

IOT DEVICE SMART MANAGEMENT FRAMEWORK FOR ENERGY EFFICIENT HOME AUTOMATION SYSTEM

Abstract

With the enormous development, the Internet of Things is expanding its potential applications to improve people's quality of life by transforming houses into "smart homes." A smart house is an interconnected household that has multiple types of digital devices connected so that they may interact with one another internet. A home area network is made up of the numerous protocols that allow communication between these devices. These devices are created by many businesses using various standards and technology. Because home energy conservation is a significant issue, IoT technology is increasingly being used by a growing number of appliances. Here, a software application for IoT-based smart homes is developed that can effectively regulate household appliances continuously based on a list of rules or behaviour. The software is used by the smart home to take user input and send it to the server or host. Along with receiving input from the user, the smart home software also shows them all of the house's status information. The smart home system's protocol for communicating with the host, server, and software is ZigBee. The system encrypts all communication data to maintain security.

Keywords: Smart Home, IoT (Internet Of Things), ZigBee.

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I. INTRODUCTION

A smart house is one that delivers an intelligent living environment for daily convenient. In "smart" houses, every digital appliance is linked to the internet for remote monitoring, management, automation, and control. Nowadays, the Internet of Things (IoT) refers to advanced connectivity of anything, including systems, devices, and users access to information at any time and from any location. A smart home's network of connected devices handles a number of devices, digital appliances, and network device management. A home network uses a number of communication interfaces and methods, without interacting with other wireless networks, mobile communications must be smooth through these connections. The Internet of Things (IoT) is a technology used in smart home systems [13]. IoT technology exchanges and transmits information through the Internet. How effectively IoT is utilized in smart home systems will be determined by each user's Internet connectivity accessibility. With the use of IoT technology, consumers may access all of their home's equipment from anywhere at any time through mobile devices as long as those devices are online. Therefore, users can enjoy from the simplicity of real-time monitoring and control of the home by utilizing a smart home system [14].

Despite the significant technological advancements they have made, power consumption remains a major world issue. Information and Communication Technologies (ICT) alone are estimated to absorb 4.7% of the world's electricity, a figure that may rise to 10%. IoT technology created an opportunity for consumers to access non-smart devices through the Internet by providing programmes that transform ought to smart device. It provides a more reliable method to operate the home appliance and transforms the household into a smart home. Though, IOT uses are not restricted to remote monitoring [1]. They are necessary for automating the electricity system, and they can also increase security by installing cameras in the house that can be found online.

Mostly as outcome, the user can keep a monitoring on their house and control the lighting and appliances, saving power and money on their electric bill. Sensors and cameras that can stop an intruders from entering your home are additional security features that can be included in a smart home [11]. Additionally, the system will become more intelligent and will be able to activate the room's fan and lighting as soon as it detects a person's presence. Therefore, power saving is the primary concern and the project's basic objective. They used IoT to create a smart, electricity connected home system in order to reduce electricity consumption.

Thus, the goal of this analysis is to minimize power consumption (thereby lowering electricity costs) while also ensuring the safety and security of household appliances. The foundation of the Internet of Things is connectivity, which is based on communication standards. Many wireless network protocols, including ZigBee, are utilised in smart home applications (a low-power wireless technology). The advanced lighting control system offered by one of its characteristics. The electrical appliances no longer need to be manually turned on or off by the user. For instance, the user has two alternatives when entering the bedroom: either the light will turn on and off automatically when the user enters and exits the space, or the user can control the switching from the application using smartphone. In order to reduce power consumption, the brightness of the light can also be adjusted. In addition, the user has the option of changing the room's

settings based on sensor data (temperature, humidity, etc.), such as controlling the fan's speed from a mobile application or having the speed automatically update to modifications in the room's temperature.

Home Automation Systems (HAS) that are commonly accessible can be divided into two categories: locally controlled systems and remotely controlled systems [4]. In order to achieve home automation, customers in the first group can operate their home appliances using an in-house controller with a stationary or wireless communication technology (Bluetooth and Zigbee). In the second category, consumers can use their personal computers or mobile devices to remotely operate their homes over an Internet connection.

A user-friendly interface should be offered by a home automation system to make it simple and effective to organise, monitor, and manage household appliances. To completely realize the full potential of wireless technology, the automation system must also be quick enough, offer a sufficient data rate and communication range, have a dependable connection. In order for the general public to own the system controller and support its use in home automation, it should also be accessible [19].

II. LITERATURE SURVEY

Roy, Priyo Nath, S. M. Kamruzzaman, Maniza Armin, and Md Emdadul Hoque et al. [2] The presented method helps in creating smart environment where users may switch devices on and off using such an Android app. In addition to making activities easier for the elderly and disabled, this also contributes to energy preservation by reducing the need for electricity. Another important benefit is the technology's ability to run 8 appliances at once while being rather economical than alternative approaches.

