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IoT Based Smart Power Management in Public Areas along with Public Traffic Monitoring

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Abstract: **Electricity consumption is growing rapidly across the globe and has become an essential component in today's life. This allows us to use the various electronic and electrical equipment wherein the electricity is essential for ensuring their proper functionality. These electronic and electrical gadgets are power dependent. People use electricity in their day-to-day life by connecting to power grid without realizing how much it costs to produce it. Energy efficiency is one of the important challenges to minimize the consumption of the resources of the earth. Thus, it is important to find alternatives for power management not only in individual homes but also in public places. This paper aims to design a system that monitors the public traffic in metro trains, stations, and shopping complexes and update the live status of the web application. The system also provides automatic power management by controlling the load automation with the present person count. Based on that, it will turn on/off the fans and control the light intensity using an LDR sensor to save power.**

Index Terms**: Blynk App, Home Appliances, IoT Application, Relays, Sensors, Wi-Fi**

I. Introduction

With the advancement in automated technology, life is getting easier and simpler. Systems which were handled manually earlier are now being replaced by automated systems. Internet has become a part of life, and this led to rapid increase in internet users. Through networking sharing of information and completing tasks remotely is possible now and thus things like consumer goods, industrial goods, etc., can be networked. Now it is possible to control the basic home functions and features using IoT and this can be done from anywhere in the world. This results in saving the power and electrical energy. The main aim of the proposed work is to monitor public traffic in metro trains, stations, and shopping complexes and to update the live status of the web application. The system will be very useful to public and management to get advance public traffic information in particular areas. Based on the amount of public traffic, people will plan their schedule to visit places, and management will plan to increase train frequency for public comfort. The system also provides automatic power management by controlling the load automation with the present people count. The system monitors the people's entry and exit, and the total count inside the area. Based on that, it will turn on/off the fans and control the light intensity using an LDR sensor. It has been found that IoT plays a significant role in achieving the said objectives in a more secure way.

Due to the expansion in digital technologies currently, the smart city is becoming smarter than in the past. Many electronic equipments of various kinds such as sensors for various applications are connected and forms a transportation system which also comprises smart cities. Thus, automated power management in public areas using IoT is also a part of smart city. The paper is described in the following way. Section II discusses the related work; the proposed system is discussed in section III followed with results in section IV. Section V concludes the paper.

II. Literature Survey

A systematic review of the literature is an assessment of an existing research on one or more specific subject concepts. Here, a Smart Power Management System is considered as a topic of interest in this paper.

In paper [1], the authors Devashish et al., has introduced "Smart Power Monitoring Using IoT". In this system, an automated electric power meter is used in domestic power distribution system. By integrating Wi-Fi, Arduino and GSM a smart power monitoring distribution system is designed. The system provides optimized data and thereby reduces the power consumption. The system is useful for domestic customers wherein the power supply is cut in absence of any human beings.

In [2], Mohammad Hossein Yaghmaee et al., have proposed an IoT based smart energy metering. The system measures the amount of power consumed and the power line parameters and sends this information to a central server through an intermediate gateway on the internet. The system also controls the electric appliances and whenever necessary turns them ON/OFF during the non-peak and peak hours respectively. This reduces the electricity cost for customers and the amount of load is reduced at the electricity grid during peak hours.

Himanshu K Patel et al [3] introduced a system which eliminates the intervention of human in measuring the meter readings and in the generation of bills. This reduces the error caused due to energy related corruption and any other chaos. The system is implemented using Arduino, GSM module, LDR sensor and relay. The system cost is also less, compared to the existing smart meters with the same functionality.

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Bibek Kanti Barman et al in [4] proposed a smart energy meter based on IoT. Utilization of energy in an efficient way is very vital in the development of a smart grid in a power system. Thus, it is beneficial to have proper monitoring and controlling of power consumption in a smart grid. Since the communication is only one way, a smart energy meter was required that can provide full duplex communication. The proposed smart meter controls and calculates the consumption of energy using Wi-Fi module ESP 8266 12E and finally updates it to cloud so that the consumers can view the reading. Thus, examination of energy is made easy and is controllable by the consumers. This system also gives the information of energy loss and does the home automation job using IoT.

