

SECURE INTERNET OF THINGS

A

Minor Project Report

Submitted in Partial fulfilment for the award of
Bachelor of Engineering Degree in Computer Science & Engineering

Submitted

To

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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
LAKSHMI NARAIN COLLEGE OF TECHNOLOGY & SCIENCE
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SESSION 2016-17**



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CERTIFICATE

This is to certify that the Minor Project work entitled “**SECURE INTERNET OF THINGS**” has been satisfactorily completed by **Ashwini Gour (0157CS131023)**, **Eashan Adhikarla (0157CS131034)**, **Nihal Tiwari (0157CS101050)**, **Prakhar Shrivastava (0157CS131059)**. It is a bona fide piece of work, carried out under my guidance in the **Department of Computer Science & Engineering, Lakshmi Narain College of Technology & Science, Bhopal** for the partial fulfilment of the award of Bachelor of Engineering degree in Computer Science & Engineering during the academic year 2013-17.

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CERTIFICATE OF APPROVAL

This foregoing project work is hereby approved as a creditable study of Engineering carried out and presented in a manner satisfactory to warranty its acceptance as a prerequisite to the degree for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein, but approve the project only for the purpose for which it has been submitted.

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DECLARATION

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ABSTRACT

In the past decade, internet of things (IoT) has been a focus of research. Security and privacy are the key issues for IoT applications, and still face some enormous challenges. In order to facilitate this emerging domain, we in brief review the research progress of IoT, and pay attention to the security. By means of deeply analyzing the security architecture and features, the security requirements are given. On the basis of these, we discuss the research status of key technologies including hardware level security, communicating to the mobile via API's, protecting sensor data, DHCP application, bluetooth module HC-05 and briefly outline the challenges. It basically deals with the security for houses, offices, ATM's with indication about the intruders and generate a triggered call to the owner of the place also with a general feature of holding/controlling all the electronic household appliances which is the basic key point for saving electricity and time as well.

In this model we also present a Home Automation System(HAS) using l.e.d's that employs the wireless communication, to provide the user with remote control of various lights, fans, and appliances within their home and storing the data in the cloud. The system will automatically change on the basis of sensors' data. This system is designed to be low cost and expandable allowing a variety of devices to be controlled. It is meant to save the electric power and human energy. The home automation system differs from other system by allowing the user to operate the system from anywhere around the world through internet connection.

The future advancements for this prototype model will be face-detection with the help of Web-cam and Servo Motor, wherein the system will be machine learned with Supervised learning algorithms as Naive Bayes, n-Clustering for detecting legal member faces. Here the efficiency of the algorithm depends on the type of system used and the factors considered for the detection of face of legal members.

1) INTRODUCTION

“There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.”

1.1 MOTIVATION

In the recent time, we have seen the world getting digitised. So, we also started in the same direction and first thing that came in our mind was ‘How We Can Make Our Home Security System Digitised’. At the same we came to know about an emerging technology called Internet Of Things which gave us a platform to take up our idea to the next level and we came out with this project named ‘SECURE INTERNET OF THINGS’.

The Internet of Things (IoT) is the network of physical objects— devices, vehicles, buildings and other items—embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

British entrepreneur Kevin Ashton coined the term in 1999 while working at Auto-ID Labs (originally called Auto-ID centers, referring to a global network of objects connected to radio-frequency identification, or RFID). Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to user in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to the areas such as smart cities.

We would summarise the basic fundamental problems faced and condense in few points as ;

1. Security must be the foundational enabler for IoT.
2. There is currently no consensus on how to implement security in IoT on the device.
3. A prevalent, and unrealistic, expectation is that it is somehow possible to compress 25 years of security evolution into novel IoT devices.

4. There is no silver bullet that can effectively mitigate the threats.

However, there is some good news; the knowledge and experience are already here, but they have to be adapted to fit the unique constraints of IoT devices. Unfortunately, this is where we as system security developers stumble upon another problem, a hardware problem. U.S. Federal Trade Commission chairwoman, Edith Ramirez, addressed the Consumer Electronics Show in Las Vegas earlier this year, warning that embedding sensors into everyday devices, and letting them record what we do, could pose a massive security risk.

We investigated a selection of always-on consumer IoT devices to understand the security posture of each product. The result: product manufacturers weren't focused enough on security and privacy, as a design priority, putting consumers at risk for an attack or physical intrusion. Our team performed a set of uniform tests across all devices and organized the findings into four different domains: user-facing cloud services, back-end cloud services, mobile application interface, and device debugging interfaces. The results showed that all but one device exhibited vulnerabilities across most categories. It's clear there is a need to perform security reviews of device architecture and accompanying applications to minimize the risk to users.

Further, the study presents results of a threat modeling exercise, discussing the potential impact to users under a number of hypothetical breach scenarios. For example, since the Ubi fails to secure its communications, if attackers were to gain access to eavesdrop on the traffic of Ubi's cloud service – for instance, through a network breach – they would be able to see the full contents of every Ubi user's voice commands and responses, giving the attackers a clear view into the usage patterns of people interacting with devices in their homes and offices.

1.2 SCOPE

Large Application Scope

The IoT has a wide application range depending on the network type, scale, coverage, and user involvement. In fact, many companies have their own vision about the future of the IoT.

Cisco has been calling it the Internet of Everything, while GE CEO Jeff Immelt said that a global network connecting people, data and machines called the Industrial Internet had the potential to add \$10 to \$15 trillion to global GDP in the next 20 years. GE plans to invest

\$1 billion in the "development of industrial internet technology and applications to make customers more productive."

To ensure familiarity rather than foisting IoT on consumers, companies are considering smartening their existing appliances with cheap wireless chips and sensors. For instance, the concept of smart homes where you can control the electronic systems of your house through your smartphone is a good way of making customers familiar with the IoT without overwhelming them with connected sensors and other gadgets. Once the customers becomes a regular user of smart objects, they can come back again for other smart gear.

For example, the AllSeen Alliance, supported by Linux Foundation and a host of other manufacturers like Cisco, Qualcomm, Haier, LG Electronics, D-Link and Sharp is an open source framework that enables connection of home appliances, cars and computers. Originally developed by Qualcomm under the codename AllJoyn, this software framework would allow all kinds of systems to interact with each other regardless of their operating systems and manufacturer.

Personal and home usage

Human implanted RFID sensors can gather data about the human body and use the IoT to upload the data to servers that can be accessed by physicians or by individuals. This would serve elderly patients who can be monitored in their homes thereby reducing hospitalizations. The control of home equipment such as air conditioners, and washing machines is already possible. However constant monitoring, can improve the way electricity is consumed, improving efficiency.

Will the IoT create jobs?

Technology advances are mostly seen as a step back for workers. However, according to the GE report, Industrial Internet will supposedly create new job opportunities. With IoT being a product of Information and Communication Technology, there will be demand for professionals with IT skills such as data scientist's, user interface experts and digital-mechanical engineers.

According to the report, there will also be a marked increment in the technology awareness of workers. Thus, instead of being afraid of the IoT, future workers should prepare themselves to work alongside it.

1.3 OBJECTIVE

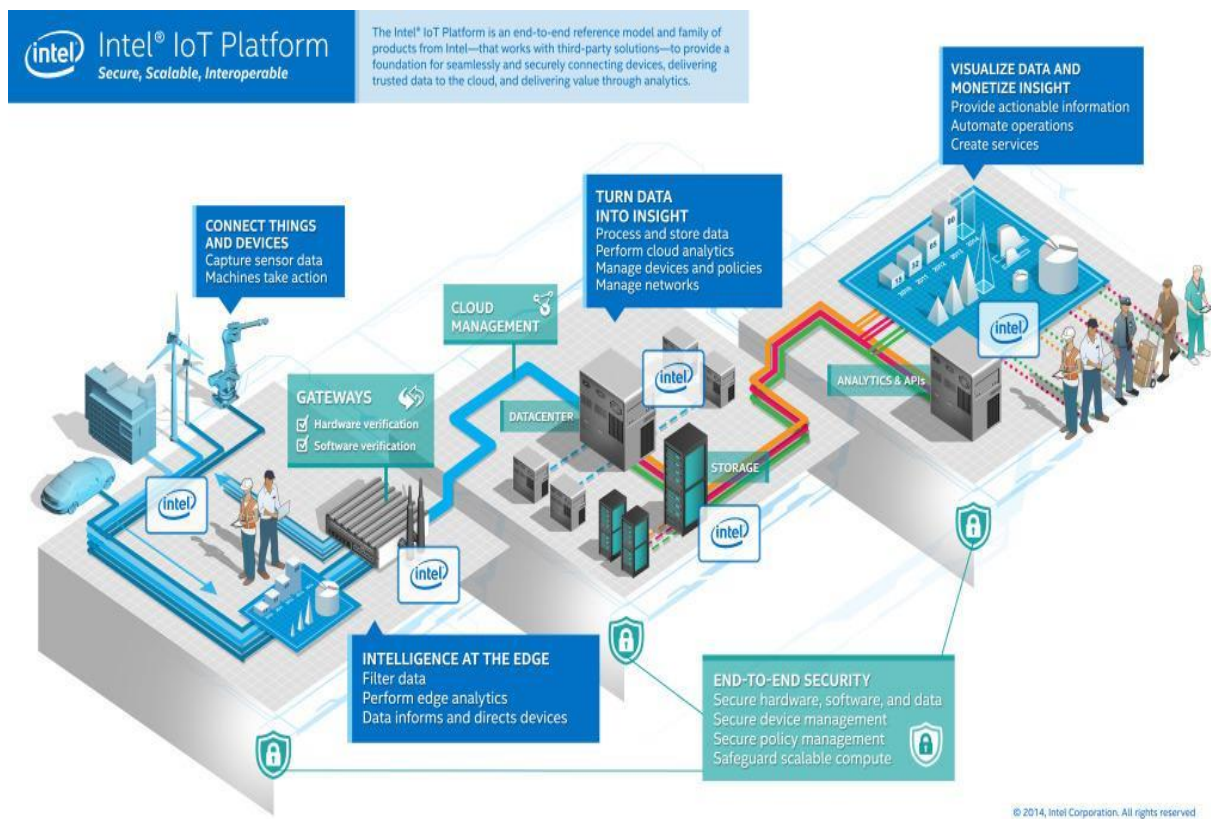
The main objective of this prototype model is security or hardware level security of the place of owner, and as it comes under our areas of interest, we developed a prototype model which can sense the people entering into the house and on the basis of that, it can trigger the call to the owner of the house with a message as per needed by the owner. Also, we had added an extra feature of electricity saving technique, where this chipset is linked with the mobile application for controlling all the high power consumption devices such as AC, Fan, Light, etc. Where, we are using Arduino UNO chip set along with the Ethernet Shield W5100, basic code written in C is embedded into the Arduino chip with device having a IP address and a Mac address for uniquely identifying the device within that network. The proposed home automation system has the capabilities to control the following components in user's home and monitor the following alarms:

- Temperature and humidity
- Motion detection
- Fire and smoke detection
- Light level
- The proposed home automation system can control the following appliance:
- Lights on/off/dim
- Fan on/off
- On/off different appliance

1.4 APPLICATION

- The Internet of Things (IoT) is moving from a centralized structure to a complex network of decentralized smart devices. This shift promises entirely new services and business opportunities. An increasingly connected world will see the growing networking and cloud-enablement of all sorts of physical devices from machines through cars to home appliances. It is even transforming manufacturing as we move towards the fourth “industrial revolution”.

- Infineon has developed a broad range of easy-to-deploy semiconductor technologies to counter growing security threats in the IoT. These solutions enable system and device manufacturers as well as service providers to capitalize on growth opportunities by integrating the right level of security without compromising on the user experience. Complemented by software and supporting services, our hardware-based products create an anchor of trust for security implementations, supporting device integrity checks, authentication and secure key management.



2) LITERATURE SURVEY

2.1 LITERATURE SURVEY

“The more you know about your topic, the more effectively you can tackle your own Research problem. It all starts with the Literature Review.”

