

Abstract

Automation has changed the world around us and is continuing to impact the way we do things. The goal of the project is to design an artificial intelligence based home security and automation system in which i will be programing in the way so that the system will be able to take intelligent automation decision for small task to be maintained in a house and along with that this will help in saving electricity by optimizing the usage of all the connected appliance according to real time environmental condition and after that this system will; be able to do numerous task to provide ease of living to the mankind.

Numerous risks have been identified for the development of the project each are proper managed and minimized with the help of proper scheduling. The developer tries to tackle these problems by developing autonomous machinery for home automation activity. To design and develop a complete AI based home security and automation system. The system is interfaced with Arduino Mega with ATmega1280 microcontroller and another small Wi-Fi inbuilt with ESP8266 microcontroller. Several sensors transmit different types of waves to control those all automation functionalities of the system Secondary and primary research along with design process and implementation of this this project with all detailing of requirement benefits and other future scopes which are possible in further development of this project had been done for the successful development of the project. Which will be discussed in details further in this report.

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Chapter: 1 Introduction

The world is running ahead and the people are trying to catch up. Technology and automation are the new trends we are living inn. Automation is increasing at a fast rate, providing the world with new technology that can assist with home tasks, automobile assembly, defense and security, agricultural economy and many other tasks. Automation has changed the world around us and is continuing to impact the way we do things. “Where did it start? No one knows; where it is going to end? No one knows that either.”

The world is moving forward in a tremendous rate with advancement in technology. Renewable power sources such as electricity, bio fuels, and hydrogen fuels are going to replace the current power sources such as fossil fuels, coal etc. The advancement in technology and research facilities has opened door for such strong interventions.

Automation has also conquered a number of sectors in the society such as industry, defense, aerospace, automobiles and even agricultural sector. Automation in Home is not a new concept in certain part of the world. Developed countries like The United States, Australia, etc. have rooted automation in Home activities years before. But what about in India? It still remains a concept or a proposed developmental activity. Why does the Indian society still lagging behind these technological advancements? Is it because India doesn't have enough capital or resources? Is it because Indian residents lack knowledge about technological advancements? The answer in ‘No’.

As technology is getting too advance in all the sector and making people lazy and busy in all the span of life line. All the people want to do the thing around them remotely for that automation technology is enhancing the capabilities of developer so now in this project a very intelligent system using artificial intelligence programming presents Artificial Intelligence home security and automation system to provide better security and a full proof ease of living to the mankind. The researcher tries to find solution to numerous dilemmas in Home automation activities such as,

- Electricity saving
- Enhanced security
- Intelligent decision for automation processes
- Increases ease of living

The developer tries to tackle these problems by developing autonomous machinery for home automation activity. To design and develop intelligent decision taking machine for home automation. This system will be solving a major problem of saving electricity and so many others too which is being faced by the common middle class family in the society they are staying with.

1.1 Automation

Automation means automatic control in which use of various control system used for operating equipment such as boiler, factories, switching in telephone network, vehicle and widely in industries. Technically, it is defined as the technique of making apparatus, process and system operate automatically. J'4

Automation is inspired by earlier word automatic which was not widely used before the establishment of automation department by general motor in 1947. Automation has been achieved by various means including hydraulic, mechanical, electrical, electronic, computers or usually in combination.

1.1.1 Classification of Automation

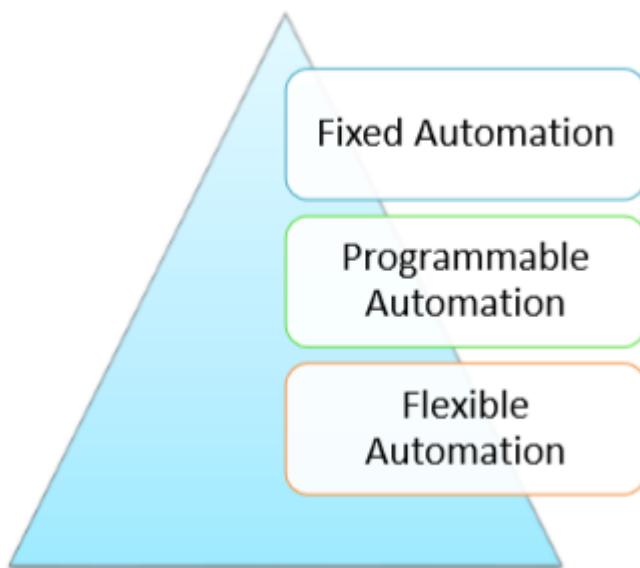


Figure 1: Classification of Automation

a) Fixed Automation

In this type of automation, sequence of processing operation of automated production is fixed by the equipment configuration. The program commands are contained in the machines in the

form of gears, wirings and other type of hardware that cannot easily changed over from one product style to another. Hence, this type of automation is also known as “hard automation”.

b) Programmable Automation

The production equipment is designed with the capability to change the sequence of operations to accommodate different product configurations. Program which is set of instructions coded used to control the operation sequence.

c) Flexible Automation

It is an extension of programmable automation and capable of producing variety of Parts with virtually lost for changeovers from one part style to the next. There is no need to group identical products in to batches, a mixture of product can be produced one right after another. Honda manufactured 113 motor.

1.1.2 Advantages of automation

There are following attributes and advantage of all three types of automation which is listed below in Table

Automation	When To Consider	Advantages	Disadvantages
Fixed	High Demand Volume Long Product Life Cycles	Maximum efficiency Low Unit Cost	Large Initial Investment Inflexibility
Programmable	Product with different options, Batch Production	Flexibility to deal with changes in product, low unit cost for large batches	New Product requires long set up time high unit cost compare to fixed
Flexible	Varying demand, low production rates, short product life cycle	Flexibility to deal with design variations, customized products	Large initial investment, high unit cost relative to fixed and programmable.

Table 1: Advantages of Automation

On the other end automation can also be categorized as the following elements

1.1.3 Office automation

Office automation refers to the varied computer machinery and software used to digitally create, collect, store, manipulate, and relay office information needed for accomplishing basic tasks and goals. Raw data storage, electronic transfer, and the management of electronic business information comprise the basic activities of an office automation system, office automation helps in optimizing or automating existing office procedures.

1.1.4 Building automation

Building automation describes the functionality provided by the control of a building. The control system is a computerized, intelligent network of electronic devices, designed to monitor and control the mechanical and lighting systems of a building. A building automation system is an example of a distributed control system. The building automation system (BAS) core functionality keeps the building climate within a specific range, provides lighting based on an occupancy schedule, and monitors system performance and device failures and provides email and/or text notifications to building engineering staff. The BAS functionality reduces building energy and maintenance costs when compared to a non-controlled building.

1.1.4 Power automation

Power automation is the automated control and monitoring of power plants, substations and transformers for effectiveness, efficiency and fault detection. It has made it possible to have a reliable municipal or national electricity system, which often comprises remote and hard-to-reach transformers and power sub-system units. It makes it possible to monitor different power units, relay their status and health information, and even carry out fault detection and correction without human interference. Example of power automation system is the Supervisory Control and Data Acquisition (SCADA) system.

1.1.5 Home automation

Home automation may designate an emerging practice of increased automation of household appliances and features in residential dwellings, particularly through electronic means that allow for things impracticable, overly expensive or simply not possible in recent decades. Home automation includes all that a building automation provides like climate controls, door and window controls, and in addition control of multimedia home theatres, pet feeding, plant watering and so on. But there exists a difference in that home automation emphasizes more on comforts through ergonomics and ease of operation.

1.2 Problem Context

Automation is defined as a process or a system that operate automatically. It is the construction and application of technology to monitor and control the production and distribution of products and services. Automation benefits to almost all sections of the society like manufacture, automobiles, defense, agriculture, etc. Automation benefits by reducing production cost, increasing rate of production, sustainable use of resources, eco-friendly environment, reduces production time and many more.

In this project the developer is designing and developing an automation system which will be installed in home to take care of house without human need which will ultimately provide human more time to relax or making it use for productive reasons. This system is able to maintain the security of the entire house using biometric and automate switching of all the regular used electrical appliances by taking intelligent decisions after analyzing the real time environmental condition. This will ultimately remove the issue of use Lesley switched on appliances and switch them off to save electricity and reduce monthly bill on electricity for the user.

This kind of system can not only designed and develop for only single area i.e. home this can be extended over network through so many other areas such as office, factory, malls, big hotels and villas.

1.3 Topic Of the system

“Artificial Intelligence home security and automation system (AIHSAAS) “, The name of the project describes its specification itself as it is a kind of combination of security cum automation system to be installed in home which will have capabilities to take intelligent decision for jobs to be done in home with automation or can help the user for so many assist they need in daily life.

1.4 Project Aim

The Aim of the project is to create a complete artificial intelligence based home security and automation system which should have capability to provide ease to human life and utilize productivity of automation technology in home to let the regular tasks to be automated to enhance ease of living of mankind.

1.5 Objective

These are the following objective which were executed on time to get accomplishment for this project.

- To design an embedded system kind of system which can be easily installed in any house without making more changes to the previous structure.
- This system will be designed keeping a focus point in mind is to save electricity and reduce monthly bill on electricity.
- The system is also designed to provide high class security as it has biometric finger print authentication installed in it.
- This system will have capabilities to adjust the surrounding i.e. in the house light, humidity and temperature maintained and will switch the maximum efficient light by judging the required light by the user and the current light in real time.
- This system will also have capabilities to give you notification about weather condition and help the user to take them off before the wet in rain and also remind about medicine timing for the old age.
- All those functionalities will be designed first on simulation software the individually these will be produced in form of hardware's
- After that all these system will be connected together to a particular small server and then testing and bug detecting will take place,
- After all the bugs were finned out then the next job will be to fix all those bugs and fix the system to the required level.

1.6 Project Functionalities

1.6.1 Security

- Biometric fingerprint authentication at the entrances to access the house area by the authorized user and if unauthorized person tries to access the area then a picture of that person will be captured and a notification will be sent to the authorized user.
- When any person takes exit from house area the gates will be automatically locked. There will be no need of another person to go with the exiting person at the back, to lock up the gate.
- Logs will be created each and every-time for all the authorized family member or others with details such as Date, Time & User Identity which can be viewed anytime on the android application by the authorized user.
- In case some unauthenticated person reach outside the house and rings the doorbell then the authorized user inside the house will be able to unlock the door remotely.

1.6.2 Remote controlled cum intelligent automation

- This system is capable of making intelligent decision by analyzing the environment by using sensors to save electricity and provide required environmental conditions such as, switching lights on/off by analyzing the intensity of light available in the real environment and switching multiple installed light according to user work desire along with checking efficiency then the most efficient light will be switched on automatically or can be done manually using the android app. and when the last person leaves the room all electrical appliances which is not being used will be automatically switched off to save electricity.
- Data log feature- This system has a data logging feature which enables it to record information about switching the electrical appliances along with timing details and how that was executed along with it also records the temperature & Humidity of the room environment at regular intervals, and after this; by using a thermostat the system will be able to maintain required temperature and humidity according to user need. Using the same logging feature it will attempt to save more energy than previous month without getting in the way of user's usual living style.
- AIHSAAS is also designed to track/manage sleeping pattern of the user e.g. this will be able frame a schedule to wake up the user at specified time in the sleep cycle where the user is most likely to wake up and feel active.
- AIHSAAS is also capable for turning off mobile/other charging adaptors when they are not being used e.g. when the device has been unplugged from the adaptor and the user doesn't switch it off AIHSAAS will do it by own without acknowledging the user which again help to reduce electricity bill and protect the adaptor from being used unnecessarily similarly it will do it for T.V. , stove as well as gaming consoles (will be done using sensors)
- AIHSAAS as an intelligent assistant- able to wake up the user in the morning with weather updates, can make coffee in the morning, reminder for medicines as well for favorite T.V. shows timings and will notify the user to take off drying cloths when the weather gets changed to rainy or windy.
- This home automation also has feature to auto turn on water pumps at the particular time when water supply is active and turn the pump off when it detects the water tank is full.
- An inbuilt feature of hazard protection is also implemented in this system exhaust out if it finds any LPG leakage and alert the user turn off the Stove regulator if he left that open.

Apart from that if this automation system detects any high temperature that could have been generated due to any fire or any other hazardous situation then an alert notification will be sent to the user about this issue so that user can get control over that as soon as possible.

1.7 Project Benefits

1.7.1 Tangible Benefits

Tangible benefits mean those who get direct benefits and by this project monitoring department of electrical industries will get direct benefits it will reduces industrial losses.

1.7.2 Intangible Benefits:

Intangible benefits mean those who get indirect benefits and here workers of industries will get intangible benefits. By this project they have to give less effort for monitoring of temperature and control the system

Several major Benefits of the system are available below which solves the problem mentioned in the problem context.

- Energy management and monitoring (remote access via smart Phone) – integration with PECO smart meter and other devices to allow for real time feedback on utility usage, as well as historical data analysis.
- Security management with video monitoring (remote access via Smart Phone) and central station monitoring capability for intrusion, fire (heat and smoke) and water sensors.
- HVAC management (remote access via Smart Phone).
- Lighting control and management; dimming capabilities; LED low voltage and line voltage will be used throughout house (remote access via Smart Phone)
- Structured wiring for audio and video distribution; internet access, separate AV cabinet for equipment; central location in mechanical room for home run wiring; robot charging area (future).
- Systems integration and control – connecting with current and future electronic systems and protocols.
- Home networking management – wired and wireless to provide for robust internet services for computers, tablets, phone, etc. in a way that maximizes bandwidth and allows for wireless network virtualization. Internet service coming into the house most likely

will be will be Verizon FiOS (50/25 Mbps). There will be a high speed fiber optic connection directly to the house from the street.

1.8 Project Feasibility

1.8.1 Social Feasibility

Socially this project is feasible because middle class family is too busy these to maintain small task in their house and it will be need of present as well as people of future generation.

1.8.2 Economic Feasibility

According to cost estimation there will be no doubt that project is not economical feasible. All parts are easily available such as component used in building the prototype are easily available at door step by online shopping and easily available at shops also.

1.8.3 Time Feasibility

Given time is not sufficient but still the best effort can make it sufficient for building my project and I will also prepare the Gantt chart in which I will be mentioning the sufficient timing work done accordingly with proper effort and finished this development of incredible design.

1.8.4 Technical Feasibility

This project is full of technical feasibility as the component required to build this is easily available in the market as well as by doing online shopping they are even cheaply available there.

1.9 Target Audience

My audience are Middle class people who own a flat or villa and they can use this system very efficiently to secure and control the automation of home appliances in a very smart way with intelligence they want to stay with. This statement is too close to say like to provide a better life experience and help them to live an effortless life what actually we call as ease of living. Along with this this system has energy saving concept in it which also help again a middle class family to save bills on electricity that again comes with them as happiness.

1.10 Problem Description

The field of Automation has well advanced in Industries, as majority of automobile industry plants as well as bottling plants have Automated assembly lines. But automation has not yet penetrated in the homes especially in India. If automation was to be used in homes than everyday

life would be get eased. Simple example of use of automation in home can be seen in the transfer of water from the under-ground water tank to the over-head water tank, by sensing the level of water in both the tanks. This process eases the every time effort the user has to put in for filling the tank and also helps in saving water. Also people are getting more acquainted daily with the use of Smartphone and tablets which are capable of doing much of PC's work handy. So we have decided to make a low cost Embedded System in which the smart phones can be used to help automate entire home. In this system the user will have remote access and control over all the subsystems present in the house.

1.11 Project Scope and Limitations

This project work is complete on its own in remotely and automatically switching on and off of any electrical appliance not limited to household appliances, and sends a feedback message indicating the new present state of the appliance. It does not implement control of multiple appliances or automatic detection of faults in the controlled appliance.

1.12 Project Justification

This project is of contributory knowledge to the development and implementation of home security and automation systems in Nigeria using low cost, locally available components like microcontroller, free voice dial service (popularly referred to as 'flashing') and very cheap short message service (SMS) text.

1.13 Learning Outcomes

- Design and demonstrate a working artificial intelligence and neural network program and script
- To interface stepper motor with the micro-controller for the control motion of locking systems
- To interface sensor with the micro-controller for sensing different environmental conditions
- To develop program for the micro-controller based plat formed system for parallel working of the several sensors and stepper motor accordingly.
- To implement manual control of the entire system using android application which will be communication with the system using a smart phone and wireless technology.
- Built a mechanical 3D model for the prototype which includes CAD designing and perfect measurements.

The developer seeks to gain knowledge on number of functionalities and techniques throughout the development of the system such as

- ✓ Automation Technology
- ✓ Sensor interfacing
- ✓ Automated and semi-automated controls.
- ✓ High level programming language Software coding for project propulsion.
- ✓ System Designing & Management
- ✓ Artificial intelligence and their usage techniques
- ✓ Versatile methods planning

Chapter: 2 Literature Review

2.1 History of Home security and Automation

Home automation has been around since the World War 1 (1914), in fact, the television remote (a simple home automation system) was patented in 1893 (Wikipedia, 2009). Since then different home automation systems have evolved with a sharp rise after the Second World War its growth has been through various informal research and designs by technology enthusiasts who want a better way of getting things done at home without much effort on their part. The systems evolved from one that can automatically do routine chores like switch on and off security lights, to more sophisticated ones that can adjust lighting, put the television channel to favorite station and control doors. And the term security also arising from the current high develop security system which are making security of home on finger tap and it's more secure as only the particular individual can access this which carried biometric authentication system. This has also been carried out in old days as we use to take thumb impression if someone is illiterate, now a days same thing is being used very technically as we keep all the data in digital format and the matching criteria is done without any mistake as it is being done by computers and they are very much precise.

2.2 Home Automation system

Home automation systems may designate electronic systems in homes and residential buildings that make possible the automation of household appliances. The new stream of home automation systems has developed into a vast one and the current market is flooded with a flurry of home automation systems and device manufacturers.

The types of home automation systems based on their control systems are:

1. Individual Control Systems

These types were the first to hit the market in the early years, here each device like the heater or the air conditioner will have an independent control dedicated to it.

2. Distributed Control Systems

The main feature of these type of systems is emergency shut-down. With this system you can preset or change the control parameters of several similar devices, for example, the thermostat of several air conditioners and their ON/OFF timings.

3. Central Control Systems

These are computerized systems programmed to handle all functions of multiple utilities like air conditioning system, home entertainments, doors, windows, refrigerators and cooking systems, all at the same time regardless of whether you are at home or away. You can connect to the control system through telephone or internet from anywhere in the world.

The types of home automation systems based on the carrier mode are:

1. Power line carrier Systems

The least expensive type of home automation system operates over the home's existing wiring, or power line carrier. These can range from X10based lamp timers, to more sophisticated systems that require installation by a trained professional.

2. Wireless systems

Also available are wireless home automation systems that utilize radio frequency technology or Wi-Fi wireless transmission technology or we can also use IoT i.e. Internet if thing protocols. They are often used to operate lights, sometimes in conjunction with a hardwired lighting control system or we can also design a complete centralized home automation system to control almost any appliance of a home from anywhere in the world using web transmission of commands.

3. Hardwired systems

Wired, or “hardwired” home control systems are the most reliable and expensive. These systems can operate over high-grade communications cable such as Category 5 or 5e, or their own proprietary “bus” cable. That is why it is best to plan for them when a house is being constructed. Hardwired systems can perform more tasks at a time and do them quickly and reliably, making them ideal for larger homes. They can also integrate more systems in the home, effectively tying together indoor and outdoor lighting, audio and video equipment, security system, even the heating and cooling system in to one control package that will be easy and intuitive to operate.

4. Internet Protocol control system

Internet Protocol (IP) control automation system uses the internet, gives each device under its control an Internet Protocol address, and creates a local area network (LAN) in the home. Hence, the home can be interacted with over the internet with possibility of live video streaming and real-time control.

2.3 Home Automation Standards

There are many established industry standards for home automation systems and are implemented over the various carrier modes ranging from power line to wireless. The popular and major standards are INSTEON, European Home Systems (EHS), Zig-Bee, Power line Bus (UPB).

2.3.1 INSTEON standard

INSTEON standard is a dual-band mesh topology employing ac-power lines and a radio frequency (RF) protocol to communicate with and automate home electronic devices and appliances, which normally work independently. It is a home automation networking technology invented by SmartLabs Inc. INSTEON was developed, based on the X10 model, for control and sensing applications in the home (Wikipedia, 2009).

INSTEON is designed to enable simple devices to be networked together using the power line and/or radio frequency (RF). All INSTEON devices are peers, meaning each device can transmit, receive, and repeat any message of the INSTEON protocol, without requiring a master controller or complex routing software. INSTEON is not only an effective system for connecting lighting switches and loads without extra wiring, but it also forms the basis for a more sophisticated home Automation network.

The following are the possible applications of INSTEON:

- Scene and remote control lighting,
- Security alarm interfaces and sensors,
- Home sensors (e.g. water, humidity, temperature),
- Access control (e.g. door locks),
- Heating, ventilating and air cooling (HVAC) control,
- Audio-video control, and
- Appliance management.

2.3.2 European Home Systems (EHS) protocol

The European home systems (EHS) protocol was aimed at home appliances control and communication using power line communication (PLC). Developed by EHS (European Home Systems Association) it was merged with two other protocols to form the KNX protocol, which

complies with CENELEC norm EN 50090 standard and had a chance to be a basis for the first open standard for home and building control (Wikipedia, 2009).

The areas of application of EHS are:

- Heating, ventilating and air cooling (HVAC) control,
- Scene and remote control lighting, and
- Appliance management.

2.3.3 Zig-Bee standard

Zig-Bee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology defined by the Zig-Bee specification is intended to be simpler and less expensive than other WPANs such as Bluetooth. Zig-Bee is targeted at radio frequency (RF) applications that require a low data rate, long battery life, and secure networking (Wikipedia, 2009). Zig-Bee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. Zig-Bee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Zig-Bee chip vendors typically sell integrated radios and microcontrollers with between 60K and 128K flash memory, such as the Free scale MC13213, the Ember EM250 and the Texas Instruments CC2430. Radios are also available as stand-alone to be used with any processor or microcontroller. Generally, the chip vendors also offer the Zig-Bee software stack, although independent ones are also available. The Zig-Bee Alliance is a group of companies that maintain and publish the Zig-Bee standard.

Typical areas of application of Zig-Bee are:

- Home Entertainment and Control — Smart lighting, advanced temperature control, safety and security, movies and music,
- Home Awareness — Water sensors, power sensors, smoke and fire detectors, smart appliances and access sensors,
- Mobile Services — m-payment, m-monitoring and control, security and access control, m-healthcare and tele-assist,

- Commercial Building — Energy monitoring, HVAC, lighting, access control, and
- Industrial Plant — Process control, asset management, environmental management, energy management, industrial device control.

2.3.4 ONE-NET standard

ONE-NET is an open-source standard for wireless network designed for low-cost, low-power (battery operated) control networks for applications such as home automation, security and monitoring, device control, and sensor networks. ONE-NET is not tied to any proprietary hardware or software, and can be implemented with a variety of low-cost off-the-shelf radio transceivers and microcontrollers from a number of different manufacturers (Wikipedia, 2009).

ONE-NET uses UHF ISM radio transceivers and currently operates in the 868 MHz and 915 MHz frequencies. The ONE-NET standard allows for implementation on other frequencies, and some work is being done to implement it in the 400 MHz and 2.4 GHz frequency ranges. It utilizes Wideband FSK (Frequency shift keying) to encode data for transmission and it features a dynamic data rate protocol with a base data rate of 38.4 kbit/s. The specification allows per-node dynamic data rate configuration for data rates up to 230 kbit/s. ONE-NET supports star, peer-to-peer, and mesh networking topologies. Star network topology can be used for lower complexity and cost of peripherals, and also simplifies encryption key management. In peer-to-peer mode, a master device configures and authorizes peer-to-peer transactions. The wireless mesh network mode allows for repeating to cover larger areas or route around dead areas. Outdoor peer-to-peer range has been measured to over 500 m, indoor peer-to-peer range has been demonstrated from 60 m to over 100 m, and mesh mode can extend operational range to several kilometers. Simple, block, and streaming transactions are supported. Simple transactions typically use message types as defined by the ONE-NET protocol to exchange sensor data such as temperature or energy consumption, and control data such as on/off messages. Simple transactions use encryption techniques to avoid susceptibility to replay attacks. Block transactions can be used to transmit larger blocks of data than simple messages. Block transactions consist of multiple packets containing up to 58 bytes per packet. Block transactions can transfer up to 65,535 bytes per block. Streaming transactions are similar in format to block transactions but do not require retransmission of lost data packets.

ONE-NET is optimized for low power consumption such as battery powered peripherals. Low-duty-cycle battery-powered ONE-NET devices such as window sensors, moisture detectors, etc. can achieve a three to five year battery life with "AA" or "AAA" alkaline cells. Dynamic power

adjustment allows signal strength info to be used to scale back transmit power to conserve battery power. High data rates and short packet sizes minimize transceiver on time. Further power

Efficiency can be gained utilizing deterministic sleep periods for client devices.

