

MAJOR PROJECT REPORT

On

Home_Automation

Submitted to Rajiv Gandhi Proudhyogiki Vishwavidyalaya in partial fulfillment
of the requirement for the award of degree of

Bachelor of Engineering

in

COMPUTER SCIENCE AND ENGINEERING

Submitted By

Palak Tiwari

0208CS161089

Shreedutt Tiwari

0208CS161149



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Gyan Ganga College of Technology

Jabalpur, Madhya Pradesh

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PREFACE

Major Project is an integral part of B.E and each and every student has to create the Major Project in the 8th Semester while studying in Institute.

This record is concerned about our practical Major Project during 8th Semester i.e. final year of B.E. course. We have taken our Practical Major Project in Home_Automation during this Major Project, we got to learn many new things about the technology and its practical implementation. This Major Project proved to be a milestone in our knowledge of present environment. Every say and every moment was an experience in itself, an experience which theoretical study can't provide.

ACKNOWLEDGEMENT

It is our pleasure to be indebted to various people, who directly or indirectly contributed in the development of this work and who influenced my thinking, behavior and acts during the course of study.

We express my sincere gratitude to our principal, ***Dr. Neeraj Shukla***, for providing us an opportunity to undergo Major Project in Home_Automation.

We am thankful to Dr. Ajay Lala for his support, cooperation, and motivation provided to us during the Major Project for constant inspiration, presence and blessings. Also we would like to mention our gratitude to the entire faculty of our department for their support and suggestions.

We also extend our sincere appreciation to all the faculty members of Computer Science and Engineering department who provided his valuable suggestions and precious time in accomplishing our Major Project report.

Lastly, we would like to thank the almighty and our parents for their moral support and our friends with whom we shared our day-to-day experience and received lots of suggestions that our quality of work.

Palak Tiwari

Shreedutt Tiwari

DECLARATION

I, **Palak Tiwari**, Roll No. 0208CS161089, and **Shreedutt Tiwari**, Roll No. 0208CS161149 B.E (Semester- VIII) of the **Gyan Ganga College of Technology, Jabalpur** hereby declare that the Major Project Report entitled “**Home_Automation**” is an original work and data provided in the study is authentic to the best of my knowledge. This report has not been submitted to any other Institute for the award of any other degree.

Palak Tiwari

(Roll No. 0208CS161089)

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(Roll No. 0208CS161149)

Place: Jabalpur

Date: 18-April-2020

This is to certify that above statement made by the candidate is correct to the best of our knowledge.

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Approved by AICTE New Delhi & Govt. of M.P.

(Affiliated to Rajiv Gandhi Prodyougiki Vishwavidhyalaya, Bhopal)

Certificate

This is to certify that the Major Project report entitled “**Home_Automation**” is submitted by “**Palak Tiwari**” and “**Shreedutt Tiwari**” for the partial fulfillment of the requirement for the award of degree of Bachelor of Engineering in Department of Computer Science & Engineering from Rajiv Gandhi Proudyougiki Vishwavidyalaya, Bhopal (M.P).

(Internal Examiner)

(External Examiner)

ABSTRACT

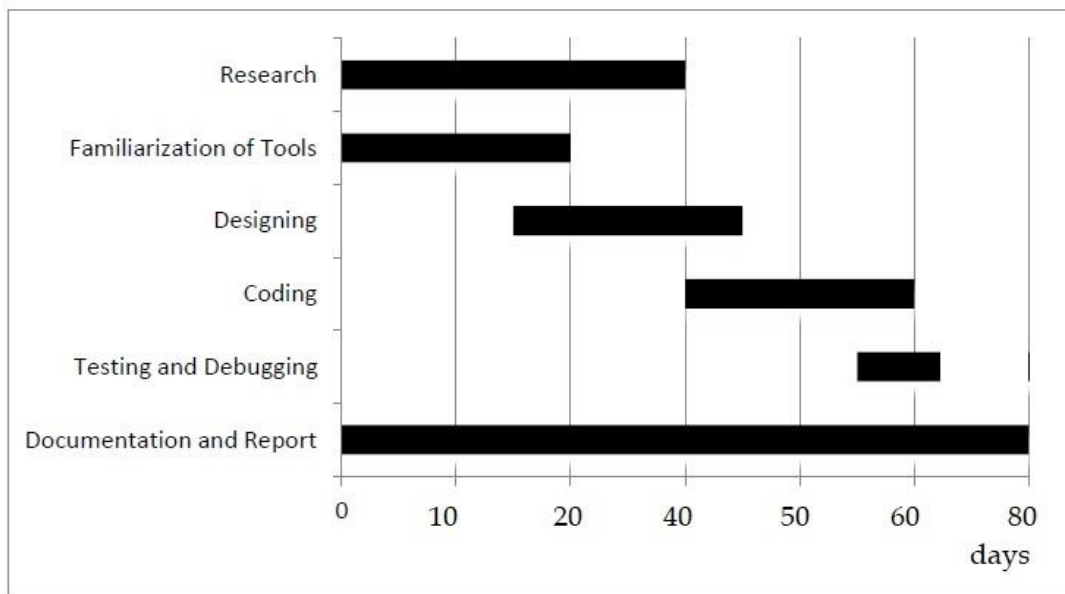
The Home_Automation is a wireless home automation system that is supposed to be implemented in existing home environments, without any changes in the infrastructure. This project demonstrates a simple home automation system that allows the user to control home appliances and check live status with Smartphone.

In order to achieve this, NodeMcu is used at receiver end while on a transmitter end, a GUI application on the Smartphone sends commands to receiver and checks the results.

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Gantt chart of Work



Gantt chart of work schedule

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CHAPTER 1 :
INTRODUCTION

1.1 PROBLEM DEFINATION

People have become negligent in proper utilization of the available energy. Most of the people forget to turn -off, their home appliances when in hurry, which indeed leads to waste of energy and money. Even in those situations, application of home automation makes it possible to control them from a distant place in easy way with our Smartphone. We never have to worry about opening the door, switching off the appliances and so on. In short, we can save precious time and experience more daily productivity. Many home devices now have Wi-Fi and can interact with other home devices, Smartphone applications and home computers. An issue is that these devices cannot communicate with each other or require an additional device to do so and need an individual application on the Smartphone to be controlled. A much better option is to unify these devices into one program/device that controls them. As an example, one can control the lights, microwave, oven, TV, air-conditioning and door locks through one application on the Smartphone. This gives the consumer more control of their home, for example, it allows them to set up conditions for when the lights turn on, or if they are on their way home, to preheat the oven before they get home. Therefore, home automation can simplify many manual actions. However most advanced home automation systems in existence today require a big and expensive change of infrastructure. This means that it often is not feasible to install a home automation system in an existing building.

1.2 PROJECT OVERVIEW

Home Automation is automation of home, housework or household activity. In other words it refers to use of IT/computer to control home appliances. It integrates electrical devices in a house with each other. For example: It can include centralized control of lighting, appliances, security lock of gates & doors to provide improved convenience, comfort, energy, efficiency and safety. In today's IT world, home automation is being popular due to easiness, flexible means of viewing/monitoring and controlling the appliances and other things according to users comfort and needs. The challenging part lies in simplicity and cost of installing them in home and varies with increasing number of services to be monitored and controlled. This

project named 'HOME AUTOMATION' is idea of home automation using android. The popularity of home automation has been increasing greatly in recent years due to considerable affordability and simplicity through smartphone and tablet connectivity. A home automation system integrates electrical devices in a house with each other. The techniques employed in home automation include those in building automation as well as the control of domestic activities, such as lighting control system, and the use of other electrical appliances. Devices may be connected through a home network to allow control by a personal computer, and may allow remote access from the internet. Through the integration of information technologies with the home environment, systems and appliances can communicate in an integrated manner which results in convenience, energy efficiency, and safety benefits. Due to the advancement of wireless technology, there are several different of connections are introduced such as GSM, WIFI, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HA project, WIFI is being chosen with its suitable capability. The capabilities of WIFI are more than enough to be implemented in the design. Also, most of the current laptop/notebook or Smartphone come with built-in WIFI adapter. It will indirectly reduce the cost of this system. The android running OS in any phone connected to a network can access the status of the home appliances via an application. It presents the design and implementation of automation system that can monitor and control home appliances via android phone or tablet.

1.3 OBJECTIVES

The main objectives of our project are as follows:

- To remotely control home appliances and monitor them.
- To save time and utilize the energy efficiently.

1.4 MOTIVATION

The CEO of Facebook, Mark Zuckerberg has built an Artificial Intelligence (AI) voice controlled assistant for his home. His inspiration came from the character “Jarvis” from the movie called Iron-Man. He has described that it is like a digital butler who can speak, play music, control lights and toasters. It can also say who is at the door. This project has made a movie character almost come to real. This excellent work of his has inspired us to do the project of home automation. There are many smart home appliances like underground refrigerator, smart closet etc. used in few luxurious houses of western countries. We believe a day will come when almost all houses will be a smart house. This project is a small step to reach this goal. Almost every house has smart phones, smart television, smart watch, smart refrigerator, smart washing machine, smart garage which ultimately leads to a smart home. From there it is predictable that one day almost every house will be a smart house with automatic control system.

1.5 APPLICATIONS

The application includes remote controlling of home appliances and lighting systems in an easy way. Also, home security and monitoring can be achieved.