- N. Sriskanthan and Tan Karand in their work have presented an application of Bluetooth Technology for Home Automation. The Bluetooth technology which emerged in late 1990's is used for implementing the wireless home automation system. Various appliances such as air conditioners, home theatres, cellular phones etc., are interconnected, thus creating a Personal Area Network in Home Environment. The communication between several client modules and the host server takes place through the Bluetooth module. A Home Automation Protocol has been developed to enhance communication between the host server and the client modules. The system also allows integration or removal of devices to the network which makes the system scalable. The wireless system aims at reducing the cost of Home Automation. But the system does not use the trending mobile technology.
- Franck Greverie, Jerome Buvat, Ashish Bisht, Roopa Nambiar, Didier Appell had a survey which was conducted in November 2014 and covered more than 100 industry executives involved in the development of IoT products. Survey respondents came from a range of industry segments, including Wearables, Medical Devices, Automotive, Home Automation, Smart Metering, and Industrial Manufacturing. The survey focused on gathering opinions on the following areas – the current levels of security in IoT products, key challenges that organizations face in securing their IoT products, and the approach to securing IoT products.
- Shahriyar, E. Hoque, M. M. Akbar, S. Sohan, I. Naim, and M. K. Khan presented a GSM based communication and control for home appliances. Different AT

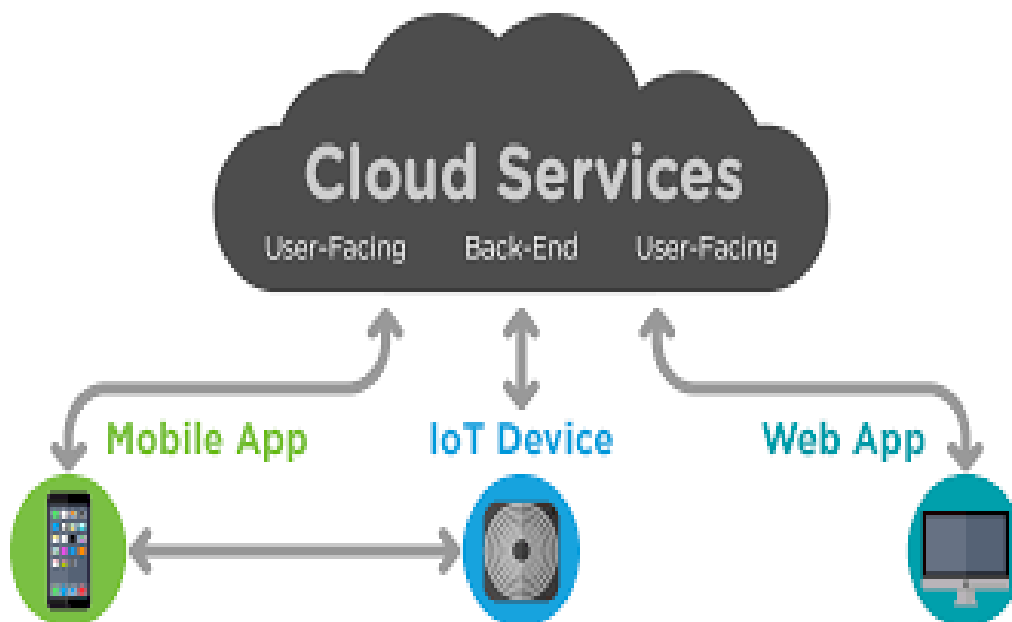
commands are sent to the Home Mobile for controlling different appliances. The drawback of this system is that a Graphical User Interface (GUI) is not provided to the user. Different AT commands have to be remembered by the users to control the connected devices. Also, the system supports Java enabled mobile phones. The system thus becomes less functional as nowadays the use of Java enabled phones are reducing and the use of Android phones are increasing tremendously.

- Deepali Javale, Shreerang Nandanwar, Mohd. Mohsin and M. Shingate have used Android ADK for implementing a home automation and security system. It presents a system in which the devices are connected to a Bluetooth subcontroller physically. It does not require internet connectivity. The Smartphone is used to access and control the devices using built-in Bluetooth connectivity. Communication is established between the android mobile device and the ADK, by connecting the appliances to the ADK. However, the system restricts mobility and can only be controlled within the specified boundary due to limited range of operation.
- Chen Qiang, Guang-ri Quan, Bai Yu and Liu Yang -There are many problems in security of Internet of Things (IOT) crying out for solutions, such as RFID tag security, wireless security, network transmission security, privacy protection, information processing security. This article is based on the existing researches of network security technology. And it provides a new approach for researchers in certain IOT application and design, through analyzing and summarizing the security of ITO from various angles.
- Tuhin Borgohain, Uday Kumar, Sugata Sanyal performed a general survey of all the security issues existing in the Internet of Things (IoT) along with an analysis of the privacy issues that an end-user may face as a consequence of the spread of IoT. The majority of the survey is focused on the security loopholes arising out of the information exchange technologies used in Internet of Things. No countermeasure to the security drawbacks has been analyzed in the paper.

2.2 CONCLUSION

After all the survey we came across to conclude various key points with some major factors keeping in mind as *time, money, implementation, scope, etc ;*

- How to make our existing technology more useful and easy to use ?
- How can we secure in hardware level as well as software level ?
- How can we connect our working model to cloud ?
- What possible features can be implemented in h/w Security ?
- Mobiles can be connected to gather information from various electronic appliances, if yes ! How ?
- What API's are to be implemented in linking mobile > model > Cloud ?



3) **PROBLEM STATEMENT**

“Problems are not stop signs, they are guidelines.”

Here are some of the problems which were been faced during the survey research of the making of model, defined as follows ;

Secure from any kind of Intruders : One of the more frightening and potentially dangerous crimes that can occur to a family is a home invasion robbery. A home invasion is when robbers force their way into an occupied home, apartment or hotel room to commit a robbery or other crimes. It is particularly frightening because it violates our private space and the one place that we think of as our sanctuary.

Home invasion is like the residential form of an automobile carjacking and it's on the rise. Like the crime of carjacking, most police agencies don't track home invasions as a separate crime. Most police agencies and the FBI will statistically record the crime as a residential burglary or a robbery. Without the ability to track the specific crime of home invasion, little can be done to alert the public as to the frequency of occurrence in their community or devise a law enforcement plan of action to control it.

To make everything digitize so as to control everything from a single place : Home automation devices typically don't solve any problems by itself, because most of them are usually single purpose devices. However, when it comes to a home automation system that connects different devices and processes the data from each one, it's a different story.

Just having smart devices installed does not necessarily mean you've got a smart home. It's what you do with this system, what you teach and program it to do and it takes some efforts and creative thinking to get good results. Ability to use your cell phone to view camera footage, unlock your door or turn lights on/off are just some basic connected home features. Teaching your home to react and adjust based on your preference is where the true potential is.

To save electricity and time via IOT : Other than controlling other IoT devices, your smartphone will also be much like a remote control for your life, said Brendan Richardson,

co-founder and chief executive officer of PsiKick, a Charlottesville, Va.-based startup that develops IoT wireless sensors.

One of the most convenient aspects of IoT is that you have devices that "know" you and will help save time by allowing you to get in and out of places and conduct transactions faster using a mobile device.

"The iPhone or Android will increasingly interact with a whole range of sensors that you never see and don't own, but which provide your smartphone with valuable information and act on your behalf through an app," Richardson said.

To make use of house-hold things more productively by connecting it to internet : IoT is the next big thing in your daily commute. The interconnectivity of mobile devices, cars and the road you drive on will help reduce travel time, thus enabling you get to work faster or run errands in record time. Today, the "connected car" is just the start of IoT capability. "AT&T, together with automotive manufacturers such as GM and BMW, are adding LTE connectivity to the car and creating new connected services, such as real-time traffic information and real-time diagnostics for the front seat and infotainment for those in the back seat," said Macario Namie, vice president of marketing at Jasper Wireless, a machine-to-machine (M2M) platform provider.

Know where everything is, all the time : "IoT has the potential to make the workplace life and business processes much more productive and efficient," Cronin said. One significant way IoT will increase productivity and efficiency is by making location tracking much simpler and seamless. As currently done in hospitals, Internet-connected equipment and devices will all be geographically tagged, which will save workers time hunting things down and save money by reducing the loss rate. "Companies can track every aspect of their business, from managing inventory and fulfilling orders as quickly as possible to locating and deploying field service staff. Tools and factories and vehicles will all be connected and reporting their locations," Cronin said.

You may actually have to work harder : IoT may make workers' lives easier on many levels, but Richardson said IoT also means big changes in every industry.

"Every business and every industry will be disrupted over the next 30 years," Richardson said. "We're seeing this now beginning with the regular old Internet. It's being driven by data and large-scale efficiencies when you convert something to bits rather than atoms."

Richardson cited the evolution of movie rentals as an example.

"Netflix more or less destroyed Blockbuster by using the Internet to vastly improve the logistics of exchanging DVDs and removing pesky late fees. Then they converted the atoms of a DVD into bits and deliver 80 percent of their movies over broadband now. [You get] more movies on-demand and lower costs. And an entire industry — the DVD rental business — is consigned to the archive of history."

Richardson said such disruptions will happen in every industry, so companies and their employees have to be prepared.

HARDWARE & SOFTWARE REQUIREMENTS

ARDUINO UNO :

- ★ Arduino is an open-source prototyping platform based on hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.
- ★ The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.
- ★ It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.
- ★ "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the ;

★ **Arduino Programming Language :**

Arduino programs can be divided in three main parts: structure, values (variables and constants), and functions.

Void : The void keyword is used only in function declarations. It indicates that the function is expected to return no information to the function from which it was called.

```
// actions are performed in the functions "setup" and "loop"  
// but no information is reported to the larger program
```

```
void setup()  
{  
  // ...  
}
```

```
void loop()  
{  
  // ...  
}
```

Setup() : The setup() function is called when a sketch starts. Use it to initialize variables, pin modes, start using libraries, etc. The setup function will only run once, after each powerup or reset of the Arduino board.

```
int buttonPin = 3;
```

```
void setup()  
{  
  Serial.begin(9600);  
  pinMode(buttonPin, INPUT);  
}
```

```
void loop()  
{  
  // ...  
}
```

Loop() : After creating a setup() function, which initializes and sets the initial values, the loop() function does precisely what its name suggests, and loops consecutively,

allowing your program to change and respond. Use it to actively control the Arduino board.

```
const int buttonPin = 3;
// setup initializes serial and the button pin
void setup()
{
  Serial.begin(9600);
  pinMode(buttonPin, INPUT);
}
// loop checks the button pin each time,
// and will send serial if it is pressed
void loop()
{
  if (digitalRead(buttonPin) == HIGH)
    Serial.write('H');
  else
    Serial.write('L');
  delay(1000);
}
```

★ **Arduino Software (IDE) :**

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the

configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

NB: Versions of the Arduino Software (IDE) prior to 1.0 saved sketches with the extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

ETHERNET SHIELD W5100 : The Arduino Ethernet Shield allows an Arduino board to connect to the internet. Provides a network (IP) stack capable of both TCP and UDP. Use the Ethernet library to write sketches which connect to the internet using the shield. The Arduino Ethernet Shield allows an Arduino board to connect to the internet. It is based on the Wiznet W5100 ethernet chip (datasheet). The Wiznet W5100 provides a network (IP) stack capable of both TCP and UDP. It supports up to four simultaneous socket connections. Use the Ethernet library to write sketches which connect to the internet using the shield. The ethernet shield connects to an Arduino board using long wire-wrap headers which extend through the shield. This keeps the pin layout intact and allows another shield to be stacked on top.

The most recent revision of the board exposes the 1.0 pinout on rev 3 of the Arduino UNO board. The Ethernet Shield has a standard RJ-45 connection, with an integrated line transformer and Power over Ethernet enabled. There is an onboard micro-SD card slot, which can be used to store files for serving over the network. It is compatible with all the Arduino/Genuino boards. The on-board micro SD card reader is accessible through the SD Library. When working with this library, SS is on Pin 4. The original revision of the shield contained a full-size SD card slot; this is not supported. The shield also includes a reset controller, to ensure that the W5100 Ethernet module is properly reset on power-up.

INFRARED SENSOR (IR) : A passive infrared sensor is an electronic sensor that detect infrared radiations radiating from objects in its field of view. An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared

emission pattern, and thus moving them with respect to the background may trigger the detector as well.

LIGHT EMITTING DIODE (LED) : It is a two-lead semiconductor diode used for this prototype model. It is a pn-junction diode which emits light when is activated. For this project we have used RGB colors.

JUMPER WIRES :

A jump wire, is a short electrical wire with a solid tip at each end (or sometimes without them, simply "tinned"), which is normally used to interconnect the components in a breadboard. PE: among others, they are used to transfer electrical signals from anywhere on the breadboard to the input/output pins of a microcontroller. Three types of Jumper Wires are used;

- Male to Male
- Male to Female
- Female to Female

BLUETOOTH MODULE (HC-05) : High performance classic Bluetooth Low Energy module for data and audio applications for shorter range wireless connectivity. So, we have six (or four) leads in this module. But we will genuinely care about only four of them. Where, the two are for Vcc and GND.

