UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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HTC CORPORATION and HTC AMERICA, INC.
Petitioners,

v.

UNILOC LUXEMBOURG S.A.,
Patent Owner

_____

Declaration of Joseph A. Paradiso, PhD under 37 C.F.R. § 1.68

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I. INTRODUCTION

1. I am making this declaration at the request of HTC Corporation and HTC America, Inc. in the matter of the *Inter Partes* Review of U.S. Patent No. 7,653,508 ("the '508 Patent") to Kahn et al.

2. I am being compensated for my work in this matter at the rate of $600/hour. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this investigation. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

3. I have been asked to provide my opinions regarding whether claims 1-4, 6-8, 11-16, 19, and 20 of the '508 Patent are unpatentable, either because they are anticipated or would have been obvious to a person having ordinary skill in the art ("POSITA") at the time of the alleged invention, in light of the prior art. It is my opinion that all of the limitations of claims 1-4, 6-8, 11-16, 19, and 20 would have been either anticipated or obvious to a POSITA.

4. In the preparation of this declaration, I have studied:

a) The '508 Patent, Ex. 1001;

b) The prosecution history of the '508 Patent, Ex. 1002;

c) U.S. Patent No. 7,463,997 to Fabio Pasolini et al. ("Pasolini"), Ex. 1005; and

d) U.S. Patent No. 7,698,097 to Fabio Pasolini et al. ("Fabio"), Ex. 1006.

5. In forming the opinions expressed below, I have considered:

a) The documents listed above, and

b) My own knowledge and experience based upon my work in the field of wireless communications, as described below.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

6. My complete qualifications and professional experience are described in my *Curriculum Vitae*, a copy of which can be found in Ex. 1004. The following is a brief summary of my relevant qualifications and professional experience.

7. As shown in my curriculum vitae, I have devoted my career to various fields of physical, electrical, and computer science with more than two decades focused on embedding sensing, including wearable and wireless sensors. I have 20 years of experience in wearable devices and computing, during which I invented and fielded many types of wearable activity tracking devices that utilized a variety of power management and wakeup protocols.

8. I am the Alexander W. Dreyfoos (1954) Professor in Media Arts and Sciences at the Massachusetts Institute of Technology (MIT), where I direct the Responsive Environments Group, which explores how sensor networks augment and mediate human experience, interaction and perception. I also have served as co-

director of the Things That Think Consortium, a group of MIT Media Lab researchers and industrial partners focused on the future of embedded computation and sensing, and am now serving as our Associate Department Head.

9. I received my B.S. in electrical engineering and physics summa cum laude from Tufts University in 1977 and my PhD in physics from MIT in 1981. From 1981 to 1984, I did post-doctoral research at the Swiss Federal Institute of Technology (ETH) in Zurich, working on sensor technology for high-energy particle physics. From 1984-1994, I was a physicist at the Draper Laboratory in Cambridge, Massachusetts, where, as a member of the NASA Systems and Advanced Sensors and Signal Processing Directorates, my research included spacecraft control systems and sensor technology for both sonar systems and high-energy physics. I also worked at Draper Lab as an undergraduate (1974-1978) on software for advanced strategic inertial measurement units and guidance systems. From 1992-1994, I directed the development of precision alignment sensors for the GEM muon detector at the Superconducting Supercollider, and worked on design of particle detectors at the CERN Large Hadron Collider (LHC).

10. I joined the MIT Media Lab in 1994. The MIT Media Lab was founded in 1985 to actively promote a unique, anti-disciplinary culture that focuses on research projects joining different technological and academic fields. As described further below, researchers at the MIT Media Lab have pioneered areas such as

wearable computing, tangible interfaces, and affective computing. Examples of products or platforms spun off Media Lab research include electronic ink readers such as the Amazon Kindle and Barnes & Noble Nook, the popular video game Guitar Hero, the MPEG-4 structured audio format, the first bionic lower-leg system for amputees, wireless mesh networks developed by Nortel, and the Mercury RFID Reader, commercialized by spin-off ThingMagic. Today, the Lab is supported by more than 70 sponsors/members, comprising some of the world's leading corporations and representing the fields of electronics, entertainment, fashion, health care, greeting cards, and telecommunications, among others. Faculty members, research staff, and students at the Lab work in more than 25 research groups on more than 350 projects that range from digital approaches for treating neurological disorders, to a stackable, electric car for sustainable cities, to advancing imaging technologies that can see around corners.

11. Upon joining the Media Lab, I focused on developing new sensing modalities for human-computer interaction, then by 1997 evolved my research into wearable wireless sensing and distributed sensor networks. This work anticipated and influenced transformative products and industries that have blossomed in recent years. For example, the sensor-laden wireless shoe I developed for interactive dance in 1997 is recognized as a watershed in the field of wearable wireless sensing and was an inspiration for the Nike+, one of the very first activity trackers and the first

commercial product to integrate dynamic music with monitored exercise. My team went on to pioneer clinical gait analysis with wearable wireless sensors in collaboration with the Massachusetts General Hospital (MGH) in 2002, and then broke new ground in sports medicine with another MGH collaboration that developed an ultra-wide-range wireless inertial measurement unit system for evaluating professional baseball pitchers in 2007. My team and I have also been leaders on wearable sensing for Human-Computer Interfaces, over the past decade fielding, for example, wristbands to measure finger position, wristbands to enable pointing interaction and control of heating and lighting, and even a wireless touchpad mounted on a fingernail.

12. Leading to over 300 publications, 17 issued patents, and a string of awards in the Pervasive Computing, Human Computer Interaction, and sensor network communities, my research has become the basis for widely established curricula. Many of these publications are directed to wearables. I have also advised over 55 graduate (MS and PhD) theses for students who have done their work in my research group, and served as a reader for roughly 100 MS and PhD students in other groups and at other universities. Some of my own students have gone on to prominence in their own careers that have involved wearables—for example, Dr. Nan-Wei Gong (PhD 2013) was the R&D lead of Project Jacquard (integrating electronics and textiles) at Google ATAP before becoming founder and CEO of her

own companies with a wearable focus ‘Circular2’ and ‘Figure8’, and Dr. Stacy Morris Bamberg (PhD 2004) became a tenured professor at the University of Utah doing wearable gait analysis, then started a company in this space (Veristride). I have given over 300 invited talks, panel appearances, and seminars worldwide, recently keynoting on topics relating to ubiquitous sensing and the Internet of Things (IoT) for prestigious venues ranging from the Sensors Expo (the main industrial sensors conference) to the World Economic Forum. I am frequently asked to address industrial groups on wearables and IoT, and often engage with the Media Lab’s extensive list of industrial partners in strategizing these areas.

13. I belong to and participate in various professional organizations. I am a senior member of the IEEE (Institute of Electrical and Electronics Engineers), and also belong to the ACM (Association for Computer Machinery). I also belong to the APS American Physical Society (the major professional society in physics), and am a senior member in the AIAA (the American Institute of Aeronautics and Astronautics). Within the IEEE, I belong to the Signal Processing Society, the Controls Society, and the Computer Society. As detailed in my CV, I have served on many Technical Program Committees (TPCs, which solicit, review, and select papers for academic conferences) and journal editorial boards, plus have organized academic conferences in areas such as wireless sensor networks, wearable

computing and wearable sensing, human-computer interfaces, ubiquitous computing, etc.

14. One of the themes of my research has been on low-power embedded systems and energy harvesting. I have written several well-regarded papers on these topics that well predate the '508 Patent—for example, the review article that I wrote for IEEE Pervasive Computing in 2005, 'Energy Scavenging for Mobile and Wireless Electronics' has become their most popular article and is widely cited. My work on smart wakeup systems (e.g., as described in my papers such as 'A Framework for the Automated Generation of Power-Efficient Classifiers for Embedded Sensor Nodes' and 'CargoNet: A Low-Cost MicroPower Sensor Node Exploiting Quasi-Passive Wakeup for Adaptive Asynchronous Monitoring of Exceptional Events,' both presented at SenSys 2007), are also of relevance here.

III. LEVEL OF ORDINARY SKILL IN THE ART

15. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

16. I am familiar with accelerometers (including those found in portable devices such as mobile phones). I am also aware of the state of the art at the time

the application resulting in the ’508 Patent was filed. I have been informed by Apple’s counsel that the earliest alleged priority date for the ’508 Patent is December 22, 2006. Based on the technologies disclosed in the ’508 Patent, I believe that a person of ordinary skill in the art (“POSITA”) would include someone who had, at the priority date of the ’508 Patent, (i) a Bachelor’s degree in Electrical Engineering, Computer Engineering, Computer Science, or equivalent training, as well as (ii) approximately two years of experience working in hardware and/or software design and development related to MEMS (micro-electro-mechanical) devices and body motion sensing systems. Lack of work experience could have been remedied by additional education, and vice versa. Such academic and industry experience would be necessary to appreciate what was obvious and/or anticipated in the industry and what a POSITA would have thought and understood at the time. Based on this criteria, as of the relevant time frame for the ’508 Patent, I possessed at least such experience and knowledge of a POSITA, as well as trained many of them by then, hence am qualified to opine on the ’508 Patent.

17. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of December 22, 2006. Unless otherwise stated, when I provide my understanding and analysis

below, it is consistent with the level of a POSITA prior to the priority date of the '508 Patent.

IV. RELEVANT LEGAL STANDARDS

18. I understand that prior art to the '508 Patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the '508 Patent. For purposes of this Declaration, I have been asked to apply December 22, 2006, the earliest alleged priority date, as the priority date.

19. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '508 Patent, I am relying on certain basic legal principles that counsel have explained to me. These principles are discussed below.

20. I understand that a claim is unpatentable if it is anticipated under 35 U.S.C. § 102 or obvious under 35 U.S.C. § 103.

A. Anticipation

21. I have been informed by counsel that a patent claim is unpatentable as anticipated if each element of that claim is present either explicitly or inherently in a single prior art reference. I have also been informed that, to be an inherent disclosure, the prior art reference must necessarily disclose the limitation, and the fact that the reference might possibly practice or contain a claimed limitation is insufficient to establish that the reference inherently teaches the limitation.

B. Obviousness

22. I have been informed that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been informed by counsel that the obviousness analysis takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

23. I have been informed by counsel that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior

art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

V. OVERVIEW OF THE '508 PATENT

A. Summary of the Patent

24. The '508 patent is directed to "a method of monitoring human activity, and more particularly, to counting periodic human motions such as steps." Ex. 1001, 1:5-7. As admitted by the Applicant, "inertial sensors (e.g., accelerometers)" are commonly used in commercial electronic devices such as "cellular phones, portable music players, pedometers, game controllers, and portable computers." Ex. 1001, 1:13-18. These conventional "[s]tep counting devices are used to monitor an individual's daily activity by keeping track of the number of steps that he or she takes." Ex. 1001, 1:19-21. These devices, however, "are often confused by motion noise experienced by the device throughout a user's daily routine. This noise causes false steps to be measured and actual steps to be missed in conventional step counting devices." Ex. 1001, 1:27-31.

25. The claims of the '508 patent are directed to two separate concepts that allegedly improve conventional step counting devices. The first concept (associated with independent claims 1 and 11) relates to determining and assigning a "dominant axis," and counting steps along that axis. *See* Ex. 1001, claim 1. In the '508 patent,

the dominant axis is the axis "with the largest absolute rolling average . . . most influenced by gravity, which may change over time (e.g. as the electronic device is rotated). Therefore, a new dominant axis may be assigned when the orientation of the electronic device . . . changes." Ex. 1001, 6:16-21.

26. The second concept (associated with independent claims 6 and 15) relates to counting steps in two different modes—a non-active mode and an active mode. In the non-active mode, steps are detected but not yet added to the total step count. Instead, such steps are buffered until the device switches to the active mode, which occurs when a certain number of steps have been detected and validated. Steps are determined to be valid if they fall within a particular time interval, referred to in the '508 patent as a "cadence window." The cadence window is based on a user's motion cycle or stepping period: "once a stepping period (or other motion cycle period) is determined, that period may be used to set the cadence window (the allowable time window for steps to occur)." Once in the active mode, the detected steps are added to the total step count as they are detected.

27. Before the '508 Patent was filed, a developer named Fabio Pasolini was actively working on pedometer devices that included the concepts described and claimed in the '508 patent. Mr. Pasolini filed two patent applications (issued as U.S. Patent No. 7,698,097 ("Fabio") and U.S. Patent No. 7,463,997 ("Pasolini")) before the '508 patent was filed. The Pasolini reference describes a pedometer updates the

vertical axis with each acquisition of an acceleration sample to take into account variations of the orientation of the pedometer device during use. Ex. 1005, 8:20-24. The Fabio reference, on the other hand, describes applying a regularity condition to the detected step data so that a step is counted when it occurs within a "validation interval." In my opinion, the disclosures provided in the Fabio and Pasolini references either anticipate or render obvious each and every element of the claims discussed below.

B. Prosecution History

28. The '508 patent issued on January 26, 2010 from U.S. Patent Application No. 11/644,455 filed on December 22, 2006.

29. The first Office Action issued on August 31, 2009, and included no prior art rejections. *See* Ex. 1002, p. 70. The Action did, however, include multiple objections to the drawings and other informalities. On October 9, 2009, the Applicant filed a response to replace drawings and amended the specification to address the other objections. *See* Ex. 1002, p. 54. A Notice of Allowance then issued on November 30, 2009. *See* Ex. 1002, p. 16. In the Allowance, the Examiner did not provide any specific reason but instead quoted the independent claims and merely stated that a few cited references did not teach the limitations of the claims.

See Ex. 1002, p. 22. As can be observed from the prosecution history, the Fabio and Pasolini references discussed below were not cited or applied by the Examiner.

VI. BROADEST REASONABLE INTERPRETATION

30. It is my understanding that in order to properly evaluate the ’508 Patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be given their broadest reasonable interpretation in light of the specification. It is my further understanding that claim terms are given their ordinary and accustomed meaning as would be understood by one of ordinary skill in the art, unless the inventor has set forth a special meaning for a term. In order to construe the following claim terms, I have reviewed the entirety of the ’508 Patent, as well as its prosecution history.

A. “dominant axis”

31. This term appears in at least claims 1 and 11. In the specification of the ’508 patent, the dominant axis is determined based on the accelerometer’s alignment with gravity. For example, the specification states that “[i]n one embodiment, the dominant axis is assigned after identifying a gravitational influence. The gravitational influence may be identified by calculating total acceleration based upon the acceleration on each axis.” Ex. 1001, 14:34-38. The specification also states that “[i]n one embodiment, once the orientation is determined, a dominant axis is assigned based upon the orientation. Determining an orientation of the electronic

device 100 may include identifying a gravitational influence." Ex. 1001, 6:12-15. In other words, the dominant axis is "the axis most influenced by gravity, which may change over time (e.g., as the electronic device is rotated)." Ex. 1001, 6:16-18.

32. Thus, for the purposes of this proceeding, it is my opinion that a POSITA would understand the broadest reasonable interpretation of the term "dominant axis" to include "*the axis most influenced by gravity.*"

B. "cadence window"

33. This term appears in at least claims 3, 6, 7, 10, 13, 15, 16, 19, and 20. The specification specifically defines this term as "a window of time since a last step was counted that is looked at to detect a new step." Ex. 1001, 3:64-65.

34. Thus, for the purposes of this proceeding, it is my opinion that a POSITA would understand the broadest reasonable interpretation of the term "cadence window" to include "*a window of time since a last step was counted that is looked at to detect a new step.*"

C. "a dominant axis logic to continuously determine an orientation of a device, to assign a dominant axis, and to update the dominant axis as the orientation of the device changes"

35. This term appears in at least claim 11. The specification describes that "dominant axis logic 127 is used to determine an orientation of the electronic device 100 and/or an inertial sensor within the electronics device 100." *See* Ex. 1001, 3:4-8. "At processing block 812, in one embodiment the inertial sensor is oriented by

assigning a dominant axis. Assigning a dominant axis may include calculating rolling averages of acceleration and assigning the dominant axis based on the rolling averages of acceleration." Ex. 1001, 12:42-43. The specification further describes that the present invention may be performed by hardware, software, or a combination of both. *See* Ex. 1001, 14:50-56.

36. Accordingly, it is my opinion that a POSITA would have understood the broadest reasonable interpretation of this claim term to include "hardware, software, or both to continuously determine an orientation of a device, to assign a dominant axis, and to update the dominant axis as the orientation of the device changes."

