

GENERAL POWER OUTLET AND REMOTE SWITCH MODULE

PRIORITY DOCUMENTS

[0001] The present application claims priority from Australian Provisional Patent Application No 2012904902 titled "Modular Switch for General Power Outlet" and filed on 7 November 2012, the content of which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to general power outlets (GPOs). In a particular form, the present invention relates to switching modules for GPOs.

BACKGROUND

[0003] General Power Outlets (GPOs), also known as power points, outlets, wall mounted sockets, etc, comprise one or more sockets which are used to supply electrical power to devices via a plug which is removably inserted into one of the sockets. The sockets are typically used to supply AC power (eg 220-240V, 50Hz; 120V, 60Hz) and typically comprise three connectors for an active line, neutral (return) line and a ground line, although in some cases the ground connector may be omitted. Typically, sockets always have 3 connectors to accommodate either 2 pin or 3 pin plugs.

[0004] Generally the plug is the movable connector attached to an electrically operated device's power cord, and the socket is a fixture on equipment or a building structure. Plugs have male circuit contacts, while sockets have female contacts. The plug has protruding prongs, blades, or pins that fit into matching slots or holes in the socket. The geometrical arrangement of the socket and plugs varies from country to country according to the relevant national standard. For example, Australia New Zealand Standard AS/3112 defines two flat current-carrying blades orientated at 30° to the vertical to form an upside down V-shape and a flat vertical grounding blade.

[0005] GPOs may also be fitted with a switch for switching or toggling the supply state of power to a socket (and plug) between on and off states. A GPO without a switch will always be in the on state, ie will always supply power to a plug connected to a socket on the GPO. Inclusion of a switch (or switches) allows a user to selectively control power to a device, independent of any power switch contained within the device. The use of switches in GPOs is extremely common in Australia and the United Kingdom. Switches provide an additional level of control and safety.

[0006] However, in some cases it is desirable to restrict control of a socket in a GPO in order to provide greater convenience or peace of mind. For example, in some cases it is desirable that devices such as refrigerators or computer servers are always left on. In other cases, the GPO may be located in a public location (eg on an external wall of a house or building), and it may be desirable to prevent members of the general public from tampering with the switch (either to steal power, or to turn off devices). Additionally, parents may wish to restrict use of switches in a child's bedroom, or similarly hospital carers, child care workers, or other supervisors may wish to restrict the use of GPOs in certain rooms.

[0007] There is thus a need to provide a modular switch for a general power outlet that allows smart or improved control of power, and/or to provide users with a useful alternative.

SUMMARY

[0008] According to a first aspect, there is provided a general power outlet system comprising:
a general power outlet, comprising:

- at least one socket;

- a power module for supplying electrical power to each of the at least one socket;

- a control module for controlling the power supply state of each of the at least one socket by controlling the power module, comprising a controller communications module for receiving a switching signal from a remote switch module, wherein the control module switches the power supply state in response to the received switching signal; and

- the remote switch module, comprising:

- at least one switch actuator;

- a power supply module; and

- a remote communications module, comprising a transmitter for transmitting the switching signal to the control module in the general power outlet to cause switching of the power state of at least one of the at least one socket in response to actuation of one of the at least one switch actuators.

[0009] According to a second aspect, there is provided a general power outlet comprising:

- at least one socket;

- a power module for supplying electrical power to each of the at least one socket; and

- a control module for controlling the power supply state of each of the at least one socket, comprising a controller communications module for receiving a switching signal from a remote switch module, wherein the control module switches the power supply state in response to the received switching signal.

[0010] According to a third aspect, there is provided a remote switch module for use with a general power outlet, comprising:

at least one switch actuator;

a power supply module; and

a communications module, comprising a transmitter for transmitting a switching signal to a control module in the general power outlet to cause switching of the power state of at least one of the at least one socket in response to actuation of one of the at least one switch actuators.

[0011] The system or the individual components in the system (general power outlet and remote switch module) may comprise further features.

[0012] In one form, the remote switch module is a mobile computing apparatus further comprising at least one processor and a memory, at least one user input module and a wireless communications module, and the memory comprises instructions for using the at least one user input module as the at least one switch actuator, and instructions for using the wireless communications module to transmit the switching signal. In a further form, the at least one user input module is a touch screen, and the memory comprises instructions for using at least a portion of the touch screen for the at least one switch actuator. In a further form, the mobile computing device is a phone or tablet, and the instructions are stored in an app downloaded to the phone or tablet.

[0013] In one form, the power supply module comprises a battery. In one form, the power module of the general power outlet wirelessly provides power to the power supply module in the remote switch module for powering the remote switch module. In a further form, the power module comprises a transmitter and the power supply module comprises a receiver for receiving power transmitted by the transmitter in the power module of the general power outlet.

[0014] In one form, the controller communications module and the remote communications module communicate using a radio frequency protocol. In one form, the protocol is the Zigbee protocol.

[0015] In one form, the remote switch module comprises a removable attachment module for removable attachment to a general power outlet. In one form, the GPO further comprises a housing and the housing is adapted to allow removable attachment of the remote switch module to the housing. In one form, the attachment module comprises one or more clips. The clips may clip on to the exterior of the general power outlet, or be inserted in apertures in the general power outlet. In one form, the attachment module may be a magnetic attachment module. In one form, the remote switch module comprises a housing that is constructed to match the thickness and shape of the GPO around the attachment location so that when the remote switch module is attached to the GPO the system has a flush appearance.