2.3.5 Universal Power line Bus

The Universal Power line Bus (UPB) is an industry emerging standard for communication among devices used for home automation. It uses power line wiring for signaling and control. Household electrical wiring is used to send digital data between UPB devices. While in the X10 protocol this digital data is encoded onto a 120 KHz carrier which is transmitted as bursts during the relatively quiet zero crossings of the 50 or 60 Hz AC alternating current waveform, the UPB protocol works differently. The UPB communication method consists of a series of precisely timed electrical pulses (called UPB Pulses) that are superimposed on top of the normal AC power waveform (sine wave). Receiving UPB devices can easily detect and analyze these UPB Pulses and pull out the encoded digital information from them. UPB Pulses are generated by charging a capacitor to a high voltage and then discharging that capacitor's voltage into the power line at a precise time. This quick discharging of the capacitor creates a large "spike" (or pulse) on the power line that is easily detectable by receiving UPB devices wired large distances away on the same power line. UPB controllers range from extremely simple plug-in modules to very sophisticated whole house home automation controllers. The simplest controllers are plug-in controllers that are recommended for a moderate amount of switches and devices as it becomes cumbersome to control a wide range of devices. More sophisticated controllers can control more units and/or incorporate timers that perform pre-programmed functions at specific times each day. Units are also available that use passive infrared motion detectors or photocells to turn lights on and off based on external conditions. Finally, whole house home automation controllers can be fully programmed. These systems can execute many different timed events, respond to external sensors, and execute, with the press of a single button, an entire scene, turning lights on, establishing brightness levels, and so on. UPB was developed by PCS Power line Systems of Northridge, California and released in 1999. Based on the concept of the ubiquitous X10 standard, UPB has an improved transmission rate and higher reliability. While X10 without specialized firewalls has a reported reliability of 70-80%, UPB reportedly has a reliability of

More than 99% (Wikipedia, 2009).

2.4 Home Automation and Implementation Platforms

Home automation can be implemented over a number of platforms namely, Power line, RS232 serial communication, Ethernet, Bluetooth, Infrared and GSM. Each platform having its own peculiarity and area of application.

2.4.1 Power line communication

Power line communication is a system for carrying data on a conductor also used for electrical power transmission. Though electrical power is transmitted over high voltage transmission lines, distributed over medium voltage and used inside buildings at lower voltages, power line communication can be applied at each stage.

All power line communication systems operate by impressing a modulated carrier signal on the wiring system. Different types of power line communications use different frequency bands, depending on the signal transmission characteristics of the power wiring used. Since the power wiring system was originally intended for transmission of alternating current (AC) power, in conventional use, the power wire circuits have only a limited ability to carry higher frequencies. The propagation problem is a limiting factor for each type of power line communications. Data rates over a power line communications system vary widely. Low-frequency (about 100 – 200 KHz) carriers impressed on high-voltage transmission lines may carry one or two analog voice circuits, or telemetry and control circuits with an equivalent data rate of a few hundred bits per second; however, these circuits may be many miles long.

2.4.2 RS232

The RS232 stands for recommended standard number 232. The serial ports on most computers use a subset of the RS232 standard. The full RS232 standard specifies a 25-pin "D" connector of which 22 pins are used. Most of these pins are not needed for normal PC communications, and indeed, most new PCs are equipped with male D type connectors having only 9 pins, trading off compatibility with the standard against the use of less costly and more compact connectors.

In RS232, the communicating devices are referred to as Data Terminal Equipment (DTE) and Data Communication Equipment (DCE). The DTE is an end instrument that converts user information into signals or reconverts received signals and uses the male connector. The DTE is the functional unit of a data station that serves as a data source or a data sink and provides for the data communication control function to be performed in accordance with link protocol. While the DCE is communication link control device that provides the clock signal and uses the female

connector. The DTE ends the communication line, whereas the DCE provides a path for communication. In connecting a DTE device to a DCE a straight pin-for-pin connection is used. However, to connect two DCEs or DTEs for transmit and receive lines must be crossed. The DTE is usually a computer or a terminal device and the DCE is usually a modem.

2.4.3 IoT (Internet of things)

Home automation or smart homes is described as a technology which is used within the home environment to provide comfort, security, convenience, and energy efficiency to its user or occupants. By inclusion of the Internet of Things (IoT's), the research and development of home automation are going to become more and more popular. Different wireless technologies that supports remote data transfer, control and sensing such as RFID, Wi-Fi, Bluetooth, and also cellular networks have been evolved to add intelligence at various levels in the home

A huge majority of the technology experts and engaged Internet users who responded 83 percent agreed with the conception that the Internet of Things, embedded, wearable computing will have widespread and beneficial effects by 2025. Implementation of Internet of Things for Home Automation for billions of devices that can sense, communicate, calculate and potentially actuate.

Presents a practical and scalable solution that aims to achieve the Internet of Things (IoT) paradigm in complex contexts, such as the home automation market, in which problems are caused by the presence of proprietary and closed systems with no compatibility with Internet protocols. Home automation is an appealing context for the Internet of Things (IoT). We envisage future home environments with self-configured embedded sensors and actuators (e.g., in consumer electronic products and systems) that can be controlled remotely through the Internet, enabling a variety of monitoring and control applications. Manufacturers will produce their own IP gateways so that proprietary demotic systems can be interfaced with an IPv4 enabled Ethernet socket. The Dioptase solution aims at providing a common middleware layer that runs directly on the Things, enabling them to manage the huge volume of data continuously being produced (measurements, events, logs) Dioptase: data Streaming Middleware provides developer with new methods for writing distributed application for the Internet of Things.

2.4.3 GSM

GSM which stands for Global System for Mobile Communication, is the most popular standard for mobile phone communication in the world. It is used by over three billion people across more than 212 countries and territories (Wikipedia, 2009).

GSM basically provides voice call and short message service (SMS). It operates as a cellular network that mobile phones connect to by trying to search for cells in their immediate vicinity. The modulation used in GSM is Gaussian minimum shift keying (GMSK), a kind of continuous-phase frequency shift keying. In GMSK, the signal to be modulated onto the carrier is first smoothed with a Gaussian low-pass filter prior to being fed to a frequency modulator, which greatly reduces the interference to neighboring channels (adjacent channel interference). GSM networks operate in the 900 MHz or 1800MHz frequency bands in most countries of the world except in few countries like USA and Canada where 850 and 1900 MHz bands are used as the 900 and 1800 MHz bands were already allocated. The GSM technology uses a 200 KHz radio frequency channels that are time division multiplexed to enable up to eight users to access each carrier.

2.5 Conclusion

All the above study supports the improvement of home automation technology available now with integration of latest gadgets and technologies coming up due to large rate of enhancement and updates in newly developed technologies. Home automation actually started a continual process this can improve the economics of each every family as it highly supports energy saving parameter. (Kumar A., Kumari N. (IJSER, Jan-2015)) discusses factors relating the removal of man consciousness from daily small jobs.

This study also described architecture and implementation of home automation system. The proposed idea is to utilize nodes as an alternative to regular Switch boards in traditional home, thereby effectively converting it into Smart Home. The implemented system uses basic electronic development boards to minimize the system development cost. The cost effectiveness of the system can be justified by cost estimation as shown in the for the sake of comparison, costing of battery and relays are neglected. Although the total costing will vary depending on the number of nodes. It has also been discussed by so many researchers that selection of all the components which are going to be used in the system should not cost much and should also have long term implementation. Few Researcher also presents the design and the implementation of a low cost home automation & security system that has easy installation procedure (which makes the professional assistance unnecessary). The system has monitoring and controlling capabilities. The novel design uses a local Wi-Fi network including an embedded server. The home network can be reachable over Internet access and via smart phone application. Unlike the similar systems, employed embedded server makes the maintenance costs almost zero, the system cost

is low since low profile-high quality equipment (such as Wi-Fi chip, ARM µC, etc.) are used in the design.

The Internet has changed drastically the way we live, so study also says like Smart Home system integrates various electrical appliances in a home with each other using information technology, and it provides monitoring and controlling these devices automatically according to the user's need. After performing literature survey and studying other existing works, we proposed a Novel technique that will give us better understanding of the Environmental conditions in home with less human interaction. Our system not only just monitors environmental conditions and controls the devices accordingly but it also detects problems in any device automatically. Development of such Smart Home achieves by using Internet of Things technologies. And its intelligence increases even more by adding Naïve Bayes Algorithm for data mining. By using these systems we can actually manage to make low cost, flexible and energy efficient smart homes. It can also be concluded that, moving interactions between people at a virtual level in several contexts spanning from the professional life to social relationships. The IoT has the potential to add a new dimension to this process by enabling communications with smart objects, thus leading to the vision of “anytime, anywhere, any media, anything” communications. To this purpose, we observe that the Internet of Things should be considered as part of the overall Internet of the future, which is likely to be very different from the Internet we use today.

In one another study discussion with home automation system by defining four major applications of these systems which are comfort ability, remote control, optimal resource utilization and security. After that we see the detailed structure of home automation for implementing these services one by one explaining the working of each system and use of heuristic based tools in these systems. At the last we discuss about the applications of AI tools in all four types of home automation systems. From this discussion it is clear that AI is emerging as a very useful and applicable technology for Home automation. On the other hand, home automation systems provide AI a vast range of Application. There exist a number of AI tools that make an automation system more sophisticated but here we will discuss the knowledge based systems only as it is used frequently. The major differentiating factor of this system from previously discussed systems is that this is sequential while previous one was atomic, because, in this system the action to be taken depends upon the present and previous environment conditions.

Chapter: 3 Project Management

3.1 Initial Investigation

From basic research and reviews on the project methods, functionalities and application. The developer was able to observe that there has been a hike in Home automation from traditional Tools at home and mechanical machinery to semi-automatic or fully- automatic machinery.

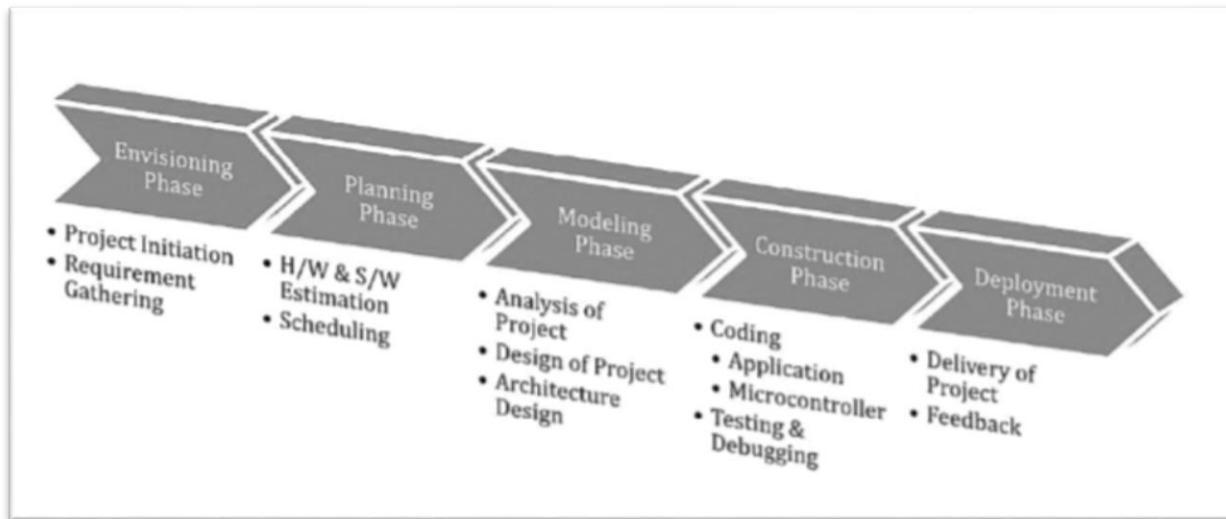


Figure 2: Project Plan

It was also observed that there are machineries for automation & security activity that holds similar concept or functionalities as the proposed system. Some such similar machinery include

- Cubilogs Smart home automation
- Wi-Fi based smart home automation system
- Samsung Smart Thing Hub

From the initial investigation on the approved topic the developer wishes to include number of functionalities to the unmanned field plugging robot including:

- Sensor Requirements: For detecting real environment and other signals parameters.
- Serial Communication: For semi-automatic control.
- Biometric Authentication: For integrating high class security and make system complete
- Mechanical Door locks: For controlling locking and unlocking using digital system
- Power Source: For providing energy to the system to process high amount of data for manipulation for that Renewable power source such as electricity is used.

- Web server: to interpret data that has to be used for applying further automation to the system to enhance human ease of living.

3.2 Project Planning

Effective project planning requires few guide lines.

- **Define Aim:** What is the developer indented to improve.
- **Be specific and clear about objectives:** What are the changes the system going to bring once it is implemented.
- **Breakdown project into simple tasks:** For easy execution smaller tasks are favorable.
- **Deciding what resources should be used:** On deciding and finding out whether the resources are available and feasible for implementation.
- **Decide when task are to be completed:** Make a deadline for completion of task, and make sure that the developer will complete it within the proposed timeline.
- **Conduct secondary research on the proposed system.**
- **Make primary research analysis for acknowledged information**
- **Time management:** Provide a specific time line for each task and always complete them within the specified time.
- **Research and findings:** Find out valuable information that will be helpful for the development of the project. Review and tabulate them.
- **Graphical Representation:** The project planning for the proposed system is represented using block diagram
- **Implementation:** After individual completion of task fragments each should be merged together. This includes the hardware and software parts, hardware assembly.
- **Review:** Always stick to the schedule and keep reviewing the tasks and progress.

3.3 Risk Management

Developing, progressing and completion of a project involve a number of risks. It is a non-avoidable factor and follows every developer to the completion of the projects. Risks can always be minimized or neglected. A good developer always sees that the risk associated with his or her project is properly managed. The developing of the system can face a number of risks, such as:

3.3.1 Scheduling Risk

It is a risk related to time management. It often occurs when an objective is not completed at the scheduled time. It can lead to delayed completion of the project effecting cost and performance.

This risk can be minimized by using work bread down structure and Gantt chart to plan and schedule every milestones leading to completion of the project.

3.3.2 Resource Risk

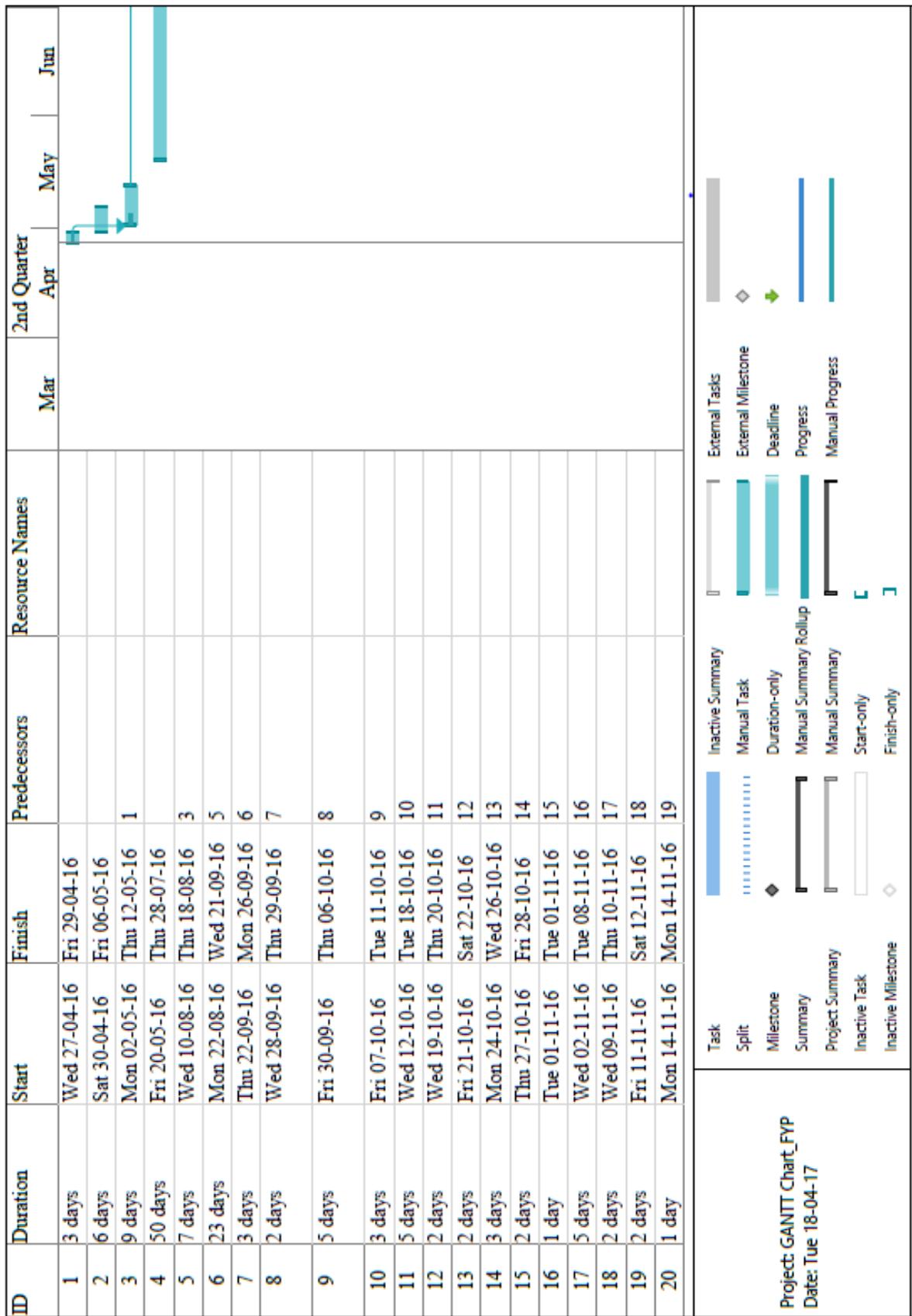
This risk arises due availability of resources for the completion of the project. It could be limited or unexpected fund the developer cannot afford during the mile stone completion.

The resource risk can be handled by making cost estimation to make sure that the developer will be able to afford the production charges.

3.3.3 Technology Risk

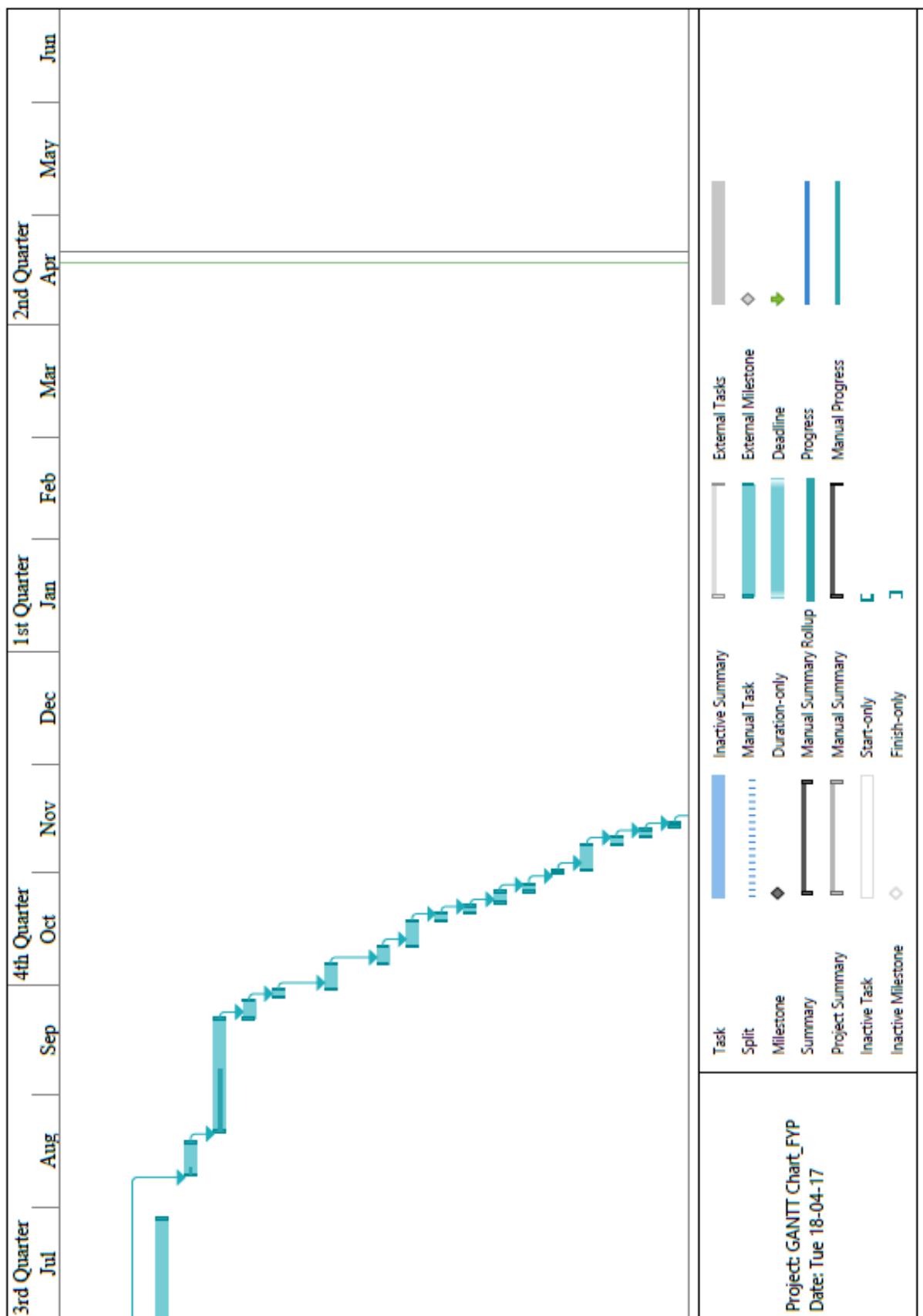
Technology risk arises due to hardware and software factors. Limited or unavailability of the components can lead to delay or failure of the project. In case of the proposed system technology risk includes any components like hardware, circuit components, software, etc. that could delay or failure the project. It can be managed by checking availability of components and software beforehand of project implementation.

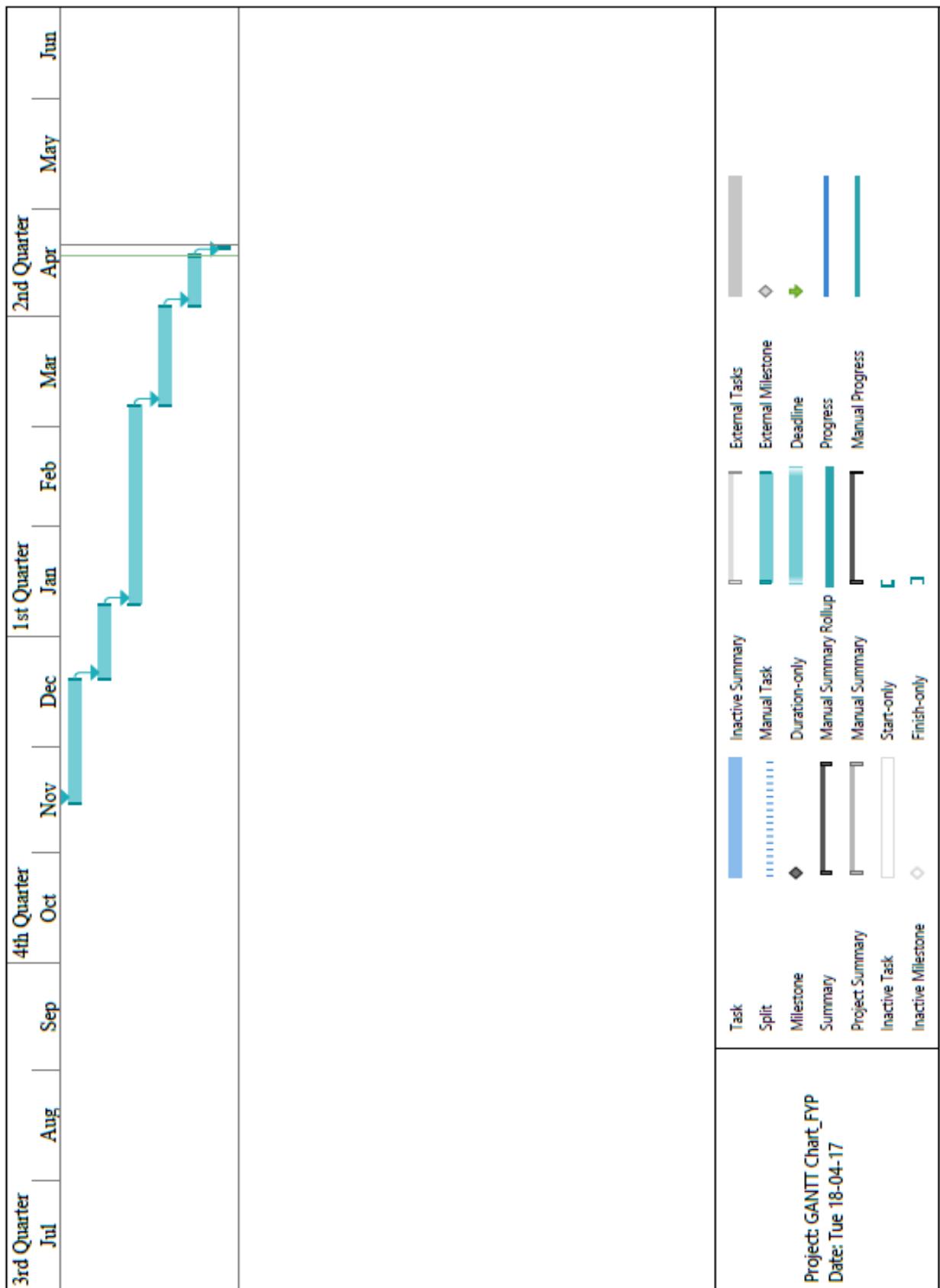
3.4 Gant Chart



ID	Duration	Start	Finish	Predecessors	Resource Names	2nd Quarter		
						Mar	Apr	May
21	25 days	Tue 15-11-16	Mon 19-12-16	20				
22	15 days	Tue 20-12-16	Mon 09-01-17	21				
23	40 days	Tue 10-01-17	Mon 06-03-17	22				
24	20 days	Tue 07-03-17	Mon 03-04-17	23				
25	10 days	Tue 04-04-17	Mon 17-04-17	24				
26	1 day	Thu 20-04-17	Thu 20-04-17	25				

Project GANTT Chart_FYP Date: Tue 18-04-17		Task	Inactive Summary	External Tasks
		Split	Manual Task	External Milestone
		Milestone	Duration-only	Deadline
		Summary	Manual Summary Rollup	Progress
		Project Summary	Manual Summary	Manual Progress
		Inactive Task	Start-only	
		Inactive Milestone	Finish-only	





3.4.1 Gant chart analysis

A Gantt chart, commonly used in project management, is one of the most popular and useful ways of showing activities (tasks or events) displayed against time. On the left of the chart is a list of the activities and along the top is a suitable time scale. Each activity is represented by a bar; the position and length of the bar reflects the start date, duration and end date of the activity. This allows you to see at a glance. Some 15 years after Adamiecki, Henry Gantt, an American engineer and project management consultant, devised his own version of the chart and it was this that became widely known and popular in western countries. Consequently, it was Henry Gantt whose name was to become associated with charts of this type.

