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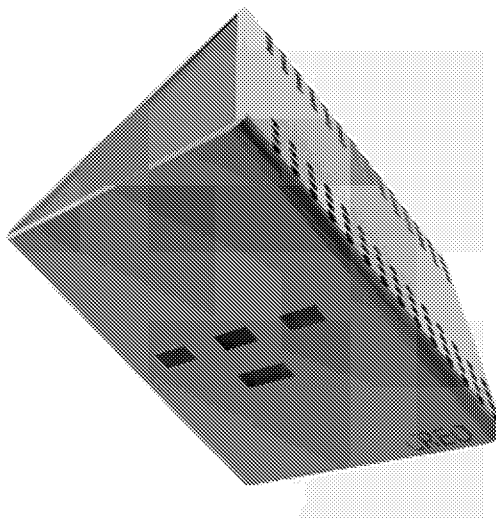


Fig. 1

(57) Abstract: An integrated smart energy monitoring and control device that allows for smart home automation, media and content delivery and internet routing for consumer devices such as phones and computers. A portable energy monitoring point includes at least transmitters and receivers at different radio frequencies such as IR, ZigBee, ZWave, WiFi.



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AN INTEGRATED SMART ENERGY MONITORING AND CONTROL DEVICE

FIELD OF THE INVENTION

This invention is directed towards monitoring and control of electrical systems, and more particularly towards energy monitoring and control. The present invention relates generally
5 to systems and methods for monitoring and controlling the energy consumption and generation of devices in a household.

BACKGROUND OF THE INVENTION

With the rising cost of home energy use, especially electrical power, it has become desirable to know the quantity of electrical power used by various household appliances so
10 that inefficient uses of electricity can be eliminated. Apart from inefficient usage of energy, there is a need for a simple and effective energy management and control mechanism for users. While it is possible to obtain a monthly, daily or weekly total for aggregate home energy use by reading the outside utility meter, such a practice is awkward and cumbersome. Furthermore, the only information that can be obtained from the utility meter
15 is the total energy use of the entire residence. Obviously it cannot be determined from the utility meter which particular appliances contribute most heavily to the total amount of energy usage within any given time frame.

Issues such as global warming and the pending oil crisis have the global population constantly worried about the effects of their individual effect in relation to national energy
20 concerns. Some people are even trying to push themselves “off-the-grid” by only

consuming renewable energy sources, such as solar or wind power. Carbon credits and carbon footprints have entered the common vernacular and can often be heard on major news networks as well as major motion pictures. But even with all of this concern relating to the conservation of resources and energy, it remains nearly impossible for a concerned
5 global citizen to be able to actively measure the effects of their day-to-day energy consumption.

Some electric companies have recently switched to a pricing model where the price of a kilowatt-hour of power is constantly in flux. This constant change in pricing only serves to bring confusion to the consumer base, as a typical consumer has no clue what the going rate
10 of electricity may be, nor do they have any clue what their current consumption is. The only metric of consumption that electricity providers give to consumers is in the form of a bill at the end of the month; not nearly enough information to inform consumers of their daily—not to even mention real-time—energy needs. Such information is critical for consumers to have an in-depth understanding of their energy usage that can be controlled
15 either with manual intervention or via machine learning and artificial intelligence based algorithms.

In the past, systems have been available for automatically controlling certain household appliances from a central location. These systems typically use a power line modem which is a transmitter/receiver capable of operating over conventional AC 120/240-volt wiring. In
20 addition to the modem, these systems include a switch for controlling the operation of the appliance which is activated or deactivated by a central control unit.

Examples of this type of system are shown in the U.S. Pat. Nos. 4,174,517 and 4,418,333.

In both of these systems a control unit may be programmed to initiate certain functions within various appliances depending upon the time of day. For example, lights may be programmed to automatically turn on at dark and a coffee maker may be programmed to automatically turn on at a given hour in the morning. Neither of the system, however, provides any means for monitoring energy usage of the various appliances or devices connected to either system.

Another type of device uses a digital counting technique responsive to the shaft revolutions of a conventional utility power meter as shown in US Patent No. 3,747,068. Another type of system, disclosed in US Patent No. 4,350,980, uses an optical method for scanning the revolutions of the meter wheel of a standard electric meter and generating digital pulses which are then induced in the electric power cables of the meter to provide data at existing power outlets within the home which may be recorded by a receiving device plugged into an outlet.

