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IoT Platform Based Home Automation System Using Raspberry Pi

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ABSTRACT

The Internet of Things is one of the fast-growing telecommunications technologies. The primary aim of communication and cooperation between stuff, people and items is to meet the goal laid for them as a merged organization Electricity is a community's minimum necessity for good living standards. The graph of energy consumption is growing day by day, while energy resources are declining at the same time. The use of energy is increasing, clearing the way for parallel drastically. Consumption of power is growing drastically paving the manner for energy economical technologies and excavation for renewable energy sources. Currently, a major task is to reduce energy demand in housing, industrial and business locations. Renewable power is drastically extinguishing and electricity supply is growing quickly.

Keywords: *Sensors, wireless technology, WSN, Raspberry Pi .*

1. INTRODUCTION

Energy efficiency, energy saving and consciousness of the surroundings are the latest and most common subject in present studies today. Devices for electricity consumption and lightning systems are one of the world's main causes of energy wastage. In Asia, the amount of electricity usage used in fire structures is roughly 50%, where power wastage is roughly 10-15%. This waste of energy is linked to human irresponsibility because they do not know how much energy spent in a day. And now the Asian state has begun to promote awareness campaigns for energy saving and energy consumption in recent years. The above-mentioned study centered on energy efficiency and manufacturing initiatives demonstrates that the PIR detector (PyorelectricInfraRed device) renowned for its motion detection can control easy lightning. These devices are extremely efficient in storing the electricity used for fire construction, but there is such a large quantity of fresh sophisticated assessment happening at the moment that power sharing is much more efficient than before. These sophisticated devices have stronger lightning control strategies, excellent possibilities and greater flexible, offering many more advantages over simple on / off technologies. There are some sophisticated methods of leadership, such as daylightning or strain shedding, but they need a much more system-oriented strategy and are therefore not so effective.

When specifying these lightning power parts as a scheme, they often do not operate together well, especially in dimming apps. This cabling is so complex and therefore more complicated to operate in the sector, leading to bad results. The finest strategy to overcoming these kinds of issues is to progressively transform analog operating environment into digital one with ICT (Information and Communication Technology) depending on WSN technology. Many researchers disclose that some connected devices are accessible that are useful for managing lightning processes. These fitted devices also assess the natural and daylight radiance by using detectors to regulate the light intensity, thereby achieving their energy consumption. But connected device is not so accurate and complex to manage owing to the presence of amount of wires and cables for interaction and distribution. Maintenance of these connected devices has therefore become a major task for the consumer. Recent surveys bring cellular detector network i.e. to resolve these connected associated issues. In the supply hand, the WSN technology is more accurate and common. This technology is much greater and easier to plug in and retain. This bundle offers advantageous energy efficiency alternatives when combining this WSN technology-based ICT with a DC-powered lightning system [5].

This article recommends a intelligent control system that is constructed into the testbed region and circulated. This intelligent control system is linked to the lightning scheme driven by dc: I collecting sensor information for performance observation from outdoor environments, ii) managing and adapting wind scheme, real time.

2. RELATED WORK

Maintaining electricity consumption is extremely essential to save tons of electricity for our millennia to come. There are countless studies that have already done their utmost in this sector, but these studies are only relevant on a small scale. Due to hyperbolic daily electricity consumption, some sophisticated assessment should be carried out which is relevant on a gigantic scale. Despite pressing the information and understanding wherever and how extensive policies can be implemented. Many literatures are examined and given below:

M. Mango and others. (2013). In this article, author recommends a low-cost, easy-to-install, versatile, mobile intelligent LED lighting scheme that adjusts the visual radiance to decrease electricity automatically. The customer can readily regulate power usage by using Zigbee interaction with the assistance of movement detectors and visual sensors [1].

D. Caicedo and others. (2013). Author recommends an algorithm in this article that solves the issue of LED's big energy consumption. This method automatically controls the color strength and thus increases power savings [2].

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Y. K.Tan and others (2013). This article offers data on smart sensor applications to keep the LED lightning driven by dc. The frequency of glare is the same as in standard technique by using intelligent detectors, but this technique saves energy by 44 percent [3].

