ADVANCED SMART POWER SOCKET USING IOT

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ABSTRACT

A high percentage of electricity is lost due to power theft and improper management. However a bulk of these losses is caused by electricity theft. The illegal usage of electricity must be solved by electronic, without any human interaction. The purpose of this work is to provide an implementation methodology for electricity theft detection and controlling which allows violators to be detected at a remote location. In the proposed method GPRS technology is used to transmit the energy reading and alert automatically to the authorized energy provider via an alert message which eliminates the various issues related to the meter reading and theft detection. This also includes controlling device from a remote location through internet which enables efficient use of electricity.

Keyword: MorSocket, IoT, Sensors, Zigbee protocol, Arduino Uno, Relay.

INTRODUCTION

Due to flourishing development of Internet of Things (IoT) technology, many smart home applications have become commercially available. One of the most popular applications is remotely controlled smart sockets, which is one of the easiest ways to integrated general home appliances with IoT. Examples of smart socket products including Xiaomi MI smart socket, MINI smart socket, and Wi-Fi smart socket. Most of these products are non-expandable single sockets controlled through one wireless technology such as Wi-Fi. Most of them provide voice control and may have alarm clock function to turn on or off the sockets. These types of smart sockets cannot be expanded with arbitrary number of sockets. Also, they do not allow arbitrary sensors to automatically control the sockets. We will give the details of these approaches and compare them with our solution. National Chiao Tung University (NCTU) is deploying IoT applications through a smart campus program, where smart socket is an application to be developed in a new student dorm. This application is called MorSocket sockets'').

Like other commercial smart socket products, MorSocket can be controlled by smart phones through either Wi-Fi or Bluetooth. Furthermore, MorSocket allows control of multiple sockets (in the current implementation, the maximum number is 30) with only one wireless module that supports both Wi-Fi and Bluetooth. This project extends MorSocket so that the user can flexibly control smart socket by using the sensors. For example, through the light sensor, MorSocket is automatically turned on or off according to the light intensity of the room. We utilize an IoT management system called IoT talk to achieve the above goal [1]. IoT talk allows the user to easily and flexibly accommodate arbitrary sensors to control home appliances connected to MorSocket. This illustrates the simplified functional block diagram for the IoT talk platform, which consists of the IoT talk server. The IoT talk server interacts with the Device Application.

The IDA implements the sensor and/or actuator software to be executed in the IoT device hardware. The DA communicates with the IoT talk server for IDA registration and data exchange. The connection is established with wireline or wireless technologies (LTE, NB-IoT or Wi-Fi). When an IoT device attaches to IoT talk, the DA initiates the registration procedure to inform the IoT talk server of this connection. After the registration, the IoT device is recognized, and the network application corresponding to the device is automatically created and executed by the IoT talk server. In the current implementation, the IoT talk server provides HTTP-based REST full application programming interfaces (APIs) or MQTT APIs for the DA to deliver the IoT data [3]. In this scenario, the DA in the smart phone typically communicates with the IDA by using Bluetooth, and the DA in the server typically communicates with the IDA by using Wi-Fi. We note that multiple sockets are linked to the master socket through wire lines to share the same wireless module [2]. Therefore, the hardware cost for wireless communications is reduced. In the IoT talk platform, an IoT device can be directly controlled by a smart phone without connecting to the IoT talk server. This smart phone is

considered as an IoT device with the IDA that interacts with another IDA directly using Bluetooth or indirectly through the gateway (using Wi-Fi). In IoT talk, every device is defined as a set of input and output ''device features'' (DFs). An input DF (IDF) can be a sensor (such as those for temperature, UV, humidity and so on) or a controller (such as a button). An output DF (ODF) is an actuator.

