Technologies in Home Automation System: A Survey

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Abstract: - Technology is the ever upgrading field that which changes day-to-day and may include small changes like apps used in the mobile to major changes which include to security system upgrades in the field of Transportation, Building security etc., among this changes Home Automation is one of the evolving and has been rapidly updated over years. Home Automation was introduced in order to provide security along with the elimination of the manual control of devices and monitoring the devices in the upgraded technology and hence in this paper we briefly view the different technologies that has been used over years in Home Automation, along with it we have also discussed the future technology that can be implemented in the field.

Keywords: Home Automation, Monitoring, technology.

I. INTRODUCTION

Home Automation was the feature of Science Fiction over many years but mainly came in to existence in the 20th century following the wide spread introduction of the Electricity and the emergence of Electrical home appliances in the year 1915 to 1920 and the decline in the domestic servants meant that households needed cheap mechanical replacements and hence home automation was introduced. Home automation can be defined as the residential extension of the building automation and it can be described as the automation at the Home, household activity and the popularity of the home automation greatly increased due to its Higher affordability and simplicity in handling the devices and the technology became more And more popular by the introduction of the new Topic Called IoT(Internet of Things)[1], and the different platforms from infrared to Wi-Fi technologies that has been discussed in this paper.

The benefits and application of using the home automation are as follows:

1. Saves time
2. Saves money and increases convenience
3. Contributes to economy
4. Allows you to control when out of town
5. Increase peace of mind
6. Increase awareness

Applications may include the entrance guard system, home entertainment, pet feeding, lighting, ventilation, air conditioning etc, and home automation includes the following types of devices in them, namely,

1. Sensors: To measure or detect temperature, humidity, intensity or motion.
2. Controllers: Such as Pc or Dedicated home automation controller.
3. Actuators: Such as motor valves, light switches and motors
4. Buses: For communication that can be wired or wireless.

A Smoke Detector that alerts the owner upon detection of some outrages is an example for home automation. The home automation that have been implemented for real in 1966 is by Jim Sutherland an engineer working for the Westing house electric developed a home automation system called “ECHO IV” this was a private project that was never commercialized.

In the upcoming section we discuss the different technologies and future upgrades in the field of home automation.

II. TECHNOLOGIES

Before going to the implementation of different technologies let us see the types of home automation based on:

1. Control Systems
2. Standards
3. Carrier modes

The description about the above terms is as shown below:

1. CONTROL SYSTEMS: Here each device like heater or air condition will have control either individually, Distributed or centrally [15].
2. STANDARDS: There are many established industry standards for home automation system and are implemented over various carrier modes ranging from power line to wireless, the major standards are INSTEON, European home systems(EHS),ZigBee, KNX, Z-Wave, X10, Lon Works, ONE-NET and universal power line bus(UPB)[15].
3. CARRIER MODE: Tells us about the different technologies, power consumption, time, reliability etc, the
III. PLATFORMS OF IMPLEMENTATION

Now let us see the different technologies or either the platform upon which the home automation is been implemented, the technology started in the year 1914 with the evolution of the home appliances and the first technology that was used was the Infrared technology[2], which was implemented in television, let us see the architecture, advantages and disadvantages in brief:

![Diagram of RTU Master, Modbus/RTU Slave, IR-210, PC, and PLC]

Invisible radiant energy, electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 700 nanometers (frequency 430 THz) to 1 mm (300 GHz) Most of the thermal radiation emitted by objects near room temperature is infrared.

Infrared radiation is used in industrial, scientific, and medical applications. Night-vision devices using active near-infrared illumination allow people or animals to be observed without the observer being detected and, Military applications include target acquisition, surveillance, night vision, homing and tracking. And the infrared radiation has certain subdivision as shown below, in which the user has the choice of selecting the frequency and type of IR to be used [6].

In the above figure1 we can see how different home appliances are connected through the modbus which receives infrared radiations/signals from the devices and transfers them to the monitoring devices like Mobile, Pc etc., and infrared technology has advantages as follows:

1. Can be used in adjacent rooms.
3. Widest bandwidth.
4. Secure systems because the signal will not leave the room.

Disadvantages:
1. Receivers required for everyone.
2. Must have direct line of sight.
3. Indoor use only.
4. Large areas require multiple emitter panels.

