SMART ROBOT COMPANION

A Project Report

Submitted in partial fulfillment of the
requirements for the award of the Degree of

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

By

NISHANT ANIL AMBRE

Seat Number: _____

Under the esteemed guidance of

Mrs. MAITREYI JOGLEKAR

Assistant Professor, Department of Information Technology

DEPARTMENT OF INFORMATION TECHNOLOGY

VIDYALANKAR SCHOOL OF INFORMATION TECHNOLOGY

(Affiliated to University of Mumbai)

MUMBAI, 400 037

MAHARASHTRA

2018 - 2019

VIDYALANKAR SCHOOL OF INFORMATION TECHNOLOGY

(Affiliated to University of Mumbai)

MUMBAI-MAHARASHTRA-400037

DEPARTMENT OF INFORMATION TECHNOLOGY

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Internal Examiner **External Examiner**

Date: **College Seal** **Principal**

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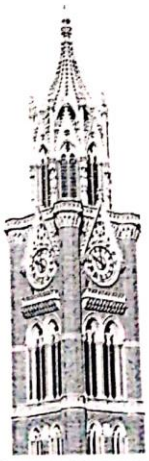
Date: December 14, 2019



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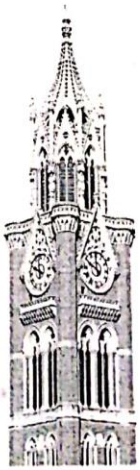

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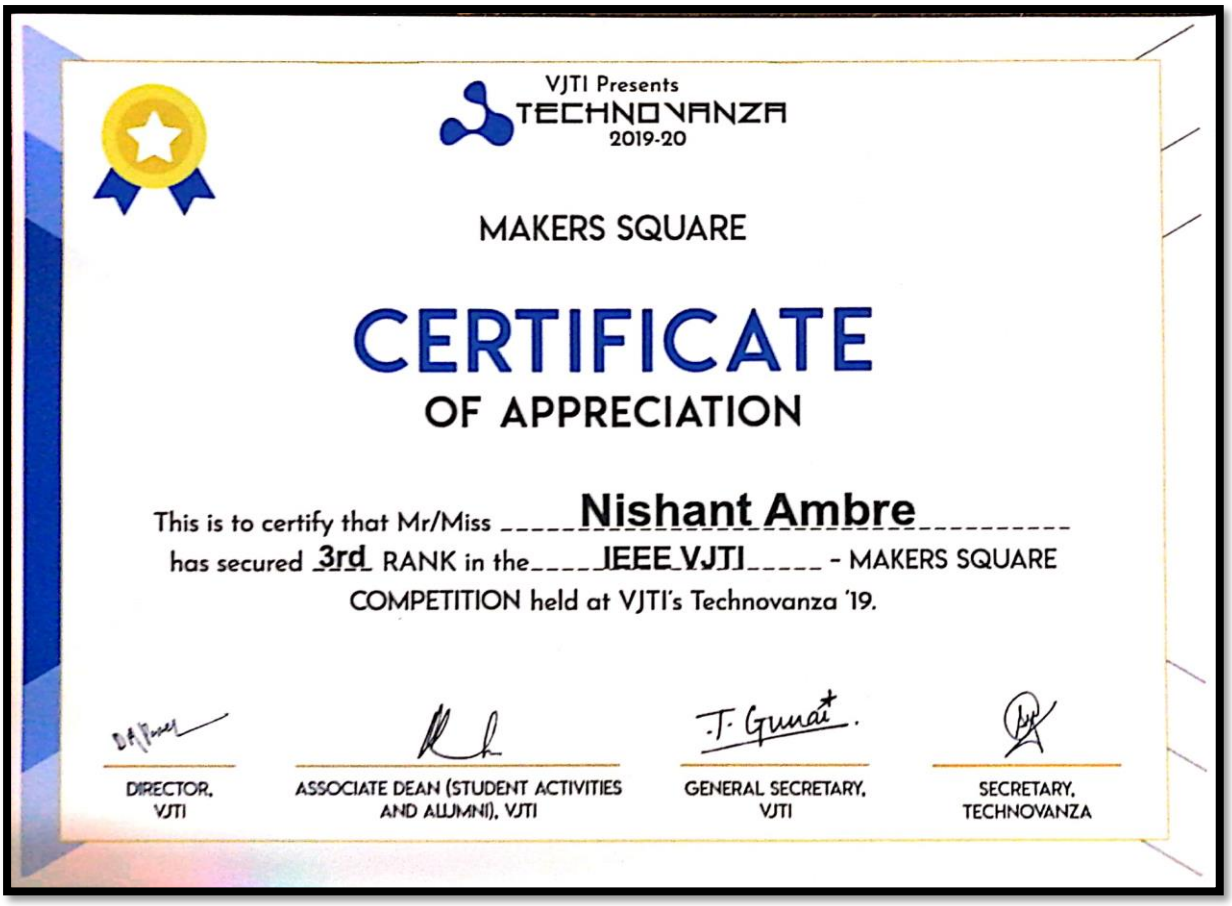
OSD
Avishkar Research Convention,
University of Mumbai