37. However, to the extent that Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph, a POSITA would have understood the claim itself and the specification to provide:

> **Function**: continuously determine an orientation of a device, to assign a dominant axis, and to update the dominant axis as the orientation of the device changes;
>
> **Structure**: software, hardware, or combination thereof to perform actions in block 812. *See* Ex. 1001, 12:42-43, 14:50-56;

D. "a counting logic to count periodic human motions by monitoring accelerations relative to the dominant axis"

38. This term appears in at least claim 11. The specification describes "step counting logic 130" that is used "to determine if a step has occurred" and indicate if "a step may be counted . . . ." Ex. 1001, 6:40-45, 7:2. In one example, at block 615, "measurement data is checked to determine whether an additional step is recognized." Ex. 1001, 11:19-21. At block 620, "[i]f an additional step is recognized, then it is added to the final or actual step count." Ex. 1001, 11:21-22. The specification further describes that the present invention may be performed by hardware, software, or a combination of both. *See* Ex. 1001, 14:50-56.

39. Accordingly, it is my opinion that a POSITA would have understood the broadest reasonable interpretation of this claim term to include "hardware, software, or both to count periodic human motions by monitoring accelerations relative to the dominant axis, or identify and count periodic human motions."

40. However, to the extent that Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph, a POSITA would have understood the claim itself and the specification to provide:

> **Function**: count periodic human motions by monitoring accelerations relative to the dominant axis;

Structure: software, hardware, or combination thereof to perform actions in blocks 615 and 620. *See* Ex. 1001, 7:46-60, 14:50-56.

E. "a counting logic to identify and count periodic human motions"

41. This term appears in at least claim 15. The specification describes "step counting logic 130" that is used "to determine if a step has occurred" and indicate if "a step may be counted . . . ." Ex. 1001, 6:40-45, 7:2. In one example, at block 615, "measurement data is checked to determine whether an additional step is recognized." Ex. 1001, 11:19-21. At block 620, "[i]f an additional step is recognized, then it is added to the final or actual step count." Ex. 1001, 11:21-22. The specification further describes that the present invention may be performed by hardware, software, or a combination of both. *See* Ex. 1001, 14:50-56.

42. Accordingly, it is my opinion that a POSITA would have understood the broadest reasonable interpretation of this claim term to include "hardware, software, or both to count periodic human motions by monitoring accelerations relative to the dominant axis, or identify and count periodic human motions."

43. However, to the extent that Patent Owner overcomes the presumption against construction under 35 U.S.C. 112, sixth paragraph, a POSITA would have understood the claim itself and the specification to provide:

Function: identify and count periodic human motions;

Structure: software, hardware, or combination thereof to perform actions in blocks 615 and 620. *See* Ex. 1001, 7:46-60, 14:50-56.

F. "a cadence logic to continuously update a dynamic cadence window"

44. This term appears in at least claim 13. The specification describes "cadence logic 132 [that] detects a period and/or cadence of a motion cycle. The period and/or cadence of a motion cycle may be based upon user activity (e.g. rollerblading, biking, running, walking, etc.)." Ex. 1001, 3:9-16. In one example, at block 574 "a new cadence window is set (block 574) based on a stepping cadence of the M steps measured." Ex. 1001, 10:56-57. The specification further describes that the present invention may be performed by hardware, software, or a combination of both. *See* Ex. 1001, 14:50-56.

45. Accordingly, it is my opinion that a POSITA would have understood the broadest reasonable interpretation of this claim term to include "hardware, software, or both to continuously update a dynamic cadence window."

46. However, to the extent that Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph, a POSITA would have understood the claim itself and the specification to provide:

Function: continuously update a dynamic cadence window;

Structure: software, hardware, or combination thereof to perform actions in block 574. *See* Ex. 1001, 10:56-57, 14:50-56.

G. "a mode logic, to switch the device from a non-active mode to an active mode after a number of periodic human motions are detected within appropriate cadence windows by the counting logic"

47. This term appears in at least claim 15. The specification describes mode logic 190 that determines the "operating mode that the electronic device is in." Ex. 1001, 7:23-24. In one example, block 580 describes logic to check "whether there are N steps in the buffered step count." Ex. 1001, 10:63-64. At block 584, "a stepping [active] mode is entered into." Ex. 1001, 11:2-3. The specification further describes that the present invention may be performed by hardware, software, or a combination of both. *See* Ex. 1001, 14:50-56.

48. Accordingly, it is my opinion that a POSITA would have understood the broadest reasonable interpretation of this claim term to include "hardware, software, or both to switch the device from a non-active mode to an active mode after a number of periodic human motions are detected within appropriate cadence windows by the counting logic."

49. However, to the extent that Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph, a POSITA would have understood the claim itself and the specification to provide:

Function: switch the device from a non-active mode to an active mode after a number of periodic human motions are detected within appropriate cadence windows by the counting logic;

Structure: software, hardware, or combination thereof to perform actions in blocks 580 and 584. *See* Ex. 1001, 10:63-11:3, 14:50-56.

VII. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

50. It is my opinion that claims 1-4, 6-8, 11-16, 19, and 20 of the '508 Patent are unpatentable, as discussed below, based on the following:

Challenge	Claims	Ground
Challenge #1	1-2 and 11-12	Obvious under 35 U.S.C. § 103(a) over U.S. Patent No. 7,463,997 to Fabio Pasolini et al. ("Pasolini").
Challenge #2	6-8, 15-16, and 19	Obvious under 35 U.S.C. § 103(a) over U.S. Patent No. 7,698,097 to Fabio Pasolini et al. ("Fabio").
Challenge #3	3-4, 14-13, and 20	Obvious under 35 U.S.C. § 103(a) over Pasolini in view of Fabio.

A. State of the Art at the Time of the '508 Patent

51. By the time the '508 Patent was filed on December 22, 2006, others were actively working on pedometer devices that monitored a user's steps. My own team fielded several well-known systems to monitor human gait in the late 90s and early 2000s using wireless MEMs accelerometers mounted on shoes. Another such developer was Fabio Pasolini, who designed motion detection systems using MEMS

that could be implemented in phones or other portable electronic devices. *See* Ex. 1006, 2:33-36; Ex. 1005, 8:31-34. The pedometers devices that Mr. Pasolini designed use an inertial sensor, such an accelerometer, to count steps of the user while the user is carrying the device. Ex. 1006, 1:10-11, 2:49-64; Ex. 1005, 3:30-35.

52. To detect and identify the user's steps, Mr. Pasolini's devices analyze positive and negative acceleration peaks provided by the accelerometer. Ex. 1006, 4:12-21; Ex. 1005, 3:35-41. In this way, Mr. Pasolini's devices provide features that help avoid "false positives" with respect to the step recognition. Ex. 1006, 7:16-19; Ex. 1005, 1:61-2:3. These step-recognition features are described in two of Mr. Pasolini's issued patents—U.S. Patent No. 7,698,097 ("Fabio") and U.S. Patent No. 7,463,997 ("Pasolini")—that were both filed on October 2, 2006.

53. Both of Mr. Pasolini's patents describe a number of features in common with the pedometer devices. This includes, for example, an accelerometer with multiple axes of detection, so that step recognition is advantageously performed using the accelerations measured by the axis that is most aligned with gravity. Ex. 1006, 8:20-32; Ex. 1005, 8:15-24.

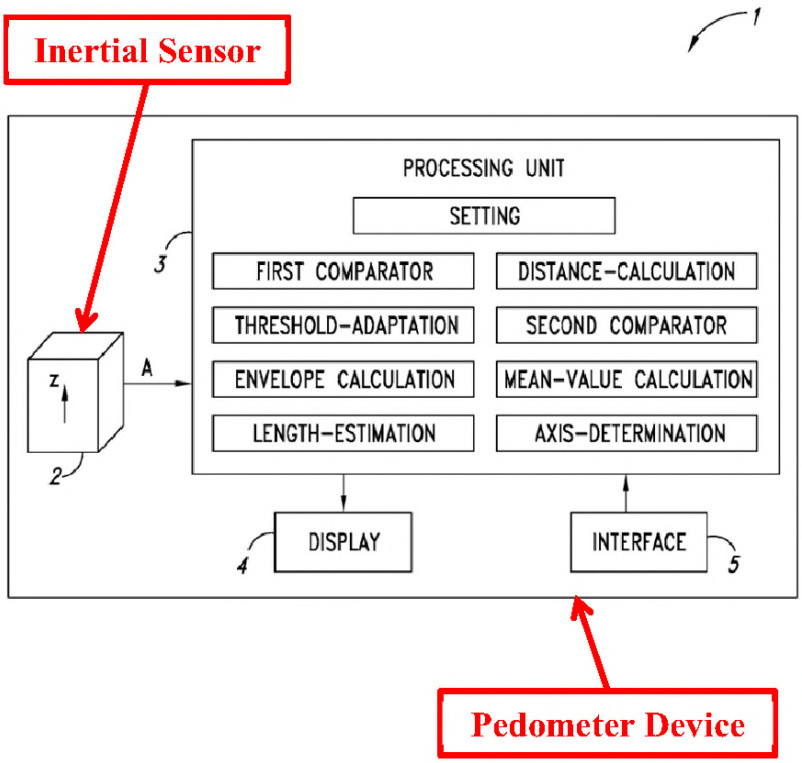
54. The references differ in that the Pasolini reference provides additional detail regarding step detection using linear and multi-axes accelerometers, including describing that the pedometer updates the vertical axis with each acquisition of an

acceleration sample to take into account variations of the orientation of the pedometer device during use. Ex. 1005, 8:20-24. The Fabio reference, on the other hand, describes applying a regularity condition to the detected step data so that a step is counted when it occurs within a "validation interval," which is identified as a window of time since a previous step was counted. Ex. 1006, 4:35-39, 7:16-19, FIG. 6.

55. As described in more detail below, it is my opinion that the disclosures provided in the Fabio and Pasolini references either anticipate or render obvious each and every element of the claims discussed below.

B. Summary of Pasolini

56. Pasolini is directed to "a pedometer device and to a step detection method using an algorithm for self-adaptive computation of acceleration thresholds." Ex. 1005, 1:10-12. In one embodiment, Pasolini describes a pedometer device having an "accelerometer 2 [that] detects the component along the **detection axis z of the vertical acceleration** generated **during the step**, and produces a corresponding acceleration signal A." Ex. 1005, 3:13-19. The processing unit in the pedometer device "acquires at pre-set intervals samples of the **acceleration signal A** generated by the accelerometer 2, and executes appropriate processing operations for **counting the number of steps**." Ex. 1005, 3:30-41. A diagram of Pasolini's pedometer device is reproduced below:



Ex. 1005, Fig. 1 (annotated).

57. Pasolini also teaches an embodiment where the accelerometer 2 may be a tri-axial accelerometer rather than a linear accelerometer: "The **accelerometer 2** could be equipped with a number of axes of measurement, for example **three** mutually orthogonal axes of measurement." Ex. 1005, 8:11-13. When using the three axes of measurement, the axis most aligned with gravity is used for step detection.

58. Pasolini further teaches that the axis identified as the one most aligned with gravity changes as the device rotates. Specifically, Pasolini states that the "processing unit 3 envisages identifying the **main vertical axis** to be used for **step**

detection as the axis of detection that has the highest mean acceleration value Accm (on account of gravity). For example, the **main vertical axis** can be identified at **each acquisition of a new acceleration sample**, block 30 of FIG. 4, so as to take into account **variations in the orientation** of the pedometer device 1." Ex. 1005, 8:18-24.

59. Thus, the various embodiments described in Pasolini teach a pedometer using a tri-axial accelerometer to continuously determine which axis is the one most aligned with gravity, and uses that axis to count steps.

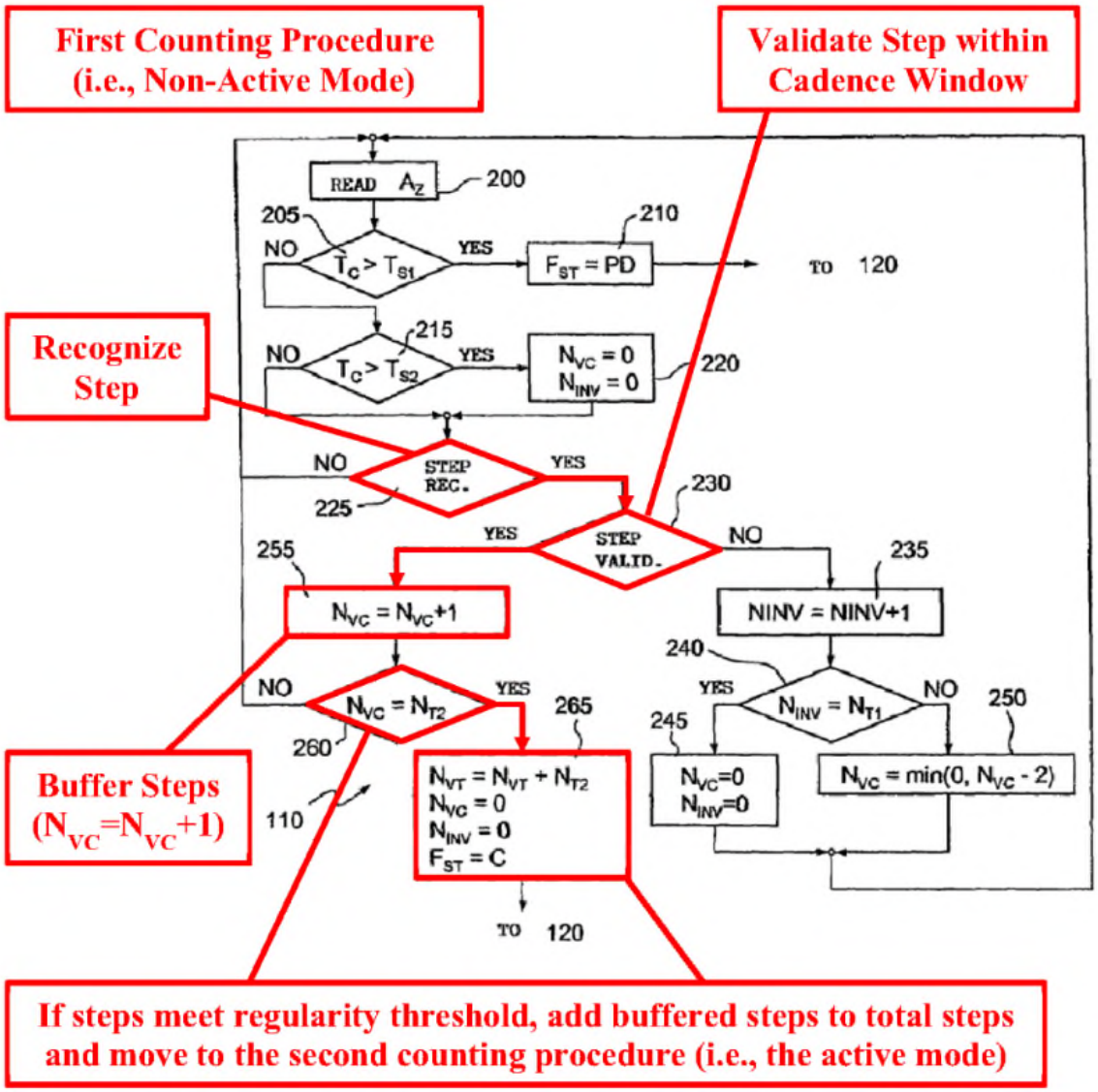
C. Summary of Fabio

60. Fabio is directed to "controlling a pedometer based on the use of inertial sensors." Ex. 1006, 1:10-11. Fabio notes that "there are many random events that can interfere with correct recognition of the step. Impact or other external vibrations and given movements of the user can, in fact, give rise to so-called 'false positives.'" Ex. 1006, 1:38-41. Consequently, Fabio describes a pedometer having various features to overcome such challenges.

61. Fabio's device uses two separate counting procedures. In the first counting procedure, steps are detected and counted but not added to the "total number of valid steps N_{VT}." Ex. 1006, 3:43. Instead, "**the number of valid control steps N_{VC} is incremented by one** (block 255), and then the control unit 5 executes a first test on regularity of the sequence of steps recognized (block 260)." Ex. 1006,

5:10-13. In other words, the valid control steps value N_{VC} is incremented rather than the total step count N_{VT}. After the number of valid control steps N_{VC} reaches a threshold N_{T2}, the value of N_{T2} (the same as N_{VC}) is added to the total step count N_{VT}: "Otherwise (output YES from block 260), a sequence of steps is recognized that satisfies the first condition of regularity, and the first regularity test is passed . . . the total number of valid steps N_{VT} is updated and incremented by a value equal to the second threshold number N_{T2} (block 265)." Ex. 1006, 5:10-39. "[W]hen the first regularity test (block 260) is passed, **the total number of valid steps N_{VT} is immediately updated so as to take into account the valid steps** (equal to N_{T2}) that make up the sequence considered as being regular." Ex. 1006, 5:52-56.

