ISSN (Print): 0974-6846 ISSN (Online): 0974-5645

Smart Homes: Sensible Living Using Internet of Things

Taranjot Kaur^{1*}, Sushil Kakkar¹ and Shweta Rani²

¹Department of ECE, BGIET, Sangrur – 148001, Punjab, India; tarangandhock@gmail.com, Kakkar778@gmail.com ²Department of ECE, GZSCCET, Bathinda – 151001, Punjab, India; shwetaranee@gmail.com

Abstract

Objectives: Home for a belonging is the best place than ever, it provides a restful shelter to us. It is a dream to make it fully controlled from a place away from home. Internet of Things has come this dream true, as it allows the person to operate his/her house remotely from any place where the person is just with a internet connection. **Analysis:** IOT Homes are the coming time for us when all our home appliances will work automatically, we can monitor our things and home environment with our smart phones. IOT gave our home a power of deciding everything according to our comforts whether we are present or not. It includes all communication phases like machine2machine, machine2human or cloud, cloud and human (C = H). **Findings:** Various controlling devices like fit bit, remote controlled lighting, etc. Working now a day's describe the initial phase of the smart livings. IOT scenario will gave home with controllability at distant operable devices using the data packet connection with the world. This paper is about the designing and modelling our sensible home automation system using the Internet of Things. The paper describes the various steps regarding the implementation of Smart Homes in the present days.

Keywords: Cloud Computing, Internet of Things (IoT), Internet Protocol, Machine to Machine Communication (M2M), Sensor Network (WSN)

1. Introduction

Smart Homes using Internet of Things (IoT) provide the user varied features to operate home devices from any place where the user being and at any time whenever needed. In Internet of Things (IoT) home provide notification to the user regarding the activities at house and also provide insightful tips in form of the information via changing the data into meaningful notifications¹.

Back in history when, Le Corbusier a Swissarchitecture describe home as a machine for living in, since the idea of transforming the house motivated and a vision of Smart Home came into existence with the development of the gadgets for easy and fatigue free life².

Smart Homes are transforming our lives with varied smarter world's applications. Smart Homes are the

symbol to the house in which owner is allowed to monitor house, control access, home care and efficiency in energy and security using a internet gateway into the house, combining the distribution the devices over the web and manage data from sensors and controlling various appliances³.

IOT homes create a link to various standards and different sensor application together to create a real-smart world of intelligence and integrated means. These will no longer need the attention of the user because of the intelligent decision making behind features^{4,5}.

Internet of Things is all about the connecting of things that surround us in a global cloud form. In Smart Homes these connections are the collection of several networks of small home devices over the wide internet and have the property of inbuilt intelligence and decision making like a human⁶.

^{*}Author for correspondence

Devices when ever needed to be connected it needs two things: 1 The Internet Protocol Address Space having (DNS) Domain Name System of organised body. 2. The (ICANN) Internet Corporation for Assigned Name and Number for policies of directing DNS internationally^{7,8}.

2. Internet of Things Technology

Internet of Things is a scenario where input to the internet is the data consists of the situations detected by sensors node and the output to the user is the relevant event drive by the machines or devices at end. IOT provides an environment where the data over the network is being prepared by the machines and result is their triggering to the consecutive action. IOT technology would come with some different techniques as were working in the present time. This is described in Figure 1.

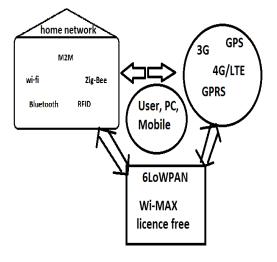


Figure 1. IOT network.

In IOT the resource identifiers URI used as a web address be based on the (IPv6) internet protocol version 6 which were standardized with the (EPCIS) Electronic Product Code for Information Services. EPCIS is the event data that is captured by the sensors present over nodes. These data is addressed over the internet in the form of 8 groups of 4-bit hex-decimal digit notation. Example:

2001:0de4:14b0:0000:4300:288a:0370:8a2e

IOT drives the human to an ambient world where the machine helps us to do our daily life activities. The ambient intelligence refers to the electronic space that is sensitive

to the user's information and respondent of the action. This act as the phase of computing or the mathematical calculation of the data sequences. IOT being a intelligent network would allow the devices to walk openly.

