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A Smart Energy Resource Management System Using IOT and Data Analytics Approach

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Abstract: *In this world of growing technology, Internet of Things and Data Science are the most trending technologies, either it is in business field or in a commercial field its features makes these technologies more popular and more useful. In this paper we have implemented a Smart Home Automation System using Internet of Things (IOT) Technology which includes two types of modules working on various sensors. Internet of Thing is technique which offers interrelationship via the internet of computing devices surrounded in ordinary objects, permitting them to transmit and receive data. In this paper, first module is of automatic fan speed controlling in which we are controlling speed of fan automatically according to current room temperature. In the same manner, we are automatically adjusting light brightness according to the brightness present in the atmosphere which is the second module of this paper. These modules have various components which include sensors too, which generates data values after timely interval. We are doing data analysis on those data values by using web application. We have implemented live data tracking system using the web application. The resulting analysis reports will help us to understand the energy consume by the modules. Also it is useful for efficiently manage electricity. The modules present in the paper makes it more impressive and provide standardization in this advance era of technology.*

Keyword: *Internet of Things, LED, DC Fan, Automation, sensors, web application, Data Analysis.*

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1. INTRODUCTION

In this era of new evolution, Though new sensors, wireless technologies and mobile phones are driving the growth of the Internet of Things (IOT), the exact business ethics of the IOT lies in analytics rather than in hardware inventions. This paper following same metrics. At first we have implemented two modules which works completely on IOT basis. First module is of automatic light brightness controlling in which we are adjusting the light brightness according to the brightness present outside. The module uses LDR sensor for sensing the brightness present outside and increases or decreases intensity of light using the code done in the microcontroller. In the second module we have implemented an automatic fan speed controlling system which uses a DC Fan automatically adjusting its speed according to the surrounding room temperature. It contains LM35 temperature sensor for sensing the surrounding temperature and adjust the fan speed in levels. The DC fan regulates its speed according to the code done in microcontroller. The implementation of both the modules are done using PCB (Printed Circuit Board).

After the implementation of both the modules we have build a Web application for fetching the values generated by the sensors using GSM module. The term web application refers to a software system that provides a user interface through a web browser. We have created this web application using PHP. The web application shows the interface in which it show values of different fields such as power, voltage, current, temperature, etc. The web application generates a sheet which contains the values generated by all the fields. On this data sheet we are doing data analysis for calculating consumption of electricity, energy used by the devices. This will help us to efficiently manage the power consumption in houses, industries, etc. This paper basically points the major concern of people towards high electricity bills and electricity consumption. So the idea of this paper will help them to reduce their concern about bills and electricity consumption.

2. LITERATURE REVIEW

From the reference paper [1], [7] and [8], the key idea of the paper is to control the speed of fan automatically using temperature sense by the temperature sensor. We know that the normal fan in household as well as in offices is manually controlled by the regulatory switch which involve potentiometer in it. But here we are adjusting the fan speed according to the surrounding environment. We used LM35 temperature sensor for sensing the temperature. The sensor is connected to the PCB which sense temperature and sends the data to PCB. After that the fan speed is controlled using the pulse width modulation and PCB board. The fan speed will automatically control according to the room temperature and according to the persons need present in that room as the human body has higher and higher absorption during day time and it require more cooling and at night time the body require less cooling.

According to the reference paper [2], [5] and [6], the main aim of these papers is to automate street light management system using IOT. We know that the street lights are essential part of our city as it facilitate improved night vision, safe roads and exposures to civic areas. It has one disadvantage that it consumes large amount of electricity. So this wastage of energy can be evaded by switching of lights automatically. To overcome this situation we have implemented a module in which we are using LED for automatically adjusting its brightness according to the brightness present outside. We have used LED rather than using traditional lamp as LED consumes less amount of energy. Here we used LDR sensor for sensing the brightness present in the surrounding. LED with LDR sensor provide intensity variations which is very helpful to automate the light brightness. The values detected by the LDR sensor is then send to the PCB. The LED bulb then adjust its intensity according to the outside brightness. If the outside brightness is increases then the intensity of LED bulb decreases. If outside brightness decreases the intensity of LED bulb increases. All these components in this module are executed using programmed microcontroller present on PCB for providing essential intensity of light.