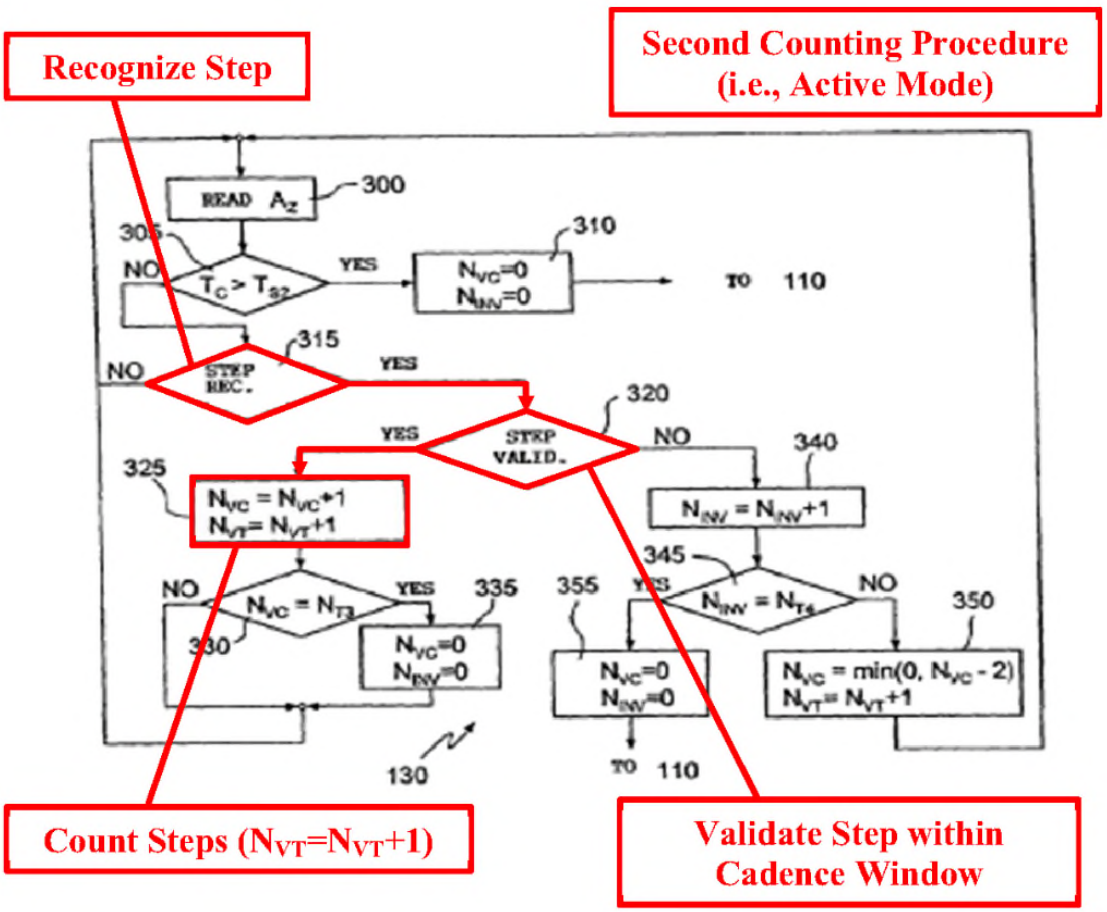
62. A flowchart for Fabio's first counting procedure is shown below.



Ex. 1006, Fig. 4 (annotated).

63. After a certain number of validated steps have been detected, Fabio's device enters a second counting procedure. In the second counting procedure, detected steps are added to the step count. Specifically, Fabio teaches "**If the check yields a positive result (output YES from block 320), the control unit 5 updates the total number of valid steps N_{VT}**." Ex. 1006, 6:27-53. Additionally, Fabio

teaches that "**[t]he user is considered to be moving**, and a first counter, hereinafter referred to **as total number of valid steps N_{VT}, is incremented whenever an event corresponding to a step is recognized**." Ex. 1006, 3:37-49. A flowchart of the second counting procedure from Fig. 7 is reproduced below:



Ex. 1006, Fig. 7 (annotated).

64. Using these counting procedures, Fabio's device is able to more accurately count steps and adapt to changes in the user's pace. Specifically, Fabio teaches:

> Possible isolated irregularities are ignored and do not interrupt or suspend updating of the count, which is, instead, interrupted when prolonged pauses occur or in the presence of significant discontinuities in locomotion. However, if the gait becomes regular again, even with a different rhythm, also the count promptly resumes, because the first counting procedure is once again executed. This prevents a significant number of steps from being neglected.

Ex. 1006, 7:16-23.

D. Challenge #1: Claims 1-2 and 11-12 are obvious under 35 U.S.C. § 103(a) over Pasolini.

65. In my opinion, the disclosures in Pasolini render obvious claims 1-2 and 11-12 of the '508 Patent.

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Claim 1	
[1.0] A method of monitoring human activity using an inertial sensor, comprising:	Pasolini discloses this limitation. First, Pasolini teaches a step detection method for detecting steps in the gait of a user: > One embodiment of the invention is a **step detection method for detecting steps in the gait of a user**. The method includes producing an acceleration signal relating to an acceleration generated during a step; and processing the acceleration signal to detect the occurrence of the step. The processing step includes comparing the acceleration signal with a first reference threshold, and modifying the first reference threshold as a function of the acceleration signal. Ex. 1005, 2:22-28.
	Pasolini's step detection method detects or monitors steps in a gait of a user which is a *human activity*. Accordingly,

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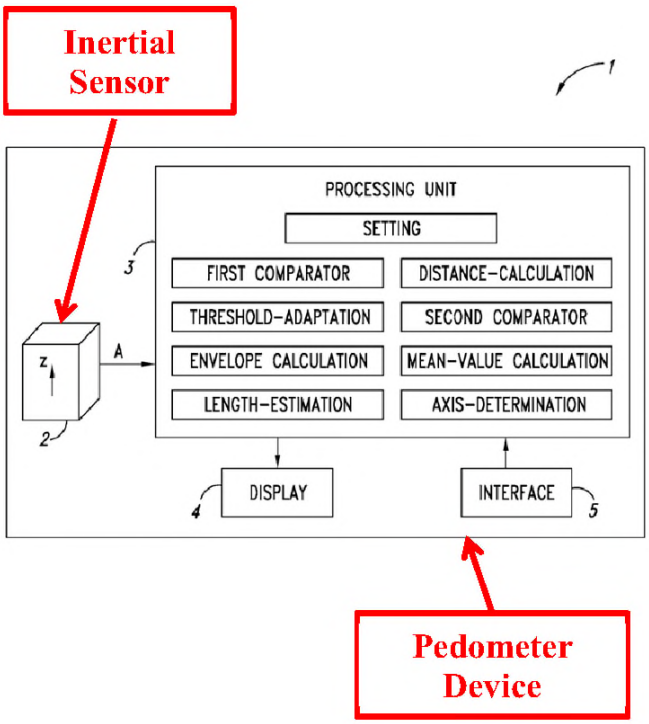
	Pasolini teaches the *method for monitoring human activity*. Second, to detect the human activity, Pasolini teaches a pedometer that detects and counts the user's steps" > One embodiment of the present invention provides a **pedometer device and a method for detecting and counting steps** which will enable the aforesaid disadvantages and problems to be overcome. Ex. 1005, 2:6-9. To detect stepping motions, the pedometer employs an accelerometer, as illustrated in Fig. 1, replicated below:  Ex. 1005, Fig. 1 (annotated). An accelerometer is an *inertial sensor* because it detects acceleration of an object:

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	The accelerometer 2 is advantageously an integrated sensor of semiconductor material, made using the MEMS technology, of a known type and thus not described in detail herein. In use, **the accelerometer 2 detects the component along the detection axis z of the vertical acceleration generated during the step, and produces a corresponding acceleration signal A**. Ex. 1005, 3:13-19. Pasolini states that its pedometer and method can be included, for example, in a mobile device: "as shown in FIG. 8, the pedometer device 1, due to its reduced dimensions, **may advantageously be housed inside a portable device, in particular a mobile phone 50** (or else an Mp3 reader, a camera, a PDA, a game console, etc.)." Ex. 1005, 8:31-34. An example of the mobile device in Fig. 8 with the pedometer (and the inertial sensor) is shown below:

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	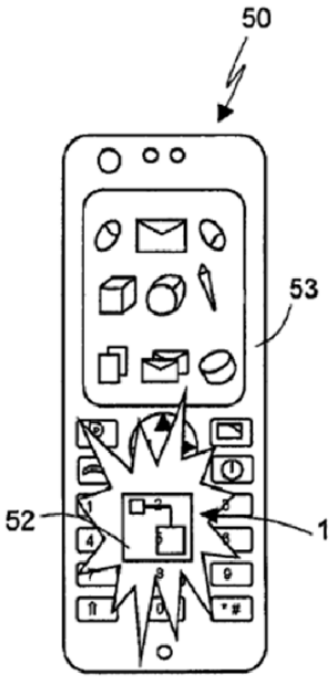 Fig.8 Ex. 1005, Fig. 8. Thus, Pasolini's method for detecting steps with a pedometer device that includes an accelerometer teaches "[a] method of monitoring human activity using an inertial sensor" as recited in the claim.
[1.1] continuously determining an orientation of the inertial sensor;	Pasolini renders this limitation obvious. Pasolini teaches a three-axis accelerometer that determines which of three axes is the main vertical axis as the device's orientation changes: > **<u>The accelerometer 2 could be equipped with a number of axes of measurement, for example three mutually orthogonal axes of measurement</u>**, and be built, for example, as described in "3-axis Digital Output Accelerometer For Future Automotive Applications", B. Vigna et al.,

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	AMAA 2004. In this case, according to one embodiment of the present invention, **the algorithm implemented by the processing unit 3 envisages identifying the main vertical axis to be used for step detection as the axis of detection that has the highest mean acceleration value Accm (on account of gravity)**. For example, the main vertical axis **can be identified at each acquisition of a new acceleration sample**, block 30 of FIG. 4, so as to take into account variations in the **orientation of the pedometer device 1, and consequently of the accelerometer 2 arranged inside it**. Ex. 1005, 8:11-24. By determining which axis is the main vertical axis as the device's orientation changes, Pasolini teaches that "an orientation" is being determined based on alignment of the accelerometer with gravity. For example, if the X-axis is determined to be the main vertical axis, then it is determined that the device is oriented such that the X-axis is most aligned with gravity. Alternatively, if the Y-axis is the main vertical axis, then it is determined that the device is oriented such that the Y-axis is most aligned with gravity. Further, Pasolini's determining of the main vertical axis is performed *continuously* because it is done "**at each acquisition of a new acceleration sample**." Ex. 1005, 8:20-22. In Pasolini, the device "**acquires at pre-set intervals samples of the acceleration** signal A generated by the accelerometer 2." Ex. 1005, 3:31-33. By acquiring acceleration samples at pre-set intervals and determining the device's orientation as each acquisition, a POSITA would thus recognize that Pasolini's device is determining device orientation continuously, at a pre-set interval.

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	Thus, Pasolini's pedometer that determines the main vertical axis (and thus an orientation) at each new acceleration sample teaches "continuously determining an orientation of the inertial sensor" as recited in the claim.
[1.2] assigning a dominant axis;	Pasolini discloses this limitation because it teaches identifying a main vertical axis of the accelerometer to be used in step detection: > The accelerometer 2 could be equipped with a number of axes of measurement, for example three mutually orthogonal axes of measurement, and be built, for example, as described in "3-axis Digital Output Accelerometer For Future Automotive Applications", B. Vigna et al., AMAA 2004. In this case, according to one embodiment of the present invention, the algorithm implemented by the processing unit 3 envisages **identifying the main vertical axis to be used for step detection as the axis of detection that has the highest mean acceleration value Accm (on account of gravity)**. For example, the main vertical axis can be identified at each acquisition of a new acceleration sample, block 30 of FIG. 4, so as to take into account variations in the orientation of the pedometer device 1, and consequently of the accelerometer 2 arranged inside it. Ex. 1005, 8:11-24. A POSITA would understand the main vertical axis to be a dominant axis because the main vertical axis is most aligned with gravity (i.e., has the highest mean acceleration value Accm on account of gravity).

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	Thus, Pasolini's identification of a main vertical axis as the axis most aligned with gravity teaches "assigning a dominant axis" as recited in the claim.
[1.3] updating the dominant axis as the orientation of the inertial sensor changes; and	First, as discussed in sections [1.1] and [1.2], Pasolini's embodiments teach determining the orientation of the accelerometer (i.e., an inertial sensor) by identifying the axis most aligned with gravity (i.e., assigning the dominant axis). Second, Pasolini teaches in its second embodiment that: > The accelerometer 2 could be equipped with a number of axes of measurement, for example three mutually orthogonal axes of measurement, and be built, for example, as described in "3-axis Digital Output Accelerometer For Future Automotive Applications", B. Vigna et al., AMAA 2004. In this case, according to one embodiment of the present invention, the algorithm implemented by the processing unit 3 envisages identifying the main vertical axis to be used for step detection as the axis of detection that has the highest mean acceleration value Accm (on account of gravity). For example, **the main vertical axis can be identified at each acquisition of a new acceleration sample**, block 30 of FIG. 4, so as to **take into account variations in the orientation of the pedometer device 1**, and consequently of the accelerometer 2 arranged inside it. Ex. 1005, 8:11-24. Along with identifying the main vertical axis with each new acceleration sample, Pasolini also "executes appropriate processing operations for **counting the number of steps** and measuring the distance traveled." Ex. 1005, 3:33-35. Based on these disclosures, a POSITA

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	would have recognized that as the pedometer (and by extension the accelerometer inside it) is rotated, new acceleration sample are acquired to both identify the main vertical axis (i.e., the dominant axis) and count the steps that occur along this axis. Accordingly, Pasolini teaches that the axis identified as the dominant axis is "updated" at the acquisition of each acceleration sample to count steps along that axis. A POSITA would have also recognized that as the pedometer (and by extension the accelerometer in it) is rotated, the accelerometer would obtain acceleration samples at different orientations. Accordingly, a POSITA would have recognized that the main vertical axis will change based on the orientation of the pedometer with respect to gravity. For example, if the Z axis is currently most aligned with gravity, it will have the highest mean value of acceleration. Then, if the pedometer is rotated so that the Y axis has the highest mean acceleration value on account of gravity, then Pasolini teaches that the Y axis would be updated to become the new main vertical axis (*the dominant axis*). Thus, Pasolini's pedometer that regularly (i.e., at each acquisition of a new acceleration sample) updates the axis which is the main vertical axis to account for various orientations and counts steps along this axis teaches "updating the dominant axis as the orientation of the inertial sensor changes" as recited in the claim.
[1.4] counting periodic human motions by monitoring accelerations relative to the dominant axis.	First, Pasolini teaches that "the algorithm implemented by the processing unit 3 envisages identifying the **main vertical axis** to be used for **step detection**." Ex. 1005, 8:15-20. As discussed above, in [1.2] and [1.3], Pasolini's main vertical axis is the dominant axis because it is updated at each acceleration sample to be the axis most aligned with gravity. Second, Pasolini teaches that the pedometer device is for detecting and counting the steps of a user:

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	> One embodiment of the invention is a pedometer device for **detecting and counting the steps of a user**. The device includes an accelerometer sensor configured to detect an acceleration generated during a step; and a processing unit connected to the accelerometer sensor, and configured to process an acceleration signal relating to the acceleration to detect the occurrence of a step. The processing unit includes a first comparator configured to compare the acceleration signal with a first reference threshold, and a threshold-adaptation circuit configured to modify the first reference threshold as a function of the acceleration signal. Ex. 1005, 2:10-21. To count the user's steps the device generates an acceleration signal A by detecting a vertical acceleration component along the detection axis z during a step: > The accelerometer 2 is advantageously an integrated sensor of semiconductor material, made using the MEMS technology, of a known type and thus not described in detail herein. In use, **the accelerometer 2 detects the component along the detection axis z of the vertical acceleration generated during the step, and produces a corresponding acceleration signal A**. Ex. 1005, 3:13-19. A POSITA would have understood that detection along the z-axis would be the main vertical axis when the pedometer is oriented such that detection along the z-axis has the highest mean acceleration value Accm as

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	discussed in section [1.3]. Accordingly, a POSITA would have understood that the z-axis is the dominant axis. Thus, the combination of Pasolini's teachings of counting steps relative to the z-axis and identifying the main vertical axis at each acceleration sample renders obvious "counting periodic human motions by monitoring accelerations relative to the dominant axis" as recited in the claim.
Claim 2	
[2.0] The method of claim 1, further comprising:	See analysis of claim 1.
[2.1] using acceleration measurements along only the dominant axis to count steps.	Pasolini renders this limitation obvious because it teaches a triaxial embodiment that uses the "main vertical axis" to detect and count steps: > In use, the **accelerometer 2 detects the component along the detection axis z of the vertical acceleration generated during the step**, and produces a corresponding acceleration signal A. Ex. 1005, 3:16-19. Pasolini further explains that the process used to determine the step only takes into account the acceleration along the main vertical axis. > The accelerometer 2 is advantageously an integrated sensor of semiconductor material, made using the MEMS technology, of a known type and thus not described in detail herein. In use, **the accelerometer 2 detects the component along the detection axis z of the vertical acceleration generated during the step, and produces a corresponding acceleration signal A**.