Vcc = Power Supply (in other words 5V or 3.3V)

GND = Ground (in other words 0 volt)

And the next two leads are for RX (Receiving End) and TX (Transmitting End). From the basic idea, we can say the RX of the module will go to the TX of the Arduino UNO. In the same way, we connect the TX of the module with the RX of the Arduino UNO.

METHODOLOGY

PROCEDURE

Components Required :

- Arduino Board
 - Genuino UNO
- Bluetooth Module
 - HC-05
- Breadboard / Circuit Board
- Ethernet Shield
 - W5100
- Resistors
 - 1 kilo ohm
 - 2 kilo ohm
- LED's
 - Red
 - Green
 - Yellow
- IRSensor
 - PIR Sensor - Full Module
- USB Cable
 - Arduino - USB Cable
 - Mobile - USB Cable
- Ethernet Cable / LAN Cable

- Jumper Wire
 - Male - Male
 - Male - Female
 - Female - Female

Steps to Follow :

- 1) Mount Ethernet Shield on Arduino UNO Properly.
- 2) Connect LAN Cable with Ethernet Shield & Laptop/Router.
With a voltage supply and ethernet cable (LAN cable) for its unique MAC address in its field of network.
- 3) Connect Vout of IR Sensor to Pin 2 on Arduino Ethernet Shield.
- 4) Connect GND of IR Sensor to GND on Arduino Ethernet Shield.
- 5) Connect Vcc of IR Sensor to 5V on Arduino Ethernet Shield.
IR sensor working as an input for the system.
- 6) Connect +ve of LED on Pin 8 on –ve of LED on GND on Arduino Ethernet Shield.
yellow LED on ethernet is an output trigger to the Caller domain subscribed.
- 7) Connect -ve of Red LED on C9 & +ve on C10.
- 8) Connect -ve of Yellow LED on C14 & +ve on C15.
- 9) Connect -ve of Green LED on C19 & +ve on C20.
- 10) Connect a jumper wire between –ve Terminal of Bread Board (GND) & A9.
- 11) Connect a jumper wire between –ve Terminal of Bread Board (GND) & A14.

- 12) Connect a jumper wire between –ve Terminal of Bread Board (GND) & A19.
- 13) Connect a Jumper Wire from Arduino GND to Breadboard –ve (GND) Terminal Strip.
- 14) Connect a jumper wire between Arduino PIN 13 & D10.
- 15) Connect a jumper wire between Arduino PIN 12 & D15.
- 16) Connect a jumper wire between Arduino PIN 11 & D20.
- 17) Mount the HC-05 Bluetooth Module between J25 to J30 wherein STATE Pin on J25 & EN Pin on J30.
- 18) Connect a 2K Ohm resistor between I26 and I28.
- 19) Connect a 1K Ohm resistor between H26 & D 26.
- 20) Connect a Jumper Wire between (GND) of Arduino to H28 of Breadboard.
- 21) Connect a Jumper between G27 to Rx (Pin 0) on Arduino.
- 22) Connect a Jumper between C26 to Tx (Pin 1) on Arduino.
- 23) Connect a Jumper Wire between G29 to +ve terminal of Breadboard.
- 24) Connect a jumper between +ve terminal of breadboard to 5v of Arduino
- 25) Create your account on Nemboo.com to get API Key & Secret Key.
- 26) Create your account on Temboo.com.
- 27) Go to Library on Temboo Site then Click on Nexmo Voice Text to Speech.

By using the Google's Text-to- Speech API, we had linked an Android application in our mobile with bluetooth module.

28) Fill the required details on Screen and copy the code to Download in the Arduino.

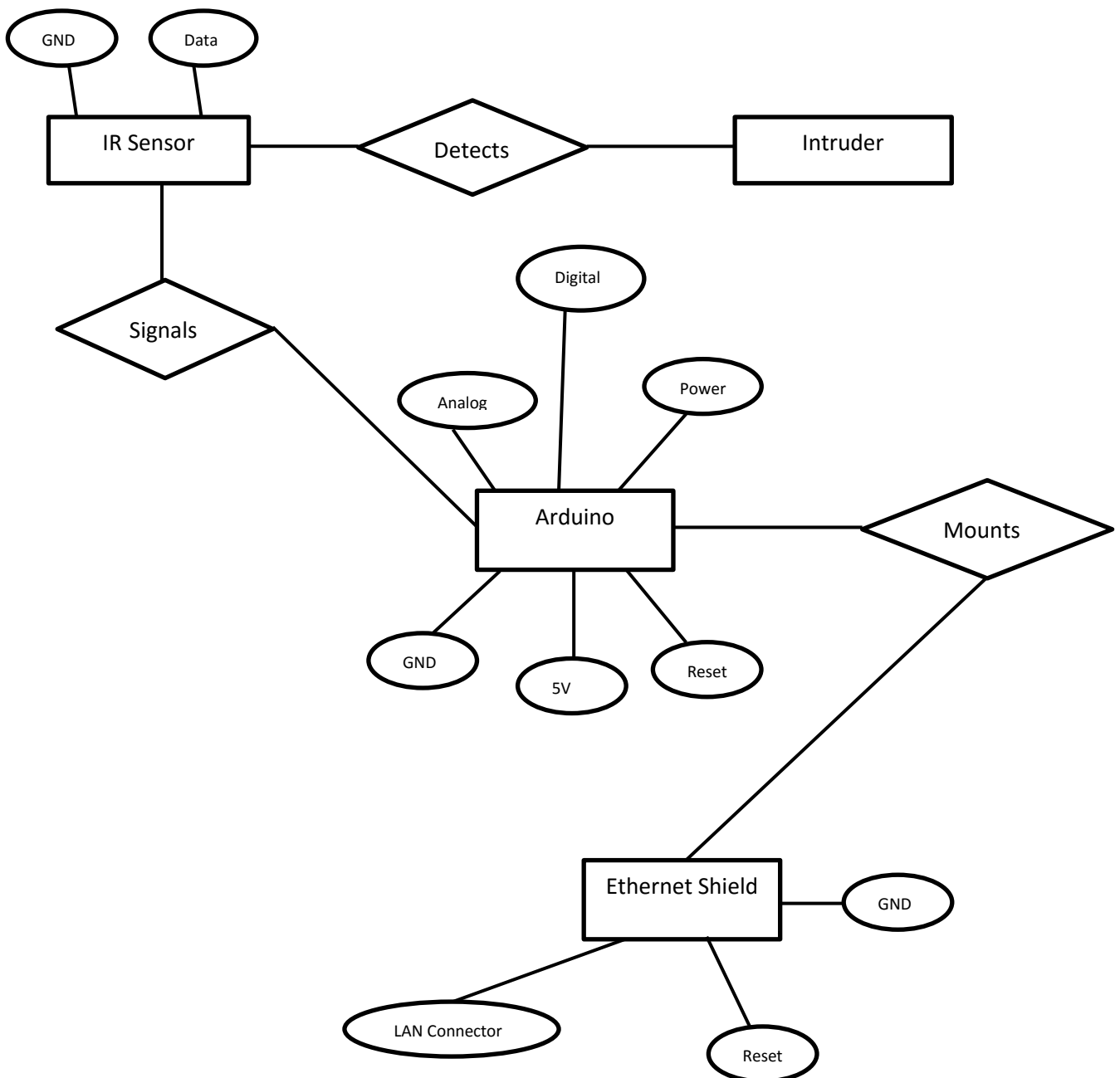
29) Connect the USB Cable with Arduino & Laptop.

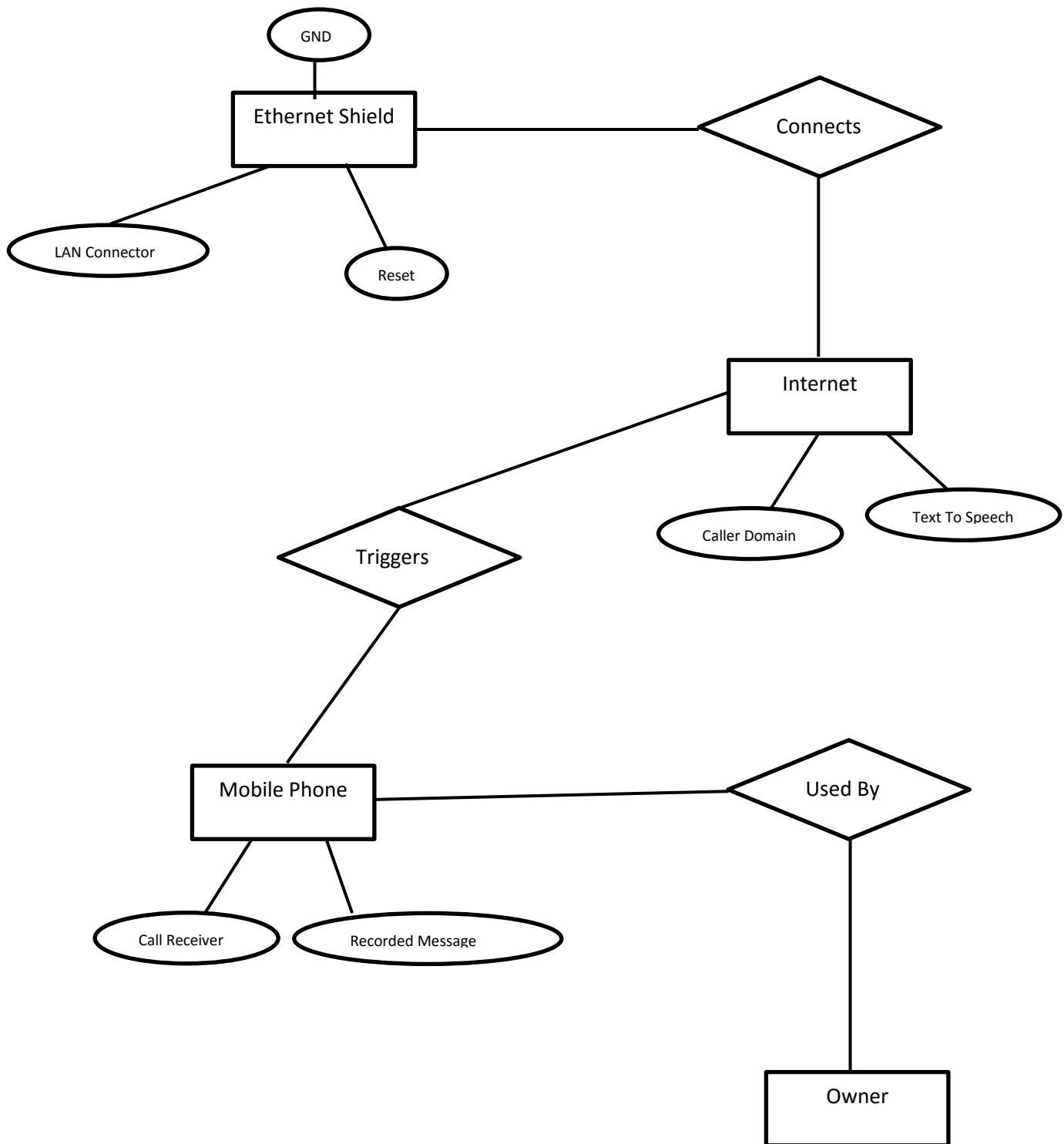
30) Upload the Program in Arduino.

