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Box Provisional Application

Assistant Commissioner for Patents
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Sir:

Transmitted herewith for filing is the **PROVISIONAL** patent application of:

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and

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For: Smart Remote Monitoring System and Method

Enclosed are:

Twelve (12) Pages of Specification (Letter Size); and

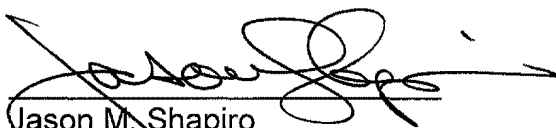
One (1) Sheet of Drawings (Informal).

Enclosed is a check in the amount of \$150.00 for payment of the filing fee under 37 C.F.R. §1.16(k).

The Commissioner is hereby authorized to charge payment of any additional fees required for the above-identified application or credit any overpayment to Deposit Account No. 05-0460.

All correspondence regarding this application should be directed to Jason M. Shapiro at the address listed above.

Respectfully submitted,


Jason M. Shapiro
Registration No. 35,354

Hand-delivered: _____

PROVISIONAL PATENT APPLICATION

Title: Smart Remote Monitoring System and Method

Inventors: Robert N. Johnson and George H. Harrop

66390-64703

FIELD OF THE INVENTION

The present invention relates to a system and method used for the remote monitoring and control of property and equipment. The primary application is for absentee owners of yachts and vacation homes, however, the invention also can be used for commercial and industrial monitoring and control.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A smart remote monitoring system according to the present invention, as illustrated in Figs. 1 and 2, includes one or more smart, self-identifying, "plug-and-play" transducers 10; a wired or wireless local area network (LAN) 12 for connecting to the transducers; a transducer control module 14 which connects to the transducers and to a communications device; a communications device 16 which connects through a wide area network (WAN) 18 to a monitoring system or station 20 composed of one or more monitoring devices; and end-user display terminals 22 which connect to the monitoring device(s) through the same or a different wide area network. A block diagram of this system is shown in Figs. 1 and 2. Figure 1 illustrates the portion of the system that is generally located at or very near the monitored property or equipment, and Fig. 2 illustrates the monitoring station and end-user portion of the system.

The system can be used to provide real-time on-demand status information to end users, as well as alarm notification to the end user and other appropriate entities if certain pre-defined conditions and/or events are detected. These alarm notifications can take the form of telephone, telegraph, facsimile, pager, electronic mail, or other type of communications.

5 The end-user terminals 22 are used for obtaining real-time on-demand status information, for entering real-time control instructions, and for programming the monitoring system characteristics such as setting the alarm notification conditions, communications media, message destinations (e.g., telephone number or e-mail addresses), and message content.

10 The transducers 10 can be sensors and/or actuators. In a preferred embodiment, multiple transducers are used and connected by a local area network (LAN) 12. At least some of the transducers are preferably "smart" transducers using technology such as that represented by the IEEE 1451.2 standard, the contents of which are incorporated herein by reference. Each smart transducer preferably includes:

- 15 (1) An actual sensing or actuation element;
- (2) Signal conditioning (filters, amplifiers, buffers, electrical isolation, etc.) and conversion between the analog and digital domains;
- (3) A digital communications interface (hardware and protocol) compatible with the LAN; and
- (4) A Transducer Electronic Data Sheet (TEDS).

20 The TEDS is generally in accordance with IEEE 1451.2, although some items can be omitted or added as needed for specific monitoring applications. Simple analog transducers (both sensors and actuators) can be used as is or converted to smart transducers for use with the smart remote monitoring system by use of technology such as that described in U.S. Patent Application Serial No. 08/949,284, filed on October 21,

1997, and U.S. Patent Application Serial No. 09/167,465, filed on October 7, 1998, the disclosures of which are incorporated herein by reference.

Each transducer preferably has a unique identifier for use in registering that transducer with the monitoring system.

5 The transducer LAN 12 can be wired or wireless. Preferably, the LAN uses a multi-drop architecture to support the use of multiple transducers in a single system. Representative wired LANs include the EDC 1451.2-NA network node and the Controller Area Network (CAN) described in ISO 11898 and ISO 11519-2.

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10 Representative wireless LANs include the digital spread-spectrum units used in wireless home security systems and cordless phones, IEEE 802.11 (wireless Ethernet), and any one of a number of available wireless networking products intended for use with office computers and related equipment.

15 The range and extent of the transducer LAN will generally be limited to the equipment or premises being monitored. For yachts or other vehicles including boats and aircraft, this range can be limited to the vehicle being monitored, or it can encompass the entire marina, port, or airport. For industrial monitoring applications, it can encompass the entire factory or site being monitored. For homes, this range can be limited to just the premises being monitored, or it can encompass the entire neighborhood, development, or resort.

