication with the processing system said second hand-held communication device, comprising a transmitter for transmitting signals;

wherein the processing system is adapted to determine movement information of the second hand-held communication device and send feedback data to the user based on the movement information of the first and second hand-held communication devices;

wherein the first hand-held communication device is adapted to receive and process the feedback data and generates sensory stimuli for the user based on the received data and delivered through the output device; and

wherein the movement information of the first and second hand-held communication devices are used to control a graphical object on a display screen.

33. **(original)** The video game system of claim 32, wherein the system is interactive and responds to verbal command input from the user to modulate an activity.

34. **(original)** The video game system of claim 32, wherein the system is adapted to visually queue the user to move according to a desired movement trajectory to assess balance control.

35. **(original)** The video game system of claim 32, wherein the system is adapted to determine range of motion of a user's joint or body segment.

36. **(original)** The video game system of claim 32, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

37. **(original)** The video game system of claim 36, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.

38. **(original)** The video game system of claim 36, wherein the system is adapted to provide feedback data to the user through the touch screen display.

39. **(original)** The video game system of claim 36, wherein the system is adapted to provide performance data to the user through the touch screen display.

40. **(original)** The video game system of claim 36, wherein the system is adapted to allow system setup through the touch screen display.

41. **(original)** The video game system of claim 36, wherein the system is adapted to provide a menu oriented interface to the user through the touch screen display.

42. **(original)** The video game system of claim 36, wherein the system is adapted to allow program selection to the user through the touch screen display.

43. **(original)** The video game system of claim 36, wherein the system is adapted to biophysical data to the user through the touch screen display.

44. **(original)** A system according to claim 32, wherein:

the first hand-held communication device is adapted to attach to a modular extension piece.

45. **(original)** A system according to claim 44, wherein the second hand-held communication device is adapted to attach to the modular extension piece.

46. **(original)** A system according to claim 44, wherein the first hand-held communication device is connected to the modular extension piece via a flexible coupling.

47. **(original)** A system according to claim 44, wherein the first hand-held communication device is connected to the modular extension piece via a snap joint.

48. **(original)** A system according to claim 44, wherein the first hand-held communication device is connected to the modular extension piece via a twist joint.

49. **(original)** A system for a user to play a video game, comprising:

a first hand-held communication device comprising:

a transmitter for transmitting signals;

a receiver for receiving signals; and

an output device; and

a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitter, to determine movement information for the first hand-held communication device;

wherein the movement information of the first hand-held communication device controls the movement of at least one object in a computer generated virtual environment;

wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user, based on the received data signals and delivered through the output device; and

wherein the processing system is adapted to determine the three-dimensional position of the first hand-held communication device and wherein the object is controlled in a virtual three-dimensional environment.

50. **(original)** A system for a user to play a video game, comprising:

a first hand-held communication device comprising:

a transmitter for transmitting signals;

a receiver for receiving signals; and

an output device;

a second hand-held communication device, the second hand-held communication device comprising a transmitter for transmitting signals; and

a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitters of the respective communication devices, to determine movement information for each of the respective communication devices, and to send data signals to the receiver to provide feedback data to the user;

wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user, based on the received data signals and delivered through the output device;

wherein the movement information of the first and second hand-held devices are used to control a graphical object on a display screen; and

wherein the system is interactive and responds to verbal command input from the user.

51. **(original)** A system according to claim 50, wherein the first hand-held communication device is adapted to attach to a modular extension piece.

52. **(original)** The system of claim 51, wherein the modular extension piece is a rod.

53. **(original)** The system of claim 51, wherein the modular extension piece provides force resistive feedback.

54. **(original)** The system of claim 51, wherein the modular extension piece is a weighted extension.

55. **(original)** A system according to claim 50, further comprising:

a strap connected to the first hand-held communication device for securing the first hand-held communication device to a user's wrist.

56. **(original)** A system according to claim 50, wherein:

the first hand-held communication device comprises a user input device adapted for communication with the processing system through the transmitter.

57. **(original)** A system according to claim 56, wherein:

the user input device is adapted for calibrating the first communication device to establish a reference position.

58. **(original)** A system according to claim 50, wherein:

the processing system is adapted to determine position information for each of the respective communication devices.

55-58. **(cancelled)**

59. **(original)** A system for a user to play a video game, comprising:

a first hand-held communication device comprising:

a transmitter for transmitting signals;

a receiver for receiving signals; and

an output device;

a second hand-held communication device adapted to electrically communicate with the first communication device, and adapted for being attached to, in contact with, or held by the user, the second hand-held communication device comprising a transmitter for transmitting signals;

an array of receiving devices remote from the first hand-held communication device for tracking the movement of the first hand-held communication device;

a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitter of the first hand-held communication device, to determine movement information for each of the respective communication devices, and to send data signals to the receiver to provide feedback data to the user;

wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user, based on the received data signals, the sensory stimuli delivered through the output device;

wherein the first hand-held communication device is further comprised of a user input device adapted for communication with the processing system through the transmitter; and

wherein the user input device is adapted for calibrating the first communication device to establish a reference position.

60. **(original)** A system according to claim 59, wherein:
the processing system is adapted to determine position information for each of the respective communication devices.
61. **(original)** A system according to claim 59, wherein:
wherein the output device is a speaker for providing audible stimuli to the user.
62. **(original)** A system according to claim 59, wherein:
the first hand-held communication device is adapted to attach to a modular extension piece.
63. **(original)** A system according to claim 62, wherein the second hand-held communication device is adapted to attach to the modular extension piece.
64. **(original)** A system according to claim 62, wherein the first hand-held communication device is connected to the modular extension piece via a flexible coupling.
65. **(original)** A system according to claim 62, wherein the first hand-held communication device is connected to the modular extension piece via a snap joint.
66. **(original)** The video game system of claim 59, wherein the first hand-held communication device is further comprised of:
a touch screen display for accepting input from the user.
67. **(original)** The video game system of claim 66, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.
68. **(original)** A system for a user to play a video game, comprising:
a first hand-held communication device comprising:

a transmitter for transmitting signals;
a receiver for receiving signals; and
an output device;

a second hand-held communication device adapted to electrically communicate with the first communication device, and adapted for being attached to, in contact with, or held by the user, the second hand-held communication device comprising a transmitter for transmitting signals; and

a processing system, remote from the first hand-held communication device, adapted to wirelessly receive the signals transmitted by the transmitter of the first hand-held communication device, and to send data signals to the receiver to provide feedback data to the user;

wherein the first hand-held communication device receives and processes the received data signals and generates sensory stimuli for the user, based on the received data signals and delivered through the output device;

wherein the first hand-held communication device is further comprised of a user input device adapted for communication with the processing system through the transmitter; and

wherein the user input device is adapted for calibrating the first communication device.

69. **(original)** A system according to claim 68, wherein:

the processing system is adapted to determine movement information for each of the respective communication devices.

70. **(original)** The video game system of claim 68, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

71. **(original)** The video game system of claim 70, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.

72. **(original)** The video game system of claim 70, wherein the system is adapted to provide feedback data to the user through the touch screen display.

73. **(original)** The video game system of claim 70, wherein the system is adapted to provide performance data to the user through the touch screen display.

74. **(original)** The video game system of claim 70, wherein the system is adapted to allow system setup through the touch screen display.

75. **(original)** The video game system of claim 70, wherein the system is adapted to provide a menu oriented interface to the user through the touch screen display.

