Energy Saving Solution using IoT

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Abstract: Now a days the home environment is introduced with a network enabled digital technology. This type of home automation increases the connectivity of smart equipment within the room. With the continuity of home automation, we have designed a circuit which will track the person in the living room by using image processing. Previous research of human tracking was done depending on IR and PIR sensors. IR sensor has a dead zone between 0 - 4 CM that means no object detection closer than 4 CM. PIR sensors are insensitive to slow motion or the body in standing mode. But image processing doesn't have distance criteria based on the camera we use to cover wider range instead of zone like a PIR sensor and overall detection range is comparable to that of a PIR sensor. So in this research we have used image processing for easy exact human position tracking that rotates a fan independently to direct air flow to whatever position a person moves to in the room and working of light. In addition the fan can be turned ON or OFF based on human tracking to save electricity towards smart home user experience.

I. INTRODUCTION

A lot of people in the world are without electricity and modern lighting. This problem is more severe in rural areas or in cities. The rural electrification varies widely from country to country. Our country frequently suffers from unreliable and intermittent electricity supply. In some places, people get electricity only few hours a day. Without adequate electricity, it becomes challenging for adults towards concentrating on their professional work or studies. Rural communities of course needs a reliable and sustainable solution for lighting towards providing a brighter future. The country has made significant progress towards the augmentation of its power infrastructure. Moreover, poor quality of power supply and frequent power cuts and shortages impose a heavy burden on India's fast growing trade and industry. So current scenario insist towards highly efficient and effective usage of any form of power like College ,Universities and Public places where we use power for our teaching in class room and daily usage. It is common practice that most of us leave the rooms with Air conditioner, Fan and lighting on even if no members are present. In some cases we see only few members sitting in one corner of the room entire fan, light and aircon is running. All these amounts to unnecessary wastage of power contributing to country energy resource Lot of research been conducted on smart lighting system, where automated lighting system with visitor counters been implemented. This system is used in controlling the lights and fans in a room and keeps track of number of persons / visitors entered or exit from the room. Researchers also have employed vacancy sensor that replaced the standard wall switches. In our country, manual switches are still frequently used to turn on and off electrical fans, particularly in rooms. People are consequently become so busy that they neglect to turn off switches when leaving a room. Rapid global warming necessitates the development of new technology to accommodate the fluctuating temperatures. The concern of modern technology is the requirement for automatic systems. This mechanism serves two purposes. Controlling the fan's speed in accordance with temperature and turning it on and off in response to human detection. When the temperature appears to reach 270 C and a person enters the room, the fan will come on automatically according to temperature utilizing the LM35. When a person leaves the room, the fan will be turned off. A LED screen will show information about the temperature and speed. The room temperature will be detected via a temperature sensor (LM35). Using the PWM approach, the fan's speed is adjusted based on the ambient temperature. People entering or leaving the room are detected using PIR sensors. PIR sensors can detect motion and are virtually always used to determine whether a person has entered or exited a room..

In recent days the consumption of electric power is tremendously increasing. In such condition it is the usage of electric power efficiently is the responsibility of every citizen of our country. Energy saved is energy generated. Resources to generate electric power either are limited or have side effects. There are many devices invented to use the electric power efficiently. But there are hardly any to be used in our everyday life. Hence a system is suggested to analyse the power usage in a Gathering Hall/Auditorium by deploying a visitor counter and automatic fan control system.

The main goal of this project is to save the electricity from being wasted when not necessary by automatically switching ON of the appliances that are required based on the number of people present in the hall, instead of blindly switching on all the appliances and also switching them off as and when the people move out of the hall, again based on the count of people leaving the hall.

II. BACKGROUND AND RELATED WORK

According to [1], This system was created to help and support older and differently abled people who may experience trouble using the manual system. The IoT vision includes a number of building structures that combine and involve multi- and inter-disciplinary activities from the commercial and technical domains. This system aims to operate embedded devices and appliances in the home for a reasonable cost, with simple installation and a user-friendly interface. The system's main concept is to use a variety of sensors and control systems to monitor the appliances and give services based on the demands of the user. It allows users to remotely operate household equipment including lights, fans, air conditioners, televisions, and more by pressing a mobile key. With the use of a touch, the idea of remotely operating the appliances is realised. Input smart phone along with Android Operating System.