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	Ex. 1005, 3:13-19. Thus, Pasolini's teachings of processing the acceleration signal correlated to the accelerations undergone along only the main vertical detection axis to count steps renders obvious "using acceleration measurements along only the dominant axis to count steps."
Claim 11	
[11.0] An inertial sensor based device, comprising:	Pasolini discloses this limitation because it teaches a pedometer (e.g., an inertial sensor based device) that detects and counts a user's steps: > One embodiment of the present invention provides **a pedometer device** and a method **for detecting and counting steps** which will enable the aforesaid disadvantages and problems to be overcome. Ex. 1005, 2:6-9. The pedometer device includes an accelerometer (e.g., inertial sensor) to detect and count the steps: > FIG. 1 is a schematic illustration of **a pedometer device 1, comprising an accelerometer 2**, of a linear type and having a vertical detection axis Z, and a processing unit 3, connected to the accelerometer 2. Advantageously, the accelerometer 2 and the processing unit 3 are mounted on the same printed circuit, housed inside a casing of the pedometer device 1 (not illustrated). Ex. 1005, 2:60-66. > The device includes **an accelerometer sensor configured to detect an acceleration generated during a step**; and a processing unit connected to the accelerometer sensor, and configured to **process an acceleration signal relating to**

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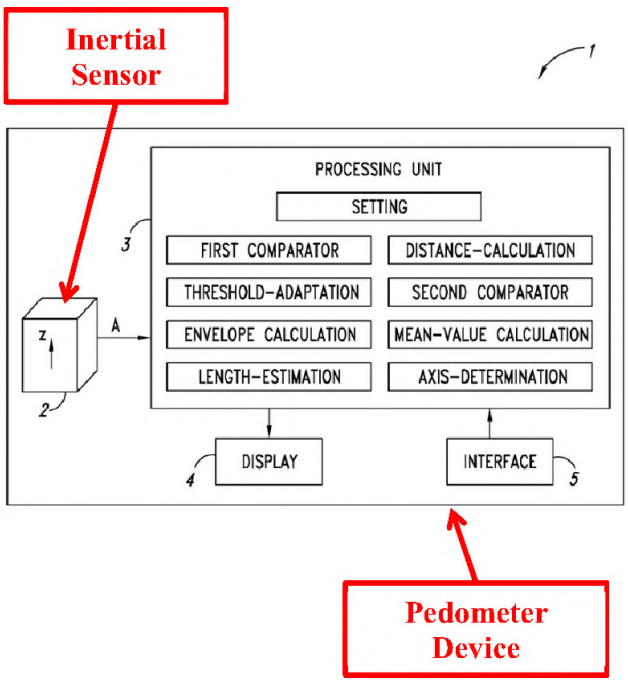
	the acceleration to detect the occurrence of a step. Ex. 1005, 2:11-16. An example diagram of Pasolini's pedometer is illustrated in Fig. 1, replicated below:  Ex. 1005, Fig. 1 (annotated). Since Pasolini's accelerometer detects accelerations of a user to detect a step, a POSITA would have recognized that Pasolini's accelerometer is an *inertial sensor*. Thus, Pasolini's pedometer, including the accelerometer, which counts a user's steps teaches "[a]n inertial sensor based device," as recited in the claim.
[11.1.1] a dominant axis logic to continuously determine an orientation of a device, to assign a dominant axis, and to	Pasolini renders this limitation obvious because the combination of its embodiments teaches a processing unit that continuously determines which of three axes is the one most aligned with gravity. First, Pasolini teaches "logic" that performs the functions recited in the claim because it states that the various

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update the dominant axis as the orientation of the device changes,	accelerometer related functions are done through "**digital implementation** of the pedometer device 1." Ex. 1005, 8:53-58. Pasolini also regularly refers to processing steps being performed by the processing unit, which executes processing operations (i.e., "logic"). For example, Pasolini states that "[t]he processing unit 3, comprising a microprocessor circuit (for example, a microcontroller or DSP), acquires at pre-set intervals samples of the acceleration signal A generated by the accelerometer 2, and **executes appropriate processing operations** for counting the number of steps and measuring the distance traveled." Ex. 1005, 3:30-41. Accordingly, Pasolini teaches hardware (e.g., processing unit 3) and software (e.g., processing operations). Second, consistent with the analysis at [1.1], Pasolini discloses that one of the functions of the processing unit and processing operations is determining the main vertical axis (and thus an orientation) at each new acceleration sample. Thus, Pasolini teaches "a dominant axis logic, to continuously determine an orientation of a device," as recited in the claim. Third, Pasolini teaches dominant axis logic . . . to assign a dominant axis. Consistent with the analysis at [1.2], Pasolini renders obvious the identification and use of the main vertical axis (i.e., the dominant axis) to count a user's steps. Thus, Pasolini renders obvious "dominant axis logic . . . to assign a dominant axis" as recited in the claim. Fourth, Pasolini teaches dominant axis logic . . . to update the dominant axis as the orientation of the device changes. Consistent with the analysis at [1.3], Pasolini's pedometer equipped with the three-axis accelerometer regularly (i.e., at each acquisition of a new acceleration sample) updates

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	the main vertical axis (i.e., the dominant axis) to account for various device orientations. Thus, Pasolini renders obvious "dominant axis logic . . . to update the dominant axis as the orientation of the device changes" as recited in the claim. The above analysis is applicable even if the Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph. To the extent that the term "dominant axis logic" is interpreted to include the example described in block 812 of the '508 Patent for "assigning the dominant axis based on the rolling averages of acceleration" (Ex. 1001, 12:40-44), Pasolini teaches that the hardware of Pasolini calculates the rolling averages by using "the mean value" of the acceleration samples to determine a main vertical axis. Thus, Pasolini's processing unit that identifies the dominant axis at each acceleration sample to account for variations in the orientation of the pedometer renders obvious "a dominant axis logic to continuously determine an orientation of a device, to assign a dominant axis, and to update the dominant axis as the orientation of the device changes."
[11.2] a counting logic to count periodic human motions by monitoring accelerations relative to the dominant axis.	The combination of Pasolini's embodiments renders this limitation obvious. First, as described above at [11.1.1], Pasolini teaches hardware and software for performing the disclosed functions (i.e., logic). Second, consistent with the analysis at [1.4], Pasolini teaches counting steps (i.e., periodic human motions) based on acceleration signal A (i.e., accelerations) taken along the main vertical axis (i.e., the dominant axis). Thus, Pasolini teaches "a counting logic to count periodic human motions by monitoring accelerations relative to the dominant axis" as recited in the claim.

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	The above analysis is applicable even if the Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph. To the extent that the term "a counting logic" is interpreted to include the following example described in the '508 Patent: "measurement data is checked to determine whether an additional step is recognized (block 615). If an additional step is recognized, then it is added to the final or actual step count (block 620)" (Ex. 1001, 11:21-24); Fabio discloses this example. In particular, Pasolini teaches that the "processing unit 3 compares the value of the acceleration signal A . . . with a positive reference threshold $S^{\pm}$ and with a negative reference threshold S^{-}, for identifying, respectively, the positive phase (positive acceleration peak) and the negative phase (negative acceleration peak) of the step." Ex. 1005, 3:34-41. A POSITA would have thus recognized that detecting peaks in the acceleration signal A is "measuring" the acceleration data in the signal. Thus, Pasolini's processing unit that counts steps by detecting accelerations along a main vertical axis showing a positive peak followed by a negative peak teaches "a counting logic to count periodic human motions by monitoring accelerations relative to the dominant axis" as recited in the claim.
Claim 12	
[12.0] The device of claim 11, wherein:	See analysis of claim 11.
[12.1] The counting logic uses acceleration measurements along only the dominant axis to count steps.	Pasolini renders this limitation obvious. First, as described above at [11.1.1], Pasolini teaches a "counting logic." Second, consistent with the analysis at [2.1], Pasolini teaches that "the counting logic uses acceleration measurements along only the dominant axis to count steps" as recited in the claim.

E. Challenge #2: Claims 6-8, 15-16, and 19 are obvious under 35 U.S.C. § 103(a) over Fabio.

66. In my opinion, Fabio renders obvious claims 6-8, 15-16, and 19 of the '508 patent.

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Claim 6	
[6.0] A method of monitoring human activity using an inertial sensor, comprising:	To the extent that the preamble is limiting, Fabio discloses it. First, Fabio teaches a method implemented in a pedometer for detecting the steps of a user: > A method for controlling a pedometer includes the steps of generating a signal correlated to movements of a user of the pedometer; and detecting steps of the user on the basis of the signal. The method moreover envisages the steps of checking whether sequences of detected steps satisfy pre-determined conditions of regularity; updating a total number of valid steps if the conditions of regularity are satisfied; and preventing the updating of the total number of valid steps if the conditions of regularity are not satisfied. Ex. 1006, 1:62-2:3. A POSITA would understand that a user's steps are a form of "human activity." Fabio's pedometer is shown in Figure 1 (below):

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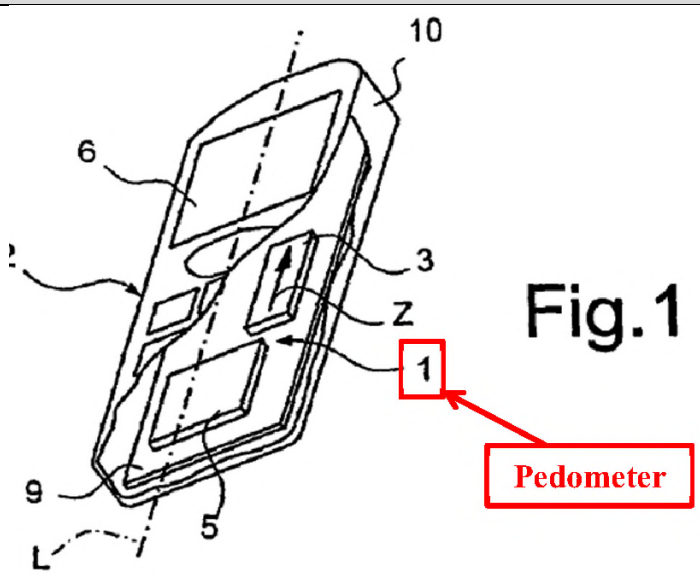
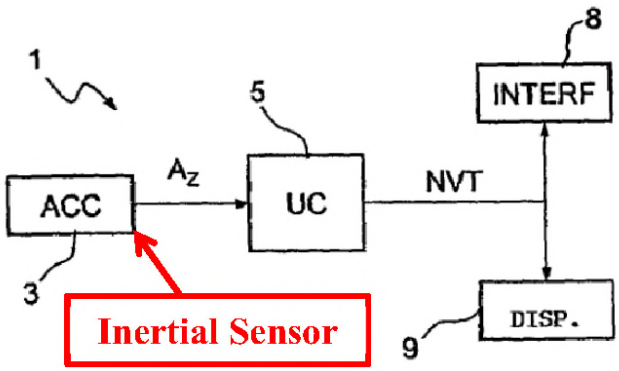
	 Ex. 1006, FIG. 1 (annotated). Second, Fabio teaches that its pedometer includes an inertial sensor that monitors acceleration: > With reference to FIGS. 1 and 2, a pedometer 1 is integrated within a portable electronic device, such as a cell phone 2. The pedometer 1 comprises an inertial sensor 3, a control unit 5, equipped with a nonvolatile-memory module (not illustrated herein), a display 6, and a communication interface 8, all housed on a card 9, which is, in turn, fixed within a casing 10 of the cell phone 2. Ex. 1006, 2:34-52. Fabio's "inertial sensor 3" of the "pedometer 1" is shown in Figure 1 (above) and also in Figure 2 (below):

USP 7,653,508	Fabio
	 Fig.2 Ex. 1006, FIG. 2 (annotated). In Fabio, the accelerometer monitors the user's steps because "inertial sensor 3 supplies at output an acceleration signal A_Z" that the pedometer's "control unit 5 receives and processes . . . for identifying and counting a total number of valid steps N_{VT} made by a user wearing or carrying the pedometer 1." Ex. 1006, 2:49-64. A POSITA would have thus recognized that Fabio's device "monitor[s] human activity" because it uses the acceleration signal from the accelerometer to detect the steps taken by a user. Thus, Fabio's method of detecting a user's steps using an inertial sensor-based pedometer device teaches "[a] method of monitoring human activity using an inertial sensor," as recited in the claim.
[6.1] running a device that includes the inertial sensor in a non-active mode, in which periodic human motions are buffered;	First, as discussed above in [6.0], Fabio teaches that is method is running on a pedometer device that includes an accelerometer (i.e., an inertial sensor).

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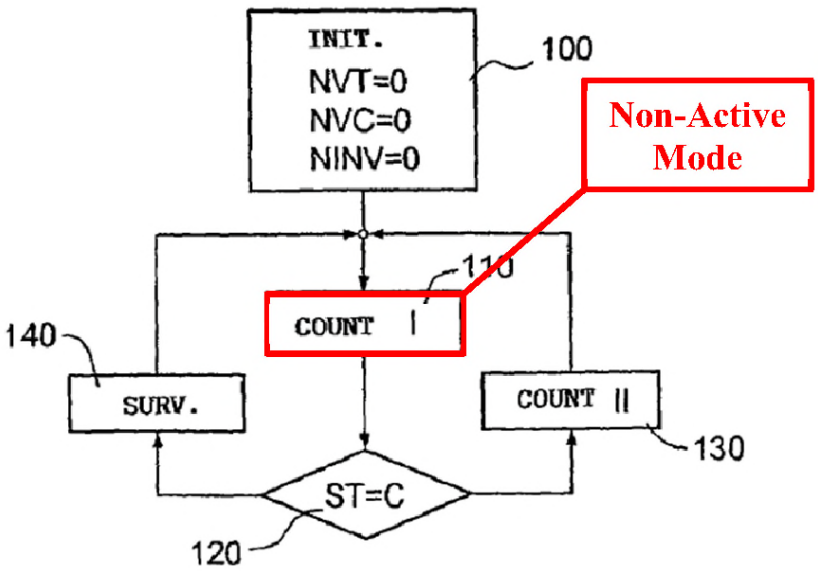
	Second, Fabio discloses that the device runs in a non-active mode.[1] Fabio teaches a counting procedure 110 wherein motion is detected but the steps are buffered, but not counted. Fabio's method, including the counting procedure 110 (i.e., the non-active mode), is shown below in Fig. 3:  Ex. 1006, Fig. 3 (annotated). The counting procedure 110 is a "non-active" mode because it corresponds with when the user is at rest waiting to recognize the wearer's periodic motion:

[1] The specification of the '508 Patent makes clear that it is the *device* rather than the *inertial sensor* that is in the non-active mode: "The exact behavior of the step count buffer 165 depends on which operating mode the electronic device 100 is in . . . operating modes include a non-active mode, in which periodic human motions are buffered." Ex. 1001, 7:21-28.