Dr. Sunil Patil
Director,
Department of Students' Development,
University of Mumbai

January 2, 2020
Vashi, Navi Mumbai



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2. RESEARCH PAPER

Smart Robot Companion

Nishant Ambre

Student, BSC-IT,

Vidyalankar School of Information Technology, Vidyalankar Marg, Wadala(E), Mumbai-400037

Email: nishantambre1999@gmail.com

Mobile: 8082186501

Srushti Nangare

Student BSC-IT,

Vidyalankar School of Information Technology, Vidyalankar Marg, Wadala(E), Mumbai-400037

Email: srushtinangare@gmail.com

Mobile: 9769511120

ABSTRACT

In the present scenario considering the fast-paced life, people don't have time to look after their kids, old parents and physically challenged people.

To overcome this problem, we are making a robot which will take care of all these things. The main objective of this project is to develop a robot capable of supporting human beings in all those activities which require the ability to interact actively and safely with the environment. It is a multipurpose robot that can be used by kids, adults and physically challenged people. It is a personal digital assistant which makes their day to day life easy. It is a friend to the kids and companion to the adults.

It will help the adults, elderly and disabled to live a normal life in their own homes without having a full-time human helper.

Our robot contains features like face recognition, obstacle detection, scheduling and reminders, fall detection, controlling household appliances, talking and live feed. Our robot implements technologies from various domains like Android, some algorithms of Artificial Intelligence and Machine Learning, Internet of Things and Data Analysis.

Keywords: Smart robot companion, Smart robot, companion, social, secure, reliable

1. INTRODUCTION

In the present scenario considering the fast-paced life, people don't have time to look after their kids, old parents and physically challenged people.
With the development of science and technology, machines are taking over a lot of tasks, but they are single purpose.

Loneliness is a common feeling among the old age group. It is difficult to carry out a lot of tasks considering the health and risk factors in that age group. Parenting is not an easy task in today's world considering the hustle and bustle in life.

The main objective of this project is to develop a robot capable to support human beings in all those activities which require the ability to interact actively and safely with the environment.

Since the robot is supporting and assuring security to the user, people will tend to work more efficiently at their workplaces.

It will help the adults, elderly and disabled to live a normal life in their own homes without having a full-time human helper.

2. PROBLEM DEFINITION

Nowadays a lot of old people are alone at their home. The same goes for the kids especially in nuclear families where both the parents are working.
With the increasing crime rates, it's difficult to trust a maid or a caretaker. It's difficult to have a common solution for such a problem and it's costlier too. The findings revealed that 53% of adults who feel lonely fear that they'll have no one there to support them should something bad happen to them, and one in nine people don't feel that they have anyone in their lives that they'd be able to rely on if they were experiencing a crisis. **"Life circumstances can change in the blink of an eye, meaning it can happen to anyone, no matter your age or background".**

3. EXISTING RELATED TECHNOLOGIES

There are many single-purpose robots available in the market like NAO, which is used education, Pepper which is used for emotion recognition, Miko for kids, etc.

3.1. Improvements in current technologies:

Our robot is a multipurpose robot that can be used by kids, adults and physically challenged people. It is a personal digital assistant which makes their day to day life easy. It is a friend to the kids and companion to the adults.

Our robot implements technologies from various domains like Android, some algorithms of Artificial Intelligence and Machine Learning, Embedded Systems, Internet of Things and Data Analysis.