In the past few years there has been an explosion of a new kind of connected platform labelled as “Internet of Things”. This new paradigm allows for addition of computing infrastructure to our daily objects ranging from consumer appliances, clothes and even our homes hence earning the name “smart devices”.

In a US Patent No. 8265776 B2; a energy monitoring system portable energy monitoring point includes at least one power plug receptacle, each power plug receptacle operably coupled to a separate integral power sensor circuit. Each integral power sensor circuit is

configured to determine an electrical current drawn by an electrical load connected to the corresponding at least one power plug receptacle. An integral digital communications circuit is configured to wirelessly transmit to a remote device a power consumption for each of the at least one power plug receptacles. The power consumption is derived from the electrical current drawn by the electrical load connected to the corresponding at least one power plug receptacle.

The invention in a US Published Patent No US 20090195349 A1 generally concerns systems and methods for monitoring and controlling the power consumption of a power-consuming device. The system and method may connect to a power source and a power-consuming device, connecting the power-consuming device to the power source. The power usage of the power-consuming device may then be measured and monitored. This monitoring data may then be stored and optionally sent to a controlling device on a data network. The location of the power-consuming device may also be determined, recorded, and sent to a controlling device. The system may also control the power usage of the power-consuming device. In some cases, a remote server may connect multiple energy monitoring systems in order to gain additional efficiencies and foster a community-based social network.

US Patent Application No. 14/085,867 describes a communication interface and a device control, management and monitoring system are provided to enable the networking of and communication between a multiple devices operating under different protocols. The communication interface may act as a translator or protocol converter that reformats transmissions from one protocol to another based on protocol compatibility between the

recipient and transmitting devices. The device control and monitoring system may store predefined rules that are triggered when specified conditions associated with the networked devices are detected. The rules may specify an action to take such as transmitting a discount offer to a user or turning off a light. According to one or more arrangements, the
5 communication interface may act as an intermediary between the networked devices and the device control system so that the device control system is not required to understand or be compatible with the various other protocols used by the networked devices.

The high cost of electrical energy today creates the need for energy consumers to be able to monitor and analyze the energy usage of electrical devices and reduce the amount of energy
10 consumption within a facility. The term “facility” is construed as any self-contained or multi-occupancy premises for private, public, or professional use. The term “electrical devices” is construed as any device that is plugged into electrical outlets in the facility and draws power from the electrical system of the facility.

Prior art patents related to the subject matter of the illustrative embodiments include US
15 Patent No. 6,993,417 B2 which discloses a system in which energy-related information is gathered at electrical junction boxes in a facility. The information is visually displayed and communicated to a centrally located intelligent device, where the information is then monitored, and analyzed, and used for energy-related control functions. US Published Patent Application No. 20030050737A1 also discloses a system that gathers energy-related
20 information (electrical and thermal) at electrical junction boxes and displays the information at the point of energy use or measurement. The information is also

communicated to a centrally located intelligent device for monitoring, analyzing, and used for energy-related control functions.

In US Patent No. 8090480 B2, a mechanism for managing energy consumption of electrical devices within a home or building. Energy usage data is collected for a first electrical outlet
5 connected to an unidentified electrical device in a facility. A pattern of energy usage is determined from the energy usage data collected at the first electrical outlet. The pattern of energy usage of the first electrical outlet is then compared against known patterns of energy usage for one or more other electrical outlets. Responsive to identifying a match between the pattern of energy usage of the energy usage data collected at the first electrical outlet
10 and a known pattern of energy usage of a second electrical outlet in the one or more other electrical outlets, the electrical device connected to the first electrical outlet is identified as the same electrical device that is associated with the known pattern of energy usage of the second electrical outlet.

Addition of this computing platform allows the functionality of these devices to be
15 controlled and manipulated in a way that was not possible before. This allows creation of a device that using differently abled radio frequencies can control these smart devices leading to convenience, environmental understanding and most importantly energy savings.

In the same breath, media has taken an alternative route leading to high quality on demand content through the Internet.