Electric Fan (Mithal, 1992) is a very simple device that consists of rotating blades used to move air in the room. As compared to A.C., fan doesn't change the temperature of air they only move it. It is a non-linear system, as we are considering to rotate it according to the environment temperature. We have tried to make a fuzzy inference system that has been used without any failure in establishing the relation between environment temperature and fan speed. Due to the shortage of electricity supply, we have to start research in areas energy can be used efficiently. In households during summer, A.C. is responsible for 60-70% of our summer electricity bill. The window A.C. that has been mostly employed uses 500 to 1440 watts. In comparison, an electric fan uses only 90 watts, depending upon the speed and size. Electric fan is a device that helps us to stay cool in summer while saving our money as well as protecting the environment by limiting the release of Carbon-di-oxide [12].

Streaming analytics has rapidly emerged as a key IoT initiative for timely decision-making processes One of the most prominent features of IoT is its real-time or near-time communication of information regarding "connected things". Big data and analytics in IoT require streaming events on the fly and storing streaming data in an operational database. Given that much of these unstructured data are streamed directly from web-enabled "things", big data implementations

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must perform analytics with real-time queries to help organizations obtain insights quickly, rapidly make decisions, and interact with people and other devices in real time [11].

IOT and Big Data are the two hotcakes which everyone is talking about, the relation between these two will gets tightly bonded as the days are passing ,the reason is because of the rapid increase in usage of internet. There is no chance that this will decrease because as the days are passing, the internet users are increasing but not decreasing. The statistics are clearly mentioned that the internet users will be approximately 6 billion by 2025.Then it would be left to our imagination that how much data will be produced in the internet every minute. So there is a need of IOT and big data should be combined to be reliable and be strong from the data obstacles in the future.[10]

As we see reference paper [3], [4] and [9], In this a energy management system is used to efficiently manage energy consumption by the IOT sensors. But in this paper we have design a web application which contains SQL as a database in the backend. So when both the modules in this paper are working, the data generated by the sensors is collected by the server and stored the data in the database. It is done by the GSM module which we are using for sending the sensors data to the server. The data collected on the server are update itself in every 5 seconds so that the live data tracking should be done. After the execution of all this steps we get an excel sheet of the data generated by the sensors through our web application. We are doing data analysis on this sheet to show the energy consumption, amount of current used, voltage, power, temperature, etc. The whole paper will help user to know the energy consumption so that he can use efficient way for saving electricity bills and can efficiently manage electricity for reducing the cost of energy consumption. It also provide user control towards electricity [13].

3. PROPOSED SYSTEM

The proposed system consist of four main units:-

1. Automatic Fan Speed Controlling
2. Automatic Light Brightness Controlling
3. Live Data Tracking Using Web Application
4. Data Analysis Using R Language

3.1. Automatic Fan Speed Controlling

In this unit, it includes components like LM35 Temperature sensor, PCB, L298N driver & a DC fan. On the PCB board we have connected a microcontroller ATMEGA16 with LCD display on it. We have done input connection of L298N driver with the PCB and the output connection with the DC fan. The temperature sensor sense the temperature of surrounding condition and adjust the speed of fan in the levels according to the code done in the microcontroller. The temperature sense by the sensor is then shown on the LCD display in degree Celsius. We have set four levels in the code so that the fan can adjust its speed in those levels according to the temperature sense by the sensor. It provides control over the speed of Fan according to the user needs.

3.1.1. LM35 Temperature sensor

The LM35 is a kind of commonly used temperature sensor that can be used to measure the temperature with an electrical output comparative to the temperature. It can measure temperature more correctly than the thermistor. This sensor generate high amount of output voltage.

3.1.2. DC Fan

A DC fan is basically a cooling fan which is used to meet requirements such as higher air flows at high static pressures. A DC fan provides lower power consumption.