IOT being the largest collection of communicating devices, the data related to the devices need a great handling in the network space. The event-driven architecture e.g. (BOTTOM-UP) approach used in real time operation, Constrained Application Protocols such as IPv6 over Low Power Wireless Personnel Area Network (6LoWPAN) is required. There would be the need of computing for solving errors during handle of large burst data through channel (FOGGING) a type of computing used in IOT, (MQTT) message queue telemetry transport known as 'light weight' used in networks with limited bandwidth, (ZERO MQ) a asynchronous message library used in distributed many-to-many connections, all would be required to analyse and process the data over the real time scale.

3. Features of Smart Homes using IoT

Smart Homes or sensible livings with Internet of Things are self-configuring, decision-maker, relevant in work, durable for security. Smart homes consist of following features:

3.1 Temperature Control in Sensible Homes

Smart Homes consists of remote temperature control systems using the thermostats. These thermostats have the embedded coding to measure the temperature, humidity value in the room. It predicts the values for cooling and exhaust range via measuring the Heat Index. This prediction also varies with the outlay temperature of the room. As, the user about to come to the house the (HVAC) Heating, Ventilation and Air Conditioning can operate by getting remote alert by the user through smart gadget and when user came in he/she got the validated range of temperature as per requirement².

3.2 Security in the Smart Systems

Smart security systems can be used for unlocking the doors of the homes as the user is about to come and reach at a certain distance. The system will get the response to unlock the door through the user smart phone when the user is within the threshold distance range. It does not

need the intervention of user to operate function using key for opening the door. Smart security also allows the home owner to unlock door remotely for the guests in his absence10.

3.3 Lighting System in Smart Homes

In Smart Homes the user can control lights of the house with the help of a smart phone which includes the inbuilt program to turn on/off at needed precautions. It will also monitor the electricity use. The user can screw the damage if occur from any place and control the intensity from phone with dimmer function. Thus, user operate house remotely and the lighting work easily without wiring in the whole house11.

3.4 Outdoors Monitoring in the Smart **Homes**

Smart homes are not only limited for the interior of the house but also look after the outdoor. Smart plant sensors can be used to keep the monitoring of plant's water and sunlight. It will send alert when it will need the water and if the water necessity in soil is enough to turn off. Smart sprinkler system can be controlled remotely and allow the user to turn it on/off in the condition like heat or rain 12-14.

3.5 Alarming System in the Smart Home

In smart homes various detectors are being used to alarm the user regarding the home's condition. The smoke detectors are there for the fire smoke prediction, carbon monoxide prediction or any other. The motion sensors are there for the anti-theft purposes. These detectors will earshot off the beeps of alarm in the user's phone and also gave alert to the security officer regarding it. The smart home gave the alarm with beep if there is any detection over the user's mobile phone $\frac{15-17}{2}$.

4. The Advantages of IOT Smart **Homes**

The Smart Homes using Internet of Things is a technology in which interconnection is there between varied interconnected devices and the Internet and provide various examples as:

4.1 Communication between the Devices at Home

Internet of Things encourages the communication between the devices, known to be Machine-to-Machine (M2M) communication. Because of this, the physical sensors/devices are able to stay connected with the main hub as well as with each other and hence there is the transparency between them. As, our temperature controlling sensor connected to the internet will give the variation value of temperature or humidity to user and the fan and ventilation controllers so that they will operate according to the requirement.

4.2 Automation Controls at Homes

In IoT physical objects are connected to the universal network called Internet and controlled digitally with central wireless hub known as the controller. This main hub works and controls automation without human intervention, thus machines are able to communicate with each other lead to faster and in time outputs in the absence of human. As the fire alarm gave alert to the user when there occur fire at home and the automation controller self gave the command to sprinklers.

4.3 Homes to Monitor Automatically and **Provide Regarding Information to User**

There is the advantage of Internet of Things based Homes in functioning regarding the care. There are sensors in these houses which monitor the environmental conditions, regularly keep track on the household regarding supplies and there quantity in the storage. This will help user with remotely providing the vision regarding ingredients in refrigerators using camera and user get things from grocery store in the easy manner. The air condition at home also gave information regarding the smoke or carbon monoxide in air so that exhausts will work regarding to the condition. It is obvious that having information regarding situation at home help the user in making better decisions. Furthermore, monitoring the expiration of products also improves safety for the user.