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	The control unit 5 then executes a first counting procedure (block 110), based upon the sampling of the acceleration signal A_Z at a pre-determined frequency, for example 25 Hz. In this step, **the user is considered at rest and the control unit 5 is considered as waiting to recognize, on the basis of the acceleration signal Az, sequences of events corresponding to a sequence of steps that are close to one another**, which satisfy pre-determined conditions of regularity described in detail hereinafter. When a sequence of steps corresponding to a regular gait of the user is recognized, the first counting procedure is interrupted. Alternatively, the first counting procedure terminates when a time interval TC that has elapsed from the last step recognized is longer than a first time threshold T_{S1}, for example 10 s. On exit from the first calculation procedure, the control unit 5 sets a state flag F_{ST} to a first value C, if a sequence of steps that satisfies the conditions of regularity has been recognized, and to a second value PD, if the first time threshold T_{S1} has been exceeded. Ex. 1006, 3:19-36. Second, Fabio teaches that the steps recognized in the first counting procedure 110 are *buffered* because the first counting procedure tracks the "valid control steps" N_{VC} in step 255 but does not immediately count them (i.e., add them to the total number of valid steps N_{VT}):

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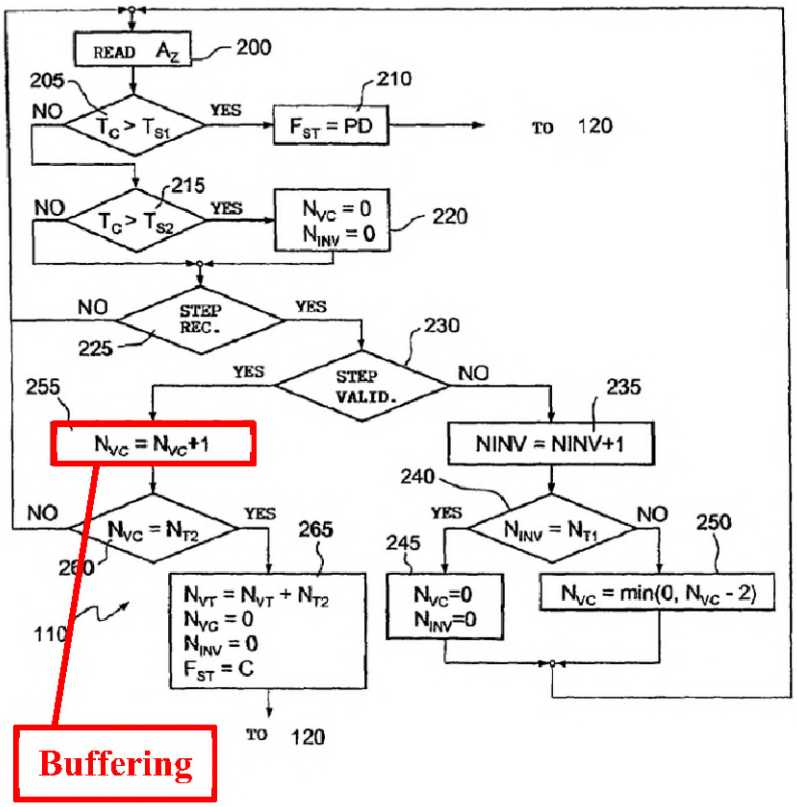

Ex. 1006, Fig. 4 (annotated).

> **If the first validation test of block 230 is passed, the number of valid control steps N_{VC} is incremented by one** (block 255), and then the control unit 5 executes a first test on regularity of the sequence of steps recognized (block 260). The first regularity test is based upon a first condition of regularity and envisages comparing the number of valid control steps N_{VC} with a second programmable threshold number N_{T2} greater than the first threshold number N_{T1} (for example, 8). In practice, the first condition of regularity is satisfied when there is a significant prevalence of steps spaced in a substantially uniform way, at the most interrupted sporadically by a number of irregular steps smaller than the first threshold

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	number N_{T1}. If the number of valid control steps N_{VC} is smaller than the second threshold number N_{T2} (output NO from block 260), the first condition of regularity is not satisfied, and the first regularity test indicates that there has not yet been identified a sequence of steps corresponding to a sufficiently regular gait, and hence the control unit 5 acquires once again a new sample of the acceleration signal A_Z (block 200), without the total number of valid steps N_{VT} being incremented. Otherwise (output YES from block 260), a sequence of steps is recognized that satisfies the first condition of regularity, and the first regularity test is passed. The number of invalid steps N_{INV} and the number of valid control steps N_{VC} are set to zero, whereas the total number of valid steps N_{VT} is updated and incremented by a value equal to the second threshold number N_{T2} (block 265). Furthermore, the state flag F_{ST} is set at the count value, and the first counting procedure is terminated. In this case, after the test on the state flag of block 120 of FIG. 3, the second counting procedure is executed (block 130). Ex. 1006, 5:10-39. Fabio teaches that these valid control steps N_{VC} are *buffered* because they are not counted (i.e., added to the total step count) until it is determined that the user is actually engaging in periodic human motion, e.g., walking (step 260). Only then are the valid control steps N_{VC} counted by adding them to the total number of valid steps N_{VT}. In practice, the first counting procedure enables the pedometer 1 to remain waiting

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	for a sequence of events corresponding to a sequence of steps that satisfies the first condition of regularity. **The regularity of the gait is considered sufficient when the number of valid control steps N_{VC} reaches the second threshold number N_{T2}**. The events considered irregular or a waiting time that is too long between two successive steps cause the decrement (block 250) or the zeroing (blocks 220 and 245) of the number of valid control steps N_{VC}, so that the first counting procedure resumes from the start. As long as the pedometer 1 is in the waiting condition, the total number of valid steps N_{VT} is not incremented because the user is still considered as at rest. However, when the first regularity test (block 260) is passed, **the total number of valid steps N_{VT} is immediately updated so as to take into account the valid steps** (equal to N_{T2}) that make up the sequence considered as being regular. Isolated events and sequence of steps that are in any case too short are thus advantageously ignored, whereas counting of the steps promptly resumes also in the case of isolated irregularities (for example, due to a non-homogeneous acceleration or to a loss of balance at the start of locomotion). Ex. 1006, 5:40-61. Because the valid control steps N_{VC} are added to the total number of valid steps N_{VT} when the first counting procedure determines that the gait of a use is regular, the valid control steps N_{VC} are *buffered* until the first counting procedure makes the determination. Fabio's Fig. 4, reproduced below, shows the first counting procedure in more detail:

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	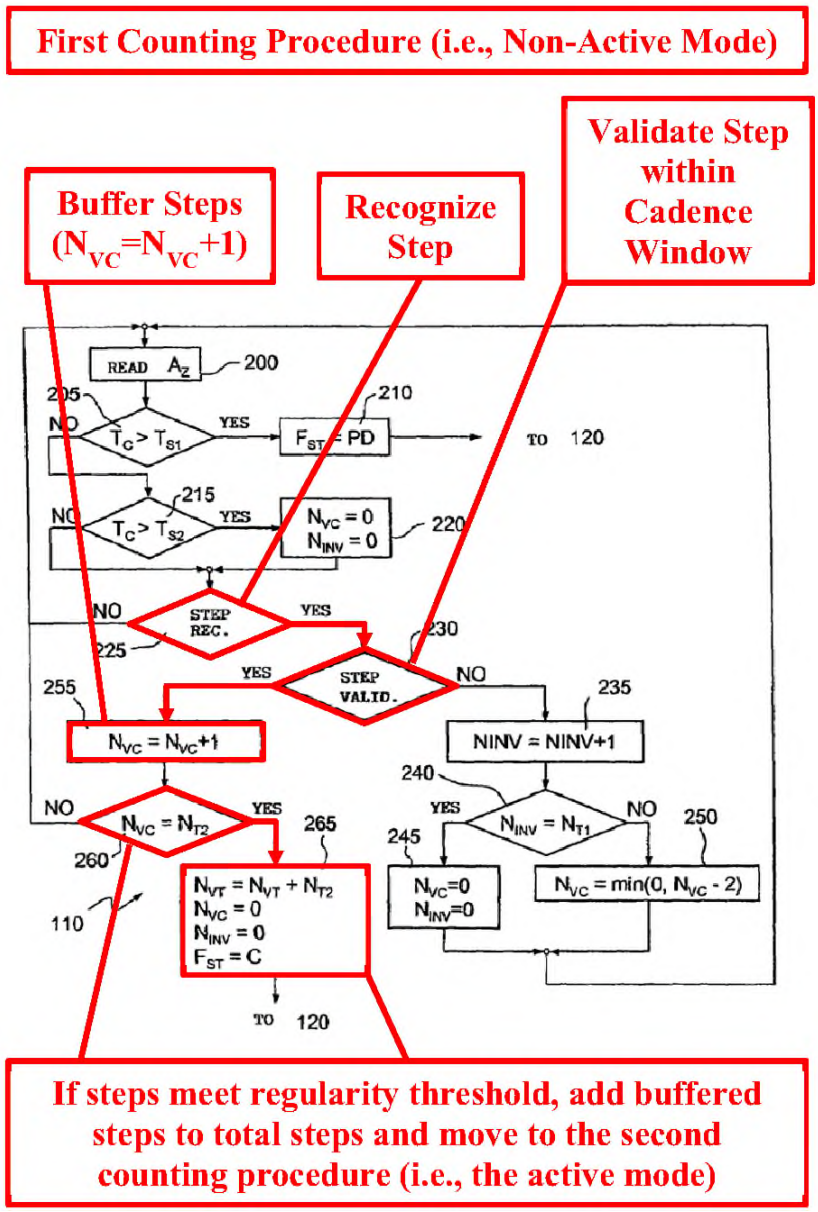 Ex. 1006, Fig. 4 (annotated). Accordingly, Fabio teaches that the valid control steps N_{VC}—that are maintained during the counting procedure 110—are buffered because they are not counted (i.e., added to the total step count) until they are validated, which indicates that they meet a threshold of regularity. Fabio also discloses that while in non-active mode, "the user is considered at rest." Ex. 1006, 3:19-27

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	Thus, Fabio's first counting procedure that maintains a number of steps without updating the total step count until a condition of regularity has been met teaches "running a device that includes the inertial sensor in a non-active mode, in which periodic human motions are buffered" as recited in the claim.
[6.2] switching the device from the non-active mode to an active mode, after identifying a number of periodic human motions within appropriate cadence windows	Fabio discloses this limitation because it teaches switching the pedometer from the first counting procedure 110 (e.g., a non-active mode) to a second counting procedure 130 (e.g., an active mode) after a condition of stepping regularity has been met. The condition of regularity is determined based on the detected steps falling within a validation interval TV (i.e., a cadence window). First, as described in section [6.1], Fabio teaches operating in a *non-active mode*. Second, Pasolini first teaches that its pedometer device switches from the first counting procedure 110 (e.g., the non-active mode as discussed in [6.1]) to the second counting procedure 130 (e.g., the active mode) after identifying a recognized sequence of steps: "[a]t the end of the first counting procedure, the control unit 5 checks whether the state flag F_{ST} has been set at the first value C (block 120), i.e., whether a sequence of steps has been recognized. **If so (output YES from block 120), a second counting procedure is executed (block 130)**." Ex. 1006, 3:37-49. The switching between the first counting procedure and the second counting procedure based on a valid step count is shown below in reference to Fig. 3:

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	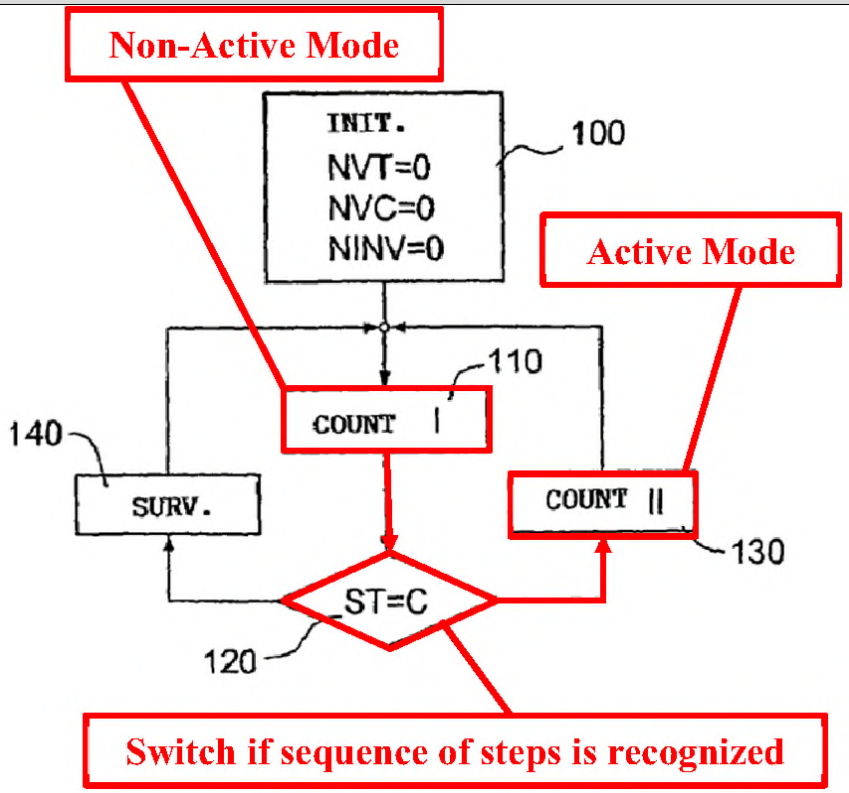 Ex. 1006, Fig. 3 (annotated). Fabio's second counting procedure 130 is an "active mode" because, unlike the non-active mode that buffers steps, each step recognized and validated in this mode is added to the total step count N_{VT}. > At the end of the first counting procedure, the control unit 5 checks whether the state flag F_{ST} has been set at the first value C (block 120), i.e., whether a sequence of steps has been recognized. If so (output YES from block 120), **a second counting procedure is executed (block 130). The user is considered to be moving, and a first counter, hereinafter referred to as total number of valid steps N_{VT} is incremented whenever an event corresponding to a step is recognized**. Furthermore, the control unit 5 checks the regularity of the sequences of

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	steps, as explained hereinafter, and, when an interruption in the locomotion is detected, the second counting procedure is terminated, and execution of the first counting procedure resumes (block 110). Ex. 1006, 3:37-49. **At the end of the first counting procedure, the control unit 5 checks whether the state flat F_{ST}, has been set at the first value C (block 120), i.e., whether a sequence of steps has been recognized. If so (output YES from block 120), a second counting procedure is executed (block 130)**. The user is considered to be moving, and a first counter, hereinafter referred to as total number of valid steps N_{VT}, is incremented whenever an event corresponding to a step is recognized. Furthermore, the control unit 5 checks the regularity of the sequences of steps, as explained hereinafter, and, when an interruption in the locomotion is detected, the second counting procedure is terminated, and execution of the first counting procedure resumes (block 110). Ex. 1006, 3:37-49. A POSITA would thus understand that second counting procedure to be an "active mode." Third, Fabio teaches switching between the non-active mode and the active mode after a sequence of steps are recognized within a validation interval (i.e., a cadence window: If the control unit 5 does not recognize an event corresponding to a step (output NO from block 225), a new sample of the acceleration signal AZ is read (block 200).

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	If, instead, the step-recognition test is passed (output YES from block 225), the control unit 5 executes a first validation test, corresponding to the regularity of the individual step (block 230). With reference also to FIG. 6, the validation occurs when the duration ΔTK of a current step K is substantially homogeneous with respect to the duration ΔTK-1 of an immediately preceding step K-1 (the duration of a generic step is determined by the time that has elapsed between an instant of recognition of the step of which the duration is evaluated and an instant of recognition of the step that immediately precedes it). More precisely, the last step recognized is validated if the instant of recognition of the current step TR(K) falls within a **validation interval TV**, defined with respect to the instant of recognition of the immediately preceding step TR(K-1), in the following way: $TV=[T_R(K\text{-}1)+\Delta T_{K-1}-TA, T_R(K\text{-}1)+\Delta T_{K-1}+TB]$ where TA and TB are complementary portions of the validation interval TV. In the embodiment of the invention described herein, the complementary portions TA, TB are defined as follows, for the generic current step K: $TA=\Delta T_{K-1}/2$ $TB=\Delta T_{K-1}$ Ex. 1006, 4:12-29.