3.2. Automatic Light Brightness Controlling

Under this unit we have used components such as LED bulb, LDR sensor, PCB, L298N driver. In this unit it uses the same PCB board as we used in our first unit (i.e. Fan unit). Here the connection is same as in our fan module. We have used a separate L298N driver for this module. Here the output connection is given to the LED bulb. The LDR sensor sense the brightness present outside and adjust the intensity of LED bulb according to it. The percentage intensity of light is then shown on the LCD display. We have burn the code in the microcontroller, such that if outside brightness is increases the intensity of light decreases and if the darkness in the outside conditions increases then the intensity of light increases. This is majorly happens because of the LDR sensor and the according to the code done in the microcontroller. So this modules adjusting the brightness of light according to the human need.

3.2.1. LED Bulb

It is a light source created by a Light Emitting Diode (LED). It is a solid state lighting device that fits in standard screw in connection but uses LED to produce light. LED used less power and are upto 80% more efficient.

3.2.2. LDR Sensor

LDR stands for Light Dependent Resistor. It is a passive electronic component. It is basically a resistor which has a resistance that varies depending on the light intensity. It is used in many electronic circuits, in alarm, switching devices, clocks, street lights, etc.

Both the modules (1 & 2) uses some common components they are as follows:

A. PCB (Printed Circuit Board):- It is a thin board which is made of fiberglass & laminate materials. It

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provide pathways which is used to connect different components such as transistors, resistors and integrated circuits. The PCB used in both desktop and laptop computers. They serve as a foundation for many internal computer components such as video cards, control cards, network interface cards(NIC). All these components connected to the motherboard which is also a printed circuit board.

B. L298N Driver:- It is a motor driver module which is a high voltage dual H-bridge manufactured by ST company. It is designed to accept standard TTL voltage levels. Here we are using this to control speed of fan and also for controlling the intensity of light. H-bridge drivers are used to drive inductive loads that requires forward and reverse function with speed control such as DC Motors, and Stepper Motors.

C. GSM Module:- Gsm module is used to establish a communication between a computer and a GSM/GPRS system. It is assembled together with the power supply circuit and it needs AT commands for interacting with the controller. This commands are sent by the controller. It is an architecture used for mobile communication in most of the countries. We have used this module for sending the sensors data to the web application.

3.3.Live Data Tracking Using Web Application

Here in this unit we have created a web application using PHP language with SQL as a backend database. In this web application all the fields like temperature, total number, voltage, current, power, status of fan & Light. The web application uses GSM module for tracking the data. After the implementation of both the modules the data values of all the fields is then sent to the web application using the code done in GSM module. The values of all the fields is updated in every 5 seconds and can be shown on the web application. In the web application we have given graph buttons to every field where user can see the individual field graphs with date and time. There is a log button in the web application which provide user to see the data sheet. This unit gives the live data tracking of data values which generated by the sensors and other components of implemented modules.

3.4. Data Analysis Using R Language

Data Analysis is the major part of this paper. In this through the web application we can download the excel sheet which contains data values of all the fields specified in the web application. We are doing data analysis on this data sheet using R language. The platform we used for it is R studio in which we are doing R programming and obtaining statistical results, graphs. This provide user to see the energy consumption by the devices and also it provide efficient way of saving electricity. This means analysis of the devices made it more convenient & efficient to use. This will help user to reduce bills and electricity consumption in his home.