J. Love and others (2011). The writer conducts field experiments in this article by placing two chambers side by hand. Then writer explores the effect on the contrast of retail photocontrolled constant dimming glare command scheme of different settings of manually operated venice screens scheme. This technique provides up to 5 to 45 times power effectiveness when the heavens is cleared [4].

Research associated with monitoring, regulate, power conservation and power potency is extremely considered and this is linked with a great deal of research[5].IOT-related research provides several methods and alternatives that are extremely cost-effective and economical[6]. The two primary technologies used in the above research are wired and cellular technology. In order to enhance light intensity and energy efficiency, Wired technology operates on the concept in which devices assess natural and daylight illumination in a specific network region. But owing to the existence of an enormous amount of wires and cables, the systems are not so cost-effective at assembly and servicing. These big amounts of cables therefore give rise to a number of managing problems [7]. Wireless devices are used to solve all these kinds of problems, which are becoming more common than connected surveillance and controlling technologies.

WSN is used to control energy in houses and departments and to manage it more cost-effectively and do not pose any other problems. WSN is used jointly in structures and unfriendly surroundings for measuring parameters such as heat, moisture and gas[14].[15] WSN utilizes various procedures to interact with distinct sensors[12].

Recently, WSN is used in energy efficiency apps such as one of the current initiative, the Bluetooth-based energy efficient scheme, which is one of the required arduino projects [16]. Arduino-based energy efficient scheme using the Bluetooth module enables the customer to handle electronic equipment and also helps to control electricity using the Bluetooth terminal tool on their Android smartphone [17]. The Bluetooth terminal device provides orders from bluetooth to the arduino by means of cable interaction. The arduino is linked to the primary scheme with few relays linked to various electronic appliances. Wireless communication between smartphone and arduino Uno is performed via bluetooth technology in voice recognition oriented home automation. This will be advantageous for individuals with disabilities and the elderly who want to use voice command to regulate devices. Communication between customer and voice recognition instrument relies on the signal-to-noise ratio (SNR)[13]. If noise signal is loud then communication can be extremely effective and precision will not be shown by the scheme. Most of these schemes are focused on arduino, which enable energy efficiency, control and observation of structures, but these arduino do not seem to be the most accurate, economical and flexible. Raspberry Pi switches are used to solve this problem [19]. Models from Raspberry Pi are lately introduced. The similarities between arduino and raspberry Pi2 template are shown below in section 1. They can be regarded as mini pcs with several features [18].

TABLE I
A Comparison between Raspberry PI and Arduino Uno

	Arduino Uno	Raspberry pi2
Price	Rs 300-1500	Rs 2635
Size	7.6x1.9x6.4cm	8.6x5.4x1.7cm
Memory	4MB	512MB
Clock Speed	16MHZ	700MHZ
Operating system	None	Linux Distributions
Input voltage	7to12v	5v
Flash	32kb	SD card (2 to 16GB)
USB	One, input only	Two peripherals
Multitasking	No	Yes
Time to market	Minimum	maximum
Latency	Poor	Better
Maintainability	Poor	Better

The chart indicates a number of sophisticated alternatives for the Raspberry Pi2 than for arduino Uno. Raspberry Pi, however, also has some disadvantages, i.e. handling, maintaining and controlling is difficult. In addition, its original cost is greater than that of arduino UNO. So the choice of device relies on the system's need.

3. METHODOLOGY

Till currently there are such a lot of researches that are performed. However there are totally different issues conferred with the i.e. lack in security, flexibility, efficiency, saving electricity in accordance with the user desires. So as to beat the drawbacks of various strategies, this paper proposes an energy efficient smart building automation system which is designed for building lightning and automation [8].This interactive energy efficiency system can be prepared by taking Raspberry Pi2 as a processing unit. Sensors are used for Data collection units. Based on Sensor values, this system can automatically control the devices and provide energy efficiency. We are using PIR sensor for recognizing the persons. Temperature, LDR sensors are monitoring the Room parameters. All information is then analyzed in Raspberry Pi2, which controls the FAN and Bulbs. After analyzing, this information is then used to alert gas leakage by using gas sensor and provide alert with the help of Buzzer. All these information are monitored in the Web server by using GPRS module. And Bluetooth Module is then used for Monitoring Sensor values locally which also controls the devices according to the Sensor values. The proposed system of given methodology is shown in below figure3.