20 These situations are leaving consumers in the dark about their energy consumption and expenditures, potentially preventing them from making wiser energy-conscious decisions in

their homes and businesses. More broadly, no system currently exists in which a consumer can effectively and efficiently monitor, understand, and control their personal energy usage in a home or business.

OBJECTIVE OF THE INVENTION

- 5 Objective of the present invention is to provide a novel device that enables consumers manage, monitor and control their energy requirements combined with the need of on-demand media and smart home automation along with the functionality of acting like a IP router for digital devices.

- Another objective of the present invention is rather than multiple devices for each of these
10 functionalities, the device of the present invention provides an all-in-one solution. Along with AI enabled app it allows for a seamless user interface to manage all your energy, media and automation needs. The monitoring cloud platform further compliments the app with AI and Machine Learning based environment understanding. In combination, the energy, media and data usage of a consumer is encapsulated in a form of an Energy Score -
15 a single metric that defines how good or bad is a house's energy consumption, saving and management pattern.

- The above and other objects, advantages and features of the present invention will become more readily appreciated and understood from a consideration of the following detailed description of preferred exemplary embodiments of the present invention when taken
20 together with the accompanying drawings of the present invention.

SUMMARY OF THE INVENTION

The present invention provides a an integrated smart energy monitoring and control device that allows for smart home automation, media and content delivery and internet routing for consumer devices such as phones and computers.

- 5 The monitoring device consists of transmitters and receivers at different radio frequencies such as IR, ZigBee, ZWave, WiFi and more. These on-board electronics allow for Internet routing and control of various smart home peripherals such as relay switches, security cameras, motion tracking devices and other consumer appliances.

In accordance with the foregoing objects, monitoring device of the present invention
10 includes –

- a. Custom Processor with multiple cores that allows for energy monitoring, smart home control, media transmission and IP routing;
- b. In-build radio transmitters and receivers including – Infrared (IR), ZigBee, Z-Wave, Wi-Fi and more;
- 15 c. Dual or Quad-band Wi-Fi Chip to act like a router for computing devices;
- d. HDMI, Ethernet connectors for display and broadband Internet respectively;
- e. 4G SIM Card Slot;
- f. Energy Control System through which all energy entering the home can pass through;

- g. Bluetooth remote for media, smart home and gaming control;
- h. mobile application for controlling the monitoring box;
- i. A gamification engine over the mobile application;
- j. Cloud infrastructure for AI and ML based recommendation and smart control
5 engine;
- k. Energy Score that acts like a proxy for your energy usage/savings;

BRIEF DESCRIPTION OF THE DRAWING

The foregoing and other features and advantages of the present invention will be more fully understood from the following detailed description of illustrative embodiments, taken in
10 conjunction with the accompanying drawings in which:

Figure 1: An isometric, top, left and right view of the JOULE device. The JOULE device consists of varied transmitters and receivers such as WiFi, IR, ZigBee, ZWave and more. It also contains a SIM Card Slot for transmission of 4G Data along with Ethernet, HDMI Slots for broadband Internet and display respectively. The JOULE box is controlled via the
15 JOULE mobile application that handles energy monitoring, smart home control and media transmission. Environmental understanding is provided by the monitoring cloud based on its AI Engine.

DETAILED DESCRIPTION OF THE INVENTION

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only, and should not be considered restrictive of the scope of the invention, as described and claimed. Further, features and/or variations may be provided in addition to those set forth herein. For example, embodiments of the invention may be directed to various combinations and sub-combinations of the features described in the detailed description and include systems and methods for transmission of patient heart beat data from a patient work station to a remote health provider analysis system.

The monitoring device of the present invention is an integrated smart energy monitoring and control device that allows for smart home automation, media and content delivery and internet routing for consumer devices such as phones and computers.

The monitoring device consists of transmitters and receivers at different radio frequencies such as IR, ZigBee, ZWave, Wi-Fi and more. These on-board electronics allow for Internet routing and control of various smart home peripherals such as relay switches, security cameras, motion tracking devices and other consumer appliances.

The monitoring device also allows tethered and un-tethered connectivity to various display devices for Internet enabled streaming media.

The backbone of the monitoring device has an AI enabled smart control system that has in-built environment understanding to allow for energy savings via smart home automation. Internet connectivity is enabled on the device through in-built SIM card or Ethernet cable for broadband transmission.

