



Challenges and Types of Home Automation Systems

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Abstract— Automation is the use of management systems and information technology to manage equipment, industrial machinery and processes, reducing the necessity for human intervention. Within the scope of industrial enterprise, automation may be a step beyond mechanization. Home automation is use of one or additional computers to manage basic home functions and options automatically and generally remotely. An automated house is generally referred to as a smart home. This paper discusses some of the different types of smart homes build up using various technologies.

Keywords— Automation, Home Automation, Components, Characteristics, Challenges

I. INTRODUCTION

Automation plays a progressively vital role in the global economy and in daily expertise. Engineers try to combine machine-driven devices with mathematical and structure tools to make complicated systems for a speedily increasing vary of applications and human activities. Several roles for humans in industrial processes presently lie beyond the scope of automation. Human-level pattern recognition, language recognition, and language production ability are well on the far side the capabilities of latest mechanical and laptop systems. Tasks requiring subjective assessment or synthesis of complicated sensory information, like scents and sounds, in addition as high-level tasks such as strategic designing, presently require human experience. Automation has had a notable impact during a wide selection of extremely visible industries beyond producing. Then the present telephone operators can be replaced largely by automatic telephone switchboards and responsive machines.

Home Automation System is changing into more advanced and standard day by day. Intelligent living areas are preferred with home automation systems that simply not only offer convenience, comfort, and security however additionally reducing their efforts but also provide energy saving solutions. The demand for appliance monitoring systems is increasing rapidly day by day and promise to be a potential market trend in the coming future. Home automation isn't new. Throughout history, we've

endlessly strived to modify tasks within the home in order to create our lives easier. Technology has currently advanced to the purpose at that we want to require an integrated approach to home automation, permitting appliances to communicate with one another and to be controlled in versatile ways. A wireless network approach to the present communication and management provides a straightforward, cost-efficient and scalable solution to home automation. The home automation systems provides mutual ability between varied electronic, electrical, and power devices further as interactive interface for individuals to manage their operation. These options are very useful to optimize and to economize energy consumption whereby saved energy throughout some few years may make more money than home automation systems implementation price. These technologies build peoples' life additionally easier, particularly for senior persons and persons with disabilities. These systems exist in fact, however there are several non-interoperable, expensive, and often wired systems. Wiring complicates implementation of the home automation in buildings that are already designed, particularly in historical ones.

Various progressive wireless communication standards were developed and enforced into implementation throughout last decade. GSM and Bluetooth are accepted by the majority within the modern society. These standards have penetrated into their daily routine with outstanding popularity. "An internet of people" has become standard for everyone} who desires to have everybody and everything accessible. Despite the fact that it appears that everyone peoples' wireless necessities have consummated, it activates, that they lack of one thing like "a net of things" particularly in thought Home Automation (HA).

The HA systems provides mutual ability between varied electronic, electrical, and power devices further as interactive interface for individuals to regulate their operation. These options are terribly useful to optimize and to economize energy consumption whereby saved energy throughout some few years may build more money than HA systems implementation value. These technologies build peoples' life additionally easier, particularly for senior persons and persons with disabilities. These systems exist in fact, however there are several non-interoperable, expensive, and often wired systems.

IoT grants individuals the ability to ideally use any network and any service anywhere and anytime while the appliances and people need to be connected to a network. IoT technology therefore uses Automation as an important application.

II. HOME AUTOMATION

Home automation can also be referred as a Smart Home. Various domiciliary activities can be made more economical, secure, comfortable and convenient by using this technology that is Home Automation.

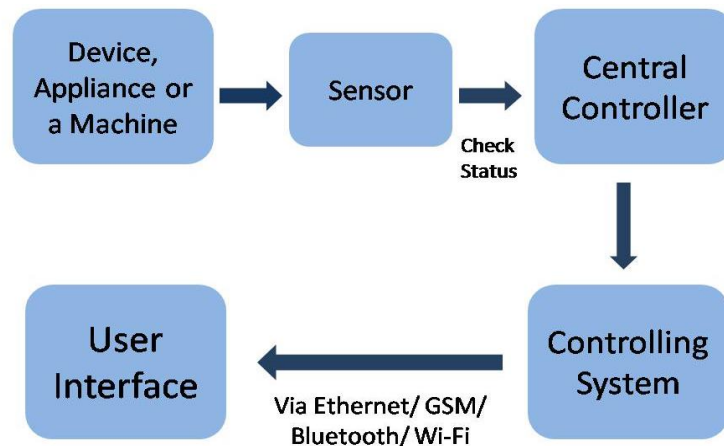


Fig. 1. Basic architecture of a Home Automation System.

A. Components to be included in a Home Automation System:

- 1) *User Interface*: Devices that can give commands to control a system such as a monitor or a phone.
- 2) *Transmission Medium*: Wireless (Bluetooth/GSM) and Wired Connections (Ethernet).
- 3) *Control Centre*: A hardware interface that communicates with the user interface to control household services.
- 4) *Electronic Devices*: Devices that are compatible with the transmission mode and is connected to the control centre.