J. L. Ramírez-Mendiola, P. Grunewald, and N. Eyre et al. [3] explains a stochastic model of household activity patterns. By analysing experimental data collected, the model looks for patterns that can be explained by stochastic processes with selective memory. The abovementioned models do not function as comfort items and do not offer calculations for energy conservation that are applicable in the real world.

Madhu, G. M., and C. Vyjayanthi et al. [5] dual-mode approach that is presented a home automation system with Natural language processing (NLP) and a touchscreen interface was constructed using the Internet of Things. The appliances may be controlled with an Android app. This approach has the important advantage of allowing for demand-based expansion or reduction of existing rooms.

D. Yan, X. Feng, Y. Jin, and C. Wang et al. [6] developed a framework for methodological validation of the domestic lightning model. However, those approaches do not take into account or predict the energy utilization of a home because they focus on a limited set of factors, such as user occupation and/or lighting requirements within a home.

Ravi Kishore Kodali, Suvadeep Bose Vishal Jain, and Lakshmi Boppana et. al. [7] presented a mechanism for the Internet of Things project, described the IoT project model that focuses on developing a smart, wireless home security system that can optionally sound an alarm and send owner notifications via the Internet in the event of trespassing. The

TICC3200 microcontroller Launchpad board serves as the prototype's microcontroller in this circumstance. These system can send warnings and the information sent by the wifi associated microcomputer centralized network can be received by the user on his phone from any location depending of whether the user's mobile phone is directly connected or not.

A. Nilsson, M. Wester, D. Lazarevic, and N. Brandt et al. [8] demonstrates the significance of ensuring communication for the day-to-day activities of a household in order to increase the accuracy of estimates of electricity consumption. The development includes the idea of providing input to the system and recognize the considers human comfort limitations to lower energy usage in smart homes.

Kishore. P, T. Veeramanikandasamy, K. Sambath and S. Veerakumar et al. [9] developed two or three home appliance controls that operate automatically. There aren't many technologies that have been developed specifically for monitoring gas levels inside homes. All of the earlier works only resolved with house automation; however, this method combines security and automation at a low cost.

Bhargav Mypati, Naseer Ahamed and Gopa Sai Chandra et al. [12] describes a microcontroller-based smart home system with a ZigBee module and a GSM network. Anyone can make use of an IOT-capable product. The Wi-Fi communication module implemented into IOT capable devices allows for cross-network communication between system components. ZigBee is implemented as an external communication module in the system because the Peripheral Interface Controller (PIC) microcontroller requires an internal communication module.

Byeongkwan Kang, Sunghoi Park, Tacklim Lee and Sehyun Park et al. [15] explains the collection and analysis of sensor data that will be used in smart homes. It provided a framework for analyzing the data gathered from multiple sensors to provide services that are aware of their surroundings and collect information about the environment.

B. R. Pavithra, D. et al. [17] described the framework for successful IoT implementation in controlling and measuring household appliances through the use of the World Wide Web (WWW). This approach is both cost-effective and scalable. The architecture made it possible to control the appliance remotely without internet access using a web server.

III. FRAMEWORK FOR ENERGY EFFICIENT HOME AUTOMATION SYSTEM

In this section, IoT device smart management framework for home automation system is presented and each of the system is discussed in detail in Fig.1

Software for smart homes is created using the Android operating system. Since Android is now regarded as the most widely used operating system for portable devices, it has been selected as the underlying system for smart home applications. The smart home system is expected to gain more users as a result of this consideration.

Selecting communication and routing protocols that offer a scalable, adaptable, and predictable solution is a key design factor for connectivity. It might be challenging to assess networking and routing characteristics in a physical network. Therefore, the needed data can be obtained using a software simulator. CoAP (Constrained Application Protocol), which offers a dependable and adaptable method to remotely collect sensor and network data is used to access web-based services.

A home network's responsibilities include monitoring connected devices and distributing bandwidth. The role of the home network to control network connections and transfer bandwidth. Faster, more dependable, and more energy-efficient are some of the newer generations of home networking technology.

Any wireless protocol can be used to link sensor nodes to a gateway or Home Control Unit (HCU). A gateway device essentially serves as a bridge to connect the Internet to a wireless sensor network. Node and sensor data can be read from an existing database and displayed to users using a web-based system or mobile app. A broad global network framework that allows access to smart home devices is shown in Fig. 1. The ZigBee is connected to the gateway.

