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IoT BASED SMART POWER MANAGING SYSTEM

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Abstract
The electrical wire plays a vital role in transmitting power to all the appliances and devices in the home. Therefore, it causes a tremendous increase in usage of wires in the house. However, creating a new power connection requires huge man-power. So, this project aims to implement a wireless smart home system using internet of Things (IoT).The main objective of the system is to control all functionalities and the voltage consumed by appliances in home. The system uses primary and secondary coils to transfers power to the home appliances based on wireless power transmission technique (WPT). Arduino UNO and Node MCU 8266 microcontroller boards are used, so that the end user could control the home appliances by sending instructions/commands to microcontroller boards by using a web application. This project also provides features to control the voltage consumed by the home appliances such as to control the speed of a fan and the light intensity of a lamp. These connections are pluggable and it can be use easily whenever it is needed. Hence, this system removes the use of residential wires in the house and provides the user to have a full-fledged control over the home appliances remotely using an internet connection.

Keywords--Wireless power transmission (WPT), Arduino UNO, Node MCU 8266, Internet of Things (IoT), Web application

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INTRODUCTION

This concepts need to use new high technology in wireless environment to attain automation in daily used appliances. This concept can quickly bring the future to our homes by security, climate, and household gadgets and transforms our regular home into a futuristic smart home.

The power managing system has the ability to do tasks automatically and monitor or change status remotely. Common tasks include turning off lights when no one is in the room, locking doors via smart phone, automates air condition systems that can sense and memorize temperature settings and appliances that help you reduce the time.

The easiest way to set up IoT based power managing system is to start with stand-alone Wi-Fi or Bluetoothfriendly products. Recent times the market has many consumer products with pre-existing Wi-Fi modules. We canalso use smart mobile apps or to connect the products to a wireless gateway to communicate with them to start your power management journey.

By using this we can start this in plug and play segment we can start with Wi-Fi smart plugs. This smart plug converts an ordinary power outlet into a smart one without any installation. Now this can automate a device or power outlet only one at a time and also start building your managing network.

This system consists of a devices which communicates to a gateway or else hub. The number of devices required in the home depends on the degree of control that you have in your home.This can be achieved by using DIY set up. Each device works with a protocol. Your choice of protocol will show which products you can use in your system.

You want a user friendly app to control your products at your convenience. Whether using a power management system or a basic automated system or plug and play devices we can find an application which is intuitive and interactive application in the market. Different application may work better for you based on your mobile and the system you choose.

There are many plus points for user by managing your home.
- This gives you a peace of mind with security solutions.
- Save time by accessing and controlling with the help of touching button.
- Save money and help build a friendly environment by avoiding wastage of electricity and water.

Making sure that our home is safe when we are not there is one of our biggest fears. Alarm contracts can be very expensive, and you don't know if have closed all the doors and windows. They are simple to set up and make life much easier. Controlling your heating effectively is one of the best ways to save you money. This is where power management is really coming into its own.

The aim of this paper is to control electrical and electronic appliance with low cost and reduce the wire usage. The IoT based power management concept in the system improves the standard living at home. This control system implements wireless technology to provide remote access in your smart phone. In addition, IR sensors are used for detecting the presence of a person inside the room to control the lighting.

A wireless charging concept using electromagnetic flux is used to control all appliances in the home or workplace. A microcontroller will be used for controlling all the appliances in the home. This microcontroller can be controlled using mobile application. This shows the control of all the appliances in the house and reduces the usage of wire.

LITERATURE REVIEW

In this section some of the related work describedfor motivation to do the work to be carried out.

Benanti S., et al [1] implemented a prototype of wireless power transfer system for House appliances which was implemented by copper wire windings. The system is based on resonant coupling, where the power is transmitted over the two coils over distances. Analyses of the wireless efficiency is with respect to axes alignments were tested. The efficiency and effectiveness of the prototype were determined as result.

Hilal A., Fadhil., et al [2] investigated and analyzed the system performance of wireless electricity system based on electro-dynamic induction technique. This system was recommended for successful development of Smart Home applications. The parameters like number of turns of coils, distance between the transmitter and the receiver coils and the diameter of both coils were determined and also how could each of these parameters could affect the efficiency of the system were analyzed as result.
Zhen Zhang., Hongliang Pang., et al [3] presented an overview of Wireless Power Transfer (WPT) techniques. The importance of technical challenges, working mechanisms and applications of the technique were focused. The distance of transmission, energy security, and bidirectional exchange were shown as result.