4. WORKING:

Our robot can talk, walk, see and listen just like humans and as the name of the project suggests a smart robot companion, it has some smart features like:

*** Scheduling and Reminders** – Old people usually tend to forget important things like taking medicines, to remind them we can set reminders on our robot using the touch interface and it will remind them accordingly.

*** Live-feed -** This feature is basically for the working parents who cannot be physically present to look after their kids all the time and even if they install a CCTV camera, it will be fixed in one place, it cannot cover every nook and corner of the house. Our robot will provide the live feed to the parents on an app we have made whenever they want to see what their kids are doing.

*** Talking** – People usually tend to bond with things that look attractive and can interact. Our robot can talk with people. We can ask the current time, today's weather etc.

*** Face recognition** – Our robot can detect and recognize the faces of known people and if an unknown person is detected it will inform the user and confirm its identity saving it in the database, it's basically for security purposes.

*** Obstacle detection** – While moving there are chances that it might hit an object. Hence with the help of sensors in all four directions, it detects the obstacles in its path so that it won't bump on something and change its path accordingly.

*** Its own fall** – If it is moving on an elevated surface it will detect that it can fall and hence stop at the edge or it will move back.

*** Fall detection** – Usually old people are prone to injuries due to falls. If a person falls it will ask him or her **'hey are you okay'** and if the user won't reply in 10 seconds it will send a notification through SMS to the users relative that the person has fallen.

*** Controlling Household Appliances** – Buying an IOT product is a bit costlier. So, we have made a device(switch) that will make any device an IoT device. Basically, it is an IoT module to control any household appliances through an app or with the help of a Robot.

5. LITERATURE REVIEW

Major life challenges are increasingly likely to occur with old age. Elderly people are at a wider risk of social isolation compared to the general population due to the increased likelihood of health problems and major life-events like the death of relatives and friends [1]. We can define a social robot as “an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact” [2]. There are different kinds of social robots: service- type robots are designed to provide functional help; companion-type robots are designed to enhance psychological wellbeing [3]. Social robots are mainly studied in the fields of Socially Interactive Robotics (SIR), Socially Assistive Robotics (SAR), and Assistive Robotics (AR) [4]. Many areas are important foci for research in these fields: engagement, adaptation (the robot’s ability to learn about the user and adapt its capabilities according to
the user’s personality needs and preferences), embodiment (bodily presence), personality, empathy, and transfer (the ability of a robot to bring about long-term behavioral change in the user) [5, 6]. In previous studies, researchers have found that physical robots are more “watchful” and enjoyable than virtual ones [7]. Social robots are mainly developed for the elderly focus on companionship or healthcare, which is only one aspect of psychological wellbeing. Other aspects, such as a sense of purpose and interest, are not specifically investigated.

6. EQUATIONS, FIGURES AND TABLES

Our Robot	Others
Multi-purpose robot with more functionalities	Single-purpose robot with limited functionalities
Targets multiple set of audience	Targets only one set of audience
Cost-effective	Cost-intensive