Fakieh, Khalid [5] proposed a new simple and inexpensive method to regulate the wastage of power by imposing penalties to the individuals or the organizations by the power distribution. The system compromises of thermal sensing and associated hardware and requires less installation cost and maintenance is very cheap. This method allows the government to control the entire power wastage remotely and thus helps in power saving.

III. Proposed Method

One of the most effective methods for power management is the smart power management system based on IoT. Industrialists and researchers are working towards power management systems and the latest developments in IoT have made it possible to save energy. Saving energy is possible through the usage of IP (Internet Protocol) enabled service.

The main objective of this proposed method is to implement IoT-based smart power management in public areas, along with advanced public traffic monitoring, to create smart technology in cities thus making it a smart city incorporating smart transport, buildings and thus creating a digital society.

The system can be seen in figure 1. The system consists of a micro controller (Arduino) which can communicate with Blynk server via Wi-Fi. The code is written using Arduino IDE editor. Arduino with Wi-Fi module transmits the values i.e., the persons count to Blynk App which is also displayed on LCD screen.

The system uses Blynk Server which is an Open-Source Netty based on Java server. The messages are forwarded between the various microcontroller boards like Rasberry Pi, Arduino etc., and the Blynk mobile application.

The block diagram shows all the hardware components in blocks. It includes blocks of IR sensor 1, IR sensor 2, Light Dependent Resistor (LDR), Relays, Wi-Fi module and Power Supply along with loads. Here the input components are IR sensor modules, LDR sensor. The input components after sensing give input signals to Arduino board. The output devices are 16x2 LCD display, relay module and loads. These take signals from Arduino.

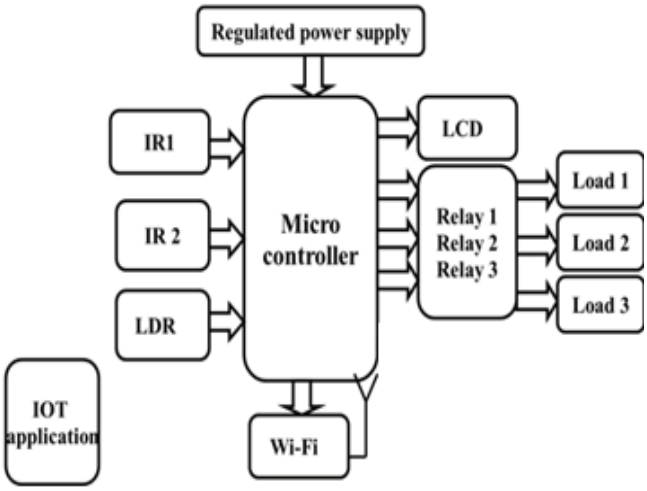

Figure1. Block Diagram of IoT based Smart Power Management System

The following gives the functionality of each block.

A. IR Sensor

These sensors (IR Sensors) are Infrared Sensors made of electronic devices and are used to measure as well as detect infrared radiation from the surrounding environment. The semiconductor chip inside the sensor should be powered to 3-5V for it to function.

It basically consists of two parts i. an LED i.e, a light emitting diode and ii. A receiver. If any human being or an object is close to the sensor, then the infrared LED within the sensor reflects off the object and is detected by the receiver at the sensor. These are the proximity sensors and are mostly used in any obstacle detection system. In the proposed work, two IR sensors are used, one at the entry and the other at exit. These sensors are used to count the number of persons entering and leaving.