20 The transducer control module 14 includes the physical and protocol interface to the smart transducers over the sensor LAN 12, the event detection and reporting logic,

and the physical and protocol interface to the communications device. The transducer control module 14 can be implemented as an application specific device having a microprocessor, memory and appropriate communication ports, or as a standard personal computer running application specific software. The event detection logic
5 monitors the sensors for reportable events, prepares event and status messages in the appropriate format for the communications system or WAN being used, controls the communicator or WAN interface as necessary to conserve communications bandwidth and battery power, and sends the event and status messages to the monitoring system. In one embodiment, the transducer control module collects data from each transducer at predetermined intervals corresponding to a default sample rate or a user-defined sample rate. Preferably, the module will gather the current absolute level from the transducer and keep a running average so that the difference between the current level and the long term average level can be determined, for example to identify shock loading conditions and other transient conditions. Root mean square (RMS) levels can also be calculated and stored by the module, e.g., to evaluate vibrations. The module is preferably programmed to generate and send messages to monitoring system 20 when measured levels exceed user-defined or default thresholds. Message-generating events can also be defined by combinations of thresholds which are exceeded so that, for example, if the level on channel one exceeds some first number and the level on
20 channel two exceeds some second number, an event message is generated by the transducer control module and sent to the monitoring system. In a preferred embodiment, the module memory is partitioned and detailed information on an event is

stored in one of the partitions for later analysis. The message preferably includes a summary which quantifies the event so that the monitoring system can decide whether or not to send an alarm as described below.

The communications device 16 connects the transducer control module 14 to the WAN 18 of choice. The communications device can be physically incorporated into the transducer control module or it can be a separate component. Some examples of suitable communications devices include modems, routers and network interface cards.

The connection between transducer control module 14 and monitoring system WAN 18 can be either wired or wireless, or a combination of both. Representative wired WANs include Ethernet, telephone dialup connections, and the complex communications network commonly referred to as the Internet. Representative wireless WANs include wireless Ethernet (IEEE 802.11), cellular telephones, radio-telephone systems, and commercially-available satellite-based communications systems. The data transmitted over the WAN can be encrypted to prevent unauthorized access.

The monitoring system 20 includes computer hardware and software which receives, stores, and analyzes event and status information from the item or facilities being monitored. The monitoring system watches for, detects, and reports trends in the monitored data, as well as detecting when the alarm conditions have been met.

The monitoring system is the principal interface between the overall system and the end user. It is the sub-system with which they interact to receive status reports, program event and alarm conditions, and issue control commands to actuators.

One preferred embodiment of the monitoring system 20 includes what is commonly referred to as a web server, allowing the end user to interact with the monitoring system over the Internet using commercially available software known as web browsers. This enables end users to receive event reports and check the status of the monitored facilities from anywhere in the world without requiring special communications facilities or having to install special software on their local computer. Standard capabilities of web servers and browsers, such as secure sockets layer (SSL) service, can be used to provide the required security and data access controls.

The monitoring system provides for multiple users and multiple levels of access to the reports and information for the monitored facilities. Preferably, each end user is provided access to the information for their monitored facilities and none other.

End users are able to designate multiple levels of access for themselves and in turn their staff or clients. For example, a trucking company can authorize their customers to receive simple location and shipment status reports, but not reports on equipment condition or driver performance. Similarly, the maintenance facility can receive the equipment reports, but not information on shipments or the driver.

These security provisions and access levels are selectable by the end user through their interface with the monitoring system.

As described above, one preferred embodiment of the end-user terminals is standard personal computers with web browser software, connected to the monitoring system through the Internet. This embodiment permits access to the information form

anywhere in the world that has Internet access, without having to install special software on each computer used for access to the monitoring information. Alternatively, the end-user terminals can be personal computers running special software developed for the above purpose, dumb terminals connected to a network or a mainframe, personal information managers and digital assistants, pagers, cellular phones, etc.

The exact sensors and actuators used will vary with the application. For example, when monitoring private yachts for absentee owners, the sensors might include any or all of the following:

1. Bilge water level sensor (actual depth or high-low detection by float switch).
2. Bilge pump performance sensor (how long it takes to drain the bilge).
3. Leak rate sensor (how often the bilge pump comes on).
4. Battery voltage sensor (with and without charger on).
5. Battery current sensor (indicative of occupancy or electrical problem).
6. Engine starting cycles sensor (may indicate unauthorized use).
7. Engine running time sensor (for maintenance or to detect unauthorized use).
8. Engine oil level sensor.
9. Fuel level sensor.
10. Water level sensor.
11. Pitch and roll of the boat sensor (may indicate problem with mooring lines).