- Home Is Where the Smart is machine-to-machine communication, and you understand you're not the most tech-savvy consumer, it's impossible that you've missed the abundance of home automation products filling the shelves and ads of every home improvement store. Suddenly an ordinary errand for light bulbs will leave you wondering if your lamp could send you a message alerting you that the light bulb needs to be replaced. Furthermore, if your lamp is talking to you, could your refrigerator and sprinkler system be too? Experts say: Yes, the possibilities are endless. If that's the case, where do you begin? Any day-to-day, repeatable process is automatable with smart home applications. The greater the control and flexibility of these processes, the more energy and cost savings the resident experiences, which are factors anyone who pays utilities strives to moderate. The smart home revolution is likely to be more of an evolution, with the incorporation of one or two home systems at a time, gradually automating our households through smart mobile devices.

However, with these elements of efficiency comes the question of ease of use. Will it bring you enjoyment or exasperation? With so many brands and models already available in an ever growing market, how do you know which is best for you?

- **Lighting Control: Leaving the Dark Ages and Stepping Into the Light** Smart lighting allows you to control wall switches, blinds, and lamps, but how intuitive is a lighting control system? It turns out, quite; its capabilities are extensive. You're able to schedule the times lights should turn on and off, decide which specific rooms should be illuminated at certain times, select the level of light which should be emitted, and choose how particular lights react through motion sensitivity, as seen with Belkin's WeMo Switch + Motion, which is both affordable and easy to use with its plug-and-play simplicity.
- **HVAC Regulation: No Longer Burned by Your Heating Bill** As fuel costs rise and the availability and sustainability of our resources becomes a greater concern, heating/cooling our homes efficiently is less a budgetary bonus and more of a necessity. Over the past year, smart thermostats and automated home heating systems have become more readily available and easily incorporate into any home. Heating and cooling our homes consumes an average of 50% of energy costs yearly, making daily HVAC regulation progressively rewarding. Maintaining a substantial lead among the nearly non-existent competition, the Nest Learning Thermostat, learns your heating and cooling preferences over time, eliminating the need for programming and is accessible from your smartphone app. With automated HVAC you are able to reduce the heat when a room is unoccupied, and increase or decrease it at specific times based on your schedule and occupancy.
- **Lawn Irrigation Systems: The Grass is Always Greener** A lush and healthy lawn is a source of pride for most homeowners, but the weather doesn't always cooperate and provide the adequate elements for a flourishing landscape. For decades we've relied on sprinkler systems to keep our yards at peak presentation, but at what cost? The average American home spends approximately 30% of their daily water usage on lawn and garden maintenance. Nearly half of that amount is wasted due to inefficiency. If you apply that statistic to the national average, up to 4.5 billion gallons of water is wasted per day through ineffective watering methods. If we reflect upon the monetary impact

of this, it results in Americans spending over a thousand dollars a year in water, with a portion of that being waste. The global effects are even greater when you consider the growing concern over climate change and the dramatic decrease in agricultural natural resources. However, sprinkler control systems, like Skydrop, are providing water regulation through real-time communication with local weather data. If a rainstorm develops and deposits two inches of rainwater on your lawn, the automated sprinkler detects the saturation and disables its scheduled watering. Conversely, the system will be alerted to dry conditions and supply the necessary amount of nourishment, without over-watering.

- **Smart Appliances: What's for Dinner?** Will smart kitchen appliances actually make you a better cook? Maybe. Smart refrigerators, such as LG's Smart ThinQ, allow you to scan grocery store receipts and keep an inventory of your items, and alerts you if an item is about to expire. More impressively, it suggests recipes based on your refrigerator's contents and lets you know when you need to replace items. Smart ovens synch with your smartphone and automatically preheat to the correct temperature based on a recipe selected from your database. While these appliance options seem a bit superficial and convenience based, there is a conservation factor as well. By automating your kitchen appliance and making them accessible from your smart device, you're able to sever the electricity supplied to unused appliances and reduce your energy consumption and costs. Considering the number of appliances the average household owns; this could save a substantial amount of money over time.
- **Security Systems: Knock, Knock... Who's there?** The Internet of Things. While efficiency and conservation are certainly IoT benefits, its potential to have improved control over home security is a primary focus. Smart locks, like Kwikset's Kevo, a Bluetooth enabled electronic deadbolt, and various connected home security systems, such as iSmartAlarm, offer a variety of features including door and window sensors, motion detectors, video cameras and recording mechanisms. All of which are connected to a mobile device and accessible via the cloud, thus enabling you to access real-time information on the security status of your home. Naturally, there is a great deal of scrutiny regarding the level of trust in controlling your home's security system

via a mobile device, but it begs earnest exploration when weighing the potential benefits and peace of mind it provides homeowners.

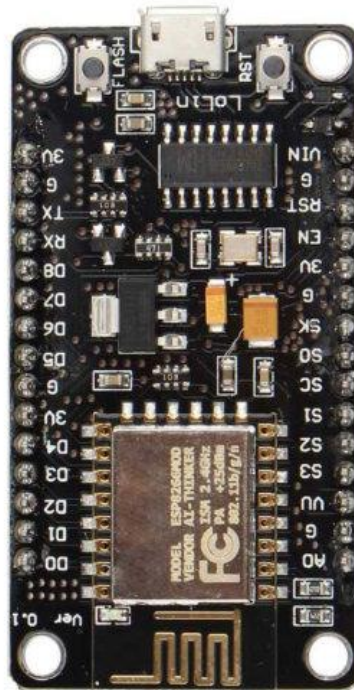
1.6 PROJECT FEATURES

The features of our project can be highlighted in following points:

- Remote control of home appliances from anywhere using app.
- Continuous monitoring and security of home with camera module.
- Considerable reduction in electricity bills with efficient energy utilization.

1.7 HARDWARE REQUIREMENT

- NodeMcu [12E ESP8266] –



The Node MCU (Node Micro Controller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (wifi), and even a modern operating system and SDK. Its less price makes it an excellent choice for IoT projects of all kinds.

- Relay Board 5V [x4] –



A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. Here we are using SPDT (Single Pole Double Throw) relay. The Single Pole Double Throw SPDT relay is quite useful in certain applications because of its internal configuration. It has one common terminal and 2 contacts in 2 different configurations: one can be Normally Closed and the other one is opened or it can be Normally Open and the other one closed. So basically you can see the SPDT relay as a way of switching between 2 circuits: when there is no voltage applied to the coil one circuit “receives” current, the other one doesn’t and when the coil gets energized the opposite is happening. We are using it in Normally Open mode.

- Servo Motor – (For controlling the door lock)

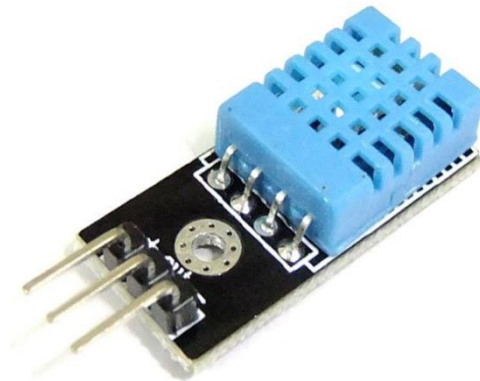


A **servo motor** is an electrical device which can push or rotate an object with great precision. If you want to rotate an object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which runs through **servo mechanism**. If the motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. Due to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motor's shaft, the greater the distance the lesser the weight carrying capacity.

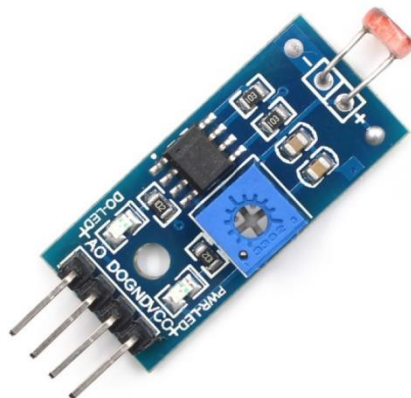
The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

- DHT11-



The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

- Flame Sensor –

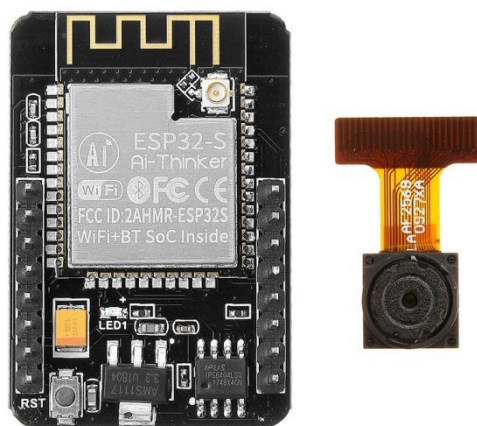


This Flame Sensor can be used to detect fire source or other light sources of the wave length in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation. When the sensor detects flame the Signal LED will light up and the D0 pin goes LOW.

- Smartphone [Android] –

Here we will be using android application made on mit app inventor.

- Jumper Wires
- RGB Led
- 5V Power Supply
- ESP32-CAM –



The ESP32-CAM is a very small camera module with the ESP32-S chip. Besides the OV2640 camera, and several GPIOs to connect peripherals, it also features a microSD card slot that can be useful to store images taken with the camera or to store files to serve to clients.

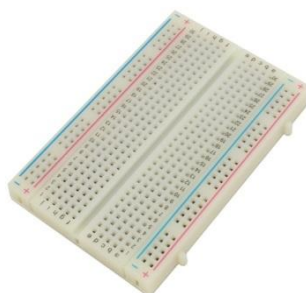
- PIR Sensor



A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications. PIR sensors detect general movement, but do not give information on who or what moved. For that purpose, an active IR sensor is required.

PIR sensors are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector". The term *passive* refers to the fact that PIR devices do not radiate energy for detection purposes. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects.