DESIGN FRAMEWORK

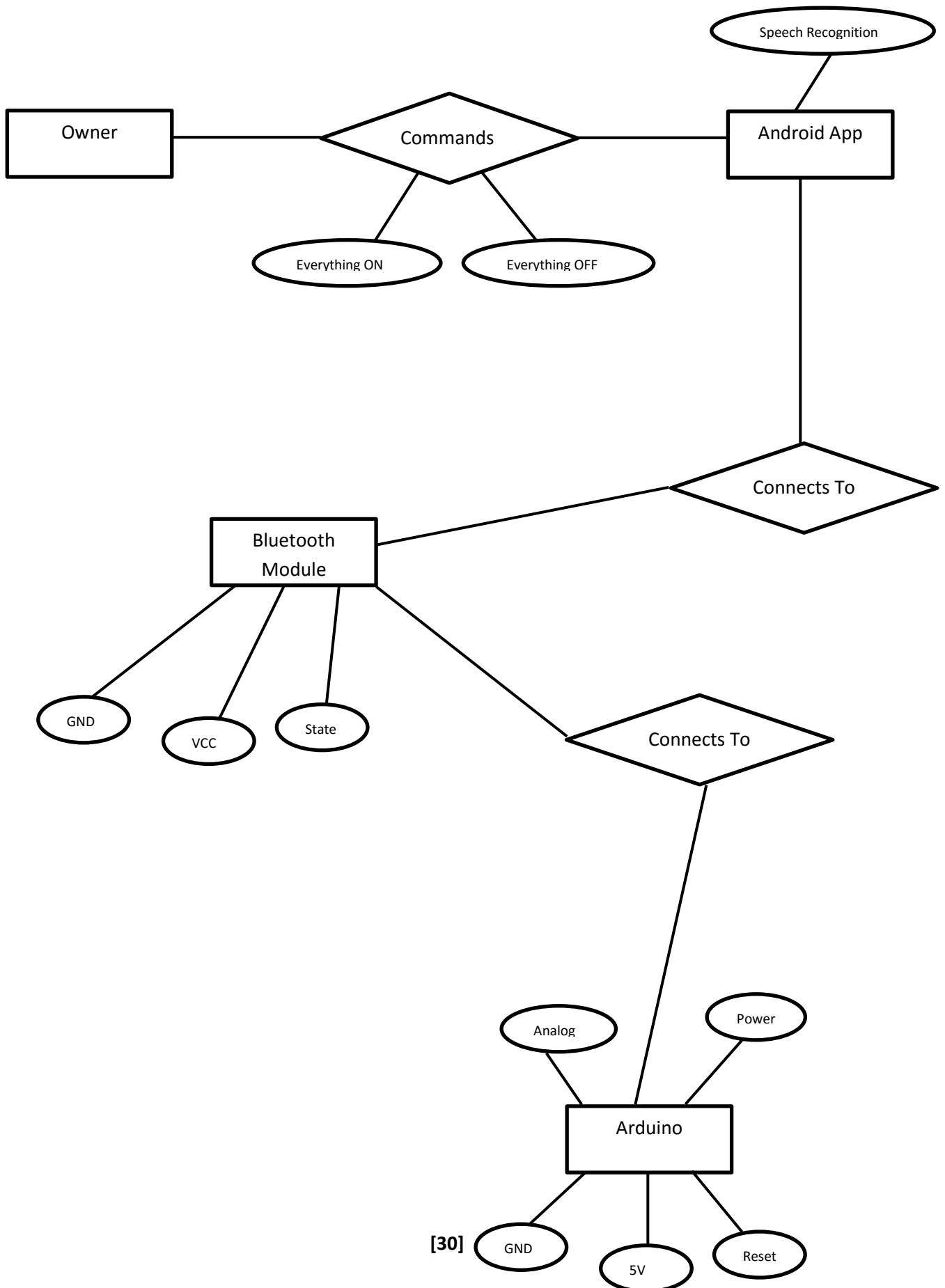
6.1 E-R DIAGRAM

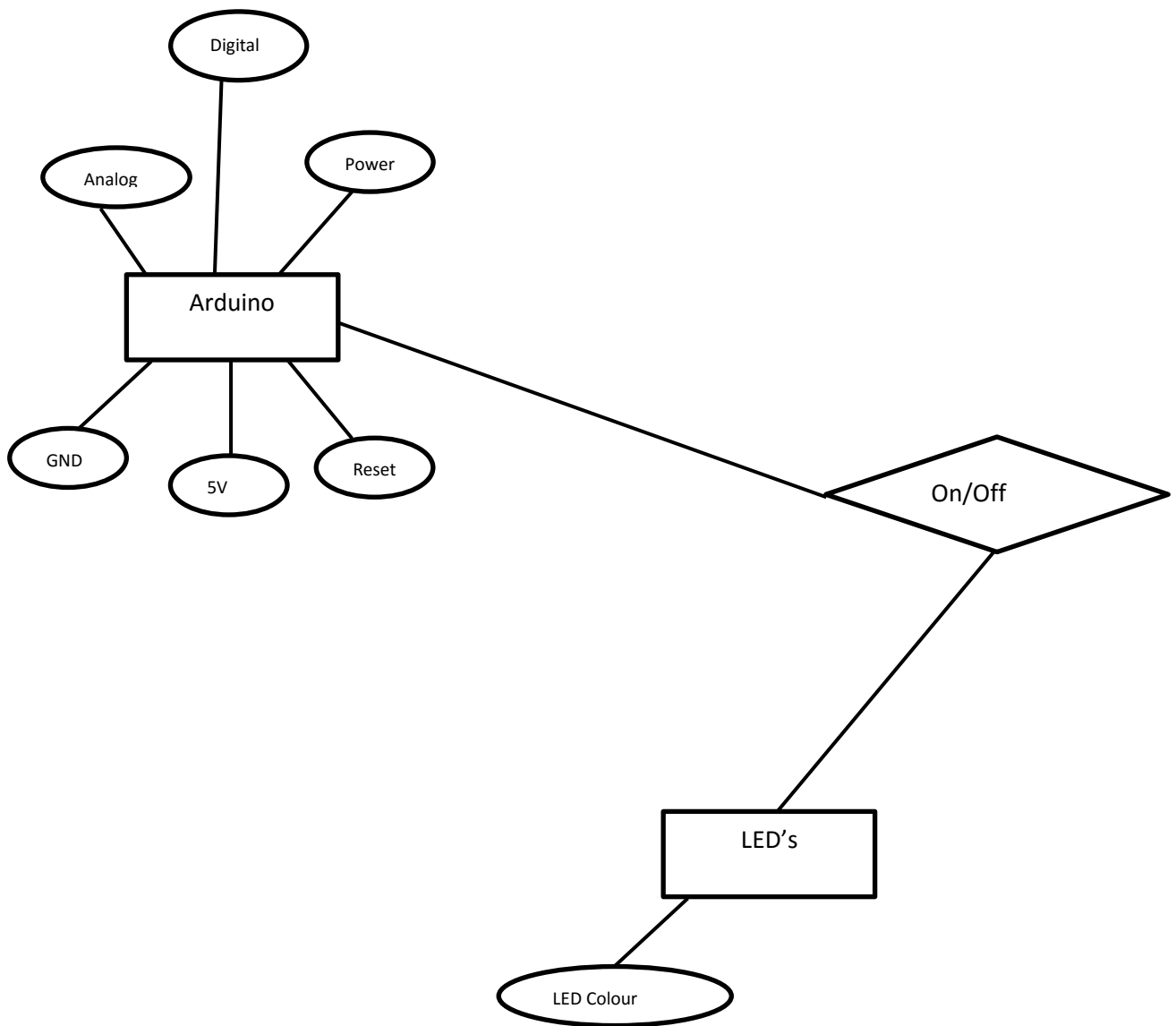
- E-R Diagram For Home Security System





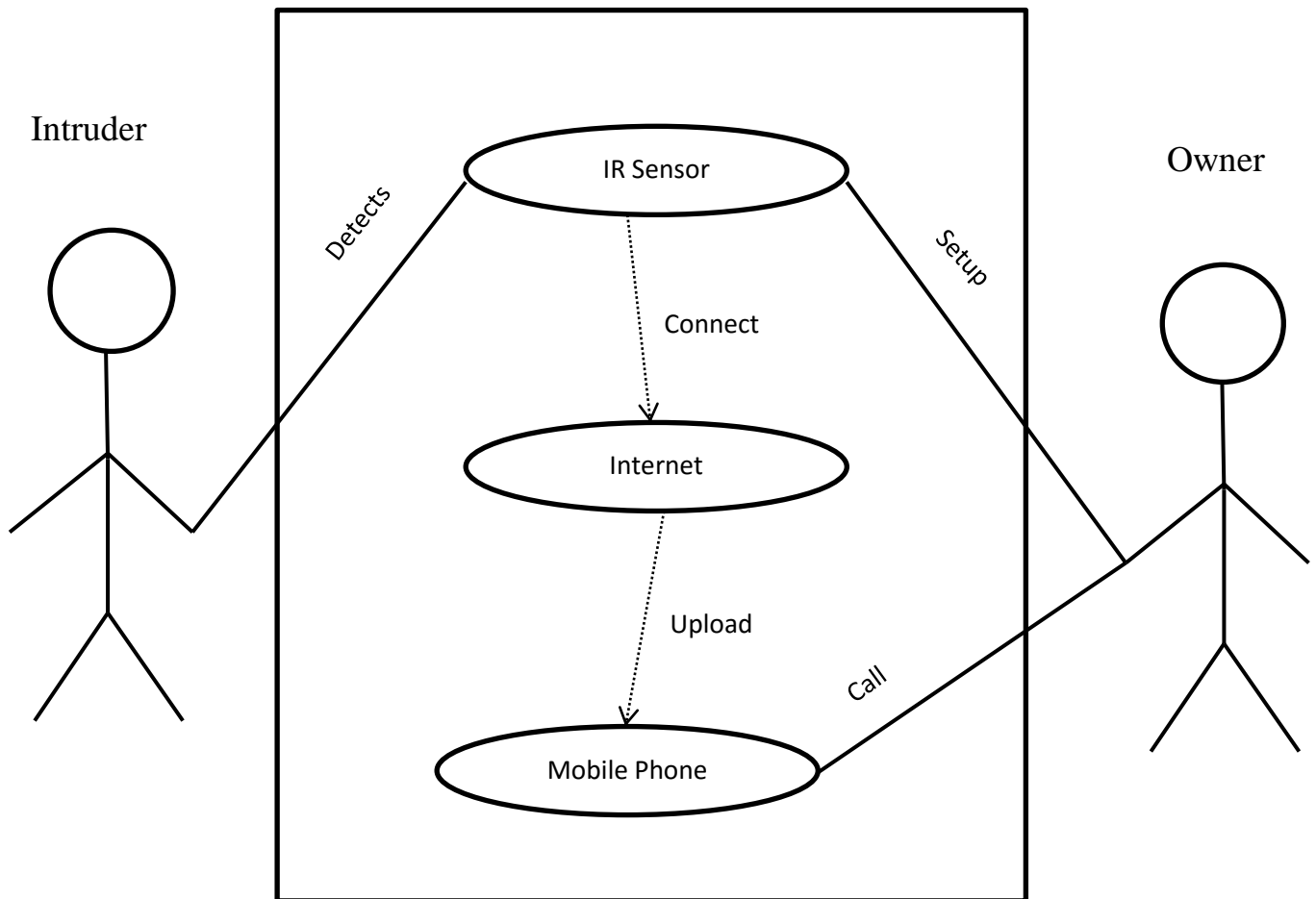
- **E-R Diagram For Home Automation System**