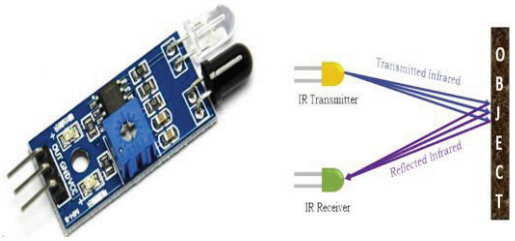

Figure 2. IR Sensor module for Arduino

B. LDR Sensor

LDR sensors are light dependent resistors also called photoresistors. The resistance of these sensors changes with the light intensity falling upon them. The application of LDR sensors is to automatically turn on a light at a certain light level. Thus, the streetlights or the bulbs in rooms will be turned on. In the proposed work one LDR sensor is used and based on the light intensity level i.e., if it is dark then

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automatically light(bulb) will be turned on.

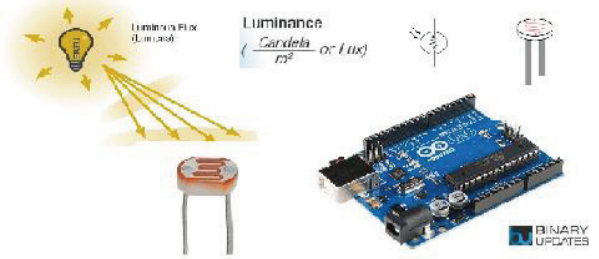

Figure 3. Interface LDR with Arduino

C. Relay

Relay is a switch which can be operated electrically. By using low voltage signals, relays are used to control high voltage circuits. Similarly, with the help of low current signals they are used to control high current circuits. In the proposed work, to protect the load from getting damaged by the high voltage/current a relay is used to connect the light bulbs between Arduino pin and bulb.

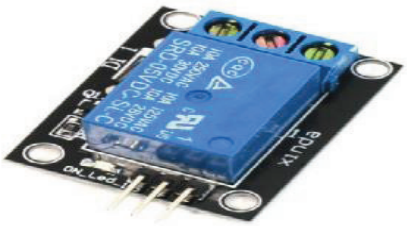

Figure 4. Arduino Relay module

D. LCD Display

In the proposed work, the user can interact with the device through the messages displayed on the LCD display. The liquid crystal display is a kind of display that uses liquid crystals for its operation and helps the user to operate the device. The serial input from the computer is accepted and the sketch is uploaded to the Arduino. The characters will be displayed on the LCD.

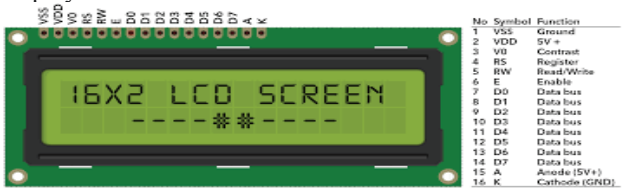

Figure 5. LCD Display

E. Arduino

Arduino is a project for designing and manufacturing single board microcontrollers which is an open-source hardware and software electronics platform and is easy to use.

These Arduino boards uses mostly Atmel 8-bit AVR microcontrollers with different pins and features and varying size of flash memories. The microcontrollers are pre-programmed with a boot loader thus simplifying the uploading of programs to the on-chip flash memory. Through serial connection the program code is loaded in the boards from other computers. Using sensors and actuators, the electronic devices can interact with the environment through Arduino projects which are low at cost and are very easy for the professionals to work with.

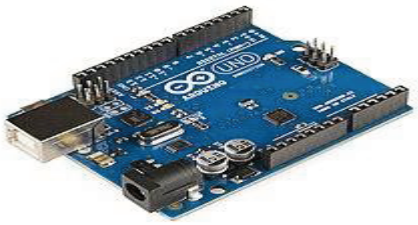

Figure 6. Arduino

F. Wi-Fi Module

Wi-Fi is a local area network of devices and internet access and allows the exchange of data wirelessly among digital devices. The Wi-Fi module can give any microcontroller access to the Wi-Fi network. The module will be capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

G. Power Supply

For the components to work, a power supply of +5V is provided. ICLM7805 is used to provide a constant power supply of +5V.

The schematic layout of the proposed model is shown as circuit diagram which is implemented in software.