[0016] In one form, the control module comprises an attachment detection module, and the control module only switches the power supply state when the remote control module is detected as being attached to the general power outlet. In one form, the GPO comprises a plurality of sockets, and the remote switch module may be attached to the GPO in a plurality of attachment locations, and each attachment location is associated with one or more sockets, and the attachment detection module detects the attachment location, and the control module only allows the remote switch module to control switching of the one or more sockets associated with the current attachment location.

[0017] In one form, the control module further comprises a security module for verifying that the remote switch module is authorised to control the at least one socket of the GPO.

[0018] In one form, the remote switch module comprises at least one indicator for indicating the power supply state of at least one socket, and the controller communications module transmits the state of at least one socket to the remote communications module. The at least one indicator may be a single LED, or multiple LEDs, with each LED being associated with a socket in the general power outlet. In one form, the at least one indicator indicates the power status of the remote switch module.

BRIEF DESCRIPTION OF DRAWINGS

[0019] Embodiments of the present invention will be discussed with reference to the accompanying drawings wherein:

[0020] FIGURE 1 is a block diagram of a general power outlet (GPO) system according to one embodiment;

[0021] FIGURE 2 is a schematic diagram of a general power outlet illustrating a range of sizes and attachment locations for embodiments of remote switch modules;

[0022] FIGURE 3A is schematic diagram of an attachment module for attaching a remote switch module to a general power outlet according to one embodiment;

[0023] FIGURE 3B is schematic diagram of an attachment module for attaching a remote switch module to a general power outlet according to one embodiment;

[0024] FIGURE 3C is schematic diagram of an attachment module for attaching a remote switch module to a general power outlet according to one embodiment;

[0025] FIGURE 3D is schematic diagram of an attachment module for attaching a remote switch module to a general power outlet according to one embodiment;

[0026] FIGURE 4A is a schematic diagram of a user interface for a remote switch module according to an embodiment;

[0027] FIGURE 4B is a schematic diagram of a user interface for a remote switch module according to an embodiment;

[0028] FIGURE 4C is a schematic diagram of a user interface for a remote switch module according to an embodiment;

[0029] FIGURE 5A shows a perspective view of a rear assembly of an embodiment of a GPO;

[0030] FIGURE 5B shows an exploded perspective view of the contact assembly in the rear assembly of the GPO of Figure 5A;

[0031] FIGURE 5C shows a perspective view of an arrangement of printed circuit boards (PCBs) in the rear assembly of the GPO of Figure 5A;

[0032] FIGURE 5D shows a perspective view of the contact assembly of Figure 5B and the PCB arrangement of Figure 5C in the rear assembly of the GPO of Figure 5A;

[0033] FIGURE 5E shows a perspective view of the power board in the rear assembly of the GPO of Figure 5A;

[0034] FIGURE 5F shows a perspective view of the radio frequency (RF) board in the rear assembly of the GPO of Figure 5A;

[0035] FIGURE 5G shows a perspective view of the control board in the rear assembly of the GPO of Figure 5A;

[0036] FIGURE 5H shows a front view of the control board, RF board and shutters in the rear assembly of the GPO of Figure 5A;

[0037] FIGURE 5I shows an exploded perspective view of a rear housing in the rear assembly of the GPO of Figure 5A;

[0038] FIGURE 5J shows a perspective view of the power board inside the rear housing in the rear assembly of the GPO of Figure 5A;

[0039] FIGURE 6 is a schematic diagram of the circuit for the GPO;

[0040] FIGURE 7A is a perspective view of a faceplate and rear assembly according to an embodiment of a GPO;

[0041] FIGURE 7B is a perspective view of a faceplate and rear assembly according to an embodiment of a GPO;

[0042] FIGURE 7C is a perspective view of a faceplate and rear assembly according to an embodiment of a GPO; and

[0043] FIGURE 7D is a perspective view of a faceplate and rear assembly according to an embodiment of a GPO.

[0044] In the following description, like reference characters designate like or corresponding parts throughout the figures.

DESCRIPTION OF EMBODIMENTS

[0045] Referring now to Figure 1, there is shown a block diagram of general power outlet system 10 according to one embodiment. The system 10 comprises a general power outlet (GPO) 20 and a remote switch module 30. The general power outlet (GPO) 20 comprises at least one socket 21, a power module 22 for supplying electrical power to each of the at least one socket, and a control module 23 for controlling the power supply to each of the sockets by controlling the power module. The power module comprises connectors for receiving the electrical supply wiring (eg mains supply such as 220-240V AC 50Hz used in Australia or 120VAC 60Hz used in the United States of America) and may comprise additional circuits or modules for filtering, switching, routing or monitoring the electrical power supply to enable supply of electrical power to the socket. The control module further comprises a controller communications module 24 for receiving a switching signal 40 from the remote switch module 30. The control module switches the power supply state (ie from on to off or off to on) to the socket in response to the received switching signal 40. The control module may also comprise an attachment detection module 25 which may include a sensor 26. The control module may also comprise a security module 27.

[0046] The remote switch module 30 comprises at least one switch actuator 31, a power supply module 32 and a remote communications module 33. The remote communications module comprises a

transmitter 34 for transmitting the switching signal 40 to the receiver in the controller communications module 24 in the general power outlet 20 to cause switching of the power state of one of the sockets in response to actuation of the switch actuator. The switch actuator may be a toggle switch, a button or touch sensitive pad. The remote switch module may also comprise a user input module 37 that may provide the functionality of the switch actuator 31, such as configuring a region of a touch screen to be used as a switch actuator. In one embodiment, the remote switch module further comprises an indicator 35 for indicating the power supply state (ie on or off) of a socket 21 in the GPO 20.