According to [2], The proposed system principally monitors and control some of the environmental parameters such as light intensity by LDR, room temperature and gas levels by MQ2 Sensor. This proposed system also monitor the status of Appliances and send an SMS alert via GSM network automatically to a concerned authority and the status will also update in Embedded Web Server. We can also control the devices i.e ON or OFF the by using web server links. If the conditions get abnormal and find a wide application areas where physical presence is not possible all the time. The Wi- Fi and Raspberry pi are used in the implementation of sensor module.

This system offers a complete low cost, powerful and user friendly way of real time monitoring and control of industry or Home. According to [3], In this project, we use Arduino to design and create a control system for a home automation system that can be accessed by a Wi-Fi module or a Web server. This project deals with the automated control of various home appliances, including lighting. The user will speak with Arduino online via a Wi-Fi network. Because of this system's lower cost, more home appliances are possible. For us, it's more secure. We can operate hardware through the internet thanks to a new technology called IOT, or the Internet of Things. Here, we suggested using IOT to automate the modern home by using the internet to control home appliances. This system uses three loads to represent a fan and lighting fixture for a dwelling. A smart home is one that has heating, cooling, and electronic systems that can be managed online or by a smartphone. Whether you are inside or outside of your home, your electronic gadgets can be controlled by a home automation system that is internet-based.

According to [4], Smart home security has become absolutely pre-eminent in daily life of household and industrial works. Home security is something that is applicable to all of us and involves the hardware and a personal security practice. The hardware would be the doors, alarms, lock systems and different type of sensors like PIR sensor, Temperature sensor, fire sensor to detect unfavourable condition. In case of personal security practice involving doors locking, activating alarms, closing the windows and many other daily life tasks are performed to prevent a burglary. In the present time a lot of unsolicited deactivates like theft are increasing continuously so there is need to modify the functionality of existing security systems. Apart from unauthorized entry, fire and LPG leakage in the house etc. are the problems faced by the society which needs equal attention. The Internet of Things (IoT) is a physical network of devices, structures, cars, and other items that are equipped with electronics, software, sensors, and network connectivity. This technology enables these devices and objects to gather and share data. An anti-theft system is any tool or technique intended to stop or discourage unlawful theft .the taking of something deemed valuable. Both machine to machine and human to machine communication should increase as a result of the Internet of Things. This project suggests an IoT-based security system to stop theft in homes, banks, and other establishments. This project's main goal is to minimise human labour. Security system automation has long been a key component. The project's goal was to create and put in place a security system. System that allows control via a handheld mobile phone thanks to the Internet of Things.

According to [5], The IoT paradigm's "smart house" concept integrates home automation. The Internet can be used to connect household items and gadgets, allowing users to monitor and control them from a distance.

These include light switches that respond to voice commands or smartphone apps to turn on and off, thermostats that change the indoor temperature and produce energy usage reports, or smart irrigation systems that start at a specific time of day on a personalised monthly schedule to reduce water waste. Smart home solutions have become very popular in the last years.

One of the greatest advantages of home automation systems is their easy management and control using different devices, including smartphones, laptops and desktops, tablets, smart watches, or voice assistants. Home automation systems offer a series of benefits; they add safety through appliance and lighting control, secure the home through automated door locks, increase awareness through security cameras, increase convenience through temperature adjustment, save precious time, give control, and save money.

According to [6], This system can provide an alert if anyone intrudes. Different types of control systems use different types Studies on home automation systems such as Bluetooth, GSM,Internet, and speech-controlled wireless interactive home lifetime automation system. Machine to Machine Chain System using Global System for Mobile Communication. The Bluetooth concept is suitable for controlling home appliances. Although these systems do not work remotely. A Java-based home automation process has been described in Introduced ZigBee-based system Details.

The most popular home automation system in the international market is the Internet- based home automation system . Installation cost is reduced and the system is increased Flexibility through wireless-based home automation and monitoring systems. The homeowner's lifestyle is according to the internet Things can observe, guide,and manage home situations.

According to [7], Both academics and professionals have worked very hard to advance the idea. Son et al., for instance, proposed a resource-aware management system for smart home management that represents the home context using a domain-object hierarchical model. Technically, they used the Simple Object Success Protocol (SOAP) and Web Services Description Language (WSDL) to allow mobile devices to access home information remotely. Han et al. suggested a new Smart Home Energy Management System (SHEMS) based on IEEE802.15.4 and ZigBee for effective energy management. To lower overall energy costs, they created a SHEMS-based multi-sensing and light control application. Wu et al. presenteda framework to describe the link between services, places, and users in order to satisfy the human-centric interaction need ofa smart home with regard to the "home nature" of a smart home in servicing its users. They created the framework and two ubiquitous applications called Media Follow Me (MFM) and Ubiquitous Skype. Alam et al. introduced an approach termed sequence prediction using enhanced episode discovery to forecast user behaviour (SPEED).