Every IoT device consists of two parts: the input device (the set of IDFs) and/or the output device (the set of ODFs). The mechanism to retrieve the sensor/control values to the IDFs and to send the values to the ODFs is implemented in the IDA of the device. One or more network applications are automatically created/re-used at the IoT talk server for the IoT device. When the IDFs of the IoT device produce new values, they are sent to the server, and the corresponding network application is executed to take actions, which may produce results to be sent to the ODFs of the same or other IoT devices. The mechanism to exchange the data with the IoT talk server is implemented in the DA [6]. With the DA/IDA structure and the concept of device feature, we effectively modularize the software components of the IoT devices, and can easily reuse these components to speed up the creation of IoT devices for IoT talk applications. This project shows how smart socket can be easily implemented in IoT talk.

EXISTING SYSTEM

In order to help the consumers interact with smart homes, this paper proposes the use of a small wireless, hand-held tangible cylindrical device called a Sense Pod. As Fig.1shows these low-cost devices can be placed in various living spaces like the bedroom, the living room and even in the bathroom. In order to communicate with the smart home, the homeowner employs gestures like tapping and rolling the Sense Pod on any surface. Each Sense Pod can be programmed to control a specific appliance or object or a group of objects within a space. The devices for man ad-hoc wireless ZigBee network and communicate with the smart home controller through a coordinating device connected to the home controller via a Universal Serial Bus (USB) interface. The coordinating device forwards an appropriate code (e.g., "raise curtain 234") for Object/appliance to the smart home system that takes an appropriate action either through a wired (e.g., X10) or wireless interfaces (e.g., Wi-Fi, ZWave, ZigBee etc.). Sense Pods can be easily integrated with any smart home system because only a USB interface is required .In addition; Sense Pods do not require frequent charging because they are based on the low-power ZigBee protocol. Finally, Sense Pods use the 2.5 GHz wireless frequency, which makes them particularly suited for a home environment.

The primary criteria for design of Sense Pods were simplicity and an appropriately low physical, processing, and memory footprint. The design and implementation of hardware and software is described below.

Fig 1: SensePods for smart homes forming an ad-hoc ZigBee network

DISADVANTAGES

1. The range of the device is limited to 30m.
2. Logging of power usage and sensor values is not possible.
3. We can monitor only the present status of the house.

SMART POWER SOCKET USING IOT

Modern homes provide electricity to electrical devices through the last element of the power supply chain, the power sockets, which have been regarded traditionally as a mere junction. In fact, power sockets have not evolved as fast as other everyday devices, although they seem to be one of the best positioned candidates to be improved as smart homes are becoming increasingly popular. In the last years, different functionalities have been added to power sockets, like wireless control or current consumption monitoring, but there are still many others that could make such devices smarter [5]. This project addresses some of the most common problems that arise when interacting with power sockets and shows a novel approach to two of them: the prevention of electrical fires and the avoidance of electrical shocks. Regarding electrical fires, they are described as fires that begin because of some type of electrical failure or malfunction [7].

The National Fire Protection Association (NFPA) latest report states that, in 2011, just in the USA, there were 47,700 home electrical fires that resulted in 418 civilian deaths,1,570 civilian injuries, and $1.4 billion in direct property damage. In the same report it is also stated that, of

all the electrical fires whose cause could be determined precisely, the vast majority were caused by short- circuits [1]. A similar situation occurs with electrical shocks. According to the Electrical Safety Foundation, in North America each day nearly 7 children are treated in hospital emergency rooms for electric shock or burn injuries caused by tampering with a wall outlet. In the same region, fires and burns are the third leading cause of unintentional death among children aged 14 and under. In order to address the two issues previously mentioned this paper presents a smart power outlet system that has the following features:

1. It is able to detect over consumptions that might lead to overheat in low-current systems and, therefore, to an electrical fire.
2. It prevents electrocutions, since it only supplies power when it identifies a valid appliance.
3. It can be controlled remotely using wireless sensor network technology.
4. It is able to monitor in real-time and make available to external devices (e.g., PCs connected to the Internet, smart phones, and tablets) current consumption data.
5. It can disconnect the power supply when a vampire current is detected (a vampire current is a current that arises when an appliance consumes power when it is in stand-by mode or when it claims to be switched off).