Originally Gantt charts were prepared laboriously by hand; each time a project changed it was necessary to amend or redraw the chart and this limited their usefulness, continual change being a feature of most projects. Nowadays, however, with the advent of computers and project management software, Gantt charts can be created, updated and printed easily.

Today, Gantt charts are most commonly used for tracking project schedules. For this it is useful to be able to show additional information about the various tasks or phases of the project, for example how the tasks relate to each other, how far each task has progressed, what resources are being used for each task and so on.

3.5 Pert Chart

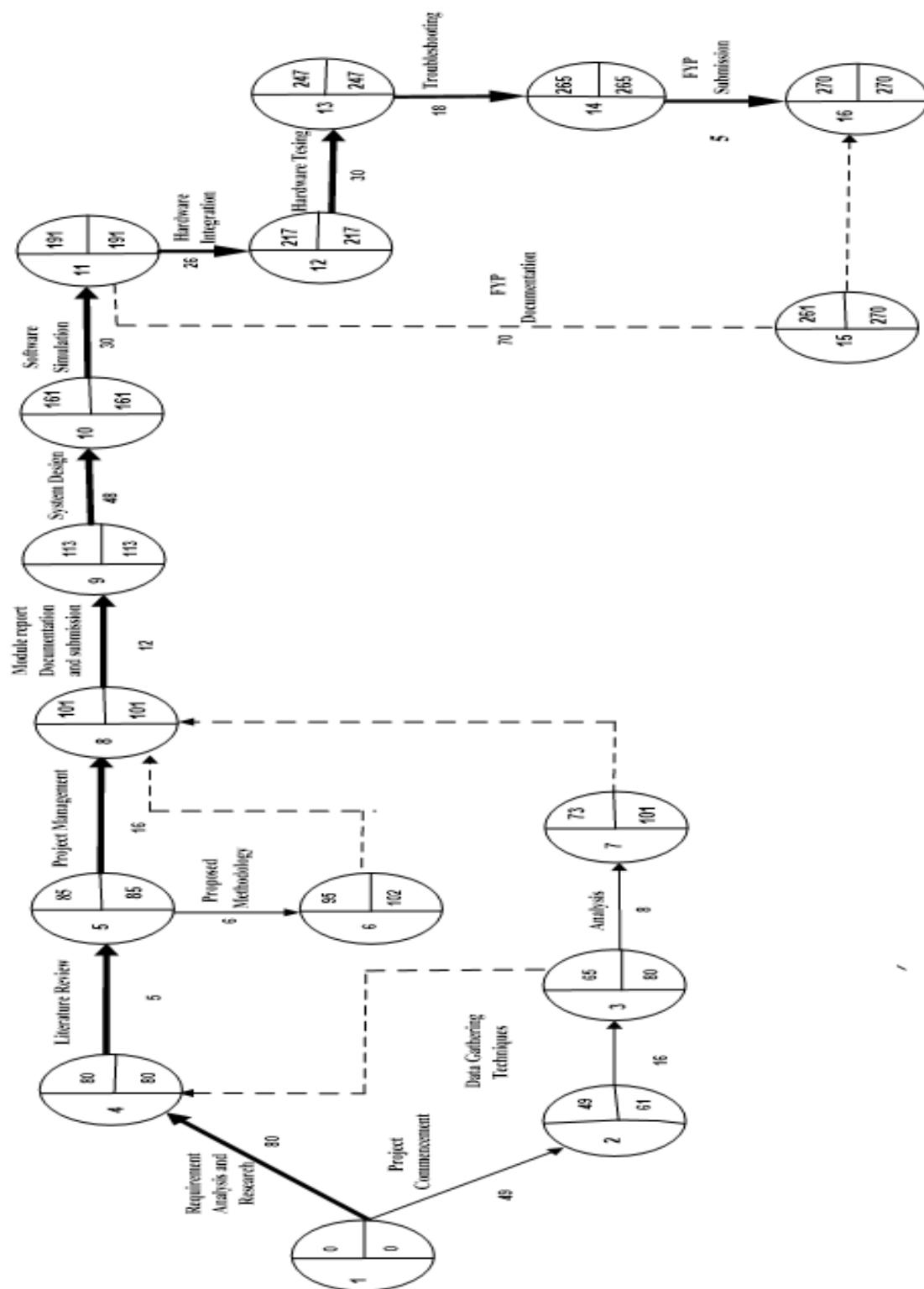


Figure 3: PERT Chart

3.5.1 Pert chart analysis

A PERT chart presents a graphic illustration of a project as a network diagram consisting of numbered nodes (either circles or rectangles) representing events, or milestones in the project linked by labelled vectors (directional lines) representing tasks in the project. The direction of the arrows on the lines indicates the sequence of tasks. In the diagram, for example, the tasks between nodes 1, 2, 4, 8, and 10 must be completed in sequence. These are called dependent or serial tasks. The tasks between nodes 1 and 2, and nodes 1 and 3 are not dependent on the completion of one to start the other and can be undertaken simultaneously. These tasks are called parallel or concurrent tasks. Tasks that must be completed in sequence but that don't require resources or completion time are considered to have event dependency. These are represented by dotted lines with arrows and are called dummy activities. For example, the dashed arrow linking nodes 6 and 9 indicates that the system files must be converted before the user test can take place, but that the resources and time required to prepare for the user test (writing the user manual and user training) are on another path. Numbers on the opposite sides of the vectors indicate the time allotted for the task.

The PERT chart is sometimes preferred over the Gantt chart, another popular project management charting method, because it clearly illustrates task dependencies. On the other hand, the PERT chart can be much more difficult to interpret, especially on complex projects. Frequently, project managers use both techniques.

3.6 Cost Estimation

Under This Project that, this is needed at this point to compare potential solutions and associated costs and will be one of the key factors for decision making. Items that will be supplied by homeowner (and excluded from my bid proposal). It is the process of generating relationship between cost object and cost driver for predicting the cost of the product. It is used for the management of the product. Cost estimation is used because of the following reason:-

- To develop standard cost of the product
- To determine the budget of expenditure, profit and cash flow

Below is the table explains the entire cost estimation of the system for the parts which will be used-

Sl. No.	Name of the components	Total Price in Rupees
1	Arduino Mega 2560 *1	800
2	IR Sensors *2	400
3	Rain sensor *1	109
4	Water Pump *1	270
5	Nod MCU ESP8266 *1	470
6	Battery Li-Po	630
7	Humidity & Temperature sensor DHT11 *1	180
8	Gas Sensor MQ5 *1	155
9	Stepper Motor with door lock *1	205
10	RTC DS3231*1	165
11	4 Channel Relay Module *1	180
12	2 Channel Relay Module *1	115
13	Finger Print Sensor *1	2400
14	SD Card module *1	235
15	Programming Cables *2	160
16	0 PCB Board *3	60
17	Headers *6	60
18	Exhaust Fan Small *1	199
19	Small Lamp *1	80
20	Small fan *1	160
21	Other pasting and mounting materials	200
22	Extra Tools needed	400
23	Android App Domain Purchase	145
	TOTAL COST	8533

Table 2: Cost Estimation

Labor Cost: As the entire project is going to build by the developer itself and no other assistance is required to the developer so no extra labor cost only the cost for the components will be required and considered as overall cost of the entire system.

And the total cost for all the components listed above come as equals to Rs 8533 and as this is estimation so it can highly reach to Rs 9000 and this will be final cost for developing the entire system.

As the entire system works on 12 volt power supply so not taking so much power but still if in a middle class family house total electricity usage is about 1800 units per month and if this system is being installed then only 4.3 unit of extra power usage will increase which with not effect much to the user and total hardware cost including the mini server will come up to Rs. 8000 and if I talk about the entire installation cost it might come up to Rs 12000.

As it is also noted that the entire system is connected with internet so consuming data also and for that calculation has done which gives almost 1GB of data usage per month which also doesn't matter when we already have unlimited data access plans by telecommunication companies. The complete description will be added in the report in which each part price wise description will be available.

3.6.1 Cost Estimation for the industry

Let us consider that industry makes 100 set of this system then the cost estimation will come as

Sl. No.	Name of the components	Total Price in Rupees
1	Arduino Mega 2560 *100	80000
2	IR Sensors *200	40000
3	Rain sensor *100	10900
4	Water Pump *100	27000
5	Nod MCU ESP8266 *100	47000
6	Battery Li-Po*100	63000
7	Humidity & Temperature sensor DHT11 *100	18000
8	Gas Sensor MQ5 *100	15500
9	Stepper Motor with door lock *100	20500
10	RTC DS3231*100	16500
11	4 Channel Relay Module *100	18000
12	2 Channel Relay Module *100	11500
13	Finger Print Sensor *100	240000
14	SD Card module *100	23500
15	Programming Cables *200	16000

16	0 PCB Board *300	6000
17	Headers *600	6000
18	Exhaust Fan Small *100	19900
19	Small Lamp *100	8000
20	Small fan *100	16000
21	Other pasting and mounting materials	20000
22	Extra Tools needed	40000
23	Android App Domain Purchase	14500
	TOTAL COST	8,53,300

Table 3: Cost Estimation Industrial

- For set up the machine for integrated circuit, industry needs to invest = Rs853300
- For set up the soldering machine, and other tools industry needs = Rs20,000
- Transportation cost for the industry = Rs 4000 (nearly)
- Electricity bill for industry = Rs6,000
- Labour Cost for each Set = Rs 1500

So the total cost for making 100 system, industry needs

Rs $(853300+20000+4000+6000+150000=10,33,300)$ Hence, the cost for the industry is Rs 10,33,300 for 100 units.

The cost for per unit of the system = Rs 10333

3.7 Cost Analysis

Cost analysis is an economic evaluation technique that involves the systematic collection, categorization and analysis of program or intervention costs and cost of illness. It allows researchers to achieve cost minimization for the programs under consideration with the goal to identify the least costly method to obtain a certain level of output. Cost analysis can also be used together with effectiveness assessment techniques within the frame work of three types of economic evaluation. In this project, costing is done in three different way such as user costing, industrial costing, and designer costing.

Chapter: 4 Research Methods and Analysis

4.1 Research

Analysis of a topic on different point of view is known as research. It is a process of investigation which helps the researcher to collect information on a subject he or she is looking for. Research is focused on relevant, useful, and important questions. It is a systematic and organized process. The purpose of research can be categorized into three exploration, description and explanation. Exploratory research is the initial research used for understanding a subject or learning its magnitudes; it gives the researcher an idea of the research topic and lays the base for future researches. Descriptive research helps to provide detailed knowledge and information on the research topic. Explanatory research explains the cause and effect on particular topic on which the research is conducted on.

The research technique can further be divided into primary research and secondary research. In the development of the proposed project the developer consider using primary research and secondary research techniques to collect data and analysis the collected data.

4.2 Primary research

Primary research is any type of research in which the researcher or the developer finds out the information or collect the data on his own. Different types of research include surveys, interviews, observations and ethnographic research.

Primary research includes collecting data which will be useful for later or secondary research such as journals, magazines or books. Primary research is basically used to collect information or data on a specific subject or topic of which the research has a little or no knowledge of or little research is there to back up the topic. Primary research is done when the researcher is working on a topic or subject which is relatively new or original and only a few publications exist on the subject.

In the project proposed on Artificial Intelligence based Home security and automation system the developer has to collect new data regarding different processes and the need or extent to which the proposed project will be beneficial to the society. The best way to collect information and opinions is through primary research methods since no data is available of the project. The primary research can be conducted through three different processes such as questionnaires, interview and Focus-group Discussion observation.

In the proposed project the developer uses Questionnaires, in-depth interview and Focus-group discussion observation to collect primary data.

4.2.1 Questionnaire

It is used to collect information from a large group of people. The response to the questionnaires will be strictly limited to queries drafted in the survey. In questionnaires the respondent is not allowed to express his views or opinions.

In the current research questionnaires are used to-

- Finding out the respondents view on home security and automation system
- Preference on automated machines and AI integration
- Impact of the project implementation among users

4.2.2 Interview

It is a primary research method used to collect valuable views and opinion on a particular topic. The number of respondents will always remain limited in interview when compared to questionnaire.

In the current research the developer seeks

- To obtain expert opinion on technology preference in home automation and security.
- Opinion on impact and future of intelligent automation in for home.
- Knowledge on different kind of technologies can be used in such kind of proposed project.

4.2.3 Focus-group Discussion Observation

It is a primary research method by which the researcher interacts with the respondent and becomes a part of the community or activity. In the present research developer tries to observe:

- Opinion on project functionalities
- Respondents opinion on feasibility
- Effects of automation & security using AI integration in smart homes

4.3 Why Primary Research analysis

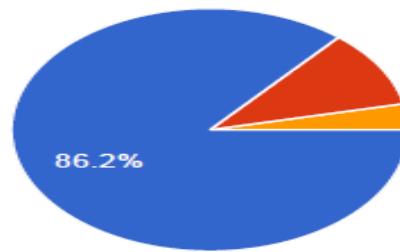
After completing the interview and questionnaires questions successfully the researcher distributes all of them to the concerned persons then the final data was collected. Finally, researcher analyses the result after completing primary research. The analysis is very important because collected data is of no use until and unless a proper analysis of the data is done. It helps the researcher in understanding the final requirements of the system and then further designing and implementation those functionalities in the system

4.3.1 Questionnaire Analysis

Questionnaire was given to people having close relation to technological project in which different age group of people has participated and given their feedback in which most of them were youngsters who are currently studying or work for some company having busy schedules and need this kind of system to save their time. Thirty different respondents were analyzed based on their answers. A set of questionnaires were distributed to several type of users of different age group along with gender criteria and their current occupation status. The main purpose of doing questionnaire is to know their views and analysis for betterment of the home security and automation system and to find the present flaws and satisfaction of the users with the present system and to know what else can be improved to satisfy the user to the extent of human touch by applying artificial intelligence technique to this system. The target user, audience responses are presented as graph to get a better insight and understanding. A conclusion of the questionnaires is given in the end.

Questions 1 to question 3 enquire about the details of the respondents on the basis of which the developer is doing analysis of the entire primary research data. In this data collected the questions enquired about the age of the respondent in which among 30 respondents 25 i.e. (86.2%) of the respondent were found of under an age group of 18 – 25 years old, among these thirty respondents 23 i.e. (76.7%) of them were male and else (23.3%) were female among these (86.7%) were students, (3.3%) were employed, (3.3%) were self-employed and (6.7%) were house-wife.

Age



18-25 Years	25	86.2%
26-35 Years	3	10.3%
36 years and above	1	3.4%

Figure 4: Respond Pie Chart (Age)

Justification: This question helps the developer to know that what age group respondents are interested or want to have a home security and automation system in their home.

Analysis: From the data collected the developer is concluding that the age group between 18-25 years old respondents are more interested in such kind of product because they are mostly in touch with such kind of technologies and they are more reliable to use such kind of system described.

Gender

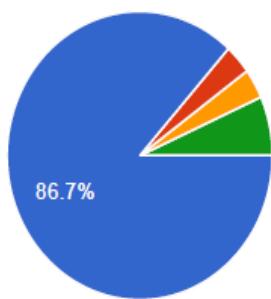


Figure 5: Respond Pie chart (Gender)

Justification: The developer is trying to know whether a male or female are more interested in technological home security and automation product.

Analysis: From this observation the developer has concluded that male are more interested in such kind of products to use efficiently as they have much work for what they are lazy to execute majorly of age group 18-25 years.

Occupation Status



Student	26	86.7%
Employed	1	3.3%
Self Employed	1	3.3%
House wife	2	6.7%
Other	0	0%

Figure 6: Respond Pie Chart (Occupation Status)

Justification: By asking this question the developer is trying to understand that what kind of people in concern with their occupational status are having need of this kind of system and they want to get this system installed in their home.

Analysis: Developer has concluded from the data observed that student are in very concern with technological products are too busy in their lifestyle are having very much requirement of this and on the other hand house wife and self-employed are very less likely to have this system in their house.

Question 4 to Question 8 was drafted to gather information about if any respondent have any kind of home security and automation system. Majority of the respondents i.e. 83.3% of them wants to update their home with technological projects, whereas (16.7%) don't want to take part in such kind activity. Question 4 was asked about the kind of residence they are staying in this data helps the developed to design the system in a way that the system goes versatile for almost every kind of home, (56%) of the respondents have primary home and the other (44%) are staying in other kind of house such as vacation home(3.3%), Newly constructed home(6.7%), Single family home(20%) this data clearly states that the design of the system should be maintained for primary house & single family house. In the same section question 6 was asked to know the respondent who uses smartphones, from the responses analysis came out as all the respondents (100%) of them uses smart phones. After that Question 7 and Question 8 were asked to know the data about having some kind of same system as proposed with the respondents,

analysis came out from the collected data was that almost (80%) of the respondent doesn't have any system as proposed, (20%) of them have and they have it either in very expensive or the system is giving unsatisfied response.

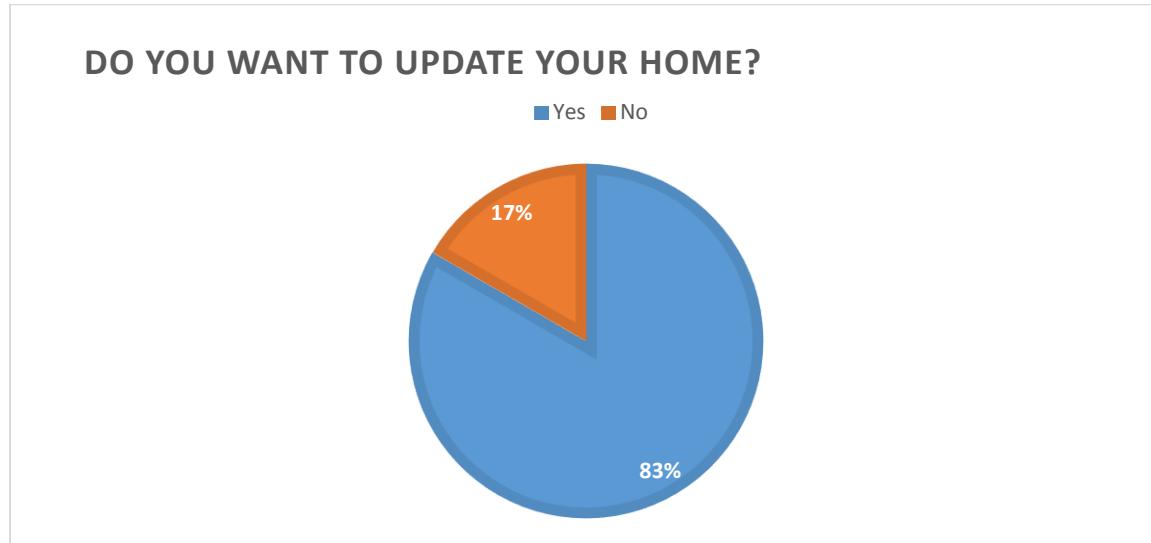
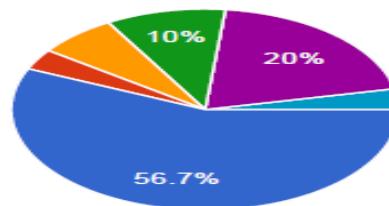


Figure 7: Responded Record (Q4)

Justification: By asking this question developer want to understand that how many user who answered the questionnaire are aware of this system functionalities and they understand that there is a high need of such kind of intelligent home security and automation system.

Analysis: The recorded data lets the developer conclude that there is actually a high requirement of a complete home security and automation system and the system described is the best solution to make they live a live with ease.

What type of residence you are staying in?



Primary Residence	17	56.7%
Vacation Home	1	3.3%
New Construction Home	2	6.7%
Existing home Remodel	3	10%
Single family Residence	6	20%
Other	1	3.3%

Figure 8: Pie Chart (Resident type)

Justification: By asking this question the developer will understand that what kind of home the needy people want to automate or i can say I am trying to know the size of their home and what are the things available in their house that they want to automate with intelligence.

Analysis: By doing the analysis of this recorded data the developer understand that till what extend a house can be automated according to their own requirement and what kind of resident they want to automate along with analyzing the system development in the same direction.

Do you use smart phones, tablets, or other smart mobile devices?



Figure 9: Pie chart (Smart Phone availability)

Justification: This question was framed to know that how many respondent are fulfilling the pre-requirement of the system being developed i.e. having personal smart phone which are having android platform based operating system.

Analysis: The result from the responded clears that all of them retain a smart phone which gives a very good feasibility of this system towards fulfilling the pre-requirement for the installation of the system being developed.

Do you have a home security system?



Figure 10: Pie Chart (Q7)

Justification: This question is framed to know how many user are already having a security system installed in their home?

Analysis: The recorded response clears that very few of them have any kind of digital security system installed in their home and most of them does not but they are seeking for that.

Do you currently have a home automation system?



Figure 11: Pie chart (Q8)

Justification: This question is framed to know how many user are already having a home automation system installed in their home?

Analysis: The recorded response clears that very few of them have any kind of home automation system installed in their home and most of them does not but they are seeking for that.

Are you hoping to begin updating or automating your home? (If 'No' for 7 & 8).



Figure 12: Pie Chart (Q9)

Justification: This question is draft to know about those all respondent who doesn't have such system but they want to automate their house?

Analysis: (Data collected say (80%) of the respondent doesn't have any such kind of proposed system) and in this case either they want to or they do not want to install this kind of system in their home.

Do any family members have physically limitation for consideration?



Figure 13: Pie Chart (Q10)

Justification: This question was framed to understand that if anyone in the family has any issue with physical limitation?

Analysis: The observed data helps to understand if the system need to also work in the area to help those and make their living style easy who are physically disabled. Basically this analysis justify if there is need of any kind of feature in the system for physically limited people.

What are the major area you want to be involved for automation in your home?

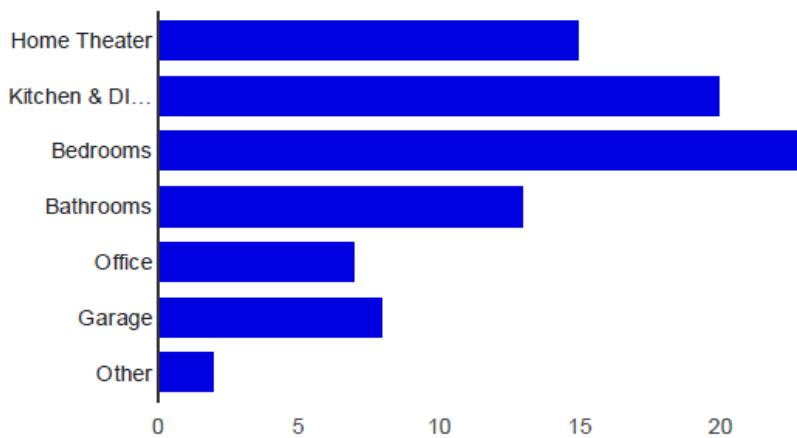


Figure 14: Bar graph (Q11)

Justification: This question was drafted to know in what area of their house, the respondent want intelligent automation this actually mean what are the area in which the daily task is not getting done to maintain energy saving and in those area what kind of automation requirement is there as the respondent think off.

Analysis: Analysis of the recorded data for this question also gives priority of the area people want to be automated in their home which are in the series below.

- Bed-Room
- Kitchen & Dining
- Home-Theatre music cum video system
- Bathroom
- Garage
- Office & else other.

Question 12 to 16 were framed to know about the details of competitive product their available in the market and user are using them and sharing their experience to actually help in improving the functionalities and feature of the proposed system. For this question the analyzed data from response come up with few names of competitive companies i.e. LG, Godreg, Sigmotel, Cubilog and so on along with that come to know with some dates on which the contract or warranty or can say maintenance services are ending for the current users. Question 14 of this section lets the researcher understand the market price of proposed kind of system and compare the available and proposed system price and features and authorize the developer to get idea about most feasible and successful system.

Is your system connected with your smartphone?



Figure 15: Pie chart (Q16)

Justification: This question was framed to understand the problem context for system the users are already using and they want improvement in that.

Analysis: The observed data helps the researcher to know about a major functionality of the existing system that if their system are connected with smart phone and the response says (84%) of the existed system doesn't have smart phone connectivity.

Are you able to manage your current system from smart phones , tablet, or other mobile devices?



Figure 16: Pie Chart (Q16)

Justification: This last question was framed to understand that if the user's current system is connect with smartphone? Are they able to use that properly in a very user friendly way?

Analysis: The analysis says (76%) of the respondent are not able to use them accordingly. As the provided platform are GSM based and they not user friendly and helped to understand the need of better GUI based control.

Conclusion

On concluding the questionnaire analysis the respondents emphasized their interest in home security and automation. Their responses conclude that people want to save energy, time and want an assistant in their home to assist them for kind of easy work to be executed automatically and biometric based security system made the respondents tilt toward this project as this project with all the proposed feature comes out as a complete intelligent home security and automation system.

