

Implementation of IoT in Smart Homes

Omkar Bhat¹, Sagar Bhat², Pradyumna Gokhale³

IT Dept., Smt. Kashibai Navale College of Engineering, Ambegaon¹⁻³

Abstract: The Internet of Things (IoT) is the network of physical objects, devices, vehicles, buildings and other items which are embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. IoT has many potential applications and can be implemented in fields like home automation, offering several features like economical use of energy to protection and safety. This section illustrates detailed working of IoT based security systems and Energy efficient devices. This topic aims at controlling home appliances via Smartphone using Wi-Fi as communication protocol. It provides information regarding various hardware and software components required for implementing the same. It shows us how the IoT will touch our life in near future.

Key words: Internet of Things (IOT).

I. INTRODUCTION

Internet has changed human life by providing facility of connecting anyone with anyone at any instance, from anywhere to anywhere. Similarly the advancements in the fields of hardware such as processors, sensors, transmitters, receivers has led to rapid development in the field of communication in turn changing the pace of our every-day life. So to expand the services of Internet, Internet of Things has been introduced. Though a relatively new concept it is gaining fame in the recent endeavors of technology.

1.1 Internet of Thing: It is a network of computer systems and the real-life objects that we interact with. These real-life objects includes mobile devices (e.g. Smartphones, smart-bands, and smart-watches), vehicles, home appliances such as lights, television, radio, refrigerator etc. This network communicates via standard protocols.

1.2 Things: Things maybe real virtual, steady or mobile but they will continuously relay information to each other it is called things-to-things communication. When these things communicate with humans it is called as things-to-humans communications [8].

Now, Internet of Things is a reality and it helps devices to configure devices to configure themselves without the intervention of human-beings. The population of the world is continuously increasing similarly the number of devices connected to internet is also increasing at a steep rate. As of now 7.2 billion is the world's population and surprisingly the number of connected devices in today's world is over 10 billion (Fig1.1). Saying so the projected world population in 2020 is 7.8 billion while the number of connected devices will be over 50 billion almost 6.5 times the population. This tells us about the importance of IOT in the near future.

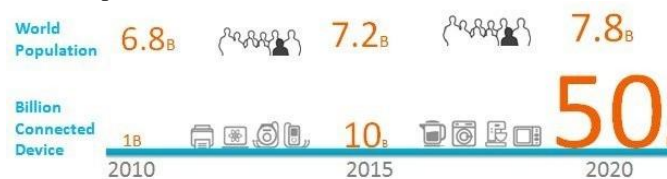


Fig 1.1: Increase in connected devices with respect to world population.

IOT can be implemented on various scenarios like factories, laboratories, houses etc. With the changes in socio-economic structure, household structure, as well as information technology development and human security of the home environment, comfort, increased efficiency requirements, resulting in increased demand of home automation. Smart Homes means the houses/homes which will respond to nearby changes and actions. The devices in the network must be accessible to the user irrespective of his location. That means the user should be able to control, monitor settings and any other parameters as he wishes from where ever he wishes. Though thought of as a fantasy it can now be realized due to IOT.

Smart Homes System is divided into two parts-

- 1) All Sensory and Relay Hardware (home devices and switch modules and RF transmitter receiver etc.)
- 2) User Interface and Processing Hardware (interface device, processor, data collector, GPRS module that will communicate with the internet.)

In this paper for consideration let's consider two systems – energy efficiency systems and security systems. To understand this let's take a look at the architecture of IOT used in smart homes. All the devices will be connected to a device called as smart central controller which will be connected to a switch module for each device connected and hence enabling us to access each device separately. This device will also be connected to the router for internet connection which will in turn help us to communicate will the user, in case a permission is ever required to be taken.

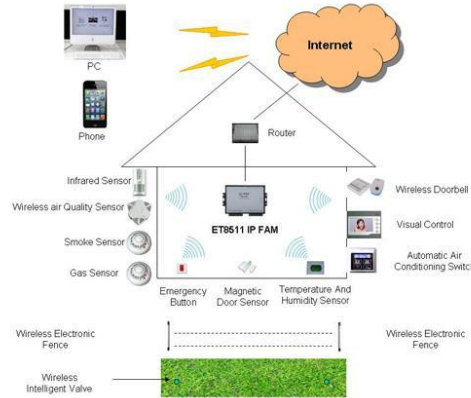


Fig 1.2: Communications using IOT in Smart Home

II. EXISTING SYSTEMS

Smart Homes as discussed above is just a network of devices used in our daily life and other sensors which help us to make our life easy. Though we say the devices communicate with each other but in reality all devices communicate/relay information to the smart central controller which then due to triggers and other programs changes the setting of other devices.