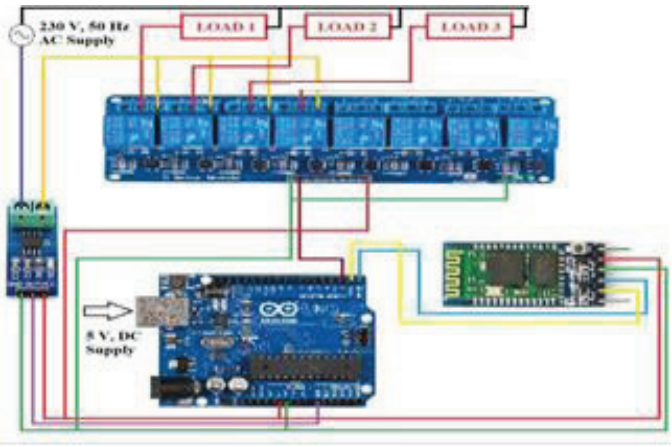

Figure 7. Circuit diagram of the proposed system

Monitoring and controlling of the power i.e., ON/OFF functionality is done by the communication protocol. The environment is sensed and monitored by the sensors which measures and sends the data to the microcontroller which in turn is processed and the sensed data is used to control and to monitor the appliances. Voltage and current sensors are interfaced with the microcontroller to monitor the voltage and current respectively. All the loads are connected to the board through a relay which acts as an electrical switch.

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IV. RESULTS

IoT based Smart Power Management with Public Traffic Monitoring System was developed by employing Arduino and Wi-Fi module. It also uses IR sensor module, LDR sensors as inputs to Arduino (microcontroller unit). The system communicates with the Blynk server via Wi-Fi. The system not only controls the appliances but also considers the public traffic in specific areas and the information is sent to the Blynk server through Arduino and Wi-Fi module. In the system an LCD display is also used so that the persons count (public traffic) is available at the Blynk app as well as is displayed on the screen. The results are updated in the server. Figure 8 shows the complete IoT based Smart Power Management with Public Traffic Monitoring System prototype with all the connections, sensors, relays, and load. Results are explained with the help of images.

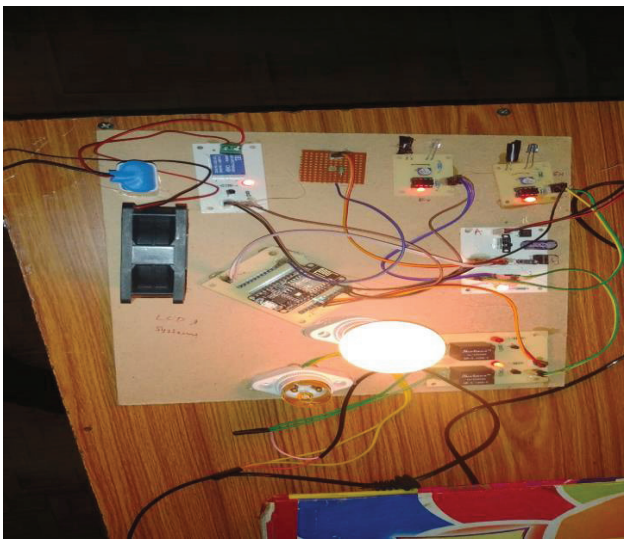

Figure 8. Image with bulb on as per the count

As shown in figure 8, the bulb glows according to the people count. The IR sensor will sense the number of persons entered in the room and leaving the room, if the count is below 5 then it will automatically turn on one bulb and one fan.