Due to above mentioned disadvantages the technology of home automation switched to Internet/Ethernet technology that is more efficient than IR technology, now let us briefly discuss about the Internet/Ethernet[3], technology in home Automation, the Internet was first introduced in the year 1950 with the development of computers and hence it is the most rapidly developing technology till date and later development was in the field of the mobile or telecommunication[4][5]. And the Internet/Ethernet, mobile application based home automation systems that are operated in different platforms as follows:

1. Bluetooth
2. Android
3. Wi-Fi
4. Using cloud

1. BLUETOOTH

Bluetooth is a wireless technology standard for exchanging data over short distances from mobile devices, and building personal area networks (PANs) and is standardized as IEEE 802.15.1. The applications of Bluetooth are Wireless control of and communication between a mobile phone and a hands free headset [7].

The block diagram of the Bluetooth based home automation system is as shown in the below figure2:

![Diagram of Bluetooth based home automation system]

The fig2 explains that it is the low cost, secure cell phone based control system[8], the appliances in the home are connected to the BT controller and any number of devices can be connected to the controller and the communication between the BT controller and user is wireless, the Advantages are,

1. Widely Used.
2. Free of Charge.
3. Go wireless
4. You’re in Control.

The Disadvantages are,

1. Battery use.
2. Bluetooth Internet.

2. ANDROID

The version history of the Android mobile operating system began with the release of the Android beta in November 2007. The first commercial version, Android 1.0, was released in September 2008, till date Lollipop (5.0-5.0.2) is released [9].
In the figure3 [10], we can see how the android OS is used in the place of Bluetooth to control the home appliances as it is the most advanced and leading technology after Bluetooth, the devices are connected to the network and through the network the devices are connected to the android based cell phone through which it is accessed and controlled. The advantages are,
1. Multitasking.
2. Ease of notification.
3. Options are diverse.

The disadvantages are,
1. Continuous internet connection.
2. Advertising.

3. Wi-Fi

Is a local area wireless technology that allows an electronic device to exchange data or connect to the internet [11].

In the figure5, we can see how the Relays, Motors and alarms are connected to driver which in turn is connected to the Microcontroller which is attached to analog to digital converter at one side which is connected to different sensors and on the other side of the MC is connected to the Hardware profiles that can be customized to personal needs and H/W profile is connected to the cloud server through which the devices are controlled using the concept of BIG DATA [13].

Cloud computing is a recently evolved computing terminology or metaphor based on utility and consumption of computing resources. Cloud computing involves deploying groups of remote servers and software networked that allow centralized data storage and online access to computer services or resources. Clouds can be classified as public, private or hybrid. The Service models are, IaaS (Infrastructure as a Service), PaaS (Platform as a Service), SaaS (Software as a Service)[12]. And The Deployment models are, Public cloud, Private cloud, and hybrid cloud [12].

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IV. FUTURE TECHNOLOGY IN HOME AUTOMATION

There are many technologies that are being evolving every day among them the most promising technology is the Li-Fi (Light fidelity) [14], which is the upgraded version of the Wi-Fi (Wireless fidelity). Now the recent upgrade is use of Li-Fi in home automation system, the below figure 6 shows the use of the Li-Fi in home automation, here we can notice that the data can be fetched through the LED lights which is the source of information in the home through which we can access the internet, PDA, Printers etc., and even control them in the same manner as we do in Wi-Fi.

![Figure 6: Example of Li-Fi Based System](image)

Li-Fi has thousand times greater speed than Wi-Fi and provides security as the visible light is unable to penetrate through the walls, which propose a new era of wireless communication. The concept of Li-Fi is data communication on fast flickering of light which is not detected by human eye but it is focused on photo detector which converts the on-off state into binary digital data.

![Figure 7: model of Li-Fi LED Light](image)

The Advantages are,
1. Intensity.
2. Fast and cheap.

The Disadvantages are,
1. Presence of light is essential.
2. There should be line of sight.

Hence, we have seen different technology in HAS till now but when the question arises WHICH HOME AUTOMATION TECHNOLOGY IS THE BEST? Because all have their own advantages and disadvantages, the Answer is, it depends totally upon the standards, carrier modes, control systems and platform upon which we are implementing and the benefits are obtained as features selected as mentioned above.

CONCLUSION

HAS is undeniably a resource which can make a home environment automated. People can control their electrical devices via these home automation devices and set up controlling actions through devices which they use like Mobile’s PC etc., and one can build the Smart home that blends luxury and technology together to present a futuristic home, and also has the high potential for marketing in future.

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