[0047] In one embodiment, the remote switch module is a mobile computing apparatus comprising at least one processor 38, a memory 39 and a wireless communications module. The memory stores instructions for causing the at least one processor to cause the apparatus to implement the functionality of the remote switch module. The mobile computing apparatus may be a mobile (ie cell) phone, a tablet computer, a netbook, a laptop, a PDA, a portable music player, a portable gaming console or a controller for a gaming console etc. In one embodiment, the remote switch module is a mobile electronic device with a wireless communications capability, such as an alarm remote, a garage door remote, an air conditioner remote, a building automation system controller, camera, audio/visual device remote, a cordless telephone (eg for a landline), etc. Such devices may comprise a microcontroller or low cost processor and typically have much more limited functionality and capabilities than the mobile computing devices discussed above. In one embodiment, the remote switch module includes control software that is provided as a software application or “app” for a smartphone, tablet, or similar device that is stored in a memory (eg RAM, SD card, etc) of the device. In this embodiment, the control software is programmed or configured to cause the touchscreen of the apparatus to display one or more switch actuators 31 to allow remote control of the switch of the GPO, or configures an existing button or buttons (or keys) on the apparatus to act as the switch actuator 31. In some embodiments, the control software also provides an indicator 35 on the screen, as well as other GPO status information. In some embodiments, the remote communications module is provided by configuring or controlling the on board wireless communications components of the device. That is, an apparatus with a mobile communications module may be adapted, programmed or otherwise configured to communicate (ie send switching signals) with a GPO using the existing communication components.

[0048] In one embodiment the remote switch module further comprises a removable attachment module 36 to allow the remote switch module to be removably attached to a GPO. Figure 2 is a schematic diagram 200 of a GPO illustrating a range of sizes and attachment locations for embodiments of remote switch modules. The remote switch module may be attached adjacent to the GPO, and comprise a faceplate with one or more actuators and indicators, which may be associated with one or more sockets. Figure 2 illustrates a GPO 210 with two sockets, a left socket 212 and a right socket 214. The GPO has a predefined length, width and faceplate thickness (ie the amount that the face plate projects from the wall

that the GPO is mounted in) dimensions. In one embodiment, the housing of the remote switch module may be constructed to align with a specific side (length or width) of the GPO and thus be designed to have the same dimension as the side to which they are aligned. Figure 2 illustrates an embodiment of a remote switch module 220 which is attached to the top edge of a GPO (see arrow 216) and comprises two switch actuators 221, 224, and two indicators 222, 223. Each actuator and indicator pair (221, 222; 224, 223) are associated with a socket (212, 214 respectively). Figure 2 illustrates another similar embodiment of a remote switch module 230 which is attached to the right hand side of a GPO (see arrow 218) and comprises a single indicator 231 and switch actuator 232 which is associated with right hand socket 214. In other embodiments, the remote switch module is provided in a compact housing such as remote switch module 240 comprising single indicator 241 and switch actuator 242 which is attached to the right hand side of the upper right hand corner of the GPO and associated with the right hand socket 214, and similarly remote switch module 250 with single indicator 251 and switch actuator 252 which is attached above the upper right hand corner of the GPO and is associated with the right hand socket 214.

[0049] In some embodiments, the location of the connection of the remote switch module to the GPO determines which components (or switches) of the GPO 210 is or are controlled by the remote switch module when connected. For example, when the remote switch module 250 is connected to the GPO 210 in the top right hand corner of the GPO 210 as described above with reference to Figure 2, the remote switch module 250 only controls socket 214. If remote switch module 250 is instead connected to the GPO 210 in the top left hand corner of the GPO 210 then the remote switch module only controls socket 212. That is not to say that the remote switch module cannot control multiple switches, rather the location of connection limits what switch or switches of the GPO are able to be controlled by the remote switch module whilst the remote switch module is attached to the GPO. In the above example, remote switch module 250 could be first used to control left switch 212 of GPO 210 by connection in the top left hand corner, and then moved to the top right hand corner to allow control of right switch 214 of GPO 210.

[0050] The remote switch module may be attached on any side (top, left side, right side, bottom) or even multiple sides. For example, the module could be attached to a corner, or be provided in an annular frame which is placed over and frames or encloses the GPO. In the case of more than two sockets, a switch actuator and indicator pair may be associated with each of the multiple sockets as required. Alternatively, a single switch actuator and indicator may be used for control and indication of the state of multiple sockets as will be described below.

[0051] In one embodiment, the housing of the remote switch module is constructed to have thickness and a design which matches the faceplate thickness (ie the amount the face plate projects from the wall that the GPO is mounted in) to give the system a visually appealing smooth or flush appearance and may be constructed out of suitable materials such as plastics.

[0052] The attachment module 36 is used for removably attaching the remote switch module to the GPO. This allows the remote switch to be left with the switch, for example when the switch is under direct supervision by the owner, and can then be removed when the owner leaves the vicinity of the switch and does not wish the state of the switch to be changed in their absence. Additionally, attachment of the remote switch module ensures the remote switch module and GPO are sufficiently close to ensure reliable communications. Additionally or alternatively, attachment of the remote switch can be used as a security measure to ensure that switching is only performed by authorised remote switch modules.