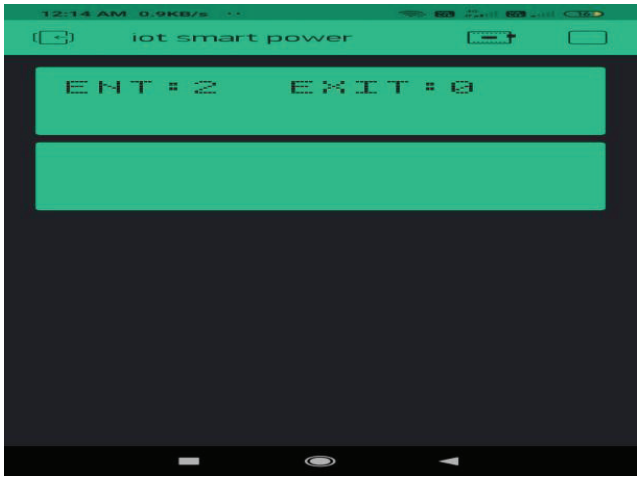

Figure 9. People count on LCD display

Figure 9 displays the number of people entered in the room; the IR sensor will sense the number of counts. The count will be read by Arduino through IoT application and then the count is displayed on the Blynk app. The count is also displayed on the LCD display.

Figure 10. Image with bulbs and fan on

Figure 10 shows the glowing of bulbs according to the people count. The IR sensor will sense the number of people entered in the room and the number left. If the count is more than 5 it will automatically on two bulbs and one fan.

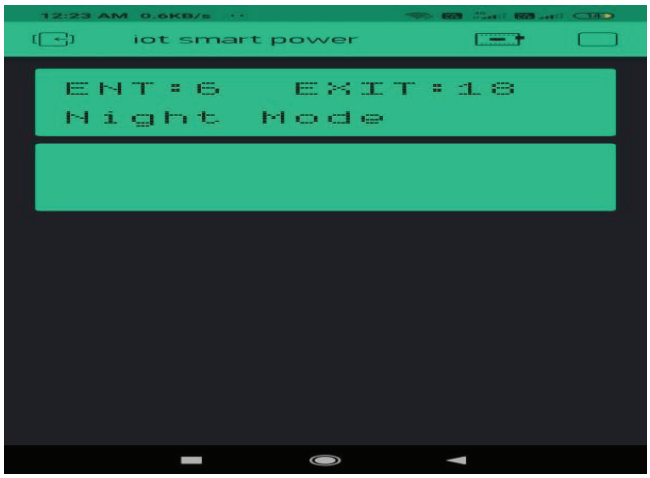

Figure 11. Image displaying number of people

According to figure 11, the count shows 6 persons present in the room and 18 have left. Thus, depending on the number of persons entering and exiting the count is varied and is displayed on the screen. Also, as per the count the appliances are automatically turned ON and OFF. This information regarding the number of persons in a particular area is also uploaded to Blynk server via Wi-Fi network and is useful for both public as well as management to know the crowd at that place such as malls, stations, stadiums, etc.

V. Conclusions

In this paper, an IOT based smart power management along with advanced public traffic monitoring system has been developed. The system monitors and controls the power consumption of home appliances at home as well as at other places automatically, manually, and remotely by using wireless network. The system is easy to design and consumes less power and is provided at low cost with portable size. The Arduino is programmed accordingly in Arduino IDE software which works without any time lag. The LCD display provides comfortable interaction by displaying essential data without any uncertainties in time. The device is implemented with an idea to provide accessibility at any public place with affordable cost of installation.

Futurescope

The proposed system will be controlling only two appliances such as bulb and fan and thus is a prototype and is not a completely developed system. In future, it can be extended for controlling other appliances like ovens, washing machines, refrigerator, air conditioners, etc., and that too for real time applications. To control the home appliances human intervention is required. If the usage of appliances is reduced, then power saving will improve and thus whenever the appliances are not needed then they should be turned off automatically to save power. The appliances can also be controlled manually. The system can also be extended to incorporate algorithms that can measure the changes in the weather conditions according to the season. Also to detect, update the changes in season based on the temperature, humidity, and brightness. Thus, IoT based energy management system for numerous applications plays an important role in the scheduling, monitoring, controlling, optimization of enterprise energy, and improving organization/ labor productivity. This can be implemented with low power consumption and can be operated with high speed. In the future advancements of Traffic Monitoring System, a feature of emergency stop can be added, and the components used can be upgraded accordingly.

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