Maulana Yusuf Fathany., et al [4] proposed a scheme for data communication protocol at the application layer. This scheme attempts to realize the Smart home automation concept, where Digi Mesh topology is chosen as the basic topology. Mobile device is used to monitor and control various home appliances and devices. The system uses dynamic characteristics to reduce the power cost.

Xiang Gao., et al [5] proposed a wireless smart home network using Zig-Bee technology. The system improved the development efficiency and also provided various expansion and up-gradation functionalities. The system has high flexibility and availability. The future works of the system could meet the routine life requirements which are to control the household appliances and to monitor the real-world environment.

VigneshGovindraj., et al [6] designed a smart home automation system based on Internet of Things (IoT). The main objective of the system to convert the normal home environment to a smart home automated environment. The system aimed to implement an extensible low cost, flexible wireless smart home automation system based on Internet of Things (IoT). This paper presented the design framework that uses the integration of cloud networking services and wireless communication, to control various home appliances by users within the home using a smart phone. The framework would have future enhancements like security features such as to capture the picture of human motion (for surveillance purpose).

Shreedhar A Joshi., et al [7] developed a system, which is used to control home appliances and devices in house. The system is designed at a low cost and also provided a user-friendly interface. The purpose of the system is to implement simple algorithm that is used to control the behavior of home appliances reducing the human efforts. The system also provides remote access of the home appliances via smart phones through wireless technology.

David Vasicek., et al [8] presented a project based on a solution using Google cloud services. The system monitors the data and information of the smart home using the Android application. The application provides the control over the behavior of the appliances such as lighting, and brightness of the light. This application also detects the control object intrusion by the stranger and change of property from the natural environment elements.

YAN Wenbo., et al [9] introduced a wireless solution based on Internet protocol to control the home appliance units at low cost. The system aims at helping users to control the home appliances using the software in the smart phone or tablet and to build an autonomous environment at workplace or home. The solution uses the integration of remote server and home proxy for controlling the units which was implemented using XMPP protocol. The remote server was used to act as a service provider and this server provided services for different homes and workplaces.

Silviu Folea., et al [10] proposed a solution to transform a normal house environment to smart house automation and reducing the energy consumption. The system is implemented by using wireless sensor networks and LabVIEWTM graphical programming environment. The results were data from the sensors which were saved and analyzed by NI LabVIEWTM State chart Module.

K. Lova Raju, et al [11] described a notation of IOT based sensing systems and monitoring systems for implementation of a home automation. The system uses Node MCU which is the heart of the system, which performs as a web server and also acts as an interface for controlling various hardware devices. Node MCU can be controlled by an android device using internet. The home appliances such as lights, fans are connected to the relay system, which provides switching functionalities. This system is also used for environmental monitoring by collecting data about humidity and temperature. The system also has notifying features that can alert intrusion detection using motion sensor. All of these features can be controlled by using an android mobile application.

PROPOSED SYSTEM

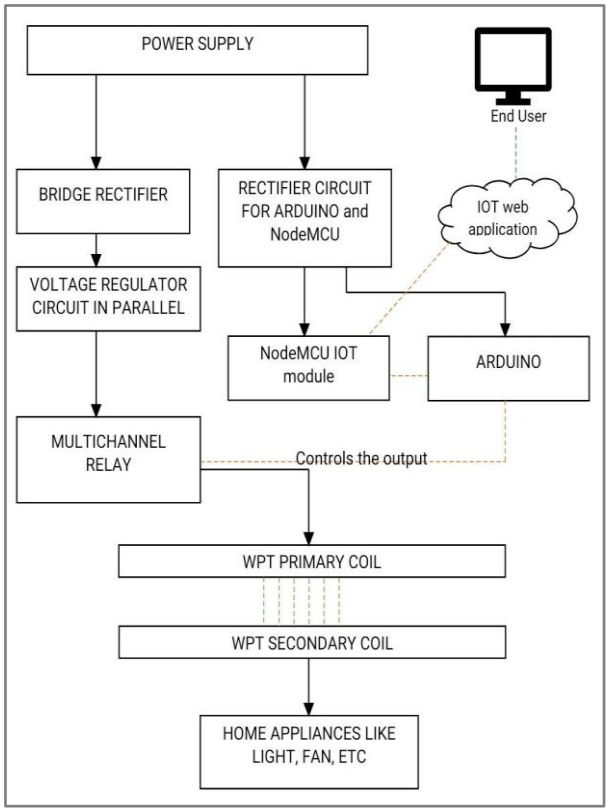

Figure 1. Block diagram of proposed system

Figure 1 depicts the complete circuit diagram of the proposed system. Here the power supply is step downed by center tapped transformer for both arduino and wireless power transfer