[0053] Figures 3A to 3D illustrate various attachment modules. The attachment module may be designed to clip on to a GPO using one or more clips. The clips may clip on to the exterior of the general power outlet, or be inserted in apertures in the general power outlet. Figure 3A is a schematic view 301 of a remote switch module 320 with two clips 322, 324 which clip on to the exterior of a GPO 310 with a socket 312. Figure 3B is a schematic view 302 of a remote switch module 330 with two clips 332, 334 which are inserted into apertures 313, 314 in GPO 310. The clips 332, 334 may be sprung or biased to push away from each other (ie vertically up and down) and thus engage the internal sidewalls of the apertures to attach the remote switch module. The remote switch module may be removed by applying a horizontal (lateral) sideways force. In another alternative embodiment (not shown), the apertures could comprise retaining lugs or projections, and the clips may be connected to a lever or button arrangement to bias the clips towards each other for attachment or removal. In another alternative embodiment, the attachment module may be magnetically based. Figure 3C is a schematic view 303 of a GPO 310 with a magnetically sensitive material 316, such as block of steel or a permanent magnet located near a sidewall of the outlet. The remote switch module 330 comprises a permanent magnet 340 for attachment to the magnetically sensitive material 316 in the GPO. Alternatively, the permanent magnet 342 and magnetically sensitive material 316 could be swapped (ie magnet located in GPO), and the magnetically sensitive material includes a permanent magnet of opposite polarity to the polarity of the engagement surface of permanent magnet 340. Figure 3D is a schematic view 304 of an embodiment in which the attachment module of the remote switch module 350 comprises an external projection 352 for insertion in an aperture 318 of the GPO 310. The external projection 352 comprises two lugs 354, 356 which are used to attach (and retain) the remote switch module 350 to the GPO 310, in a similar way to that illustrated and described in relation to Figure 3B. The aperture 318 may comprise locating recesses to receive resilient lugs or projections. In other embodiments (not shown), the remote module could completely surround or frame the GPO, or be designed to clip over a corner of the GPO.

[0054] In one embodiment, the controller communications module further comprises a transmitter and the remote communications module further comprises a receiver to allow bi-directional communication between the two communications modules. In each module the transmitter and receiver may be implemented as a transceiver. Communications modules may communicate over any appropriate

wavelength suitable for short range communication such as Infra Red (IR), or Radio Frequency (RF). Communication may use a propriety or standard communications protocol such as WiFi, ZigBee or Bluetooth, which allow the use of low cost communication chips in devices.

[0055] In one embodiment, the power supply module 32 comprises a battery. A battery compartment may be provided to allow replacement of the battery. The battery type and capacity may be selected to provide long life (eg > 2 years) based upon an expected use profile.

[0056] In one embodiment, the power supply module 32 comprises a receiver for receiving power transmitted by the general power outlet, and thus does not need to be able to generate its own power directly, but can simply act as an interface between an external power source and components of the remote switch module. Power may be wirelessly transmitted between a transmitter and a receiver using a range of technologies such as inductive coupling or resonant inductive coupling. In one embodiment, power transmission is performed by inductively coupling two spaced coils (one acting as a transmitter and one as a receiver) based on the principle of mutual induction as is well known in the art (eg transformers). The power module in the general power outlet can be used to drive or excite a transmitting coil to produce a time varying magnetic field. The receiving coil is within this varying magnetic field and thus a corresponding signal is induced or inductively picked up in the receiving coil. Inductive coupling is highly efficient over very short ranges (mm to tens of cm) with increased efficiency being obtained when the coils are co-axially aligned. Another electromagnetic power transfer technique is resonant inductive coupling, in which the transmitting coil generates a magnetic field at a specific resonant frequency and the receiving coil is then tuned to this specific resonant frequency. Figure 3D further illustrates an inductive coupling arrangement used to supply power to the remote switch module. A transmitter coil 362 is located within the GPO and used to transmit power to a receiver coil 364 located within the external projection 352.

[0057] In other embodiments, power is transferred to the remote switch module via pins that conduct power from the GPO to the power supply module 32 of the remote switch module 30 upon connection of the remote switch module to the GPO. The pins could also form part of a projection or projections used to attach the remote switch module to the GPO. Similarly, an aperture in the GPO for receiving a projection may include pin receiving elements to receive the pins.

[0058] In one embodiment, the remote switch module further comprises an indicator 35 for indicating the power supply state (ie on or off) of a socket 22 in the GPO 20. In the case of multiple sockets, a single indicator may be used, or multiple indicators may be used with one indicator associated with each socket. The controller communications module transmits the state of a socket to the remote communications module so that the associated indicator can indicate the status. This may be in response to a status query

from the remote communications module. The indicators may be one or more LEDs, lighting elements, or an audio signal. In one embodiment, a signal is transmitted to a further remote device, such as a mobile phone, computing device, or other device, which is used to indicate the status. In one embodiment the indicators are LEDs and a green colour is used to indicate an off state, and a red colour to indicate an on state. This functionality may be provided by a multi-colour LED, or multiple single colour LEDs. The LEDs may also indicate alternative states such as low power in the remote communications module or a fault condition, such as inability to communicate with a GPO. Such other functionality may be provided using a different colour, such as yellow, or through a pattern of indications, such as flashing or strobing of the LED.

[0059] Figures 4A to 4C illustrate various user interfaces for a remote switch module according to various embodiments. Figure 4A illustrates a remote switch module 410 with a single button 412 and a single LED indicator 414. Figure 4B illustrates a remote switch module 420 with a single button 422 and two LED indicator, 424 and 426. Both LEDs may be used to indicate the state of a socket, such as one LED indicator being one colour, such as green to indicate an off state, and the other LED indicator being another colour such as red to indicate an on state. In another embodiment, each LED may be associated with a specific socket and may be a multicolour LED, or use various patterns to indicate the supply state of the associated socket, or other status information. Figure 4C illustrates another embodiment of a remote switch module 430 with two buttons 432 436 and two LED indicators 434 and 438. The buttons are paired with a LED indicator (eg 432 and 434, 436 and 438) and each pair is associated with a specific socket. In an embodiment where the remote switch module has a display screen (eg smartphone, tablet, mobile computing device), these indicators could be displayed on the screen.