12. Intrusion sensor (unauthorized boarding).
13. Cabin temperature sensor.
14. Engine compartment temperature sensor.
15. Fire or smoke detectors.
- 5 16. Hazardous gas detectors.
17. Position/motion sensors for unauthorized use or mooring failure (broken anchor chain, etc.).
18. Galvanic action sensor (to detect excess galvanic action of the hull and/or fittings due to an electrical grounding fault or depletion of the sacrificial anodes).
19. Sensors to monitor operation or status of any other system on board the boat (e.g., air conditioning, food storage temperature, engine room air vents, owner's hot tub, etc.).

In addition to an actual sensing element, the sensors preferably include signal conditioning electronics, an analog to digital converter, a digital communication interface and TEDS to provide plug-and-play capability and other features such as temperature compensation and correction, and decision making capability. For example, changes in trends for any of the above sensors, such as a significant change in how long or how often the bilge pump runs, can be cause for an alarm notification.

Actuators may be used to control systems or to enable or enhance the sensor

measurements. For example, an actuator can be used to disconnect the battery charger in order to measure the true voltage of the battery.

As a further example, a vacation home monitoring system can have similar sensors except that the emphasis would be on the basement instead of the bilge, plumbing leaks, and the performance of the heating and air conditioning system. Other sensors, such as intrusion detection, will be very similar.

In accordance with one aspect of the smart remote monitoring method of the present invention, the end user obtains (purchases, leases, etc.) a smart remote monitoring kit. The kit includes a basic suite of transducers for the selected application, a transducer control module, a communicator for the WAN of choice, and complete instructions for installation and activation. A default user name and password can also be supplied for use in activating the monitoring account.

The end user installs (or has installed) the monitoring kit. As part of this installation, the communicator is connected to (for wired systems) or makes contact with (for wireless systems) the WAN.

The monitoring system recognizes and validates the unique identifier of the transducer control module and starts receiving and processing event reports and status information.

The end user contacts the monitoring system through an end user terminal using, for example, the Internet and a web browser. The end user activates the monitoring account, makes arrangements for payment of monitoring fees (e.g., by

deposit account, credit card or applying for a corporate account), defines the desired alarms and status reports, and defines the distribution list (e.g., names, telephone numbers, e-mail addresses, etc.) for messages.

5 The monitoring system continues to receive event reports and status information from the transducer control module, and processes them according to the options selected by the end user when the account was activated.

10 The end user optionally purchases additional transducers for use with the smart remote monitoring system. When installed and connected to the transducer control module, these optional transducers identify themselves to the transducer control module and, in turn, to the monitoring system.

The monitoring system recognizes the additional transducers, knows what they are, and what data and reports they can provide. It adds the new transducers to the user account.

15 The end user contacts the monitoring system through the end user terminal as described above and selects the monitoring options appropriate to the additional transducers.

At any time, the end user can contact the monitoring system through an end user terminal and update the alarm conditions, status reports, distribution lists, access controls, etc.

20 Some of the advantages of the remote monitoring system and method according to the present invention is that it can be internet based allowing end users to

interact with the system from anywhere in the world without the need for special equipment, communications facilities, or software; that it provides real-time, on-demand status information, not just alarm notifications so that end users can check on monitored facilities at any time, from anywhere; that the transducers and transducer control modules are self-identifying so that once connected, the monitoring system knows what the sensors are and what to do with the information they provide and end users can simply install and connect new transducers or control modules, with the monitoring system immediately accepting data reports; that all transmitted messages can be encrypted to control access to event reports and status information; that all features, including event detection thresholds, alarm conditions, alarm notification actions, lists and addresses, information access, etc. are user programmable by direct interaction with the monitoring system; that the system and method provides direct notification to the end user using the communications media, addresses or telephone numbers, and message format selected by the user so that, for example, in the case of a yacht, messages can be sent to the boat owner, the charter operator, the boat's home marina, and the customary maintenance facility, depending on the content of the message and the options selected by the user; and that any or all of the above can occur automatically, without human intervention on the part of the monitoring service.

Inasmuch as the present invention is subject to many variations, modifications and changes in detail, it is intended that all subject matter discussed above or shown in the accompanying drawings be interpreted as illustrative only and not be taken in a limiting sense.

