

IOT Based Home Automation System: A Review

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Abstract — The rapid advancements in technology have led to the emergence of the Internet of Things (IoT) as a transformative paradigm in various domains, including home automation. This review paper aims to provide a comprehensive overview of IoT-based home automation systems, exploring their architecture, components, benefits, challenges, applications, and future prospects. With the increasing integration of IoT devices into our daily lives, a critical analysis of the current state of IoT-based home automation systems becomes crucial for understanding their potential impact on society, security concerns, and the path toward a smarter and more connected future.

Keywords: Android Application, Bluetooth, IoT, Wi-Fi, GSM, Home Automation

I. INTRODUCTION

The concept of home automation has evolved significantly over the years, transitioning from simple remote controls to complex systems that leverage IoT technology. IoT-based home automation systems enable the interconnection and communication of various devices, appliances, and sensors within a home environment. This interconnectedness allows homeowners to monitor, control, and automate various aspects of their homes remotely, leading to enhanced convenience, energy efficiency, security, and comfort.

Home automation is evolving the quality of human life at an unprecedented rate. This eliminates the need of labour and also helps in the consumption of electricity thereby saving energy. The motive of this paper is to supervise and operate the appliances through different methodologies from anywhere in the world just by using an android application. In this paper the various techniques of automation methodologies used in homes are compared with their speed, cost and other functions. It highlights the drawbacks and advantages of each method [1]. Over the years

there have been many definitions for home automation [2]. These definitions endure the phenomenon of the components of technology highlighting its functions and need to meet the aim of smart home. There are numerous definitions given by a variety of people which may be overlapping each other but the common points of everyone can be narrowed to services, technology and the desire to meet the user's demand. Home automation system also helps the elderly or the handicapped people. It is easier for them to operate or control all the house appliances with an android application. In addition to this home automation system also helps in reducing the energy consumption within an area. There are a lot of threats to environment which are emerging nowadays such as global warming, change of climate and volatility in the prices of energy which has helped in developing the home automation system. As shown in Fig. 1, the use of automation system through different mediums has made it possible to reduce the consumption of energy [2]. Home automation also provides opportunities to create new fields in architecture, computing and engineering. The wireless technology introduced various connections namely bluetooth, IoT, Wi-Fi and GSM each of which have their own advantages, disadvantages, applications and the specifications [3].

Home automation system is a rapidly developing field but it has not evolved much due to high expenditure [4]. This paper presents the control of appliances through an android application which helps to overcome the drawbacks of traditional smart home control. The traditional home automation control system that has been used widely includes bottom push buttons, PCs and infrared remote controls. The usage of these will consume more power and energy. They are the least efficient and require more expenditure. The advantage of using android as a platform is that it is easy to understand. Also, it can use any medium such as bluetooth, IoT, Wi-Fi and GSM to execute the commands given by the user [5].