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	Because a validation interval is used for each step, multiple steps involve multiple validation intervals (cadence windows). Fabio's validation window is a *cadence window* because a step taken by a user, step K, is validated when the instant of recognition of the step $T_R(K)$ falls within a validation interval TV: > With reference also to FIG. 6, **the validation occurs when the duration ΔT_K of a current step K** is substantially homogeneous with respect to the duration ΔT_{K-1} of an immediately preceding step K-1 (the duration of a generic step is determined by the time that has elapsed between an instant of recognition of the step of which the duration is evaluated and an instant of recognition of the step that immediately precedes it). More precisely, **the last step recognized is validated if the instant of recognition of the current step $T_R(K)$ falls within a validation interval T_V**. Ex. 1006, 4:28-37. In Figure 6 (below), Fabio shows a time-based representation of how its system validates whether a step occurred within a validation interval TV (i.e., a cadence window):

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	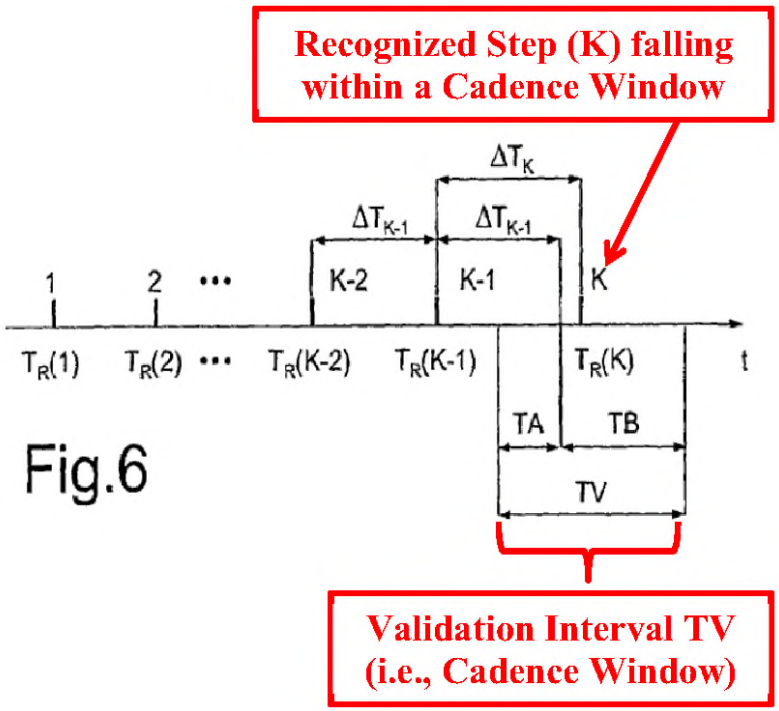 Ex. 1006, FIG. 6 (annotated). Fabio explains that each step is validated based on that step's appropriate cadence window in that the validation interval TV for each step is "defined with respect to the instant recognition of the immediately preceding step T_R(K-1)." Ex. 1006, 4:37-39. In other words, in Fabio, a step is validated "**when the duration ΔT_K of a current step K is substantially homogenous with respect to the duration of ΔT_{K-1} of an immediately preceding step K-1**. Ex. 1006, 4:28-31. Thus, Fabio teaches identifying whether each step falls within an appropriate cadence window since the appropriate cadence window for each step (K) is defined as a window of time based on the immediately preceding step (K-1). Fabio's teachings regarding its validation window are consistent with the '508 patent's descriptions of its cadence window. For example, the '508 patent describes that "[a] cadence window is a window of time since a last step was counted that is looked at to detect a new step."

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	Ex. 1001, 3:67-4:3. Similarly, A POSITA would thus recognize that the '508 patent's "cadence window" and Fabio's "validation interval" are both defined with respect to the time that an immediately preceding step was recognized. Thus, a POSITA would understand that the "validation interval" in Fabio discloses the recited "cadence window." Accordingly, Fabio's teaching of recognizing each step with its particular validation interval teaches "identifying a number of periodic human motions within appropriate cadence windows." Thus, Fabio's switching from the first counting procedure 110 to the second counting procedure 130 after detecting a number of steps within validation intervals teaches "switching the device from the non-active mode to an active mode, after identifying a number of periodic human motions within appropriate cadence windows" as recited in the claim.
[6.3] during the active mode, counting each of the periodic human motions to enable the monitoring of human activity.	Fabio discloses this limitation. First, as described in section [6.2], the second counting procedure 130 in Fabio is an active mode where each step is counted as it is validated. Second, Fabio teaches that while operating in the second counting procedure, each validated step (i.e., in a cadence window) is added to the total step count. > If the control unit 5 does not recognize an event corresponding to a step (output NO from block 315), a new sample of the acceleration signal A_Z is read (block 300). If, instead, the step-recognition test is passed (output YES from block 315), a second validation test is made, corresponding to the regularity of the individual step (block 320). The second validation test is altogether similar to the first validation test carried out in block 230 of FIG. 3. Also in this case, then, the last step recognized is validated if

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	the instant of recognition of the current step $T_{C(K)}$ falls within the validation interval T_V defined above. In practice, it is verified that the last step recognized is compatible with the frequency of the last steps made previously. **If the check yields a positive result (output YES from block 320), the control unit 5 updates the total number of valid steps N_{VT}** and the number of valid control steps N_{VC}, incrementing them by one (block 325). The number of valid control steps N_{VC} is then compared with a third programmable threshold number N_{T3} (block 330), which, in the embodiment described herein, is equal to the second threshold number N_{T2}. If the number of valid control steps N_{VC} is smaller than the second threshold number N_{T2} (output NO from block 330), the control unit 5 once again directly acquires a new sample of the acceleration signal A_Z (block 300), whereas otherwise (output YES from block 330), the number of invalid steps N_{INV} and the number of valid control steps N_{VC} are set to zero (block 335) prior to acquisition of a new sample A_Z. Ex. 1006, 6:27-53. Additionally, Fabio teaches: At the end of the first counting procedure, the control unit 5 checks whether the state flag F_{ST} has been set at the first value C (block 120), i.e., whether a sequence of steps has been recognized. If so (output YES from block 120), a second counting procedure is executed (block 130). **The user is considered to be moving**, and a first

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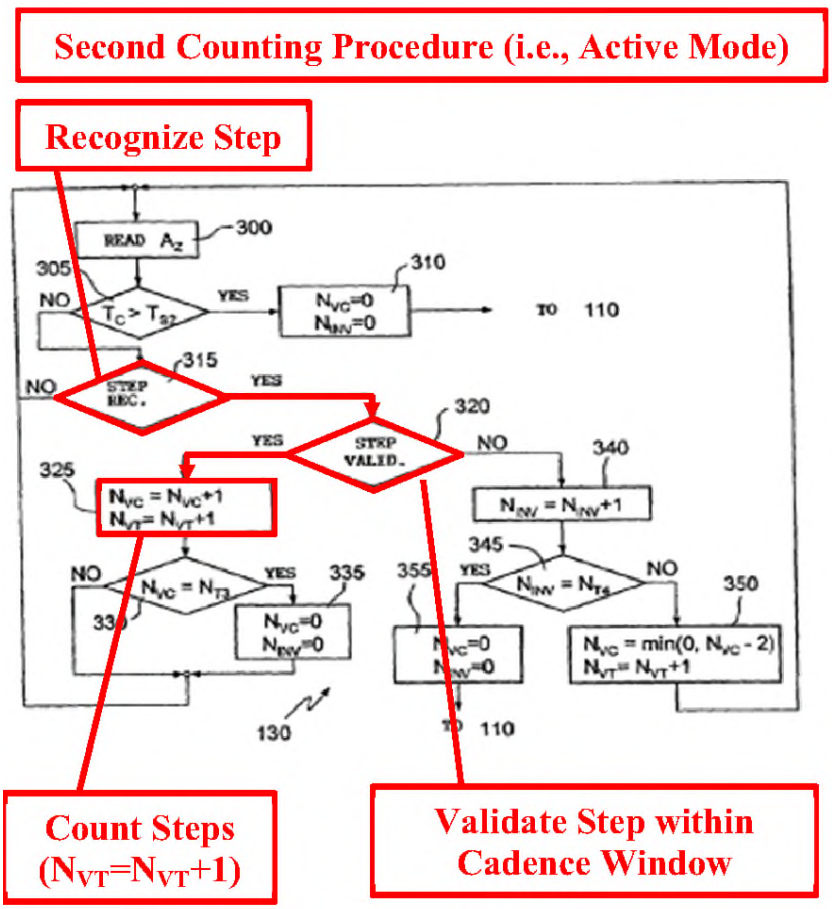
	counter, hereinafter referred to **as total number of valid steps N_{VT}, is incremented whenever an event corresponding to a step is recognized**. Furthermore, the control unit 5 checks the regularity of the sequences of steps, as explained hereinafter, and, when an interruption in the locomotion is detected, the second counting procedure is terminated, and execution of the first counting procedure resumes (block 110). Ex. 1006, 3:37-49. A flowchart in "FIG. 7 illustrates in detail the second counting procedure," and shows that each step is counted. Ex. 1005, 6:12-13. 

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	Ex. 1006, Fig. 7 (annotated). Because the second counting procedure counts the valid steps (the periodic human motions) the second counting procedure monitors human activity when, for example, the user is running or walking. > As is known, a **pedometer is a device that can be carried by a user and has the function of counting the number of steps during various walking or running activities** for estimating accordingly the distance traveled. Ex. 1006, 1:14-21. Because walking and running are periodic human motions, detecting steps while running and walking is monitoring periodic human motions. Accordingly, a POSITA would have understood that when Pasolini's pedometer counts steps, it is monitoring human activity. Fourth, Fabio's device enables the monitoring of human activity because "**the function of counting the number of steps during various walking or running activities**" is, for example, "**for estimating accordingly the distance traveled**." Ex. 1006, 1:14-17. Thus, Fabio's pedometer that counts steps while in the second counting procedure teaches "during the active mode, counting each of the periodic human motions to enable the monitoring of human activity" as recited in the claim.
Claim 7	
[7.0] The method of claim 6, further comprising:	See analysis of claim 6.
[7.1] switching the device from the active mode to the	Fabio discloses this limitation because it teaches switching from the second counting procedure (*active*

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non-active mode when a number of expected periodic human motions are not identified in the appropriate cadence windows.	*mode*) to the first counting procedure (*non-active mode*) when an interruption in locomotion occurs. First, as above in [6.0], Fabio teaches a pedometer, which is the *device*. Second, Fabio teaches an "active mode" in that its pedometer implements "a second counting procedure [that] is executed" when "the user is considered to be moving." Fabio, 3:37-44. Fabio also discloses a "non-active mode" in that its pedometer "executes a first counting procedure" when "the user is considered at rest." Ex. 1006, 3:19-27. Fabio teaches that the control unit 5 of the pedometer *switches* from the second counting procedure to the first counting procedure when an interruption occurs: > At the end of the first counting procedure, the control unit 5 checks whether the state flag F_{ST} has been set at the first value C (block 120), i.e., whether a sequence of steps has been recognized. If so (output YES from block 120), a second counting procedure is executed (block 130). The user is considered to be moving, and a first counter, hereinafter referred to as total number of valid steps N_{VT}, is incremented whenever an event corresponding to a step is recognized. Furthermore, **the control unit 5 checks the regularity of the sequences of steps, as explained hereinafter, and, when an interruption in the locomotion is detected, the second counting procedure is terminated, and execution of the first counting procedure resumes** (block 110). Ex. 1006, 3:37-49. In Fabio, the interruption occurs when a certain number of steps (N_{INV}) are not identified within validation intervals.

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	If the control unit 5 does not recognize an event corresponding to a step (output NO from block 315), a new sample of the acceleration signal A_Z is read (block 300). If, instead, the step-recognition test is passed (output YES from block 315), a second validation test is made, corresponding to the regularity of the individual step (block 320). The second validation test is altogether similar to the first validation test carried out in block 230 of FIG. 3. **Also in this case, then, the last step recognized is validated if the instant of recognition of the current step $T_{C(K)}$ falls within the validation interval T_V defined above. In practice, it is verified that the last step recognized is compatible with the frequency of the last steps made previously**. If the check yields a positive result (output YES from block 320), the control unit 5 updates the total number of valid steps N_{VT} and the number of valid control steps N_{VC}, incrementing them by one (block 325). The number of valid control steps N_{VC} is then compared with a third programmable threshold number N_{T3} (block 330), which, in the embodiment described herein, is equal to the second threshold number N_{T2}. If the number of valid control steps N_{VC} is smaller than the second threshold number N_{T2} (output NO from block 330), the control unit 5 once again directly acquires a new sample of the acceleration signal A_Z (block 300), whereas otherwise (output YES from block 330), the number of invalid steps N_{INV} and the number of valid control steps N_{VC} are set

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	to zero (block 335) prior to acquisition of a new sample A_Z. **If, instead, the second validation test of block 320 is negative, the number of invalid steps N_{INV} is incremented by one (block 340)** before being compared with a fourth programmable threshold number N_{T4} (block 345), which, in the present embodiment, is equal to the first threshold number N_{T1}. If the number of invalid steps N_{INV} is smaller than the fourth threshold number N_{T4} (output NO from block 345), the number of valid control steps N_{VC} is decremented (block 350), here by two. Also in this case, if the result of the decrement operation is negative, the number of valid control steps N_{VC} is set to zero (the updated value of the number of valid control steps N_{VC} is equal to the smaller between zero and the previous value of the number of valid control steps N_{VC}, decreased by two). Then, the control unit 5 reads a new sample of the acceleration signal A_Z (block 300). **If the number of invalid steps N_{INV} has reached the fourth threshold number N_{T4} (output YES from block 345), the number of invalid steps N_{INV} and the number of valid control steps N_{VC} are set to zero (block 355), and the second counting procedure is terminated**. **In practice, the second counting procedure is based on a second condition of regularity, which is satisfied as long as sporadic irregular steps occur within sequences of steps spaced in a substantially homogeneous way**. More precisely, the second condition of regularity

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	is satisfied as long as the number of invalid steps N_{INV} is smaller than the fourth threshold number N_{T4}. Consequently, **the second counting procedure continues to update and increment the total number of valid steps N_{VT} as long as the gait of the user is kept regular**. Possible isolated irregularities are ignored and do not interrupt or suspend updating of the count, which is, instead, interrupted when prolonged pauses occur or in the presence of significant discontinuities in locomotion. However, if the gait becomes regular again, even with a different rhythm, also the count promptly resumes, because the first counting procedure is once again executed. This prevents a significant number of steps from being neglected. Ex. 1006, 6:14-7:23. As a result, Fabio discloses switching from the active mode to the non-active mode because the second counting procedure (active mode) is terminated and execution of the first counting procedure (non-active mode) resumes. This switch happens when steps are not detecting within validation intervals (cadence windows). Thus, Fabio's switching the pedometer from the second counting mode to the first counting mode when a number of steps are not identified in the appropriate validation intervals TV teaches "switching the device from the active mode to the non-active mode when a number of expected periodic human motions are not identified in the appropriate cadence windows" as recited in the claim.

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Claim 8	
[8.0] The method of claim 6, further comprising:	See analysis of claim 6.
[8.1] switching from a sleep mode to the non- active mode of operation when an acceleration is detected.	Fabio discloses this limitation because it teaches a surveying procedure (i.e., a *sleep mode*) in which the pedometer is placed in a low-power state that includes a lower sampling rate: When the surveying procedure is started, a current mean value A_{ZM} of the acceleration signal A_Z is stored in the nonvolatile-memory module (not illustrated) of the control unit 5 (block 400). The current mean value A_{ZM} represents an estimate of the DC component of the acceleration signal A_Z, which, when the cell phone 2 containing the pedometer 1 is stationary, is determined substantially by the contribution of the acceleration of gravity along the detection axis Z. In practice, then, the current mean value A_{ZM} provides an estimate of the position of the cell phone 2 and of the pedometer 1. After storage of the current mean value A_{ZM}, the pedometer 1 is set in a low-consumption operating condition (power-down condition), in which at least the inertial sensor 3 is inactive (block 410). **A waiting cycle is then carried out (block 420), for example of the duration of 10 s**, after which all the functions of the pedometer 1 are re-activated ("power on", block 430). The control unit 5 acquires from the inertial sensor 3 a number of samples of the acceleration signal A_Z sufficient for

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	estimating an updated mean value A_{ZM} (block 440), which is then compared with the current mean value A_{ZM} previously stored (block 450). Ex. 1006, 7:27-50. Fabio further teaches that the surveying procedure (sleep mode) terminates and then starts execution of the first counting procedure (non-active mode) when accelerations are detected. If, instead, the state flag F_{ST} has the second value PD, the pedometer 1 is set in a low-consumption wait state ("power down" state), and the control unit 5 executes a surveying procedure (block 140). The surveying procedure terminates when a variation of the d.c. component of the acceleration signal A_Z is detected, i.e., when the cell phone 2 that includes the pedometer 1 is moved. **The control unit 5 then returns to execution of the first calculation procedure (block 110)**. Ex. 1006, 3:50-57. The '508 patent similarly describes its sleep mode as executing "a low sampling rate" in order to "reduce[] power consumption and prolongs battery life." Ex. 1001, 8:66-67. In the '508 patent's sleep mode, "the sampling function may be executed every ten seconds . . . ." Ex. 1001, 9:12-13. Thus, a POSITA would recognize that the surveying procedure in Fabio is a sleep mode as described in the '508 patent because it also samples at a reduced rate. Fabio's surveying procedure is described as follows: The **surveying procedure terminates** when a variation of the d.c. component of the