- Resistors
- Bread Board –



1.8 SOFTWARE AND TOOLS REQUIREMENT

- **Arduino IDE -**

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

- **Google Firebase [Database]-**

The Firebase Realtime Database is a cloud-hosted database. Data is stored as JSON and synchronized in realtime to every connected client. When we build cross-platform apps with our iOS, Android, and JavaScript SDKs, all of our clients share one Realtime Database instance and automatically receive updates with the newest data. Firebase provides a quick way to keep sensory data collected at the device level, and it works great with the Android APIs, which is supported by AndroidThings. A lot of mobile and device programmers that I have come across struggle with server-side programming. Firebase can really help bridge that gap and make it easier. It will be interesting to see developers use its offline features. If you are new to IoT or generally any device that collects data

and needs to transmit it over networks, the golden rule to be assumed is that network connectivity cannot be assumed. As a result, you will need to collect the data offline and when the network is available, transmit this over to your server. Firebase with its offline features can really make this simple for a lot of developers.

Firebase has a ton of features including Real-time Database, Authentication, Cloud Messaging, Storage, Hosting, Test Lab and Analytics, but I'm only going to use Authentication and Real-time Database.

- **Android Development Tool (MIT Inventor)-**

App Inventor for Android is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create software applications for the Android operating system (OS). It uses a graphical interface, very similar to Scratch and the Star Logo TNG user interface, which allows users to drag-and-drop visual objects to create an application that can run on Android devices.

CHAPTER 2 :
LITERATURE SURVEY

Home automation or smart homes can be described as introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants . There are many other projects done on home automation in different countries. They are all different from each other in designs; features, devices, elements and algorithm. They were designed according to specific needs and availability of components in the respective areas. Some of them are cheap; some of them are very expensive. Availability of both hardware and software is necessary to work. After a long searching, we have found a lot of articles. Searching for security purpose articles, we also found some projects done for garage security. These are mainly done in western countries. Many projects are done only for security purpose with Arduino or Raspberry Pi. Again, the projects are done only for controlling home appliances using Arduino or Raspberry Pi. There are few projects on Fingerprint recognition module for strong home security issues. One of the projects used biometric method for next generation E-passport. The e-passport, as it is sometimes called, represents a bold initiative in the deployment of two new technologies: Radio-Frequency Identification (RFID) and biometrics . Furthermore, there are projects done on fingerprint recognition module describing the methods how to identify the fingerprints. A wide variety of systems requires reliable personal recognition schemes to either confirm or determine the identity of an individual requesting their services. The purpose of such schemes is to ensure that the rendered services are accessed only by a legitimate user and no one else. Those papers didn't mention about how to use it for home security using any kind of microcontrollers . Face recognition is another excellent and smart way that serves security purpose. We have found projects for door security using face recognition using Raspberry Pi. We avoided this part for the security purpose because error occurs more in face recognition than fingerprint recognition. Fingerprint has high accuracy . They didn't explicitly mention about the security purpose of Raspberry Pi. They have only mentioned about the techniques of recognition. Different people have described the procedure of recognition in different ways. Basically all of them have tried to minimize errors for computer to recognize face.

2.1 EXISTING SYSTEM

Existing system include some apps like Samsung SmartThings, Philips Hue, Blynk. Also there are some IR remote based appliances and some Bluetooth controlled devices.

DRAWBACKS OF EXISTING SYSTEM

- IR remote based and Bluetooth controlled devices are range specific.
- There aren't any flawless retrofit solutions available yet; If you are building a new home, then wired solutions work great but for customers with existing homes there has not yet come a solution to have them on-board the 'Smart Home' revolution.
- Home Automation is still an expensive product, by Indian consumer standards, and there's a lot of scope of the prices to be whittled down.
- Most commercially available home automation system are all in one solutions which require that all controllable appliances should be from same company.

2.2 PROPOSED SYSTEM

OVERVIEW

The Home Automation system uses NodeMcu, relay board and some sensors to control any electronic device using app on their Android Smartphone. The android app sends commands to the Firebase and also receives live status from sensors such as temperature, humidity, flame and reflects in app. The changes in Firebase are reflected to NodeMcu which in turn will control the appliances, door etc. according to user instructions, from anywhere.

- The proposed system has tried to overcome above listed drawbacks in existing system. Cost is less and can be easily implemented.

- Our main objective is to remotely control appliances.
- Monitor room temperature and other factors from anywhere.
- This project aims to develop a prototype of a product capable of locking/unlocking a door, with an emphasis on low cost and open source configurability.
- The end goal beyond this project would be a product that would hopefully allow people to connect to many other home devices through Wi-Fi. It will save time and utilize the energy efficiently.

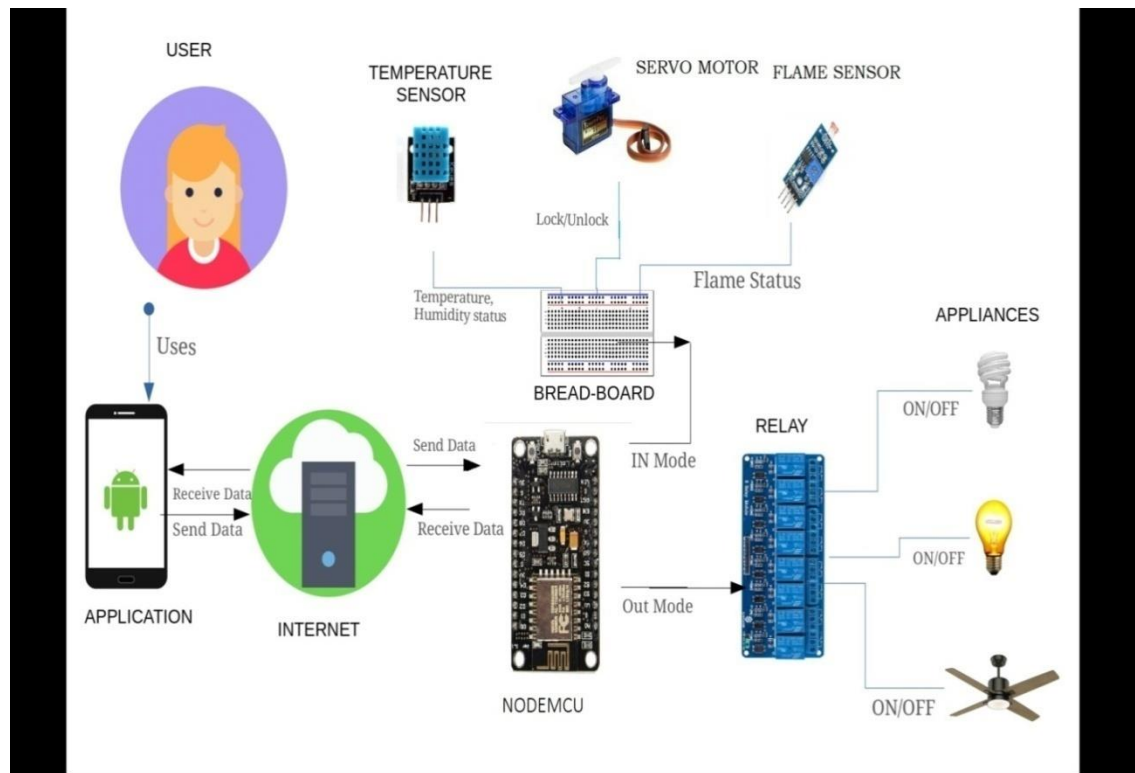


Fig. 2

2.3 FEASIBILITY STUDY

This project can be implemented using affordable electronic and software technology making it economically, technically and operationally feasible.

2.3.1 Economic Feasibility

This project is based on android phone based and few electronic components like microprocessor, camera modules, relay switches, sensors etc. which are affordable, making it economically feasible to implement.

2.3.2 Technical Feasibility

This project is based on wireless technology and embedded system which are reasonably in phase with currently used technology. Therefore, it is very much favoured by the technology.

2.3.3 Operational Feasibility

This software will have very easy to use, user friendly interface so it will be pretty much operable by anyone having little experience of using android phone. It could be helpful for physically disabled person too, controlling home appliances with the click of a button. So it is operationally feasible.

CHAPTER 3 :
SYSTEM ANALYSIS AND DESIGN

3.1 REQUIREMENT SPECIFICATION

3.1.1 FUNCTIONAL REQUIREMENT

Functional requirements are the functions or features that must be included in any system to satisfy the business needs and be acceptable to the users. Based on this, the functional requirements that the system must require are as follows:

- **Switch ON/OFF the Appliances**

INPUT- ON/OFF command

DETAILS- User will open the app and will go to control appliances option and will select ON/OFF option according to his requirement, on the particular device.

- **Monitor room temperature and detect Flame**

INPUT- Select check status

DETAILS- User will be able to view the live temperature, humidity and can check is there any flame or not at his home.

- **Change led color-**

INPUT- Select color

DETAILS- User can change the led color and set it according to his choice from anywhere by change led color option in app.

- **Lock/Unlock Door-**

INPUT- Select lock/unlock

DETAILS- User can lock or unlock door at anytime.

- **Automatic lights switch-on on motion-**

INPUT- MOTION

DETAILS- By the motion sensor automatic light will be switched on and off.

- **Live streaming-**
INPUT- Camera
Details- Live streaming of home.

3.1.2 NON FUNCTIONAL REQUIREMENT

A non-functional requirement is a description of features, characteristics, and attributes of the system as well as any constraints that may limit the boundaries of the proposed system. The non-functional requirements are essentially based on the performance, information, economy, control and security efficiency and services. Based on these the non-functional requirements are as follows

- **User Friendly-** The app will be clear and uncluttered keeping in mind the various kinds of people who will use the product.
- **Flexibility-** Changes can be incorporated as and when required with utmost ease.
- **Portable-** App is easily available for any Android device.
- **Reliability-** The product should be easy and without errors as the user will rely on it for controlling appliances, door locks and monitoring .
- **Maintainability-** Should be easy to maintain by the administrators and must be bug free as much as possible.
- To perform efficiently in a short amount of time.