ADVANTAGES OVER EXISTING SYSTEM

1. The device can be accessed from anywhere around the world.
2. Every sensor values and power consumption is logged on the server for future reference.
3. We can even detect power theft using this technology.

PROCEDURAL VIEW

The conceptual design of the proposed smart socket for real-time remote power monitoring and controlling of connected load. As shown in the figure, the socket can be remotely accessed through a wireless medium. The instrument determines and processes the single-phase power line voltage and current of the connected device. The socket sends the captured data to the master node when connected to a master node or controller. The socket utilizes wireless connectivity and a memory for storing raw data. Special signal- conditioning circuits are also used to sample the line voltage and current and relay data. Furthermore, the socket can turn on or off the connected appliance from the master controller.

The signals are initially processed by the micro controller and stored in its memory. Then, the processed data are passed to the GPRS module for transmission. Therefore, the microcontroller is the most important part of the smart socket.

BLOCK DIAGRAM

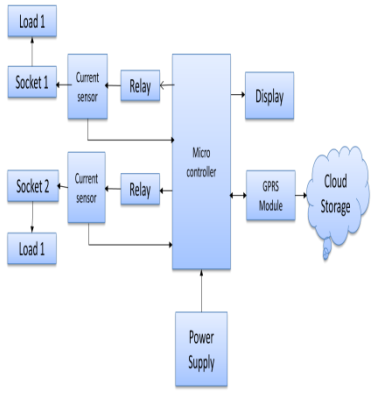

Fig.2.Block diagram of proposed system

HARDWARE REQUIREMENT

ARDUINO UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes pre programmed with a boot loader that allows uploading new code to it without the use of an external hardware programmer. It communicates

using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Fig.3.Arduino Uno

CURRENT SENSOR

A current sensor is a device that detects electric current in a wire, and generates a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. The generated signal can be then used to display the measured current in an ammeter, or can be stored for further analysis in a data acquisition system, or can be used for the purpose of control. The sensed current and the output signal can be:

ALTERNATING CURRENT input,

1. Analog output, which duplicates the wave shape of the sensed current.
2. Bipolar output, which duplicates the wave shape of the sensed current.
3. Unipolar output, which is proportional to the average or RMS value of the sensed current.

DIRECT CURRENT inputs,

1. Unipolar, with a unipolar output, which duplicates the wave shape of the sensed current
2. Digital output, which switches when the sensed current exceeds a certain threshold

Fig.4. Current Sensor

SOCKET:

AC power plugs and sockets allow electric equipment to be connected to the alternating current (AC) power supply in buildings and at other sites. Electrical plugs and sockets differ from one another in voltage and current rating, shape, size, and connector type. Different standard systems of plugs and sockets are used around the world.

Plugs and sockets for portable appliances became available in the 1880s, to replace connections to light sockets with wall-mounted outlets. A proliferation of types developed for both convenience and protection from electrical injury. Today there are about 20 types in common use around the world, and many absolute socket types are found in older buildings. Coordination of technical standards has allowed some types of plug to be used across large regions to facilitate trade in electrical appliances, and for the convenience of travellers and consumers of imported electrical goods.Some multi-standard sockets allow use of several types of plug; improvised or unapproved adaptors between incompatible sockets and plugs may not provide the full safety and performance of an approved socket–plug combination.

Fig.5. Socket

RELAY:

Relays are the primary protection as well as switching devices in most of the control processes or equipments. All the relays respond to one or more electrical quantities like voltage or current such that they open or close the contacts or circuits. A relay is a switching device as it works to isolate or change the state of an electric circuit from one state to another.

Classification or the types of relays depend on the function for which they are used. Some of the categories include protective, reclosing, regulating, auxiliary and monitoring relays. Protective relays continuously monitor these parameters: voltage, current, and power; and if these parameters violate from set limits they generate alarm or isolate that particular circuit [10]. These types of relays are used to protect equipments like motors, generators, and transformers, and so on.