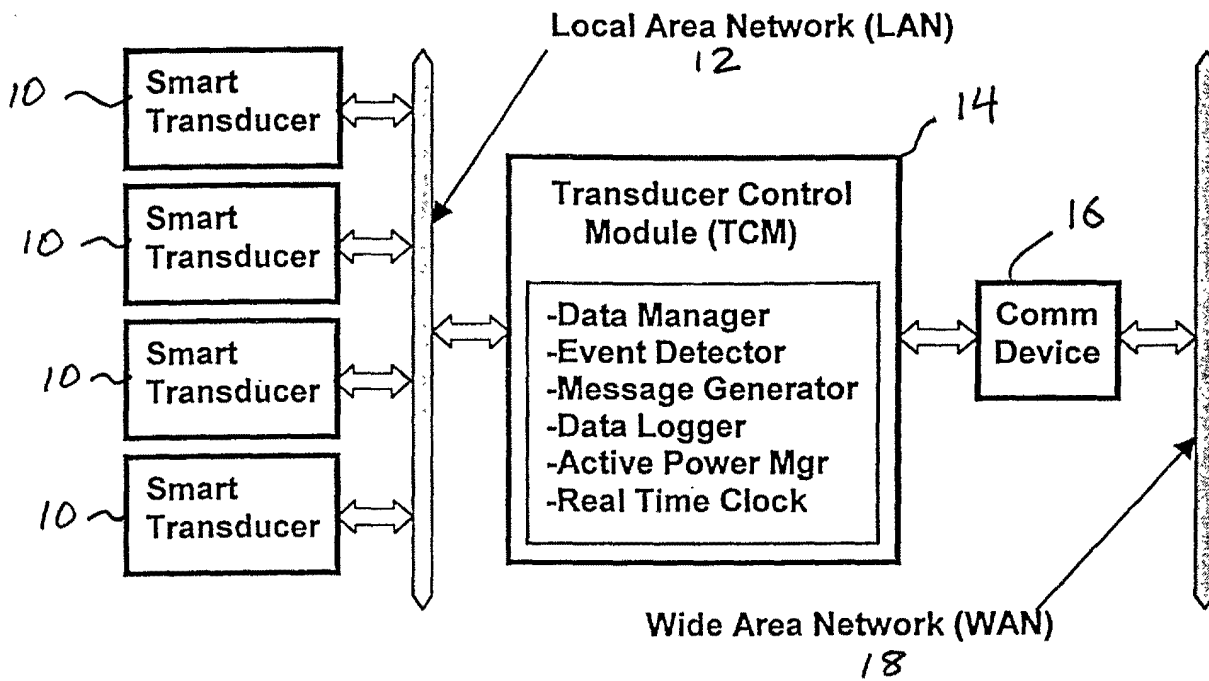


FIG. 1

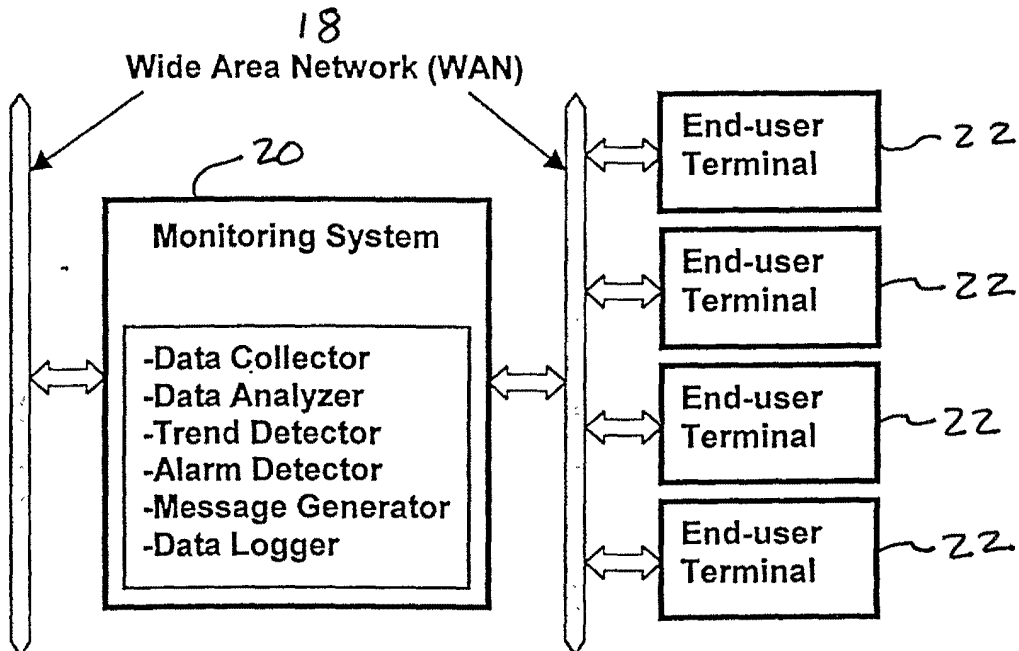


FIG. 2