According to [8], This approach is implemented to control various home appliances with ARM9processor.This will also provide safer physical control to the user compare to the conventional high voltage switches. The Bluetooth connection in the system is established by Bluetooth module that directly receives /transmits commands from/to ARM9.Mainly, it is used to control home devices from a central control point. The communication between the devices is wireless. The system is secured for access from outside through an SSL algorithm protected server. SSL algorithm to help create a more secure and scalable future. SSL means secure sockets layer it is a computer networking protocol for securing connectionsbetween network application such as internet.

According to [9], The smart home should be contained withmany machine driven sensors and customized systems for secure life elegance. The security issues are having different types and which increases day by day in our regular life . However, the attacks exist with many associations of techniques and interrupt in the smart home management system. When important information about something is exchanged, information privacy is a crucial concern. As long as there isn't a robust firewall in place, hackers can easily access the network that is linked to sensors and smart home systems. The context attentive and privacy categories include the recognition and identifying category. The distinguishing characteristics change with mental ability and relate to energyuse. Privacy can be a general concept that refers to how values, time periods, and age groups vary.

According to [9], A smart home system integrates various electrical appliances in a home. It provides monitoring and controlling the home devices automatically according to the user's need. After performing literature survey and studying other existing works, we proposed a technique that gives us better understanding of environmental conditions within the home with less human interaction. In this system we have overcome certain drawbacks like complexity, highcompetition with vendors, incompatible standards and higher costs. And also providing a user-friendly interface on the host side so that the devices are easily monitored and controlled. Furthermore, the overall system should be swift enough to realize the true power of wireless technology. Our system not only just monitor and control devices but also detects problem in any device automatically. By using these system we can actually manage to make low cost and energy efficient homes

III.   LITERATURE REVIVE

Table 1 Relevant studies on advantages and disadvantages of Smart Appliances

Related Studies	Advantages	Disadvantages	Methodology
[1]	• The mobility of the application makes to be available to the user independent of the user's location. • It eliminates the need for manual work and makes a remote device to take control of the appliances. • This system provides authentication of usersthat increases the security	• Sensor data may not beaccurate . • Requires constant and good internet connection for datatransmission. • Slower transmit cycles. • Lack of security encryption. • Creating a globally scalable network is difficult with anMQTT	• This system enables to control the applianceswith the help of a mobile application which is easilyportable and reliable. Iteliminates the need formanual work and makes aremote device to take control of the appliances. It alsoprovides special functionslike customizable timing,temperature offset, and speed for an appliance making it more efficient and convenientfor the users.

