



SMART HOME USING IOT

Sandhya P., Siddharth Gupta, G. Saikishan and Harsh Mohan Garg

SCSE, VIT, Chennai, India

E-Mail: sandhya.p@vit.ac.in

ABSTRACT

The core ambition of this article is to provide benign, Smart and Sophisticated Life for all the households. Our ultimate aim is to make our client feel safe and secure in their houses. Our methodology uses wireless communication. Our System has an Arduino which acts as a 'Back Bone' to whole project, its focal functionality is to accumulate information from sensors and provide them appropriate response. Our complete Smart System is energy efficient and intelligent enough to handle real world circumstances in real time without daunting.

Keywords: IOT, sensors, piconet, face detection, arduino.

1. INTRODUCTION

Our article is built on Open Source and open hardware system which makes it vigorously flexible to update or change the system conditions without any complexities. Clients can monitor their home by means of internet or by using a Bluetooth interface. In present conditions, with the introduction of smart TV, smart mobiles and smart watches etc., has habituated man to live his life to its full extent without any physical stress. Besides that burgeon of internet with online tutorial and classes made it much more facile to learn and apply new technologies which will rejuvenate their mundane life.

However, technology these days is proliferating stupendously than ever before, main credit goes to IT and Electronic field engineers who are striving hard to bring newfangled inventions in to common man's life. This article is a small contribution from our side as fledglings to this community, to make home automation much cheaper and efficient than current systems. We have even included PIR sensors and actuators to guide blind people in this project, which will be a good enough to monitor and indicate directions for them

2. PROPOSED WORK

In this system we have implemented some fledgling ideas prevailing in the modern-day industry and few others from the papers we referred from, every idea we added had a relevance to the current discrepancies faced by typical households. Our focal aims were to design system, which consume less power and in turn work more, beside that we planned to make it completely automatic which is appropriate for all types of rooms, finally we added a new feature which assists blind people to know which room they are in, for implementing this we used Passive Infrared sensor, these sensors will sense the presence of a person in a room and speaks out the current room name.

3. PRESENT WORK

The technology of home automation revolves back to World war 1, fact, the television remote (a simple home automation system) was patented in 1893 (Wikipedia, 2009). Home automation is a collective outcome of every possible thing or work inside a house,

which include climatic controls, monitoring door and window openings, controlling home theaters etc.

Throughout times arduous works have been contributed to this state of art, but no technology was as good as smart phones, these intelligent devices made a huge transformation in this field, in the terms of portability, flexibility, availability and security. Substantial work has been done by coalescing these embedded devices with smart-phone to abate the number of sensors that needs to be integrated on the embedded device, thereby increasing its portability without sacrificing the accuracy of the reading provided by these devices

In today's world, Home automation or smart home is building automation for the home. It comprises the control and automation of lighting, heating (such as smart thermostats), ventilation, air conditioning (HVAC), and security, as well as home appliances such as washer/dryers, ovens or refrigerators/freezers. Wi-Fi is often used for remote monitoring and control. Home devices, when remotely monitored and controlled via the Internet, are an important constituent of the Internet of Things. Modern systems generally consist of switches and sensors connected to a central hub sometimes called a "gateway" from which the system is controlled with a user interface that is interacted either with a wall-mounted terminal, mobile phone software, tablet computer or a web interface, often but not always via Internet cloud services.

4. MATERIAL AND METHODS

The work on project of open-source modules for intelligent home was dedicated to search for the contemporary technologies and provide their features as on an open-source platform. Sensor array modules including PCB schematics, layout development and 3D models were designed and assembled. The most relevant, accessible and effective sensors available on the market with respect to the open-source approach were selected.

Block diagram

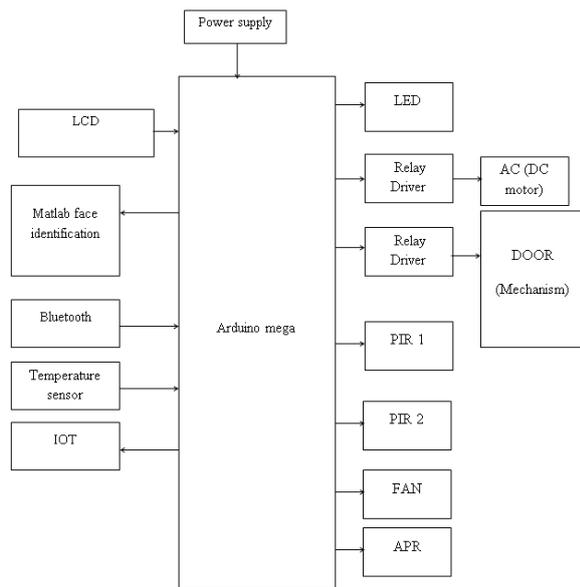


Figure-1. Block diagram.