4.3.2 Interview Survey Analysis

The interview was conducted to analyze about the idea of developing an intelligent home security and automation system. In this process 20 persons were interviewed of different age group and

economy as they can say their requirement for the future and current development of this kind of project. Relevant question were asked from them during interview and accordingly pie chart and other conclusion from the transcript has been discussed in this report. Through the extracted figures from the questionnaire, some facts can be pointed out to understand consumer's behavior in regard to the technology offered.

The first question intends to find out what is the first idea consumers have when the topic Home Automation is discussed. The most chosen alternative involves people who think it is an attractive option, however they do not know much about the topic. Combining this with the people who do not have an opinion about it, it sums (70%) of the total. This emphasizes that despite liking the sound of the Home Automation, the concept has not completely reached people's awareness and it results in lack of knowledge. As a result, this absence of information could be the explanation the demand might be defined as low and the reason why products/services have never aroused and provoked a great interest on consumers.

Another important point in this questionnaire was related to the user's main motivation to adopt Home Automation. More than (75%) responded that Security (60%) and Comfort (67%) are their favorite option, which can delimit some areas the business can focus its operation on. Nonetheless, there is a downside which is about their perception around the cost-efficiency. The idea of investment is still distorted and most of them (30%) of the total associate these products/services with high prices of acquisition, installation and maintenance as the leading cause for not purchasing it.

The question number 8 also indicates that by acquiring these technologies, customers' time might be spent on tasks in order to keep all the devices working properly or as the way they want which is due to maintenance and customization as well. So (21%) of the interviewees might consider it superfluous.

Therefore, with the purpose of discovering a possible solution for the cost issue, the question number 6 presents some potential alternatives that might be considered attractive to customers and would make them interested in adopting this lifestyle. As expected, the majority chose Affordable Price as their main aspect with (33%) of the total. Following it, we have Transparency of the Investment and Cost, Demonstration of Efficiency and Timely and Regular Maintenance provided by the company with (23%), (22%) and (22%), respectively. Even though the Demonstration of Efficiency had a certain balance amongst the other

alternatives apart from Affordable Prices it is a topic which aroused lots of questions from customers about its implementation and how this demonstration would be like. It can be used as a good starting point for customers to understand and perceive the whole idea of using such product/service. Linked with it, there is the Transparency of Costs, which can be placed as the following step after the demonstration part. By understanding and assimilating the functionalities and benefits, customers will be able to judge with more precision what is convenient and useful to them and besides they will be capable of analyzing the cost-investment they are making.

There is another important characteristic related to question 6 which consist of is that although the interviewees judge the Affordable Prices something that would give them a chance to try using Home Automation, the perception of cost-investment is considerably different. This argument can be seen in the question 7 where asked how much of investment would be reasonable for them to cover all the needs with automation This information is of great significance for the company to elaborate its set of offerings in a way not to launch cheap which may be perceived as of not good quality or overpriced, which may become unaffordable to consumers.

Conclusion

In conclusion, some findings identified in this target market analysis can be used to drive the company's strategic towards consumers. The following list gives us some of the highlights already discussed in this work and will probably be used to position and target the market which it will be included.

4.3.3 Focus-group discussion observation Analysis

Recognition of the benefits associated with smart home technology for energy, security, safety, convenience, and communications management within residential housing is still quite low. This lack of understanding may be exacerbated by the technology suppliers who have often focused their marketing efforts on the prestige housing market by highlighting aspects unrelated to the practical benefits available from smart home systems. Whether the market recognizes these intrinsic benefits and is prepared to pay an appropriate premium for them is currently unknown. Therefore, this conclusion examines the monetary value (if any) added by the inclusion of smart technology in new homes. In addition, this research seeks to understand how new home-buyers value the use of "smart technology" and its associated capabilities. The aim of the research was to establish whether inclusion of smart technology adds to the market value of new houses

- To provide an indication of the likelihood of the future acceptance of smart technology within the residential market, enabling the development of more effective strategies to encourage its inclusion into new housing;
- To determine the characteristics of those homebuyers who have demonstrated an interest in the use of smart technology; and
- To discover the impact of smart technology on home purchasing decisions.

The main aim of the research was to measure the price premium that a group of new homebuyers would pay for smart technology. The objective was to determine if the value of smart technology is reflected in the market price of the new homes. In addition, it is important to identify the characteristics of that group in order to compare them with the total population of homebuyers in Melbourne, Australia. The respondents of the control group were randomly selected and were considered to be typical of other middle-income homebuyers elsewhere in the community.

Demographic factors

The first section of the survey investigated the demographic background of respondents. This information was used to forecast demographic characteristics of the various groups in relation to smart home technology. Data collected in the Appendix summarizes the comparative classifications based on analysis of the respective survey responses from both case study and control groups. Responses from both groups reveal a very similar profile in most classifications.

Factors influencing purchasing decisions

In addition to the above demographic data, the survey respondents were also asked to rate the importance of a number of factors that impacted on their new home purchasing decision. Respondents were required to rate their attitudes to factors considered to be important in use of smart technology, using a five-point Likert scale; the level of importance of these factors was collected for both groups. Once again the responses from both groups were reasonably similar, with location; value for money; layout, accommodation and usability; and quality, being rated highly by both groups. All categories except adaptability for home office returned a mean score of 12 (of 20); this relates to “reasonably important” or better.

Discussions and conclusions

Smart technology represents a major step forward in the development of Indian housing. As with any property decisions developers must make their own assessments on system choice and applicability, including the associated costs and margins. This research proves that the technology adds value to residential housing which indicates that suitable target markets may be

larger than first thought. This research indicated that most survey respondents were happy to use modern high technology equipment in their household. The research also indicated that “quality” was a highly rated factor in people’s general purchase decisions. Respondents also indicated that “value for money” and “builder’s reputation” were the two important features they consider when choosing new homes. Many property professionals and tradespeople still do not fully understand the characteristics, capabilities and attributes of automated home systems. While this low level of understanding of the technology at a technical and professional level exists, the uptake of smart technology by the wider new home market may also remain at a relatively low level. This situation could create market opportunities for developers and builders who recognize the potential of the technology. By developing a strong understanding of the systems and offering it as part of their new home packages, developers could obtain a marketing edge over their competitors. Interpretation of the survey responses suggests that properly marketed smart home systems could have a broad market appeal to new homebuyers. The market analysis study showed that a considerable premium over normal housing was being paid for homes featuring elements of smart home technology. The results showed that there is a \$300/m² differential which emerged in the net added value of the improvements. While some minor differences between the homes may still occur due to slight variations in the quality of finishes and other intangibles, the results suggest that the use of smart technology is a significant contributing factor to the price premium. Evidence from smart home technology suppliers suggested that there has been some reluctance from women and the elderly to embrace smart home systems, two groups who could derive significant benefits from the technology. However, the survey responses in this research indicates that there now seems to be widespread interest in the inclusion of a basic smart technology in a new home.

Chapter: 5 Proposed Methodology & Hardware Selection

5.1 Proposed Methodology

It is outlining the strategy for conducting an investigation in order to answer his objectives of project. In this section, the method, approaches and procedures are explained which will be going to use in designing or completing the project. Specific tools will be described and evaluated and it helps to determine which one will help to meet project goal.

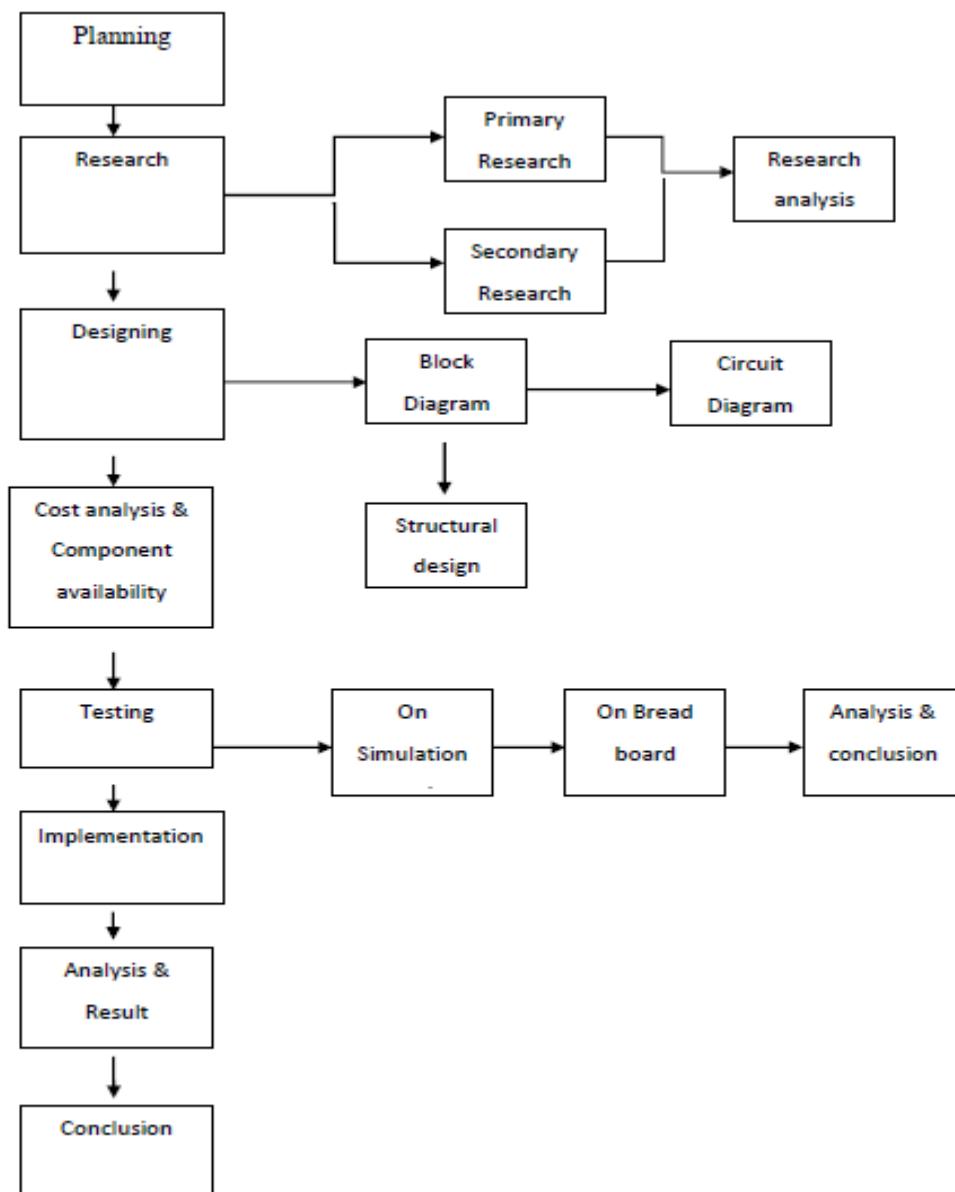


Figure 17: Block Diagram of Proposed Methodology

5.2 Planning

Planning is the process of thinking and organizing the activities which is required to achieve desired goal. Generally, it involves the maintenance and creation of a plan. Planning is basically a thought process which is essential to the creation and refinement of a plan or integration of it with other plan.

There are following steps used to create an effective plan:

- Knowing the goal and purpose of project: Successful professional understand a simple core concept that if don't know about the goal or where are you going, you are likely to wind up anywhere.
- Be Specific: Specifying not only goal but also creates an intention as well as specific task that will move towards the completion of goal.
- Create measurable milestones: It is very important for the completion of goal. Set up the small-small objective which leads to completion of project.
- Creating a list and accompanying time line of specific action items and tasks to complete in order to hit those milestones.
- Some tasks seem more daunting to achieve than others. So, break the large tasks in to smaller and more manageable chunks.
- Create specific time frames ad deadlines and without these the work will definitely expand to fill the time allotted and may be some tasks never get completed.
- After creating specific time frames, creates a visual representation like flow chart, Gantt chart, spreadsheet or some other type of business tool to accomplish this.
- Once the plan is established then sharing with the others like supervisor and accomplishment are supervised. Finally, take daily action and follow-up with responsibility.
- Occasionally, unforeseen events can arise that can affect the schedule, deadlines and also create problem in the completing of goal. Change the date of milestone but never give-up on the goal.

This system is capable of making intelligent decision by analyzing the environment by using sensors to save electricity and provide required environmental conditions such as, switching lights on/off by analyzing the intensity of light available in the real environment and switching multiple installed light according to user work desire along with checking efficiency then the most efficient light will be switched on automatically or can be done manually using the android

app. and when the last person leaves the room all electrical appliances which is not being used will be automatically switched off to save electricity.

Data log feature- This system has a data logging feature which enables it to record information about switching the electrical appliances along with timing details and how that was executed along with it also records the temperature & Humidity of the room environment at regular intervals, and after this; by using a thermostat the system will be able to maintain required temperature and humidity according to user need. Using the same logging feature it will attempt to save more energy than previous month without getting in the way of user's usual living style. This system is also designed to track/manage sleeping pattern of the user e.g. this will be able frame a schedule to wake up the user at specified time in the sleep cycle where the user is most likely to wake up and feel active. Also capable for turning off mobile/other charging adaptors when they are not being used e.g. when the device has been unplugged from the adaptor and the user doesn't switch it off AIHSAAS will do it by own without acknowledging the user which again help to reduce electricity bill and protect the adaptor from being used unnecessarily similarly it will do it for T.V., stove as well as gaming consoles (will be done using sensors). Work as an intelligent assistant, able to wake up the user in the morning with weather updates, can make coffee in the morning, reminder for medicines as well for favorite T.V. shows timings and will notify the user to take off drying cloths when the weather gets changed to rainy or windy. NFC (Near Field Communication) feature is being enabled in this system which let the user switch off all the lights in the room when the mobile phone of the user is kept on the table beside bed while going to sleep to provide ease of living.

5.3 Artificial Intelligence

A new London startup wants to make controlling a smart-home more natural and intuitive. The startup, AI Build, is making a home-hub prototype that it says will make turning on a light as easy as asking your mate to get up and do it. It plans to do this through the introduction of the addition of 'teachable' programming and visual input methods to instruct a home-hub. Current models rely on voice or the use of apps for input of instructions. But AI Build's prototype will be the first to include a range of cameras as well, according to Daghan Cam, cofounder and chief executive officer of the startup.

The device will attach to the ceiling of a room in a connected home. It will have an array of six cameras each covering 60 degrees to give it a 360 degree perspective of the room. The in-built

computer can then be taught where objects are in the room, to recognize certain people and to respond to a range of motions and gestures.

“The idea is to make home automation as easy as asking a friend to turn on a light,” he explains. “You’d ask your friend and point at the light you’d want to activate. Compare that to what’s currently on the market. Currently a mobile app takes multiple steps to activate. You unlock your phone, you open the app, and you tell it to turn on a specific light. This is more natural. Instead of using a mobile or a remote control, you use existing skills and natural language.”

To facilitate this the AI Build hub will use algorithms to give itself reinforcement learning. This means over time it should be able to pick up the natural gestures and voice idiosyncrasies of frequent users. Users can customize it to respond in certain ways to specific gestures – although it will come pre-programmed with a standard set of commands for most functions.

5.4 Hardware Selection

In the earlier chapter of cost estimation all the list of hardware has been mentioned now under this topic all the block and circuitry explanation of all the selected hardware components will be discussed so that a brief description about all the components should get cleared.

5.4.1 Arduino Mega 2560:

The Arduino-Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARts (hardware serial ports), a 16 MHz crystal oscillator, 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 an AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

Microcontroller	ATmega2560
Operating Voltage	5V
Digital I/O Pins	54 (of which 14 provide PWM output)
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Analog Input Pins	16
DC Current per I/O Pin	40 mA

DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by boot loader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

Table 4: Arduino Mega Details

The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

Programming

The Arduino Mega can be programmed with the Arduino software. The ATmega2560 on the Arduino Mega comes pre-burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header.

Schematic Circuit Diagram

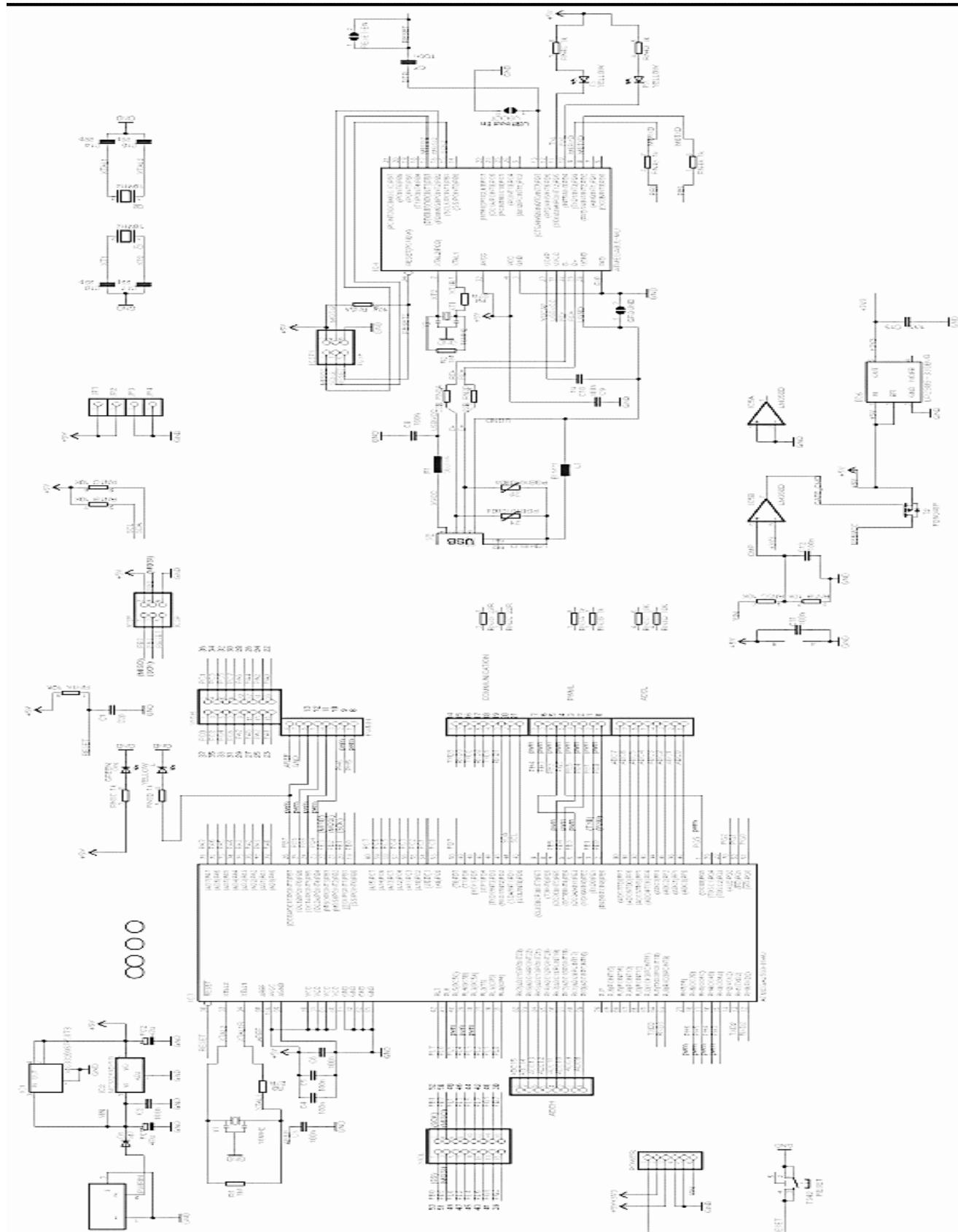


Figure 18: Arduino Mega Schematic Circuit Diagram



Figure 20: Arduino Mega-Front

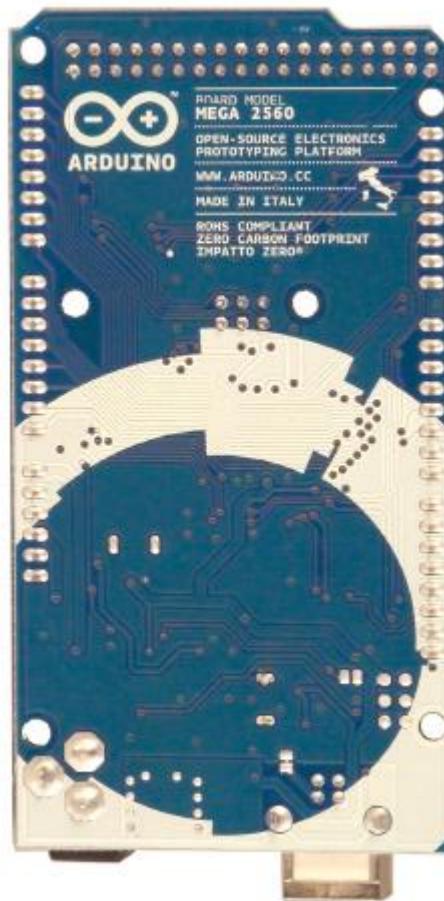


Figure 19: Arduino Mega-Back

Like its little brother, the Arduino Mega 2560 serves as a great development platform for 8-bit microcontroller projects. The additional I/O and serial ports and plentiful code space in the Mega provide significant advantages over the Uno or other previous-generation Arduino boards. What is great about the Mega, and the Arduino family as a whole, is the ability to transport your code from one hardware solution to another and even beyond to your own custom PCBs. Once you run out of resources on one of the smaller boards, and with only minimal code changes and a simple board selection in the Arduino IDE, you can be up and running on the Mega with ease. I would strongly recommend the Arduino Mega 2560 if your project has outgrown the Uno and you can afford the extra price and board size.

5.4.2 Infrared Sensors:

The IR Sensor-Single is a general purpose proximity sensor. Here we use it for collision detection. The module consist of an IR emitter and IR receiver pair. The high precision IR receiver always detects an IR signal. The module consists of 358 comparator IC. The output of sensor is high whenever it IR frequency and low otherwise. The on-board LED indicator helps user to check status of the sensor without using any additional hardware. The power consumption of this module is low. It gives a digital output.

Application Ideas

- Obstacle detection
- Shaft encoder
- Fixed frequency detection

Pin Configuration

Pin No	Connection	Description
1	Output Digital	Output (High or Low)
2	VCC	Connected to circuit supply
3	Ground	Connected to circuit ground

Table 5: IR Sensor PIN Description

The figure shown below are schematic and a top view of the IR Sensor module. The following table gives its pin description.

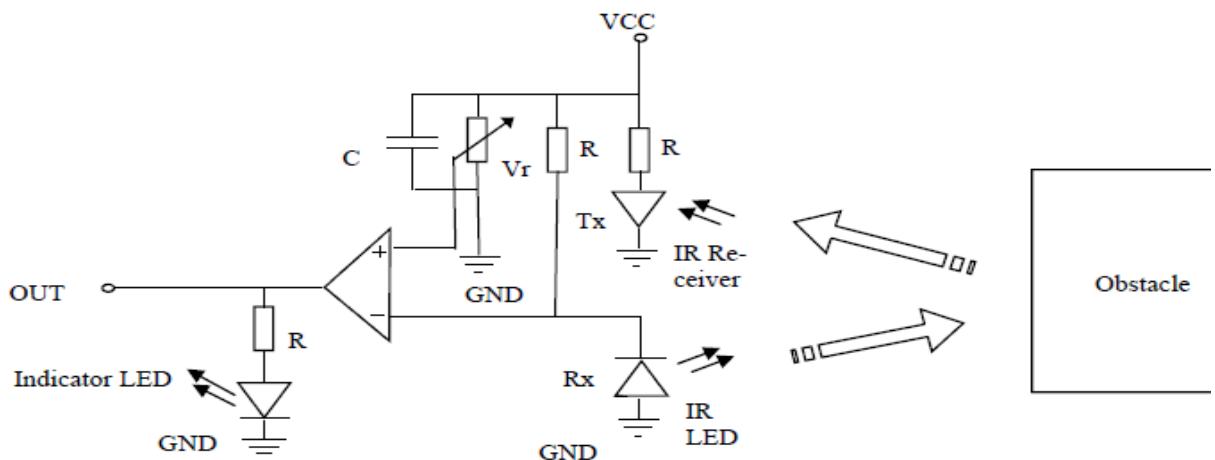


Table 6: IR Sensor Module Schematic

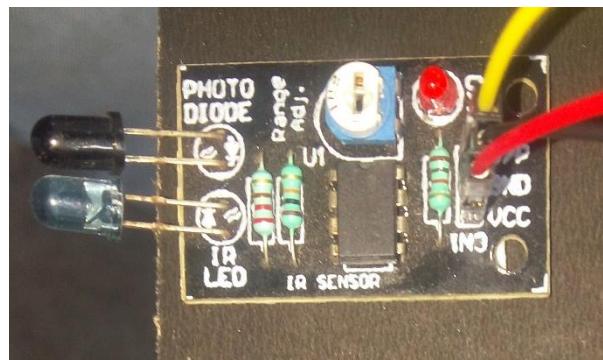


Figure 21: IR sensor module

5.4.3 Rain Sensor:

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level.