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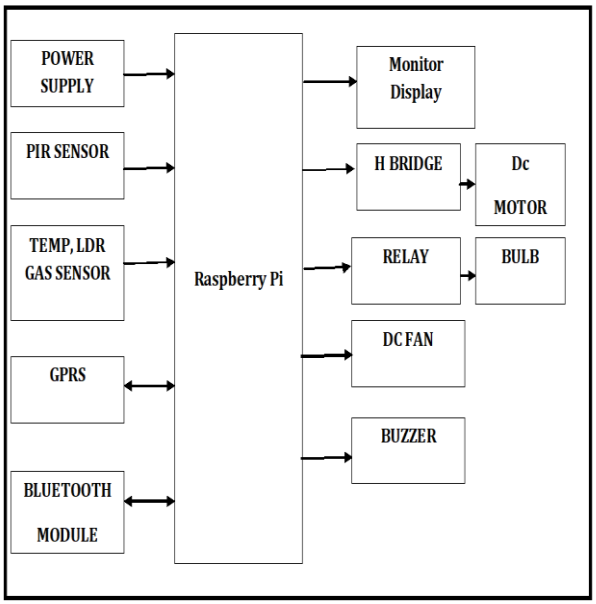
BLOCKDIAGRAM:



A. Microcontroller Section:

This is the main unit of the entire system. This basically consists of a Microcontroller (Raspberry pi) with its related circuits like Crystal with capacitors, Reset circuits, resistors (if required) and many more. The microcontroller is the core of the research because it manages all the devices to work according to the program coded. In this we use the Raspberry pi as microcontroller. The Raspberry pi is a mini computer board with debit cardsize which will be used for several functions as any pc will as a result of it keeps its software system, documents and package programs, it works as a traditional pc at low price server to handle net traffic. It has two peripherals which is very beneficial by using these peripherals many sensors are used at a time with the help of WSN. These controllers are very portable and have a very low cost. The Raspberry pi has two models in it and they are model A and model B. The important difference between these two models is presence of USB peripherals. Model A board will take less power but doesn't have Ethernet port while model B includes an Ethernet port. So, decision of choosing the models depends upon the need, however in this smart control system model B is used.

B. Power Supply:

This section provides power to all the various parts of the proposed system. It generally consists of a Transformer to step down the 230V ac to 12V ac using diodes. Here diodes are used as a rectifier which converts the ac power to dc. The output of the rectifier is obtained as rippled dc which is filtered by capacitor. Then voltage regulator is used to regulate the obtained dc voltage.

C. PIR sensor:

A PIR sensor stands for Passive Infra-Red sensor which is an electronic device that detects infrared (IR) light radiation from objects in its surrounding area. PIR sensors are basically motion detectors. The motion is detected when an infrared light radiation with one temperature, such as a human, passes in front of an infrared light radiation with another temperature, such as a door.

D. Temperature sensor:

Thermistors are a temperature sensing device. In this research work thermistor operates on the value of temperature of the testbed.

E. LDR:

LDR stands for light dependent resistor which is basically used to measure the light intensity.

F. Humidity sensor:

Humidity sensor is an electronic device that measures the relative humidity of a surrounding area. A humidity sensor can be operate in both indoors and outdoors places. They are also available in both analog and digital forms.

G. GPRS:

This consists of a GPRS modem. The GPRS modem will communicate with raspberry pi using serial communication. The modem is interfaced to microcontroller using MAX 232, a serial driver. The GPRS stands for Global Packet Radio Service is a TDMA based digital wireless network technology which is used for the internet connection. GPRS module will be used to post data in the web page directly.

H. Bluetooth:

AUBTM-22 is a Bluetooth v1.2 module with SPP profiles. The Bluetooth module is meant to be integrated into another host system which needs Bluetooth functions. The HOST system will send commands to AUBTM-22 through a UART.AUBTM-22 can analyze the commands and execute correct functions, e.g.to set the maximum transmit power, to vary the name of the module Later, the module can transmit the data receive from the UART with SPP profiles.