A low-power wireless mesh technology is ZigBee. With a focus on management and surveillance, and sensing applications, it uses digital radios based on the IEEE 802.15.4 standard for local area networks. It mostly uses the 2.4 GHz Information Systems Management (ISM) band. The Zig Bee alliance offers a standard for products used in homes, such as temperature and lighting controls, security cameras, and smoke detectors. ZigBee has a strong, independently developed mesh networking system that enables dependable data delivery. It also has multiple topologies of networking flexibility.

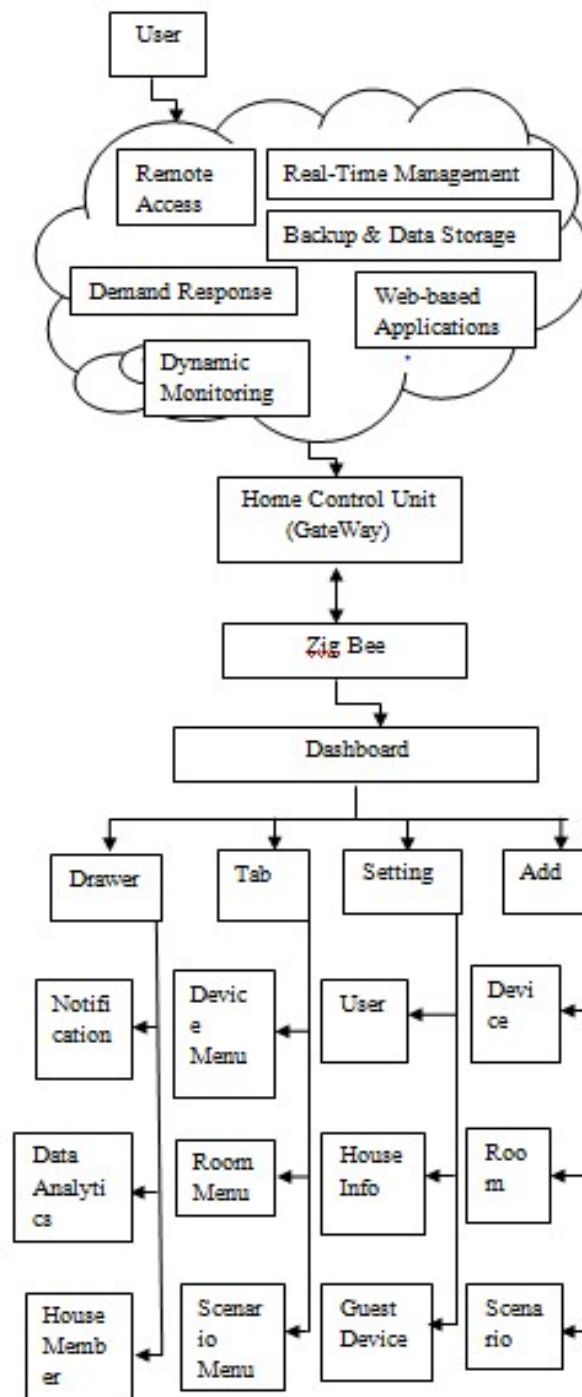


Figure 1: Structure Of IoT Based Smart Management Energy Efficient Home Automation System

Every equipment can be categorized using the device class features as per its type and location in the room. Every user will find it simple to manage or regularly check on the devices in homes according to this functionality. The lamp, the curtain, the door, the switch, the temperature, and the fan are the six types of devices. A user can manually create a room category. The user can activate several devices at once according to this capability. A user can add scenarios by entering a device's name and status. Even after situation has been recorded, the user can activate it by pressing the power button on the situation list. If the user enters the scenario's activation time in the input column, scenarios can also be activated every day automatically.

Scheduling is another name for scenarios that activate automatically. The scheduling feature can automatically set a scenario as a daily routine. By utilising this feature, customers can reduce their household's energy consumption by setting appliances like lights and air conditioners to switch off automatically in the morning. Normal and warning messages are the two different kinds of notifications. A normal notification is one that informs you of the addition, modification, or removal of a device, room, scenario, or person. A notification signal is sent when the home is secured and the system discovers an instruction to change a device's condition before even opening the home condition. Through this application, users may lock and unlock their homes at any time and from any location. When secure the house, any user can enable the lock mechanism. The unlocked situation can be used by the user to enter the home. When a danger notification is sent, the system informs the user that someone else is looking to hack their home automation system.

In order to distinguish the user's level of authorization when managing a device inside the home, use of member privilege. Even though only authorised users may use every device in the house, this function can increase home security. The privileges available on the smart home system are admin and guest. The only devices in the home that outsiders can control those that the admin has given them permission to use.

The duration of device usage data in the house will be displayed in usage monitoring data. A curved graph showing the device duration data has the date of the device use on the horizontal axis and the device duration on the vertical axis. Users should use the gadget more effectively around the house with the help of this feature. Therefore, this function can be used to reduce energy consumption.

