IOT *(Internet Of things)* Based Wireless Smart Socket

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Abstract-*energy saving has been one of the key issues in our everyday lives. In fact, energy control for some appliances is an effective method to save energy at home, since it prevents users from consuming too much energy. which is developed based on wireless smart socket and Internet of Things technology to minimize energy consumption of home appliances without deploying sensors. TheRECoS provides four control modes, including peak-time control, energy-limit control, automatic control, and user control. The former two are operated for all smart sockets in a house, while the latter two are used by individual smart sockets, aiming to enhance the functionality of energy control. The experimental results show that the proposed scheme can save up to 43.4% of energy for some appliances in one weekday.*

Keywords—*Internet of Things (IOT) ,Residence Energy Control System (RECOs), Air-conditioner (AC) , Programmable Logic Controllers,(PLC) Graphical User Interface (GUI), analog-to-digital converter (ADC), Pulse-width modulation (PWM).*

I.INTRODUCTION

The greenhouse effect energy saving is the one of the critical issue in designing the electronic appliances. The smart houses it is the house equipped with highly advanced automatic light systems, temperature controlling systems, security controlling mechanism and some other functions can seen everywhere in world. The Residence Energy Control System (RECOs) is basically based on wireless smart sockets and technology as Internet of Things (IOT) technology, not only to monitor and control the power consumptions but also to manage the energy consumption of controllable appliances.

The fast development of electrical makes our lives become more and more convenient. Social demand for power supply capacity is becoming more and more strictly. On one hand is how to save power; On the other hand is how to meet the need of the society of electricity ,this area has being one of

The most intractable problem therough out the world, under the environment of internet of things intelligent socket realizes to consume capacity and feedback to the client's function timely.

A network system which connects electronic devices, sensors, software and concerned network entities together will make a network of internet of things, which will provide more services to users. Moreover this system deals with the complete savings of energy in the home appliances, as compared to the old system this system includes IoT based project the system control through internet by using a GPRS network. This saves more percentage of energy as compared to the earlier based system. As we can say in the earlier system model, the usage of internet is not adopted, where in the mode the usage of internet is adopted which make use of usage of on and off anywhere. There are many theories and controlling methods are proposed using internet of things, developed a tablet computer based home energy management scheme to monitor the energy agency. In this system the energy saving, the energy efficiency users living convenience all are need to be balanced.

II.LITERATURE REVIEW

We present the state-of-the art in electricity management in smart homes, the various enabling technologies that will accelerate this concept, and topics around consumer behavior with respect to energy usage. Smart homes rely on numerous enabling technologies in both the electricity grid and consumer electronics. Standardization and maturity of the technologies in each of these realms is required if smart homes are to be pervasive. Given that buy in from users is a key that will unlock the adoption of smart homes, rigorous tests with consumers must be integrated into the smart home design procedure. Without the comprehensive multi-disciplinary assessment of the smart home, an expensive system may fall short of expectations [1]

We developed a smart socket with the help of Internet of Things to minimize the energy consumption on home appliances. This application is controlled by four application mode, they are peak time control mode, Auto control mode, user Control mode, energy limit control. The main aim is to control the energy at home appliances The main purpose of establishing this system is to control the electricity and the energy of home appliances by automatic control. Where it cansave up to 43.4 % of energy in day to day life by human. A simple Internet of Things construct the connection between smart socket and the server which can operate through the internet. It uses neural network algorithm which mainly save unnecessary energy that are being wasted from the home appliances [2].

We implemented Smart Automation system with the help of wireless technologies. The purpose of home automation system using internet and wireless

networks is to control the parameters like voltage, current and temperature and monitor it. It helps to improve the performance of control network. IoT (Internet of Things) is fast rising technology which involves interaction among object (things) through internet without human interference. The main objective of using smart automation based on wireless and IoT is to reduce the unnecessary energy consumption of smart home [3].