IOT in Smart Homes System is described by a layered architecture by Kang Bing as shown in diagram below:

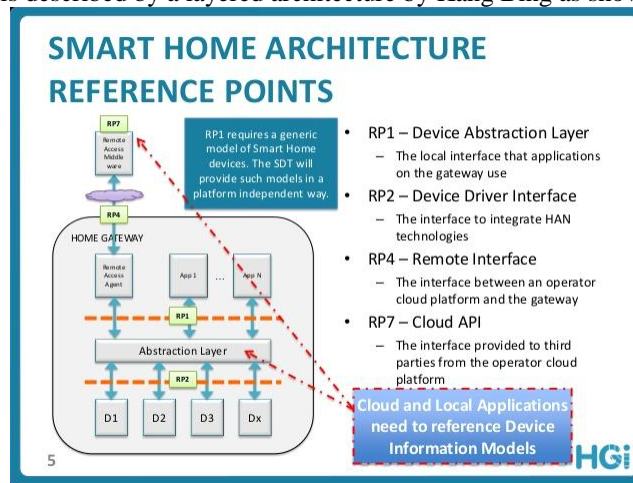


Fig 2.1: Architecture of IOT in Smart Home

The layers shown in above image are as follows:

Sensing Layer: It is the actual layer which collects the data from surroundings and home appliances and devices. It then sends this data to middle layer [7].

Network Layer: It send the received data to top layer (Application layer) for sorting and analysis.

Application Layer: This layer does the actual analysis, the result of such analysis is then used by triggers to trigger a respective action. It contains the application developed for interface and settings of kind [8].

2.1 Energy Efficiency

Consider the energy efficiency devices, now a days we do get a variety of energy efficient devices but they implement the use of energy at the primal level. Now consider we could control these devices so as to make them more efficient. Energy efficient products are reported to use 30-50% less energy during its lifetime. In such a case annual saving are about \$400 (considering devices are used round the clock and 7 days a week). Existing system predicts the lighting sense according to the weather conditions and other factors [3].



Fig 2.2: Connected devices in Smart Home

Existing systems don't provide us with an optimal solution but a feasible one. Due to this though we save energy, we don't save it as much as we can.

Existing Energy Efficiency Systems work on a simple basis of saving energy by considering two key parameters-

- 1) Presence of people in the house.
- 2) Local External (weather) Conditions

If there are few people in the house and that too scattered then their respective locations are needed to light up, rather than whole house. How much, how many lights are needed to be lit is completely dependent on external weather conditions [9].

2.2 Security System

Security system comprises of all devices which provide security features to our abode. This system ensures the safety of all the persons inside the home.

The security devices that are used are:

- 1) Cameras
- 2) Infrared Sensors
- 3) Magnetic Door Sensors
- 4) Smoke Sensors
- 5) Gas Sensors
- 6) Automatic Doors and Windows

Of all the devices shown above automatic doors and windows are passive devices because they don't relay information but react to information given to it by the controller (like open a particular window/door).

While other devices are all sensors which detect a particular thing /object and then trigger the appropriate changes in the respective devices, interface. The sensors will relay all the information continuously to smart central controller (which in above case is ET8511IP FAM). The cameras will monitor the surroundings for any threats while gas, smoke sensors will sense if there is presence of gas leak or fire (resulting in smoke). These will guarantee the safety of persons inside the house at all times. Magnetic door sensors and automatic doors and windows will take care of the security against breaking and entering.