[0060] In one embodiment where a single LED is associated with multiple sockets, various patterns could be used to indicate the status of each LED. In one embodiment, the indicator may cycle through the status of the sockets. Each socket could be assigned a number starting from 1, and the status of that socket could be indicated by flashing or pulsing the LED an appropriate status colour (eg red for on, green for off) the number of times associated with the assigned socket number, with fixed length pauses between sockets. A longer pause could be used to indicate a gap between indication cycles. For example, if socket 1 is in the off state, and socket 2 in the on state, then the LED indicator could flash green once for 0.5s, pause for 1 second (inter socket pause), then flash red twice for 0.5s with a 0.25s gap between flashes (ie smaller than the inter socket pause), followed by a 5 second pause (ie longer than the inter socket pause) before starting the cycle again.

[0061] In one embodiment, the indicators are maintained in an off or sleep state (thereby conserving battery power) and only perform indication function in response to actuation of an associated input device. On actuation, the status of the associated socket is displayed for a set period of time (eg 5, 10, 30,

60, etc seconds), or a set number of cycles (eg 5, 10, 50 etc) in the case the indicator is used to indicate the state of multiple sockets as discussed above.

[0062] In one aspect the control module, the GPO and/or the remote switch module comprises an attachment detection module which is used to control or inhibit functionality such as switching of the power supply state or communications between the GPO and the remote control module. This may be performed to extend battery life or to provide added security. The attachment detection module comprises a sensor which may detect physical attachment of the remote switch module. In one embodiment, a sensing element or projection may be located on the side wall or in a receiving aperture such that passage of a clipping element of the remote control module depresses and retains the sensing element or projection in a depressed state which signals attachment of the remote switch module. In another embodiment, a wireless sensor detects proximity of the remote switch module. For example, if a wireless power transmission is utilised a sensor could detect the presence of the receiver coil by the effect on the transmitter coil signal. Alternatively, the sensor could comprise a wireless transmitter and receiver such as a photo diode arrangement which would detect proximity of the remote switch module based on the reflected return signal. In another embodiment, attachment could be detected based upon the strength of the communication signal between GPO and the remote control module (for example using a predefined threshold). Sensors may be located in either the GPO or the remote switch module.

[0063] In an embodiment in which the remote module is supplied with power from the GPO via pins that are inserted into pin receiving elements in the GPO, the sensor could monitor either the pins or the pin receiving elements. For example, the sensor could monitor current flow through the pins or pin receiving elements or a change in the resistance (eg from open circuit to closed circuit conditions). In one embodiment, an identifier of the switch associated with the pin receiving elements could be encoded onto the power signal supplied to the pins, and the power supply module of the remote switch module could decode and extract the encoded identifier so that it could be used in wireless communications between the remote switch module and the GPO to identify the switch of the GPO to be controlled.

[0064] The sensor could generate an attachment signal which indicates to the control module that the remote control module is attached to the GPO. This attachment signal could then be used to control functionality, such as inhibiting switching of the power supply state in the absence of the attachment signal (ie to prevent switching when the remote control module is not attached to the GPO). In another embodiment, the remote switch module may conserve power by preventing communication in the absence of an attachment signal. In an embodiment in which the GPO comprises a plurality of sockets and the remote switch module can be attached to the GPO in a plurality of attachment locations, then the attachment detection module may also detect the attachment location. In this embodiment, the control module is configured to associate each attachment location with one or more sockets (eg individual

sockets, pairs of sockets, etc). When the remote switch module is attached, the control module detects where it is attached (via attachment detection module and any associated sensors), and only allows the remote switch module to control switching of the one or more sockets associated with the current attachment location.

[0065] In some embodiments, the control module further comprises a security module for verifying that the remote switch module is authorised to control one or more sockets of the GPO to provide improved control of switching of the GPO. The security module may be a physical module, implemented electronically or, in software using security protocols (eg utilising authorisation codes, keys or pass words or phrases) or a hardware software combination. In one embodiment, a physical lock is provided on either the GPO or the remote module, so that only users with a key matching the lock can attach or remove a remote module to/from the GPO.

[0066] In another embodiment, only authorised remote control modules may be used to control the sockets or power supply in a GPO. In one embodiment, security protocols, such as key exchange protocols, are used to verify attachment or proximity of an authorised remote control. In another embodiment, authorisation codes may be provided using RFID technology and methods. For example, an RFID tag could be provided in the remote control module, and queried by the GPO (or vice versa). In another embodiment, a user may have to first enter a code using one or more actuators provided on the user interface of the remote control module. For example, a binary code could be entered using a series of short and long button presses or a combination of buttons if more than one button is provided, and then this entered code could be verified by the remote control module and/or the GPO.

[0067] During manufacture or installation, a GPO and/or a remote switch module could be programmed with a list of authorisation codes or keys. Groups of GPO's and remote switch modules may share a common authorisation code or codes. This would enable use of a single remote switch module, with any GPOs at a specific location (eg building), or locations. The use of authorisation codes prevents unauthorised users from attempting to obtain power from a GPO or change the state of a GPO using their own remote switch module.

[0068] In the embodiments where the remote switch module is a mobile computing device such as a smart phone or tablet, these authorisation codes or keys could be provided in an app, or otherwise input using the devices input interface (eg virtual touch screen keypad or physical keypad). The mobile computing device and the GPO could then be linked using the authorisation codes.