module. A parallel connection of 4 voltage regulators are used to provide a constant voltage supply to the module.

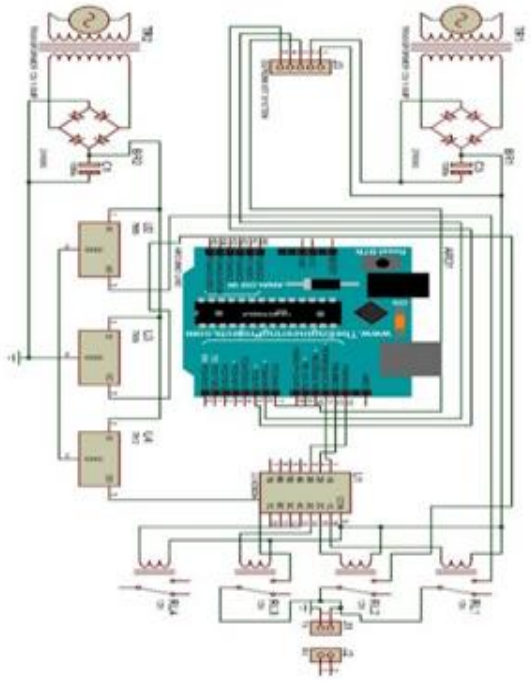

Figure 2. Circuit diagram of proposed system

Multi-channel relay is used to provide a variety of output such as 5v, 9v and 12v respectively. Arduino is used to control the output of the relay and it commands which relay to be opened and which should be closed. The arduino is connected to a node mcuwi-fi / iot module. A web application is developed by using which the end user can communicate with the arduino and the end user can give instruction whether to switch on/off the appliances. The user can also vary the power supplied to the appliances by giving instruction to arduino and in return the arduino varies the relay and thus power changes.

HARDWARE DETAILS

Wireless Power Transfer

Power is transferred by two ways. It can be done either by physical medium such as using electrical wires, cables etc., or by using air as a medium. The second method can be done by using Wireless Power Transfer Module. The principle behind the WPT module is "Wireless Power Transfer". That is when two objects or two coils such as primary and secondary coil having same resonant frequency and in magnetic resonance at powerfully coupled rule which tends to transfer the energy while dissipating relatively little energy to the extraneous off-resonant objects. In simple words, when two similar copper wound coils have the same properties, where one coil (named as primary coil) is connected to a power source either it is DC or AC, the current flowing through the coil produces a magnetic flux around it. Thus, a magnetic field is created around the coil. When the other coil is introduced (named as secondary coil) near to the primary coil, the magnetic field around the coil creates a magnetic flux in the secondary coil and thus the current flows and the power from the primary is transferred to the secondary. When the distance between the two coils are smaller, large amount of power can be transferred. When the distance increases, the power transfer between the coils is decreased. Distance is inversely proportional to the transfer.