5. STATE OF ART

We are in an era of artificial intelligence, in which man is accustomed and adapted to rely on machines to do their basic unexciting job, starting from a small calculator to the usage of super computers; every tiny humdrum job is handled with impeccable perfection by the computers. The proliferation of three core fields have made this accomplishment, first one is development of wireless technology, which gave rise to many enormous ubiquitous technologies WIFI, Bluetooth, ANT, ZigBee etc., take the liability to deliver information without plundering its authenticity and confidentiality. Besides that we experience a remarkable growth in field of Internet, with the introduction concepts like cloud, big data have played a most prominent role in this development. In the end we observe augmentation in the field of IoT, which is related to the field of Embedded Systems, it is mainly used to connect electronic part of the project to internet.

Improvements in Microelectromechanical system sensors are escalating opportunities to invent better embedded systems projects, by introducing new sensors like personal radar, radio imaging, Audio Beam Forming sensors etc. Along with that, IOT has also been a great help and its main contribution to its family is to connect its sensors to internet, so that we can store data collected in the cloud, which can be later efficiently processed and retrieved where ever we want it, over the internet. Apart of few differences among the vendors and manufacturer of individual Home automation or IoT components the main differences are defined by communication protocol use.

In this context most of companies use ZigBee network which basically maintains a mesh topology, which works at a frequency of 2.4 GHz, but it contrast to that it is used at a diversified frequencies in different countries, however it has single point failure can destroy the whole network.

Apart from this we have few more technologies like Z-Wave and KNX networks, which are prominent in Europe and USA; they have their own pros and cons in maintaining, monitoring and controlling the network.

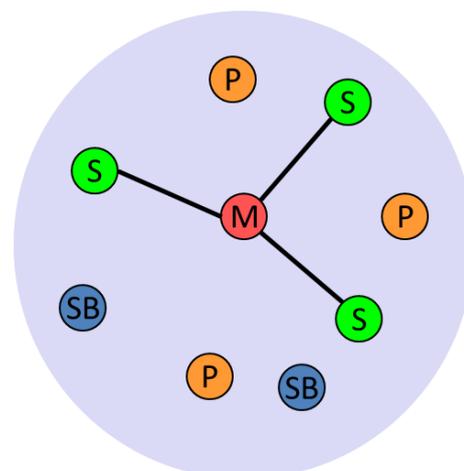
6. COMMUNICATION STRUCTURE

Starting from the scratch, we have to keep in mind our network's topology and structure of communication network, along with the technologies used to connect the user, which plays a crucial role to carry data from the sensors to the user and in return collect the response from user to handle corresponding situation.

In this project we have 7 types sensors and actuators, which will sense temperature, security intrusion and motion inside a room and sends that particular information to the user, so the amount of power consumed to send and receive information depends on distance and size of the message, in such situation considering WIFI would be a most awful solution because, it has a bit rate of 54Mbit/s and power consumption is 80mW. Which is humongous amount power urge and it is not complaisant with our situation, on the other hand we have ZigBee and XBee hardware antennas which are perfectly appropriate to our need, but they are very costly and at the same time designed for long distance communication, finally we considered Bluetooth would be a perfect match, which will consume less amount of energy and very economical to, it contains a mesh topology.

Bluetooth has a Collection of devices connected in an ad hoc fashion, One unit acts as master and the others as slaves for the lifetime of the piconet, Master determines hopping pattern, slaves have to synchronize, Each piconet has a unique hopping pattern, Participation in a piconet = synchronization to hopping sequence, Each piconet has one master and up to 7 simultaneous slaves (> 200 could be parked).

Our main unit which is Arduino Mega is will be attached to a Bluetooth module which will help us connect to our mobile, laptop devices and assist us to control and monitor the whole system.