[2]	• With an IoT system, you can control your appliances remotely using smartphone or other device, regardless of where you are. • It can help you monitor and optimize the performance of your appliances, which can lead to energy savings and reduce operating costs. This is done by increasing efficiency.	• As with any system that is connected to the internet, there is a risk of hacking and data breaches. It is important to ensure that the system is secure and that sensitive data is properly protected. • Implementing an IoT system can be expensive, especially if you need to purchase new appliances that are compatible with the system.	• Remote Monitoring and Control: This involves using sensors and other devices to collect data from appliances and transmit it to a central server or cloud-based platform. From there, the data can be analyzed and used to remotely control the appliance.
[3]	• Controlled electrical fixtures such as lights and air conditioners • Simplified garden or lawn management • Controlled smart home appliances • Enhanced safety and security at home	• Not suitable for advanced application • Requires stable internet connection • Needs constant power supply. In case of power cutdown the module as to be connected to internet again manually. .	• The arduino controller is programmed such that the fan and light are control based on the data send by the mobile phone to the arduino through a Wi-Fi interfacing model.
[4]	• Arduino boards are available at low cost • It is not only limited to Windows it is also available across multiple platforms like Linux and macOS. • PIRS include low false alarm rates when compared to microwave and ultrasonic sensors.	• Arduino has limited scope in the robotic world and cannot be used in industrial scale projects. • Limited Support for Programming Languages • Less Memory Storage Capacity.	• The Arduino Uno connects to the Wi-Fi through serial software. When the connection is established it will start reading the parameters of sensors.
[5]	• Very accurate • Affordable • No special maintenance necessary • ESP8266 chips and RaspberryPi boards Both choices are cost effective, small.	• Time consuming • Relatively slow response time	• using qToggle system a very basic core API, allowing for a more flexible network design It is aimed to be a complete smart home prototype, with a lot of functionalities-automation, control, monitoring, and security. •
[6]	• It ensures home security • Low power consumption • Motion Detection • Secures the home through the web control	• Not able to run Windows Operating system • Overheating as the board doesn't come with any heat-sinks pre-applied or any cooling fan.	• In the proposed system temperature and motion will be monitored and stored in cloud. If it exceeds cooler will automatically turne ON baes on light.
[7]	• Managing all of your home devices from one place. • Flexibility for new devices and appliances • Maximizing home security. • Remote control of home functions. • Increased energy efficiency.	• Installation cost • Internet dependency • Privacy concern • Complicated user interfaces.	• This approach utilizes microcontroller-enabled sensors for measuring home conditions, microcontroller-enabled actuators for monitoring home appliances in the front end. It utilizes PaaS (Platform as a Service) and SaaS (Software as a Service) in Cloud computing for processing data at the backend.
[8]	• With smart home automation, you can control your home's systems and devices remotely using a smartphone app or voice assistant. This makes it easier to manage your home and perform tasks like adjusting the thermostat or turning off the lights from anywhere. .	• These devices have security flaws and can be hacked. Some companies that make these products don't have strong backgrounds in security. • The systems can be costly.	• Through a server protected by the SSL algorithm, the system is secured against access from the outside. Users must create a login and password in order to access the website. GHAS uses mobile phones to control home appliances. It features a built-in SMS feature and modem for home automation.

| [9] | • Increased convenience: Smart home devices can be controlled remotely using a smartphone or voice assistant, making it easy to adjust the temperature, turn off lights, or lock doors when you're not at home.
• Improved energy efficiency: Smart thermostats and smart lighting systems can learn your schedule and adjust the temperature and lighting in your home accordingly, helping you save on energy costs. | • The interoperability allows information associated properties modified between the various ensorial module in smart home environment's row.
• Still there is a challenge task is that the absence of proper row communication between the connected devices which is in smart home environment.
• At consistent operation of various integrated devices, there may be delay assimilation interruption with any new devices. | • The smart meter is one of the equipment that registers a digital signal with Central Process unit (CPU). The communication devices will be shaped and records by smart meter.
• In essence of smart home were primarily conceptualized and later developed to mechanically address the daily necessities of aged and users with disabilities.
• It is suggested that potency of smart homes is anticipated to be climaxed whereas utilizing new approaches. |
| [10] | • Improved efficiency: can be programmed to turn on and off based on the occupancy of a room, as well as the temperature and humidity levels. This can help to reduce energy consumption and save on electricity costs.
• Enhanced comfort: can be controlled remotely through a smartphone app or voice assistant
• Improved safety: can be programmed to turn off automatically if they detect an obstacle in their path, such as a person or pet. This can help to prevent accidents and injuries. | • Cost: Smart electrical fans with these features may be more expensive than traditional fans, which could be deterrent for some consumers.
• Dependence on internet connectivity: If the smart fan is unable to connect to the internet, it may not be able to function as intended, which could be frustrating for users.
• Data privacy concerns: Some people may be concerned about the amount of data that is collected and transmitted by IoT devices, including smart appliances. | • Detection of motion is stored in the server. If the parameters exceed the threshold level, then any electrical appliances will turn on and off automatically.
• If any electrical appliances are left on in a hurry it can be seen. This can be turned off remotely through simply typing the IP address of the web server. |

IV. CONCLUSION

In conclusion, it is the privilege of every person to utilise smart electrical appliances systems that will automatically warn users when a switch is ON or OFF and have the ability to significantly increase the efficiency of how we use electricity. When a need is sensed, switches are monitored and automatically turned on. In some instances, we notice only a few people seated in one corner of the room while the fan, light, and air conditioner are all functioning. All of these amount to wasteful energy waste that depletes the nation's energy supply. Several studies have been done on automated lighting systems with visitor counters, which are used in smart lighting systems. Overall, using smart electrical appliance technologies could significantly increase savings. By automatically turning on the appliances that are essential based on the amount of people present in the hall, you can save electricity from being wasted when it's not necessary.

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