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	acceleration signal A_Z is detected, i.e., when the cell phone 2 that includes the pedometer 1 is moved. **The control unit 5 then returns to execution of the first calculation procedure (block 110)**. Ex. 1006, 3:54-57. Accordingly, the surveying procedure (i.e., the sleep mode) terminates and then starts execution of the first counting procedure (i.e., the non-active mode) when a variation in acceleration (e.g., a variation in the d.c. component) is detected. Thus, Fabio's terminating the surveying procedure and entering the first counting procedure when acceleration is detected teaches "switching from a sleep mode to the non-active mode of operation when an acceleration is detected."
Claim 15	
[15.0] A device including an inertial sensor, comprising:	To the extent that the preamble is limiting, Fabio discloses it. Fabio teaches a pedometer device that "generat[es] a signal correlated to movements of a user of the pedometer" and "**detect[s] steps of the user** based on the signal." Ex. 1006, 1:62-2:3. To generate the signal, Fabio's device includes an inertial sensor: With reference to FIGS. 1 and 2, **a pedometer 1 is integrated within a portable electronic device**, such as a cell phone 2. **The pedometer 1 comprises an inertial sensor 3**, a control unit 5, equipped with a nonvolatile-memory module (not illustrated herein), a display 6, and a communication interface 8, all housed on a

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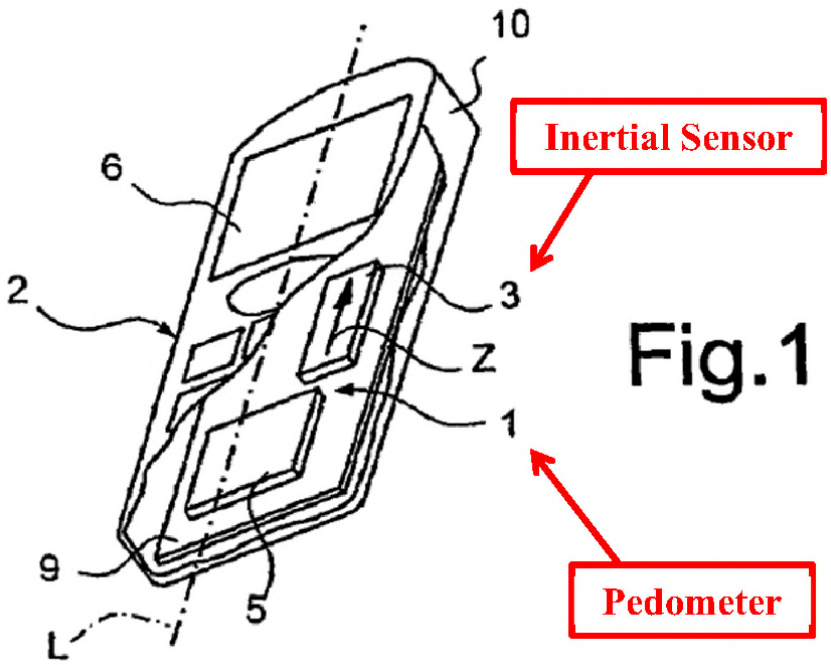
	card 9, which is, in turn, fixed within a casing 10 of the cell phone 2. Ex. 1006, 2:34-52. Fabio's pedometer, including an inertial sensor, is shown In Figure 1 (below):  Ex. 1006, FIG. 1 (annotated). Thus, Pasolini's pedometer with an "[a] device including an inertial sensor" claim.
[15.1] a counting logic, to identify and count periodic human motions.	As discussed above in [6.1] and [6.2], Fabio discloses identifying and counting steps (i.e., periodic human motions) in both a non-active mode (where steps are buffered) and an active mode (where steps are added to the total step count). In particular, as previously discussed, Fabio teaches "a pedometer device for detecting and **counting steps** of a user on foot," where "an **accelerometer sensor** detects a vertical acceleration generated during the step." Ex. 1006, Abstract. As also discussed above in [6.1] and [6.2], Fabio teaches that the identifying and counting of steps is performed by

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	a control unit (i.e., logic): "**The control unit 5** receives and processes the acceleration signal A_Z as explained in detail hereinafter for **identifying and counting a total number of valid steps N_{VT} made by a user wearing or carrying the pedometer 1**." Ex. 1006, 2:60-3:2. Accordingly, a POSITA would have understood Fabio's control unit 5 to execute machine readable instructions to perform various functions, such as detecting and counting steps. Such hardware (control unit 5) and software (instructions that are executed by the control unit 5) would have been considered "logic" as used in the claim. The above analysis is applicable even if the Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph. To the extent that the term "a counting logic" is interpreted to include the following example described in the '508 patent: "measurement data is checked to determine whether an additional step is recognized (block 615). If an additional step is recognized, then it is added to the final or actual step count (block 620)" (Ex. 1001, 11:25-28); Fabio discloses this example. In particular, Fabio teaches that its control unit performs step recognition in step 315 "based upon the detection of a positive peak of the acceleration signal A_Z followed by a negative peak" and that "the control unit 5 updates the total number of valid steps N_{VT} and the number of valid control steps N_{VC}, incrementing them by one." *See* Ex. 1006, 6:23-26, 6:40-43. A POSITA would have thus recognized that detecting peaks in the acceleration signal A_Z is "measuring" the acceleration data in the signal. Thus, Fabio's control unit that identifies and counts steps by detecting accelerations along a vertical axis showing a positive peak followed by a negative peak within a validation interval teaches "a counting logic, to identify and count periodic human motions" as recited in the claim.

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[15.2] a mode logic, to switch the device from a non-active mode to an active mode after a number of periodic human motions are detected within appropriate cadence windows by the counting logic; and	Fabio discloses this limitation. First, as discussed in [6.2], Fabio teaches the pedometer switching from a non-active mode to an active mode after identifying a number of periodic human motions with appropriate cadence windows. Second, Fabio teaches that its various functions are performed by a control unit 5. A POSITA would have understood that Fabio's control unit would execute machine readable instructions to perform various functions, such as detecting and counting steps. Such hardware (control unit 5) and software (instructions that are executed by the control unit 5) would have been considered "logic" as used in the claim. Thus, Fabio's control unit 5 that switches from the first counting procedure 110 to the second counting procedure 130 after detecting a number of steps within validation intervals teaches "a mode logic, to switch the device from a non-active mode to an active mode after a number of periodic human motions are detected within appropriate cadence windows by the counting logic" as recited in the claim. The above analysis is applicable even if the Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph. To the extent that the term "a mode logic" is interpreted to include the following example described in the '508 patent: "When the number of steps in the buffered step count reaches N, the buffered steps are added to an actual or final step count, and a stepping mode is entered into (block 584)" (Ex. 1001, 10:67-11:3); Fabio discloses this example. In particular, Fabio teaches that its control unit performs switches from the first to the second counting procedure after "a sequence of steps is recognized that satisfies the first condition of regularity" by incrementing "the total number of valid steps N . . . by a value equal to the second

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	threshold number N (block 265)" and executing "the second counting procedure." Ex. 1006, 5:32-39. Thus, Fabio's control unit that switches from a first counting procedure to a second counting procedure based on steps detecting within their appropriate cadence windows teaches "a mode logic, to switch the device from a non-active mode to an active mode after a number of periodic human motions are detected within appropriate cadence windows by the counting logic" as recited in the claim.
[15.3] a buffer, to buffer periodic human motions when the device is in the non- active mode.	First, as discussed in [6.1], Fabio teaches running a pedometer in a non-active mode that buffers counted steps in an N_{VC} value until a threshold is reaches, whereby the steps are then added to a total step count value N_{VT}. Second, a POSITA would find it obvious that the N_{VC} value is a buffer since it is used to store a count of these detected motions while in a non-active mode. Accordingly, Fabio's N_{VC} value that counts steps during a non-active mode but does not add them to the total step count until a threshold is reached teaches "a buffer, to buffer periodic human motions when the device is in the non-active mode" as recited in the claim.
Claim 16	
[16.0] The device of claim 15, wherein:	See analysis of claim 15.
[16.1] the mode logic to switch the device from the active mode to the non-active mode when a number of expected periodic human motions are not identified in the appropriate cadence windows.	Fabio discloses this limitation. First, as discussed in [7.1], Fabio teaches that its pedometer terminates a second counting procedure (i.e., an active mode) and returns to a first counting procedure (a non-active mode) when a number of recognized steps (i.e., periodic human motions) are not identified in the appropriate cadence windows. Second, Fabio teaches that the various functions of its pedometer are performed by a control unit 5. *See, e.g.*,

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	Ex. 1006, 3:37-49. A POSITA would have understood that Fabio's control unit would execute machine readable instructions to perform various functions, such as detecting and counting steps. Such hardware (control unit 5) and software (instructions that are executed by the control unit 5) would have been considered "logic" as used in the claim. Thus, Fabio's control unit that terminates the second counting procedure (active mode) and returns to the first counting procedure (active mode) after not detecting steps within validation intervals teaches "the mode logic to switch the device from the active mode to the non-active mode when a number of expected periodic human motions are not identified in the appropriate cadence windows" as recited in the claim. The above analysis is applicable even if the Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph. To the extent that the term "the mode logic" in this claim includes the following example described in the '508 patent: "If the cadence window has elapsed, then an expected step was not counted, and an exit mode is initiated" (Ex. 1001, 10:67-11:3); Fabio discloses this example. In particular, Fabio teaches that its control unit determines whether a "number of invalid steps N_{INV} has reached" a threshold and terminates "the second counting procedure" to then return to the first counting procedure. Ex. 1006, 7:1-6, Fig. 3. Thus, Fabio's control unit that switches from a second counting procedure to a first counting procedure based on detecting a number of invalid steps (i.e., motions not within appropriate cadence windows) teaches "the mode logic to switch the device from the active mode to the non-active mode when a number of expected periodic human motions are not identified in the appropriate cadence windows" as recited in the claim.

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Claim 19	
[19.0] The device of claim 15, further comprising:	See analysis of claim 15.
[19.1] a cadence logic, to set the appropriate cadence windows.	Fabio discloses this limitation. First, as discussed in [6.2], Fabio teaches determining appropriate cadence windows for each step because the validation interval TV (i.e., the cadence window) is "defined with respect to the instant recognition of the immediately preceding step T_R(K-1)." Ex. 1006, 4:37-39. Second, Fabio discloses that the of setting the validation interval at each step is performed by its control unit (i.e., a cadence logic): "the control unit 5 executes a first validation test" that is performed as described in [6.2]; *see also* Ex. 1006, 4:22-40. A POSITA would have understood that the hardware (control unit) and software (instructions executed by the control unit) are "logic" as used in the claim. The above analysis is applicable even if the Patent Owner overcomes the presumption against construction under 35 U.S.C. § 112, sixth paragraph. To the extent that the term "a cadence logic" is interpreted to include the following example described in the '508 Patent: "a new cadence window is set (block 574) based on a stepping cadence of the M steps measured." (Ex. 1001, 10:57-58); Fabio discloses this example. In particular, Fabio describes that its formula for defining the validation interval (i.e., the cadence window) is based on both the "duration ΔT_{K-1} of an immediately preceding step K-1" as well as "the instant of recognition of the immediately preceding step T_R(K-1)." Ex. 1006, 4:28-41. A POSITA reading this formula would have thus understood that Fabio's validation interval (i.e., that cadence window) is similarly based on the cadence of measured steps. Thus, Fabio's control unit 5 that defines the validation interval TV for each step based on timing and duration of

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	previous steps teaches "a cadence logic, to set the appropriate cadence windows" as recited in the claim.

F. Challenge #3: Claims 3-4, 13-14, and 20 are unpatentable under 35 U.S.C. § 103 over Pasolini in view of Fabio.

1. Reasons to Combine Pasolini and Fabio

67. As described above, Pasolini discloses a pedometer device with various features. Specifically, Pasolini's pedometer regularly determines which axis is most aligned with gravity as the device rotates. Pasolini's pedometer uses that axis to count steps. Pasolini's pedometer further has adapting thresholds for step detection.

68. Also, as described above, Fabio describes a pedometer device with various features. Specifically, Fabio's pedometer uses different counting modes to more accurately detect and count steps. Fabio's pedometer has other features that are similar to those of Pasolini. For example, Fabio's device also detects which axis of three axes is most aligned with gravity and uses that axis for step detection. *See* Ex. 1006, 8:21-34.

69. It would have been obvious for a POSITA to combine Pasolini and Fabio because, as described below, the combination is merely a use of a known technique to improve a similar device, method, or product in the same way.

70. A POSITA would have recognized that Pasolini and Fabio describe similar pedometer devices. For example, the pedometers described in Pasolini and Fabio are both implemented in portable electronic devices, such as mobile phones, and include similar components for step detection, such as accelerometers with multiple axes of detection. Pasolini and Fabio are in the same field of endeavor as both patents describe the problem that errors in step recognition cause for step counting, and are directed to solving this problem. Both Pasolini and Fabio teach addressing the problem, at least in part, by selecting the acceleration signal from the vertical detection axis (the axis that is most influenced by gravity) and sampling the acceleration signal to recognize steps by identifying positive and negative acceleration peaks.

71. A POSITA would have recognized that as Pasolini's device is counting steps, it only counts those acceleration peaks that exceed a threshold, not all detected accelerations. For example, as the user stops moving and then later continues moving, or makes other non-periodic motions, the accelerometer will detect peaks that do not correspond to steps taken by the user. A POSITA would have understood that in order to identify acceleration peaks as steps, a pattern of regularity should be determined.

72. Fabio explicitly addresses this problem by describing a first counting procedure that "enables the pedometer 1 to remain waiting for a sequence of events

corresponding to a sequence of steps that satisfies the first condition of regularity." Ex. 1006, 5:40-44. A POSITA would have recognized that by implementing the techniques associated with Fabio's regularity test, "[i]solated events and sequence of steps that are in any case too short are thus advantageously ignored, whereas counting of the steps promptly resumes also in the case of isolated irregularities (for example, due to a non-homogeneous acceleration or to a loss of balance at the start of locomotion)." Ex. 1006, 5:56-61.

73. Combining Fabio's technique for using a regularity test to validate steps into Pasolini's pedometer would have been a relatively simple and obvious solution to enhance Pasolini's pedometer so that it does not count all acceleration peaks as steps. A POSITA would have applied Fabio's technique to Pasolini with the predictable result being that Pasolini's device would more accurately count steps. This advantage would have been readily recognized by a POSITA. Moreover, Fabio states that "the control procedure described can be used to advantage in a stand-alone pedometer or in any case one integrated in a further portable device." Ex. 1006, 8:7-9.

74. The combination of Pasolini and Fabio would therefore provide improvements to Pasolini's pedometer by providing improved step recognition, which would result in a more accurate step count. Thus, it would have been obvious

to combine Pasolini and Fabio as the combination is merely the use of Fabio's known step counting technique to improve Pasolini's similar device in the same way.

