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SMART HOME AND IOT BASED BUILDING AUTOMATION

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Abstract: Smart Home or Home automation also known as demotic, involves the control and automation of various appliances commonly found in a domestic scenario. These can include lighting, central heating and air-conditioning, surveillance systems and home appliances like washers/dryers, ovens, refrigerators and media systems. Wi-Fi is generally used to control and monitor the various devices and these smart devices connected over a common network constitute a major part of Internet of Things. This connected mesh of devices can be remotely controlled from one device like a smartphone through a common service like Google Home or Apple HomeKit. In certain cases the devices are given the freedom to function automatically according to pre set protocols, for example, a thermostat controlling the temperature of a space. Although this sounds like a recent advancement, home automation has been in use from the past two decades.
The Smart Home concept will be analyzed within the present scenario keeping India in mind and the current state of IoT in India will be looked into. The biggest problem in widespread home automation in our surroundings is linked to the penetration of stable broadband services. Since decent internet and Wi-Fi is the backbone of a smart home, an ideal smart network of devices cannot be realized until a bigger problem is addressed.

Keywords: *Smart Home; Wi-Fi; Broadband; Smartphone; Bridge;*

I. INTRODUCTION

Imagine you're home after a long day at work and are relaxing on the couch. That's when you fell the fan needs to be turned on but your body refuses to get up and walk across the room to the switch. At this point you wish you could control the fan from the phone in your pocket. That is precisely what Home automation lets you do. In a smart home setting one can not only control the appliances and various electronics but in certain cases they will function by themselves. This all sounds very utopian and ideal but what is keeping such a scenario from becoming a reality in our country? Additionally what are the parameters to decide if a device is "smart"?

II. SMART HOME

A Smart Home refers to a space consisting of multiple devices connected over a common network with a single node of granular control over all of them. This can include everyday appliances like lighting, refrigerators, washing machines, media systems etc. a common way of control would be a smartphone or a common remote control. All the above devices would be communicating through a common internet network.
There can also be instances where a certain appliance is allowed to function with active supervision. For example, a thermostat may assume control depending on the ambient temperature. A smart oven or cooker adjusts the temperature and cooking time based on the weight of the ingredients started with.
First we must define the criteria for what makes a device smart. Almost all modern appliances have some sort of smart/automatic modes which make them behave in a way that the manufacturer pre programmed. But this doesn't make them smart in this context. A smart device first and foremost must be able to connect with other similar using a common and standard protocol such as Bluetooth, Wi-Fi and 4G. Secondly, a smart device must be programmable to some extent by the user and not use proprietary software for the entirety of its operation. Lastly a smart device must be compatible with a popular framework used to control such devices available on a consumer level. The popular services which enable this are Apple Home Kit, Google Home and Amazon Echo. The latter two are smart assistant services which help the user control devices using voice commands while the former turns an iPhone into a remote control. A smart device almost always comes with support for one or many of the above frameworks.

III. PRE REQUISITES FOR A SMART HOME SYSTEM

Before one can think of setting up an automated system in an environment there are a select set of criteria that need to be met. The first and the most obvious one being the availability of smart devices. The second one is the availability of a single portable device which can control all connected devices in the network. In most cases this is a Smartphone of choice and hence isn't a big priority since nearly everyone has one or can afford a capable one. The third is the availability of a fast internet network to set up the actual connection. Mobile internet just doesn't cut it for this part since there are no facilities for multiple devices to communicate through a common network. Each device would set up its own private network with its own IP address and hence communication is not possible among them. Often some devices require a wired connection since they might not have a wireless chip or need a stable connection. This presents a major drawback in setting up a Smart Home.

IV. HOW TO GET ON THE SMART HOME BANDWAGON?

For first timers this process might seem daunting and quite expensive. But setting up a smart home isn't an overnight process and needs to be built upon in steps. That is the core

concept behind a Smart Home. Once a user sets up their internet and Wi-Fi connection it is as simple as buying a smart device to get started. Most devices come with an additional piece of hardware known as a bridge. This bridge connects to the home internet network so that each individual device need not be connected. This is important since a network can perform optimally only if it has a limited number of devices connected to it. This is a very common scenario in the case of light fixtures. All the individual lights are connected to a bridge which is connected to the internet either wired or wirelessly. After that the setup and personalization is generally done with an Android or iOS app and a few simple button presses. This process is the same for almost any smart device. The automation of the devices is also done using the app and some devices learn the user's habits over time and get better by predicting what the user wants beforehand. Of course, it is not necessary that one must go out and purchase all the smart devices he can get his hands on. It is also possible to smarten a "dumb" home. There are smart sockets which act as an interface between the main power supply and any appliance to provide some rudimentary smart functions. In practice it is limited to just turning it on and off remotely from a phone. But it still provides a good starting block for first timers.

V. SOME POPULAR SMART HOME DEVICES

A. Phillips Hue

Phillips Hue is a very popular smart lighting solution. It is a simple and yet very effective way for flexible home lighting. It can setup in a utilitarian manner or a fancy decorative one. The system consists of LEDs in various form factors like bulbs, lamps and light strips and a bridge to tie them all up. The LEDs are standard RGB ones and hence can be set to any color the user can think of. The bridge connects to all the lights it can find within a range and connects to them via a proprietary protocol. The bridge is connected to the Wi-Fi router via an Ethernet cable. Once paired up the lights can be individually named for convenience and can be controlled from within a smartphone app or by voice commands. The lights can be turned on or off or set to change to a particular color. They can also be programmed to do this automatically depending on time of the day. A creative use case can be to setup up breathing effects or even sync the lighting up to music.

Since the bridge can accept up to 50 lights, buying and adding more lights in the future is easy.