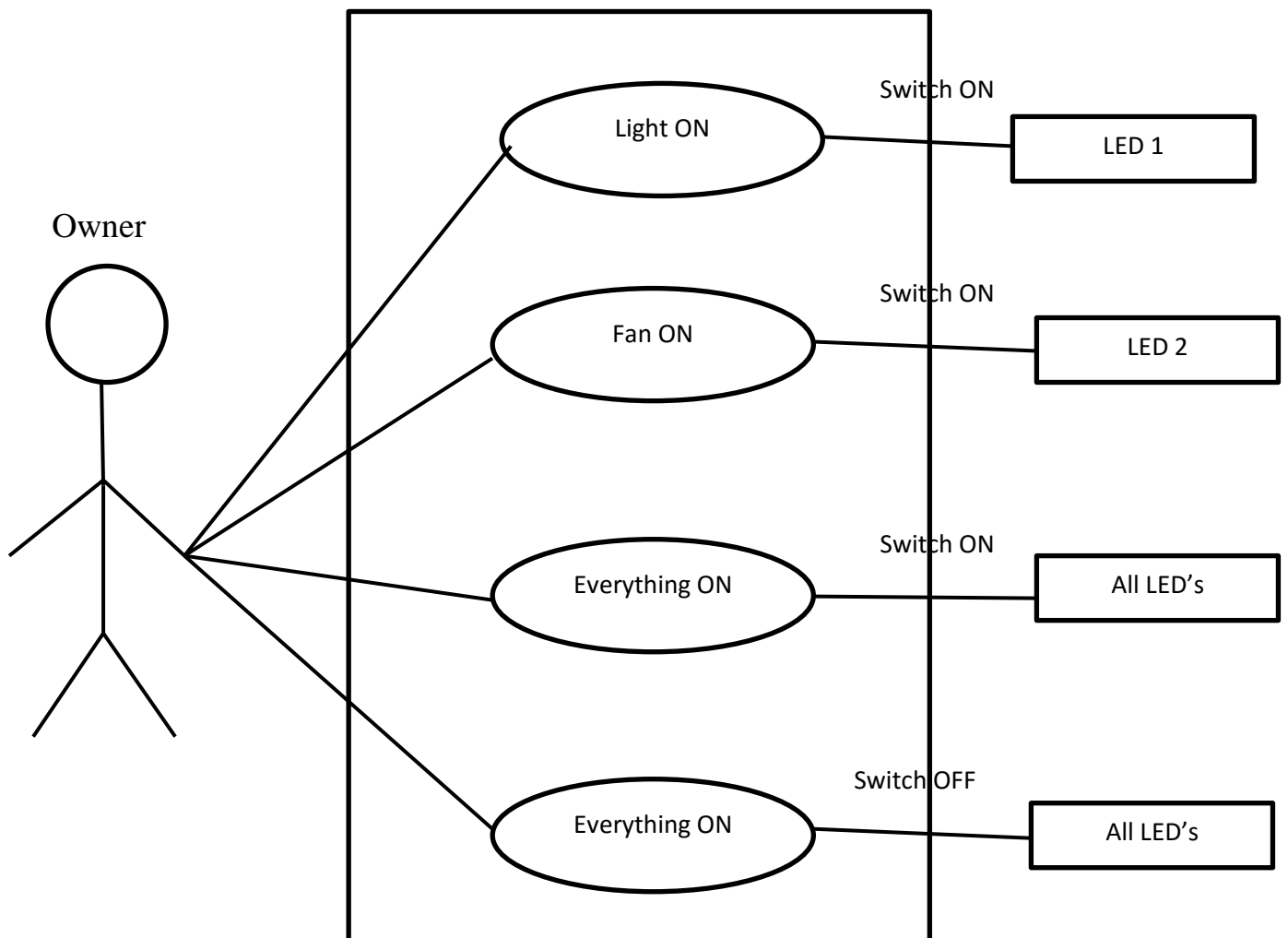


6.2 USE CASE DIAGRAM

- Use Case Diagram For Home Security System

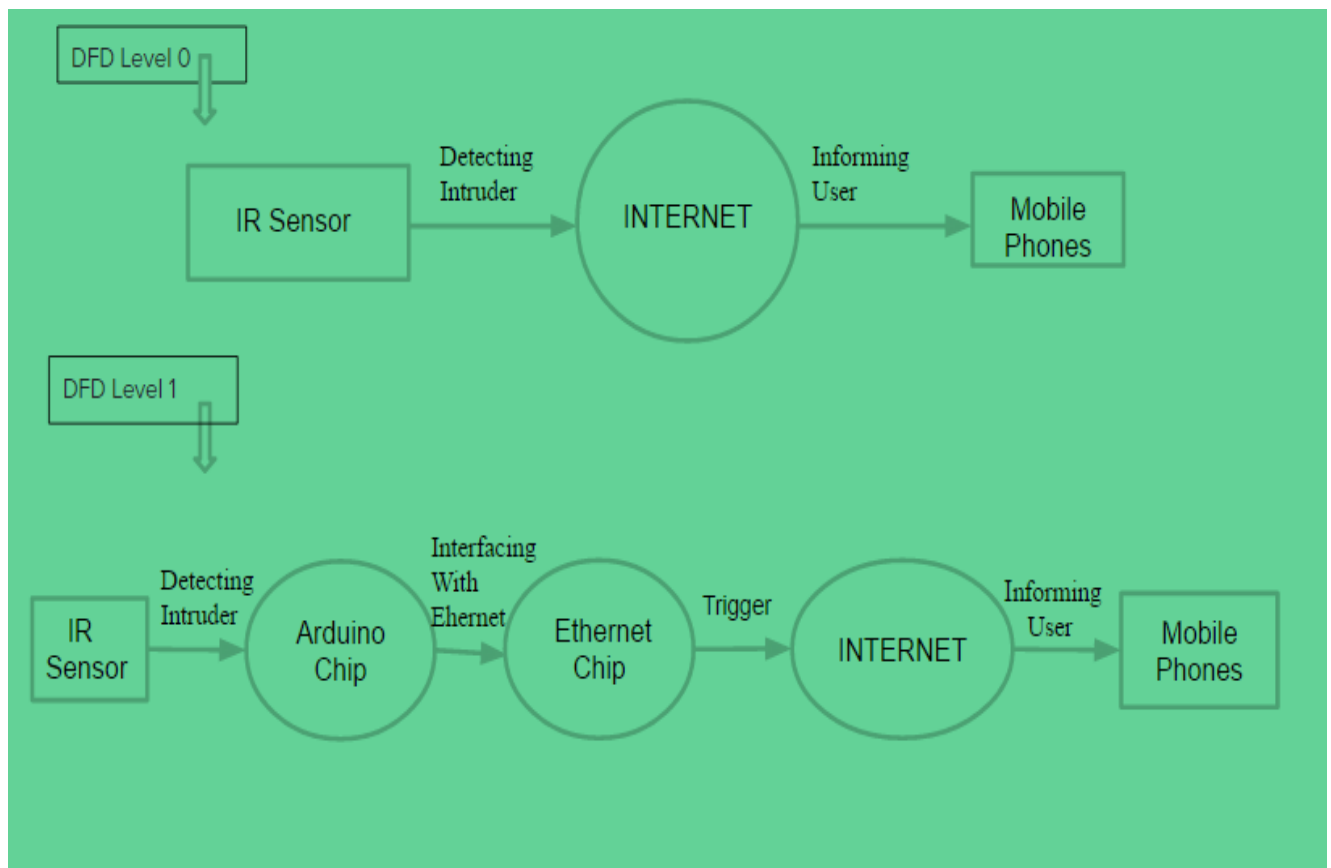


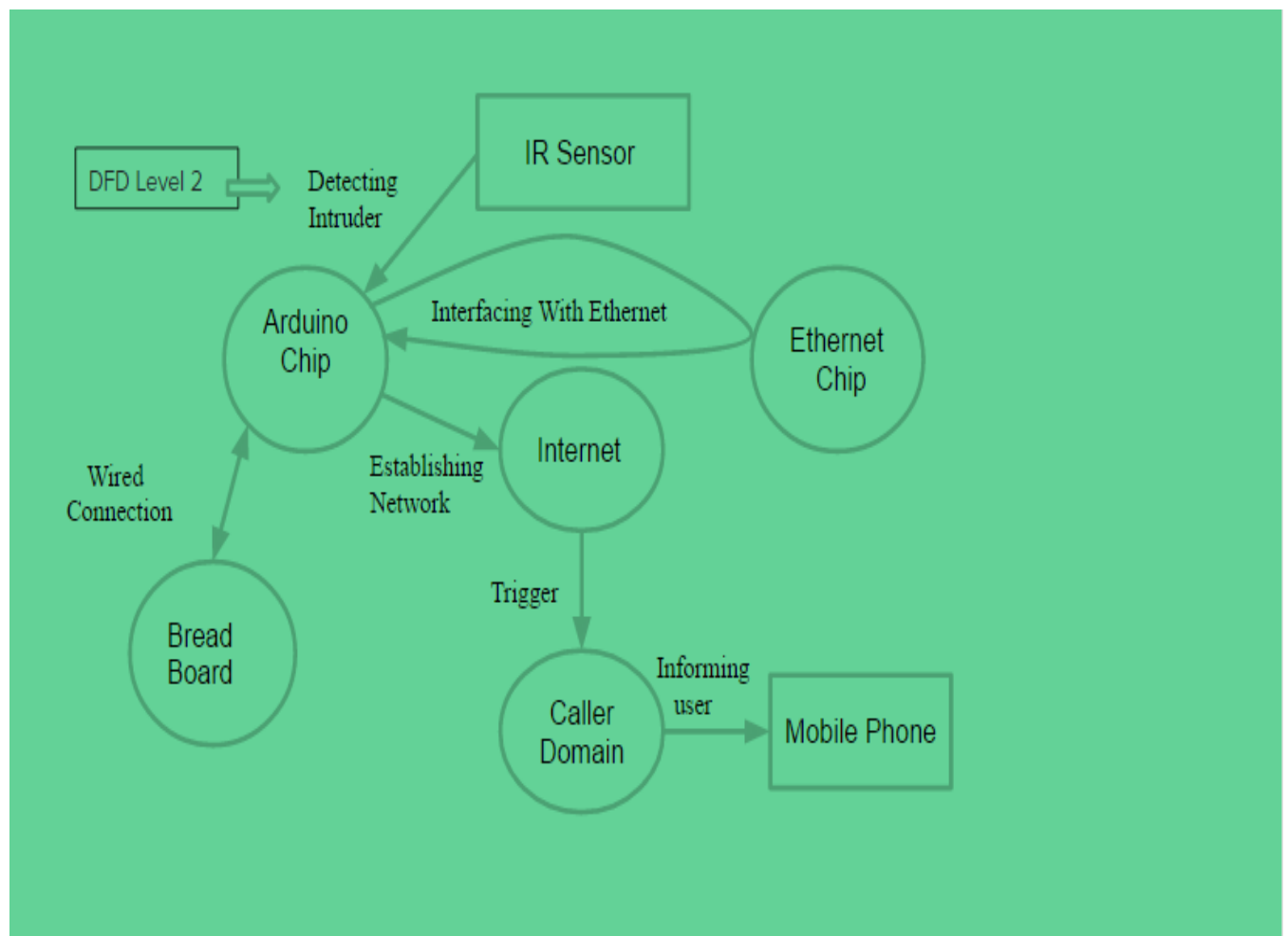
- Use Case Diagram For Home Automation System