In an embodiment a use case where all electricity/energy will be flowing through one of the smart metering peripheral allowing the monitoring device to be a one-stop shop for all energy transmission, metering and control. Combined with energy score the application allows for AI-based recommendations, gamification and loyalty points based on the same.

- 5 All functionalities of the device are controlled by the mobile application that allow for smart peripheral on-boarding, energy settings and control, over the air media streaming and general device controls. The mobile application connects to monitoring cloud that has AI and Machine Learning systems to manage the user's home environment based on historical data and pre-defined settings in the monitoring app.
- 10 The monitoring device also comes with a Bluetooth enabled remote control for media and gaming control. This critical functionality allows the device to be multi-faceted reducing entry friction in consumer home environments.

- In an embodiment the monitoring device of the present invention includes a metal enclosure that houses the radio frequency sensors, radio frequency transmitters, processor,
- 15 printed circuit boards and other elements and On-board RF sensors/transmitters such as IR, WiFi, ZigBee and ZWave.

In an embodiment the PCB consists of a micro-processor, RAM, Memory and other passive components. Separate cables to connect broadband, power and other peripherals to the monitoring Device.

In an embodiment the Add-on peripherals with the Joule Device such as Joule Energy Control System, motion trackers, security cameras, PID Sensors and Bluetooth remote for media and gaming control.

In preferred embodiments of the monitoring device the mobile application helps to on-board various smart peripherals onto the monitoring platform. It also acts like a library for all your media content. Combined with monitoring Cloud it helps in smart energy monitoring, feedback, control and savings of your electricity usage. Hybrid of on-phone and Cloud AI algorithms that help compute a single metric for a house energy consumption i.e. the Energy Score. The connectivity software package allows a direct line to the monitoring cloud where all data is synced and stored. The data is further used for processing of the energy score and smartly monitoring your environment.

In a preferred embodiment the mobile application has various portals for in-house or 3rd party content delivery. This content can include games, movies and other media. This along with in-house app also contains controls for on-boarding of various smart peripherals.

In other exemplary embodiments of the present invention the monitoring device interacts with the mobile. The device interaction involves mainly switching on-off the device. The LED status indicators will display the status of the device. The app interaction is based on standard mobile application as available in Android or iOS devices.

For monitoring and control of electrical systems, power on the monitoring device and wait for the sensors to calibrate and boot up. The mobile application, on-board various smart home devices that work on the aforementioned protocols. The mobile application and in-

built dual band Wi-Fi on the monitoring box to set up the monitoring box as a router. The TV interface or the mobile application to stream media content. Based on the daily usage the monitoring cloud automatically learns, recommends, monitors and controls various smart devices usage hence saving energy units. Based on your energy savings the Energy Score is calculated that can be gamified in future algorithm updates. Energy Control System Peripheral can be setup to transmit all energy entering into the house. This combined with the monitoring box can handle all energy transmission, metering and control for a house.

The device also has an extensive media and entertainment functionality that allows television, computer or any other display connectivity for delivery of media, content and games.

Furthermore the monitoring device is to be used primarily by consumers in a home environment. The monitoring device is to be used in conjunction with the mobile or TV application.

Other embodiments, uses and advantages of the present invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein.

While the foregoing description includes many details and specificities, it is to be understood that these have been included for purposes of explanation only, and are not to be interpreted as limitations of the present invention. Many modifications to the embodiments described above can be made without departing from the spirit and scope of

the invention, as is intended to be encompassed by the following claims and their legal equivalents.

CLAIMS:

1. An integrated energy monitoring and control device comprising;
 - a plurality of processor for energy monitoring, energy controlling, media transmission and IP routing;
 - 5 a plurality of transmitters and receivers of different radio frequencies;
 - a plurality of connectors to connect broadband, power and other peripherals;
 - a control system for energy saving;
 - a communication unit;
 - a memory unit for storing the monitoring data and
 - 10 a metal enclosure body.
2. The integrated energy monitoring and control device as claimed in claim 1, wherein the plurality of transmitters and receivers are of different radio frequencies of IR, ZigBee, ZWave and Wi-Fi.
- 15 3. The integrated energy monitoring and control device as claimed in claim 1, wherein the plurality of connectors comprising;
 - an in-built SIM card for internet connectivity on the device
 - a Ethernet cable for broadband transmission to the device and
 - 20 a plurality of cables to connect peripherals such as relay switches, security cameras, motion tracking devices security cameras, PID Sensors and other

consumer appliances and for display devices for Internet enabled streaming media.