[0069] An embodiment of a GPO will now be described in detail. Figures 5A to 5J show various views of an embodiment of a GPO and Figure 6 is a schematic diagram 600 of the circuit for the GPO. Figure

5A is a perspective view of a modular rear assembly 500 for a GPO according to one embodiment. The rear assembly is modular and comprises a rear housing 510 for housing several sub-assemblies of the GPO. The housing and assembly may be constructed from suitable plastics or other materials typically used for GPOs. The sub assembly implements the functional modules of the GPO described above and illustrated in Figure 1.

[0070] Figure 5B shows an exploded perspective view of the contact assembly 520. The contact assembly comprises contacts (female sockets or connectors) for receiving the respective individual (male) pins or spades of a plug. The contact assembly comprises a first socket housing 524a which comprises a first active contact 521a for receiving a first active spade 528a, a first neutral contact 522a for receiving a first neutral spade 529a and a first ground contact 523a, and a second socket housing 524b which comprises a second active contact 521b for receiving a second active spade 528b, a second neutral contact 522b for receiving a second neutral spade 529b and a second ground contact 523b. The two ground contacts 523a and 523b have a rear connector 525 to a ground terminal.

[0071] The rear assembly further comprises three printed circuit boards (PCBs), namely a power board 530, a RF board 540 and a control board 550. Figure 5C illustrates a perspective view of the arrangement of the three PCBs in the rear assembly with the power board orientated vertically at the rear, the RF board oriented horizontally at the bottom of the power board, and the power board located in a vertical orientation near the front of the rear assembly and above the RF board. Figure 5D illustrates a perspective view of the arrangement of the three PCBs: 530, 540, and 550, and the contact assembly 520. The three PCBs are arranged around the contact assembly so that the RF aerial on the RF power board is as close to front of the assembly as possible to maximise propagation of signals and as far away as possible from the power PCB to minimise any magnetic interference to the RF signal generated by the power PCB. The control PCB 550 is also located so that it does not interrupt access to socket housings 524a 524b.

[0072] Figure 5E is a perspective view of the power board 530. The power board comprises two relays 531a, 531b which are located at the top of the module to assist in dissipating heat and to assist in preventing excessive heating of other components or rise in temperature. A gap 532 is located between the relays to assist with removing heat generated in the assembly. A large jumper wire 535 is used to supply power to both relays from the Active 533 and Neutral 534 terminals. The wiring from the power PCB to the plug pin contacts uses IDC connection in a tight space. This reduces space, cost and the design allows assembly without screws and wiring terminals. In one embodiment, the power PCB also comprises additional components such as voltage sensors 536a, 536b and current sensors 537a, 537b for measuring voltage and current in circuits associated with each respective sockets, and a thermal fuse 538 (see Figure 6).

[0073] Figure 5F is a perspective view of the RF board 540. The RF board 540 has an edge connector 541 for connection of the RF board 540 to the power board 530, and a ribbon connector 542 for connection to the control board 550 via a ribbon cable. The RF board also includes a RF aerial (antenna) 543 on the underside of the PCB (shown in dotted form), along with components for transmitting and receiving RF signals (eg according to a ZigBee, Bluetooth, or other RF protocol).

[0074] Figure 5G is a perspective view of the control board 550. The control board has two edge mounted micro switches 555a, 555b, each for contacting a respective shutter 526a, 526b which is mounted in front of the socket outlet contacts and behind the socket fascia as illustrated in Figure 5H which is a front view of the control board, RF board, and shutters. When a plug is inserted into the socket, the shutter is moved or actuated laterally to depress (actuate) or activate the respective micro switch (ie to switch to an on state). Figure 5H illustrates the first socket with the first shutter 526a in the default position and micro switch 555a depressed, and the second socket with second shutter 526b in the actuated location clear of the second micro switch 555b which is in an open state. The design is such that the control board is joined to the RF board using a flexible connector such as ribbon cable. Figures 5G and 5H show a connector 559 for connection to the RF Board 540 via a ribbon cable 544.

[0075] The control board 550 further comprises LED 551 to indicate power to the GPO, a ZigBee configuration interface located in the centre of the control board comprising a setup tactile switch 552, a reset tactile switch 553 and a dual colour LED 554 for indicating the ZigBee status. The control board also comprises respective slider switches 556a, 556b for switching control of respective sockets from remote to manual control, switch status LED indicators 557a, 557b, and tactile switches 558a, 558b for manual switching of on/off state of the sockets. In some embodiments, access to the sliders, tactile switches and/or LED indicators may be prevented by the faceplate (see Figures 7A to 7D). In some embodiments, they may be omitted, with no manual control or indication, and all control and indication via a remote module.

[0076] The rear housing assembly has drop in terminals and all connections are made in the same plane and orientation. No soldering is required for the earth terminal. Figure 5I is an exploded perspective view of the rear housing. The rear assembly 510 receives drop in terminals 511, 512, 513 for receiving the active, ground and neutral lines (wires). The active 533 and neutral 534 connectors on the power board 530 and ground connector 525 slot into and make contact with the respective terminals. A perspective view of the power board 530 inside the rear housing assembly 510 with the assembly terminals is shown in Figure 5J.

[0077] The remote switch module may also comprise elements of the power board, control board and RF board, all provided on a single board to reduce space. As discussed above, the remote switch module may

comprise a battery power source, a ZigBee interface (including a transceiver), tactile switches, LED indicators to allow communication and remote control of the GPO.

[0078] As the rear switch mechanism is modular, it is possible to attach to a variety of face plates and rear plates to provide a range of styles for the GPO. Further, within a given style, variations of faceplates can be provided to accommodate remote controls which can be clipped on or attached. These can be assembled from the front or rear. Figure 7A illustrates an embodiment of rear assembly 500 of a GPO which is clipped into a rear plate 710 and which receives a face plate 720. In this embodiment the face plate includes apertures to provide access to the slider switches to allow a user to switch between manual and remote control modes, and provides housings and a light pipe for the tactile switches and LED indicators to allow manual control of switches via the face plate. An aperture/light pipe for the power status LED is also provided on the front. A small recess with apertures and/or light pipes that, in use, can be hidden with a cover, is also provided to allow access to the ZigBee setup switches and ZigBee status indicator.