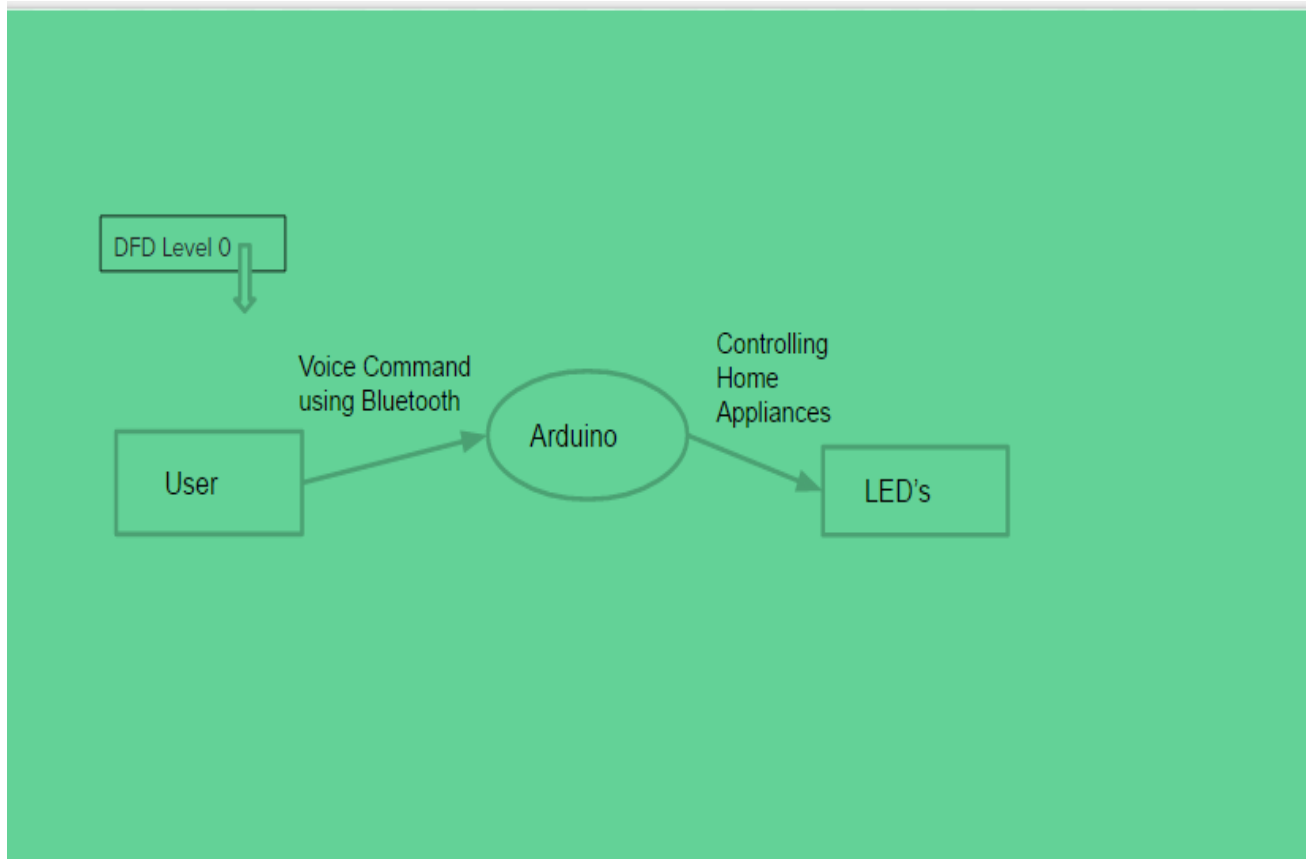
6.3 DATA FLOW DIAGRAM

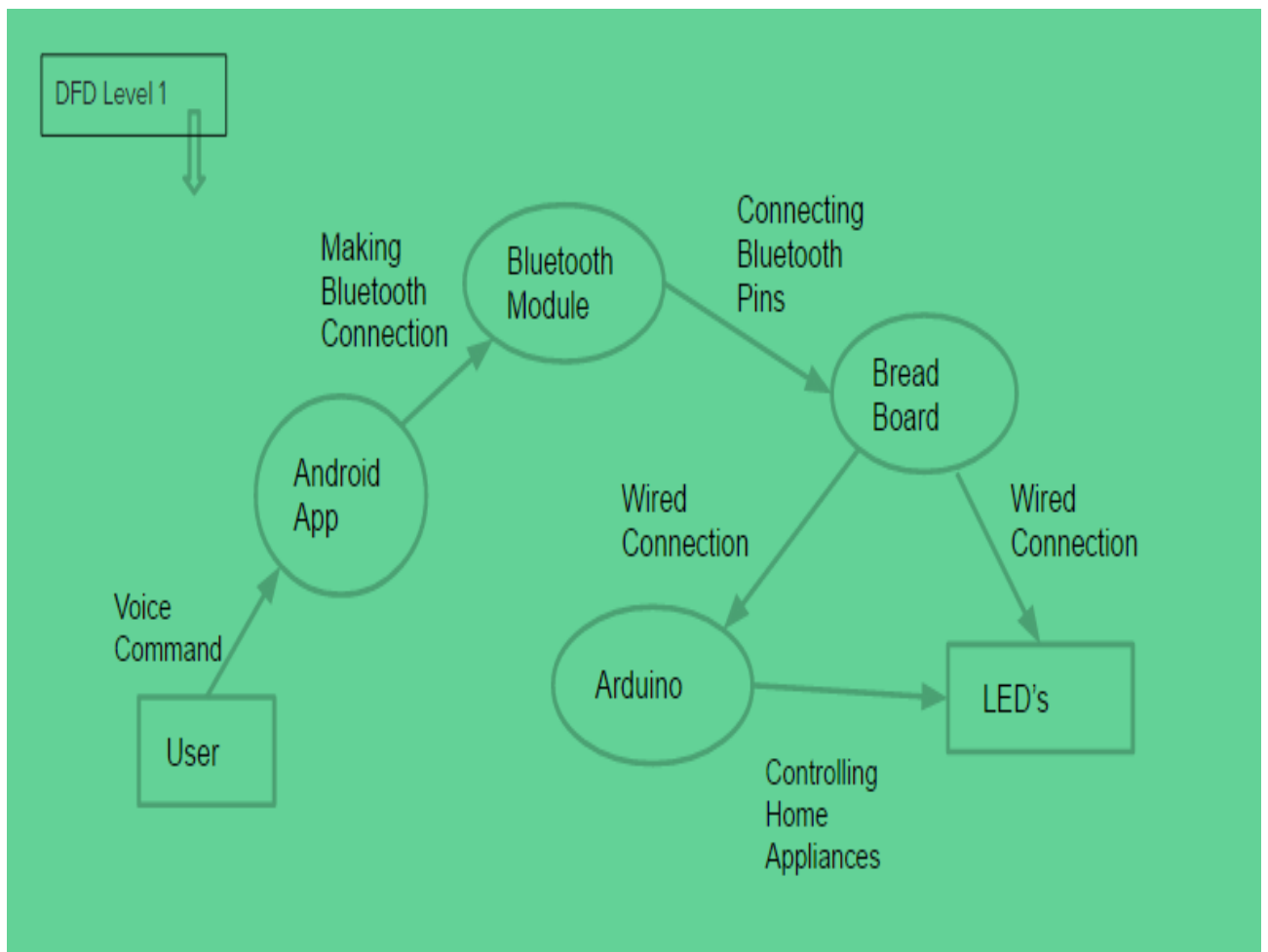
- DFD For Home Security System





- **DFD For Home Automation System**

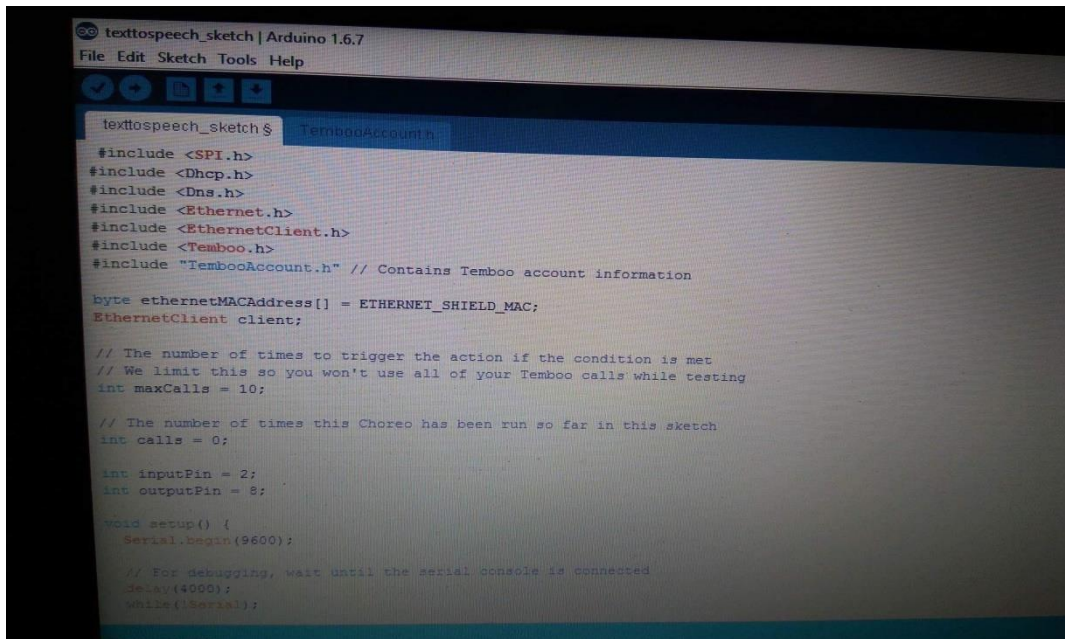




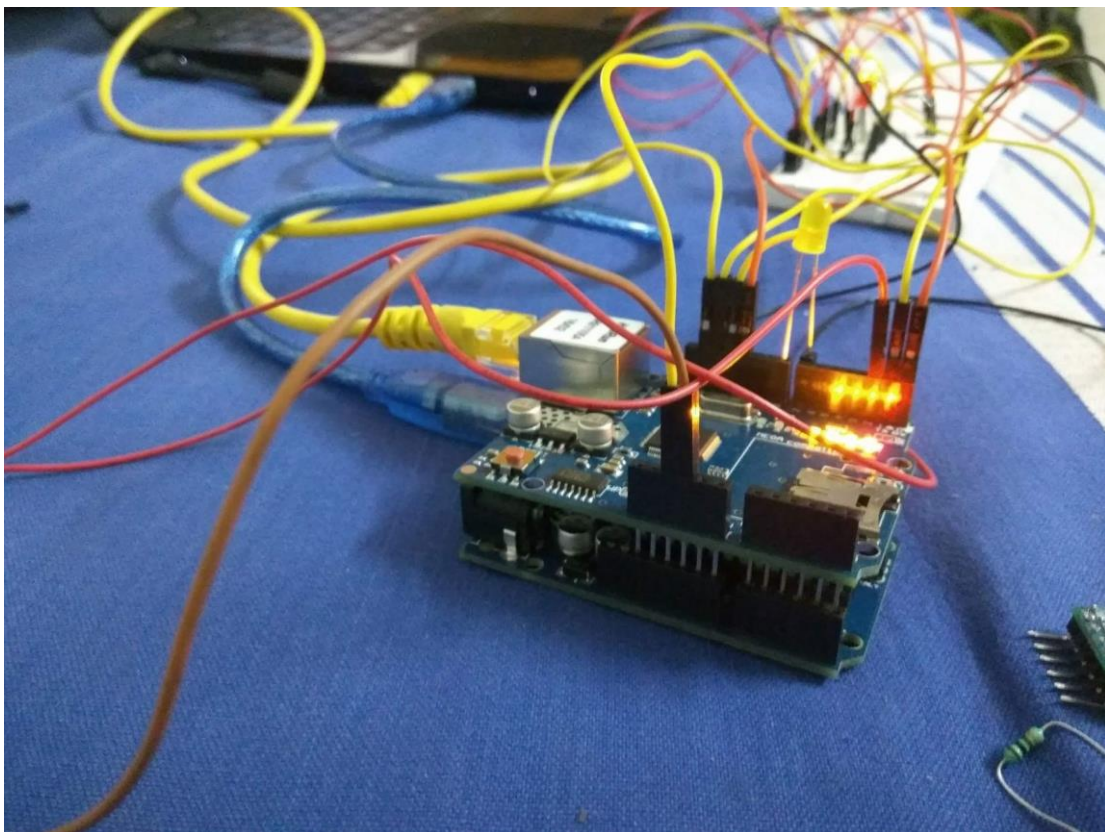
IMPLEMENTATION

7.1 SNAPSHOTS

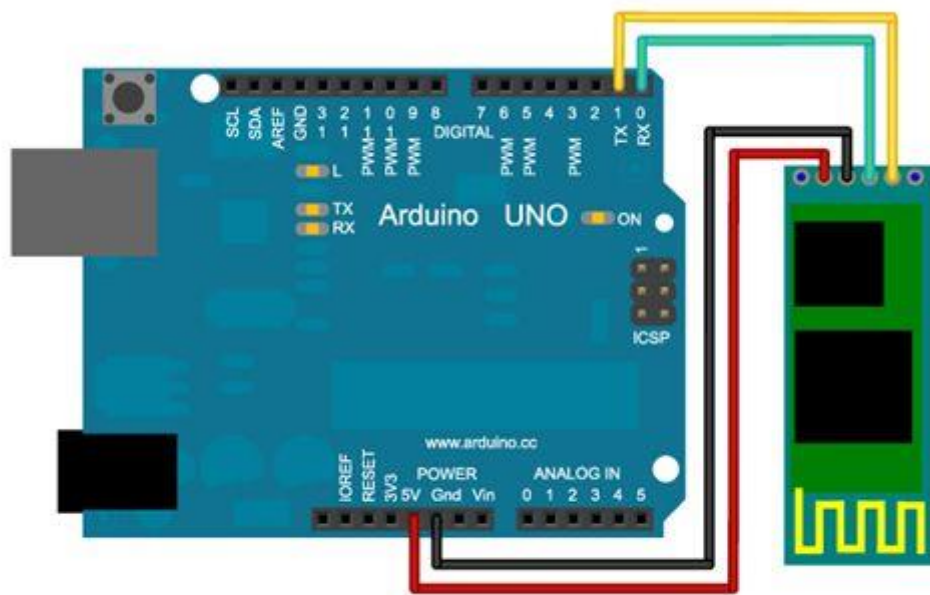
Arduino IDE



Arduino Uno (I.)

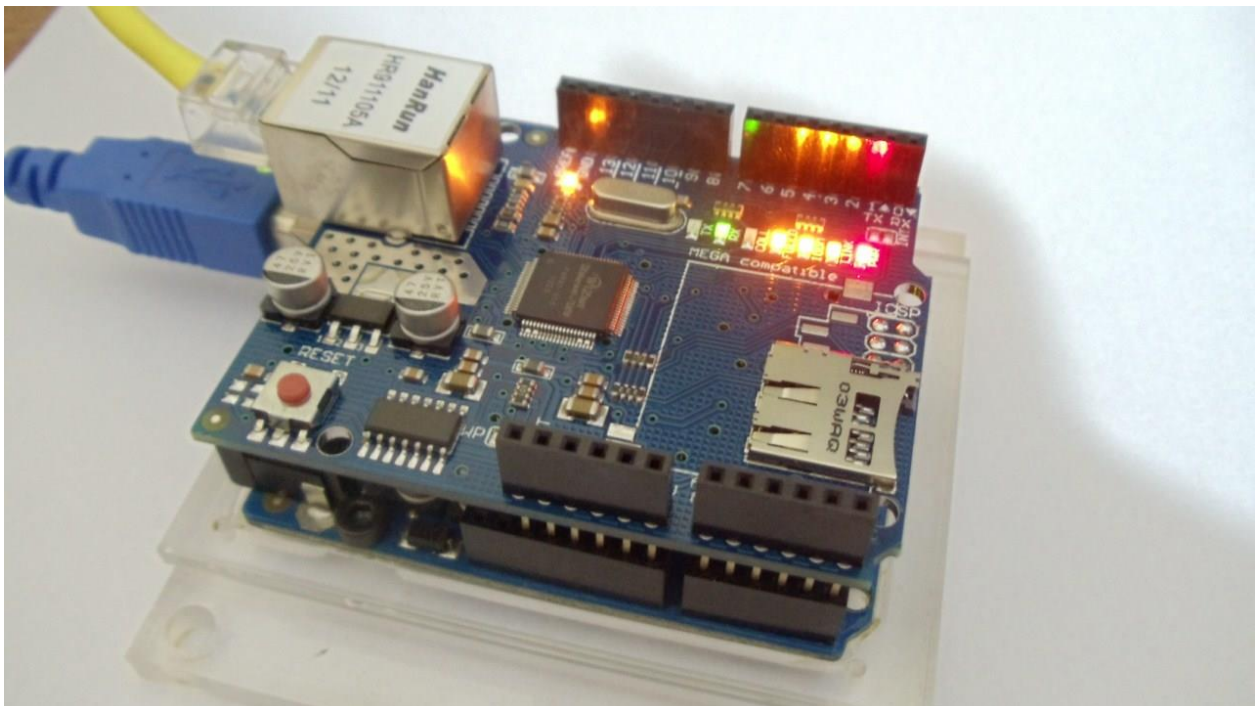


Bluetooth Module (I.)