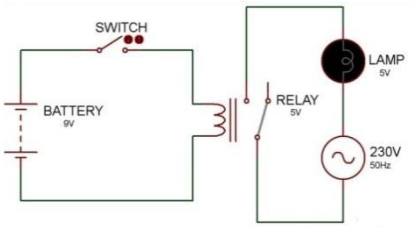

Fig.6. circuit diagram of relay

Reclosing relays are used to connect various components and devices within the system network, such as synchronizing process, and to restore the various devices soon after any electrical fault vanishes, and then to connect transformers and feeders to line network. Regulating relays are the switches that contacts such that voltage boosts up as in the case of tap changing transformers.
Auxiliary contacts are used in circuit breakers and other protective equipments for contact multiplication. Monitoring relays monitors the system conditions such as direction of power and accordingly generates the alarm. These are also called directional relays.

Fig.7. Relay

GPRS MODULE:

General Packet Radio Service (GPRS) is a packet oriented mobile data standard on the 2G and 3G cellular communication network's global system for mobile communications (GSM). GPRS was established by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i -mode packet-switched cellular technologies. It is now maintained by the 3rd Generation Partnership Project (3GPP).

GPRS is typically sold according to the total volume of data transferred during the billing cycle, in contrast with circuit switched data, which is usually billed per minute of connection time, or sometimes by one-third minute increments [6]. Usage above the GPRS bundled data cap may be charged per MB of data, speed limited, or disallowed. GPRS is a best-effort service, implying variable throughput and latency that depend on the number of other users sharing the service concurrently, as opposed to circuit switching, where a certain quality of service (QoS) is guaranteed during the connection. In 2G systems, GPRS provides data rates of 56–114k bit/sec. 2G cellular technology combined with GPRS is sometimes described as *2.5G*, that is, a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate-speed data transfer, by using unused time division multiple access (TDMA) channels in, for example, the GSM system. GPRS is integrated into GSM Release 97 and newer releases

GPRS Modules are similar to modems, but there's one difference: A GRPS Modem is external equipment, whereas the GPRS Module is a module that can be integrated within equipment. It is an embedded piece of hardware. A GPRS modem is a GSM modem with additional support for GPRS technology for data transmission. GPRS means: 'General Packet Radio Service' [8]. It is based on a packet-switched technology, as an extension to GSM (note that GSM is a circuit-switched). An advantage of GPRS over GSM is that GPRS has a much higher data transmission speed. GPRS can be used as the bearer of SMS. If SMS over GPRS is used, an SMS transmission speed of about 30 SMS messages per minute may be achieved. This is much faster than SMS over GSM. A GPRS modem is required to send and receive SMS via GPRS. Some wireless carriers do not support the sending and receiving of SMS via GPRS. A GPRS modem is typically require for MMS.

DISPLAY:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of

applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

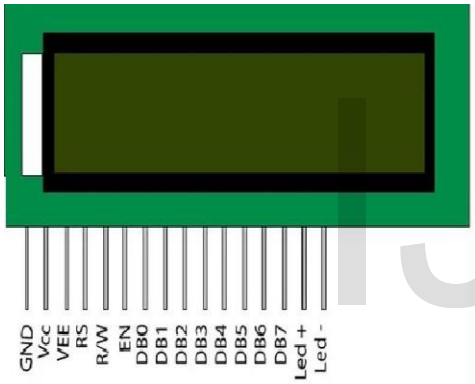

Fig.8. LCD display

POWER SUPPLY:

Introduction of Power Supply

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).

All power supplies have a power input connection, which receives energy in the form of electric current from a source, and one or more power output connections that deliver current to the load. The source power may come from the electric power grid, such as an electrical outlet, energy storage devices such as batteries or fuel cells, generators or alternators, solar power converters, or another power supply. The input and output are usually hardwired circuit connections, though some power supplies employ wireless energy transfer to power their loads without wired connections. Some power supplies have other types of inputs and outputs as well, for functions such as external monitoring and control.