P=Parked
SB=Standbv

Figure-2. Piconet.



7. RESULTS

Our project main aim was to make Home Automation more economical and in the capability range of a middle class man. The Receptive sensors, modest Systems Architecture and Finally intelligent Data processing techniques etc. are Soul of this design.

(a) Sensor unit

Our Sensor unit contains very impulsive and flexible sensors which can be fixed in any type of room. Every sensor is connected to Arduino Mega Microcontroller, which adjuncts all information from the sensors and stores them in the Database, while incase if there is any emergency, then the indication will be given to the particular household.

- Bluetooth module
- LCD panel for simple visualization.
- Matlab Face Detection Module.
- Temperature Sensor.
- 2 Relay Drivers
- Passive Infrared Sensors.

A. LCD Panel

It is mainly used to Display the contemporary information which is collected form the sensors. LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

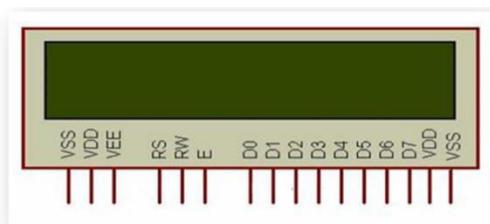


Figure-3.LCD.

B. Matlabface detection

In this particular module we connect a camera to the computer or a laptop, which can fetch a person's face and forward it to the Matlab module, where it verifies particular person's authenticity, in case that person is not registered then an alert message is sent to the particular house hold.

We used MATLAB to detect facial features of every person and match them with the ones in the database and validate with help of correlation algorithm, this algorithm will compare every pixel of a picture with another one, in the end it outputs an aggregate percentage of equivalence, which will represent how much they match, if its above 50% we declared him to be a valid

person, if not it will forward a message as a unauthorized person to website.

C. Temperature sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). It has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/°C The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 °C at room temperature and +/- 0.8 °C over a range of 0 °C to +100 °C.

Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 °C temperature rise in still air.

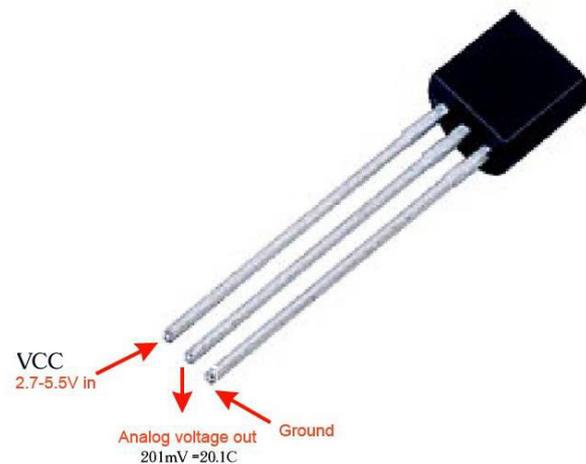


Figure-4. LM35.

D. Passive infrared sensor

2 PIR sensors are deployed in every room, this sensor is known as a passive because it does not emit even single minute ray of infrared spectrum. It just senses the changes in the amount of infrared with the help of Sensor Face.

PIR Sensors are arranged in pair's fashion, because they are arranged as an opposite inputs of an amplifiers, so that average temperature gets canceled and this differential arrangement minimizes common-mode interference, allowing the device to resist triggering due to nearby electric fields.

Motion can be detected by checking for a sudden change in the surrounding IR patterns. When motion is detected with the help of Fresnel lens, the PIR sensor outputs a high signal on its output pin. This logic signal can be read by a microcontroller or used to drive a transistor to switch a higher current load amplifier.



Figure-5. Passive infrared sensor.

E. Relay drive

A relay driver castoff as an Electromagnetic switch, which used to on and off the devices, with the help of low voltage current, these are much more capable and deserving than a normal solid state switches, because they can with stand high current capacity, ability to overcome a ESD (Electro Static Discharge), besides all these drive circuit isolation is the unique property of relays.

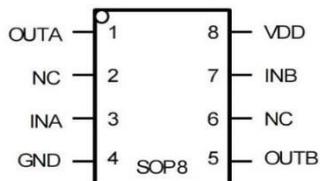


Figure-6. Relay driver.