[0079] Figure 7B illustrates another embodiment of a rear assembly 500 of a GPO on to which a face plate 730 is mounted. In this embodiment, the face plate has apertures to provide user access to the slide switches to allow switching between manual and remote control modes, and apertures/light pipes for the LED indicators to indicate the on/off state of the switches to a user. In this embodiment, tactile switches are still provided on the control board but access is prevented by the face plate (ie no apertures or actuators are provided). In this embodiment, the manual mode could be configured so that switches always supply power when a plug is inserted into a socket, but they can only be turned off (with a plug inserted) via a remote control. Alternatively, they could be configured so no power is supplied in manual mode (in which case access to the slider switches could also be prevented), with full control available via the remote control.

[0080] Figures 7C and 7D illustrate another embodiment of a rear assembly 500 of a GPO on to which a face plate 740 is mounted. As shown in Figure 7C, the face plate has no user accessible (or actuate-able) switches on the face plate, and a recessed portion 741 is provided for receiving a clip-in remote control module 742 for controlling the on/off state of the switches. Thus, a user cannot change the state of the switches or obtain an indication of their state. Figure 7D illustrates the face plate with the remote control clipped into the recess 741 allowing a user full control of the sockets, and an indication of their on/off state. The remote control comprises a respective switch and LED indicator for each socket to allow a user to switch the state of the socket (on/off), and be shown an indication of the state of the socket. In this embodiment, the remote control clips into the recessed portion 741 to provide an integrated or seamless appearance. That is, the lower edge 743 of remote control 742 is designed to match the profile of the faceplate (the seam or join is indicated by the dashed lines). In other embodiments, the remote control

may project out from the faceplate. In this embodiment, no tactile switches or manual/remote sliders are provided on the control board. In other embodiments they could be provided but access could be prevented by the face plate.

[0081] In some embodiments, a range of remote control modules 742 can provide each with different functionality and/or appearances to allow a user to change the appearance and/or functionality.

[0082] A general power outlet system has been described comprising a modular switch for use with a general power outlet that allows smart or improved control of power. The use of a removable remote switch module that communicates with a general power outlet allows greater control of use of power from the outlet. The remote power outlet can be battery powered and use wireless communications protocols such as the Zigbee protocol. Indicators such as LED indicators can be used to inform the user of the status of the GPO. An actuator such as a button or touch panel can be provided to allow the user to change the power state of socket in the GPO.

[0083] These embodiments are particularly useful in locations where it is desirable to restrict control of the power state of GPO or where greater flexibility is required. For example, a user may have a GPO located in a public location, but wish to prevent use of their power to the public. Care facilities such as hospitals, aged care, or child care facilities may wish to have some machines always on, or may wish to have unused GPO's to be maintained in an off state to prevent accidental injury which may occur if occupants (eg children or mentally impaired) attempt to tamper or play with an GPO. Similarly, parents may wish to control use of a GPO in a child's bedroom, or business may wish ensure power is always on to selected machinery. In other embodiments, use of the module switch or separate control module can provide more flexibility in the functionality of the GPO.

[0084] Those of skill in the art would understand that information and signals may be represented using any of a variety of technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips may be referenced throughout the above description and may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0085] Those of skill in the art would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and

design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

[0086] The steps of a method or algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. For a hardware implementation, processing may be implemented within one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, other electronic units designed to perform the functions described herein, or a combination thereof. Software modules, also known as computer programs, computer codes, or instructions, may contain a number a number of source code or object code segments or instructions, and may reside in any computer readable medium such as a RAM memory, flash memory, ROM memory, EPROM memory, registers, hard disk, a removable disk, a CD-ROM, a DVD-ROM or any other form of computer readable medium. In the alternative, the computer readable medium may be integral to the processor. The processor and the computer readable medium may reside in an ASIC or related device. The software codes may be stored in a memory unit and executed by a processor. The memory unit may be implemented within the processor or external to the processor, in which case it can be communicatively coupled to the processor via various means as is known in the art.

[0087] Throughout the specification and the claims that follow, unless the context requires otherwise, the words “comprise” and “include” and variations such as “comprising” and “including” will be understood to imply the inclusion of a stated integer or group of integers, but not the exclusion of any other integer or group of integers.

[0088] The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement of any form of suggestion that such prior art forms part of the common general knowledge.

[0089] It will be appreciated by those skilled in the art that the invention is not restricted in its use to the particular application described. Neither is the present invention restricted in its preferred embodiment with regard to the particular elements and/or features described or depicted herein. It will be appreciated that the invention is not limited to the embodiment or embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.