B. Robot Vacuums

Robot Vacuums are a very interesting and useful Smart home product available today. They are exactly what they sound like, little robots that clean the floor. On the outside they look like an oversized hockey puck. They employ a cleaning mechanism similar to that of a regular vacuum cleaner. Where the smartness comes is in the fact that they do the job automatically and without supervision. They are usually found in their docks in one corner of the house and at a particular time of the day or at intervals they automatically clean every inch of the floor. Upon first use, they map the house making note of furniture and other obstacles so they don't crash into something. This is done using infrared imaging. These cameras also prevent the device from bumping into some new obstacle. The popular manufacturers of robot vacuums include iRobot, Dyson and Samsung. Robot cleaners can save up to hours from a person's day and are as powerful as regular vacuum cleaners now. Taking advantage of their small size they can clean up under beds and couches making it unnecessary to move furniture around. Some models even generate statistics about the cleanliness of the different areas in the house. Although they can be a sizeable investment they can turn out to be very rewarding in the long run.

C. Surveillance Systems

There is a wide variety of products that come under surveillance. Most of them are camera related tech like the existing systems. But unlike the older systems where a human is required to continuously monitor the footage, a smart surveillance camera can do the work on its own. They can be placed in various places inside a house or office and some specialized ones can be attached outside the door or on locks. Additionally some of the systems can also back the footage up into cloud storage so that it can be accessed from any location. They are smart enough to recognize a few pre set trusted faces and for any other suspicious person seen they send a notification and a picture to the user's smartphone. They might also have alarms in built to alert people about intruders. If the user chooses to they can view a live feed of the footage being captured on their phones at any time. The security systems attached to locks can be used to remotely lock and unlock the house if need be.

D. Smart Thermostat

A smart thermostat will do everything that a regular thermostat does but it does all of it automatically. A thermostat is a device which controls the heating/cooling and the air conditioning of a space. But conventional thermostats require the person to manually adjust thing based on his convenience. A smart thermostat on the other hand has sensors which let it detect ambient temperature and presence to automatically adjust the weather of a place. They can also have access to information which enables them to know when the user is coming into a certain place and set the temperature levels appropriately for them automatically. This is great when you don't want to wait for the room to cool down after you come home and manually turn on the AC. And the best thing about them is that they can be attached to an existing HVAC system and everything will work just fine. They also contain additional sensors to detect smoke or toxicity levels and alert the user about it. This is a great addition in terms of a security standpoint too. These thermostats like many other devices can connect with a Google Home or Amazon Echo to accept directions via a voice command. Almost all of them have capabilities to learn usage statistics and come up with an algorithm to be autonomous. Some popular manufacturers include Nest and Ecobee.

VI. CHALLENGES AND SOLUTION

The current state of smart home in India faces two challenges with one being a minor one and a second more major one. The first roadblock comes in the form of affordability. A smart device is always much more expensive when compared to its non smart counterpart. And in the case of bigger appliances

like refrigerators, air conditioning units and kitchen appliances it makes very little sense to replace a perfectly working device with a smart counterpart. These devices are often only replaced once they cease functioning optimally. Therefore outright replacement of all devices at home with smart ones doesn't seem feasible. However this hurdle will be overcome once adoption becomes higher and local manufacturing starts. But the other elephant in the room preventing a smart future will rear its ugly head. That is of course a stable internet connection.

Wi-Fi is an ideal protocol when it comes to the communication among smart devices. It is superior to others such as Bluetooth and 4G in terms of range and number of devices that can be connected. But it seems very simple when looked from afar. But the question that must be asked is how many Indians currently have access to Wi-Fi?

The list of countries by number of users is as follows

Country	*Fixed-Broadband Subscriptions*				*Mobile-Cellular subscriptions*			
	Number	*Rank*	*Percentage*	*Rank*	*Number*	*Rank*	*Percentage*	*Rank*
India	18,230,000	10	1.4	137	273,380,000	1	20.3	23
China	174,285,380	1	13.0	66	231,614,860	3	17.2	75
United States	87,974,583	2	28.0	24	234,412,672	2	74.7	9
Japan	35,556,075	3	27.9	25	144,077,507	4	113.1	2
Germany	27.674,074	5	37.8	8	34,233,625	10	52.2	27

India's ranking in the world just based on the number of subscribers alone seems like an impressive number but upon closer inspection it is seen that this number is just 1.4% of the population. And the ranking based on percentages is abysmal. It can also be noted that 20.3% of Indians have access to mobile internet and this puts India at the number one spot in the rankings for cellular internet users. But in this case also the ranking based on percentages is not very optimistic.

This is a large setback to the smart home dream since an important pre requisite for Internet of Things is the internet itself. With so little of the people having access to broadband, the very basis for a smart home is absent. And one cannot guarantee that all 18,230,000 people would opt for a smart home either.

Another very important part about the statistics is that it is solely based on the number of connections alone. For instance, a family of four can have all the residents having a smartphone with an internet connection. This is the case even in the number of broadband connections. This brings about a problem in assessing how many houses are connected to the internet. This number is actually much less than ideal.

This poses a problem in wider adoption of Smart Houses which makes our first problem about affordability bigger. The solution to this is to create awareness about how internet would be a boon to people and can be a big help in other aspects of their life too. The actual internet connections themselves have to be made as affordable as mobile internet tariffs. This would encourage people to have a connection in their homes as ultimately a Wi-Fi is of much better quality than a mobile internet solution. Once people start using internet services more and more they will start to explore other uses of it and ultimately hit upon smart homes. If such measures are taken then the homes of the future can be as exciting and magical as they are in fairy tales.

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