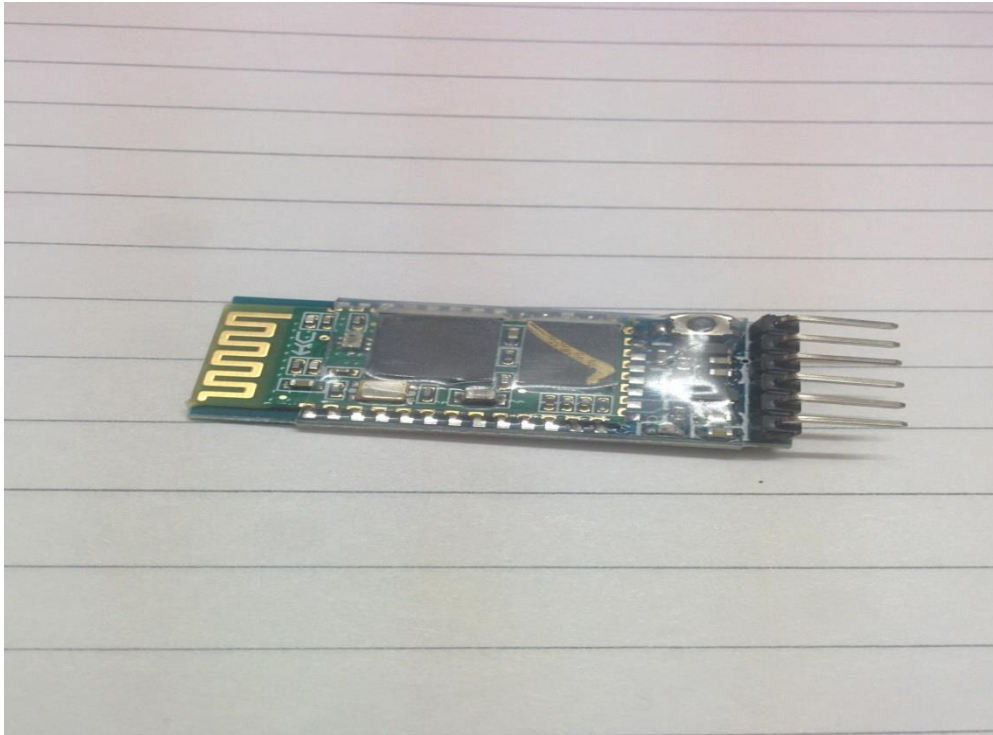


Made with  Fritzing.org

Ethernet Shield W5100



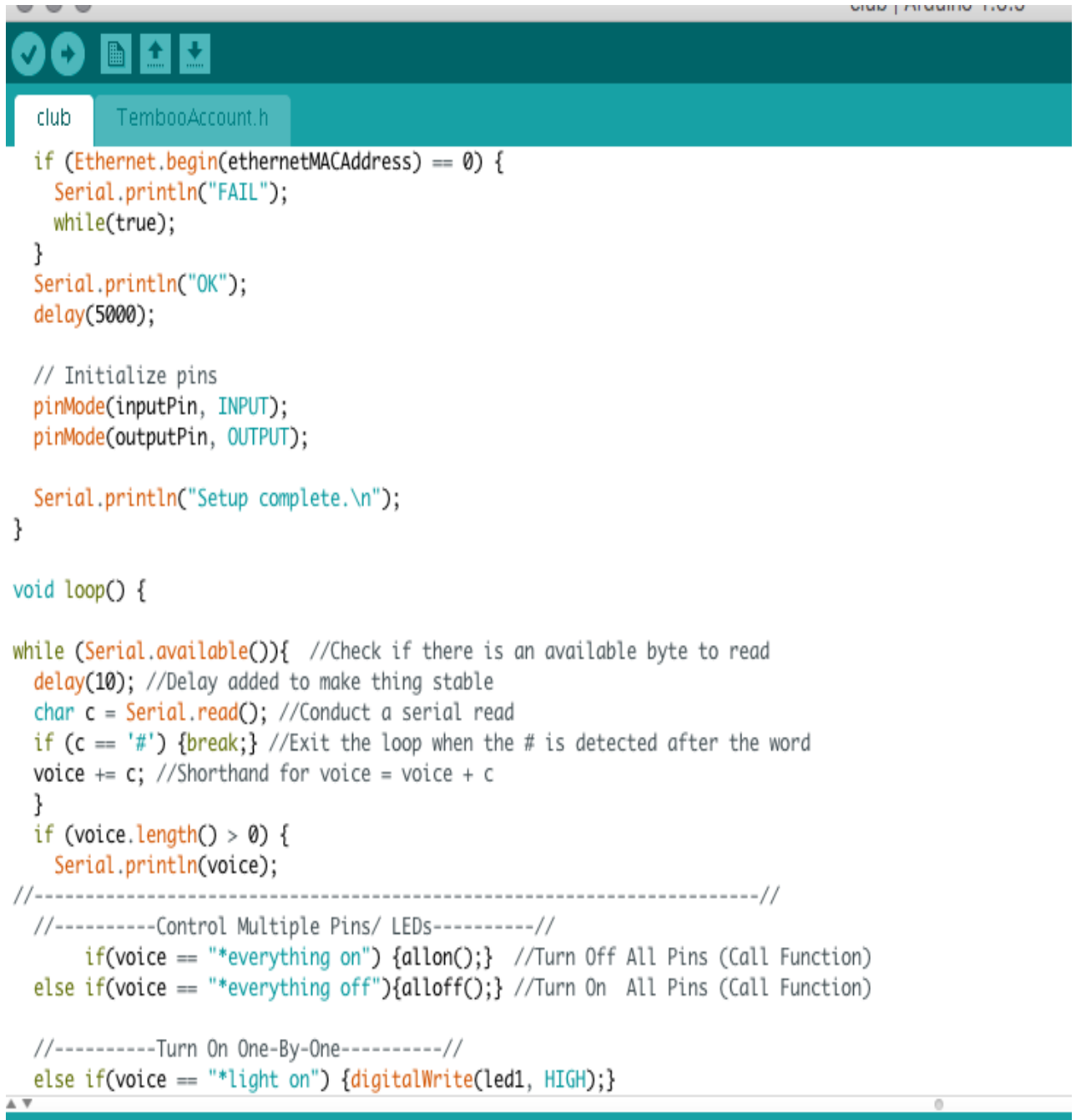
Bluetooth Module (II.)



Infrared Sensor (PIR)



Writing Code in C Language



```
club | Arduino IDE
[Icons: Check, Run, File, Upload, Download]
club TembooAccount.h
if (Ethernet.begin(ethernetMACAddress) == 0) {
    Serial.println("FAIL");
    while(true);
}
Serial.println("OK");
delay(5000);

// Initialize pins
pinMode(inputPin, INPUT);
pinMode(outputPin, OUTPUT);

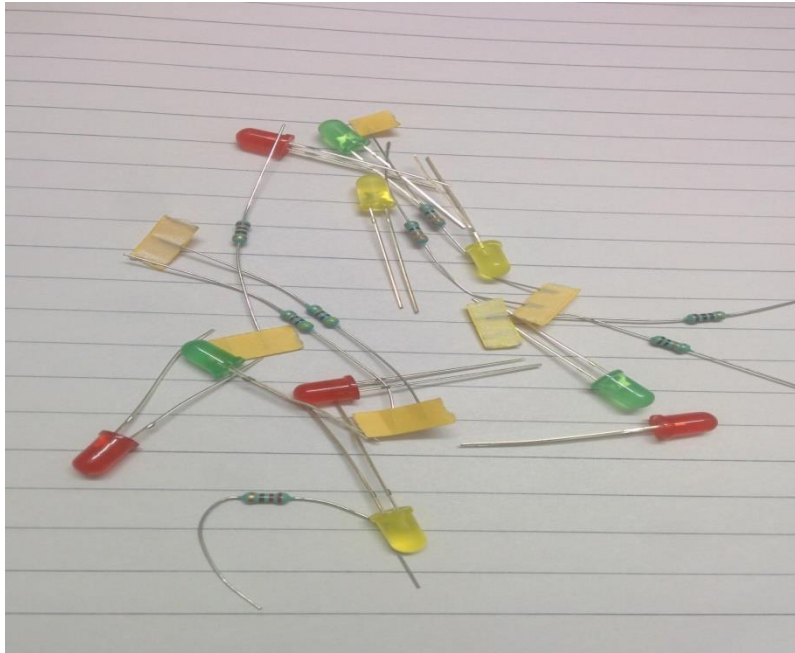
Serial.println("Setup complete.\n");
}

void loop() {

while (Serial.available()){ //Check if there is an available byte to read
    delay(10); //Delay added to make thing stable
    char c = Serial.read(); //Conduct a serial read
    if (c == '#') {break;} //Exit the loop when the # is detected after the word
    voice += c; //Shorthand for voice = voice + c
}
if (voice.length() > 0) {
    Serial.println(voice);
}
//-----//
//-----Control Multiple Pins/ LEDs-----//
    if(voice == "*everything on") {allon();} //Turn Off All Pins (Call Function)
else if(voice == "*everything off"){alloff();} //Turn On All Pins (Call Function)

//-----Turn On One-By-One-----//
else if(voice == "*light on") {digitalWrite(led1, HIGH);}
```

Jumper Wire & LED's



7.2 CODING

```
#define TEMBOO_ACCOUNT "ashwinigour9"
#define TEMBOO_APP_KEY_NAME "myFirstApp"
#define TEMBOO_APP_KEY "9cw1SqhFycnAqkEummCuDrk1fWoD6FiK" //
#define ETHERNET_SHIELD_MAC {0xAA, 0xBB, 0xCC, 0xDD, 0xEE, 0xFF}
//-----//

#include <SPI.h>
#include <Dhcp.h>
#include <Dns.h>
#include <Ethernet.h>
#include <EthernetClient.h>
#include <Temboo.h>
#include "TembooAccount.h"

byte ethernetMACAddress[] = ETHERNET_SHIELD_MAC;
EthernetClient client;

// The number of times to trigger the action if the condition is met
// Limiting the number of calls for testing purpose.
int maxCalls = 10;

// The number of times this Choreo has been run so far in this sketch
int calls = 0;

// Pin 2 is been selected for Input.
int inputPin = 2;
// Pin 8 in Arduino Board is selected for Output.
int outputPin = 8;

String voice;
int
led1 = 13, //Connect LED 1 To Pin #13
led2 = 12, //Connect LED 2 To Pin #12
```

```

led3 = 11; //Connect LED 2 To Pin #11

//-----Call A Function-----//
//Function for controlling all Appliances
void allon(){
    digitalWrite(led1, HIGH);
    digitalWrite(led2, HIGH);
    digitalWrite(led3, HIGH);
}

void alloff(){
    digitalWrite(led1, LOW);
    digitalWrite(led2, LOW);
    digitalWrite(led3, LOW);
}
//.....//
//Every activity in Aruidno Programming starts with a Setup() function.
void setup() {
    Serial.begin(9600);
    pinMode(led1, OUTPUT);
    pinMode(led2, OUTPUT);
    pinMode(led3, OUTPUT);

    // For debugging, wait until the serial console is connected
    delay(4000);
    while(!Serial);

    Serial.print("DHCP:");
    if (Ethernet.begin(ethernetMACAddress) == 0) {
        Serial.println("FAIL");
        while(true);
    }
    Serial.println("OK");
    delay(5000);