Specifications

- Adopts high quality of RF-04 double sided material
- Area: 5cm x 4cm nickel plate on side
- Anti-oxidation, anti-conductivity, with long use time
- Comparator output signal clean waveform is good, driving ability, over 15mA
- Potentiometer adjust the sensitivity
- Working voltage 5V
- Output format: Digital switching output (0 and 1) and analog voltage output AO
- With bolt holes for easy installation
- Small board PCB size: 3.2cm x 1.4cm
- Uses a wide voltage LM393 comparator

Pin Configuration

1. VCC: 5V DC
2. GND: ground
3. DO: high/low output
4. AO: analog output

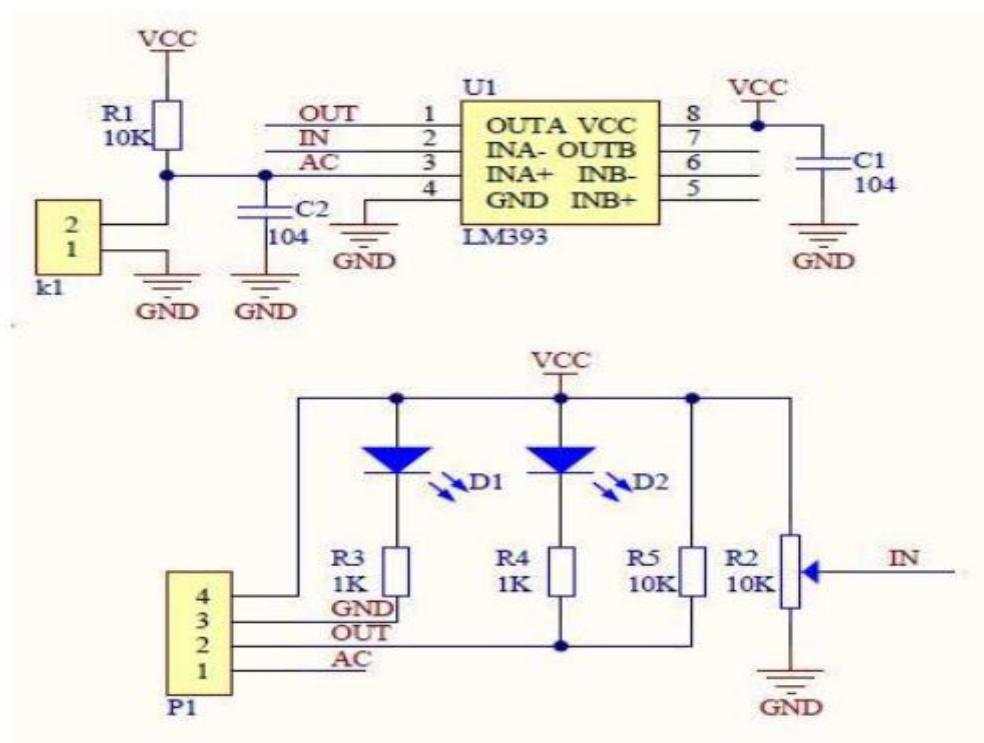


Figure 22: Rain Sensor Schematic



Figure 23: Rain Sensor

5.4.4 Nod MCU ESP8266:

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor.

When ESP8266EX hosts the application, it boots up directly from an external flash. It has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface). ESP8266EX is among the most integrated Wi-Fi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area. ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the Wi-Fi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs; sample codes for such applications are provided in the software development kit (SDK).

Features

- 802.11 b/g/n
- Integrated low power 32-bit MCU
- Integrated 10-bit ADC
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLL, regulators, and power management units
- Supports antenna diversity
- Wi-Fi 2.4 GHz, support WPA/WPA2
- Support STA/AP/STA+AP operation modes
- Support Smart Link Function for both Android and iOS devices
- SDIO 2.0, (H) SPI, UART, I2C, I2S, IR Remote Control, PWM, GPIO
- STBC, 1x1 MIMO, 2x1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4s guard interval

- Deep sleep power <10uA, Power down leakage current < 5uA
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)
- +20 dBm output power in 802.11b mode
- Operating temperature range -40C ~ 125C
- FCC, CE, TELEC, Wi-Fi Alliance, and SRRC certified

Major Applications

- Home Appliances
- Home Automation
- Smart Plug and lights
- Mesh Network
- Industrial Wireless Control
- Baby Monitors
- IP Cameras
- Sensor Networks
- Wearable Electronics
- Wi-Fi Location-aware Devices
- Security ID Tags
- Wi-Fi Position System Beacons

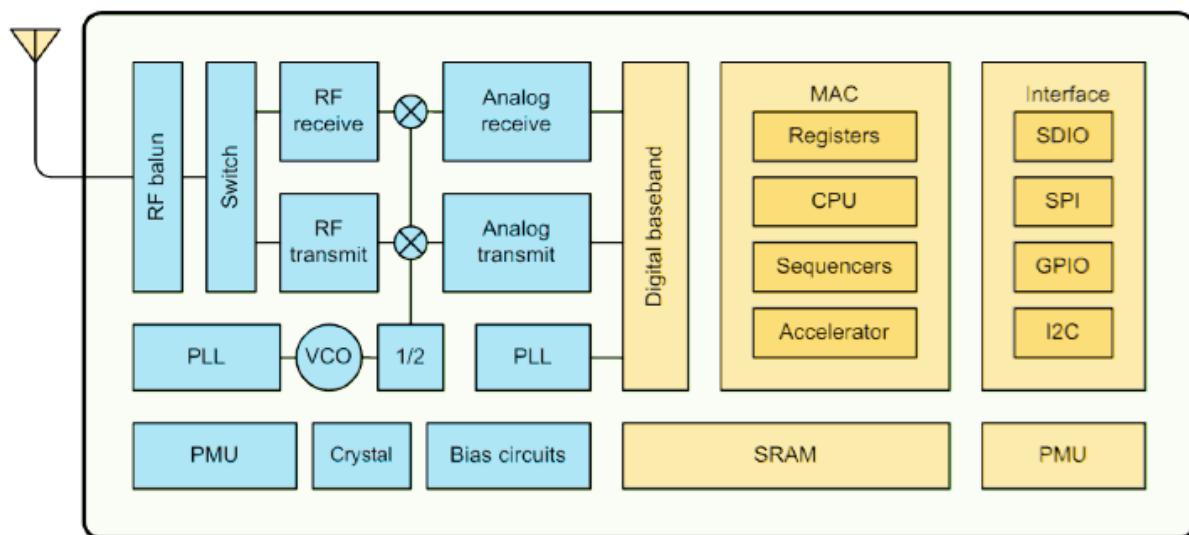


Figure 24: ESP8286 Block Diagram

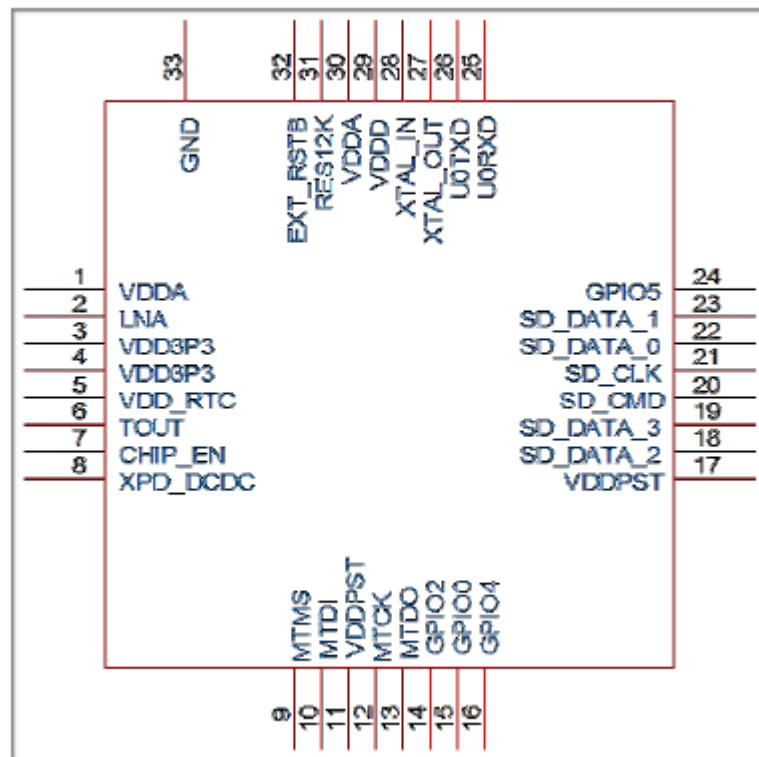


Figure 25: ESP8266 Pin Assignment

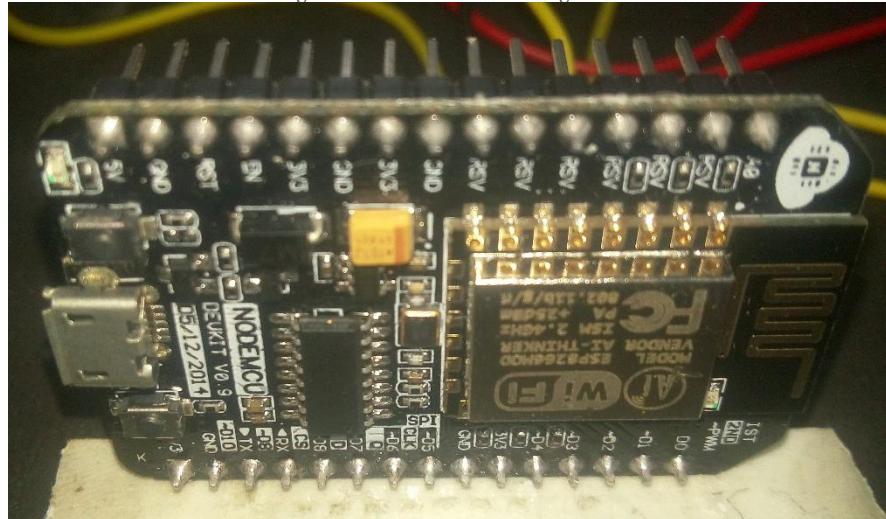


Figure 26: ESP8266 Hardware

5.4.5 Battery (Li-Po)

Li-Po batteries that are used in most of the electronic devices. Developer is looking to know the difference between Li-Ion and Li-Po batteries and want to check the battery of your device to have a long life this article to find out the difference between Li-Ion and Li-Po batteries and the features of these two batteries. You will come to know about certain safety tips and the tips to increase the life of Li-Ion and Li-Po batteries. As we use many types of batteries to run the various devices. These batteries are cheap dry cell batteries or the most advanced Li-Ion of Li-

Po batteries. Dry cell batteries are only for one time use as these batteries are not durable and provides very less backup. These batteries are not suitable for modern electronic devices. After this, rechargeable batteries called Ni-Cd came in the market. These batteries were cheap and could do well. But, lacked backup capacity. The backup issue resolved with Ni-MH cells, as these cells had a large storage capacity. But, it was taking more time to recharge. A 2100 mAh battery could take up to 15 hours of charging fully and safely. Then, the Lead-Acid batteries came in the market, these batteries were heavier to use in the electronic devices. The solution to all these backup problems came in the form of Li-Ion and Li-Po batteries. These batteries could charge very fast and available with very light weight. Also, these batteries are capable for large backup capacity.

Advantages and disadvantages

Li-Ion and Li-Po batteries comes with a great advantages than the batteries before used. Li-Ion and Li-Po batteries come with features like fast charging, light weight and long durability. These batteries used in almost all power consuming electronics equipment like Laptops, Digital cameras, Mobile phones, PDAs, Notebooks, Camcorders and more such devices. We can use these batteries at any point of charge. This means, we can use the battery even when it is not fully charged. Since there are no memory issues, these batteries are charging at any time. These batteries have a very long storage life and a low natural discharge. These batteries has some disadvantages also. You need to replace these batteries after every two to three years. These batteries are highly sensitive, as the high temperature and heat causes them to discharge very fast. Also, these batteries can damage if you completely discharge them. Very rarely, these types of batteries might burst into flames due to some inherent defect inside them. Both batteries have their own advantages and disadvantages. So, if the new technology can make the batteries more secure and safe, along with increased power and reduction in the charging time, it will greatly benefit the technological world.



Figure 27: Li-Po battery

5.4.6 Temperature and humidity sensor DHT:

This DF Robot DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

Detailed Specification's

Parameters	Conditions	Minimum	Typical	Maximum
Humidity				
Resolution		1%RH	1%RH	1%RH
			8 Bit	
Repeatability			±1%RH	
Accuracy	25°C		±4%RH	
	0-50°C			±5%RH
Interchangeability		Fully Interchangeable		
Measurement Range	0°C	30%RH		90%RH
	25°C	20%RH		90%RH
	50°C	20%RH		80%RH
Response Time (Seconds)	1/e(63%)25°C , 1m/s Air	6 S	10 S	15 S
Hysteresis			±1%RH	
Long-Term Stability	Typical		±1%RH/year	
Temperature				
Resolution		1°C 8 Bit	1°C 8 Bit	1°C 8 Bit
Repeatability			±1°C	
Accuracy		±1°C		±2°C

Measurement Range		0°C		50°C
Response Time (Seconds)	1/e(63%)	6 S		30 S

Table 8: DHT Specifications

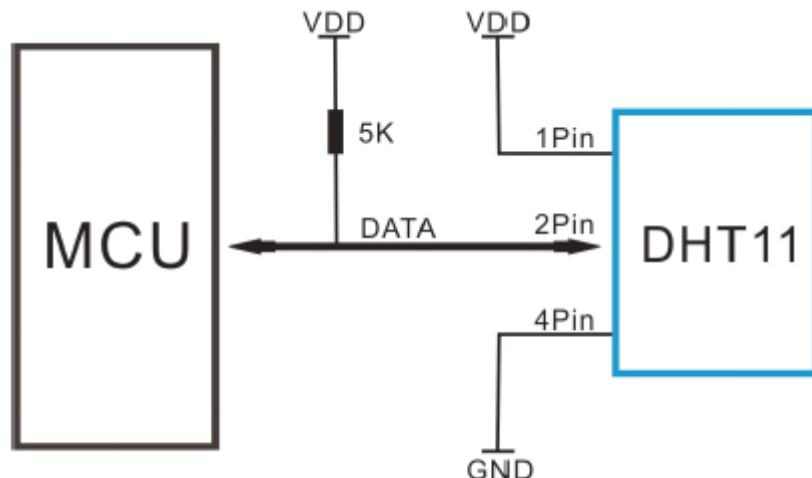


Figure 28: DHT Schematic

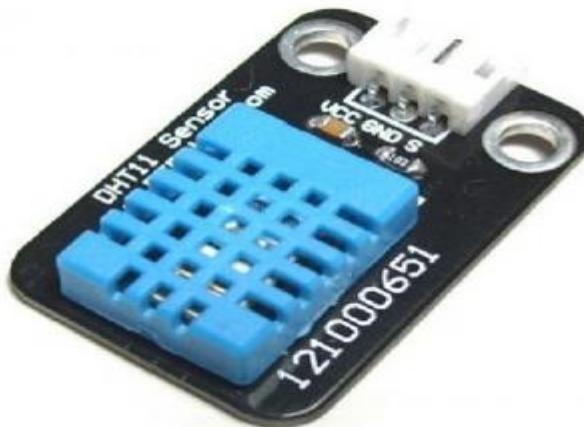


Figure 29: DHT Sensor

5.4.7 Gas Sensor MQ5:

Sensitive material of MQ-5 gas sensor is SnO₂, which with lower conductivity in clean air. When the target combustible gas exist, the sensors conductivity is higher along with the gas concentration rising. Please use simple electronic-circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-5 gas sensor has high sensitivity to Methane, Propane and Butane, and could be used to detect both Methane and Propane. The sensor could be used to detect different combustible gas especially Methane, it is with low cost and suitable for different application.

Character:

- 1、 High sensitivity to Combustible gas in wide range
- 2、 High sensitivity to Methane, Butane and Propane
- 3、 Fast response
- 4、 Wide detection range
- 5、 Stable performance, long life, low cost
- 6、 Simple drive circuit

Technical Data:

Model No.		MQ-5	
Sensor Type		Semiconductor	
Standard Encapsulation		Bakelite (Black Bakelite)	
Detection Gas		LPG, Methane, coal gas	
Concentration		300-10000ppm(Methane, Propane, Butane, H ₂)	
Circuit	Loop Voltage	V _c	≤24V DC
	Heater Voltage	V _H	5.0V±0.2V AC or DC
	Load Resistance	R _L	Adjustable
Character	Heater Resistance	R _H	31Ω±3ΩRoom Tem.
	Heater consumption	P _H	≤900mW
	Sensing Resistance	R _s	2KΩ-20KΩ(in 2000ppm C ₃ H ₈)
	Sensitivity	S	R _s (in air)/R _s (1000ppm C ₃ H ₈)≥5
	Slope	α	≤0.6(R _{1000ppm} /R _{500ppm} H ₂)
Condition	Tem. Humidity		20±265%±5%RH
	Standard test circuit		V _c :5.0V±0.1V V _H : 5.0V±0.1V
	Preheat time		Over 48 hours

Table 7: MQ5 Technical Data

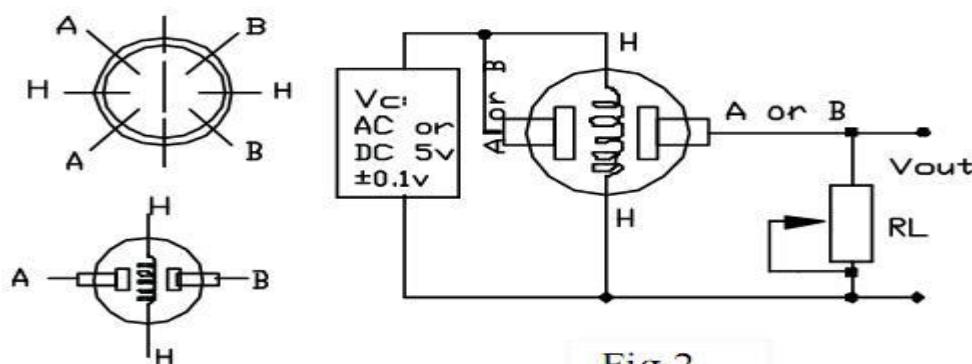


Fig.2

Figure 30: MQ 5 Schematic

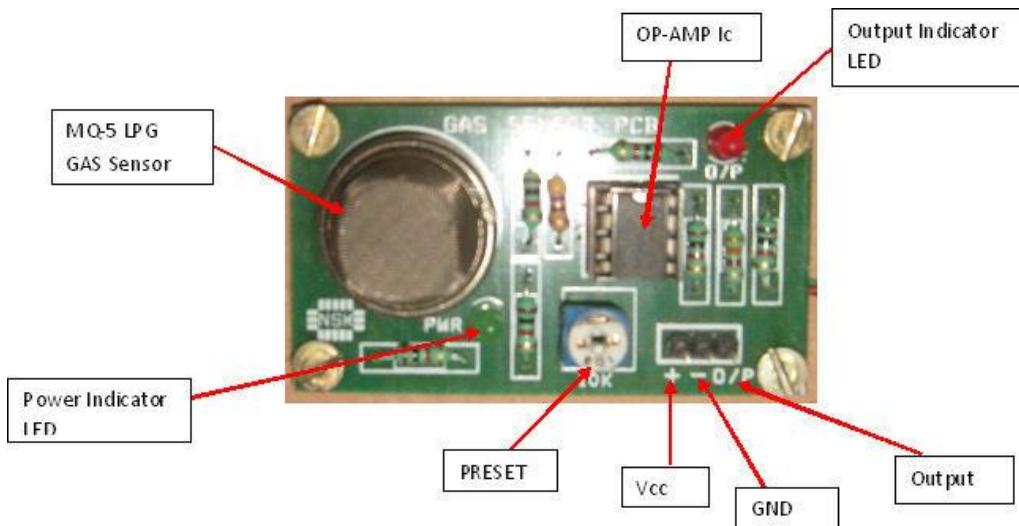


Figure 31: MQ5 Gas Sensor

5.4.8 Door lock stepper motor:

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate, one step at a time. With a computer controlled stepping you can achieve very precise positioning and/or speed control. For this reason, stepper motors are the motor of choice for many precision motion control applications. Stepper motors come in many different sizes and styles and electrical characteristics. This guide details what you need to know to pick the right motor for the job.

Application

- **Positioning** – Since steppers move in precise repeatable steps, they excel in applications requiring precise positioning such as 3D printers, CNC, Camera platforms and X,Y Plotters. Some disk drives also use stepper motors to position the read/write head.
- **Speed Control** – Precise increments of movement also allow for excellent control of rotational speed for process automation and robotics.
- **Low Speed Torque** - Normal DC motors don't have very much torque at low speeds. A Stepper motor has maximum torque at low speeds, so they are a good choice for applications requiring low speed with high precision.

- Ambient Temperature: -20°C~+50°C
- Temperature Rise: 80°C Max.
- Radial Play: 0.02mm Max.
- End Play: 0.1-0.3mm

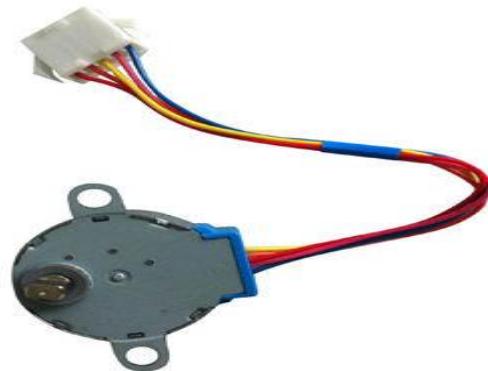


Figure 32: Door lock Stepper motor

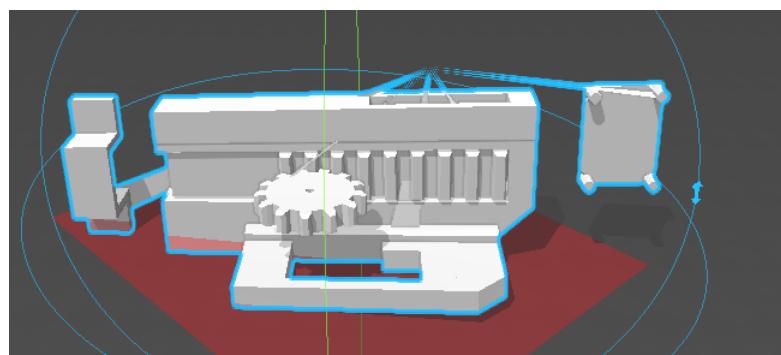


Figure 33: Frame for door lock

5.4.9 Real Time Clock RTC DS3231:

The DS3231 is a low-cost, extremely accurate I₂C real time clock (RTC) with an integrated temperature compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted. The integration of the crystal resonator enhances the long-term accuracy of the device as well as reduces the piece-part count in a manufacturing line. The DS3231 is available in commercial and industrial temperature ranges, and is offered in a 16-pin, 300-mil SO package.

The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format

With an AM/PM indicator. Two programmable time-of day alarms and a programmable square-wave output are provided. Address and data are transferred serially through an I₂C bidirectional bus. A precision temperature-compensated voltage reference and comparator circuit monitors the status of VCC to detect power failures, to provide a reset output, and to automatically switch to the backup supply when necessary. Additionally, the RST pin is monitored as a Push button input for generating a reset externally.

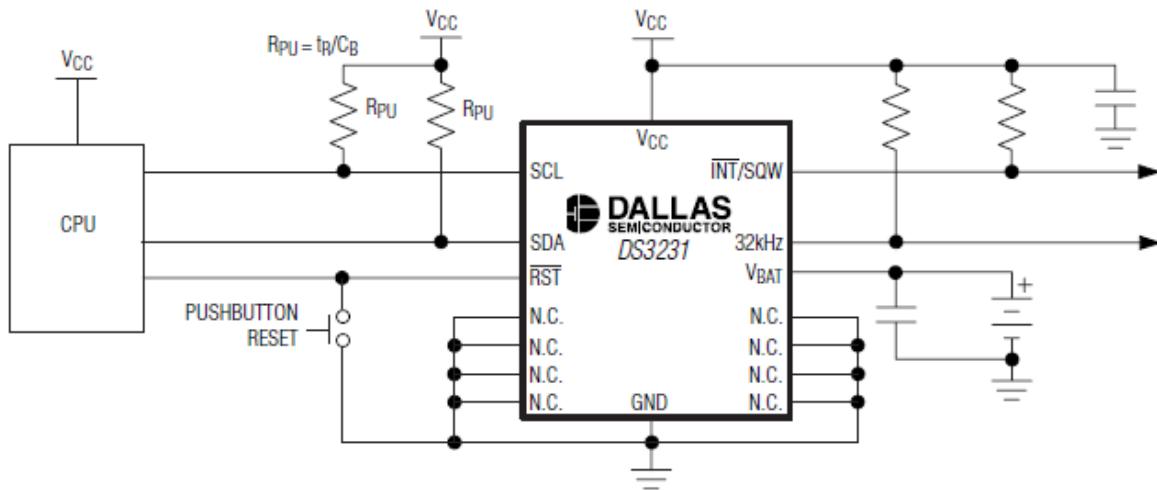


Figure 34: RTC Schematic

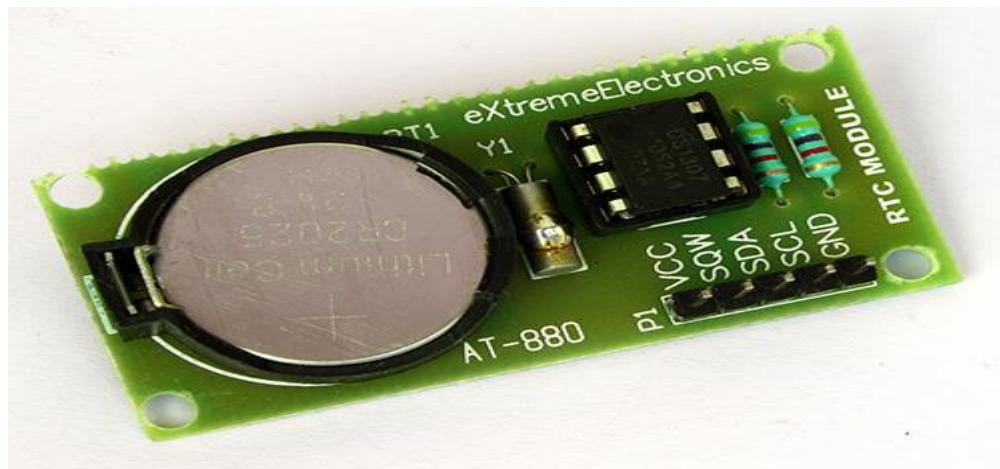


Figure 35: RTC Module

5.4.10 Relay module 4 & 2 channel:

This is a 5V 4-Channels Relay module, It can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM and MSP430.