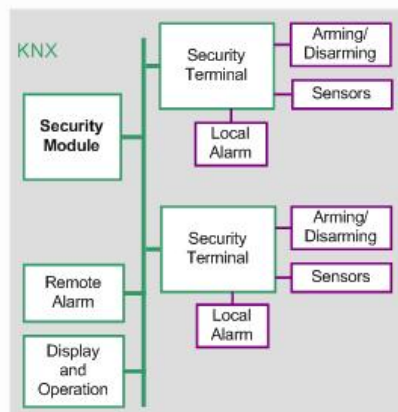


Fig 2.3: Security System in Smart Homes [5]

As shown in fig [2.3] a main security module will be present which will continuously monitor all security terminals. We can even activate the alarm (bugler etc.) from a remote location also. Display and Operation Unit displays us the entire house and its functionality such as which device is working and doing what etc. For each window, door we will have a separate security terminal which will monitor its respective window or door and hence even if breaking and entering happens we can see where the thief entered the house. There are even some security system that can help you to directly call police and send a pre-recorded audio to police so that police can be immediately caught.

Door interface will look somewhat as shown below:



Fig 2.4: Security System in Smart Homes (Door Interface) [6]

2.3 Interface

Though security and energy efficiency is important, having a good interface is equally important. The user interacts with the whole house, hence we need to make sure user can access whatever he wants whenever he wishes for it. This is done by the user interface one of the most important part and the only part visible to the user. Below are few of the interfaces currently developed,

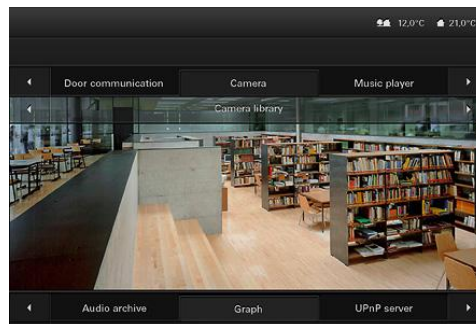


Fig 2.5: Smart Homes Interface (KNX)



Fig 2.6: Smart Homes Interface (Gira) [4]

As the user communicates with the system through the interface it is a crucial part of system. It notifies the user as well is used to set setting of a particular device and also help us in our day-to-day life style.

III. PROPOSED SYSTEMS

Even though the current systems provide us with a solution, it isn't an optimal one. For an optimal solution given below are some ideas.

3.1 Energy Efficiency

As seen earlier we have already managed to save almost 50% of energy consumption. We can predict 50-60% less energy being used in the lifetime.

Every single light bulb, tube will have an interface which will control the operation of that particular light. Some lights offer us the option of intensity variation in the lighting, this can be used with the photo sensor to predict the intensity of a light to be kept during a particular instance which will help in reducing the cost of operation further more.

Proposed Methodology:

The intensity of light required to make a room visible as also the things in it, also as we say we can check for readable conditions of that room. Now, once we have that all we have to do is continuously monitor the intensity of light in the room and if the intensity is less, then by using vector addition of intensities of lights in the room can be varied so as to get an energy efficient room lighting.

Mathematical Analysis:

Say, to make the room readable we need the intensity of light in that area to be X.

Suppose, due to some reason the natural source (Sun) is not radiating proper amount of intensity of light (Say, intensity of light radiated by sun now is Y).

Then we require more X-Y intensity this can be achieved by turning on lights in that area such that intensity of (X-Y) can be achieved along with energy efficiency.

$$\text{More intensity required} = (X - Y) \text{ (Say } Z)$$

So we have to manage or achieve this Z amount of intensity.

Say, there are 4 light emitters in the room, then we need to find the perfect balance between the intensity offered by it and cost for doing so.

Say first light emitter as L_1 , similarly for remaining light emitters i.e. L_2, L_3, L_4 .

Consider L_1 emits light of intensity Z_1 , similarly for remaining light emitters i.e. Z_2, Z_3, Z_4 .

Hence,

$$Z = Z_1 + Z_2 + Z_3 + Z_4, \text{ and}$$

$$Z_n = 1 / (\text{distance from the person}).$$

The intensity of light emitted by light emitters (i.e. L_1, L_2, L_3, L_4) in the above example depends on the position of the person in the room with respect to the light emitters. Say the person is closest to L_2 , then as the distance of the L_2 from the person being the least the Z_2 will be maximum while remaining will be negligible.

This can be determined as the closer is the light source to the sensor, less power is required by it to give the same intensity because of low dispersion of light.

Above said mechanism though useful will have a tremendous overhead and hence can be replaced by using different lighting moods like soft, romantic, reading, full-on, dark (all light emitter are turned off) etc. so that less overhead is involved and hence reduces the computing cost.