3.2 DIAGRAMS

3.2.1 USE CASE DIAGRAM

About Use Case Diagram

A use case is a software and system engineering term that describes how a user uses a system to accomplish a particular goal. A use case acts as a software modelling technique that defines the features to be implemented and the resolution of any errors that may be encountered.

Use cases define interactions between external actors and the system to attain particular goals. There are three basic elements that make up a use case:

- **Actors:** Actors are the type of users that interact with the system.
- **System:** Use cases capture functional requirements that specify the intended behavior of the system.
- **Goals:** Use cases are typically initiated by a user to fulfill goals describing the activities and variants involved in attaining the goal.

Use cases are modeled using unified modeling language and are represented by ovals containing the names of the use case. Actors are represented using lines with the name of the actor written below the line. To represent an actor's participation in a system, a line is drawn between the actor and the use case. Boxes around the use case represent the system boundary.

Characteristics associated with use cases are:

- Organizing functional requirements
- Modeling the goals of system user interactions
- Recording scenarios from trigger events to ultimate goals
- Describing the basic course of actions and exceptional flow of events

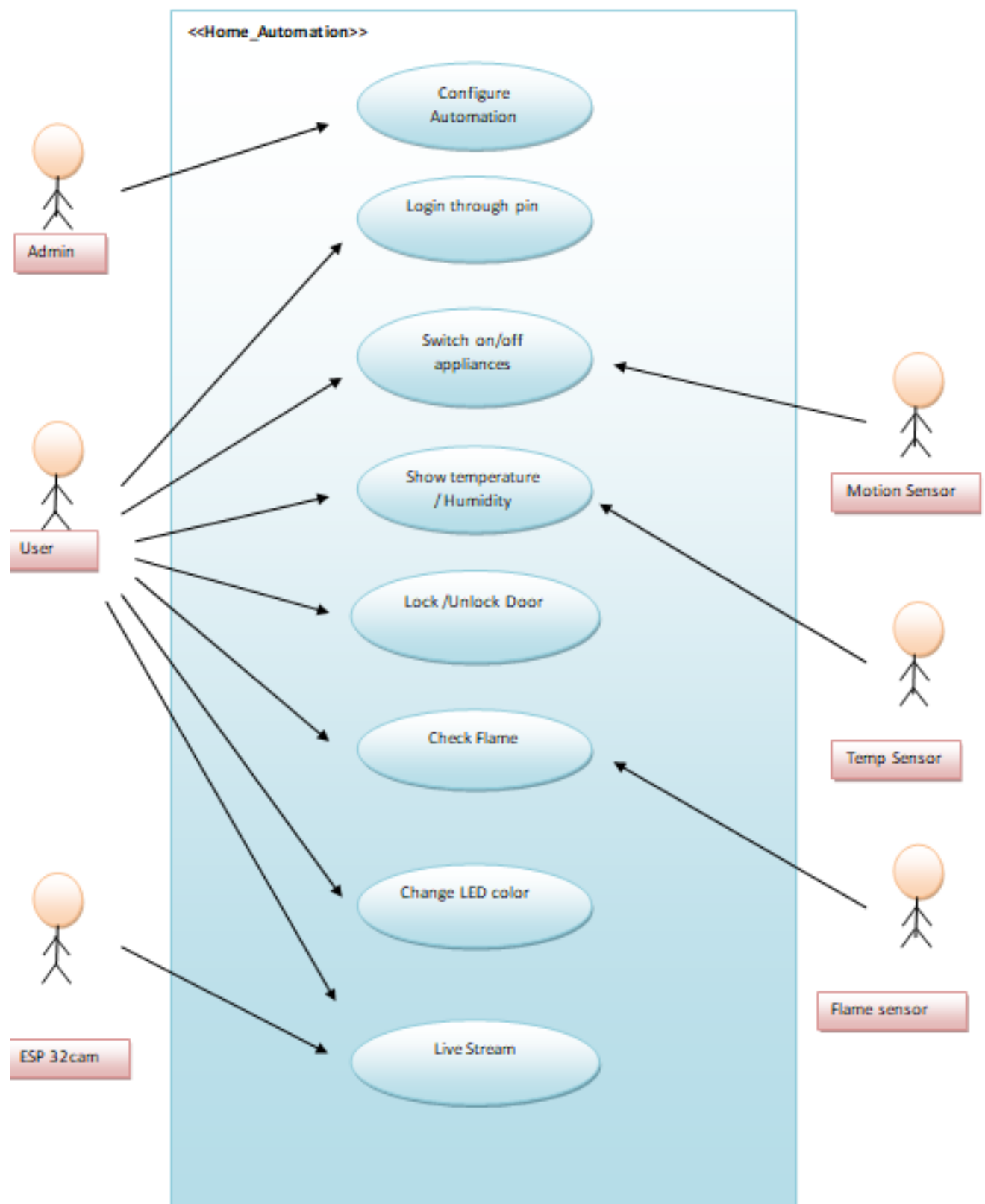


Fig. 3 Use Case Diagram

3.2.2 DATA FLOW DIAGRAM

Data flow diagrams are used to graphically represent the flow of data in a business information system. DFD describes the processes that are involved in a system to transfer data from the input to the file storage and reports generation.

Data flow diagrams can be divided into logical and physical. The logical data flow diagram describes flow of data through a system to perform certain functionality of a business. The physical data flow diagram describes the implementation of the logical data flow. DFD graphically representing the functions, or processes, which capture, manipulate, store, and distribute data between a system and its environment and between components of a system. The visual representation makes it a good communication tool between User and System designer. Structure of DFD allows starting from a broad overview and expand it to a hierarchy of detailed diagrams. DFD has often been used due to the following reasons:

- Logical information flow of the system
- Determination of physical system construction requirements
- Simplicity of notation
- Establishment of manual and automated systems requirements

0-level DFD:

It is also known as context diagram. It is designed to be an abstraction view, showing the system as a single process with its relationship to external entities. It represent the entire system as single bubble with input and output data indicated by incoming/outgoing arrows.

1-level DFD:

In 1-level DFD, context diagram is decomposed into multiple bubbles/processes.in this level we highlight the main functions of the system and breakdown the high level process of 0-level DFD into subprocesses.

2-level DFD:

2-level DFD goes one step deeper into parts of 1-level DFD. It can be used to plan or record the specific/necessary detail about the system's functioning.