76. **(original)** The video game system of claim 70, wherein the system is adapted to allow program selection to the user through the touch screen display.

77. **(original)** The video game system of claim 70, wherein the system is adapted to biophysical data to the user through the touch screen display.

78. **(original)** A system according to claim 68, wherein:

the first hand-held communication device is adapted to attach to a modular extension piece.

79. **(original)** A system according to claim 78, wherein the first hand-held communication device is connected to the modular extension piece via a flexible coupling.

80. **(original)** A system according to claim 78, wherein the first hand-held communication device is connected to the modular extension piece via a snap joint.

81. **(new)** The video game system of claim 50, wherein the first hand-held communication device is further comprised of:

a touch screen display for accepting input from the user.

82. **(new)** The video game system of claim 81, wherein the system is adapted to allow the user to provide configuration data to the system through the touch screen display.

83. **(new)** A system according to claim 50, further comprising:

a coupling attachment to the first hand-held communication device adapted to accept attachment to the second hand-held communication device.

84. **(new)** A system according to claim 50, further comprising:

a coupling attachment to the first hand-held communication device adapted to accept attachment to a modular extension piece.

REMARKS

Claims 1-80 were pending at the time of the non-final Office Action, all of which are in prosecution. Examiner objected to claims 55-58 because there were two sets and asked for one set to be cancelled. Applicant acknowledges the error in numbering the claims and the second set has been cancelled. The text of the claims has been resubmitted as new claims 81-84.

Double patenting

The Examiner has required a terminal disclaimer to overcome a non-statutory double patenting rejection based on US Patent 7,952,483. The terminal disclaimer is provided.

Conclusion

Applicant respectfully submits that the application is now in condition for examination and such action is earnestly requested. If a telephone interview is required to resolve any further issues, such a call from the Examiner is respectfully requested.

Respectfully submitted,

Dated: 16 November 2011

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**TERMINAL DISCLAIMER TO OBIATE A DOUBLE PATENTING
REJECTION OVER A "PRIOR" PATENT**Docket Number (Optional)
FER1947-002H

In re Application of: Ferguson, et al

Application No.: 13/096,587

Filed: 28 April 2011

For: A HUMAN MOVEMENT MEASUREMENT SYSTEM

The owner*, MOTIVA LLC, of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term **prior patent** No. 7,952,483 as the term of said prior patent is defined in 35 U.S.C. 154 and 173, and as the term of said **prior patent** is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ For submissions on behalf of a business/organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the business/organization.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

2. ☒ The undersigned is an attorney or agent of record. Reg. No. 41133

/James L. Kwak/

Signature

11/16/2011

Date

James L. Kwak

Typed or printed name

614-792-5555

Telephone Number

- ☒ Terminal disclaimer fee under 37 CFR 1.20(d) included.

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*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

This collection of information is required by 37 CFR 1.321. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	13096587			
Filing Date:	28-Apr-2011			
Title of Invention:	HUMAN MOVEMENT MEASUREMENT SYSTEM			
First Named Inventor/Applicant Name:	Kevin Ferguson			
Filer:	James Lee Kwak/Kimberly Hefner			
Attorney Docket Number:	FER1947-002H			
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Statutory or terminal disclaimer	2814	1	80	80
Total in USD (\$)				80

Electronic Acknowledgement Receipt

EFS ID:	11422228
Application Number:	13096587
International Application Number:	
Confirmation Number:	4852
Title of Invention:	HUMAN MOVEMENT MEASUREMENT SYSTEM
First Named Inventor/Applicant Name:	Kevin Ferguson
Customer Number:	8698
Filer:	James Lee Kwak/Kimberly Hefner
Filer Authorized By:	James Lee Kwak
Attorney Docket Number:	FER1947-002H
Receipt Date:	16-NOV-2011
Filing Date:	28-APR-2011
Time Stamp:	16:05:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$80
RAM confirmation Number	2925
Deposit Account	194076
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digits	Multi Part (if appl.)	Pages (if appl.)
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1		20111116_OAR_FER1947-002H_10-13-11.pdf	59614 d5b5f679d229d5d1aa1d657b73ac3dfb09e ce9ad	yes	17				
	Multipart Description/PDF files in .zip description								
	Document Description		Start	End					
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1					
	Claims		2	16					
	Applicant Arguments/Remarks Made in an Amendment		17	17					
Warnings:									
Information:									
2	Terminal Disclaimer Filed	20111116_Term_Disc1_FER1947-002H.pdf	209676 6234413438e24dc22d192fec5273ad67c59 72e87	no	2				
Warnings:									
Information:									
3	Fee Worksheet (SB06)	fee-info.pdf	30330 b7f733781bf80bf6731e5efef56e43d9f4b70 fdd	no	2				
Warnings:									
Information:									
Total Files Size (in bytes):			299620						
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>									


Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 13/096,587		Filing Date 04/28/2011		<input type="checkbox"/> To be Mailed	
APPLICATION AS FILED – PART I										
(Column 1)			(Column 2)			SMALL ENTITY <input checked="" type="checkbox"/> OR		OTHER THAN SMALL ENTITY		
FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)	OR	RATE (\$)	FEE (\$)			
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A				
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A				
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A				
TOTAL CLAIMS (37 CFR 1.16(j))	minus 20 =	*	X \$	=	OR	X \$	=			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X \$	=		X \$	=			
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).									
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL		TOTAL			
APPLICATION AS AMENDED – PART II										
(Column 1)			(Column 2)			SMALL ENTITY OR		OTHER THAN SMALL ENTITY		
AMENDMENT	11/16/2011	CLAIMS REMAINING AFTER AMENDMENT	MINUS	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	OR	RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	* 84	Minus	** 84	= 0	X \$30 =	0	OR	X \$	=
	Independent (37 CFR 1.16(h))	* 6	Minus	*** 6	= 0	X \$125 =	0	OR	X \$	=
<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))										
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	
(Column 1)			(Column 2)			SMALL ENTITY OR		OTHER THAN SMALL ENTITY		
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT	MINUS	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	OR	RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X \$	=	OR	X \$	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$	=	OR	X \$	=
<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))										
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
<p>* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.</p> <p>** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".</p> <p>*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".</p> <p>The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.</p>										

Legal Instrument Examiner:
/REGINA D. BALTIMORE/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Application Number 	Application/Control No. 13/096,587	Applicant(s)/Patent under Reexamination FERGUSON ET AL.	
Document Code - DISQ		Internal Document – DO NOT MAIL	

TERMINAL DISCLAIMER	<input checked="" type="checkbox"/> APPROVED	<input type="checkbox"/> DISAPPROVED
Date Filed : 11/16/11	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:

jean proctor



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

8698 7590 12/15/2011
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017

EXAMINER

PHAM, TOAN NGOC

ART UNIT

PAPER NUMBER

2612

DATE MAILED: 12/15/2011

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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13/096,587

04/28/2011

Kevin Ferguson

FER1947-002H

4852

TITLE OF INVENTION: HUMAN MOVEMENT MEASUREMENT SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	\$870	\$300	\$0	\$1170	03/15/2012

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

8698 7590 12/15/2011
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

13/096,587 04/28/2011 Kevin Ferguson FER1947-002H 4852

TITLE OF INVENTION: HUMAN MOVEMENT MEASUREMENT SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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nonprovisional YES \$870 \$300 \$0 \$1170 03/15/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
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PHAM, TOAN NGOC 2612 340-573100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s); (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/096,587	04/28/2011	Kevin Ferguson	FER1947-002H	4852
8698 7590 12/15/2011 STANDLEY LAW GROUP LLP 6300 Riverside Drive Dublin, OH 43017			EXAMINER PHAM, TOAN NGOC	
			ART UNIT 2612	PAPER NUMBER
DATE MAILED: 12/15/2011				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No.	Applicant(s)	
	13/096,587	FERGUSON ET AL.	
	Examiner	Art Unit	
	TOAN N. PHAM	2612	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to amendment and TD filed on 11/16/2011.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are 1-84.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: ____.

