

Designing Smarter & Safer Homes

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Abstract

Home automation is the residential extension of building automation. It deals with automation of the house, housework or household activities. Home automation includes centralized control of lighting, HVAC (heating, ventilation and air conditioning), appliances, security locks of gates and doors and other systems to provide improved convenience, comfort, energy and efficiency and security. In this paper we elaborate on the available features, technologies and products and suggest improvements and customizations for specific use.

A smart home in today's world would be very helpful, particularly for the working family. Smart home technology helps to keep an eye on their home and have better control from the workplace. Security of the perimeter may be monitored from remote locations by live video-streaming on smart phones. Electrical and kitchen appliances can be controlled, therefore eliminating the need for physically present at home for carrying out a specific task e.g. switching on the lights, geyser, AC or electric cooker. Home automation may also be used for monitoring & taking care of the kids, elderly, sick or even pets. In case of emergencies, individuals may be informed and appropriate actions can be taken instantly. We explore much such functionality that may be provided, the benefits and the risks associated with these services. We also elaborate on specific customization required for our country due to scarcity of resources like electricity, mobile and online connectivity, climatic conditions other socio-economic reasons.

1. Introduction

Home is an important place for the people who live in it. It affects the overall quality of the life the performance at the workplace. It is a place where people spend most of their time, especially elders and children. Hence, it is pretty clear that constant improvement and development of this area of life, needs to be taken great care of. A step in this direction is the Smart Home.[1] Smart homes, are next generation home additional electronics & communication support to make our lives more comfortable.

A smart home would generally refer to a fully equipped house, with a number of sensors and other systems and technologies, forming a network. Its sole purpose is to aid the user, and provide him

connectivity with the house in as many ways as can be possible. Initially we would like to take you across some of the advantages and disadvantages of the new smart home technology. It's a growing technology with scope for new development. According to records over 1.5 million smart homes were installed in US in the year 2012. [2]

Below we enlist some advantages and disadvantages of the smart home technology.

2. Smart Home Technology

2.1 Smart Home Networks

Smart home technology can be basically classified into two main types:

2.1.1 Wired Systems

In a wired system the equipment must be connected into the power supply directly, so that data

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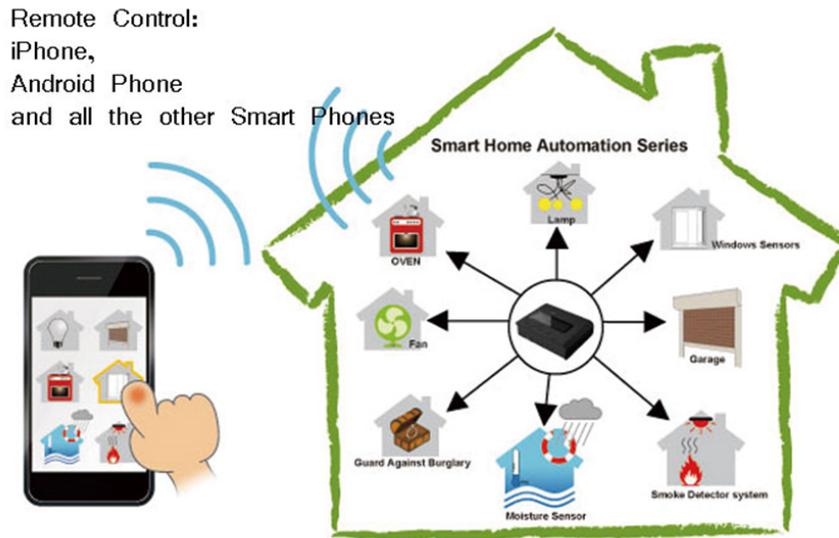


Fig: 1. Overview of a smart home

will be sent to the devices to activate or deactivate them. There are numerous ways of wiring these systems within the house. The wires may be in-wall, or pasted outside the wall depending on the convenience of the user. The wires may be new wire (twisted pair, optical fibre), bush line, power line etc. One technique for home automation is the X10. X10 transmits binary data using the amplitude modulation technique. The X10 controllers then send signals over existing AC wiring to receiver modules. Other technologies are Home-Plug, Consumer Electronics Bus (CEB us), European Installation Bus, etc.

2.1.1.1 Wireless Systems

A wireless system is required to have two main elements the sender and the receiver. Many new technologies and devices use the wireless technologies to communicate with various other devices as it is easier to install and replace such devices and even though the cost is slightly higher. Examples of wireless communication system are microwaves, Infrared (IR), radio frequency (RF), Wi-Fi, Bluetooth, IEEE 802.11, and so on. Some smart home devices can use both wired and wireless systems for transmission of the data.

An affordable and reliable wireless communication system is the Z-wave. Z-wave is a wireless RF based method for instant remote control of appliances.

Now, we'll compare wired and wireless networks on account of their pros and cons as seen in general day to day functioning.