Level 0

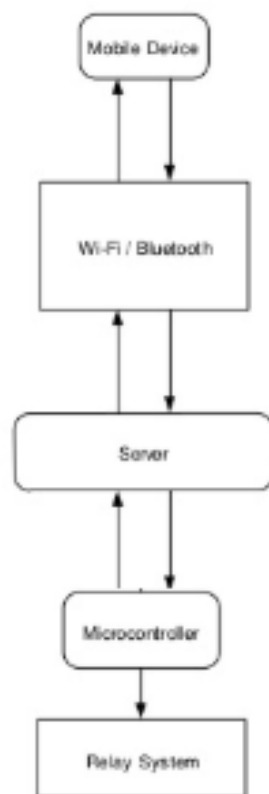


Fig. 4 Data Flow Diagram

Level 1

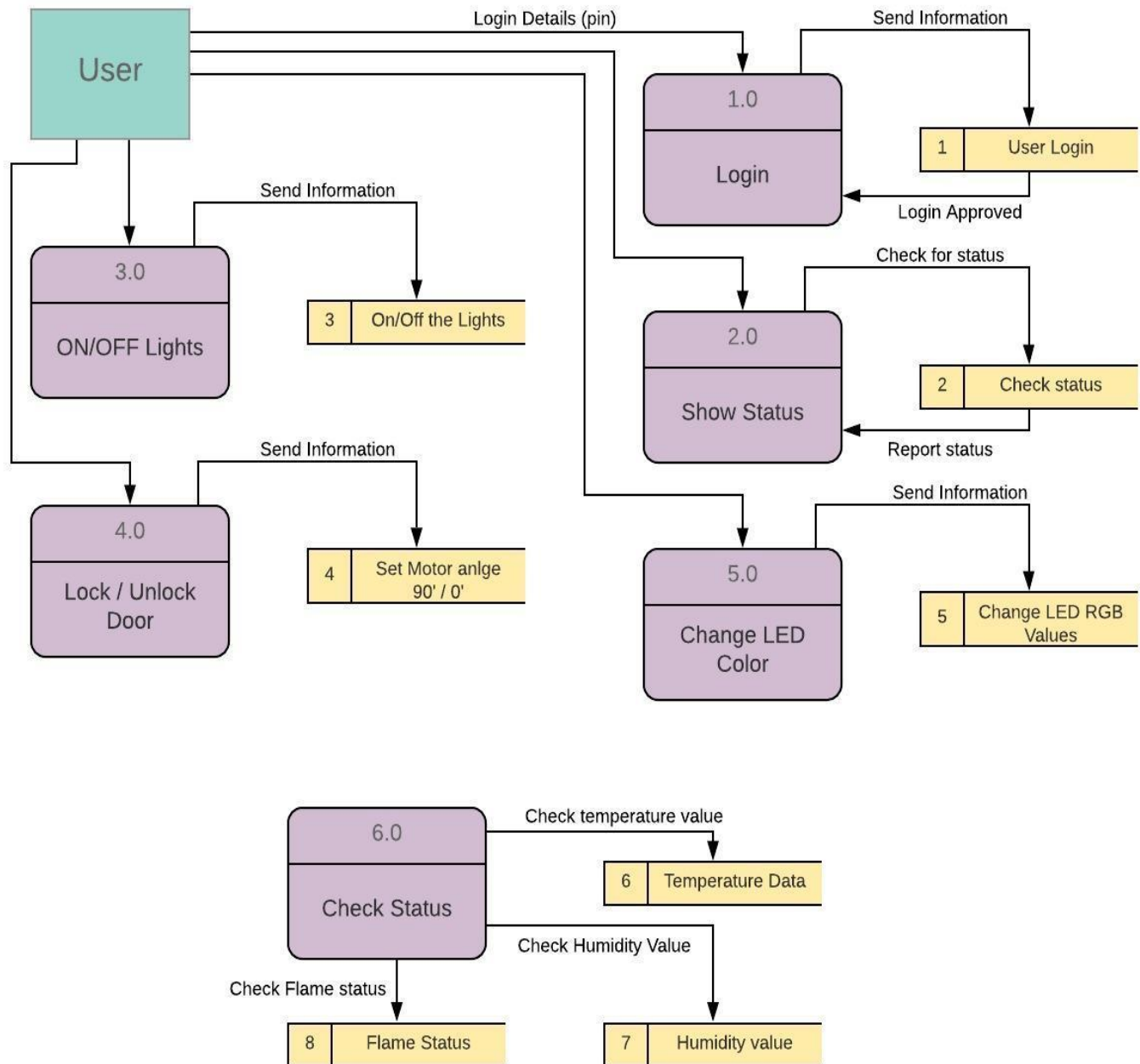


Fig. 5 Data Flow Diagram

3.2.4 SEQUENCE DIAGRAM

Sequence Diagrams are interaction diagrams that detail how operations are carried out. They capture the interaction between objects in the context of a collaboration. Sequence Diagrams are time focus and they show the order of the interaction visually by using the vertical axis of the diagram to represent time what messages are sent and when.

Sequence Diagrams captures:

- the interaction that takes place in a collaboration that either realizes a use case or an operation (instance diagrams or generic diagrams)
- high-level interactions between user of the system and the system, between the system and other systems, or between subsystems (sometimes known as system sequence diagrams)

Purpose of Sequence Diagram

- Model high-level interaction between active objects in a system
- Model the interaction between object instances within a collaboration that realizes a use case
- Model the interaction between objects within a collaboration that realizes an operation
- Either model generic interactions (showing all possible paths through the interaction) or specific instances of a interaction (showing just one path through the interaction)

Sequence Diagrams at a Glance

Sequence Diagrams show elements as they interact over time and they are organized according to object (horizontally) and time (vertically):

Object Dimension

- The horizontal axis shows the elements that are involved in the interaction
- Conventionally, the objects involved in the operation are listed from left to right according to when they take part in the message sequence. However, the elements on the horizontal axis may appear in any order

Time Dimension

- The vertical axis represents time proceedings (or progressing) down the page.

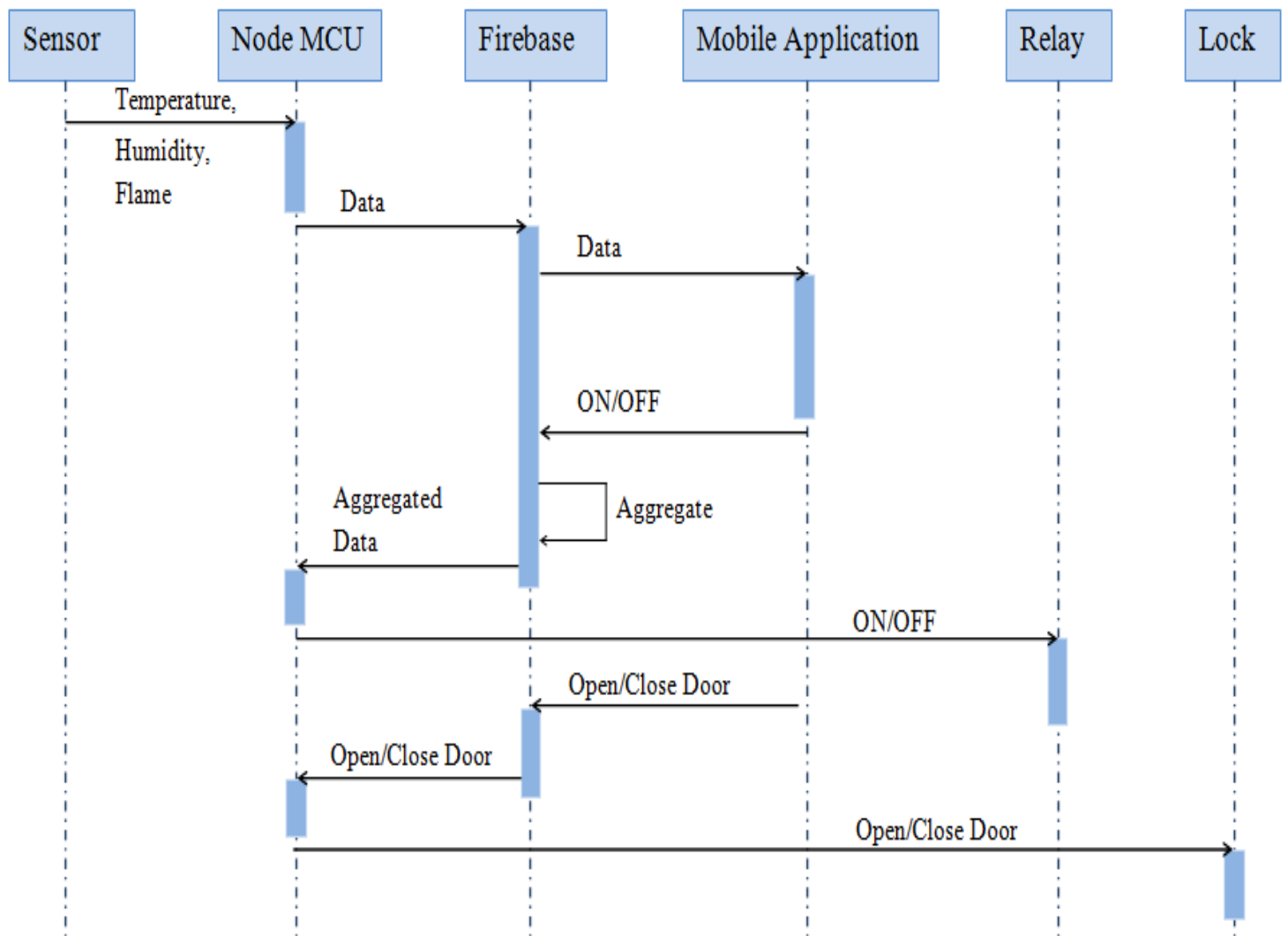


Fig. 6 Sequence Diagram

3.2.5 ACTIVITY DIAGRAM

Activity diagram is another important diagram in UML to describe the dynamic aspects of the system.

Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system.

The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc

Purpose of Activity Diagrams

The basic purposes of activity diagrams is similar to other four diagrams. It captures the dynamic behavior of the system. Other four diagrams are used to show the message flow from one object to another but activity diagram is used to show message flow from one activity to another.

Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system, but they are also used to construct the executable system by using forward and reverse engineering techniques. The only missing thing in the activity diagram is the message part.

It does not show any message flow from one activity to another. Activity diagram is sometimes considered as the flowchart. Although the diagrams look like a flowchart, they are not. It shows different flows such as parallel, branched, concurrent, and single.

The purpose of an activity diagram can be described as –

- Draw the activity flow of a system.
- Describe the sequence from one activity to another.
- Describe the parallel, branched and concurrent flow of the system.

Before drawing an activity diagram, we must have a clear understanding about the elements used in activity diagram. The main element of an activity diagram is the activity itself. An activity is a function performed by the system. After identifying the activities, we need to understand how they are associated with constraints and conditions.

Before drawing an activity diagram, we should identify the following elements –

- Activities
- Association
- Conditions
- Constraints

Once the above-mentioned parameters are identified, we need to make a mental layout of the entire flow. This mental layout is then transformed into an activity diagram.