F. IoT

It is prominently used to connect the electronic devices like sensors and actuators to a huge networks or internet to exchange information like Acknowledgements, alerts, Data from one device to another. This idea spawned many new opportunities in the field of Embedded System and Networking. Which augmented efficiency, accuracy; economic benefits of the contemporary network, along with that it subjugated many network discrepancies which redundantly tantalized electronic and computer networks in the past.

In our project it is mainly used it to open the door when the person inform at the door is recognized, with the help Matlab code which runs in the background. Here we have 2 motors in a relay driver, but we just used only one in our project. it is directly connected to the Arduino when a face is detected then that Matlab code sends 1 bit through RS232 indicating that persons authenticity.



Figure-7. IoT.

Internet of things will become part of the fabric of everyday life. Because it has a humongous number of opportunities including infrastructures like water, electricity, telephone, TV and most recently in the family of internet.

Data management is a crucial aspect in the Internet of Things. When considering a world of objects interconnected and constantly exchanging all types of information, the volume of the generated data and the processes involved in the handling of those data become critical. A long-term opportunity for wireless communications chip makers is the rise of Machine-to-Machine (M2M) computing, which one of the enabling technologies for Internet of Things. This technology spans abroad range of applications.

In our project we took the IOT's assistance to upload our sensors data in to the cloud, and finally retrieve it from there and display in on our website, which casts the live data from all the sensors on it and at the same time it can even control our house appliances, finally its work is to enable us to control our house from anywhere along length and breadth of this planet with the help of web application (where there is internet connection).

8. DISCUSSIONS

Our Product has primary advantage of using Bluetooth instead of WIFI module, which makes it more efficient than other, in comparison to them few products are using ZigBee which is way more costly than required.

So as we can observe almost everyone has a good User Interface, which include Applications and their own electronic appliances. Along with that Flexibility is also mostly persistent attribute. But in contrast to them, discrepancies arises in the case of Cost which vary from product to product, which mainly reliant on company's reputation, quality, and components of that particular product.

Our project is a prototype which represents a standard home automation system. Which can be flexibly used in any circumstances of a modern house. We additionally used cloud to store the data which include turning on and off details of electrical appliances along with their time and date, which spawns future prospect to analyze it and make it much more sophisticated and erudite system.



| Company | COST | Energy Efficiency | User Interface | Flexibility |
|-------------|----------|-------------------|----------------|-------------|
| Oakter | Moderate | Low | Good | Limited |
| Inoho | High | High | Very Good | High |
| Ifihomes | Low | Very low | Good | High |
| Sharp Node | High | High | Good | High |
| Our Product | Moderate | Moderate | Good | High |

Figure-8. Companies company.

9. CLOUD

Cloud computing is a technology, which is used over in the internet to store, process and retrieve data an lightning speed and unimpeachable perfection. Cloud is omnipresent and enables us to share a huge amount of data from any place and time.

Contemporarily, every enterprise, Software firms ranging from small to large sizes is using this technology unbiasedly. Some firms even host their own cloud, where every other firms in need of cloud, approaches them and buys a contract to use some of their data and processing capabilities for some time. Cloud computing trusts on sharing of resources to achieve coherence and economy of scale.

We used cloud to upload and store our data over the internet; this enabled us with luxuries of calibrating live data from our house appliances on website and control them at the same time.

10. APPLICATION

Our Android Application is a connected to the blue tooth controller which will help us to control our house from within, through voice instructions; we can on and off house hold appliances like lights, fans and AC. We have connected it to the APR which will produce the appropriate sound for that instruction and within time gap of 10-20 sec; we can observe the output in our set up.

The voice instructions given in the application will recognize that particular instruction and sends that bits assigned to it in application to Arduino, then Arduino will recognize the bit and perform that particular actions. Additionally the phone needs to be connected to the internet to run the application optimally.



Figure-9. Android application.

11. WEB APPLICATION

Web Application is mainly useful over long distances. This is the portion where IOT plays a crucial role to amalgamate the whole project with internet. Internet is huge platform where we can create innumerable opportunities to control and guide our system to its goal. We designed a simple web site with GUI closer to the reality, which is switches; each switch denotes an electronic item in your house. We can either switch it off or on, through that interface, it takes around 10-20 sec to get the job done.