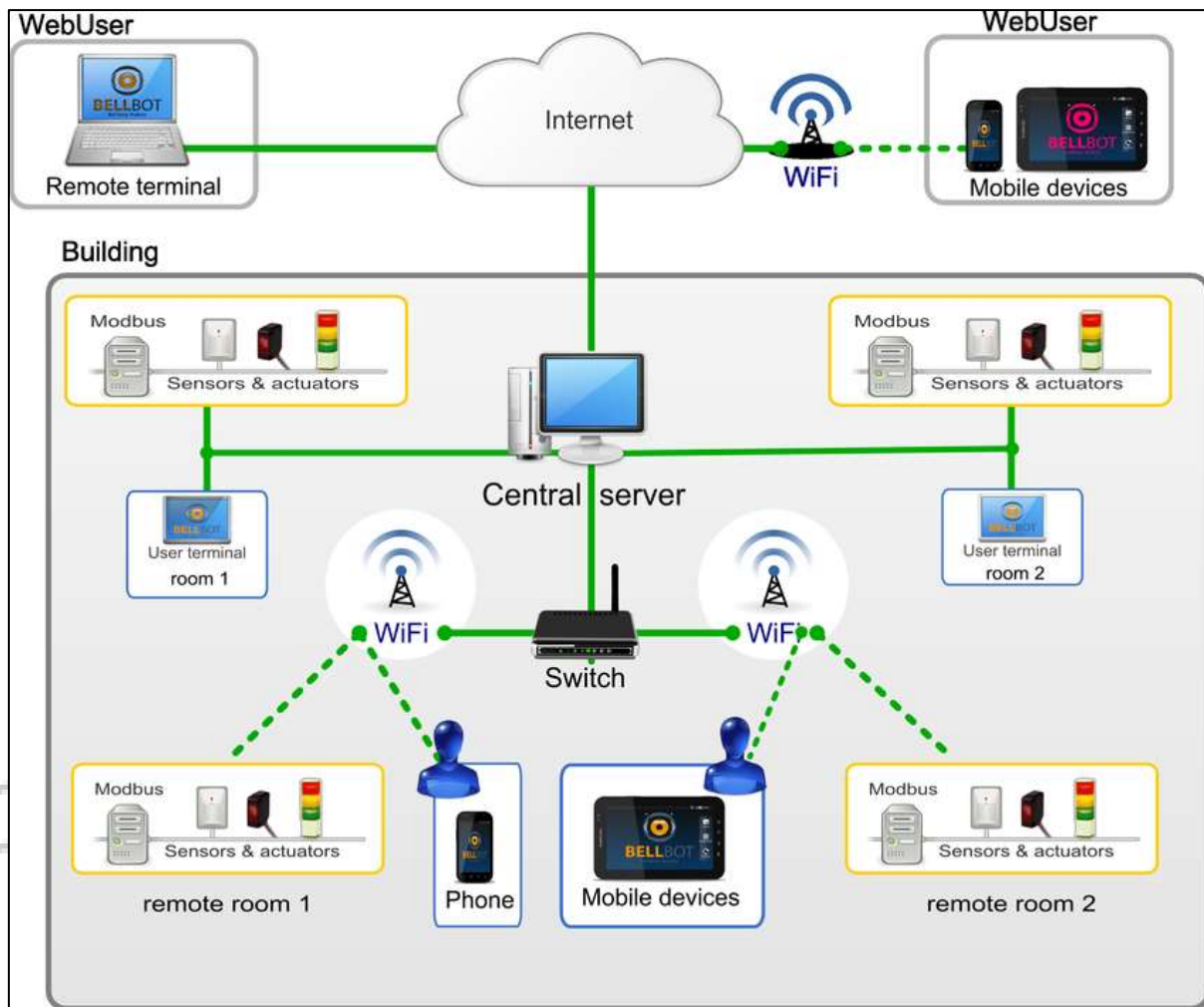


Fig. 1: Home Automation System

II. LITERATURE REVIEW:

The concept of IoT-based home automation involves connecting various smart devices and appliances within a home to a network, enabling remote control, monitoring, and automation through the internet.[6] Provided an extensive overview of IoT-based home automation, highlighting its architecture, components, and potential benefits in terms of energy efficiency, convenience, and security.

Delved into the architecture of IoT-based home automation systems, emphasizing the layered structure comprising perception, network, and application layers[7]. They discussed how various communication protocols like Wi-Fi, Zigbee, and Bluetooth Low Energy (BLE) are utilized to interconnect devices and enable seamless data exchange.

Energy efficiency is a significant focus of IoT-based home automation. Explored how IoT devices can optimize energy consumption by intelligently controlling lighting, heating, and cooling systems based on user preferences and environmental conditions. They also discussed the potential for integrating renewable energy sources into the system[8].

Smart sensors play a vital role in collecting data from the environment, while actuators enable the execution of actions. Discussed the integration of various sensors such as temperature, humidity, and occupancy sensors in IoT-based home automation systems. They highlighted the

importance of sensor accuracy and reliability for effective automation[9].

The integration of numerous IoT devices raises concerns about security and privacy. Focused on the security challenges in IoT-based home automation, including device authentication, data encryption, and vulnerability management[10]. They emphasized the need for robust security mechanisms to prevent unauthorized access and data breaches.

User interfaces and experience are crucial for the adoption of IoT-based home automation systems. Discussed user-friendly interfaces such as mobile apps and voice-controlled assistants that enable homeowners to control and monitor devices remotely[11]. They highlighted the importance of intuitive design and customization options.

Data generated by IoT devices can be harnessed for insights using data analytics and machine learning techniques. Explored how machine learning algorithms can be applied to predict user behavior and optimize device settings for energy efficiency[12]. They discussed the challenges of data processing and model accuracy.

The field of IoT-based home automation is rapidly evolving. Discussed emerging trends such as edge computing, which involves processing data closer to the source to reduce latency and enhance privacy[13]. They also highlighted the need for standardization to improve device interoperability and simplify integration.