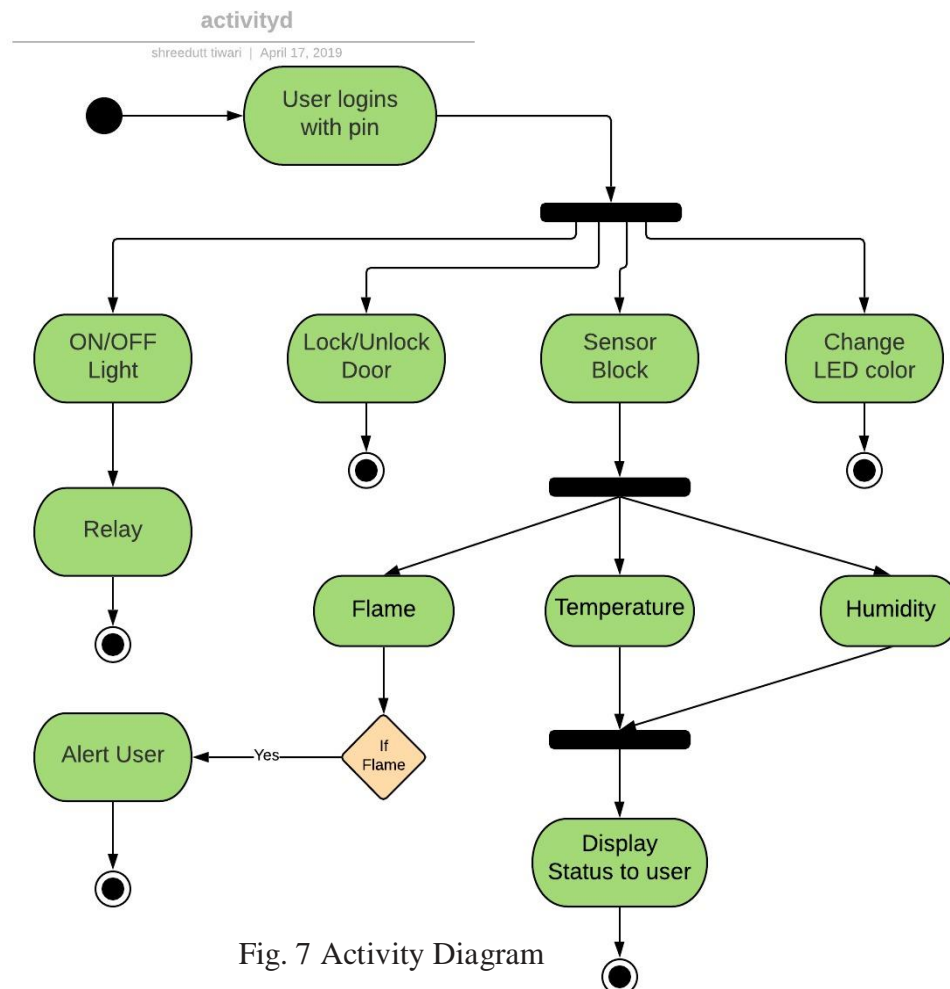


Fig. 7 Activity Diagram

3.3DESIGN

3.3.1 CLASS DIAGRAM

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

Purpose of Class Diagrams

1. Shows static structure of classifiers in a system
2. Diagram provides a basic notation for other structure diagrams prescribed by UML
3. Helpful for developers and other team members too
4. Business Analysts can use class diagrams to model systems from a business perspective

Class

A description of a group of objects all with similar roles in the system, which consists of:

- Structural features (attributes) define what objects of the class "know"
 - Represent the state of an object of the class
 - Are descriptions of the structural or static features of a class
- Behavioral features (operations) define what objects of the class "can do"
 - Define the way in which objects may interact
 - Operations are descriptions of behavioral or dynamic features of a class

Class Notation

A class notation consists of three parts:

1. Class Name
 - The name of the class appears in the first partition.
2. Class Attributes
 - Attributes are shown in the second partition.
 - The attribute type is shown after the colon.
 - Attributes map onto member variables (data members) in code.
3. Class Operations (Methods)
 - Operations are shown in the third partition. They are services the class provides.

- The return type of a method is shown after the colon at the end of the method signature.
- The return type of method parameters is shown after the colon following the parameter name.

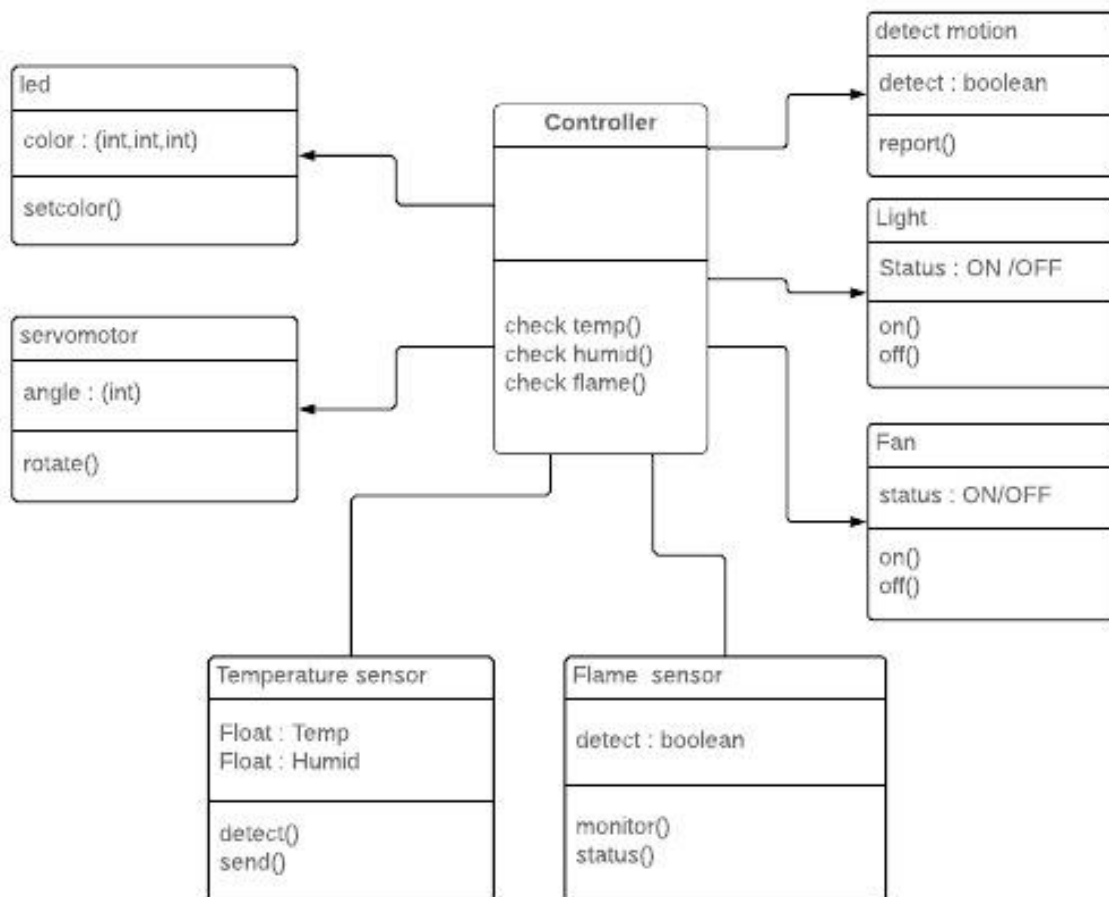


Fig. 8 Class Diagram

3.3.2 SOFTWARE DEVELOPMENT LIFE CYCLE MODEL USED

Waterfall Model-

We have used the waterfall model for our project because requirements are very well documented and clear, there is no ambiguous requirement and project is short. The Waterfall Model was the first Process Model to be introduced. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases.

The Waterfall model is the earliest SDLC approach that was used for software development.

The waterfall Model illustrates the software development process in a linear sequential flow. This means that any phase in the development process begins only if the previous phase is complete. In this waterfall model, the phases do not overlap.

Waterfall Model - Design

Waterfall approach was first SDLC Model to be used widely in Software Engineering to ensure success of the project. In "The Waterfall" approach, the whole process of software development is divided into separate phases. In this Waterfall model, typically, the outcome of one phase acts as the input for the next phase sequentially.

Waterfall Model - Advantages

The advantages of waterfall development are that it allows for departmentalization and control. A schedule can be set with deadlines for each stage of development and a product can proceed through the development process model phases one by one.

Development moves from concept, through design, implementation, testing, installation, troubleshooting, and ends up at operation and maintenance. Each phase of development proceeds in strict order.

Some of the major advantages of the Waterfall Model are as follows –

- Simple and easy to understand and use

- Easy to manage due to the rigidity of the model. Each phase has specific deliverables and a review process.
- Phases are processed and completed one at a time.
- Works well for smaller projects where requirements are very well understood.
- Clearly defined stages.
- Well understood milestones.
- Easy to arrange tasks.
- Process and results are well documented

The following illustration is a representation of the different phases of the Waterfall Model.

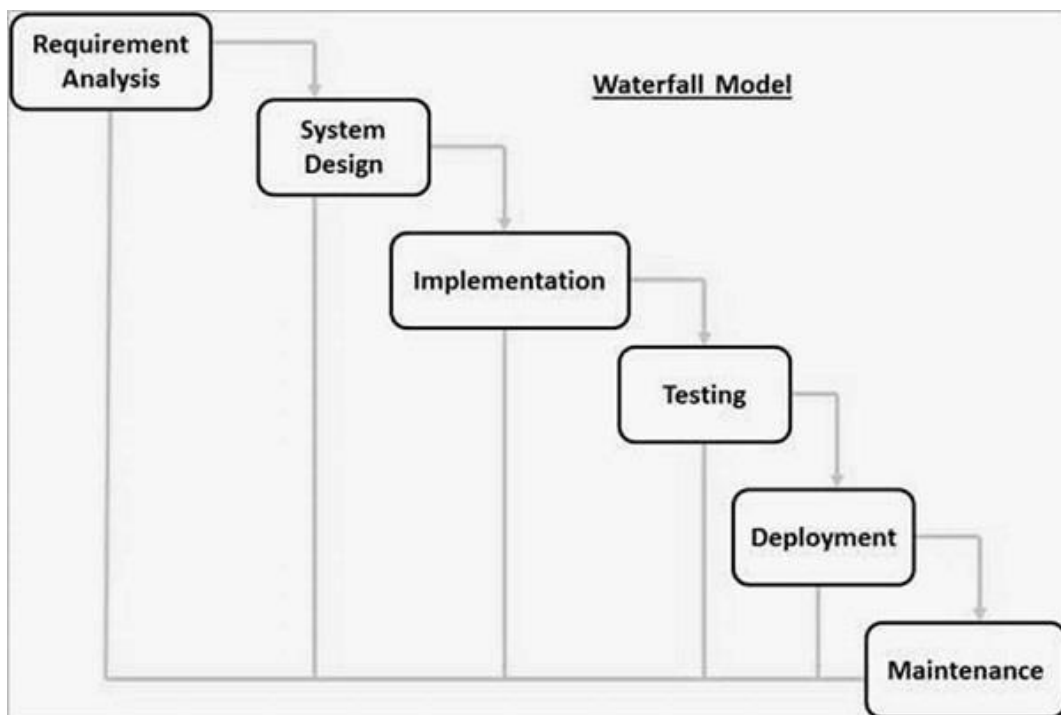


Fig. 9

- Requirement Gathering and analysis – The basic requirement of the system was to control the appliances from android app from anywhere and to monitor.