Applicant has **THREE MONTHS FROM THE "MAILING DATE"** of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date ____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date ____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|--|---|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date ____. |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date ____ | 7. <input type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other ____. |

Allowable Subject Matter

Claims 1-84 are allowed.

The following is an examiner's statement of reasons for allowance: The present invention is directed to a system and methods for setup and measuring the position and orientation of transponders. Each independent claim identifies the uniquely distinct features: a processing system, remote from the first hand-held communication device, and in electrical communication with the array of receiving devices, adapted to wirelessly receive the signals transmitted by the transmitter, to determine movement information for the first hand-held communication device, to determine position information for the first hand-held device, and to send data signals to the first hand-held device to provide feedback data to the user; wherein the movement information of the first hand-held communication device controls the movement of at least one object in a computer generated virtual environment; and wherein the first hand-held communication device is adapted to receive and process the received data signals and generate sensory stimuli for the user based on the received data signals and delivered through the output device. The prior art fail to anticipate or render the above limitations obvious.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."


Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TOAN N. PHAM whose telephone number is (571)272-2967. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin C. Lee can be reached on (571) 272-2963. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TOAN N PHAM/
Primary Examiner, Art Unit 2612
12/13/11


Search Notes 	Application/Control No. 13096587	Applicant(s)/Patent Under Reexamination FERGUSON ET AL.
	Examiner TOAN N PHAM	Art Unit 2612

SEARCHED			
Class	Subclass	Date	Examiner
340	573.1, 573.4, 539.12, 539.13, 539.22, 407.1, 825.36, 6.1, 5.61, 825.72	10/5/11	TNP
381	315	10/5/11	TNP
434	112, 114	10/5/11	TNP
463	36, 39, 7, 35, 42	10/5/11	TNP
345	161	10/6/115	TNP

SEARCH NOTES		
Search Notes	Date	Examiner
EAST	10/5/11	TNP
PLUS SEARCH	10/6/115	TNP

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
340	573.1, 407.1, 5.61, 12.22	10/5/11	TNP
434	114	10/6/11	TNP
345	161	10/6/11	TNP
463	36	10/6/11	TNP

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Issue Classification 	Application/Control No. 13096587	Applicant(s)/Patent Under Reexamination FERGUSON ET AL.
	Examiner TOAN N PHAM	Art Unit 2612

ORIGINAL						INTERNATIONAL CLASSIFICATION												
CLASS		SUBCLASS				CLAIMED					NON-CLAIMED							
340		573.1				G	0	8	B	23 / 00 (2006.0)								
CROSS REFERENCE(S)																		
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)																	
340	5.61	12.22																
345	161																	
463	36																	
434	114																	

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input type="checkbox"/> T.D. <input type="checkbox"/> R.1.47															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	21	17	33	33	49	49	69	65	59	81				
2	2	22	18	34	34	50	50	70	66	60	82				
9	3	23	19	35	35	51	51	71	67	61	83				
10	4	24	20	36	36	52	52	72	68	62	84				
3	5	25	21	37	37	53	53	73	69						
4	6	26	22	38	38	54	54	74	70						
11	7	27	23	39	39	55	55	75	71						
12	8	28	24	40	40	56	56	76	72						
13	9	29	25	41	41	57	57	77	73						
14	10	30	26	42	42	58	58	78	74						
15	11	5	27	43	43	63	59	79	75						
16	12	6	28	44	44	64	60	80	76						
17	13	7	29	45	45	65	61	81	77						
18	14	31	30	46	46	66	62	82	78						
19	15	8	31	47	47	67	63	83	79						
20	16	32	32	48	48	68	64	84	80						

NONE		Total Claims Allowed: 84	
(Assistant Examiner)	(Date)		
/TOAN N PHAM/ Primary Examiner.Art Unit 2612		12/13/2011	O.G. Print Claim(s)
(Primary Examiner)		(Date)	O.G. Print Figure 4A, 4B

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13096587
	Filing Date		2011-04-28
	First Named Inventor	Ferguson et al	
	Art Unit	2612	
	Examiner Name	Pham, Toan Ngoc	
	Attorney Docket Number	FER1947-002H	

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5715834		1998-02-10	Bergamasco et al	
	2	5720619		1998-02-24	Fisslinger	
	3	5759044		1998-06-02	Redmond	
	4	5785631		1998-07-28	Bobick	
	5	5785631		1998-07-28	Heidecke	
	6	5790076		1998-08-04	Sypniewski	
	7	5792031		1998-08-11	Alton	
	8	5812257		1998-09-22	Teitel et al	

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Attorney Docket Number	FER1947-002H	

9	5838816		1998-11-17	Holmberg	
10	5846086		1998-12-08	Bizzi et al	
11	5850201		1998-12-15	Lasko-Harvil	
12	5872438		1999-02-16	Roston	
13	5888172		1999-03-30	Andras et al	
14	5890995		1999-04-06	Bobick	
15	5913727		1999-06-22	Andoot	
16	5929782		1999-07-27	Stark et al	
17	5963891		1999-10-05	Walker et al	
18	5989157		1999-11-23	Walton	
19	6004243		1999-12-21	Ewart	

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Attorney Docket Number	FER1947-002H	

	20	6028593		2000-02-22	Rosenberg et al	
	21	6043873		2000-03-28	Ramer et al	
	22	6050822		2000-04-18	Faughnn	
	23	6050963		2000-04-18	Johnson et al	
	24	6054951		2000-04-25	Sypniewski	
	25	6066075		2000-05-23	Poulton	
	26	6073489		2000-06-13	French et al	
	27	6077201		2000-06-20	Cheng	
	28	6088091		2000-07-11	Ramer	
	29	6098458		2000-08-08	French et al	
	30	6100896		2000-08-08	Strohecker et al	

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Examiner Name	Pham, Toan Ngoc	
Attorney Docket Number		FER1947-002H

31	6132337		2000-10-17	Krupka et al	
32	6152856		2000-11-28	Studor	
33	6162191		2000-12-19	Foxlin	
34	6164973		2000-12-26	Macri	
35	6181343		2001-01-30	Lyons	
36	6183259		2001-02-06	Macri	
37	6198528		2001-03-06	Maynard	
38	6244987		2001-06-12	Ohsuga	
39	6308565		2001-10-30	French et al	
40	6346045		2002-02-12	Rider	
41	6361507		2002-03-06	Foxlin	

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42	6366272		2002-04-02	Rosenberg et al	
43	6400452		2002-06-04	Maynard	
44	6430997		2002-08-13	French et al	
45	6487906		2002-12-03	Hock	
46	6515593		2003-02-04	Stark et al	
47	6720876		2004-04-13	Burgess	
48	6749432		2004-06-15	French et al	
49	6765726		2004-07-20	French et al	
50	6774885		2004-08-10	Even-Zohar	

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Examiner Name	Pham, Toan Ngoc
Attorney Docket Number	FER1947-002H