Table: 1. Difference between wired and wireless networks for smart homes

	Wired	Wireless
Pros	<ol style="list-style-type: none"> 1. Fast connection speed 2. Easy to secure 3. Simple to connect 	<ol style="list-style-type: none"> 1. Freedom to connect to other networks 2. No tangled wires
Cons	<ol style="list-style-type: none"> 1. Wires running across floors or installed into walls 2. Incompatible with many new, smaller devices 	<ol style="list-style-type: none"> 1. More complicated to secure 2. Can be prone to threats as it is wirelessly available.

2.2 Smart Home Controllers

Smart homes are not so without controllers. Controllers are integral part of smart homes. They connect the user/owner to the home in a real-time. Smart home controllers are devices that are used for controlling systems by sending and receiving the data for the actuators. Examples of the controllers are not only the remote control but it can also be smartphones, tablets, web browsers and short message service (SMS). Also, some systems might just have a computer at the center of the environment perception or the evaluation system.



Figure 2: Smart Home controller. ^[4]

2.3 Home Automation

Below, we share our views regarding home automations of some of the rooms we think that the automation may act as a big advantage to the user:

- **In the Kitchen**

This is the area where most number of smart technology developments has been made. An example of smart appliances would be dishwashers, microwaves, coffee makers and dish-washers.

One in particular would be the Internet Refrigerator; it applies the technology of smart home to make many things much easier. It is internet enabled and allows for users to communicate via the Internet, it would be able to download recipes and then display them on its LCD screens. The refrigerator also maintains an automatic inventory of the stored items, and enlists them to the user if demanded on the LCD screens present of the front panels of the system. Similar technology could be applied to the microwaves, where it could be able to real time monitor the temperature of the item cooking inside it. It could also download recipes and help the user, by providing real time audio-visual support. Apart from these other smart technologies can be installed. Like the development of the gas stoves, those have an automatic cut off switch. Along with this, we can have integrated water purifier into the refrigerators. This would provide us with our choice of purified water, whenever we want. It could also have an added ability to fill water bottles for usage on the dining tables and other places. ^[3]

- **In the living room**

As we go away from the kitchen which is undoubtedly one of the most important parts of the house, we get to the living room. It is one part of the house which plays a very important role in smart

home integration. Smart devices such as televisions and stereo players utilize this technology to optimize effect for individuals. Also, these technologies are very user friendly and readily available to the customer at attractive costs.

The smart TV's are essentially computers that have an inbuilt TV tuner card. This simply implies that they can double up to provide many other interactive features. Also, they can double up to provide a control panel that would help to control the functions of other devices and customize them for the family member of your house.

Lighting control systems can also be used to household electric lights and appliances. It is a system that with the help of motion detectors can help turn on and off the lights, fans and other real time electrical appliances when people enter and exit the room. This would help us save the electricity expenditure and would help to reduce electricity bills.

- **In the bedroom**

The bedroom can have a smart climate control system that can set the ambience of the bedroom with a single button can have a unique night time temperature and lighting profile for each bedroom. The bed can also be equipped with sensors that can monitor the movement of a person during sleep for detecting health and also monitor the sleep routines of a person.

In addition to this, we could have an in built bed-warmer and massager, which can automatically detect the level of warmth or the degree of massage required, depending upon the person's body temperature and his body stiffness. It can also incorporate a monitoring system for the elderly or the infants, where in the person concerned can be intimidated about the well being of these family members.

2.4 Smart home for the Physically Challenged

Smart home also helps the physically challenged people in a great way. It is probably the biggest gift technology can bless them with. It enables them to remain connected and remotely remain in touch with the happening in and around the house. They can also sit at one place and monitor the whole house, without moving too much. Also, the house can take care of itself and provide interactive support. For example a smart home can read out the contents stored in its refrigerator or the menu of the dishes to be cooked in the microwave for a blind person.

Smart home can also help a person making a textual conversation happen between a deaf person and someone standing at the door. All this can make the life of the impaired person tremendously simple

and easy and they can overcome their limitations and concentrate on other more constructive activities.^[5]

2.5 Smart devices can be used in many other aspects also

1. **Security:** Smart security, simulated occupancy, property monitoring and protection, detection of fire, gas leaks, water leaks, tele-assistance.
2. **Communication:** Video telephony, home calendar, reminders, and communication inside and outside the house.
3. **Green:** They can reduce the overall electricity consumption of the house and promote a greener and a cleaner society.
4. **Health:** Health monitoring, personal interactive trainer, remote diagnosis.
5. **Entertainment:** Television, video, games, smart homes, theatre, multi-room audio etc.
6. **Environment:** Remote control lighting and, reduce the heat produced inside the house.

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7. **Energy usage and cost:** This would also reduce the carbon output of the house.^[6]

3. Concluding Remarks

Modern technology has helped to improve our quality of life and make our lives comfortable. Electronics, communications & information technology is also helping us to design smart homes. This paper explores the features available technologies & suggests ways of making modern homes smarter & more secure.

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