We mainly introduces the intelligent electrical outlet of each hardware modules; software part mainly analyses the socket's communication mechanism, and the electricity consumption of collected power statistics through diagrams to feedback through wireless communication. Things achieved in an environment of communication between the user and the smart power outlet timely feedback to the user, so as to achieve energy-saving purposes. The automatic control system realizes the automatic control for intelligent electrical outlet by WIFI wireless communication technology and Internet technology. The system has much advantages in reliability and performance, It will better realize the automation and intelligent in control process [4].

The intelligent energy control scheme named as the residency energy control system (RECOs) is proposed and it is developed based on wireless smart sockets and IOT technology to minimize energy or power consumption of home appliances with using sensors. The RECOs shows control modes as automatic control, and overload concept, other concept as Geyser control, LED, FAN, Bulb control. The results show this schemes saves more amount of power consumption .A simple technology as IOT technology which integrates wireless smart sockets home gateway energy controller, Zigbee. Most importantly the RECOs uses sensor, Other appliances can also save some amounts of energy [5].

We proposed a system that will provide remote control of electrical appliances and perform e-metering to reduce Power, Energy and Memory consumption in the web applications, create a web application for making easy energy metering, make hostel automated and intelligent and provide comfort to every user, make the application real time so that the user can monitor real time data and takes a particular action, control the devices such as Fan, Light and Air-conditioner (AC) and can increase/decrease the speed, intensity and temperature respectively through mobile app.[6]

II.SMART SOCKETMODULE

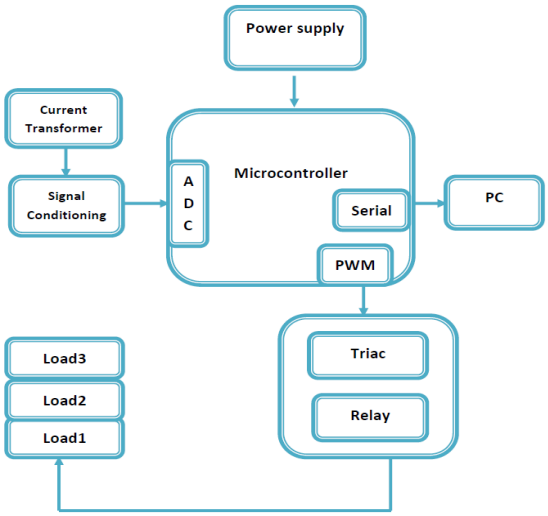

Figure 0.1Block diagram of SMART SOCKET Module

A. Microcontroller:

First unit consists of microcontroller AT91SAM3X8E along with current transformer, loads, and triac, relay and power supply. Loads are interfaced with microcontroller through relay and triac.The SAM3X8E also features a 12-bit ADC/DAC, temperature sensor, 32-bit timers, PWM timer and RTC. The 16-bit external bus interface supports SRAM, PSRAM, NOR and NAND Flash with error code correction. Based on the ARM® Cortex®-M3 processor, the Microchip's SAM3X8E runs at 84MHz and features 512KB of flash memory in 2 x 256KB banks and 100KB of SRAM in 64KB +32KB banks, with an additional 4KB as NFC (NAND Flash controller) SRAM. Its highly-integrated peripheral set for connectivity and communication includes Ethernet, dual CAN, High Speed USB MiniHost and device with on-chip PHY, high-speed SD/SDIO/MMC, and multiple USARTs, SPIs, TWIs (I^2C), and one I^2S.

B. Current transformer:

Current transformer is used to check the current passing through it and gives total watt of power used by loads. Output of current transformer is monitored using ADC channel of microcontroller. A current transformer (CT) is a type of transformer that is used to measure alternating current (AC). It produces a current in its secondary which is proportional to the current in its primary.Current transformers, along with voltage or potential transformers, are instrument transformers. Instrument transformers scale the large values of voltage or current to small, standardized values that are easy to handle for instruments and protective relays. The instrument transformers isolate measurement or protection circuits from the high voltage of the primary system. A current transformer

provides a secondary current that is accurately proportional to the current flowing in its primary.