3.2 Security System

Currently all of the security systems guarantee the safety or wellbeing of people residing in the house

Automatic doors will allow user to grant permission for a person in a limited area of the house rather than giving them a whole house as an entity. Now a days people wear smart bands, these can be used to unlock doors and hence increase the ease of access for user.

Now a days, safety is one of the most acknowledged concern in the public due to rise of crime rate and the intellect of people behind it. The security systems with respect to Smart Homes means to avoid unauthorized entry of a person. Smart Home will be tell if anyone is there in the house at any particular time. Now, there can be two conditions someone is present or no one is present.

If someone is present (authorized person) then he can give entry to any person seeking the permission to enter via smart home application or by just inviting the person in. Now, in such a case not much is needed but we can add a few features as a picture of anyone who enters will be stored (only for unauthorized personnel) if an authorized person is asking for permission then it will be directly granted to him using the same camera (that is by using facial recognition). In the above case we can verify manually as well as automatically and hence access can be granted from any place by the user this is used in second case.

Now, if no one is present at home (checked by using infrared sensors), then we check if the person requesting permission is authorized or not if yes then it is granted else a picture of the person asking for permission will be sent to authorized user so that he can grant entry if wanted.

Flow chart:

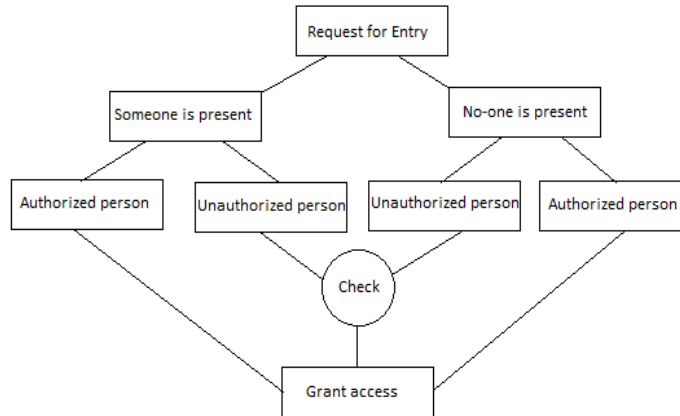


Fig 5: Flowchart for Permission granting for security in Smart Homes

IV. CONCLUSION

There is huge potential of smart homes market in the World due to changes in the socio-economic factors. The market is estimated to be worth nearly 91 billion EUR by 2025. All smart home market places will need to combat new regulatory areas. Both traditional energy companies and smart technology developers are competing against each other in the market. A specific challenge facing smart home technology developers is access to a customer base. Then also the future of smart homes is very bright and there is a huge potential yet to be tapped..

REFERENCES

- [1] Gaurav Tripathi, Dhananjay Singh, and Antonio J. Jara, "A survey of Internet-of-Things: Future Vision, Architecture, Challenges and Service", IEEE World Forum on Internet of Things (WF-IoT), 2014, pp. 287-292
- [2] Shenzhen etel Technology Co., Ltd
- [3] J. Wang, K. Sasabe, and O. Fujiwara, "A simple method for predicting common-mode radiation from a cable attached to a conducting enclosure," IEICE Trans. Communication., vol. E85-B, no. 7, pp.1360-1367, July 2002.
- [4] Gira systems
- [5] ABB safe&smart <http://new.abb.com/low-voltage/launches/safe-and->
- [6] BTicino <http://www.bticino.com/video-door-entry-system/>
- [7] Antonio J. Jara, Miguel A. Zamora and Antonio F. G. Skarmeta, "An architecture based on Internet of Things to support mobility and security in medical environments", IEEE Communication Society, in IEEE CCNC 2010 proceedings.
- [8] Pranay P. Gaikwad , Jyotsna Gabhane, Snehal Golait, "A Survey based on Smart Homes System Using Internet-of-Things", 2015 INTERNATIONAL CONFERENCE ON COMPUTATION OF POWER, ENERGY, INFORMATION AND COMMUNICATION.
- [9] Sean Dieter Tebje Kelly, Nagender Kumar Suryadevara, and Scubas-Chandra Mukhopadhyay, "Towards the Implementation of IoT for Environmental Condition Monitoring in Homes", IEEE SENSORS JOURNAL, VOL. 13, NO. 10, OCTOBER 2013