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

- ☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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- ☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

- ☐ See attached certification statement.
- ☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41,133

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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	Filing Date		2011-04-28
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	Art Unit	2612	
	Examiner Name	Pham, Toan Ngoc	
	Attorney Docket Number	FER1947-002H	

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4787051		1988-11-22	Olson	
	2	5421590		1995-06-06	Robbins	
	3	5506605		1996-04-09	Paley	
	4	5554033		1996-09-10	Bizzi et al	
	5	5602569		1997-02-11	Kato	
	6	5605505		1997-02-25	Han	
	7	5574479		1996-11-12	Odell	
	8	5679004		1997-10-21	McGowan et al	

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Examiner Name	Pham, Toan Ngoc	
Attorney Docket Number	FER1947-002H	

9	5796354		1998-08-18	Cartabiano et al	
10	5835077		1998-11-10	Dao et al	
11	5897437		1999-04-27	Nishiumi et al	
12	6013007		2000-01-11	Root et al	
13	6059576		2000-05-09	Brann	
14	6200253		2001-03-13	Nishiumi et al	
15	6304250		2001-10-16	Yang et al	
16	6415223		2002-07-02	Lin et al	
17	6424333		2002-07-23	Tremblay et al	
18	6582380		2003-06-24	Kazlauskys et al	
19	6590536		2003-07-08	Walton	

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Examiner Name	Pham, Toan Ngoc	
Attorney Docket Number	FER1947-002H	

20	6616607		2003-09-09	Hashimoto et al	
21	6676520		2004-01-13	Nishiumi et al	
22	6712692		2004-03-30	Basson et al	
23	6717573		2004-04-06	Shahonian et al	
24	6757068		2004-06-29	Foxlin	
25	6377793		2002-04-23	Jenkins	
26	6850844		2005-02-01	Walters et al	
27	6872139		2005-03-29	Sato et al	
28	6990639		2006-01-24	Wilson	
29	7000469		2006-02-21	Foxlin et al	
30	7127370		2006-10-24	Kelly et al	

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Examiner Name	Pham, Toan Ngoc	
Attorney Docket Number		FER1947-002H

	31	7182691		2007-02-27	Schena	
	32	7183480		2007-02-27	Nishitani et al	
	33	7220220		2007-05-22	Stubbs et al	
	34	7301648		2007-11-27	Foxlin	
	35	7335134		2008-02-26	LaVelle	
	36	6554781		2003-04-29	Carter et al	
	37	5919149		1999-07-06	Allum	
	38	6605038		2003-08-12	Teller et al	
	39	7261690		2007-08-28	Teller et al	
	40	4988981		1991-01-29	Zimmerman	
	41	7183480		2007-02-27	Nishitani	

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	1	20040034289		2004-02-19	Teller et al	
	2	20040070564		2004-04-15	Dawson et al	
	3	20040140954		2004-07-22	Eyeston et al	
	4	20050020369		2005-01-27	Davis et al	
	5	20050054457		2005-03-10	Eyestone	
	6	20060122474		2006-06-08	Teller et al	
	7	20070173705		2007-07-26	Teller et al	
	8	20050020369		2005-01-27	Davis	

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	1	WO199712337	WO		1997-04-03	Rosenberg et al		<input type="checkbox"/>
	2	WO2000047108	WO		2000-08-17	Gafni et al		<input type="checkbox"/>
	3	WO200187426	WO		2001-11-22	Mynhardt		<input type="checkbox"/>
	4	2004039055	WO		2004-05-06	Zimmerman		<input type="checkbox"/>
	5	JP2000308756	JS		2000-11-07	Okamoto		<input type="checkbox"/>

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	1	KAPLAN, US S.I.R. H1383, 1994-12-06						<input type="checkbox"/>
	2	HINCKLEY, KEN, "Synchronous Gestures for Multiple Persons and Computer," Chi Letter, Vol. 5, Issue 2, pp. 149-158, ACM, 2003.						<input type="checkbox"/>

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Application Number	13096587
Filing Date	2011-04-28
First Named Inventor	Ferguson et al
Art Unit	2612
Examiner Name	Pham, Toan Ngoc
Attorney Docket Number	FER1947-002H

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	1	6119516		2000-09-19	Hock	
	2	6315673		2001-11-13	Kopera et al	
	3	6545661		2003-04-08	Goschy et al	
	4	6834436		2004-12-24	Townsend et al	
	5	6876496		2005-04-15	French et al	
	6	7158118		2007-01-02	Liberty	
	7	7236156		2007-06-26	Liberty et al	
	8	7239301		2007-07-03	Liberty et al	

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9	7262760		2007-08-28	Liberty	
10	7414611		2008-08-19	Liberty	
11	5790124		2008-08-04	Fischer et al	
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	2	5875157		1999-02-23	Marrin et al	
	3	6160540		2000-12-12	Fishkin	
	4	6211861		2001-04-03	Rosenberg et al	
	5	6682351		2004-01-27	Abraham-Fuchs	
	6	6749432		2004-06-15	French E	
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	1	2003053038	JP		2003-02-25	Miyamoto		<input type="checkbox"/>
	2	2003325974	JP		2003-11-18	Nakata et al		<input type="checkbox"/>
	3	200035345	WO		2000-06-22	Carter et al		<input type="checkbox"/>
	4	2003015005	WO		2003-02-20	Teller et al		<input type="checkbox"/>
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1	WILSON et al, "Gesture Recognition Using the XWand," Assistive Intelligent Environments Group, Robotics Institute, Carnegie Mellon University, Report CMU-RI-TR-04-57 (April 2004);	<input type="checkbox"/>
2	WILSON et al, "XWand: UI for Intelligent Spaces," Microsoft Research, inProceedings of the SIGCHI Conference on Human Factors in Computing Systems (Ft. Lauderdale, Florida, USA, April 5-10, 2003; CHI '03, ACM, New York, NY, at 545-52 (2003)	<input type="checkbox"/>
3	Hinckley Synchronous Gestures Device, Oct. 12-15, 2003, Microsoft Research, USA	<input type="checkbox"/>
4	SmartSwing, SmartSwing Inc.,April 2004, Austin, Texas.	<input type="checkbox"/>
5	MULDER, AXEL, "Human movement tracking technology," Hand Centered Studies of Human Movement Project, Technical Report 94-1, Simon Fraser University (July 1994), 16 pages	<input type="checkbox"/>
6	FURNISS, MAUREEN, "Motion Capture," MoCap MIT (Dec. 1999) 12 pages.	<input type="checkbox"/>
7	Nintendo N64 Rumble Pack, Nintendo, July 1997, Wikipedia Article, 12 pages, http://en.wikipedia.org/wiki/Rumble_Pak .	<input type="checkbox"/>
8	Nintendo GameCube System, Nintendo, November 18, 2001, Wikipedia Article, http://en.wikipedia.org/wiki/Nintendo_GameCube	<input type="checkbox"/>
9	Nintendo GameCube Standard Controller, Nintendo, November 18, 2001, Wikipedia Article, http://en.wikipedia.org/wiki/Nintendo_GameCube_Controller	<input type="checkbox"/>
10	BACHMAN, E.R., DUMAN, I., USTA, U.Y., MCGHEE, R.B., YUN, X.P., ZYDA, M.J., "Orientation Tracking For Humans and Robots Using Inertial Sensors," 1999 IEEE International Symposium on Computational Intelligence in Robotics and Automation (CIRA99) at 187-94 (1999)	<input type="checkbox"/>
11	Nintendo "Kirby Tilt 'n' Tumble" video game, Nintendo, April 11, 2001, Wikipedia Article, http://en.wikipedia.org/wiki/Kirby_Tilt_%27n%27_Tumble	<input type="checkbox"/>