4.4 Homes to Provide Efficiency in Results and Save User's Time and Money

In IoT homes there is the interaction between belonging and home also machine-to-machine conversation is being there. This provides better efficiency for getting accurate results regarding the variations and controlling at home and using new IoT protocols these can be obtained fast so a user take decision in the sensible time. This results in saving our valuable time. IoT Homes saves our money. As if IoT once implemented it saves money by tagging the equipments, taking care of its condition, monitoring their daily routines and providing the alert to people in their appliances efficient manner working.

4.5 It could be Better Convenience of Life in Homes

IoT Homes provide all the applications in which there will be stress relief to human regarding home's work. This technology gave a being a life with increased comforts, convenience in tasking and optimum management system tools for controlling, thereby improving the user's life.

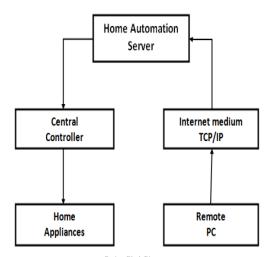
5. System Design of IoT Home System

Nowadays, Home Automation System using IoT is in its first stage. There is the implementation of Radio Frequency or Infrared based automations. The work to operate our automated homes will be our future soon. This paper has objective to prepare a model based on this futuristic technology using the present devices and integrated coders. The system design is described as follows.

5.1 Block Diagram of the Work

In this proposed work the control to all devices is provided using a central controller and the global interaction is using the agent to connect to the web.

The Figure 2 describes the central control hub is the microcontroller which code all our devices present at home and set them in one wire of processor. This central controller is connected to the server modem which interact controllers devices to global network. With the Transmission Control Protocol/Internet Protocol (TCP/IP) our home server is connected to the global network. With this we can operate our devices remotely anywhere from the world with the help of Internet.



Project Block Diagram

Figure 2. Block diagram of the project.

5.2 Devices included in the Setup

In the described system we use the microcontroller 8051 embedded with the inbuilt storage Random Access Memory and other processing units having its own MAC address. This microcontroller board is connected to the internet using the network provider module which act like a MODEM (Modulator and Demodulator) and provide Internet Protocol (IP) address to the system. Several small devices are connected to each other as well as cloud using controller. The other devices are the Light Emitting Diodes (LED), Servo motor used as fan for providing cooling, Temperature and Humidity measuring sensor, Motion Sensor and Buzzer. These devices operate using the signal which is provided to them by the controller about their turn on/off. All this system is powered using the adapter at appropriable power value. The setup for our IoT based Home System is shown in Figure 3.

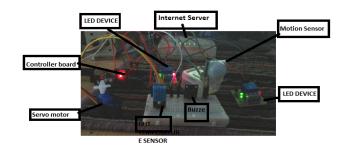


Figure 3. Implemented model setup.

5.3 Software used for the System

The devices in the setup operate using their soul called software. In this system we use two kind of software as:

5.3.1 Controller Processing Software

For controlling our central hub we use MATLAB software to provide simulation between the devices and the controlling head commands.

As shown in the Figure 4, the home automation query model is given which consist of two blocks; the transmitter block and the receiver block. The transmitter block includes the commands and the receiver block includes displays. Both these queries were operated using instrumentation to convert the various commands to the derived outputs.

Using the controller processing software; MATLAB's graphics, the design of home automation is shown in Figure 5 which shows; the controlling switches of the room, motion detection zone and temperature detecting zone.

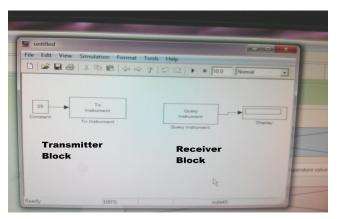


Figure 4. IOT based Home Automation Query

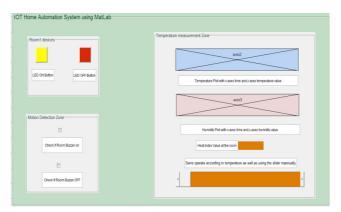


Figure 5. IOT based Home Automation design using MATLAB graphics.

5.3.2 Network Operable Software

For providing control to our system at network we use the network compatible commands which are written in the Java to provide link between our hardware setup and internet. These language command scripts bring combination between operable devices protocols in integrated development environment used is the c/c+ and hyper text transfer protocols using hypertext mark-up language.