C. signalconditioning:

In electronics, signalconditioning means manipulating an analog signal in such a way that it meets the requirements of the next stage for further processing. Most common use is in analog-to-digital converters.

D. Power Supply:

A powersupply 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.

E.triac:

Triac, from triode for alternating current, is a generic trademark for a three terminal electronic component that conducts current in either direction when triggered

F.relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations

G.analog-to-digitalconverter**:**

In electronics, an analog-to-digitalconverter (ADC, A/D, or A-to-D) is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. Typically the digital output is a two's complement binary number that is proportional to the input, but there are other possibilities.

H.Pulse-widthmodulation:

Pulse-widthmodulation (PWM) is a modulation technique used to encode a message into a pulsing signal. Although this modulation technique can be used to encode information for transmission, its main use is to allow the control of the power supplied to electrical devices, especially to inertial [*definition needed*] loads such as motors. In addition, PWM is one of the two principal algorithms used in photovoltaic solar battery chargers,[1] the other being maximum power point tracking.

The HMI is designed to have up to two communication ports. Each of the ports can be defined as Modbus slave or can connect to various third party devices such as PLC's, Drives, PID Controllers, etc. The Inside the same slots, the user can be used communication port for programming the PLC. The USB serial communication port will be provided as the input unit to the system programme

III.EXPERIMENTAL METHODOLOGY

It is proposed to carry out the work with following steps.

1. Study of microcontrollers, different peripherals and technical specifications study and software required for the development of project

2. Study of current and its interfacing with microcontroller

3. Design and development of hardware platform for the load management

4. MATLAB part implementation

mart socket ID	Smart_Socket_1	Smart_Socket_2	Smart_Socket_3	...	Smart_Socket_N
Weekday average	2.24	0.88	1.56	...	0.41
Weekend average	3.79	1.25	1.99	...	0.92
Energy limit	70.61	25.94	44.29	...	14.63
Weekday quota	2.11	0.83	1.47	...	0.39
Weekend quota	3.56	1.18	1.87	...	0.86
Accumulated energy consumption of the last 4 weeks		404.36	User-defined total energy limit		380

TABLE II. An example of energy-limit control table:
ELC mode controls a smart socket, e.g., *Q*, with a given quota, e.g., *q*(*Q*). When users set *Q*'s energy limit of the following 4 weeks (after referring to *Q*'s energy consumption in the last 4 weeks), the ELC module calculates the energy quota for *Q* with the parameters, including*Q*'s one-day, e.g. day X's, energy consumption history, what day is X (a weekday or weekend), the *Q*'s priority, etc. Table II

shows an example of the energy-limit control table, in which the _eld of the ``accumulated energy consumed of the last 4 weeks" is the actual amount of accumulated energy consumption in the last 4 weeks, and the _eld of the ``userde _ned total energy limit" is the expected energy consumption of the following 28 days which is 94% (D380/404.36) of accumulated energy in the last 4 weeks. The rows of weekday average and weekend average are, respectively, the average energy consumption in a weekday and in Saturday or Sunday during the past 4 weeks. Energy limit which is de_ned by user based on the energy consumption history represents the energy limit of the following 4 weeks of a smart socket, and weekday/weekend quota is the socket's one-day energy quota. Taking smart_socket_1 as an example, its weekday/weekend energy usage is 2.24 kWh/3.79 kWh in average, totally consuming 75.12 (D2.24_20+3.79_8) kWh in the last 28 days. Now, when the user would like to save 6% of energy consumption, smart_socket_1 during the following 4 weeks has an energy limit of 70.61 (D75.12_94%) kWh, which is shared by the following 4 weekends (8 days) and 20 weekdays. The quota of a weekday is 2.10 (D2.24_94%) kWh, whereas the quota of a weekend is 3.56 (D3.79_94%) kWh.