4 relays are included in this module, with “NC” ports means “Normally connected to COM” and “NO” ports means “Normally open to COM”. This module also equipped with 4 LEDS to show the status of relays.

Features

- 4 mechanical relays with status indicator LED
- Both “NC” and “NO” ports for each relay

Specification

- Module Type: Control

- Weight: 70.00g
- Board Size: 8 x 4.8 x 2cm
- Operation Level: Digital 5V
- Power Supply: External 5V



Figure 36: 4 channel relay

5.4.12 Finger print optical sensor R305:

Secure your project with biometrics - this all-in-one optical fingerprint sensor will make adding Fingerprint detection and verification super simple. These modules are typically used in safes there's a high powered DSP chip that does the image rendering, calculation, feature-finding and searching. Connect to any microcontroller or system with TTL serial, and send packets of data to take photos, detect prints, hash and search. You can also enroll new fingers directly - up to 162 finger prints can be stored in the onboard FLASH memory. There's a red LED in the lens that lights up during a photo so you know it's working. We like this particular sensor because not only is it easy to use, it also comes with fairly straightforward Windows software that makes testing the module simple - you can even enroll using the software and see an image of the fingerprint on your computer screen

- Operating current: 120mA max
- Peak current: 150mA max
- Fingerprint imaging time: <1.0 seconds
- Window area: 14mm x 18mm
- Signature file: 256 bytes
- Template file: 512 bytes
- Storage capacity: 162 templates

- Safety ratings (1-5 low to high safety)
- False Acceptance Rate: <0.001% (Security level 3)
- False Reject Rate: <1.0% (Security level 3)
- Interface: TTL Serial
- Baud rate: 9600, 19200, 28800, 38400, 57600 (default is 57600)
- Working temperature rating: -20C to +50C
- Working humidity: 40%-85% RH
- Full Dimensions: 56 x 20 x 21.5mm
- Exposed Dimensions (when placed in box): 21mm x 21mm x 21mm triangular
- Weight: 20 grams

Features

- Integrated image collecting and algorithm chip together, All-in-one
- Fingerprint reader can conduct secondary development, can be embedded into a variety of end products
- Low power consumption, low cost, small size, excellent performance
- Professional optical technology, precise module manufacturing techniques
- Good image processing capabilities, can successfully capture image up to resolution 500 dpi



Figure 37: R305 Finger Print optical

5.4.13 SD Card Module:

Having a project with any audio, video, graphics, data logging, etc in it, you'll find that having a removable storage option is essential. Most microcontrollers have extremely limited built-in storage. For example, even the Arduino Mega chip (the Atmega2560) has a mere 4Kbytes of EEPROM storage. There's more flash (256K) but you can't write to it as easily and you have to be careful if you want to store information in flash that you don't overwrite the program itself. If you're doing any sort of data logging, graphics or audio, you'll need at least a megabyte of storage, and 64 M is probably the minimum. To get that kind of storage we're going to use the same type that's in every digital camera and mp3 player: flash cards! Often called SD or micro SD cards, they can pack gigabytes into a space smaller than a coin. They're also available in every electronics shop so you can easily get more and best of all, many computers have SD or micro SD card readers built in so you can move data back and forth between say your Arduino GPS data logger and your computer graphing software.

There's a few useful things you can do with SD objects we'll list a few here: If you just want to check if a file exists, use SD.exists ("filename.txt") which will return true or false. You can delete a file by calling SD.remove ("unwanted.txt") - be careful! This will really delete it, and there's no 'trash can' to pull it out of. You can create a subdirectory by calling SD.mkdir ("/mynewdir") handy when you want to stuff files in a location. Nothing happens if it already exists but you can always call SD.exists () above first

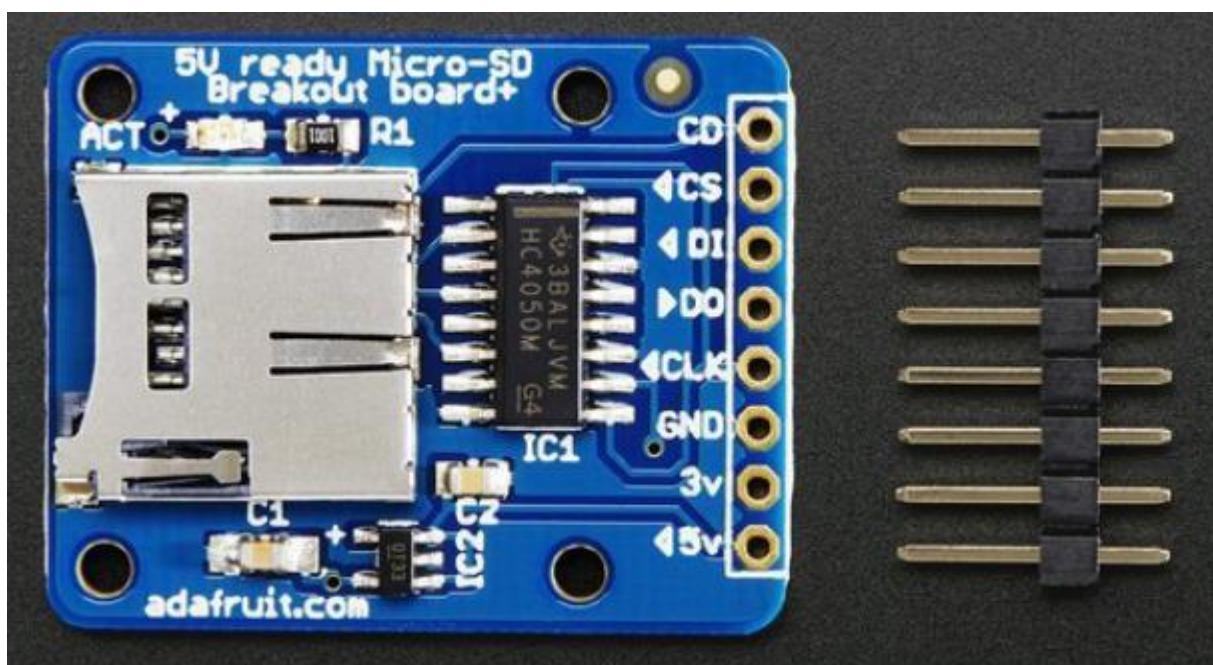


Figure 38: SD card Module

5.4.14 Programming Cables:

Use it to connect Arduino Uno, Arduino Mega 2560, Arduino 101 or any board with the USB female a port of your computer. Cable length is approximately 178cm. Cable color and shape may vary slightly from image as our stock rotates. If you want to have a closer look to USB cables and standards check the USB cable pin outs referral page on pin outs. USB cable type A/B Standard USB 2.0 cable.



Figure 39: USB A/B type cable

5.4.15 Zero PCB:

As its name suggests, general purpose PCB's are widely used to embed circuits randomly for running of hardware. Its layer is coated with copper and allows proper soldering without any short circuit

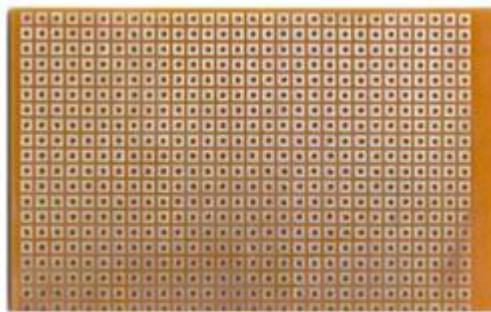


Figure 40: Zero PCB

5.4.16 Headers:

Pin header connectors comprise several different means of connection. Generally, one side is a series of pins which are soldered to a PCB, and they can either be at a right-angle to the PCB surface (usually called “straight”) or parallel to the board’s surface (confusingly referred to as “right-angle” pins). Such connectors come in a variety of pitches, and may have any number of individual rows of pins. The most commonly seen pin headers are .1" single or double row

connectors. These come in male and female versions, and are the connectors used to connect Arduino boards and shields together. Other pitches are not uncommon; for instance, the XBee wireless module uses a 2.0mm pitch version of the same connector. A common variation on this part is a “machine pin” version. While the normal version is formed out of stamped and folded sheet metal, machine pin connectors are formed by tooling the metal into the desired shape. The result is a more robust connector, with a better joint and longer life, making it somewhat more expensive.



Figure 42: Male Headers

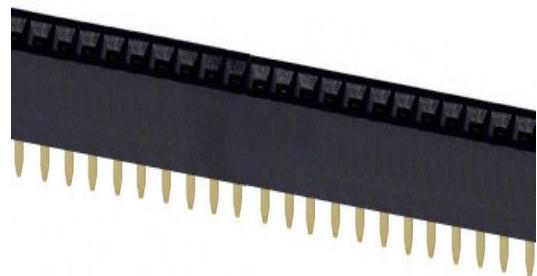


Figure 41: Female Headers

5.4.17 Exhaust Fan:

3 Pins 40x40x10mm PC Computer CPU Case Heat sink Cooler Cooling Fan 12V 0.1A. CPU Heat Sink Cooler, 3 Pins, 40x40x10mm. Improve air flow. Cool your CPU when they are used, make your PC more durable. Unique fan design for easy thermal heat dissipation, low noise Power saving design, low power consumption, easy to use. Simply plug it to your PC host,

Feature:

Connector:3pin

Cable length: 20cm

Voltage:DC12V

Rated Current:0.1A

Air flow:9.5CFM

Fan Speed:6000RPM±10%

Noise Level:<18dBA±10%

Fixed Hole Distance:32mm

Dimension:40x40X10mm



Figure 43: Exhaust Fan

5.4.18 Electrical Appliances (Lamp/Fan):

An electrical appliance is a device that uses electricity to perform a function. For instance a table lamp lights an area, a toaster 'toasts', an electric welder 'welds'. Lamps, Fan, toasters and electric welders perform a function and use electricity – they are electrical appliances.

Electric Light Bulb:



Figure 44: Light Bulb

Electrical Fan



Figure 45: Electrical Fan

Above hardware were selected after making a very critical analysis of several components of same types and after that a final list of all the require components were made. these components are very efficient and reliable as the developer has selected them by doing all the types of evaluation that were required for selection methods and mentioned above in the context in the analysis of secondary research.

Chapter: 6 Hardware System Designing & Implementation

In this chapter the developer will be discussing about the designing process of the hardware system with several block diagram explaining architecture of the system along with the procedure used for the development of the project.

6.1 Block Diagram:

A diagram showing in schematic form the general arrangement of the parts or components of a complex system or process, such as an industrial apparatus or an electronic circuit. A design will often begin as a very high level block diagram, becoming more and more detailed block diagrams as the design progresses, finally ending in block diagrams detailed enough that each individual block can be easily implemented (at which point the block diagram is also a schematic diagram).

In this chapter developer is building the block diagram in three section on the basis of functionalities types which are as follows

- Security System
- Automated home Automation
- Remote home automation

Major Block Diagram of project

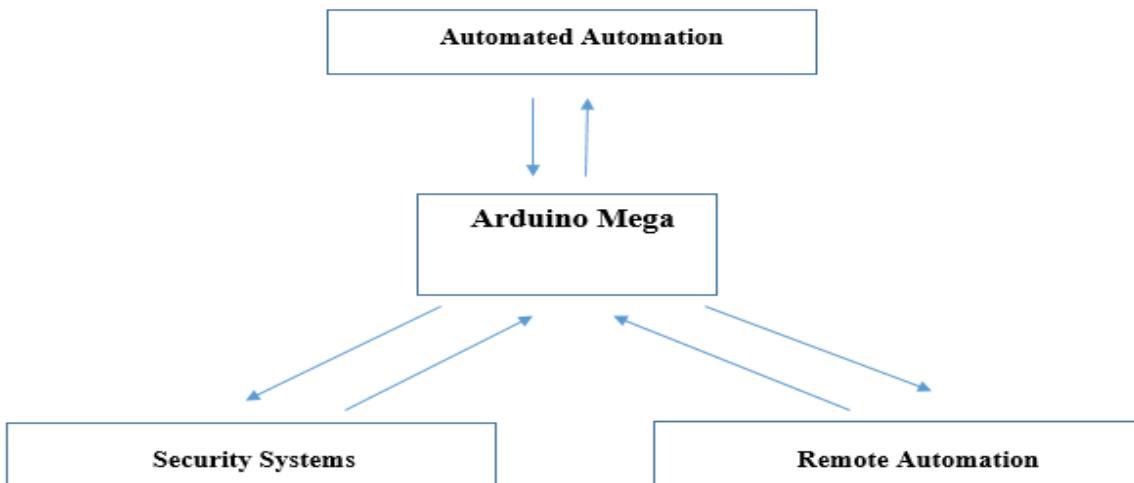


Figure 46: Basic Overall Block

In the above block the entire system is shown in 3 different blocks connected with the central block. The central block is controlling each and every block processes as processor block. The above three extended block are

Security system: This block contains all the security controlling input and output devices such as finger print sensor, surveillance camera, stepper motor based door locking and unlocking actuator. These all the working together to make intelligent security for the house and maintain high class security using finger print sensor.

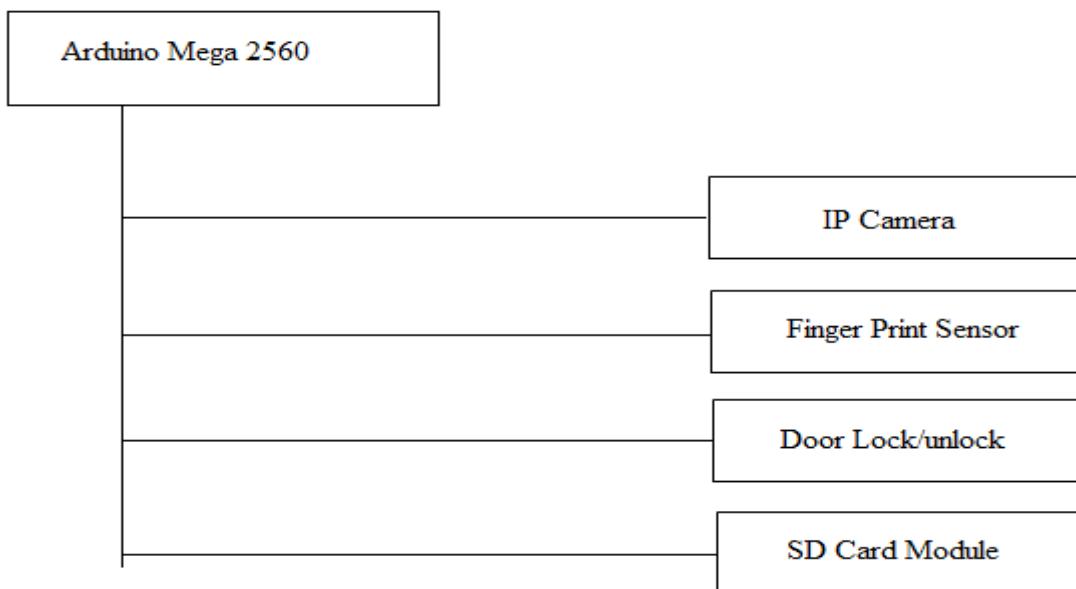


Figure 48: Security System Block Diagram

In this block developer has included connection interface with the control board and four other hardware block in which the first one i.e. IP camera is doing surveillance of the door and this is also capable of taking photograph of the individual if three continues unsuccessful attempt to authorize the door lock was made or someone tries to open the door forcefully and at the same time that picture will be saved to the SD card installed in the SD card module and the system will send notification to the owner about any theft situation and accordingly owner will take appropriate decision. Along with this logging entry for all the authentication attempts will be recorded in the SD card so that we can make a complete digital form of entry of individual for the house as office.

Automated Automation: This block contains several sensor to give input to the processor and it also has an internet enabled mobile device to get notification for the activities done using intelligence of the system by actuator connected to this which are being done automatically such

as hazard control activities lighting and temperature control by analyzing real time environmental status and so on will be explained further.

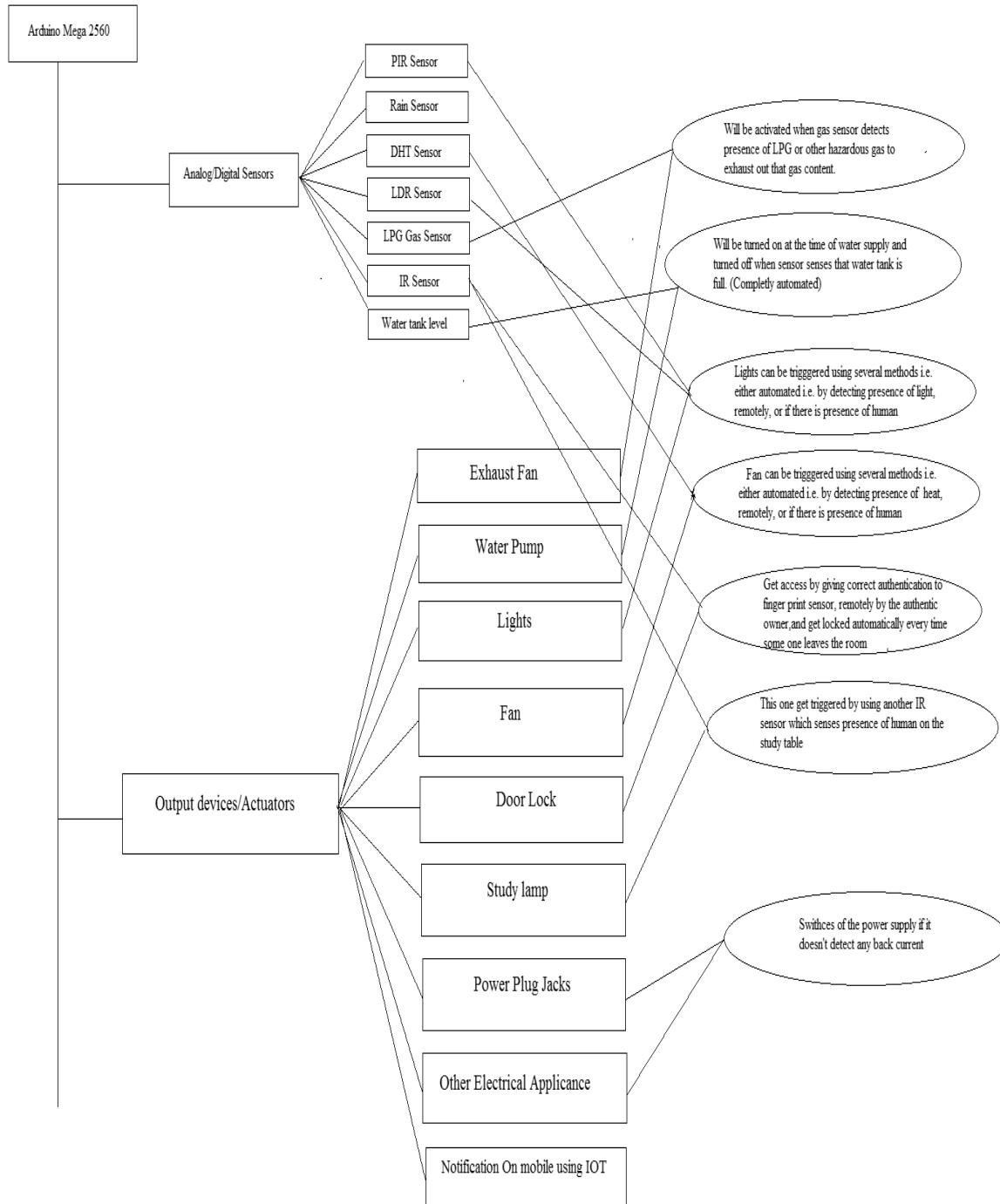


Figure 49: Block Diagram

6.2 Hardware Implementation

Remote automation: This block are same as the previous one with just a single difference that in this section the activities execution needs human being. i.e. the user have to give command on their internet enabled mobile devices to execute functionalities of this block. Detailing about this block has been included in the previous diagram itself.

The complete design of the system is based upon the same architecture which has been shown above in the block diagram after that few more features and functionalities were added to the system using coding technique to enhance its productivity.

Below is a first look i.e. mounting of hardware to create the prototype model of the system.

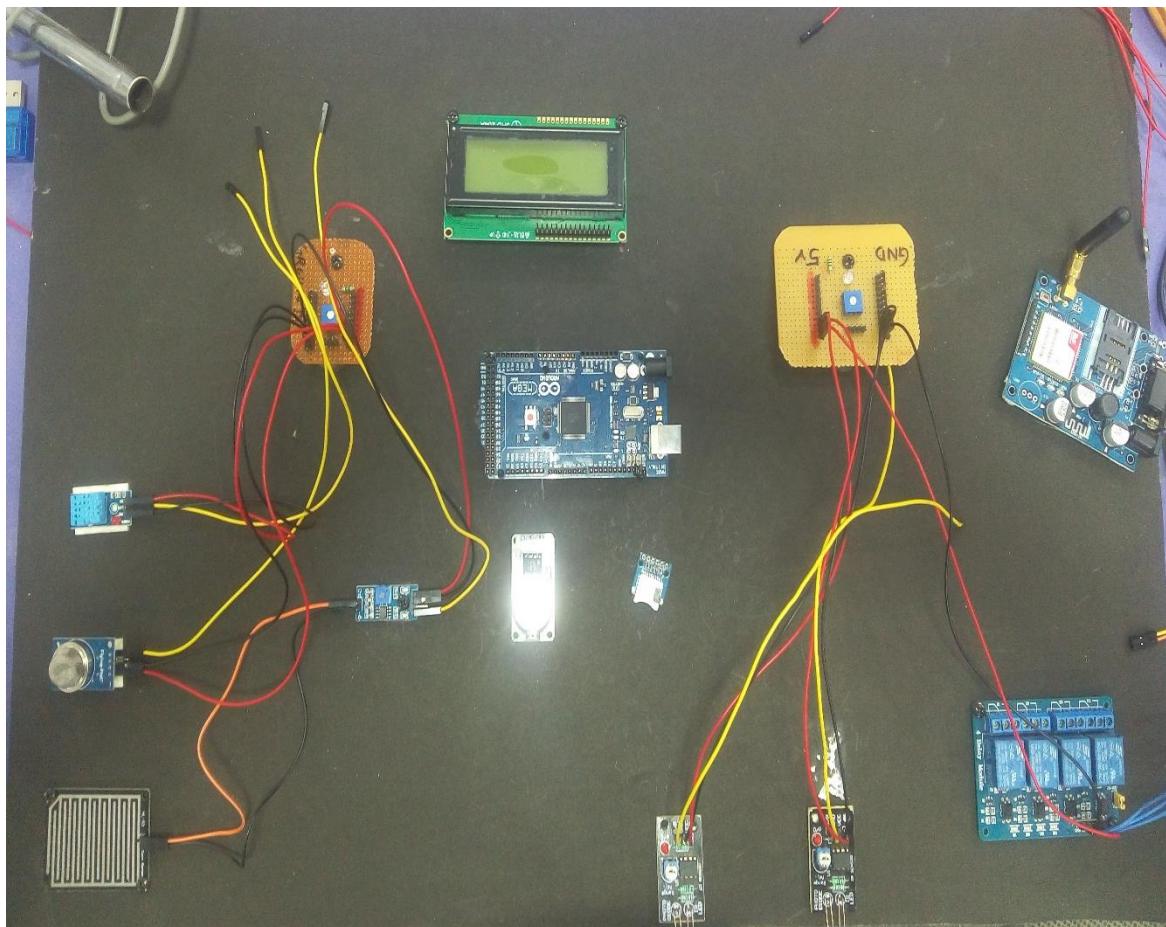


Figure 50: Hardware mounting

In the above picture some sensors the controller or we can say brain of the entire system has mounted along with relay module, RTC and other power sources of 5v and 3.3 v. Each components are mounted on a kind of wooden plank to show a clear implementation of this intelligent system.

Next picture which is shown below is almost complete design of the entire hardware design with all its available components mounted on the board and all the connection are made.