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12	BENBSAT, ARI Y., PARADISO, JOSEPH A., "An Inertial Measurement Framework for Gesture Recognition and Applications," Gesture and Sign Language in Human- Computer Interaction , vol. 2298/2002 at 77-90 (Springer-Verlag Berlin Heidelberg 2002); International Gesture Workshop, GW 2001, London, UK, 2001 Proceedings, LNAI 2298, at 9-20, I. Wachsmuth and T. Sowa (eds.)	<input type="checkbox"/>
13	Analog Devices Data Sheet, "MicroConverter®, Multichannel 12-Bit ADC with Embedded Flash MCU, ADuC812" (2003) (http://www.analog.com/static/imported-files/data_sheets/ADUC812.pdf) 60 pages.	<input type="checkbox"/>
14	MACLEAN, KAREN, "Designing with Haptic Feedback", Proceedings of IEEE Robotics and Automation (ICRA '2000), at 783-88 (April 22-28 (2000)).	<input type="checkbox"/>
15	WORMELL, D. and FOXLIN, E., "Advancements in 3D Interactive Devices for Virtual Environments," EGVE, Proceedings of the Workshop on Virtual Environments 2003, vol. 39 at 47-56 (ACM) (2003) (The Eurographics Association)	<input type="checkbox"/>
16	BALLAGAS, RAFAEL; RINGEL, MEREDITH; STONE MAUREEN; AND BORCHERS, JAN, "iStuff: A Physical User Interface Toolkit For Ubiquitous Computer Environments," Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, vol. 5, no. 1, at 537-44 (ACM) (April 5-10, 2003) (Gilbert Cockton, Panu Korhonen, eds.)	<input type="checkbox"/>
17	Pelican Accessories G3 Wireless Controller, Pelican Accessories, September 20, 2002.	<input type="checkbox"/>
18	Nintendo Wavebird Controller, Nintendo, June 2002 Wikipedia Article, http://en.wikipedia.org/wiki/WaveBird .	<input type="checkbox"/>
19	Nintendo Game Boy, Nintendo, July 31, 1989, Wikipedia Article, http://en.wikipedia.org/wiki/Game_Boy	<input type="checkbox"/>
20	Nintendo Game Boy Advance, Nintendo, September 26, 2003, Wikipedia Article http://en.wikipedia.org/wiki/Game_Boy_Advance .	<input type="checkbox"/>
21	Nintendo Game Boy Advance Wireless Adapter, Nintendo World Report, September 25, 2003, 2 pages.	<input type="checkbox"/>
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23	Nintendo Game Boy Color Game Catridge with Built-In Rumble, Nintendo, June 28, 1999, Wikipedia Article, 2pages http://en.wikipedia.org/wiki/Rumble_Pak .	<input type="checkbox"/>
24	VERPLAETSE, C., "Inertial Proprioceptive Devices: Self-Motion-Sensing Toys and Tools," IBM Systems Journal, vol. 35 Nos. 3 & 4, at 639-50 (IBM Corp.) (1996)	<input type="checkbox"/>
25	YANG, UNGYEON and KIM, GERARD JOUNGHYUN, "Implementation and Evaluation of 'Just Follow Me': An Immersive, VR-Based, Motion-Training System," Presence: Teleoperators and Virtual Environments vol. 11 no. 3, at 304-23 (MIT Press) (June 2002)	<input type="checkbox"/>
26	HINCKLEY, KEN et al, "Sensing Techniques for Mobile Interaction," Proceedings of the 13th Annual ACM Symposium on User Interface Software and Technology (San Diego, Cal.), ACM UIST 2000 & Technology, CHI Letters 2 (2), at 91-100 (2000)	<input type="checkbox"/>
27	PARADISO, JOSEPH A., "The Brain Opera Technology: New Instruments and Gestural Sensors for Musical Interaction and Performance" (November 1998) ("Brain Opera Article").	<input type="checkbox"/>
28	CyberGlove product, Immersion Corporation, 1990, http://www.cyberglovesystem.com .	<input type="checkbox"/>
29	KUNZ, ANDREAS and BURRI, ADRIAN "Design and Construction of a New Haptic Interface," ASME 2000 Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Baltimore, Maryland, September 10-13, 2000; Proceedings of DETC '00.	<input type="checkbox"/>
30	MERIAN, ALMA S. et al "Virtual Reality-Augmented Rehabilitation for Patients Following Stroke," Physical Therapy, Vol. 82, No. 9 (Sept. 2002)	<input type="checkbox"/>
31	Logitech WingMan Cordless Rumblepad, Logitech, Press release September 2, 2001, 2 pages.	<input type="checkbox"/>
32	InterSense, "Technical Overview IS-900 Motion Tracking System" www.isense.com , April 2004	<input type="checkbox"/>
33	MARRIN, TERESA and PARADISO, JOSEPH, "The Digital Baton: a Versatile Performance Instrument" (1997)	<input type="checkbox"/>

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34	MARRIN, TERESA, "Toward an Understanding of Musical Gesture: Mapping Expressive Intention with the Digital Baton" (1996)	<input type="checkbox"/>
35	HINCKLEY, KEN, "Haptic Issues for Virtual Manipulation – A Dissertation Presented to the Faculty of the School of Engineering and Applied Science at the University of Virginia" (Dec. 1996).	<input type="checkbox"/>
36	MARTI, GAETAN et al, "Biopsy navigator: a smart haptic interface for interventional radiological gestures," Swiss Federal Institute of Technology (EPFL), CARS 2003 (Computer Assisted Radiology and Surgery), Proceedings of the 17th Int'l Congress & Exhibition, International Congress Series, Vol. 1256 at 788-93 (June 2003).	<input type="checkbox"/>
37	WILLIAMS II, Robert L. et al, "The Virtual Haptic Back Project," Presented at the IMAGE 2003 Conference, Scottsdale, Arizona, 14-18 July 2003.	<input type="checkbox"/>
38	PowerGlove product Program Guide, Mattel, 1989	<input type="checkbox"/>
39	IS-900 product, InterSense, Inc. 1999.	<input type="checkbox"/>
40		<input type="checkbox"/>
41	REGAN, MARY BETH, "Smart Golf Clubs", baltimoresun.com, June 17, 2005.	<input type="checkbox"/>
42	FrontSide Field Test, "Smart Bomber Get This", Golf Magazine, June 2005.	<input type="checkbox"/>
43	ACHENBACH, JAMES, "Golf's New Measuring Stick", Golfweek, June 11, 2005, www.golfweek.com.	<input type="checkbox"/>
44	EYESTONE, DICK, "SmartSwing Company: Letter from the CEO", 3 pages, 2004, retrieved 5/19/2009, http://web.archive.org/web/20040810101314/www.smartsinggolf.com	<input type="checkbox"/>

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Application Number	13096587
Filing Date	2011-04-28
First Named Inventor	Ferguson et al
Art Unit	2612
Examiner Name	Pham
Attorney Docket Number	FER1947-002H