I. DC Motor:

DC motor is used as an output for this proposed system. DC motor is connected to raspberry pi. And this motor is controlled by the raspberry pi with the appropriate inputs given by consumer. Its speed will be change according to the speed set by the switches.

J. DC Fan:

Dc fan is also an output section which needs dc supply. So consumers can directly add the dc motor to raspberry pi with suitable transistor logic.

K. Relay Section:

This relay section consists of associate interfacing circuit to switch ON / OFF the system whenever any

unhealthy conditions i.e. overload and faults, are

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detected. This electronic equipment primarily consists of a Relay, transistor and a protection diode. A relay is also used to operate the Ac (230V) devices.

L. Buzzer Section:

This consists of a Buzzer. The buzzer is used to alert / indicate the presence of fault. It is sometimes used to indicate the start of the embedded system by alerting during start-up.

4. Hardware Design and Experimental results

a. Smart automated hardware

The actual smart building automated systems hardware is shown below in figure4.

Figure 4: Connection Diagram

An architecture implemented on energy efficient DC/AC lightening grid is proposed. This proposal has many advantages such as better flexibility, easy handling, better energy efficiency and many more. All these great advantages are only possible by using Raspberry pi with WSN technology.

b. Controlling of whole equipment

With the help of bluetooth Beacon communication module [11] consumer can control the entire system, simply by giving the command "MANUAL" .In this manual mode the entire system works according to consumer needs by giving various commands.

If consumer wants to perform entire system automatically, then by giving command "AUTO" the system will work automatically. This whole controlling process can be done using "Bluetooth Terminal APP" in consumer's mobile phones and this will be shown in below figure5:

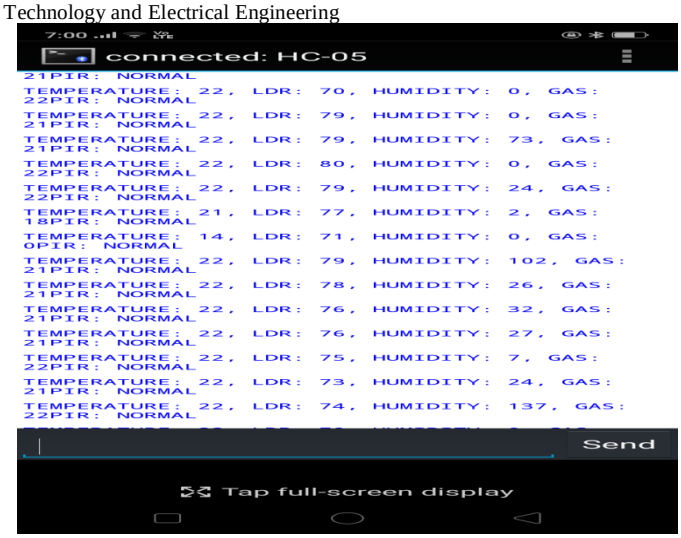
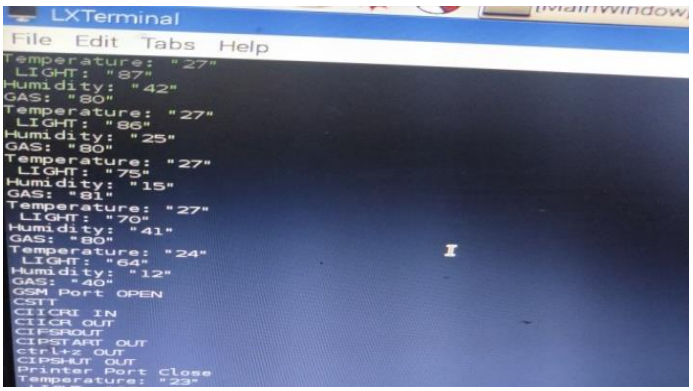