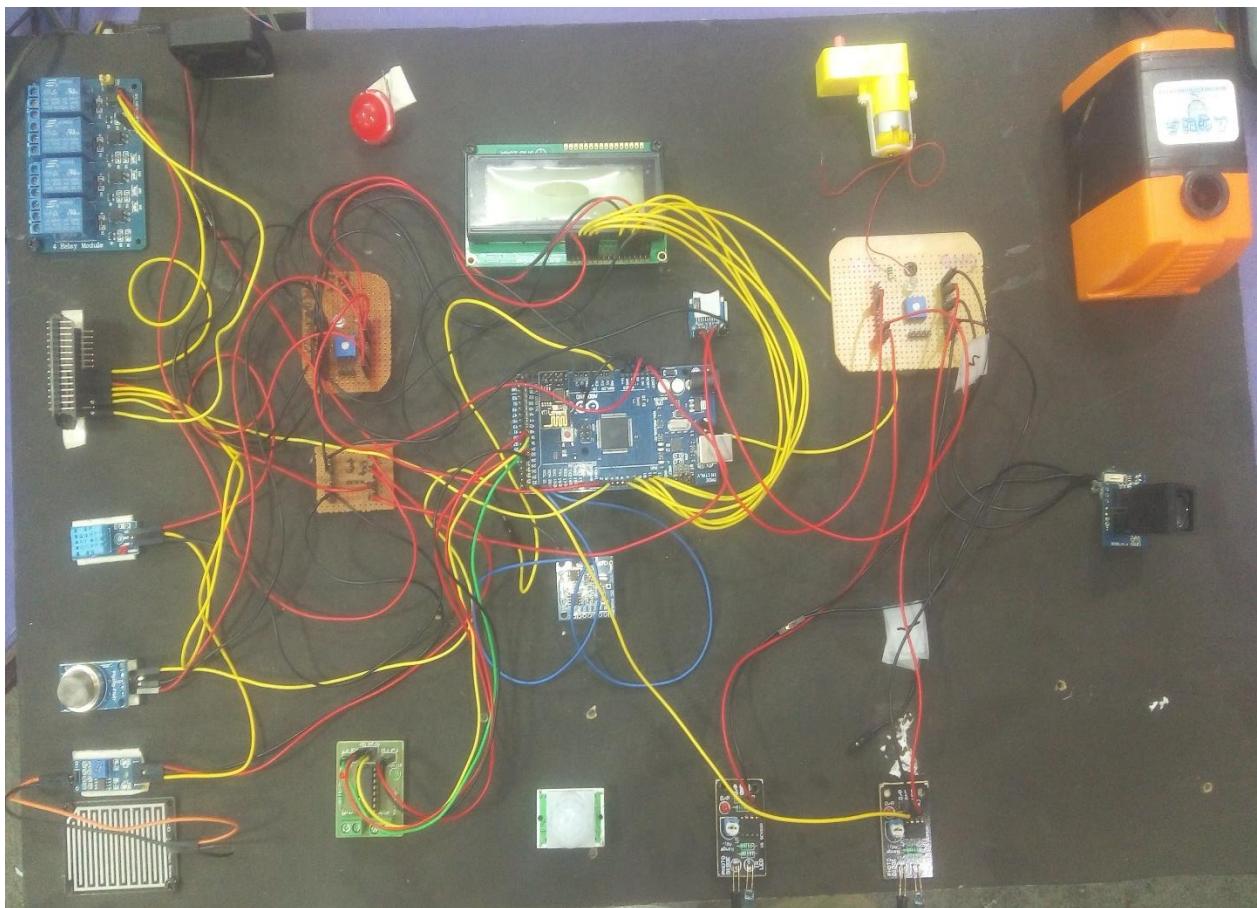


Figure 51: Hardware model with all connection

Coding using Arduino software:

In the next step developer will be writing codes on Arduino software to interface all these components together and make them work together i.e. security system as well as automation system and the developer will apply a very small technique of Artificial Intelligence i.e. in this system all the logging report will be recorded in the RTC module in real time so that system will be able to auto-generate more automation as it is going to learn the daily repeated task which were being executed by the user and the system will start auto implementing those tasks and as it starts finding changes in regular activities it again update their automation activity data base and change itself accordingly. The next picture in this chapter will be showing the programming window used to program this entire home security and automation system i.e. Arduino 1.7 which is very efficient to program various kind of embedded systems and its very user friendly also and if someone stuck in some problem then easy help can be found on web with high accuracy.

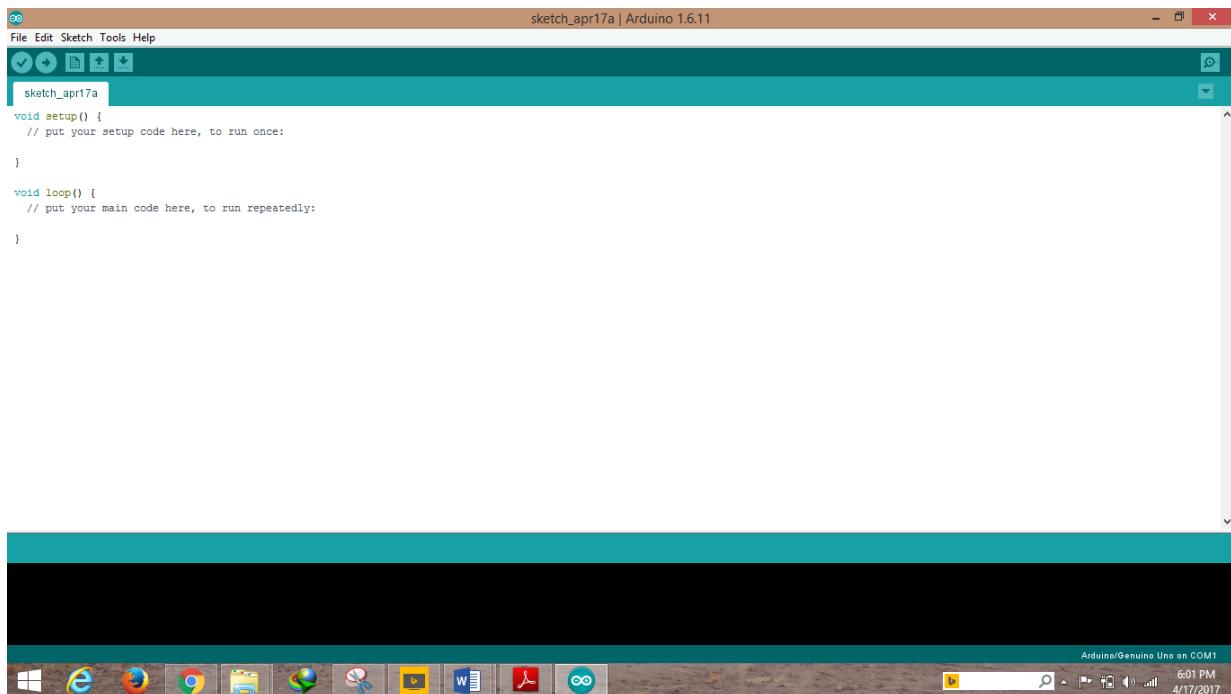


Figure 52: Arduino new sketch window

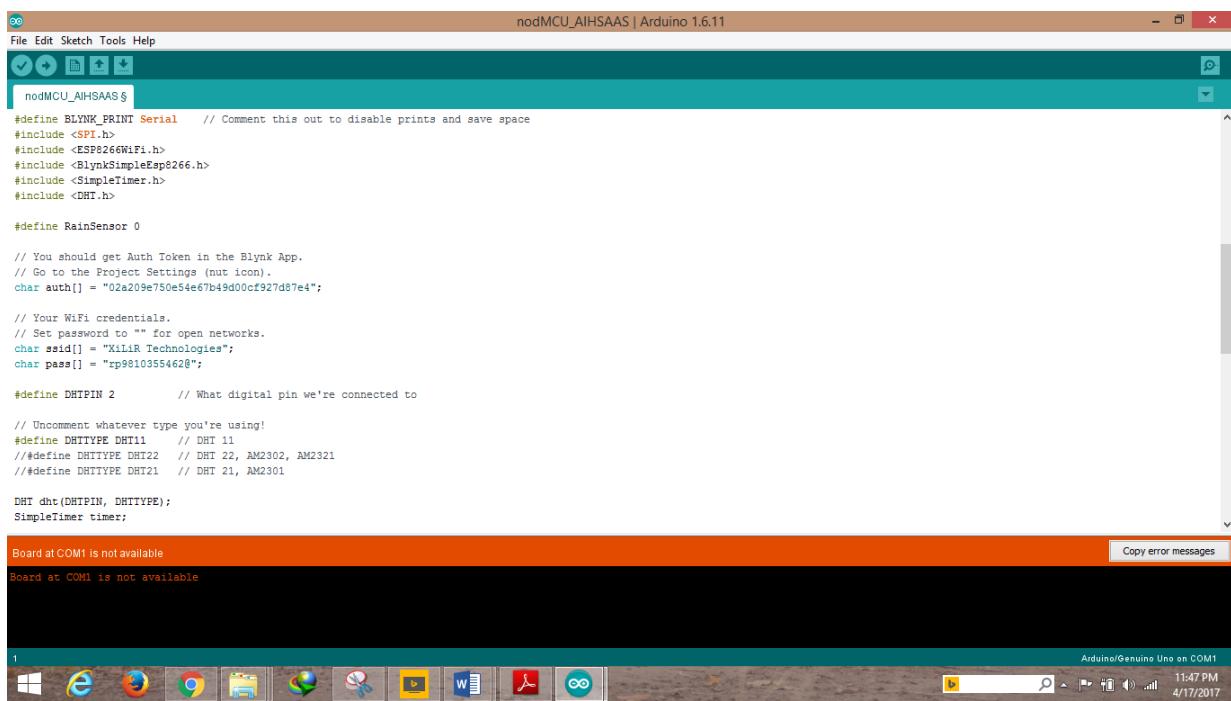


Figure 53: Arduino program window

This window is same as previous window as shown above but that was taken at the time the developer has started programming and the one just shown above is during programing of the system. The source code which will be made for perfect working of the system will be added in the appendix and can be referred from there.

Android App Development

In this section some picture of the android application which is being used to control the system in mentioned.

Android Application Icon



Figure 54: Android Application Icon

Android App Starting

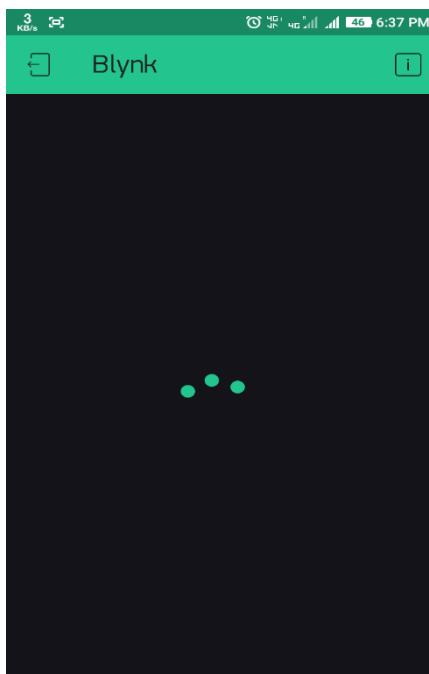


Figure 55: App Starting

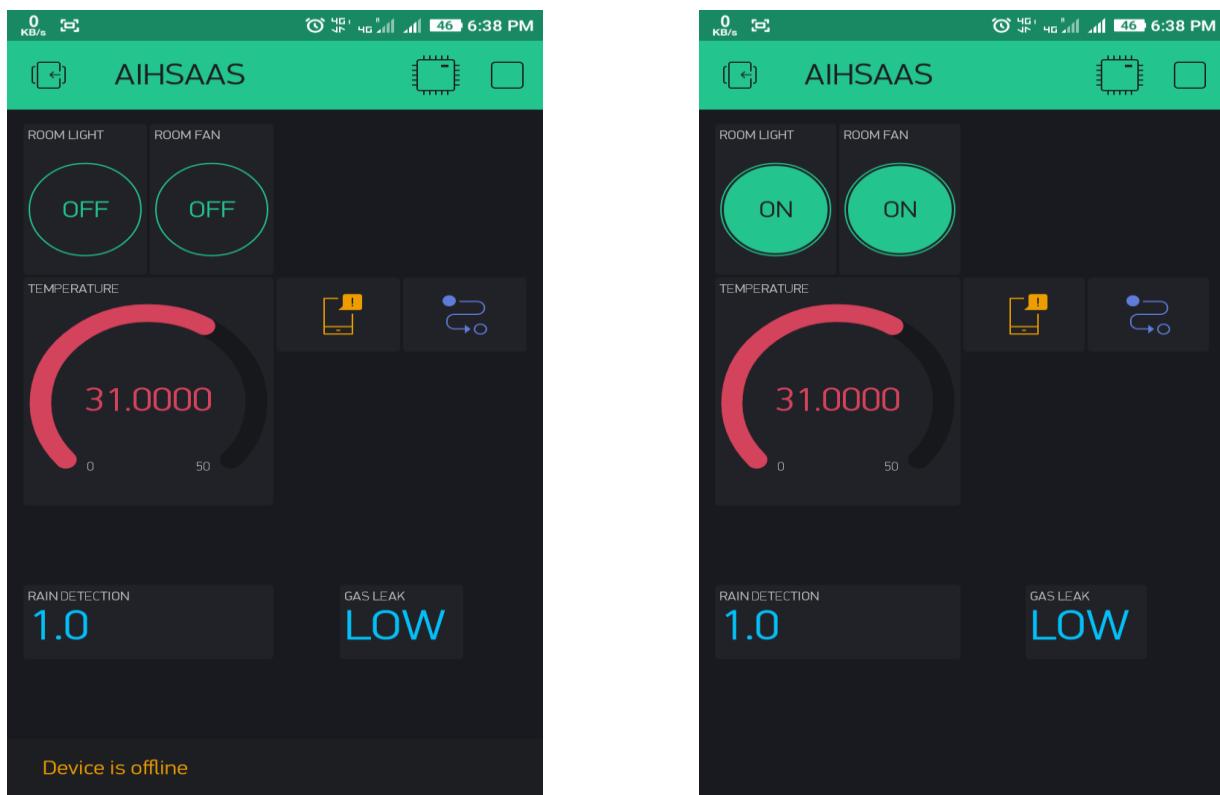


Figure 56: Working application

Circuit Diagram

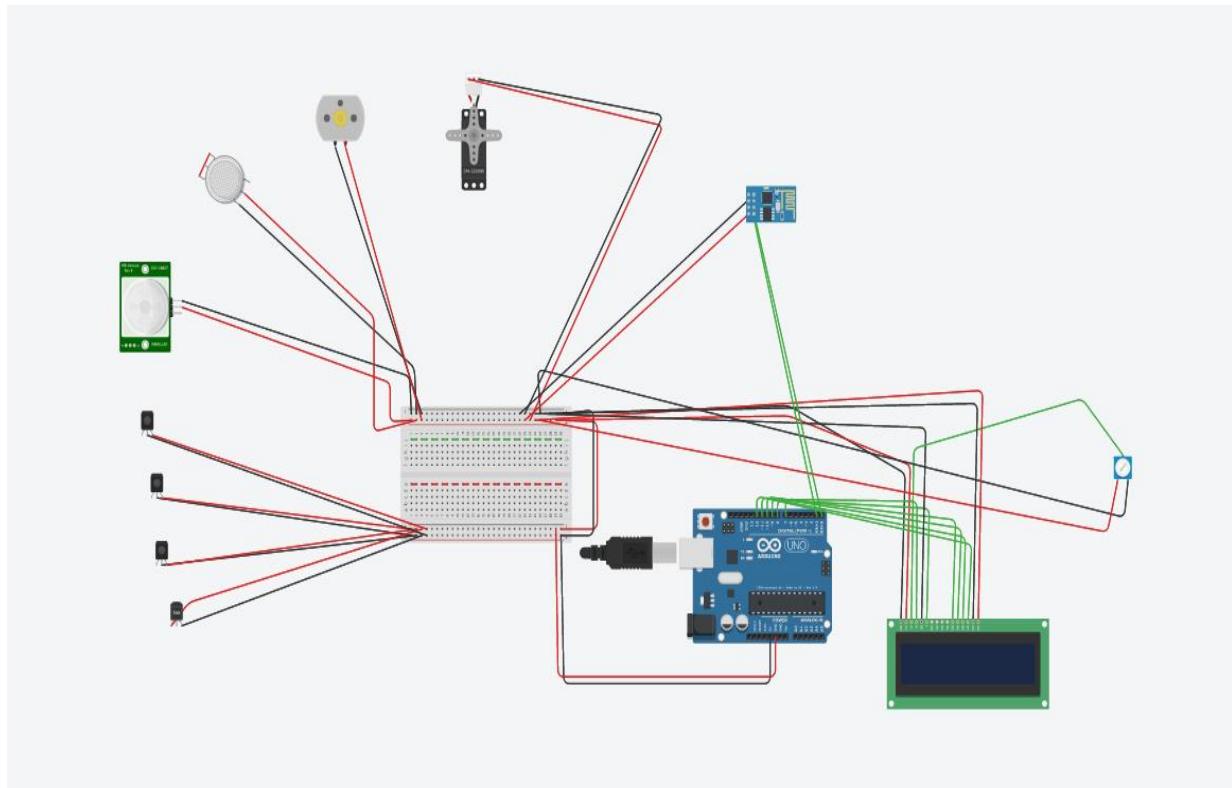


Figure 57: A basic Circuit Diagram

Circuit Diagram Development

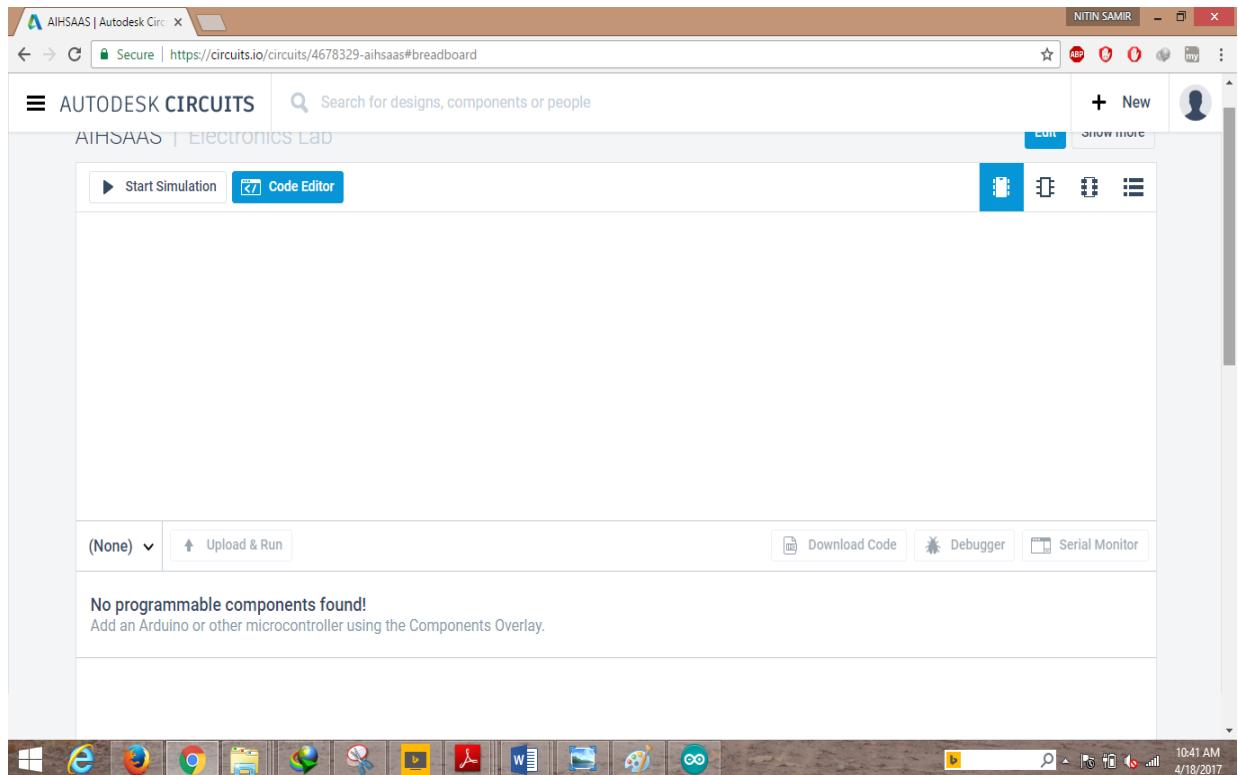


Figure 59: Main Window

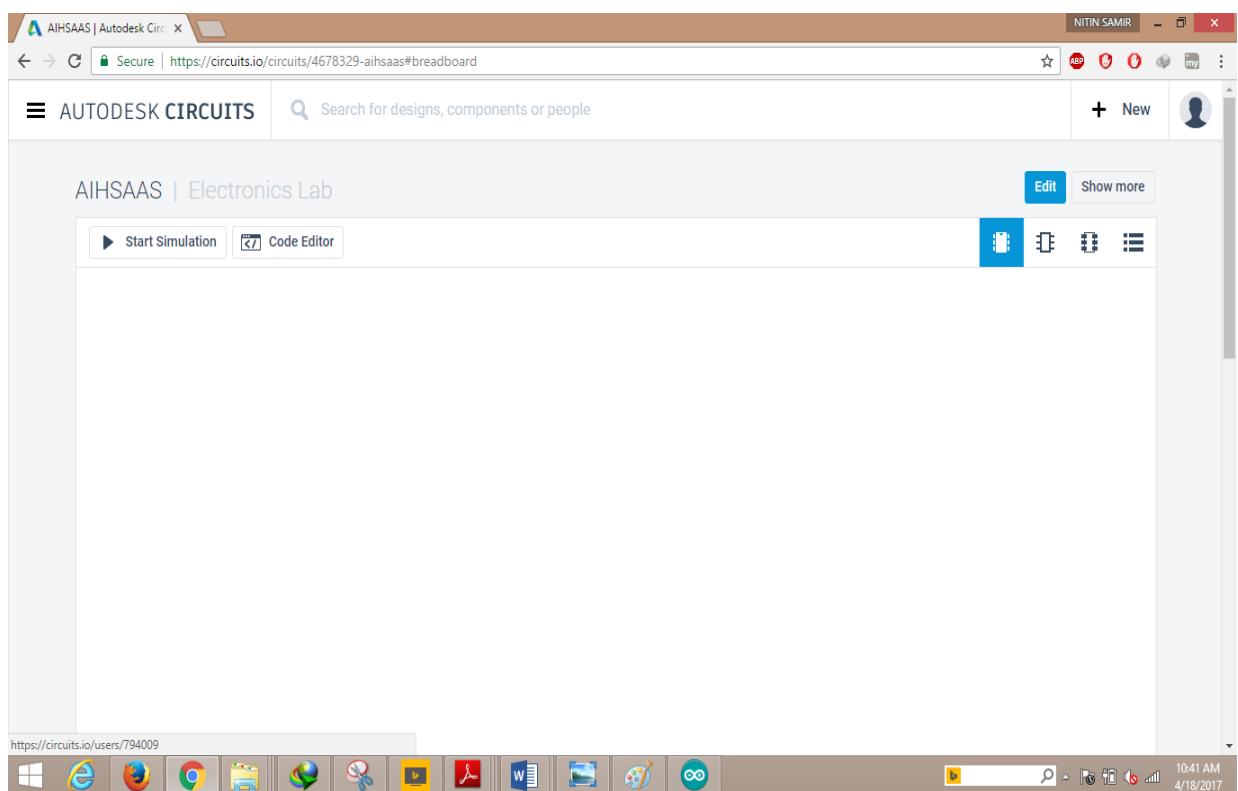


Figure 58: Programming window

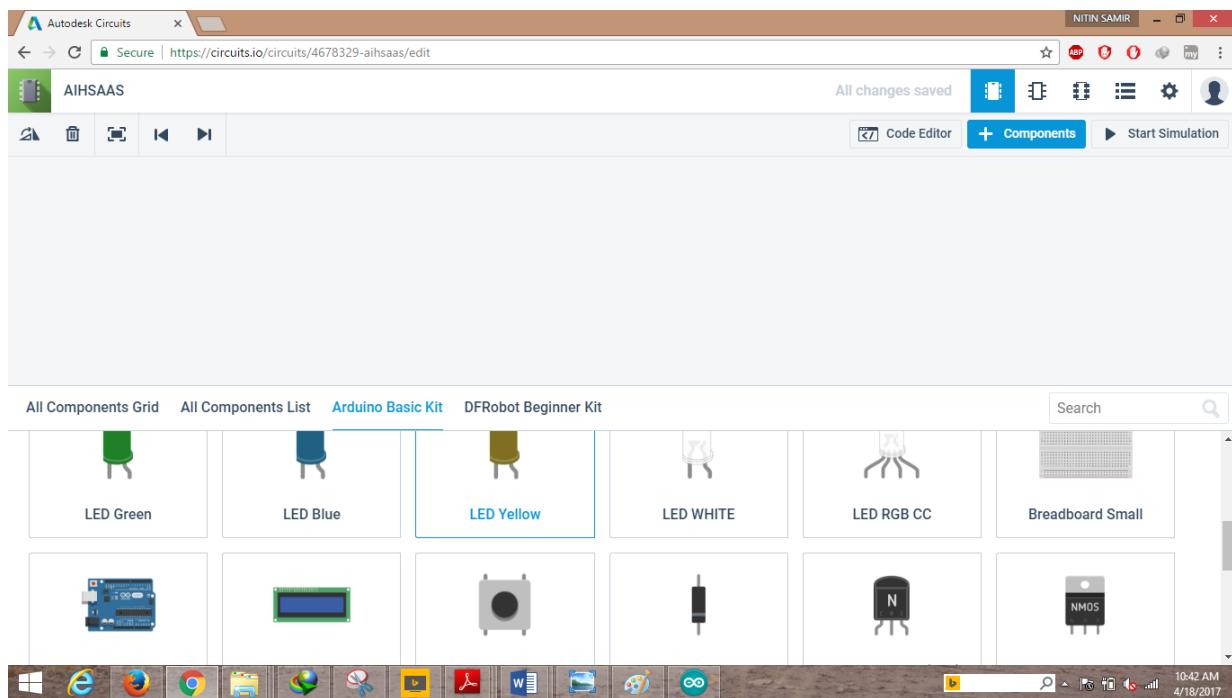


Figure 60: Component Window

The above circuit diagram is designed by the developer under development of this project using circuits.io by Autodesk as a brief structure of the entire circuitry is required so in above circuit all the components are connected with controller to work together.