2. Detailed Analysis

75. In my opinion, the combination of Pasolini and Fabio renders obvious claims 3-4, 13-14, and 20 of the '508 patent.

USP 7,653,508	**Pasolini and Fabio**
Claim 3	
[3.0] The method of claim 1, further comprising	See analysis of claim 1.
[3.1] maintaining a cadence window, wherein the cadence window is continuously updated as an actual cadence changes;	Fabio discloses this limitation. First, Fabio teaches a validation step to determine if a detected step meets a condition of regularity. This validation step uses a validation interval. As discussed above in [6.2], Fabio teaches that its validation interval TV is an appropriate cadence window because it is continuously updated for each step as a user's actual cadence changes. > If, instead, the step-recognition test is passed (output YES from block 225), the control unit 5 executes a first validation test, corresponding to the regularity of the individual step (block 230). With reference also to FIG. 6, **the validation occurs when the duration ΔT_K of a current step K is substantially homogeneous with respect to the duration ΔT_{K-1} of an immediately preceding step K–1** (the duration of a generic step is determined by the time that has elapsed between an instant of recognition of the step of which the duration is evaluated

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	and an instant of recognition of the step that immediately precedes it). More precisely, the last step recognized is validated if the instant of recognition of the current step $T_{R(K)}$ falls within **a validation interval** TV. . . . Ex. 1006, 4: 24-37. Because the validation interval TV is based on the immediately preceding step, the validation interval TV is updates continuously as the user's actual cadence changes. Second, Fabio teaches that the validation interval for each step is based in part on the validation interval for a preceding step and is thus continually updated. More precisely, the last step recognized is validated if the instant of recognition of the current step $T_{R(K)}$ falls within **a validation interval** TV, defined with respect to the instant of recognition of the immediately preceding step $T_R(K–1)$, in the following way: $TV=[T_R(K–1)+\Delta T_{K–1} – TA, T_R(K–1)+\Delta T_{K–1} +TB]$ where TA and TB are complementary portions of the validation interval TV. In the embodiment of the invention described herein, the complementary portions TA, TB are defined as follows, for the generic current step K: $TA=\Delta T_{K–1}/2$ $TB=\Delta T_{K–1}$

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	Ex. 1006, 4:35-49. Because Fabio's validation interval TV is updated at each step, a POSITA would have understood that the validation interval is maintained at each step. As described above, a POSITA would have been motivated to combine the teachings of Fabio with those of Pasolini to improve Pasolini's pedometer with the step validating procedures of Fabio's similar pedometer in order to improve step counting accuracy. Thus, Pasolini's device as modified to include Fabio's validation interval for a particular step, which is based in part on the validation interval for preceding steps, teaches "maintaining a cadence window, wherein the cadence window is continuously updated as an actual cadence changes" as recited in the claim.
[3.2] counting a periodic human motion when an acceleration measurement that meets motion criteria is within the cadence window.	Fabio discloses this limitation. First, Fabio teaches that its device recognizes and counts a step (i.e., a periodic human motion) by processing an acceleration signal provided by the inertial sensor: > The inertial sensor 3 supplies at output an acceleration signal AZ, which is correlated to the accelerations undergone by the inertial sensor 3 itself along the detection axis Z. > **The control unit 5 receives and processes the acceleration signal A_Z as explained in detail hereinafter for identifying and counting a total number of valid steps N_{VT} made by a user wearing or carrying the pedometer 1**, for example, on his belt or on his shoulder. Ex. 1006, 2:56-64. Second, Fabio teaches that its pedometer performs step recognition by monitoring an acceleration signal to detect

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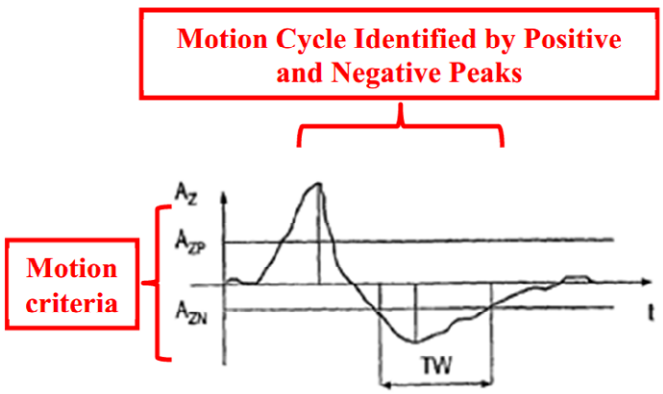
	a positive peak followed by a negative peak ("an acceleration measurement that meets motion criteria"): > Otherwise (output NO from block 305), a step-recognition test is carried out (block 315), identical to the step-recognition test of block 225 of FIG. 3. Also in this case, then, **step recognition is based upon the detection of a positive peak of the acceleration signal A_Z followed by negative peak** that falls in the time window TW (see FIG. 5). Ex. 1006, 6:21-26. Fabio also teaches that its device recognizes and counts a step (i.e., a periodic human motion): > [I]f the **acceleration signal A_Z shows a positive peak, higher than a positive acceleration threshold A_{ZP}, followed by negative peak, smaller than a negative acceleration threshold A_{ZN}**. Ex. 1006, 4:12-21. A POSITA would have recognized that detecting positive and negative peaks in the acceleration signal Az is "measuring" whether the accelerations meet a motion criteria. This is shown below in Fabio's Figure 5:  Ex. 1006, FIG. 5 (annotated).

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	A POSITA would have understood that the above acceleration measurement "is taken within the cadence window" because Fabio describes that "the last step is validated if the instant of recognition of the current step $T_R(K)$ falls within a validation interval TV." Ex. 1006, 4:35-37. A POSITA would have understood that "the instant of recognition" that "falls within a validation interval TV" refers to performing the measurements on peak accelerations taken within the validation interval. Thus, Fabio's counting of steps when peaks are detected within a validation interval teaches "counting a periodic human motion when an acceleration measurement that meets motion criteria is within the cadence window" as recited in claim 1.
Claim 4	
[4.0] The method of claim 3,	See analysis of claim 3.
[4.1] wherein at least one of the motion criteria is a dynamic motion criterion, the dynamic motion criterion being continuously updated to reflect current conditions.	The combination of Pasolini and Fabio renders this limitation obvious. First, as described above in [3.2], Fabio teaches using a "motion criteria" for step recognition: > [A] step is recognized if the acceleration signal A_Z shows a positive peak, **higher than a positive acceleration threshold A_{ZP}**, followed by a negative peak, **smaller than a negative acceleration threshold A_{ZN}**. Ex. 1006, 4:16-21, 6:21-26. Pasolini teaches a similar method to recognize a step by "compar[ing] the value of the acceleration signal A (with the d.c. component filtered out) with a **positive reference threshold S^+**, and with a **negative reference threshold S^-**, for identifying, respectively, the positive phase (positive

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	acceleration peak) and the negative phase (negative acceleration peak) of the step." Ex. 1005, 3:36-41. Pasolini also teaches that: > **The algorithm implemented by the processing unit 3 for performing, among other things, the operations of step counting** and of traveled distance measurement is now described, with reference to FIG. 3. **Said algorithm envisages the analysis of the acceleration signal A in order to look for a positive phase of the step followed by a negative phase** within a pre-set time interval from the occurrence of the positive phase. In the case where said sequence occurs (which indicates the occurrence of a step), counting of the steps and measurement of the total distance traveled are updated; otherwise, the algorithm returns to the initial condition of looking for a new positive phase of the step. Ex. 1005, 3:60-4:4. As shown in FIG. 2, the pattern of the acceleration signal A (with the d.c. component filtered out) in time t has a given acceleration profile which repeats at each step (indicated by the dashed rectangle). In detail, **the acceleration profile comprises in succession: a positive phase, in which a positive-acceleration peak occurs** (i.e., directed upwards), due to contact and consequent impact of the foot with the ground; and **a negative phase in which a negative-acceleration peak occurs** (i.e., directed downwards) due to rebound, having an absolute value smaller than that of the positive-acceleration peak. Ex. 1005, 3:20-29. The acceleration data showing the positive and negative peaks is shown below in Fig. 2:

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	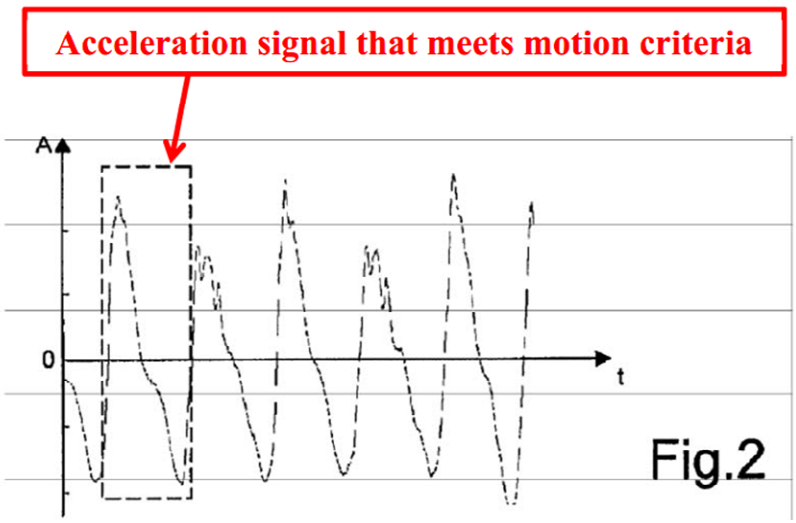 Ex. 1005, FIG. 2 (annotated). Second, Pasolini teaches that the positive and negative reference thresholds that make up the motion criteria are dynamic because they are calculated on-the-fly to be self-adaptive for the user. Ex. 1005, 3:30-54 ("**[T]he values of the positive and negative reference thresholds S+, S– are not fixed and equal to a given pre-set value, but are calculated in a self-adaptive way** (i.e., in a way a that adapts without any external intervention from a user)."). The reference thresholds are also updated as each step occurs: > The processing unit 3, comprising a microprocessor circuit (for example, a microcontroller or DSP), acquires at pre-set intervals samples of the acceleration signal A generated by the accelerometer 2, and executes appropriate processing operations for counting the number of steps and measuring the distance traveled. As will be described in detail hereinafter, **the processing unit 3 compares the value of the acceleration signal A (with the d.c. component filtered out) with a positive**

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	reference threshold S+ and with a negative reference threshold S–, for identifying, respectively, the positive phase (positive acceleration peak) and the negative phase (negative acceleration peak) of the step. Ex. 1005, 3:30-41. According to one embodiment of the present invention, **the values of the positive and negative reference thresholds S+, S– are not fixed and equal to a given pre-set value, but are calculated in a self-adaptive way (i.e., in a way that adapts without any external intervention from a user)** by the processing unit 3, based on the values assumed by the detected acceleration. In particular, as will be clarified hereinafter, the values of the positive and negative reference thresholds S+, S– are modified at each acquisition of a new sample of the acceleration signal A, as a function of the value of a positive and negative amplitude envelope of the acceleration signal, in such a manner that the reference thresholds vary with time approximately following said envelopes. Ex. 1005, 3:41-54. Since the positive and negative reference thresholds for recognizing a step are modified as each step occurs, the motion criteria defined by the positive and negative thresholds is a dynamic motion criteria. It would have been obvious to a POSITA to modify Fabio to include Pasolini's adaptive reference thresholds because Pasolini describes that this technique allows a pedometer to adapt to variations in detected conditions, such as differences in types of terrain and gait speeds:

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	> The pedometer device 1 thus adapts to variations in the detection conditions (and, in particular, to different profiles of the acceleration signal, in terms of amplitude and duration), due, for example, to a different type of terrain, or to an increase in the speed of the gait. Ex. 1005, 3:54-59. Moreover, Pasolini further describes that having pre-set reference (that are not adaptive) may cause errors that are considerable for step counting accuracy: > However, even though the acceleration signal has a profile that is repeatable at each step, its pattern (and, in particular, its amplitude and temporal extension) has a wide variability according to a number of factors that affect the gait, such as the resting surface, the type of shoe worn (rigid sole or flexible sole, etc.), and the speed of the gait (slow walking, fast walking, running, etc.). Furthermore, each individual user has given characteristics and peculiarities that affect the gait, differentiating it from that of other users. > **It follows that a step detection based upon the comparison of the value of the acceleration signal with a reference threshold having a pre-set value for the detection of acceleration peaks, involves the occurrence of errors that may even be considerable in counting of the steps**, and in the measurement of the distance traveled. In particular, if the threshold is too low, spurious signals, rebounds, or noise in general, may be counted as steps; on the other hand, if the threshold is too high, some steps may not be detected.

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	Ex. 1005, 1:61-2:2. Accordingly, a POSITA would have found it obvious to implement Pasolini's adaptive reference thresholds into Fabio's step counter, with the predictable result being more accurate step counting. The dynamic motion criterion are updated so that: > pedometer device 1 thus **adapts to variations in the detection conditions** (and, in particular, to different profiles of the acceleration signal, in terms of amplitude and duration), due, for example, to a different type of terrain, or to an increase in the speed of the gait. Ex. 1005, 3:54-59 Thus, Fabio and Pasolini's positive and negative peak reference thresholds that update as each step occurs to adapt to variations in the terrain or speed of the gait renders obvious "wherein at least one of the motion criteria is a dynamic motion criterion, the dynamic motion criterion updated to reflect current conditions."
Claim 13	
[13.0] The device of claim 11, wherein:	See analysis of claim 11.
[13.1] a cadence logic to continuously update a dynamic cadence window; and	The combination of Pasolini and Fabio renders this limitation obvious. Fabio teaches this limitation because (1) as discussed in [19.0-19.1], Fabio teaches a cadence logic that sets the appropriate cadence window for each step based on the previous step; and (2) as discussed in [3.1], the validation interval TV (i.e., the cadence window) for each new step is continuously updated based on the timing and duration of the immediately preceding step. Because the validation interval for each step is updated based on the timing and duration of the immediately preceding step, a POSITA would have

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	understood that the validation interval (i.e., the cadence window) is continuously updated upon each step, and is therefore dynamic. Thus, the combination of Pasolini's cadence logic implementing Fabio's validation interval that updated continuously upon each new step teaches "a cadence logic to continuously update a dynamic cadence window" as recited in the claim.
[13.2] the counting logic to count a periodic human motion when an acceleration measurement that meets motion criteria is taken within the cadence window.	Fabio discloses this limitation. First, as described in [11.2], Fabio teaches "a counting logic." Second, as discussed in [3.2], Fabio teaches counting steps (i.e., periodic human motions) when acceleration measurements meet motion criteria (i.e., positive and negative peak thresholds) that fall with a validation interval (i.e., a cadence window). Thus, Fabio's control unit that counts steps when an acceleration measurement showing a positive peak followed by a negative peak is taken within the validation interval teaches "the counting logic to count a periodic human motion when an acceleration measurement that meets motion criteria is taken within the cadence window" as recited in the claim.
Claim 14	
[14.0] The device of claim 11, further comprising:	See analysis of claim 11.
[14.1] a comparator, to compare measurements of acceleration to dynamic motion criteria, the dynamic motion criteria being continuously updated	First, Pasolini teaches that the processing unit compares the acceleration signal (i.e. measurements of acceleration) to motion criteria consisting of positive and negative peak thresholds: > The processing unit 3, comprising a microprocessor circuit (for example, a microcontroller or DSP), acquires at pre-set intervals samples of the acceleration signal A

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to reflect current conditions; and	generated by the accelerometer 2, and executes appropriate processing operations for counting the number of steps and measuring the distance traveled. As will be described in detail hereinafter, **the processing unit 3 compares the value of the acceleration signal A (with the d.c. component filtered out) with a positive reference threshold S+ and with a negative reference threshold S–, for identifying, respectively, the positive phase (positive acceleration peak) and the negative phase (negative acceleration peak) of the step**. Ex. 1005, 3:30-41. This is similarly disclosed in Fabio as discussed above in [3.2]. As also discussed above in [4.1], Pasolini discloses that its positive and negative reference thresholds that make up a motion cycle are dynamic because they "**are modified at each acquisition of a new sample of the acceleration signal A**." Ex. 1005, 3:48-51. Based on these disclosures, a POSITA would recognize that to detect a step, Pasolini teaches comparing the acceleration signal to motion criteria that dynamically updates as each new step is detected. Because the motion criteria is dynamically updated for each step, it is updated to reflect current conditions. Second, a POSITA would have understood that Pasolini's "processing unit 3" for performing the above comparison is "a comparator" because it performs comparisons. A POSITA would have understood that Pasolini's comparator would execute machine readable instructions to compare the measurements. Such hardware (processing unit 3) and software (instructions that are

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	executed by the processing unit 3) would have been considered "a comparator" as used in the claim. A POSITA would also be familiar with realizing this threshold detection via an analog comparator device where appropriate, as these were commonly used with all kinds of sensors at the time. Thus, Fabio and Pasolini's positive and negative reference thresholds, in view of Pasolini's processing unit that compares measurements of acceleration to the reference thresholds that are updated for each step, renders obvious "a comparator, to compare measurements of acceleration to dynamic motion criteria, the dynamic motion criteria being continuously updated to reflect current conditions" as recited in the claim.
[14.2] the counting logic to count a periodic human motion when an acceleration measurement that meets motion criteria is taken within the cadence window.	Fabio discloses this limitation. First, as described in [11.2], Fabio teaches "a counting logic." Second, as discussed in [3.2], Fabio teaches counting steps (i.e., periodic human motions) when acceleration measurements meet motion criteria (i.e., positive and negative peak thresholds) that fall with a validation interval (i.e., a cadence window). Thus, Fabio's control unit that counts steps when an acceleration measurement showing a positive peak followed by a negative peak is taken within the validation interval teaches "the counting logic to count a periodic human motion when an acceleration measurement that meets motion criteria is taken within the cadence window" as recited in the claim.
Claim 20	
[20.0] The device of claim 19, wherein:	See analysis of claim 19.
[20.1] the cadence logic adjusts the cadence windows based on a measured	The combination of Pasolini and Fabio renders this limitation obvious. Fabio teaches this limitation because (1) as discussed in [19.0-19.1], Fabio teaches a cadence logic that sets the appropriate cadence window for each

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cadence associated with the periodic human motion.	step based on the previous step; and (2) as discussed in [3.1], the validation interval TV (i.e., the cadence window) for each new step is continuously updated based on the timing and duration of the immediately preceding step. Because the validation interval for each step is updated based on the timing and duration of the immediately preceding step, a POSITA would have understood that the validation interval (i.e., the cadence window) is adjusted based on a measured cadence associated with the periodic human motion. Thus, the combination of Pasolini's cadence logic implementing Fabio's validation interval that updated continuously upon each new step teaches the "cadence logic adjust[ing] the cadence windows based on a measured cadence associated with the periodic human motion" as recited in the claim.

VIII. CONCLUSION

76. This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare that all statements made herein on 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.

Date: August 23, 2018

Respectfully submitted,

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