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## IoT based home automation and security systems: A literature survey

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### ABSTRACT

*With the significant growth of internet usage across the globe, the Internet of Things (IoT) has become an emerging solution for connecting and controlling real-world objects ranging from industrial machines to home appliances to the internet. One of the major applications of IoT technology is used in the home automation industry to build smart homes. These home automation systems allow users to perform and complete daily activities when they are busy with other tasks. Smart homes have the ability of remotely connecting, monitoring and controlling various home appliances and other objects over the internet. The smart homes are laid with various types of sensors that act as an interface for wireless communication and control between the user and the home appliances. Various types of sensors play a major role in making a home smarter, safer and automated.*

**Keywords**— Internet of Things (IoT), Wireless, Smart home, Sensor

### 1. INTRODUCTION

The concept of home automation has been around since the late 1970s.[1] But with the advancement of technology and services, people's expectations of what a home should do or how the services should be provided and accessed at home has changed a lot during the course of time, and so has the idea of home automation systems. In today's world, Automatic systems are being preferred over the manually-controlled system. With the rapid increase in the number of users of the internet over the past decade has made the Internet a part and parcel of life, and IoT is the latest and emerging internet technology. The home automation system is a system that controls the functionality of the home appliances such as glowing of light, speed of the fan, etc. With the increase in a number of user-controlled electronic home appliances and their interaction with users and internet-compatibility adds to the importance of the home automation system. Smart Homes increases the quality of life people by

providing comfort, making appliances energy efficiency and enhancing the security features of the house. Due to energy saving nature, and internet or Smartphone connectivity, it has developed huge demands in the market.

The idea of an intelligent, independently learning computer has fascinated humans for years. Machine learning recently has gained a boost in popularity among IT companies. IoT has become one of the most significant sources of new data, data science and will provide a considerable contribution to making IoT applications more smart and intelligent. Machine Learning includes a broad range of algorithms that can be applied in different domains. Data models of Machine learning as in neural networks, classification, and clustering methods, and using appropriate algorithms have to match with the data characteristics.

A smart home can be called a network of sensors. Such sensor networks have applicability in domains such as environmental monitoring and human activity recognition. Sensors generate huge amounts of data and these generated data can be subjected to various machine learning algorithms to trace resource usage patterns such as electricity usage etc. and automate household activities.

In simple words, the main purposes of the home automation systems are:[2]

*“The home automation systems are used for controlling the indoor & outdoor lights, heat, ventilation, air conditioning in the house, to lock or open the doors & gates, to control electrical & electronic appliances and so on using various control systems with appropriate sensors.”*

### 2. RELATED WORK

In today's home automation industry, there exists a large variety of home automation systems to cater to different needs.

We can categorize the existing systems based on the following metrics: [3]

- Range of Access
- Platform
- Security
- Price

Based on the range of access, we can have two broad categories: Locally controlled system and remotely controlled system. The locally controlled system provides access to the system from home this is referred to as in-home access. This allows one to use the system within a home. Example of such an existing system is ZigBee. On the other hand, remotely controlled system provides access to the system from a remote area or outside from the home. These systems use private networks or internet for communication. These systems provide a wide range to access. Based on the platform used for the development and integration, the technology world has seen a growth of different platforms which creates various options of compatibility. The existing systems have been supported using popular platforms like Android (Java), iOS and Windows-based client applications. From the security point of view, the existing systems provide security by raising alarms in case of fire or any theft, gas sensors in case of gas (LPG) leakage, CCTV for surveillance etc.

Home automation systems incorporate the following types of devices in them: [4]

- **Sensors:** To measure or detect temperature, humidity, intensity changes or motion.
- **Controllers:** Devices used to control the functions and operations of the automation systems such as web-app for smartphones and PCs, specialized remote for using the home automation system etc.
- **Interfaces:** A human, machine or machine-to-machine interactions.
- **Actuators:** Different types of motors and switches used in the system.
- **Buses:** Used for communication purposes in wired and wireless systems.