It was simply done using HTML, PHP and CSS. You can easily improvise it and include some more exciting factors and controls or add some more style sheets to make it look much more beautiful and smart.

CONTROL VIEW test



Figure-10. Web application.

12. HARDWARE DESIGN

The hardware device comprises of the motion sensors, Bluetooth module, Arduino Mega and GSM sim 800 module. The GSM sim 800 is primarily responsible for transmitting the analog values received from the sensor. It is also responsible to receive commands from talkback Android. This interface aids in controlling the Arduino device from mobile device or web interface.

The diagram represents the web dashboard of talkback Android along with the command posted. There commands are unique keywords recognized by Arduino device. The commands are queued in the google-api server when the device is not active and executed according to their position in the queue. Once executed the commands are dequeued.



Figure-11. Complete project.

13. CONCLUSIONS

This paper is a description and explanation of a working model which mainly focuses on open-source modules which can be coded and implemented according to the client's requirements and queries, this quality of the paper widens the horizon over the state of art of IOT and Embedded System together, which can be used in many applications like in home automations, handling large enterprises, rectifying and operating medical equipment coherently and many other applications.

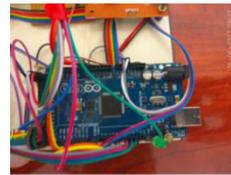
14. MODULES

We have totally 3 modules collectively, the most crucial one among them is Arduino, which contains maximum amount of code, because it connects the whole system and monitors every sensor and actuator.

Face detection module contains automatically opening door, we used MATLAB to detect face of a person with help of Viola Jones algorithm and match it the stored ones with the help of correlation algorithm. This algorithm will compare every pixel of a picture with another one.

IOT Module is used to connect internet project we took the IOT's assistance to upload our sensors data in to the cloud, which casts the live data from all the sensors on it and at the same time it can even control our house appliances, finally its work is to enable us to control our house from anywhere.

APR Module is used store our voices and play them accordingly and relevantly in our project, APR module is connected to Arduino which will trigger those voices whenever required.



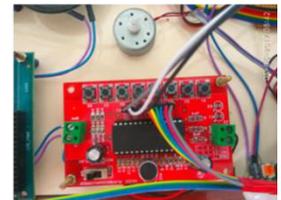
ARDUINO MODULE



Face detection module



IOT MODULE



APR MODULE

Figure-12. Modules.



BLUETOOTH

PIR

LM35

Figure-13. Sensors.

REFERENCES

- [1] Martin Juránek. 2011. Jiří Kulhánek conducted at Carpathian Control Conference (ICCC), 12th International. The use of MEMs accelerometers for measurement of driver seat comfort.
- [2] Michal Řepka, Roman Danel and Zdeněk Neustupa. Use of the Bioid Robot Kit in the Teaching of Automation and Programming Languages.
- [3] Xiaojing Ye. Junwei Huang conducted at 2011 International Conference on Computer Science and Network Technology. A Framework for Cloud-based Smart Home.
- [4] Muhammad Asadullah; Khalil Ullah. 2017 International Conference on Innovations in Electrical Engineering and Computational Technologies (ICIEECT). Smart home automation system using Bluetooth technology.



- [5] Reza Abrishambaf, Mert Bal, Valeriy Vyatkin. 2017. IEEE International Conference on Industrial Technology (ICIT). Distributed home automation system based on IEC61499 function blocks and wireless sensor networks.

- [6] Anita Chaudhari, Brinzel Rodrigues, Shraddha More. 2016. 2nd International Conference on Contemporary Computing and Informatics (IC3I). Automated IOT based system for home automation and prediction of electricity usage and comparative analysis of various electricity providers: SmartPlug.

- [7] Sukhen Das, Sanjoy Ganguly, Souvik Ghosh, Rishiraj Sarker, Debaparna Sengupta. 2016. International Conference on Intelligent Control Power and Instrumentation (ICICPI). A bluetooth based sophisticated home automation system using smartphone.

- [8] <https://en.wikipedia.org/wiki/Ethernet>.

- [9] Murad Khan, Bhagya Nathali Silva, Kijun Han. Internet of Things Based Energy Aware Smart Home Control Systems.