Basic Components and its functions

A power supply is an electronic circuit that converts an ac voltage to dc voltage. It is basically consisting of the following elements: transformer, rectifier, filter and regulator circuits. This prevents corruption of data due to power failure and low voltage.

The transformer is a static device that transfers electrical energy from the primary winding to the secondary winding without affecting the frequency [11]. It is used to step-up or step- down the ac voltage level and isolates the remainder of the electronic system from the ac power. The primary winding of the transformer is connected to an ac voltage source that produces alternating current while the secondary is connected to a load.

There are three main functions of transformers namely:

Stepping the voltage up, stepping the voltage down and providing isolation between the primary and secondary circuits. A power supply is an electronic circuit that converts an ac voltage to dc voltage. It is basically consisting of the following elements: transformer, rectifier, filter and regulator circuits.

Power supply units (PSU) are used in computers, amateur radio transmitters and receivers, and all other electronic equipment that use dc voltage as an input. The transformer is a static device that transfers electrical energy from the primary winding to the secondary winding without affecting the frequency. It is used to step-up or step-down the ac voltage level and isolates the remainder

of the electronic system from the ac power.

The primary winding of the transformer is connected to an ac voltage source that produces alternating current while the secondary is connected to a load. The primary and secondary windings are not physically connected to each other but due to electromagnetic induction following Faraday's law, there is an induced voltage in the secondary winding. There are three main functions of transformers namely: stepping the voltage up, stepping the voltage down and providing isolation between the primary and secondary circuits.

LINEAR POWER SUPPLY

An AC powered linear power supply usually uses a transformer to convert the voltage from the wall outlet (mains) to a different, usually a lower voltage. If it is used to produce DC, a rectifier is used. A capacitor is used to smooth the pulsating current from the rectifier. Some small periodic deviations from smooth direct current will remain, which is known as ripple [9]. These pulsations occur at a frequency related to the AC power frequency (for example, a multiple of 50 or 60 Hz).

The voltage produced by an unregulated power supply will vary depending on the load and on variations in the AC supply voltage. For critical electronics applications a linear regulator will be used to stabilize and adjust the voltage. This regulator will also great reduce the ripple and noise in the output direct current. Linear regulators often provide current limiting, protecting the power supply and attached circuit from over current. Adjustable linear power supplies are common laboratory and service shop test equipment, allowing the output voltage to be set over a wide range. For example, a bench power supply used by circuit designers may be adjustable up to 30 volts and up to 5 amperes output. Some can be driven by an external signal, for example, for applications requiring a pulsed output.

EMBEDDED C:

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations [7]. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C, e.g., main () function, variable definition, data type declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

PHP:

PHP: Hypertext Preprocessor (or simply **PHP**) is a general-purpose programming language originally designed for web development. It was originally created by Rasmus Lerdorf in 1994; the PHP reference implementation is now produced by The PHP Group. PHP originally stood for *Personal Home Page*, but it now stands for the recursive initialism *PHP: Hypertext Preprocessor.*

PHP code may be executed with a command line interface (CLI), embedded into HTML code, or it can be used in combination with various web template systems, web content management systems, and web frameworks. PHP code is usually processed by a PHP interpreter implemented as a module in a web server or as a Common Gateway Interface (CGI) executable. The web server combines the results of the interpreted and executed PHP code, which may be any type of data, including images, with the generated web page. PHP can be used for many programming tasks outside of the web context, such as standalone graphical applications and robotic drone control. The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on almost every operating system and platform, free of charge [10].

The PHP language evolved without a written formal specification or standard until 2014, with the original implementation acting as the *de facto* standard which other implementations aimed to follow. Since 2014 work has gone on to create a formal PHP specification.

MYSQL:

It is an open source relational database management system (RDBMS) . Its name is a combination of "My", the name of co- founders Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language. MySQL is free and open-source software under the terms of the GNU General Public License, and is also available under a variety of

proprietary licenses. MySQL was owned and sponsored by the Swedish company MySQL AB, which was bought by Sun Microsystems (now Oracle Corporation). In 2010, when Oracle acquired Sun, Widenius forked the open-source MySQL project to create MariaDB.