45	training Aid, SmartSwing, PGA Magazine, page 46, April 2005, www.pgamagazine.com.	<input type="checkbox"/>
46	"MEMS enable smart golf clubs", Small Times, Jan. 6, 2005, 2 pages.	<input type="checkbox"/>
47	SWISHER, KARA, "How Science Can Improve Your Golf Game", The Wall Street Journal, April 18, 2005.	<input type="checkbox"/>
48	SMARTSWING, "Register to be Notified When SmartSwing Products are Available for Purchase", 3 pages, May 2004, retrieved 5/19/2009, http://web.archive.org/web/20040426182437/www.smartswinggolf.com/...	<input type="checkbox"/>
49	SMARTSWING, "SmartSwing: Intelligent Golf Clubs that Build a Better Swing", 2 pages, 2004, retrieved 5/19/2009, http://web.archive.org/web/20040728221951/http://www.smartswinggolf...	<input type="checkbox"/>
50	SMARTSWING, "The SmartSwing Learning System: How it works, 3 pages, 2004, retrieved 5/19/2009, http://web.archive.org/web/20040403213108/http://www.smartswinggolf.com/t...	<input type="checkbox"/>

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- ☒ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☐ None

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Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41,133

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	Art Unit	2612	
	Examiner Name	Pham	
	Attorney Docket Number	FER1947-002H	

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1	WILSON, ANDY, "XWand: UI for Intelligent Environments", 5 pages retrieved 1/11/2009, http://research.microsoft.com/en-us/um/people/awilson/wand/default.htm .	<input type="checkbox"/>
2	Wired Glove, Wikipedia Article, 4 pages, http://en.wikipedia.org/wiki/Wired_glove .	<input type="checkbox"/>
3	Hinkley et al, Proceedings for the working conference on Advanced visual interfaces, Portal: the guide to computing literature, 1 page, 2004.	<input type="checkbox"/>

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Application Number:	13096587
International Application Number:	
Confirmation Number:	4852
Title of Invention:	HUMAN MOVEMENT MEASUREMENT SYSTEM
First Named Inventor/Applicant Name:	Kevin Ferguson
Customer Number:	8698
Filer:	James Lee Kwak/Kimberly Hefner
Filer Authorized By:	James Lee Kwak
Attorney Docket Number:	FER1947-002H
Receipt Date:	15-DEC-2011
Filing Date:	28-APR-2011
Time Stamp:	16:00:16
Application Type:	Utility under 35 USC 111(a)

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 13/096,587
Filing Date: April 28, 2011
Applicant: Kevin Ferguson
Group Art Unit: 2612
Examiner: Pham, Toan Ngoc
Entitled: A HUMAN MOVEMENT MEASUREMENT SYSTEM
Docket No.: FER1947-002H

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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As authorized and encouraged under 37 CFR §§ 1.97-1.98 and the provisions of MPEP §§ 609 and 707.05(b), Applicant submits on the attached forms PTO/SB/08A certain patent references, publications and/or other information that the Patent and Trademark Office may wish to consider in examining the above-identified patent application. The patent references, publications and/or other information are already of record and fully discussed in the parent cases, U.S. Patent Application No. 12/371,711, filed February 16, 2009, now U.S. Patent No. 7,952,483, issued May 31, 2011, which is in turn a continuation of U.S. Patent Application No. 11/953,578, filed November 6, 2007, now U.S. Patent No. 7,492,268, issued February 17, 2009, which is in turn a continuation of U.S. Patent Application No. 11/187,373, filed July 22, 2005 now U.S. Patent No.

7,292,151, issued November 6, 2007, therefore, copies are not attached. Applicant submits this statement in accordance with their duty of disclosure under 37 CFR § 1.56.

The identification of any document in this statement is not intended to be, and should not be understood as being, an admission that each such document, in fact, constitutes "prior art" within the meaning of applicable law.

Applicant respectfully requests that the documents cited in this statement be made of record in the normal manner and that such documents appear on the printed patent as being considered and made of record.

Respectfully submitted,

Date: 15 December 2011

By: /James L. Kwak/
James L. Kwak
Registration No. 41,133
Standley Law Group LLP
6300 Riverside Drive
Dublin, Ohio 43017-5315
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13096587
	Filing Date		2011-04-28
	First Named Inventor	Ferguson	
	Art Unit	2612	
	Examiner Name	Pham, Toan Ngoc	
	Attorney Docket Number	FER1947-002H	

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	2	4375674		1983-03-01	Thorton	
	3	4627620		1986-12-09	Yang	
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	9	4817950		1989-04-04	Goo	
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Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41,133

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	Filing Date		2011-04-28
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	Art Unit	2612	
	Examiner Name	Pham	
	Attorney Docket Number	FER1947-002H	

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14	InterSense, "IS-900 MicroTrax Devices" www.isense.com .	<input type="checkbox"/>
15	InterSense, "IS-900 Systems" www.isense.com .	<input type="checkbox"/>
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22	PowerGlove product, Mattel, 1989 Wikipedia Article	<input type="checkbox"/>

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Application Number	13096587
Filing Date	2011-04-28
First Named Inventor	Ferguson et al
Art Unit	2612
Examiner Name	Pham
Attorney Docket Number	FER1947-002H

23	PowerGlove and Nintendo product photo, Mattel, 1989	<input type="checkbox"/>
24	PowerGlove product photo, Mattel, 1989	<input type="checkbox"/>
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26	CROSSAN, ANDREW, WILLIAMSON, JOHN, BREWSTER, STEPHEN, " A General Purpose Control-Based Trajectory Playback for Force-Feedback Systems, University of Glasgow, Dept. Computing Science, 4 pages.	<input type="checkbox"/>
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37	VTI, "Mindflux-VTi CyberTouch, 1996, http://www.mindflux.com.au/products/vti/cybertouch.html .	<input type="checkbox"/>
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47	VILLORIA, GERALD, "Hands on Roll-O-Rama Game Cube, Game Spot, May 29, 2002, http://www.gamespot.com/gamecube/action/rollorama/news.html?sid=2868421&com_act=convert&om_clk=newsfeatures&tag=newsfeatures;title;1&m	<input type="checkbox"/>
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☐ See attached certification statement.

☒ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41,133

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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13/096,587

04/28/2011

Kevin Ferguson

FER1947-002H

4852

8698 7590 12/20/2011
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017

EXAMINER

PHAM, TOAN NGOC

ART UNIT

PAPER NUMBER

2612

MAIL DATE

DELIVERY MODE

12/20/2011

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

**Supplemental
Notice of Allowability**

Application No.

13/096,587

Examiner

TOAN N. PHAM

Applicant(s)

FERGUSON ET AL.