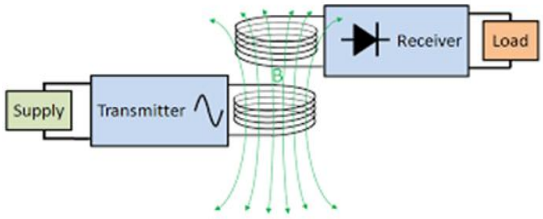

Figure 3. Wireless Power Transfer Module

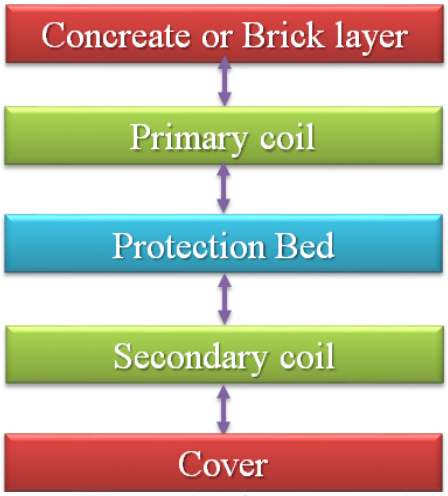

Figure 4. Layers of Wireless Power Transfer

Arduino Board

Arduino is microcontroller and a open source software easy to use hardware device which can be used to control various devices such as LEDs, motors, potentiometer, LCD display etc. Arduino UNO have input voltage ratings of 7-12 V. It has two types of pins such as digital and analog pins. The Arduino UNO comprise of fourteen digital pins and six analog pins. It has a flash memory of about 32 KB of which 0.5 KB is used by the bootloader and SRAM memory of about 2 KB and EEPROM memory of about 1 KB. The clock speed of Arduino UNO is about 16 MHz speed. Arduino programming can be done in Arduino Integrated Development Environment. It is a free open source software which be downloaded from internet freely and can be used. The Arduino UNO has atmega-328 which is attached with a bootloader that allows you to upload new program to it. It communicates using the original STK500 protocol.

NodeMCU IoT Module

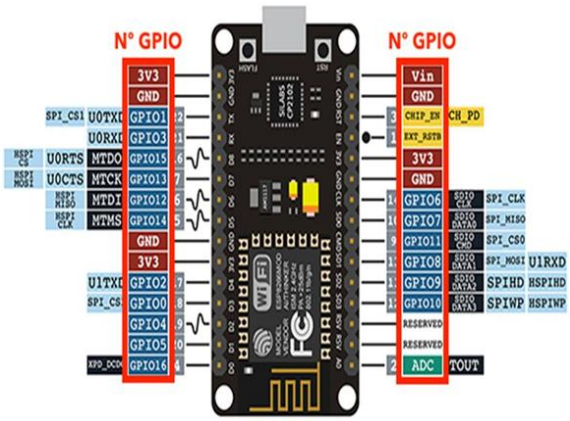

Figure 5. Pin Configuration of NodeMCU

NodeMCU is an open source IoT platform. It has a firmware which included both microcontroller unit and a Wi-Fi esp8266 module collectively used as aIoT module for all the projects. It uses an inbuild language called Lua language for connecting to the internet through.

Otherwise we can use Arduino programming as MISO or MOSI to communicate with the Wi-Fi module. It uses a circuit board functioning as a dual-in-line package which integrates a USB controller with small board containing a microcontroller unit and antenna.

We can also interface the NodeMCU with Arduino by distinguishing as master and slave. ESP8266EX can be used continuously and efficiently in many industrial environments, because of its high operating temperature range.

It can be used in mobile devices, many electronic devices and its main purpose to support IoT features for all the applications. The power consumed by ESP8266EX is very low because of its combined architecture. It has three power modes: active mode, sleep mode and deep sleep mode. This allows battery-powered designs to run longer.

The NodeMCU module is easy-to-use module since it does not require huge programming language and it can be operated using Arduino programming. The ESP8266 NodeMCU has totally 17 General purpose input/output pins which is present on both the side of the NodeMCU board. Only 11 pins are readily available for usage while other 6 pins (GPIO 6 – 11) are used to connect flash memory chip to the NodeMCU.

The on-board processing of NodeMCU is very much powerful and a powerful storage capability that allows the module to integrate with various sensors and various devices by using its GPIO pins with a small development up-front and loading during the working of the module.

Developer: ESP8266 Open Source community
Type: Single-board microcontroller
Operating system: XTOS
CPU: ESP8266
Memory: 128 kilobytes
Storage: 4 megabytes
Power By: USB or External power supply
Power Voltage: 3-5v
IDE used: Arduino IDE

RESULTS AND DISCUSSION

Switching ON and OFF of the devices arecarried outusing our mobile phoneconnected to the IOT module through mobile hotspot. This process can be implemented using an online platform 'iotclouddata.com'.The IOT module is signed in to theonline IOT platformusing the log in credentialsin the sign in web pagefig 6.