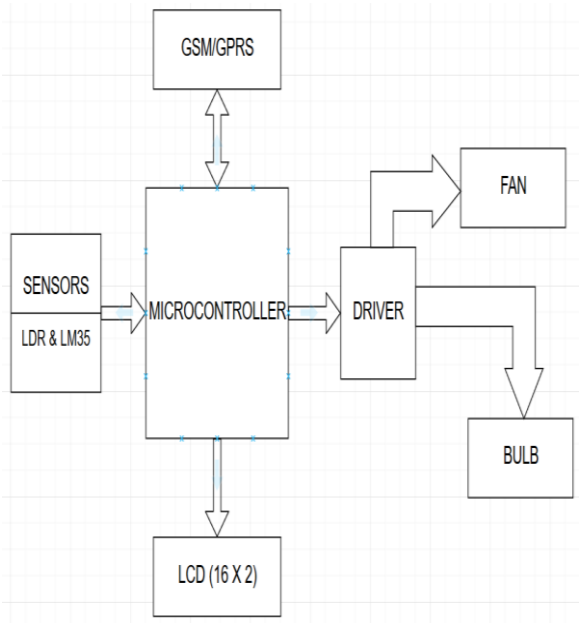

Figure 1. Block Diagram

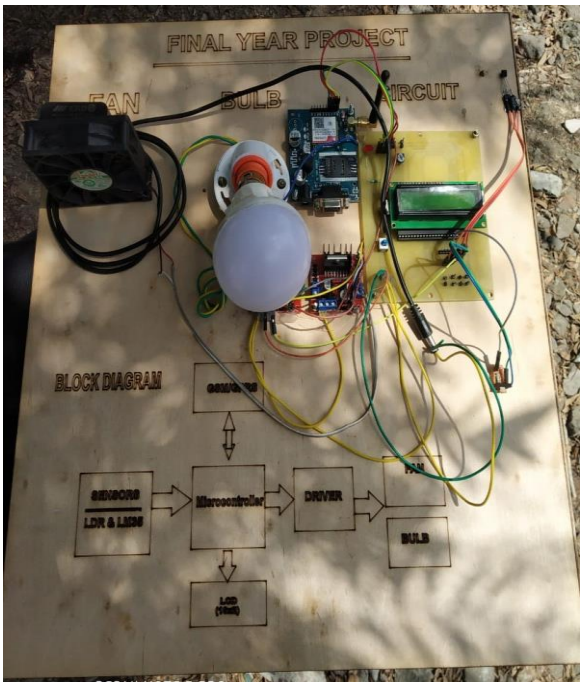

Figure 2. Implementation of Hardware Module

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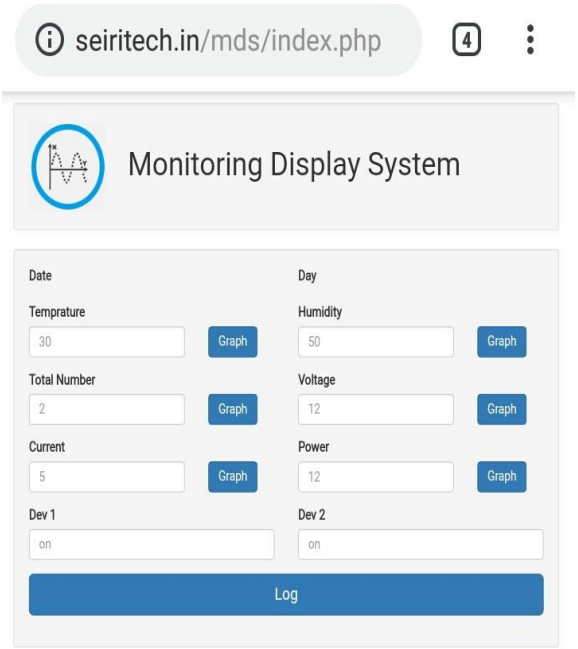

Figure 3. Web Application Interface

Figure 4. Temperature Field Graph

4. COCLUSION

By the use of this paper we have adjust fan speed according to the changing temperature which help user to adjust the fan speed according to their need. It reduces the use of remote controlling feature of fan. Similarly other module which contain automatic brightness control of light, here as we have exchanged traditional lamp by LED & adding extra feature to the module. The LED bulb adjust its intensity according to the brightness present outside. As module is used to avoid pointless consumption of electricity, due to physical switching. It provide effective and smart automatic control of light with the help of LDR. It can reduce the energy and maintenance cost. After the implementation of both module have done data analytics on data values generated from both the modules. The data collected by web application can clear users view towards the data generated from the modules. So that user get more convenient way to manage energy consumption of electricity. It helps user to see the power consumption, energy wastage from the devices in the form of graphs and charts. Data Analysis using R language provide added advantage to data collected through the web application. It provide graphical and statistical results for the user to understand the energy consumption. The main conclusion of this paper is that it uses both IOT technology and Data Analytics which makes it feasible and easy to use in future.

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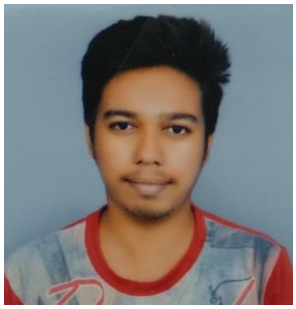

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