- System Design- After gathering the requirement and analyzing them it was found to use NodeMcu as it has Wi-Fi module inbuilt and to make an user friendly app. Also for monitoring we found the suitable sensors such as DHT11 as temperature and humidity sensor, flame sensor.
- Implementation- After gathering the required hardware the set up was made and android app was developed.
- Integration and Testing- After hardware setup and GUI was complete it was time to integrate the modules and test them. The NodeMcu was linked with Firebase and so was the app, Firebase was used as database. Testing was done connecting different appliances. Once the functional testing was done, we added some non functional requirements such as controlling color of led and making GUI more user friendly.

SOFTWARE DESIGN

OVERVIEW

Software Design is a process to transform user requirements into some suitable form, which helps the programmer in software coding and implementation. Software Design is the first step in SDLC (Software Design Life Cycle), which moves the concentration from problem domain to solution domain. It tries to specify how to fulfill the requirements mentioned in SRS.

The main objective of the system is to implement a low cost and reliable solution for controlling the home appliances from android app. This functionality can be easily implemented by using NodeMcu which has a inbuilt Wi-Fi module so any changes made in real time from anywhere can easily be reflected in real time. For this we required a realtime database for which we used Firebase and connected it with NodeMcu and the android app.

So the changes made by sensors are reflected in Firebase and app. Similarly changes made in app are reflected in Firebase and so in NodeMcu.

SOFTWARE ARCHITECTURE

Software Architecture is the defining and structuring of a solution that meets technical and operational requirements. Software architecture optimizes attributes involving a series of decisions, such as security, performance, manageability. These decisions ultimately impact application quality, maintenance, performance and overall success. Client/server architecture is a computing model in which the server hosts, delivers and manages most of the resources and services to be consumed by the client. This type of architecture has one or more client computers connected to a central server over a network or internet connection. In our project NodeMcu is server and user using the application is the client. Three tier client / server architecture is a computing model in our project the application is the client side, NodeMcu (microcontroller) is the application server and firebase is the database server.

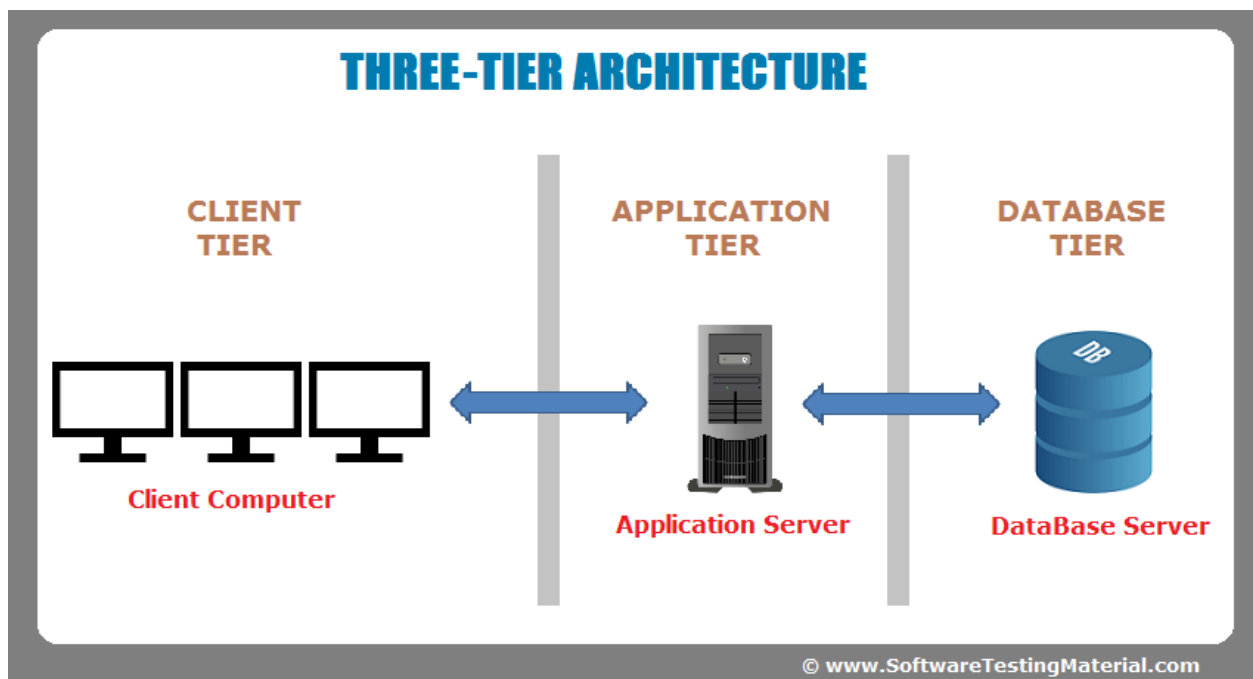


Fig. 10

3.4 Algorithms/Procedure

This project is divided into three parts:

- Creating a Firebase database
- Making the app
- Programming Arduino

Setting up Firebase-

For setting up Firebase as a real time database, first we need to create a firebase account. After that we need to generate token for real time database which will be required for linking our nodemcu and the android application for real time updates.

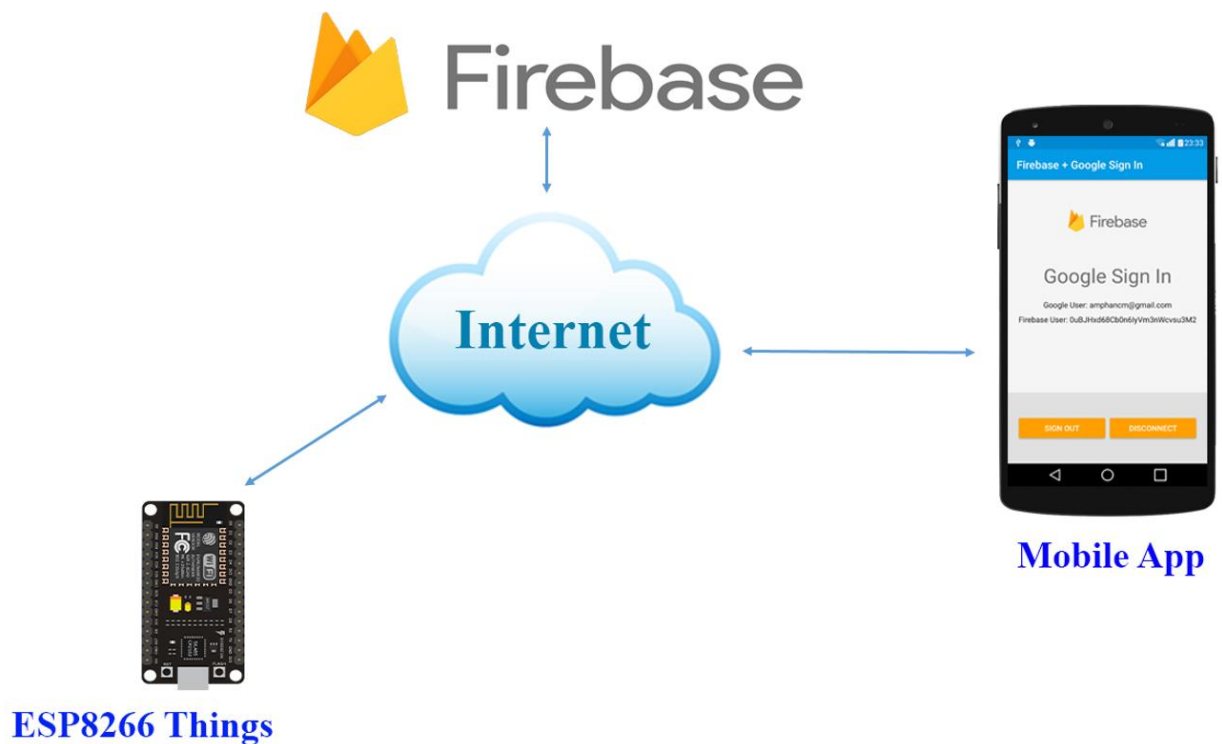


Fig. 11

Making the android application-

For making android application we used mit app inventor 2. Using this, an application can be easily developed. During application development we need to add firebase connectivity to the application using the token generated during setting of firebase.

During development of application we need to remember the tags given to each block that will be used. These tags will be further required during the arduino coding.

By these steps android app and firebase will be ready to use.

Programming Arduino-

After developing app, we need to program arduino and set up the circuit. Once the connections are established we need to carefully use the input and output pins for programming.

We need to include firebase header file for linking firebase. Firebase tokens will be used for establishing the connection. Wifi module should be linked by the available wifi for real time updates.

Once these steps are done we can test the system.