Art Unit

2612

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to IDS filed on 12/15/2011.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are 1-84.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

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Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
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- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date ____.
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7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

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/TOAN N PHAM/
Primary Examiner, Art Unit 2612
12/16/11

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	First Named Inventor	Ferguson et al	
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	Examiner Name	Pham, Toan Ngoc	
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	2	5421590		1995-06-06	Robbins	
	3	5506605		1996-04-09	Paley	
	4	5554033		1996-09-10	Bizzi et al	
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	7	5574479		1996-11-12	Odell	
	8	5679004		1997-10-21	McGowan et al	

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10	5835077		1998-11-10	Dao et al	
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16	6415223		2002-07-02	Lin et al	
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21	6676520		2004-01-13	Nishiumi et al	
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32	7183480		2007-02-27	Nishitani et al	
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	3	WO200187426	WO		2001-11-22	Mynhardt		<input type="checkbox"/>
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Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41,133

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	Filing Date		2011-04-28
	First Named Inventor	Ferguson et al	
	Art Unit	2612	
	Examiner Name	Pham, Toan Ngoc	
	Attorney Docket Number	FER1947-002H	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6119516		2000-09-19	Hock	
	2	6315673		2001-11-13	Kopera et al	
	3	6545661		2003-04-08	Goschy et al	
	4	6834436		2004-12-24	Townsend et al	
	5	6876496		2005-04-15	French et al	
	6	7158118		2007-01-02	Liberty	
	7	7236156		2007-06-26	Liberty et al	
	8	7239301		2007-07-03	Liberty et al	

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9	7262760		2007-08-28	Liberty	
10	7414611		2008-08-19	Liberty	
11	5790124		2008-08-04	Fischer et al	
12	7359121		2008-04-15	French et al	

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	1	20060028446		2006-02-09	Liberty et al	

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Examiner Signature	/Toan Pham/	Date Considered	12/16/2011
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- ☐ See attached certification statement.
- ☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

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Name/Print	James L. Kwak	Registration Number	41,133

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	Examiner Name	Pham, Toan Ngoc	
	Attorney Docket Number	FER1947-002H	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5715834		1998-02-10	Bergamasco et al	
	2	5720619		1998-02-24	Fisslinger	
	3	5759044		1998-06-02	Redmond	
	4	5785631		1998-07-28	Bobick	
	5	5785631		1998-07-28	Heidecke	
	6	5790076		1998-08-04	Sypniewski	
	7	5792031		1998-08-11	Alton	
	8	5812257		1998-09-22	Teitel et al	

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9	5838816		1998-11-17	Holmberg	
10	5846086		1998-12-08	Bizzi et al	
11	5850201		1998-12-15	Lasko-Harvil	
12	5872438		1999-02-16	Roston	
13	5888172		1999-03-30	Andras et al	
14	5890995		1999-04-06	Bobick	
15	5913727		1999-06-22	Andoot	
16	5929782		1999-07-27	Stark et al	
17	5963891		1999-10-05	Walker et al	
18	5989157		1999-11-23	Walton	
19	6004243		1999-12-21	Ewart	

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20	6028593		2000-02-22	Rosenberg et al	
21	6043873		2000-03-28	Ramer et al	
22	6050822		2000-04-18	Faughnn	
23	6050963		2000-04-18	Johnson et al	
24	6054951		2000-04-25	Sypniewski	
25	6066075		2000-05-23	Poulton	
26	6073489		2000-06-13	French et al	
27	6077201		2000-06-20	Cheng	
28	6088091		2000-07-11	Ramer	
29	6098458		2000-08-08	French et al	
30	6100896		2000-08-08	Strohecker et al	

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31	6132337		2000-10-17	Krupka et al	
32	6152856		2000-11-28	Studor	
33	6162191		2000-12-19	Foxlin	
34	6164973		2000-12-26	Macri	
35	6181343		2001-01-30	Lyons	
36	6183259		2001-02-06	Macri	
37	6198528		2001-03-06	Maynard	
38	6244987		2001-06-12	Ohsuga	
39	6308565		2001-10-30	French et al	
40	6346045		2002-02-12	Rider	
41	6361507		2002-03-06	Foxlin	

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	42	6366272		2002-04-02	Rosenberg et al	
	43	6400452		2002-06-04	Maynard	
	44	6430997		2002-08-13	French et al	
	45	6487906		2002-12-03	Hock	
	46	6515593		2003-02-04	Stark et al	
	47	6720876		2004-04-13	Burgess	
	48	6749432		2004-06-15	French et al	
	49	6765726		2004-07-20	French et al	
	50	6774885		2004-08-10	Even-Zohar	

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	Attorney Docket Number	FER1947-002H		

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13096587	13096587 - GAU: 2612
	Filing Date		2011-04-28	
	First Named Inventor	Ferguson et al		
	Art Unit	2612		
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Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41133

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1	SMARTSWING, "The SmartSwing Learning System Overview, 3 pages, 2004, retrieved 5/19/2009, http://web.archive.org/web/20040810142134/http://www.smartswinggolf.com/t...	<input type="checkbox"/>
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4	BUCHANAN, LEVI, "Happy Birthday, Rumble Pak", IGN.com, April 3, 2008, 2 pages.	<input type="checkbox"/>
5	FIELDER, LAUREN, "E3 2001: Nintendo unleashes GameCube software, a new Miyamoto game, and more", GameSpot, May 16, 2001, 2 pages, http://www.gamespot.com/downloads/2761390 .	<input type="checkbox"/>
6	Nintendo "Kirby Tilt 'n' Tumble" video game Instruction booklet, Nintendo, April 11, 2001, 18 pages.	<input type="checkbox"/>
7	Nintendo Wavebird Controller, "Operation of the WaveBird Controller Nintendo, June 2002, 2 pages.	<input type="checkbox"/>
8	WILEY, M., "Nintendo Wavebird Review" US, June 11, 2002, 21 pages.	<input type="checkbox"/>
9	Nintendo Game Boy, Consumer Information and Precautions Booklet, Nintendo, July 31, 1989	<input type="checkbox"/>
no date 10	Clove-based input interfaces, mhtml:file://(C:\Nintendo)723-2456_Motiva v. NOA and NCL - INVALIDITY CONTENTIONS__Seattle...	<input type="checkbox"/>
11	Logitech 3D Mouse & Head Tracker Technical Manual, Logitech Inc., Fremont CA, 1992, 88 pages.	<input type="checkbox"/>

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	12	SULIC, IVAN, "Logitech Wingman Cordless Rumblepad Review, IGN Entertainment Games, January 14, 2002, 3 pages.	<input type="checkbox"/>
	13	Immersion CyberGlove product, Immersion Corporation, 1990, http://www.cyberglovesystem.com .	<input type="checkbox"/>
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	18	InterSense, "InterSense Inc.-The New Standard in Motion Tracking" www.isense.com March 27, 2004.	<input type="checkbox"/>
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	23	PowerGlove and Nintendo product photo, Mattel, 1989	<input type="checkbox"/>
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	27	PERRY, SIMON, "Nintendo to Launch Wireless Game Boy Adaptor," Digital Lifestyles, 26 September 2003 http://digital-lifestyles.info/2003/09/26/nintendo-to-launch-wireless-game-boy-adaptor/ .	<input type="checkbox"/>
	28	POLHEMUS, "FASTRAK, The Fast and Easy Digital Tracker" copyrighted 2001, Coldiester, Vermont, 2 pages.	<input type="checkbox"/>
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	30	Gyration, Inc., GyroRemote and Mobile RF Keyboard User Manual, Saratoga, CA, 24 pages, www.gyration.com	<input type="checkbox"/>
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34		HOUSE, MATTHEW, Product Description: Hot Wheels Stunt Track Driver, Hot Wheels.	<input type="checkbox"/>
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36		MACLEAN, KAREN, Publications & patents, bibliography.	<input type="checkbox"/>
37		VTI, "Mindflux-VTi CyberTouch, 1996, http://www.mindflux.com.au/products/vti/cybertouch.html .	<input type="checkbox"/>
38		NINTENDO, Nintendo Entertainment System Consumer Information and Precautions Booklet , Nintendo of America, Inc. 1992	<input type="checkbox"/>
39		NINTENDO, Nintendo Entertainment System Instruction Manual, Nintendo of America, Inc. 1992	<input type="checkbox"/>
40		NINTENDO, Nintendo Entertainment System Booth 2002.	<input type="checkbox"/>
41		NINTENDO, Nintendo Entertainment System Layout 5/9/2002.	<input type="checkbox"/>
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43		NINTENDO, Nintendo Feature: History of Pokemon Part 2, Official Nintendo Magazine, 2009-17-May, http://www.officialnintendomagazine.co.uk/article.php?id=8576	<input type="checkbox"/>
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	3	6160540		2000-12-12	Fishkin	
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11	Lengyel, E., Mathematics for 3D Game Programming & Computer Graphics, Charles River Media (2004) 76-78, 467-468.	<input type="checkbox"/>
12	Medved, V., Towards a virtual reality-assisted movement diagnostics-an outline, Robotica (Jan.-Feb. 1994) vol. 12, 55-57.	<input type="checkbox"/>
13	Mulder, A., Human movement tracking technology, School of Kinesiology, Simon Fraser University (July 1994) 1-14.	<input type="checkbox"/>
14	Ruby, D., Biomechanics-how computers extend athletic performance to the body's far limits, Popular Science (January 1982) 58-60.	<input type="checkbox"/>