Rivest-Shamir-Adleman (RSA) and Advanced Encryption Standard (AES) are the two algorithms used for encryption. Even though AES was much more private than RSA, the system still needs RSA for communications since RSA uses a pair of fixed keys that are a considered as both participants, in contrast an AES encryption key is a dynamic key that changes whenever a user logs in or changes. By enhancing dynamic key security in encryption, AES attempts to make it more difficult for hackers to hacking home network security systems.

With the help of the Quick Response (QR) code scanning feature, users can quickly and easily add new devices to the smart home system. The smartphone receives the device's code after successfully scanning the product. The device type and device protocol information will be encrypted and sent to the user's smartphone by the system.

The auto-lock feature uses the user’s smartphone’s location to immediately operate the lock scenarios. The one and only situation that can immediately activate depending on location is Scenario Lock, which functions related to a regular situation in that it can be customised. When all users leave the home radius, it automatically activates. A normal house has a radius of 100 metres because its area is less than 16.180 metres.

In an IoT smart home, digital technologies can choose the most effective time to operate, resulting in increased power yield. In a smart home, a lot of IoT devices that are connected to one another constantly send signals and data, which uses a lot of CPU and electricity. Effective communication in IoT networks requires low energy consumption and battery usage. Power is used very quickly by conventional Wi-Fi. Though its signal range and number of devices are restricted, Bluetooth is excellent using a low power. Although ZigBee-based networks typically use around 25% less power than Wi-Fi networks and have lower consumption of electricity than Z-Wave Wi-Fi, they have a slower data transfer rate than Wi-Fi.

IV. RESULT ANALYSIS

In this analysis, the implementation of smart management framework for energy efficient home automation system by using IoT Device is presented. The architecture is highly useful for managing and monitoring the environment in smart homes. The security is increased by utilising this framework. Users get access to a home activity log window and door control. Such platform also offers better resource and energy utilisation through smart appliances, lighting controls, and a smart air-conditioning system. The time is also saved by this smart management framework for energy efficient home automation system. The results show that IoT based smart management framework for energy efficient home automation system provides a better performance over standard Home Automation System (HAS) for the security and time saving.

Security comparison between a traditional home automation system and an IoT-based system is shown in Fig. 2 with various thresholds. X-axis shows classification and Y-axis represents percentage (%). The IoT based automation system has a high efficiency.

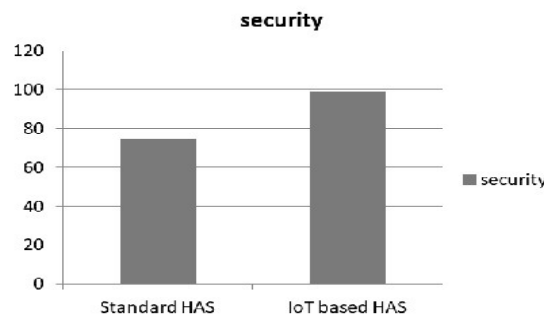


Figure 2: Security Performance Comparison Graph

The Fig. 3 shows the time comparison between presented, standard home automation system and IoT based HAS. The IoT based automation system takes less time compared to

standard HAS. The Y-axis represents the time in ms (milliseconds) and X-axis represents the systems.

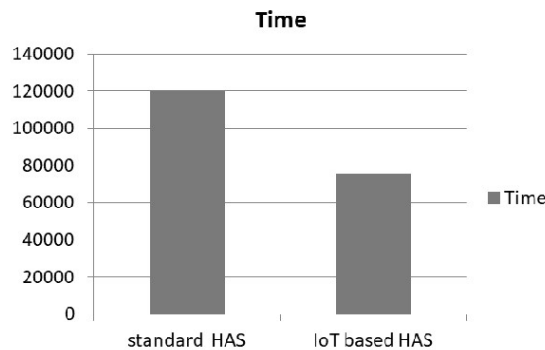


Figure 3: Time Saving Comparison Graph

Therefore IoT based automation system has better performance when compared to the standard HAS systems in terms of security, time saving.

V. CONCLUSION

People are currently being effected toward a high-quality lifestyle by smart home networks. Soon, the Internet of Things will connect even the simplest home appliances to the internet. This model also explains the industry standard that serve as the foundation of development and the home network. The issues with the smart home network are also associated with the presence on its accessibility. ZigBee modules are utilized for greater bandwidth applications and low power consumption. Software for smart homes has been developed that enables remote and real-time management of all household appliances. Through the Android-based smart home system software, users may control every element of the system and keep a monitoring on the devices. The software allows users to automatically operate their products based on their settings or behaviour. As a result, it effectively reduces household energy use while enhancing user convenience.

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