III. IOT BASED HOME AUTOMATION SYSTEM

Home automation system built on IoT is designed and implemented on an android phone, a software application, controlling appliances and embedded micro web server. It basically consists of three sections namely home gateway along with home environment and remote environment. The users can control and monitor the appliances through an android application in a smartphone supporting 3G or 4G, Wi-Fi. The hardware module of interface and home gateway is present in the home environment. The exchange of data between the internet, arduino ethernet server and router is provided by the home gateway. This scheme has the ability to decrease the consumption of energy by managing the system such as lightings, security system, door and gate locks, ventilation. The fig. 3, shows the control of appliances through IoT using an android application. The proposed method helps in creating a smart environment which helps the user to switch on/off the devices using an android application. It makes the job easier for handicapped and elderly people and also helps in saving the electricity thereby reducing the usage of energy. Another major advantage of this method is that it can operate

8 appliances at a time and the cost is also less when compared to other mediums [18]–[26]. A similar method of dual-mode IoT built home automation system is presented in the paper [19] which uses NLP and a touchscreen interface node. An android application helps in controlling the appliances. One major advantage of this method is that it can add or remove new rooms depending on the demand [20], [21]. This paper also mentions about a similar system which uses World Wide Web to control and monitor the home appliances. For the controlling of different appliances Wi-Fi and raspberry known as the server system is used. This method has an additional feature of alerting the user if there is a case of fire accident thereby protecting the complete system [1], [25]. Another method proposed in [27] controls the home equipment with the help of node MCU as the interfacing component where home automation using IoT is done with the help of a blink app. The controlling of the appliances using IoT is possible from anywhere in the world that is it does not have a limited range which makes it highly scalable [17]–[27]. The exchange of data transmission is faster as compared to other mediums.



Fig. 2: IOT based Home Automation System

A. Architecture of IoT-Based Home Automation Systems:

IoT-based home automation systems consist of three main layers: the perception layer, the network layer, and the application layer. The perception layer includes sensors, actuators, and devices that gather data from the environment. The network layer facilitates communication between devices and the central hub using technologies such as Wi-Fi, Bluetooth, Zigbee, and Z-Wave. The application layer comprises user interfaces, mobile apps, and cloud platforms that enable users to interact with and control their smart devices.

B. Components and Devices:

IoT-based home automation systems consist of a diverse range of components, including smart thermostats, lighting systems, security cameras, door locks, smart appliances, and environmental sensors. These devices are designed to enhance user comfort, energy efficiency, and security while providing remote control capabilities through mobile apps or voice assistants.

IV. BENEFITS AND APPLICATIONS:

The adoption of IoT-based home automation systems offers numerous benefits, such as energy savings, increased convenience, improved security, and enhanced accessibility for individuals with disabilities. These systems find applications in various scenarios, including smart lighting, temperature control, home entertainment, home security, and health monitoring.

V. CHALLENGES:

Despite their potential advantages, IoT-based home automation systems face several challenges. Interoperability issues between different devices and protocols can hinder seamless communication and integration. Moreover, concerns related to data privacy, security vulnerabilities, and the potential for unauthorized access raise questions about the overall safety of these systems.

VI. SECURITY AND PRIVACY CONCERNS:

The integration of IoT devices into home environments raises significant security and privacy concerns. Vulnerabilities in device firmware, weak authentication mechanisms, and insufficient data encryption can expose users to cyberattacks. Ensuring robust security measures, regular firmware updates, and user education are imperative to mitigate these risks.

VII. FUTURE PROSPECTS:

The future of IoT-based home automation systems is promising. Advancements in AI and machine learning will enable more sophisticated automation, predictive maintenance, and context-aware actions. Standardization efforts will address interoperability challenges, leading to more seamless integration between devices from different manufacturers. Additionally, advancements in energy harvesting and battery technology will extend the lifespan of IoT devices.

VIII. CONCLUSION:

IoT-based home automation systems offer a compelling vision of a connected and intelligent living environment. The ability to control and monitor various aspects of our homes remotely has the potential to revolutionize the way we interact with our living spaces. However, addressing challenges related to security, privacy, interoperability, and user education is essential to fully realize the benefits of these systems. As technology continues to evolve, IoT-based home automation systems are poised to become an integral part of our daily lives, shaping the way we live, work, and interact with our surroundings.

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