Conclusion

The prime objective of our project is to use the Smartphone to control the home appliances effectively. The switch mode and voice mode are used to control the home appliances. The video feedback is received in the android app which streams the video of IP- Camera. This project is based on the Arduino Mega, Android platform Java and Python as well as embedded C. These platforms are Free Open Source Software. So the overall implementation cost is low and can be easily configured.

Chapter: 7 Hardware System Testing

In this section the developer has tested the hardware model at all the extent and checked if all the functionalities are working properly and in the same process small debugging of codes has also been executed to make proper functioning of the system. In the testing process the very first thing what the developer has executed was the test of power supply at every component and it was done just by connecting all the Vcc And GND pins with the power supply unit and for the acknowledge purpose let the developer clear that there are 3 different power sources mounted on the hardware model which are two 5v power supply with variable resistance and one 3.3 volt power supply to power up Nod MCU. Below is picture showing the power supply testing of the hardware system.

Power Supply Test:

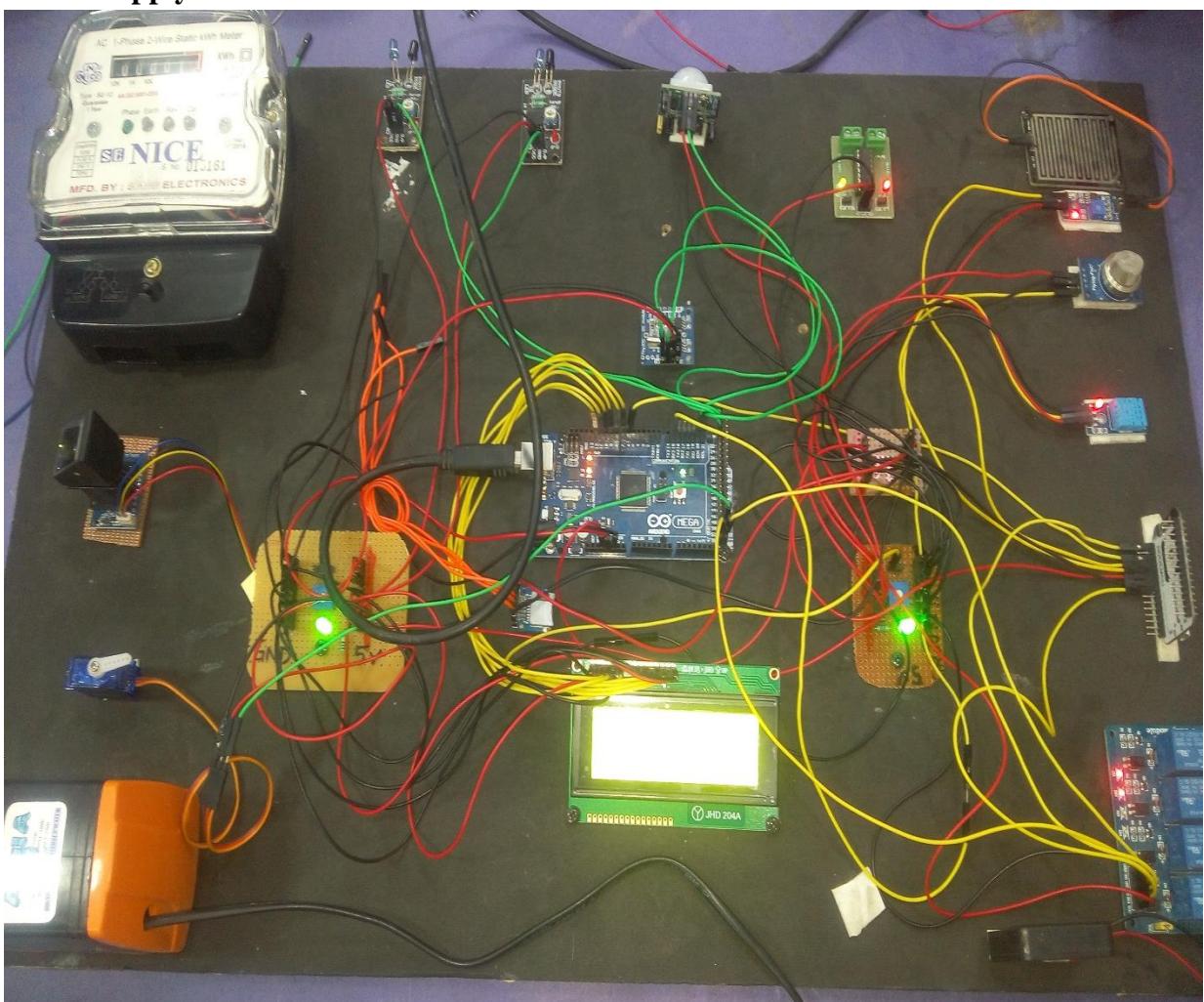


Figure 61: Power Supply Test

Sensors Input Test:

In this picture the developer is trying to show that the controller is taking input from several sensors which are working as input devices

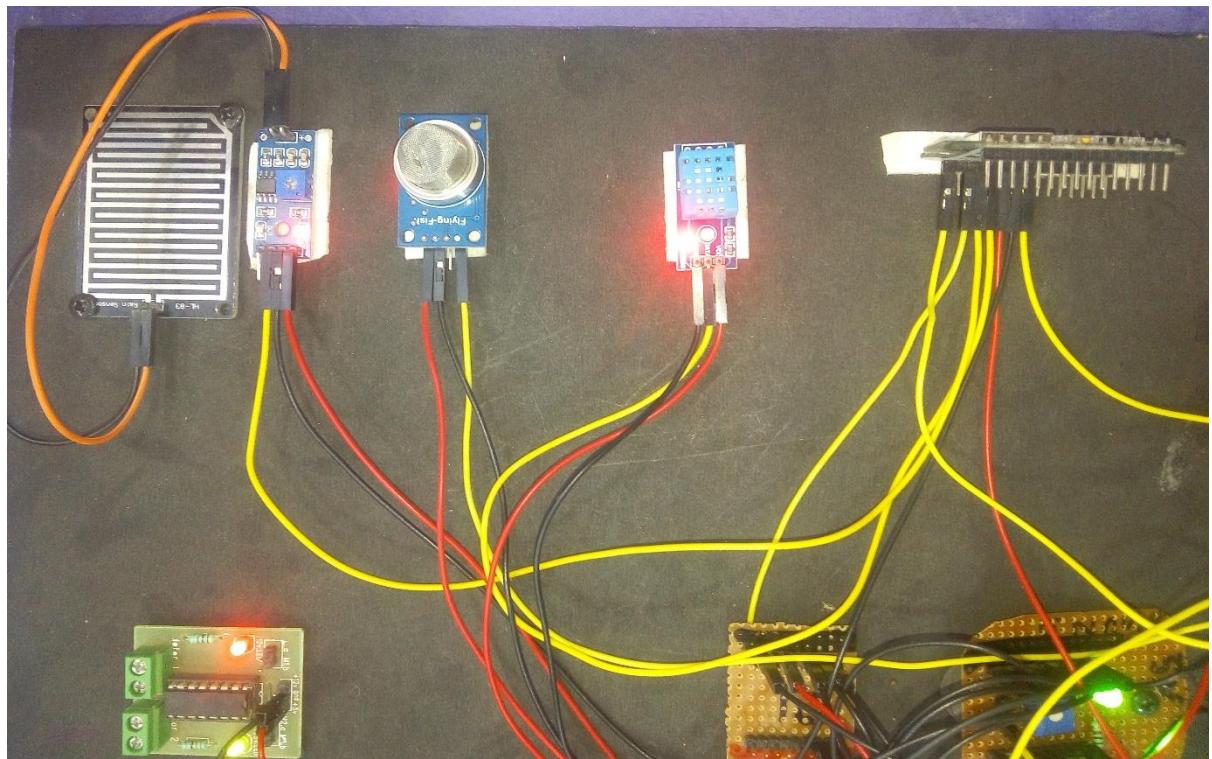


Figure 62: Sensors Input Test

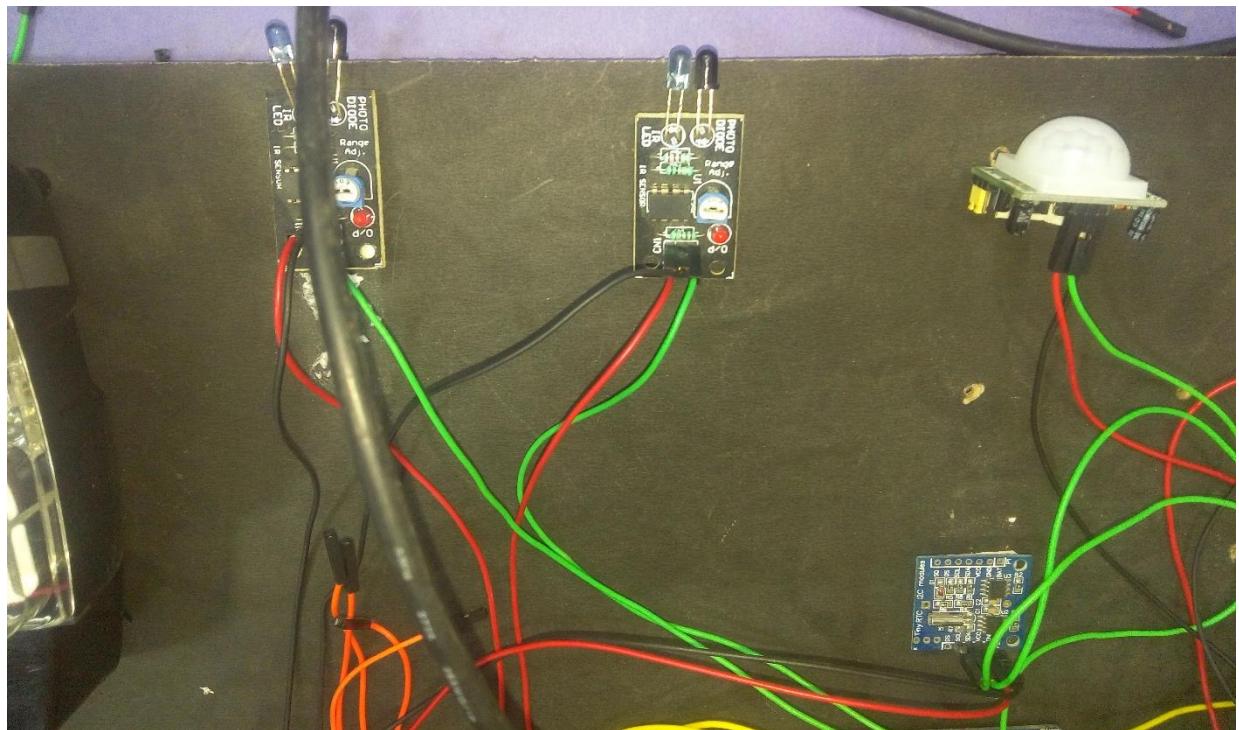


Figure 63: Sensors input Test 2

Finger Print Scanner Test

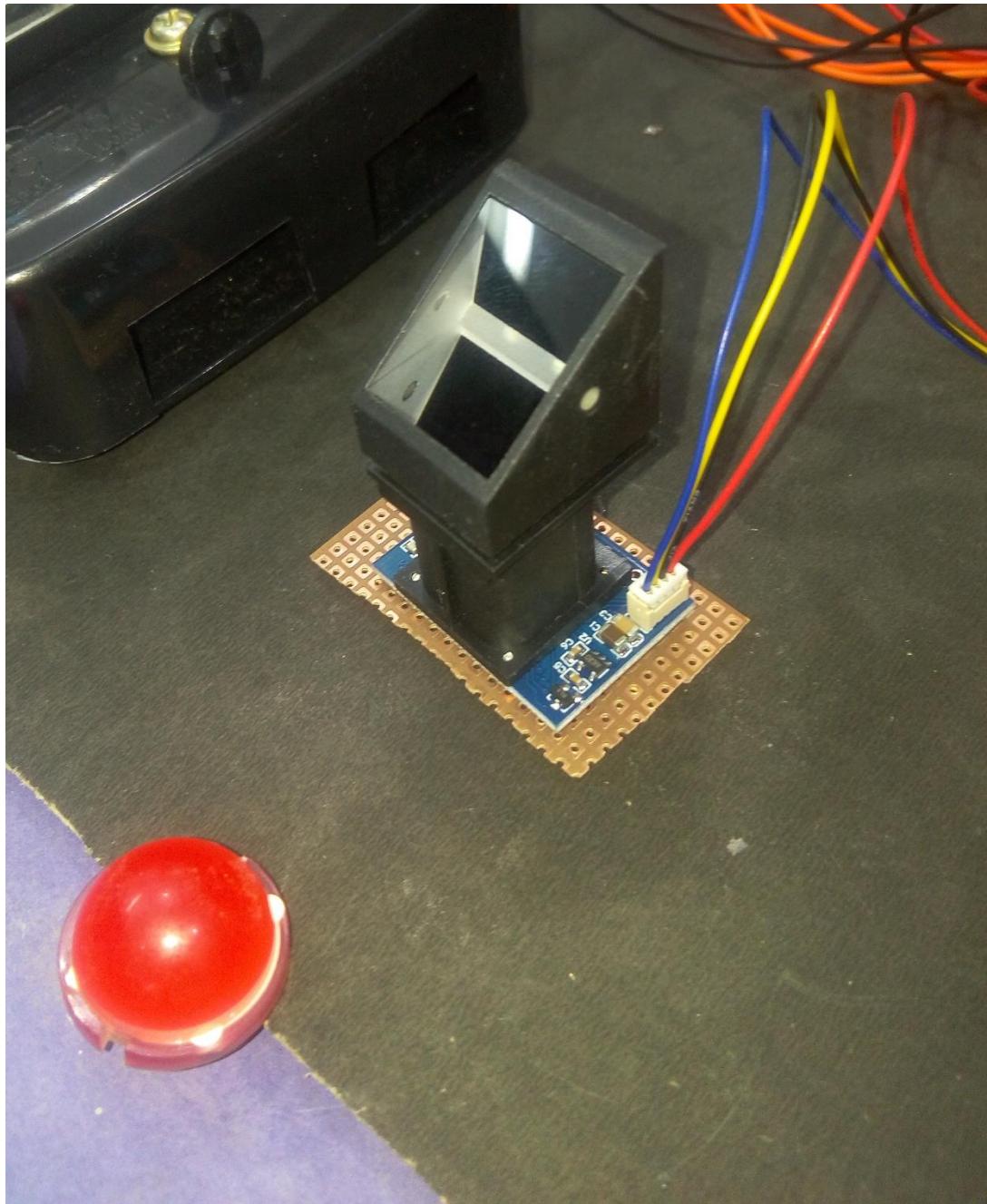


Figure 62: FP Scanner testing

In

this section the developer has tested the finger print working and at one moment he also enrolled new finger print for the time of demonstration and this testing has passed successfully.

Next testing will be showing testing of IoT application which is being executed by Nod MCU here in this developed project.

IoT test

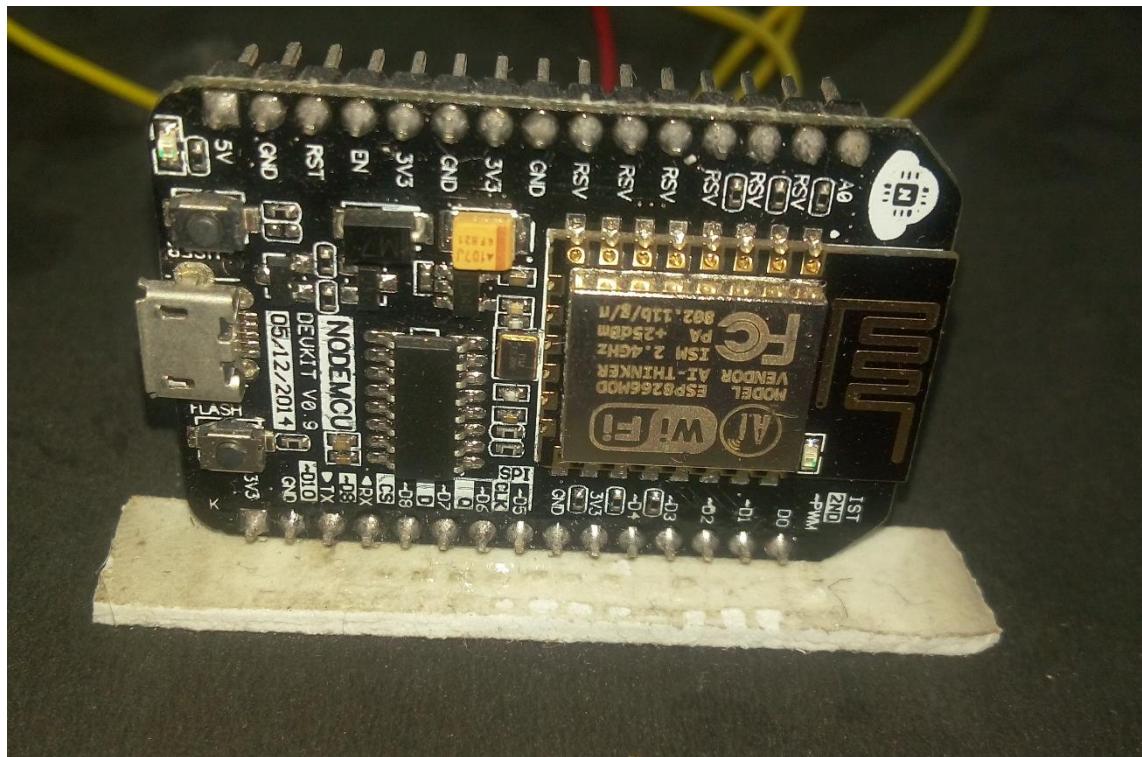


Figure 65: Nod MCU Working

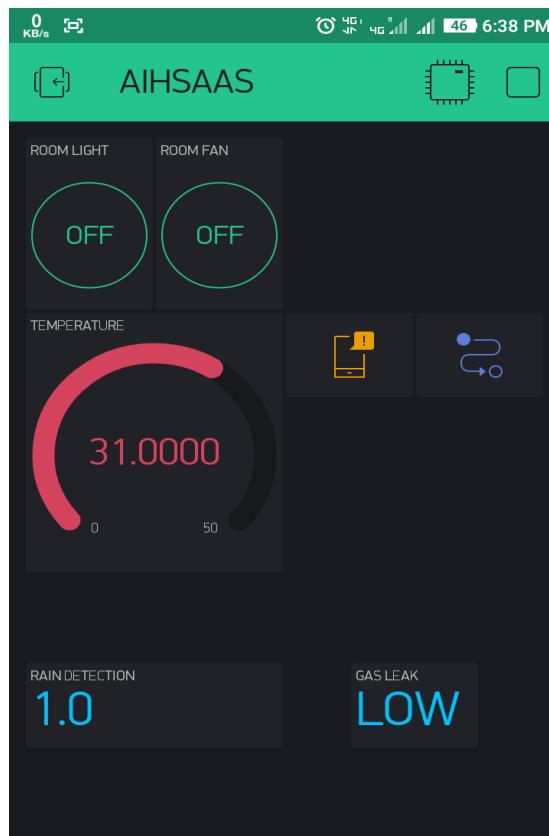


Figure 66: Working Application

As the developed shown various pictures in the above section for the testing of all the section of the hardware model and found every section to be working properly without any bug in the coding section. In the next chapter developer will be explaining critical evaluation and future scope for this project.

Chapter: 8 Critical Evaluation and Future

Scope

A year round of hard work has finally been culminated in a stunning and successful project. This has been no less than a journey. A great amount of knowledge and hands on experience has been gained by the designer right from the establishment to the completion phases of this project which will be surely beneficial in the future. Certain things are left covered that the designer wishes to discuss regarding the project such as what is the degree of success? What are the possible future enhancements? What is the limitation of this project? What are the learning outcomes?

8.1 Degree of success

It was a great challenge and experiences for the developer to complete this project his self in the given time frame. The designer has tried his best of complete all the functionalities given in the project objective. The entire core functionalities including most of the special and enhanced are implemented in the system but still there always is a room for improvement.

8.2 Limitation of the project

- The system should be protected from environmental effects like rain, moisture etc.
- Insulation should be good to protect the components.
- Sudden circuit break may affect very important and urgent works.
- Cost of circuit breaker in any area of the system increases.
- As the project works on IOT platform it is very necessary have an internet connection on both the end i.e. system and the user.

8.3 Future Enhancement

As we already see there are lots of issues in previous existing approaches. In this section we present primarily focusing on, the use of IoT for the advance, energy efficient and self-learning home automation system. The main objective is to design and implement cost effective and smart home automated system. We are using Wi-Fi based approach for communication between Server and Home appliances. This smart home automated system will design with the implementation of related software and hardware. The project proposes an implementation of IoT (Internet of Things) based smart home automated system for remotely control the home appliances using Wi-Fi. Low cost Wi-Fi module ESP8266 is used to build Smart Units. The user will operate home appliances like lights; fans and TV are remotely controlled through Android App. The server will

be interfaced with relay hardware circuits that control the appliances running at home. A smart home can becomes intelligent by applying cognitive computing to connect home IoT data to uncover insights to enhance convenience and can also monitor wellness, security and energy use. An intelligent home can even “learn” about residents to recommend further improvements below are few list that can be added to this home security and automation systems are:

- More artificial intelligence logics can be implemented using high level programming language so that whatever the human effort are applicable here in this developed project can be reduced to zero.
- Cloth washing system can also be executed to reduce human effort.
- All the sensors can be implemented wirelessly using Wi-Fi communication to reduce all the wiring issues.
- If we go for a centralized home security and automation system then all the audiophile and video phallic user can get a better advantages of this system.
- In future car parking and other regular activities can also be implemented to provide ease of living to the user.
- A complete intelligent assistant can also be implemented with this system as we all have seen in movie Iron man about Jarvis.
- At the end developer concludes that to this system has too many future scope and we can build a complete operating system which will be able to control home security, home automation, will work as Intelligent assistant, and can remove up human effort from almost all the repetitive tasks which is being executed now a days with all human efforts.

Chapter: 9 Discussion & Conclusion

9.1 Discussion

Secondary and primary researches were conducted which helped the developer to finalize on developing the system. Automation in home had numerous tangible and intangible benefits. The research methods helped the developer to identify each and every milestones required for the completion of the project.

On discussing about the system. It mainly consists of three parts. Sensors for detection and safety, IoT communication for user control is opted, gear motor that assist in motion of the system and microcontroller that works as the brain of the system.

The system has several sensor for sensing real environment detection, metal proximity sensor for safety and other for specified task. Wireless port that assists in IoT communication or handheld control. Dc gear motor of 3kgcm torque making the motion possible and Arduino Mega 2560 microcontroller that integrates all the function into one that completes the system as a whole. The cost of making a single prototype was also found out and the circuit diagram of the system was designed using Autodesk Circuits (www.circuits.io) online simulation software is also included in the documentation.

9.2 Conclusion

It is evident from this project work that an individual control home automation system can be cheaply made from low-cost locally available components and can be used to control multifarious home appliances ranging from the security lamps, the television to the air conditioning system and even the entire house lighting system. And better still, the components required are so small and few that they can be packaged into a small inconspicuous container.

The designed home automation system was tested a number of times and certified to control different home appliances used in the lighting system, air conditioning system, heating system, home entertainment system and many more (this is as long as the maximum power and current rating of the appliance does not exceed that of the used relay).

Finally, this home automation system can be also implemented over Bluetooth, Infrared and WAP connectivity without much change to the design and yet still be able to control a variety of home appliances. Hence, this system is scalable and flexible. User can easily interact with the android phone/tablet. The user can send commands via the switch mode or speech mode. The

data are being analyzed by the application and are sent over a network. The Raspberry pi acts as a server, analyses the data and activates the GPIO (General Purpose Input Output) Pins. The GPIO Pins are connected to the relays switch which activated the required home appliances. In this way, automation process is carried out. This is a simple prototype. Using this as a reference further it can be expanded to many other programs. A successful implementation of Raspberry-Pi as a home automation and security controller was completed within the given timeframe and to meet all deadlines. No insurmountable problems were encountered and the system worked as expected and is a very polished and complete product.

A novel architecture for an economic smart home system is proposed and implemented in this report. It gives basic idea of how to control various home appliances and provide a security using Arduino mega and Nod MCU. The cost of smart homes technology is for some people an argument against the choice of such installations. This project uses low cost off the shelf components, and is based on Visual Basic and Arduino platform which both are FOSS (Free Open Source Software). So the overall implementation cost is very cheap and is affordable by a common person. This low cost system is designed to improve the standard living in home. The voice control function provides help and assistance especially to disabled and elderly. The security system designed in Arduino IDE also ensures the security of the home and provides a safeguard from possible intruders. For future work, some recommendation can be made like adding motion sensors for automatic turning ON/OFF of lights, fans depending upon the position of user, wireless connectivity can be added to system, and schedulers can be added for controlling home appliances. The whole system can be fabricated as economic commercial hardware package. The concept of this home automation can also be used for grid automation in smart grids in power systems.

9.3 Recommendation

In consonance with the project work and in view of the researched methods and undertakings in the project design, the following are recommended:

- The department should help the students in getting components that are not locally available.
- Students should be taught how to make embedded systems as the use of computer software in most project work makes it uneconomical, and the use of the conventional integrated circuits and logic gates makes the project work clumsy.

- Finally, this project can be further developed to control more than one home appliance at once through the use of short message service texts rather than voice dial though it will be more expensive and will require more relay circuits, making it a distributed control home automation system. Also, to cut the cost of mobile phone, the project may be implemented using standalone GSM modems that only perform specialized functions like text messaging and/or phone calls. This GSM modems often are cheaper and more reliable than GSM mobile phones.

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