4. The integrated energy monitoring and control device as claimed in claim 1, wherein
5 the control system is a hybrid of on-phone and Cloud AI algorithms to compute a single metric for a houses energy consumption for energy savings i.e the Energy Score.
5. The integrated energy monitoring and control device as claimed in claim 1, wherein
10 the communication unit comprising;
a Bluetooth for media and gaming control and
a Dual or Quad-band WiFi Chip for computing device.
6. The integrated energy monitoring and control device as claimed in claim 1, wherein
15 the memory unit is a PCB comprising a micro-processor, RAM and memory component.
7. The integrated energy monitoring and control device as claimed in claim 1, wherein
the metal enclosure houses the radio frequency sensors, radio frequency
20 transmitters, processor, printed circuit boards and other elements and On-board RF sensors/transmitters such as IR, WiFi, ZigBee and ZWave.

8. The integrated energy monitoring and control device as claimed in claim 1, wherein the control system permits a direct line to the monitoring cloud where all data is synced and stored in the memory unit.
- 5 9. The integrated energy monitoring and control device as claimed in claim 1, wherein the control system process the data to calculate energy score for smart peripheral on-boarding, energy settings and control, over the air media streaming and general device controls.
- 10 10. The integrated energy monitoring and control device as claimed in claim 1, wherein the control system connects to monitoring cloud that has AI and Machine Learning systems to all energy transmission, metering and control for a house based on historical data and pre-defined settings in the control system.
- 15 11. The integrated energy monitoring and control device as claimed in claim 1, wherein to monitor and control of electrical systems, the monitoring device based on the daily usage the monitoring cloud learns, recommends, monitors and controls peripherals for saving energy units.
- 20 12. The integrated energy monitoring and control device as claimed in claim 1, wherein to monitor and control of electrical systems, the monitoring device based on energy saving units calculate the Energy Score.

13. The integrated energy monitoring and control device as claimed in claim 1, wherein the device augments a media, content and gaming delivery functionality to allow for a single entertainment and recreational device.

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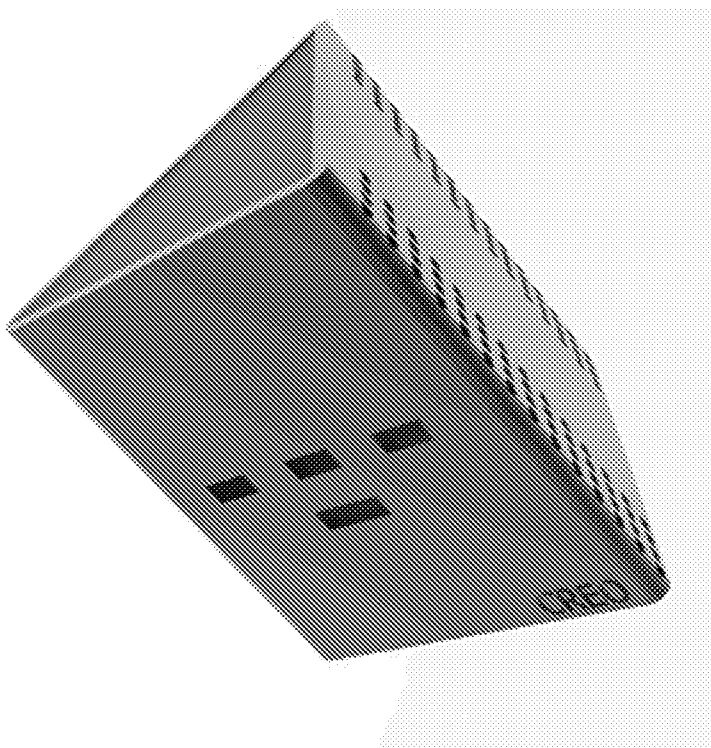


Fig. 1