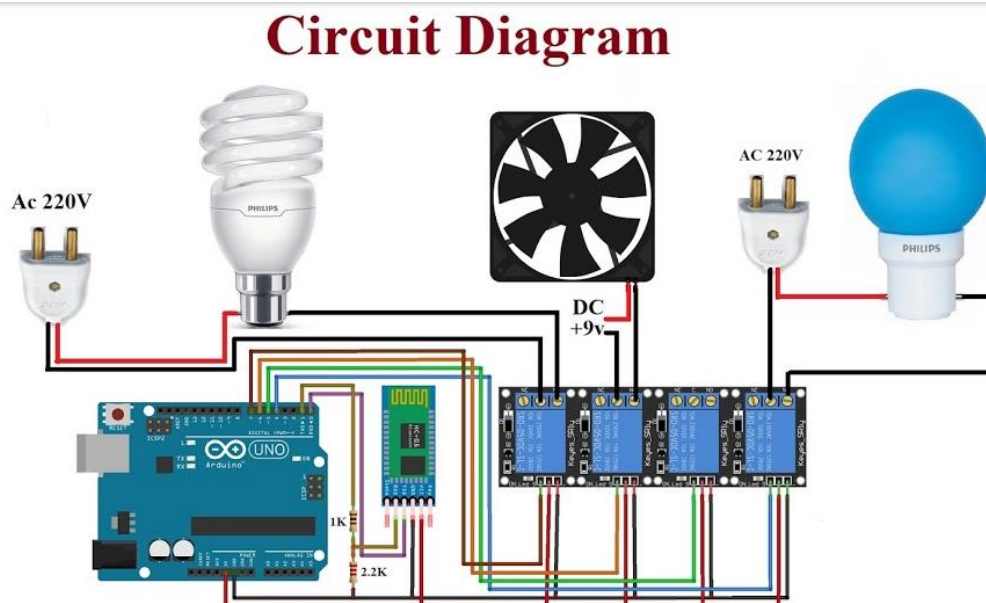


Fig. 12

3.5. SOFTWARE TESTING

OVERVIEW

In our project we have to use five types of testing these are listed below-

- Unit Testing: Unit testing where individual program units or object classes are tested. Here by using this testing we have focused on testing the functionality of methods.
- Module Testing: Where this is the combination of unit program is called module. Here we tested the unit program (5-6 programs) is where the module programs have dependency.
- Sub-system Testing: Then we combined some module for the Preliminary System Testing in our Project.
- System Testing: Where it is the combination of two or more sub-system and then it is tested. Here we tested the Entire system as per the requirements.
- Acceptance Testing: Normally this type of testing is done to verify if system meets the customer specified requirements. After submitting this project to User then they tested it and to determine whether to accept application. It is the system testing performed by the customer(s) to determine whether they should accept the delivery of the system.

BLACK BOX TESTING

It is carried out to test functionality of the program. It is also called 'Behavioral' testing. The tester in this case, has a set of input values and respective desired results. On providing input, if the output matches with the desired results, the program is tested 'ok', and problematic otherwise.

TEST CASES

S.NO.	Condition to be tested	Test Data	Expected Result	Remark

1	User login	Valid pin	Login successful	Successfully passed
		Invalid pin	Login successful	Fail
2	Switch ON/OFF appliance	Wi-Fi at home	Changes made	Successfully passed
		No Wi-Fi at home	Changes made	Fail
		Electricity available	Changes made	Successfully Pass
		No Electricity available	Changes made	Fail
		Internet connection in mobile	Changes made	Successfully pass
		No Internet connection in mobile	Changes made	Fail
3	Check Temperature of room in app	Wi-Fi at home	Live values shown	Successfully passed

		No Wi-Fi at home	Live values shown	Fail
		Internet connection in mobile	Live values shown	Successfully pass
		No Internet connection in mobile	Live values shown	Fail
4	Check if flame detected	Wi-Fi at home	Live values shown	Successfully passed
		No Wi-Fi at home	Live values shown	Fail
		Internet connection in mobile	Live values shown	Successfully Pass
		No Internet connection in mobile	Live values shown	Fail
5	Set LED color	Wi-Fi at home	Changes made	Successfully passed
		No Wi-Fi at home	Changes made	Fail

		Electricity available	Changes made	Successfully Pass
		No Electricity available	Changes made	Fail
		Internet connection in mobile	Changes made	Successfully Pass
		No Internet connection in mobile	Changes made	Fail
6	Lock Door	Internet connection in mobile	Door locked	Successfully Pass
		No Internet connection in mobile	Door locked	Fail
		Wi-Fi at home	Door locked	Successfully passed
		No Wi-Fi at home	Door locked	Fail

CHAPTER 4 :

Results

The results of this project have been up to the mark as expected when the project began initially. The user can remotely control the appliances and also monitor room temperature, detect flame, change led colors by the same mobile app. Hence, the target we set were successfully reached on time effectively.

Advantages

- **Safety.** The ability to control small appliances and lighting with your fingertips anywhere you are will add safety in your home.
- **Security.** The ability to lock the door through your phone is one of the greatest benefits of home automation. This will give you peace of mind knowing that the door is close and not guessing.
- **Convenience.** The ability to control everything with your fingertips is very convenient. You never leave the house without your wallet, keys and your smart phone. With our smart phone always with us, we can easily monitor our home and control everything with just touch of a finger.
- **Saves Time.** Since we are living in a very fast-paced environment, we don't even have time to worry about our home. With home automation, we can save time going back to our home and make sure everything is order, like if the kids close the door from school or turn on the lights when you get home.
- **Save Money.** This is the biggest advantage of home automation. With the ability to control the light, whether dimming or turning on/off on specific time will saves homeowner a great ton of money. In addition, you can save gas, by not driving back home if you forgot to turn off appliances or lock the door.
- **Save Energy**

CHAPTER 5 :
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. In this paper, Home automation system that can be controlled remotely upon user authentication is proposed and implementation is going to be take place. The objective of this system is to provide a convenient way to control home appliances by using the MIT app inverter and save energy as well as time. In the help of this project we are control all the home appliances through the IOT.

Hence, the idea to create a fully working home automation system with facility to control and monitor appliances has been finally realized. The output of this project is an array of home appliances that are controlled over the internet with the help of a mobile app and the facility to monitor room temperature, lock unlock door, set led colors as well. This project is a successful outcome of continuous and tireless effort from all the project members, supervisors, college faculty, colleagues and other helping hands. This project has been a really great experience and opportunity to learn and to experiment. Moreover, the authors got the chance to closely experiment and learn about what goes into designing and developing home automation systems. We are very much delighted that we explored this topic as our major project title and in a way, created a version of home automation system of our own, and to be closely related with the technology that is of a great interest of study and research today and is sure to revolutionize the way of living of people in the days to come.

CHAPTER 6 :
Limitations

There are some limitations observed throughout our project. Since our project is internet based, our home appliances are totally controlled through internet access. As we control the whole system through internet, we need to confirm high speed of internet.

The project relies on power supply. So if the power supply fails, the internet connection will be halted. Then database access will be stopped. For this, without security system the whole system will not be worked. In our project, security system is powered by another power source for security safety.

If there is any break due to rupturing of cables or the fibers then the total system will be crashed. So, this will not be the case of radio signals or the other signals. There will be a difficulty of receiving signal. If the individual does not handle the equipment safely or make use of the exact key to carry out the operations, human error can occur. Human faults also direct to the destructions of the device. Then there will be system collides. Home automation has numerous drawbacks. For having home automated system, people will be lazier. That ultimately might end up with making great harm in human social and professional life. In exceptionally uncommon cases, the unwavering quality of the home computerized gadgets fluctuates (decreases). It depends generally on the innovation utilized and the progressions being finished.

CHAPTER 7 :
Future development of the project

By interfacing various sorts of sensors, we can program the automatic controlling of the appliances. As for example, using temperature sensors to log the current temperature of a room, we can control the automatic turning ON/OFF of the heater or fan.

- Adaptive brightness using light sensors.
- Auto turn on/off AC according to temperature.
- Control the speed of fan.
- Auto on/off of appliances , according to schedules.
- Control the motors

CHAPTER 8:
References

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2. <https://firebase-arduino.readthedocs.io/en/latest/>
3. <https://appinventor.mit.edu/>
4. Pratik Gadtaula, “Home Automation”, Telemark University College, Faculty of Technology, Master’s Thesis.
5. Shopan Dey, Ayon Roy and Sandip Das, Home automation using IOT, IRJET.

CHAPTER 9 :
APPENDIX

QUICK START GUIDE – For Nodemcu

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language.

NodeMCU provides access to the GPIO (General Purpose Input/Output) and a pin mapping table is part of the API documentation.

I/O index	ESP8266 pin
0 [*]	GPIO16
1	GPIO5
2	GPIO4
3	GPIO0
4	GPIO2
5	GPIO14
6	GPIO12
7	GPIO13
8	GPIO15

9	GPIO3
10	GPIO1
11	GPIO9
12	GPIO10

[*] D0 (GPIO16) can only be used for GPIO read/write. It does not support open-drain/interrupt/PWM/I²C or 1-Wire.

From the following steps we will learn how to install Arduino IDE for ESP8266

Step 1: Installing Arduino IDE Software

Step 2: Preferences

Step 3: Adding ESP8266 Board Manager

Step 4: Selecting Board

Step 5: ESP8266 Board Package

The Boards Manager window opens, scroll the window page to bottom till you see the module with the name ESP8266. Once we get it, select that module and select version and click on the Install button. When it is installed it shows Installed in the module as shown in the figure and then close the window.

Step 8: Selecting ESP8266 Arduino Board

To run the esp8266 with Arduino we have to select the **Board: “Arduino/Genuino Uno”** and then change it to **NodeMCU 1.0 (ESP-12E Module)** or other esp8266 modules depending on what you have. This can be done by scrolling down, as shown in the figure

Step 6: Uploading the Program to ESP8266 Module.