IV.TABLE:1I.Appliances 'energy consumption by using/without using

Home appliance	Location	Priority	date	Energy consumption without using RECoS (kWh)	Energy consumption using RECoS (kWh)	Energy saving
Water dispenser	Office	-	Weekday	3.062	1.939	36.7%
			Weekend	1.858	0	100%
Photocopier	Office	-	Weekday	5.920	3.970	32.9%
			Weekend	3.120	0	100%
Water dispenser	House	2	Weekday	1.954	1.105	43.4%
			Weekend	2.452	1.883	23.2%
Microwave oven	House	1	Weekday	0.716	0.626	12.6%
			Weekend	1.961	1.875	4.4%
Electric boiler	House	1	Weekday	6.888	4.102	40.4%
			Weekend	6.901	4.137	40.1%
Stereo	House	3	Weekday	0.233	0.147	36.9%
			Weekend	0.325	0.231	28.9%
Washing machine	House	1	Weekday	0.524	0.428	18.3%
			Weekend	0.839	0.746	11.1%

Table II shows the home appliances' energy consumption by using and without using the RECoS. Two appliances in an of_ce and _ve appliances in a house are tested individually in a weekday and a weekend. All these appliances are controlled by the AC mode, and the priorities of appliances in the house are given 1 (the highest) to 3 (the lowest). In Table II, the water dispenser and photocopier in the of_ce are turned off during weekends since no one uses them, and the standby energy saving can achieve 100%. For home appliances in the house, the water dispenser saves up to 43.4% of energy consumption in a weekday.

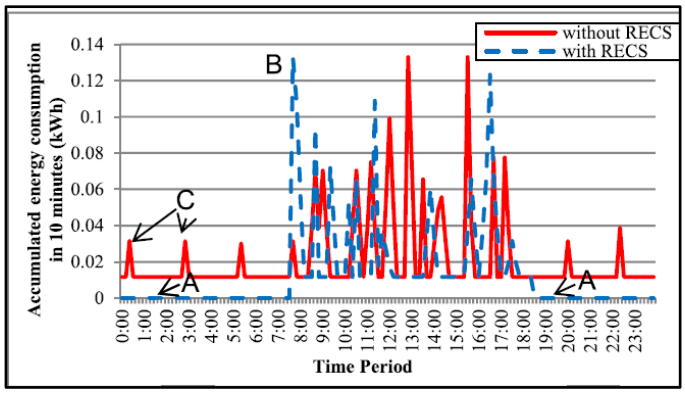

FIGURE 1. Energy consumption of a water dispenser in an office during weekday.

V. RESULT & CONCLUSION

Fig. 1 further illustrates the energy consumption of the water dispenser (in of_ce) during a weekday. The solid red line indicates the accumulated energy consumption without using the RECoS, whereas the dotted blue line is that when the RECoS is in use. Before 7:30 and after 18:30, the dotted blue line (labeled with letter A) is 0, because the proposed learning module knows that the water dispenser is only used between 8:00 and 18:00, and it turns off the water dispenser after 18:30 and turns it on at 7:30. After the energy controller turns on the water dispenser, it needs some energy (labelled with letter B) to boil cool water. When the RECoS is not in use, the water dispenser needs to keep water warm/hot all day long. Once the temperature goes down to a de_ned threshold, it will boil the water again (labeled with letter C). Also, the peak difference in Fig. 5 is due to different amounts of water contained in it. The total energy consumption of the solid red line is 3.062 kWh, and that of the dotted blue line is 1.939 kWh. The energy saving is about 36.7% .

VI. CONCLUSION

One of the main purposes of constructing a smart house is to automatically control those appliances in the house to achieve the goals of energy saving and smart living. In this paper, energy consumption in a residence through IoT and smart sockets. The four control modes to control the on/off state of home appliances connected to smart sockets.

A simple IoT structure which integrates smart sockets, home gateway, energy controller,ZigBee, and Internet is proposed. Most importantly the experimental results show that up to 43.4% of energy the energy consumption more intelligently.Furthermore, security is an important issue in safely protecting

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