CLAIMS

1. A general power outlet system comprising:
a general power outlet (GPO), comprising:
 - at least one socket;
 - a power module for supplying electrical power to each of the at least one socket;
 - a control module for controlling the power supply state of each of the at least one socket by controlling the power module, comprising a controller communications module for receiving a switching signal from a remote switch module, wherein the control module switches the power supply state in response to the received switching signal;
 - a housing wherein the housing is adapted to allow removable attachment of the remote switch module to the housing,
 - an attachment detection module for detecting attachment of the remote switch module to the GPO, wherein the attachment detection module comprises a sensor which detects physical attachment of the remote switch module to the GPO and generates an attachment signal which indicates to the control module that the remote control module is attached to the GPO and is used by the control module to control or inhibit switching of the power supply state, wherein in a remote control mode the control module only switches the power supply state when the remote switch module is detected as being attached to the GPO; and
 - the remote switch module, comprising:
 - a removable attachment module for removable attachment to the GPO;
 - at least one switch actuator;
 - a power supply module; and
 - a remote communications module, comprising a transmitter for transmitting the switching signal to the control module in the general power outlet to cause switching of the power state of at least one of the at least one socket in response to actuation of one of the at least one switch actuators.
2. The system as claimed in claim 1 , wherein the controller communications module and the remote communications module communicate using a radio frequency protocol.
3. The system as claimed in claim 2, wherein the protocol is the Zigbee protocol.
4. The system as claimed in any one of claims 1 to 3, wherein the power supply module of the remote switch module comprises a battery.

5. The system as claimed in any one of claims 1, 2 or 3, wherein the power supply module of the remote switch module comprises a receiver for wirelessly receiving a power signal transmitted by the GPO and the power module of the general power outlet wirelessly provides power to the power supply module in the remote switch module for powering the remote switch module.
6. The system as claimed in any one of claims 1 to 5, wherein the control module further comprises a manual to remote switch for the at least one socket for switching the control module between a manual mode and a remote control mode and in the manual mode the power supply state to the at least one socket is configured to be either in an on state or an off state when the remote control module is detected as not being attached to the GPO and when the remote control module is detected as attached the control module switches allows switching of the power supply state, and when in the remote control mode the control module only switches the power supply state when the remote switch module is detected as being attached to the general power outlet.
7. The system as claimed in any one of claims 1 to 6, wherein the GPO comprises a plurality of sockets, and the remote switch module may be attached to the GPO in a plurality of attachment locations, and each attachment location is associated with one or more sockets, and the attachment detection module detects the attachment location, and the control module only allows the remote switch module to control switching of the one or more sockets associated with the current attachment location.
8. The system as claimed in any one of claims 1 to 7, wherein the remote switch module further comprises a housing that is constructed to match the thickness and shape of the GPO around an attachment location so that when the remote switch module is attached to the GPO the system has a flush appearance.
9. The system as claimed in any one of claims 1 to 7, wherein the remote switch module further comprises at least one indicator for indicating the power supply state of at least one socket and the controller communications module transmits the state of at least one socket to the remote switch module.
10. The system as claimed in any one of claims 1 to 9, wherein the remote switch module further comprises an indicator for indicating the power status of the remote switch module.
11. The system as claimed in any one of claims 1 to 10, wherein the control module further comprises a security module for verifying that the remote switch module is authorised to control the at least one socket of the GPO, and the remote switch module stores one or more authorisation keys that are used to verify that the remote switch module is authorised to control at least one socket of a GPO.

12. The system as claimed in any one of claims 1 to 11, wherein the removable attachment module is configured to attach the remote switch module to at least one side of the GPO.
13. The system as claimed in any one of claims 1 to 11, wherein the removable attachment module is configured to clip the remote switch module onto the GPO.
14. The system as claimed in any one of claims 1 to 11, wherein the removable attachment module is configured to magnetically attach the remote switch module to the GPO.
15. A general power outlet (GPO) comprising:
 - at least one socket;
 - a power module for supplying electrical power to each of the at least one socket;
 - a control module for controlling the power supply state of each of the at least one socket,comprising a controller communications module for receiving a switching signal from a remote switch module, wherein the control module switches the power supply state in response to the received switching signal;
 - a housing wherein the housing is adapted to allow removable attachment of the remote switch module to the housing,
 - an attachment detection module for detecting attachment of the remote switch module to the GPO, wherein the attachment detection module comprises a sensor which detects physical attachment of the remote switch module to the GPO and generates an attachment signal which indicates to the control module that the remote control module is attached to the GPO and is used by the control module to control or inhibit switching of the power supply state, wherein in a remote control mode the control module only switches the power supply state when the remote switch module is detected as being attached to the GPO.
16. The GPO as claimed in claim 15, wherein the controller communications module communicates with the remote switch module using a radio frequency protocol.
17. The GPO as claimed in claim 16, wherein the protocol is the Zigbee protocol.
18. The GPO as claimed in claim 15, 16 or 17, wherein the power module wirelessly provides power to the remote switch module.
19. The GPO as claimed in any one of claims 15 to 18, wherein the control module further comprises a manual to remote switch for the at least one socket for switching the control module between a manual mode and a remote control mode and in the manual mode the power supply state to the at least one socket is configured to be either in an on state or an off state when the remote control module is detected as not

being attached to the GPO and when the remote control module is detected as attached the control module switches allows switching of the power supply state, and when in the remote control mode the control module only switches the power supply state when the remote switch module is detected as being attached to the GPO.

20. The GPO as claimed in any one of claims 15 to 19, wherein the GPO comprises a plurality of sockets, and the remote switch module may be attached to the GPO in a plurality of attachment locations, and each attachment location is associated with one or more sockets, and the attachment detection module detects the attachment location, and the control module only allows the remote switch module to control switching of the one or more sockets associated with the current attachment location.

21. The GPO as claimed in any one of claims 15 to 20, wherein the control module further comprises a security module for verifying that the remote switch module is authorised to control the at least one socket of the GPO.

22. A remote switch module when used in the system of any one of claims 1 to 14 , comprising:
 a removable attachment module for removable attachment to the GPO;
 at least one switch actuator;
 a power supply module; and
 a communications module, comprising a transmitter for transmitting a switching signal to a control module in the general power outlet to cause switching of the power state of at least one of the at least one socket in response to actuation of one of the at least one switch actuators.