B. Characteristics of Home Automation

- 1) *Reduced Installation Cost*: No cabling required, therefore the cost of installation is significantly cut down.
- 2) *Internet Connectivity*: The devices can be easily controlled with mobile phones using internet from anywhere in the globe.
- 3) *Scalable*: Network extension is necessary as application with wireless networks is nowadays widely used.
- 4) *Security*: As built in security ensures integrity of smart home, devices can be easily added to make an integrated smart home.

C. Challenges in Home Automation System

1) *Reliability*: For home automation to succeed, developers should address considerations regarding the dependability of sensible devices compared with ancient home appliances and equipments.

If connected devices don't possess similar practicality to precursor appliance, they might produce a replacement category of issues, like how to guarantee service continuity within the event of a sudden breakdown or service failure.

A large-scale service outage is one factor; however a connected device or home automation merchandiser is additionally at the mercy of the consumer's broadband affiliation.

If your product cannot fall back to some lower normal of helpful practicality once a web affiliation is unavailable, the consumer's valuation of your product are injured when their net connection has issues. This creates an oversized third-party dependency for sensible device corporations.

2) *Date Collection and Use*: Many connected home and smart products rely on value propositions that are in part about new functionality, and in part about the 'smarter' use of resources. In order to achieve this, data flows between the devices and servers operated by the device providers, between devices, and to and from the consumer's smart phone or computer.

This creates opportunities to gather information that may be accustomed to improve the service, or be analysed by marketers to learn regarding consumers' habits to create and grow existing relationships.

Much of the data being generated and collected is 'personal data' inside the that means of Directive 95/46/EC, and with the overall information Protection Regulation (GDPR) set to come back into force within the EU on twenty five could 2018, any businesses wanting to require advantage of those opportunities ought to keep information privacy at the highest of their agendas.

Even if the systems aren't hacked by malicious third parties, users and customers ought to be confident that the vendors provision these product and services area unit by themselves trustworthy.

Vendors ought to see compliance with information protection laws as a value differentiator when developing their product offerings and selling methods. Vendors that fail to do this may step by step lose and more and more information and privacy aware market.

In addition, failing clearly to tell customers concerning however their information is collected, hold on and processed could breach the GDPR and end in fines of up to €20m or four per cent of world annual turnover, whichever is higher.

3) *Data transformation and integration*: The evolving 'connected home' means that many related professions, such as locksmith, heating engineer and electrician, need to consider putting software at the heart of their businesses and transforming themselves into digital providers to keep up with the market.

These professionals still represent key intermediaries for consumer choices about major installation projects. Vendors that understand this, and provide software tools which can be deployed to interact with particular products, are more likely to benefit from the goodwill generated in the professional community.

Another factor to consider is standardisation and the ability to connect to systems/devices from other manufacturers. Having APIs or other standards-based connectivity solutions that allow devices to control/be controlled by other devices can add significantly to the overall value proposition to the consumer.

This raises the question of which company owns particular standards for device interconnectivity. Where any partnerships with other device manufacturers, app developers or platform providers are to be considered, both parties should address and carefully document how any newly created intellectual property will be owned at the outset to avoid difficulties down the line.

4) *Liability*: Solutions to smart device problems often come in the form of updates and patches, which aren't always completely reliable. Developers also need to bear in mind that not all users will download updates as they become available, leading to 'version lag' as devices continue to run older software.

In addition to creating support challenges for vendors, this could leave devices vulnerable to attack. All of this creates a complex situation from a product liability perspective, as the device being used at any given point may function very differently to the device the consumer first bought.

Since many connected devices require an ongoing service component from the vendor to function, the consumer-facing T&Cs associated with a service are one way for manufacturers to try to limit and exclude liability.

The effectiveness of this strategy will vary by jurisdiction, and the law is likely to step in to render exclusions or limitations invalid in jurisdictions with a more protective attitude to consumer rights.

Where the relevant manufacturer has partnered with another device manufacturer or platform provider, these kinds of liability issues can be addressed in the agreements that govern the commercial relationship.

In many cases, where manufacturers simply follow a published standard for device interaction, or use a documented public API, liabilities will be less clearly delineated, and vendors will have to proceed on the assumption that they may bear a substantial part of the risk even if there are extrinsic factors involved.

III. HOME AUTOMATION TYPES

Different technologies used to build up a home automation system will be discussed in this section along with their benefits, features and limitations.

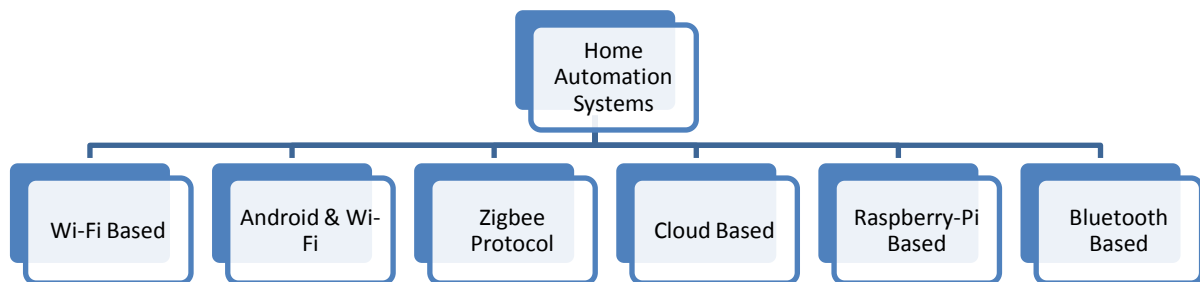


Fig. 2. Types of Home Automation Systems

A. *Wi-Fi based Home Automation System*

In the Wi-Fi based Home Automation System proposed, it consists of three modules that are the interface module, hardware, server and the software package [1].