```

```

// Initialize pins
pinMode(inputPin, INPUT);
pinMode(outputPin, OUTPUT);
Serial.println("Setup complete.\n");
}

void loop() {
while (Serial.available()){ //Check if there is an available byte to read
  delay(10); //Delay added to make thing stable
  char c = Serial.read(); //Conduct a serial read
  if (c == '#') {break;} //Exit the loop when the # is detected after the word
  voice += c; //Shorthand for voice = voice + c
}
if (voice.length() > 0) {
  Serial.println(voice);
//-----//
//-----Control Multiple Pins/ LEDs-----//

//Turn Off All Pins (Call Function)
if(voice == "*everything on") {allon();}

//Turn On All Pins (Call Function)
else if(voice == "*everything off"){alloff();}

//-----Turn On One-By-One-----//
else if(voice == "*light on") {digitalWrite(led1, HIGH);}
else if(voice == "*fan on") {digitalWrite(led2, HIGH);}
else if(voice == "*AC on") {digitalWrite(led3, HIGH);}

//-----Turn Off One-By-One-----//
else if(voice == "*light off") {digitalWrite(led1, LOW);}
else if(voice == "*fan off") {digitalWrite(led2, LOW);}
else if(voice == "*AC off") {digitalWrite(led3, LOW);}
//-----//

```

```

voice="";}

int sensorValue = digitalRead(inputPin);
Serial.println("Sensor: " + String(sensorValue));
if (sensorValue == HIGH) {
  if (calls < maxCalls) {
    Serial.println("\nTriggered! Calling TextToSpeech Choreo...");
    runTextToSpeech(sensorValue);
    calls++;
  } else {
    Serial.println("\nTriggered! Skipping to save Temboo calls. Adjust maxCalls as
required.");
  }
}
delay(250);
}

```

```

void runTextToSpeech(int sensorValue) {
  TembooChoreo TextToSpeechChoreo(client);
  // Set Temboo account credentials
  TextToSpeechChoreo.setAccountName(TEMBOO_ACCOUNT);
  TextToSpeechChoreo.setAppKeyName(TEMBOO_APP_KEY_NAME);
  TextToSpeechChoreo.setAppKey(TEMBOO_APP_KEY);

  // Set Choreo inputs for the choosen Google text-to-speech API.
  String APIKeyValue = "13e6ab28";
  TextToSpeechChoreo.addInput("APIKey", APIKeyValue);
  String TextValue = "someone entered your house";
  TextToSpeechChoreo.addInput("Text", TextValue);
  String ToValue = "918889711453";
  TextToSpeechChoreo.addInput("To", ToValue);

  String APISecretValue = "628aad7fddff8fb2";
  TextToSpeechChoreo.addInput("APISecret", APISecretValue);
}

```

```
// Identify the Choreo to run
TextToSpeechChoreo.setChoreo("/Library/Nexmo/Voice/TextToSpeech");

// Run the Choreo
unsigned int returnCode = TextToSpeechChoreo.run();

// A return code of zero means everything worked perfectly
if (returnCode == 0) {
    digitalWrite(outputPin, HIGH);
}
TextToSpeechChoreo.close();
}
```

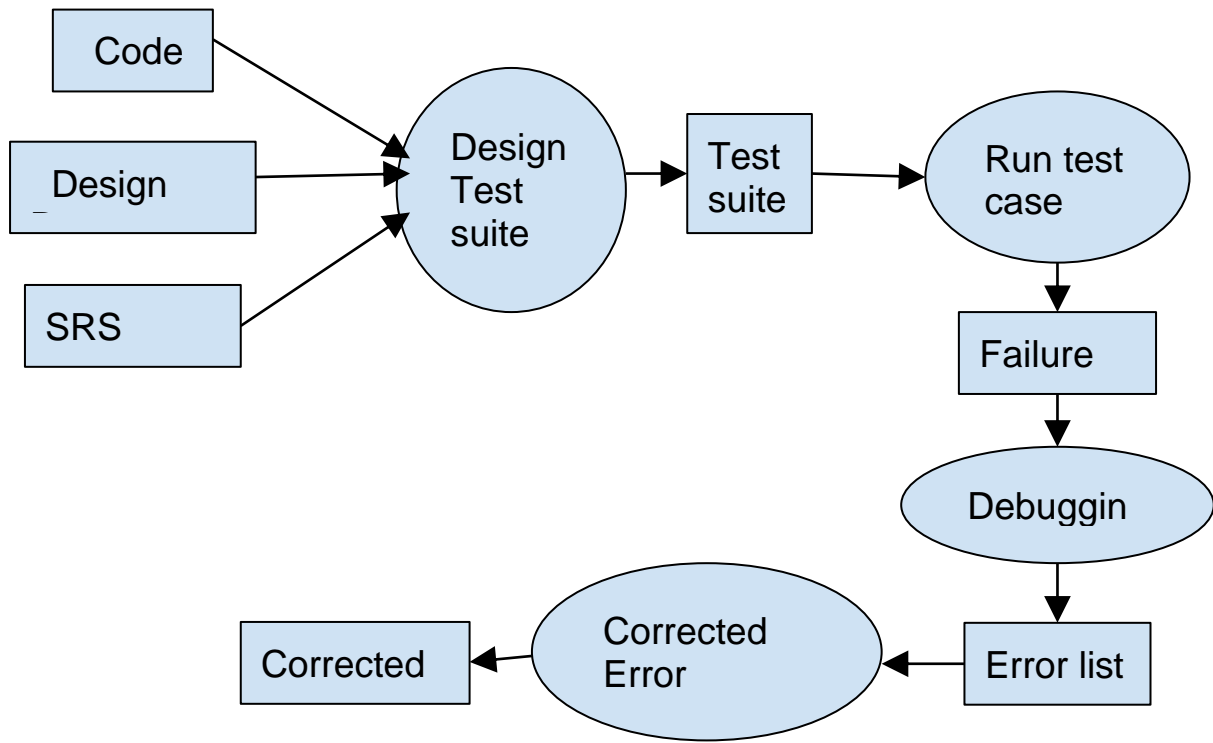

TESTING

- What is testing ? Testing is nothing but smallest executable part of the programme which perform before releasing the software or working model or in other words the process of finding the errors , defects , mistakes and bugs in our lifetime project or in realtime this is called software testing .
- Testing is a important part of our project and its come in the category of Quality control . Testing is basically divided in two types which are static dynamic testing which is mainly done by Senior software Engineer & Software Developer of development team.
- Now here in our project we perform different types of testing according to our requirements , after these test our project became totally bug free and with no flaws , later in this chapter we will show a different test which we perform to make our project bug free.
- Test planning & software testing fundamentals :-

There are some basic steps of test planning which we followed before going directly to testing phase:

1. Testability
 2. Operability
 3. Observability
 4. Controllability
 5. Decomposability
 6. Simplicity
 7. Stability
 8. Understandability
-
- In testing the different fields related to project which we covered
 1. Usability testing
 2. Performance testing
 3. Security testing
 4. Compatibility testing
 5. Recovery testing
 6. Volume testing

- These above steps is greatly focussed by us and at the time of testing we design a testing phase and we made a chart for test planning which contains different fields which are very important in testing of project and they are given as code , design document , srs document , Design test suite , test suite , run test case and checking the result , failure test , Debugging , error list ,corrected error ,corrected programme.



TEST PLANNING CHART

S.no	Description	Input data	Expected Result	Actual Result	Pass/Fail	Defect
1	Intruder	Any human being	Call will come & say someone entered in your house	Same as expected result	pass	nil
2	Intruder	Any animal	Call will come	Same as	pass	nil

			& say someone entered in your house	expected result		
3	Anything accept intruder	Any non living thing	Call will not come	Same as expected result	pass	nil
4	Voice command	Lights ON	All light in our house will ON	Same as expected result	pass	nil
5	Voice command	Lights OFF	All light in our house will OFF	Same as expected result	pass	nil
6	Voice command	fan/ac ON	Fan or ac will be ON	Same as expected result	pass	nil
7	Voice command	fan/ac OFF	Fan or ac will be OFF	Same as expected result	pass	nil
8	Voice command	All ON	All electric appliances will ON	Same as expected result	pass	nil
9	Voice command	All OFF	All electric appliances will OFF	Same as expected result	pass	nil
10	Wrong Voice command	On all/off all ,etc.	Nothing will happen all appliances	Same as expected result	pass	nil

			remain in same state			
--	--	--	-------------------------	--	--	--

- In above table we have shown you all possible test cases which we performed at the time of testing of our model(home automation and home security) and the different column shows different status at the time of testing and that's all about testing which we have done in our project.

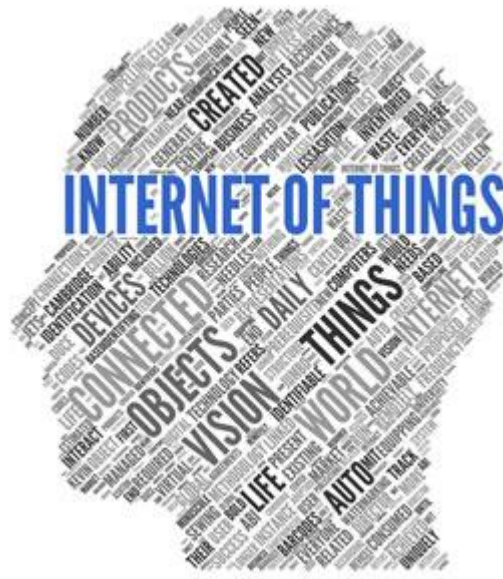
CONCLUSION & FUTURE SCOPE

- Today, Internet of Things (IoT) is creating an environment of convergence in the society. So what we conclude in our project that this technology environment brings a paradigm shift in our professional and personal life. As a connected environment, IoT adds customer value and loyalty. Recently, IoT is being implemented everywhere which is of human concern like smart city, smart environment, security, smart business process, smart agriculture, home automation and healthcare. This article discusses the evolution, advantages, Architectural design choices, Internet and Mobile Applications of Internet of Things(IoT). It is quite interesting and challenging to develop and implement web applications using open sourcing hardware and software. Authors discuss issues like invasion of privacy, governance, security, regulatory issues, migration to IPv6 and standardization Issues as barriers to adoption of IoTs. Authors also highlighted future research directions of Internet of things. Keywords : IoT, Architectural Design Choices, Internet and Mobile Applications, IPv6, Standardization Issues, Invasion of Privacy, Regulatory.
- Internet of Things is the most emerging technologies and adulated by every big brands and institutions like Google,Microsoft,Oracle and several other universities like University of Virginia where currently reasearch is going on.With latest buzz IoT has entered in IT market with full of boom and this is the reason behind why we are working on our current field of interest which is nothing but the only IoT.It gives the new way to the revolution of IT industries which is the world largest developing industries. Since,IoT is an ecosystem of connected physical objects that are accessible through the internet. And we are very sure of this thing that living is almost impossible in this era without internet. People have started using more and more devices that are connected to internet instead of un-internet devices. Looking at the preferences, companies are also moving towards creating technologies that will be internet enabled. And why not; internet saves time, cost, increases effectiveness, and help manage economy. IoT is the next superhero in this trial. Devices enabled with IoT like smart watches, smart beds, fitness trackers, etc are in the market and people are accepting them with open hearts. According to a tech-focused research firm report, IoT is expected to grow at a CAGR of 31.72 percent from 2014-2019. So, this is very precise with the insights that IoT is the next mega trend in lots of industries.

- IoT will potentially be contributing to industries like businesses in the utilities, oil & gas, healthcare, insurance, manufacturing, transportation, infrastructure and retail. Being inquisitive about how IoT is contributing to different sectors in the world especially health care, for this various seminars in big cities or webinars is to be held on IoT in healthcare like.



- If we talk about future ,the very first question which will come to our mind is ,Will IoT shape the future? So,the answer of this query is given as In December of last year, IEEE placed the web-of-things (WoT) as second in its top 10 tech trends for 2014. As the world reaches for greater connectivity, the Internet of Things (IoT) has become a vital instrument to interconnect devices. No doubt, the IoT will prove to be a disruptive technology.



- In IoT there are many research areas like IoT management, Networking & communication, Human Interaction, Services and application development support, Trials and demos and many more in which you may do your research and uplift your career with the IoT. If you people wish to work in big organisation then there Iot will create an incredible platform to be hired in these companies and they will adulate your talent if you are very aware of this technology.

REFERENCES

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