MySQL is a component of the LAMP web application software stack (and others), which is an acronym for *Linux, Apache, MySQL, Perl/PHP/Python*. MySQL is used by many database-driven web applications, including Drupal, Joomla, php, and WordPress. MySQL is also used by many popular websites, including Google (though not for searches), Facebook, Twitter, Flickr, and YouTube.

WEBSERVER:

A Web server is a program that uses HTTP (Hypertext Transfer Protocol) to serve the files that form Web pages to users, in response to their requests, which are forwarded by their computers' HTTP clients. Dedicated computers and appliances may be referred to as Web servers as well.

The process is an example of the client/server model. All computers that host Web sites must have Web server programs. Leading Web servers include Apache (the most widely-installed Web server), Microsoft's Internet Information Server (IIS) and (pronounced engine X) from NGNIX. Other Web servers include Novell's NetWare server, Google Web Server (GWS) and IBM's family of Domino servers. Web servers often come as part of a larger package of Internet- and intranet-related programs for serving email, downloading requests for File Transfer Protocol (FTP) files, and building and publishing Web pages. Considerations in choosing a Web server include how well it works with the operating system and other servers, its ability to handle server-side programming, security characteristics, and the particular publishing, search engine and site building tools that come with it.

RESULTS

Due to the flourishing development of the Internet of Things (IoT) technology, many smart home applications have become commercially available. One of the most popular applications is remotely controlled smart sockets. Most commercial smart socket products allow the user to control single-sockets. This Project proposes a smart socket system called MorSocket (‘‘more sockets’’) that allows the user to control multiple separated sockets within a control webpage. These sockets share the same wireless communication module and therefore the hardware cost of MorSocket is lower than the single-socket solutions. Furthermore, by integrating MorSensor with an IoT management platform called IoT talk, MorSocket can be automatically controlled by arbitrary sensors for temperature, humidity, UV, CO2, and soon.

Such configuration is easily and flexibly set up through the IoT talk GUI without extra programming efforts. We also develop the MorSensor system that provides multiple configurable sensors tailored to control MorSocket through simple plug-and-play. Then we investigate the user tolerance delay between when the user presses the on/off button and when he/she presses the next time if MorSocket does not respond. The user experience is poor if the MorSocket access delay is longer than the tolerance delay, and the user may keep pressing the button. We conduct measurements, analytic modeling, and simulation experiments to study the impact of the user tolerance delay. Our study observes the quick response of MorSocket, which results in excellent user experience.

CONCLUSION

This Project proposed a smart socket system called MorSocket that allows the user to arbitrarily expand the sockets in the system, and control multiple sockets within a control webpage. These sockets share the same wireless communication module and therefore the hardware cost of MorSocket is lower than the single-socket solutions. By integrating MorSensor with an IoT management platform called IoT talk, MorSocket is automatically controlled by arbitrary sensor for current measurement. Such configuration can be easily and flexibly set up through the IoT talk GUI without extra programming efforts. We have also developed the MorSensor system that provides multiple configurable sensors tailored to control MorSocket through simple plug-and-play.

We investigated the user tolerance delay tb between when the user presses the on/off button and when he/she presses the next time if MorSocket does not respond. This delay must be longer than the response time tm of MorSocket so that the user will not continue to press the button with poor user experience. We conducted measurements of the MorSocket system, and experiments on analytic and simulation models to study the impact of the user tolerance delay. The discrepancies among the models and measurements are within 1% for most cases, which validates that our models are correct. Our study

indicated good result due to the fact that E [tb] > E [tm]. Therefore, good user experience is observed in controlling MorSocket.

FUTURE SCOPE

In future by tied up with the Electricity board, automatic detection of power theft can be detected immediately and can file a complaint to the board from anywhere. By this the board can shut down the power supply for the individual house if any mishandling occurs like using domestic power line for commercial purpose, unauthorized usage of Power lines etc.

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