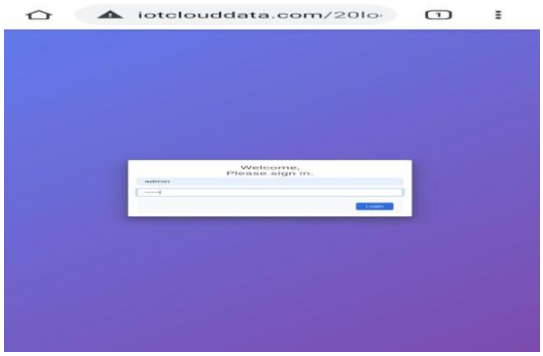

Figure 6. Sign in Page

The log in credentials will be provided by the IOT module production company. The log in credential will be unique for each and every user. This IOT platform has four analog switches in default. The number of switches can be increased as per the need. The devices are controlled using these switches through internet. When there is no need of a device the respective analog switch will be in OFF statefig 7.

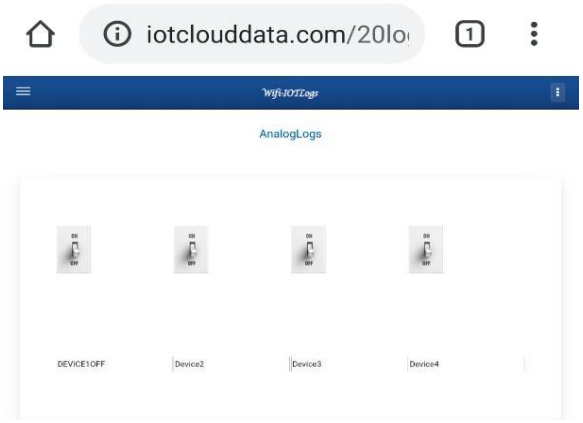

Figure 7. Analog Switch in Off State

Similarly, when there is a need of a device the respective analog switch will be in ON statefig 8.

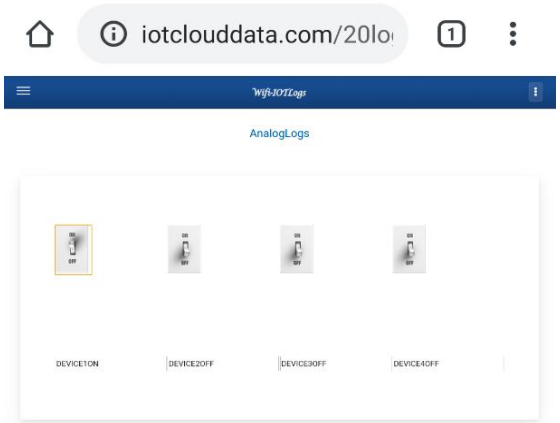

Figure 8. Analog Switch in On State

The log in ID, date, time and data will be stored in the data logsfig 9.

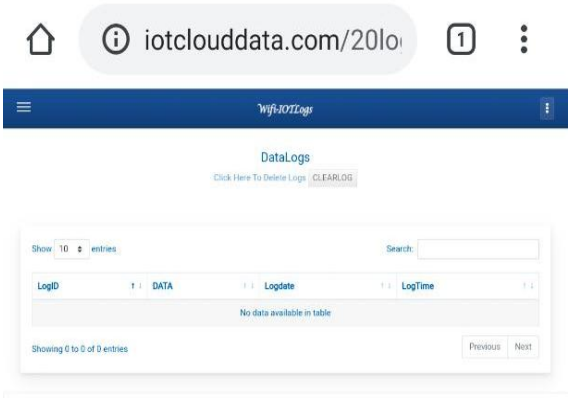

Figure 9. Data Logs

CONCLUSION AND FUTURE SCOPE

The conclusion of this project is helps in saving the wastage of power through in wireless power source and in controlling the device remotely. The smart home system connects various electrical appliances in the home with each other using information device automatically according the users need.

Further this project can be extended to large scale and it can be improved in several technical aspects for the betterment of human lives. The project is intended to automate the functions of home appliances. The smart home offers all the required services such as communication, security, entertainment, utility, medical and energy through wireless access technologies. Switching OFF of the device that a person forgets to switch OFF while being at home from anywhere instead of returning home. Remotely switching ON of the air conditioner before returning home will be much handy at times. A washing machine that programs itself to be finished washing at a specified time. These are the goals that can be achieved using home automation in the near future and it will prove to be a useful aspect for human lives.

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