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	13096587	13096587 - GAU: 2612
Filing Date	2011-04-28	
First Named Inventor	Ferguson	
Art Unit	2612	
Examiner Name	Pham, Toan Ngoc	
Attorney Docket Number	FER1947-002H	

15	Sandweiss, J., et al, Biofeedback and Sports Science, Plenum Press New York (1985) 1-201.	<input type="checkbox"/>
16	Scarborough, E.L., Enhancement of Audio Localization Cue Synthesis by Adding Environmental and Visual Cues, Air Force Inst. Of Tech., Wright-Patterson AFB, OH. School of Engineering (Dec 1992) 1-4.	<input type="checkbox"/>
17	Smith, J., et al, Virtual Batting Cage and Human Model, Virtual Human http://www.cs.berkeley.edu/~rkdavis/classes/cs294/ , (6/17/2004)1-5.	<input type="checkbox"/>
18	Zetu, D., et al, Extended range tracking for remote virtual reality-aided facility management, Department of Mechanical Engineering The University of Illinois at Chicago, http://alpha.me.uic.edu/dan/NsfPaper/nsf2.html , (4/19/2004)1-9.	<input type="checkbox"/>
19	Codamotion: The science of real-time motion capture and analysis, webpages from http://www.charmdyn.com/index.html , (4/17/2004) 1.	<input type="checkbox"/>
no data	KIDSPACE INTERACTIVE INC, EyeToy, (brochure) 1-2	<input type="checkbox"/>
21	IREX, Virtual Reality Technologies, webpages from http://www.irexonline.com/how_it_works.htm , (4/19/2004) 1-2.	<input type="checkbox"/>
22	Polhemus, PATRIOT: The Fast and Affordable Digital Tracker, www.polhemus.com , (Feb 2004) 1-2.	<input type="checkbox"/>
23	Polhemus, LIBERTY: The Forerunner in Electromagnetic Tracking Technology, www.polhemus.com , (May 2003) 1-2.	<input type="checkbox"/>
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25	Reality built for two: a virtual reality tool, Symposium on Interactive 3D Graphics, ACM Press webpages from http://portal.acm.org/citation.cfm?id=91385.91409&dl=ACM&type=series&i (6/10/2004) 1-4.	<input type="checkbox"/>

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13096587	13096587 - GAU: 2612
	Filing Date	2011-04-28	
	First Named Inventor	Ferguson	
	Art Unit	2612	
	Examiner Name	Pham, Toan Ngoc	
	Attorney Docket Number	FER1947-002H	

26	Europe is Bursting with Virtual Reality Ideas, But Developers Are Critically Strapped for Cash, webpages from https://www/lexis.com/research/retrieve?_m=66d17057c1b77f197aledb9f5fadb87d&_browseType=Text , (Jan 1993) 1-2.	<input type="checkbox"/>
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Examiner Signature	/Toan Pham/	Date Considered	12/16/2011
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STATEMENT BY APPLICANT**
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Art Unit	2612	
Examiner Name	Pham, Toan Ngoc	
Attorney Docket Number	FER1947-002H	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

- ☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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- ☐ See attached certification statement.
- ☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41,133

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13096587	
	Filing Date		2011-04-28	
	First Named Inventor	Ferguson et al		
	Art Unit	2612		
	Examiner Name	Pham		
	Attorney Docket Number	FER1947-002H		

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
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Application Number	13096587	13096587 - GAU: 2612
Filing Date	2011-04-28	
First Named Inventor	Ferguson et al	
Art Unit	2612	
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Attorney Docket Number	FER1947-002H	

1	WILSON, ANDY, "XWand: UI for Intelligent Environments", 5 pages retrieved 1/11/2009, http://research.microsoft.com/en-us/um/people/awilson/wand/default.htm .	<input type="checkbox"/>
2	Wired Glove, Wikipedia Article, 4 pages, http://en.wikipedia.org/wiki/Wired_glove .	<input type="checkbox"/>
3	Hinkley et al, Proceedings for the working conference on Advanced visual interfaces, Portal: the guide to computing literature, 1 page, 2004.	<input type="checkbox"/>

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- ☒ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☐ None

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Signature	/James L. Kwak/	Date (YYYY-MM-DD)	2011-12-15
Name/Print	James L. Kwak	Registration Number	41,133

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Kimberly Hefner	(Depositor's name)
/Kimberly Hefner/	(Signature)
March 13, 2012	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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13/096,587 04/28/2011 Kevin Ferguson FER1947-002H 4852

TITLE OF INVENTION: HUMAN MOVEMENT MEASUREMENT SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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nonprovisional YES \$870 \$300 \$0 \$1170 03/15/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
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PHAM, TOAN NGOC 2612 340-573100

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- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
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- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
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MOTIVA LLC

DUBLIN, OHIO

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Date March 13, 2012

Typed or printed name James L Kwak

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Electronic Patent Application Fee Transmittal

Application Number:	13096587			
Filing Date:	28-Apr-2011			
Title of Invention:	HUMAN MOVEMENT MEASUREMENT SYSTEM			
First Named Inventor/Applicant Name:	Kevin Ferguson			
Filer:	James Lee Kwak/Kimberly Hefner			
Attorney Docket Number:	FER1947-002H			
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
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Petition:				
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Post-Allowance-and-Post-Issuance:				
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IPR2019-01134

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Miscellaneous:				
Total in USD (\$)				1170

Electronic Acknowledgement Receipt

EFS ID:	12287627
Application Number:	13096587
International Application Number:	
Confirmation Number:	4852
Title of Invention:	HUMAN MOVEMENT MEASUREMENT SYSTEM
First Named Inventor/Applicant Name:	Kevin Ferguson
Customer Number:	8698
Filer:	James Lee Kwak/Kimberly Hefner
Filer Authorized By:	James Lee Kwak
Attorney Docket Number:	FER1947-002H
Receipt Date:	13-MAR-2012
Filing Date:	28-APR-2011
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Deposit Account	194076
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13096587
	Filing Date		2011-04-28
	First Named Inventor	Ferguson	
	Art Unit	2612	
	Examiner Name	Pham, Toan Ngoc	
	Attorney Docket Number	FER1947-002H	

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	4	4631676		1986-12-23	Pugh	
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/096,587	04/17/2012	8159354	FER1947-002H	4852

8698 7590 03/28/2012
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

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APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

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