From security, platform used and system controllability and connectivity point of view of the home automation systems, we have the following types of home automation systems (HAS): [5]

- (a) **Power line based home automation systems:** The power line based automation systems are inexpensive and doesn't require additional cables to transfer the information, but uses existing power lines to transfer the data. However, this system involves a large complexity and necessitates additional converter circuits and devices making it less preferable to install it in homes in today's world.
- (b) **Wired home automation systems:** In the wired type of automation, all the home equipment are connected to the main controller (programmable logic controller) through a communication cable. The equipment is attached with actuators to communicate with the main controller. All the operations are centralized by the computer that continuously communicates with the main controller.
- (c) **Wireless home automation systems:** The wireless home automation systems are an expansion and advancement of wired automation which uses wireless technologies like IR, Zigbee, Wi-Fi, GSM, Bluetooth, etc., for achieving remote operation. As an example, the NodeMCU ESP8266 Wi-Fi module is used to control various home appliances by connecting it to an existing Wi-Fi network.

### 3. COMPARATIVE ANALYSIS

Though the home automation concept has been in the market for over more than a decade now, still this hasn't been that widely known among the population. The main reasons why this concept is still not into much use are:

- (a) Consumers find the home automation systems very expensive
- (b) They have no idea of what a home automation system is i.e., they are completely unaware of its existence
- (c) Even if they knew what a home automation system was they didn't know its uses or how such systems could benefit them.

Figure 1 depicts a graphical representation of the same. It is true that as days are passing by, the world of technology is reaching new heights which may or may not be readily available to users. But if a new innovation is not helping out mankind, then the innovation needs to be redesigned and redeveloped to meet the needs.

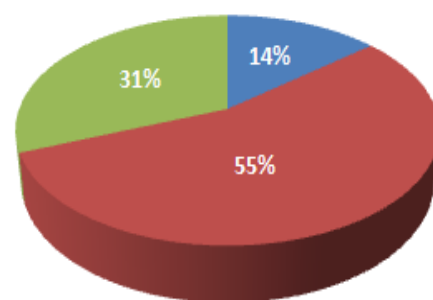
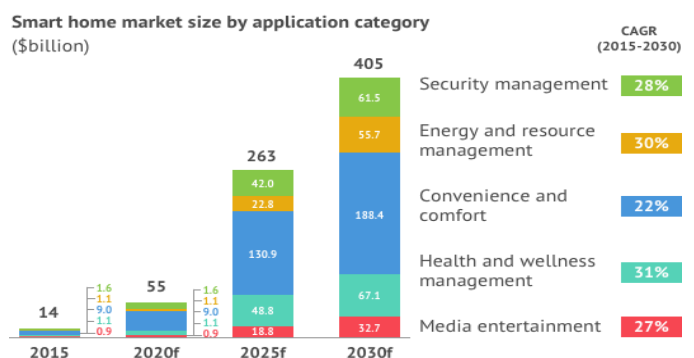


Fig. 1: Popularity of Smart Homes

The Global Smart Homes Market was valued at USD 35.7 billion in 2017 and is expected to reach a value of USD 150.6 billion by 2023 at a CAGR of 26.9%, over the forecast period (2018 – 2023). The threat of climate change, fluctuating energy prices and energy security and supply concerns have necessitated new ways of producing, delivering and consuming energy. In this regard, smart homes have gained increased attention in both policies and government regulations across the globe. [6]

#### Smart home market growth will explode after 2020



Source: A.T. Kearney analysis

Fig. 2: Home Automation future trends

Figure 2 shows the use of home automation systems in various fields and their future trends in those fields.

### 4. CONCLUSION

The main aim of any technology is to ease a task with maximum possible efficiency and the home automation

industry is just the best example for this. Controlling your home remotely just doesn't make your home smart but also improves the security of your house as in a common cause of any theft in your house; these smart homes are capable of notifying you in real time so that you can take immediate action. Apart from security, these systems enable efficient use of resources such as electricity as you can monitor the status of your appliances in any room of the house and turn them on or off at any required time. In some type of smart homes, the turning on and off of lights is automated in the way that the rooms are equipped with occupancy sensors so that whenever the room is occupied, the lights are kept on and the lights are turned off otherwise. These systems come with the option of being able to switch between the traditional manual switch systems and the automation system. This survey paper explains the various types of existing home automation systems and also provides an insight into the present and future trends of the home automation industry.

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