Figure 5: Bluetooth terminal App

The immediate consequence of this procedure is that the ability to benefit from an integrated wired and wireless solution that may facilitate to attain significant energy saving reduced operational price, perform risk management and enhance worker productivity. Furthermore, the IoT flexibility permits the straightforward upgradation of system at affordable prices. The IoT platform permits fast development within the market of innovative IoT applications, at an reasonable value, at intervals fraction of the time compared to alternative approaches [20]. This result is arises because of the mixing of a mostly distributed network engineered on the lighting infrastructure, with IoT devices, and to the synergies between energy management and IoT systems. The most infrastructures are prepared and simply obtainable, facilitating speedy application of intelligent solutions.

c. Displaying information

The results of the experiment done using Raspberry Pi is shown in figure 6. The result's showing the various readings which are taken by the different sensors through Bluetooth device which are



displayed on the RaspberryPi desktop page.

Figure 6: Result in Raspberry Pi desktop

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and another figure7 and figure 8 shows the results which are uploaded in the different clouds so that users can easily see their real time data any time from any place in the web.

Figure 7: Sensor values on cloud

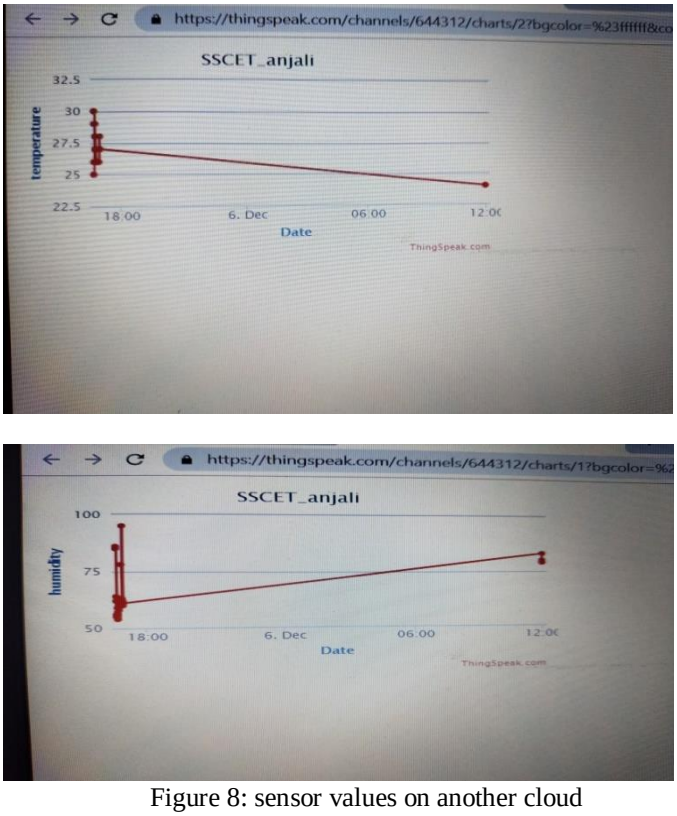

Figure 8: sensor values on another cloud

d. . Power Saving evaluation

To demonstrate the planned system in terms of power efficiency a room is employed as a testbed and different readings are determined that is shown in below table2 [9].

TABLE 2

Power efficiency measurement during 5days

Group	Day1	Day2	Day3	Day4	Day5
Room1	43% energy saving	32% energy saving	58% energy saving	18% energy saving	25% energy saving
Room2	38% energy saving	55% energy saving	32% energy saving	66% energy saving	11% energy saving

Total average power saving	44%

5. Conclusion

This paper proposes smart building automation system that operates on numerous operations very efficiently. Integrating features of all the hardware components are used very effectively in this smart control system. Presence of every module has been reasoned out and placed cautiously thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology proposed research work becomes very flexible than existing system. Compared with several existing wire system, this technique wants no wires which supplies larger flexibility and efficiency. Also users will easily participate within the network with their sensible devices like mobiles that have BLE embedded therein which doesn't need any wires.

Application of this system had been demonstrated in two ways first in "AUTO" mode and second in "MANUAL" mode. In AUTO mode different sensors and hardwares are working automatically after applying power supply to them whereas in MANUAL mode the system can be controlled through bluetooth terminal app as per consumers need.

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