The server uses secure Wi-Fi Technology, and hardware interface module is used to communicate with each other. The user can use the same technology to login to server web based application while the server is kept connected to the internet, therefore by the help of internet compatible web browser, the remote users can also access the server web based application.

B. Home Automation System using Android and Wi-Fi

A unique system has been proposed which is implemented with direct Wi-Fi fitting the bill of WLAN 802.11 standard. The system can be extended for a proper HVAC (heating, Ventilation and air Conditioning) systems [2]. Android has been used as it is open source. A number of different programming tools were used for the development of the application such as Eclipse Indigo IDE and Android SDK.

As the communication link needs to be secured efficiently and Wi-Fi protocols are secure enough to be used for such systems. Either the IP address of the Wi-Fi module can be directly coded into the app for initial testing or allow the users to search for the device, which becomes a final decision. Then user can select the device from a list to establish a connection. The basic steps for connecting to a Wi-Fi module are the same for both versions of the application. Once the ip address of the destination is received, then user can create socket with Wi-Fi module.

C. Home Automation System using Zigbee Protocol

Zigbee is a wireless technology developed by Zigbee alliance as an open global standard to address the unique needs of low cost and power wireless sensor networks. Here, the hardware module includes development of main controller, sensor nodes while the software module includes Embedded C programming in microcontroller [3].

Interface between the user and the system is the central controller. 89C51 microcontroller is implemented as it is the 'brain' of the main controller. It has a thirty two general I/O port with the clock speed of twenty four megahertz. This microcontroller is a CMOS technology IC that enables low power consumptions. To access the main system, user should first key within the password. This password may be modified as desired. The software part consists of programming 89C51 microcontroller using Embedded C using Keil μ Vision. The Graphical User Interface is designed by using Java.

This system has enticing options like SMS-Email notifications. And as Zigbee is raising network technology, wireless communication standard is capable to satisfy such requirements. Moreover, its specification relies on IEEE 802.15.4 wireless protocols, guarantees complete ability.

D. Cloud based Home Automation System

Cloud-based home appliance monitoring and controlling System [4]. Implementation and Design of a home gateway to gather information from home appliances and send to the cloud-based knowledge server to store on HDFS (Hadoop Distributed File System), process them using MapReduce and use to produce a monitoring function to Remote user.

E. Raspberry Pi based Home Automation System

Raspberry pi based home automation is healthier than various other home automation strategies in many ways. For instance, in home automation through DTMF (dual tone multi-frequency), the decision tariff is a vast disadvantage, which isn't the case in their projected technique. The LEDs are accustomed to indicate the switch action. System is interactive, economical and versatile.

It is a credit-card-sized single microcontroller computer and is using Python as the main programming language. It is easy to learn and suitable for real world applications. There are two main types of pi, first one is Model A has 256 Mb RAM, one USB port and no network connection and Model B has 512 Mb RAM, 2 USB ports and an Ethernet port. It has a Broadcom BCM2835 system on a chip which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and an SD card. Arduino can successfully work with Raspberry Pi Computers.

F. Bluetooth based Home Automation System

Bluetooth technology is considered as one of the best technologies to provide secure end to end communication between devices with no complexities. There are many types of Bluetooth devices that are being used in our daily life. In these various types of Bluetooth devices there are several types of Bluetooth modules that are designed to control various appliances. These modules are based on several specifications based on which they perform the operations that are related to it. One of its specifications is that, they work within a range of 45metres and will operate at 2.4GHz frequency. Using this we are designing a home automation system which works with the help of a Bluetooth technology. HC-05 is the Bluetooth module used here. While designing a home automation system, we have to consider about factors like, the user should be able to connect to that Bluetooth module from any device he would wish to. He should be able to change the host from one device to other device and that module should work accordingly. On displaying any error or fault, it should have the ability to diagnose it and the system should start working immediately when an instruction is given to improve the nature of wireless technology. FPGA board is used here as it is able to provide high security to our system.

IV. CONCLUSION

Various platforms are available that enable Home Automation systems quickly with low cost, high performance and without any complexity that are Arduino, Raspberry pi, Micro-controllers, etc. Here, in this review, different home automation systems such as the Web based, Bluetooth-based, Mobile-based, Zigbee-based, Cloud-based, Internet based have been explained. In future, home automation systems will much smarter and robust. We would be able to extend it to a scale of a level where it could be used in offices, colleges or factories.

Hence it can be concluded that the required goals and objectives of a home automation system can be targeted by the above technologies.

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