As the Figure 6 shows, how the home devices is going to be getting connected to the internet, its http configuration, server description, content type, location, etc.



Figure 6. Connection of the home devices to the Internet.

5.4 Implemented System Working

The working of the system is described using a flow chart as shown in Figure 7.

This model when power up and connected to the internet using static IP will be provided to the system. The equipments can be controlled over the internet where ever place we want them to control. The LED in the system operates as per user desire when we want to turn on/off using the shown buttons. The temperature device measures the value of temperature when it got the power to turn on. It provides the temperature and humidity value in the room also calculate the Heat Index value and display it to the user. The motion sensor regularly senses the obstacle if present. If anything came in the way of sensing rays it alert high using the buzzer and gave user security to the home.

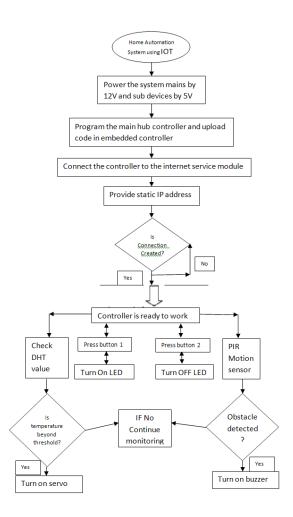


Figure 7. Flow Chart of the proposed work.

6. Result

By providing the successful implementation to the system and connecting the system over the internet work we got alerts in our server page. This gave the data regarding the temperature and humidity values are shown in figures below.

In Figure 8, the left are values of the motion detector of time for the motion to be detected and the ended time when the sensor is again to be at rest and the right are the DHT sensor's temperature detected values showing the percentage of relative humidity value, temperature value in degree Celsius and degree Fahrenheit received from the sensor nodes in the room.

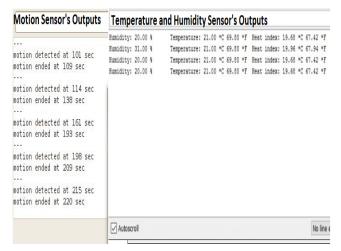


Figure 8. Various outputs get through the sensors.

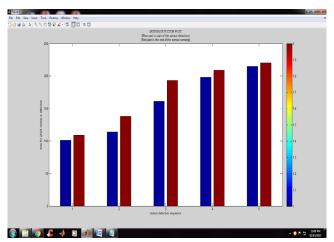


Figure 9. Motion Detector Plot (Blue part is start of the sensor detection) (Red part is the end of the sensor sensing) Model.

The plot of the motion detection is shown below taken from the values obtained from the nodes. The value of the time for the detection of the motion is shown in as:

In the plot of the motion detection blue part of the histogram is the time value when the motion is detected and red part of the histogram is sensor off time value.

Motion rested value = Ended time – detected time.

The DHT sensor obtains the value of the humidity percentage in the room using its capacitive humidity sensor and the value of the temperature using thermostat in the form of degree Celsius and degree Fahrenheit. Using the value of temperature value and percentage humidity we calculate the heat index value by Lans P. Rothfusz analysis. The Equation of Rothfusz is:

Where,

HI = Heat Index (in degree Celsius or degree Fahrenheit).

T = Temperature values in degree Celsius or degree Fahrenheit.

RH = Relative Humidity value in percentage form.

Their values are described in the Table 1 as:

The plot of the temperature and humidity detection is shown in Figure 10, taken from the values obtained from the nodes.

With the help of the Internet Protocol address of the main hub of devices we can get access to all devices through the internet at any place over the Earth. The Figure 11 shows how one can access the switching of the devices while working with other website over the network. Figure 12 shows remote operation of the devices using our Smart Phones.

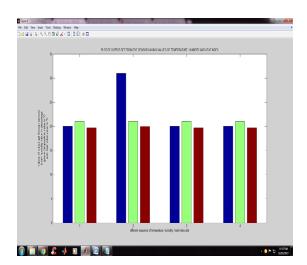


Figure 10. Plot of output from the sensor having values of Temperature (in *C), Humidity (in %), Heat Index (in *C).



Figure 11. Operating devices through the internet using the Internet Protocol address of the network.

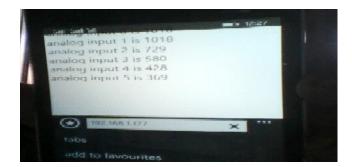


Figure 12. Accessing the devices with Smart Phone using the Internet Protocol address of the network.

7. Conclusion

Home Automation System make our home a smart, sensible home with all kinds of comforts and alerts present in them. Internet of Things based these systems will be operated all over the globe using internet connectivity. With the help of this user will analyze all conditions and situations at home. IOT based home system is the future of our homes. This research paper presents the design and provides an implemented model with the systems that could used in the future homes. The IOT in the coming time make our lives easy with its best automated Smart Homes

Table 1. Indicating values equated from temperature and humidity sensors

Sr.no.	Humidity (in percentage)	Temperature (in degree Celsius)	Temperature (in degree Fahrenheit)	Heat Index (in degree Celsius)	Heat Index (in degree Fahrenheit)
1	20.00	21.00	69.80	19.68	67.42
2	31.00	21.00	69.80	19.96	67.94
3	20.00	21.00	69.80	19.67	67.43
4	20.00	21.00	69.80	19.68	67.42

8. References

- 1. Lin Y, Kong R, She R, Deng S. Design and implementation of remote/short-range smart home monitoring system based on ZigBee and STM32. Journal of Applied Sciences, Engineering and Technology. 2013; 5:2792–8.
- 2. Javale D, Mohsin M, Nandanwar S. Home automation and security system using android ADK. International Journal of Electronics Communication and Computer Technology (IJECCT). 2013 Mar; 3(2):382–5.
- 3. Souza AMC, Amazonas JRA. A novel smart home application using an Internet of Things middleware. Proceedings of 2013 European Conference on Smart Objects, Systems and Technologies (SmartSysTech); 2013 Jun. p. 1–7.
- Kumar A, Singh IP, Sud SK. Indoor air quality estimation by using smart sensing system. Proceedings of the International Multi Conference of Engineers and Computer Scientists; Hong Kong. 2009 Mar.
- 5. Ni Y, Miao F, Liu J, Chai J. Implementation of wireless gateway for smart home. Communications and Network; 2013. p. 16–20. PMid: 23264670.
- 6. Gubbi J, Buyya R, Marusic S, Palaniswami M. Internet of Things (IoT): A vision, architectural elements and future directions. Elsevier Future Generation Computer Systems. 2013; 29:1645–60. Crossref
- Pande SP, Sen P. Review on: Home automation system for disabled people using BCI. IOSR Journal of Computer Science (IOSR-JCE). 2014. p. 76–80. e-ISSN: 2278-0661, p-ISSN: 2278-8727.
- 8. Hamed B. Design and implementation of smart house control using LabVIEW. IJSCE. 2012 Jan; 1(6):98–106. ISSN: 2231-2307.

- El-Basioni MM, Abd El-kader SM, Fakhreldin MA. Smart home design using Wireless Sensor Network and Biometric Technologies. International Journal of Application or Innovation in Engineering and Management. 2013 Mar; 2(3):413–29.
- 10. Kaur I. Microcontroller based home automation system with security. IJACSA. 2010 Dec; 1(6):60–5.
- 11. Robles RJ, Kim T. Review: Context aware tools for smart home development. International Journal of Smart Home. 2010 Jan; 4(1):1–12.
- Zhang T, Li Q, Ma F. Remote control system of smart appliances based on Wireless Sensor Network. Control and Decision Conference (CCDC); Guiyang.2013 May. p. 3704–9. Crosref
- 13. Nicholas D, Darrell B, Somsak S. Home automation using cloud network and mobile devices. Proceedings of IEEE Southeastcon; 2012 Mar.
- 14. Chan M, Campo E, Esteve D, Fourniols JY. Smart homescurrent features and future perspectives. Maturitas. 2009; 64(2):90–7. PMid: 19729255. Crossref
- Das SR, Chita S, Peterson N, Shirazi BA, Bhadkamkar M. Home automation and security for mobile devices. IEEE PERCOM Workshops; 2011. p. 141–6. Crossref
- 16. Kelly SDT, Suryadevara NK, Mukhopadhyay SC. Towards the implementation of IoT for environmental condition monitoring in homes. IEEE. 2013; 13:3846–53.
- 17. Piyare R. Internet of Things: Ubiquitous home control and monitoring system using Android based smart phone. International Journal of Internet of Things. 2013; 2(1):5–11. DOI: 10.5923/j.ijit.20130201.02