Table 1: Comparative Study

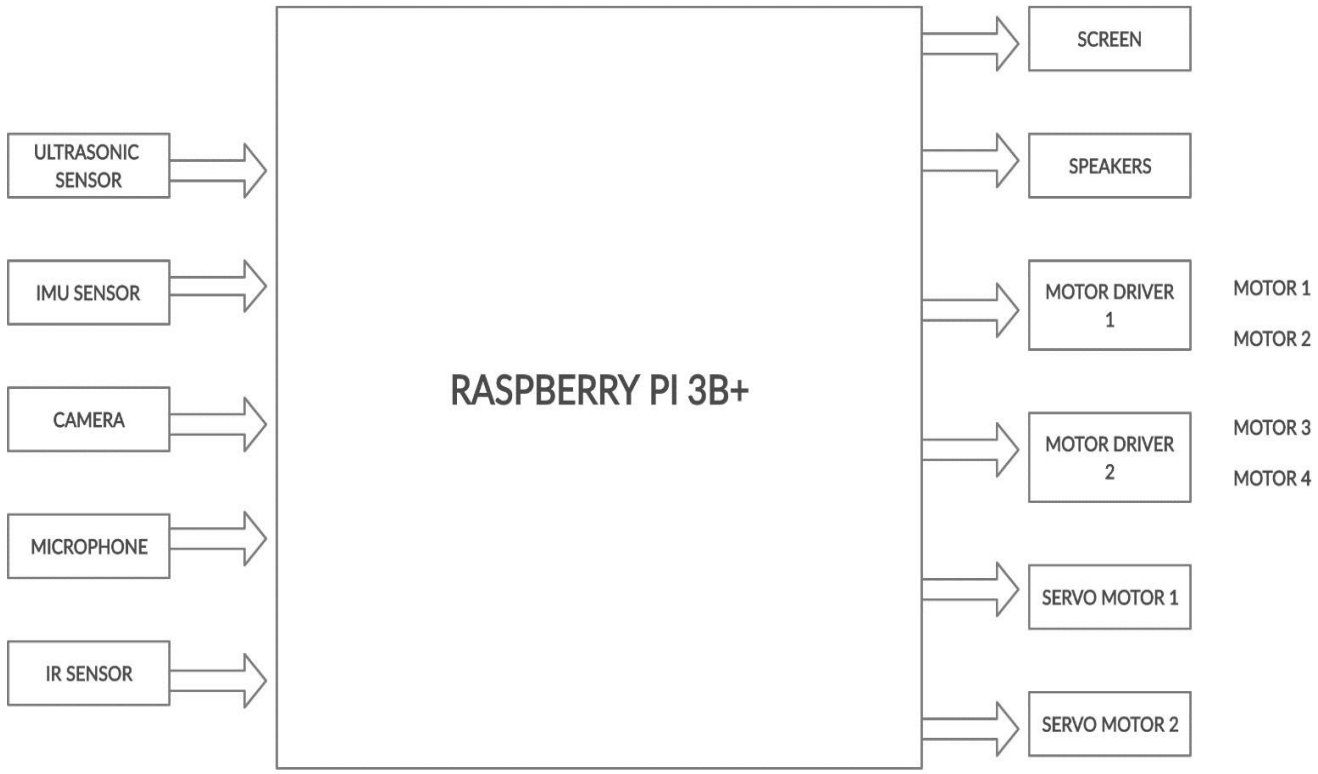

Fig. 1: Block diagram

Fig. 1: Working Model

7. FUTURE SCOPE

- Emotion Recognition
- Autonomous Indoor navigation
- Teaching Aid
- Automatic Charging

8. CONCLUSION

So hereby we can conclude that making robots part of our family and daily life is useful. Robots can socialize with humans. They can be developed in a way to connect humans. It is the future of technology and human interaction. They can be reliable and secure solving a lot of problems in our daily life.
Let's make a robot a part of our day to day life.

9. REFERENCES

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ABSTRACT

In the present scenario considering the fast-paced life people are living, we don't have adequate time to give to our family, friends and relatives. People because of their busy schedules can't spend enough time with their families. Taking care of their parents and kids becomes a tedious and time-consuming affair that people can't afford in this competitive world. To overcome this problem, we are making a robot which will take care of all these things.

It is a multipurpose robot which can be used for taking care of kids, senior citizens and physically challenged people. It is a personal digital assistant that can make their day to day life easy. It will be a friend to the kids and companion to the adults.

To build a robot, a wide variety of tools and techniques need to be used along with hardware and software. We are going to use hardware and software-based advanced technologies such as Android Studio, Raspberry Pi, Artificial Intelligence, Internet of Things and many algorithms for the security of the user.

ACKNOWLEDGEMENT

I would like to take this opportunity to convey my heart full thanks and deep appreciation for the help rendered to me, by all of you resulting in the successful completion of my project.

I wish to give acknowledgment to all ever-helpful people whose experience and guidance allowed me to make this invaluable piece of mere hard work. I would like to show my appreciation to my project guide **Mrs. Maitreyi Joglekar** for her continuous guidance and support, without which this project would not have become a reality.

I express my sincere thanks to the Principal, Dr. ROHINI KELKAR, for extending her support.

I would like to thank VIDYALANKAR SCHOOL OF INFORMATION TECHNOLOGY and all my teachers

DECLARATION

I hereby declare that the project entitled, "**Smart Robot Companion**" done at Vidyalankar School of Information Technology, has not been in any case duplicated to submit to any other universities for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university.

The project is done in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)** to be submitted as a final semester project as part of our curriculum.

Nishant Anil Ambre

Name and Signature of the Student

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Chapter 1 Introduction

1.1 Background

Considering the fast-paced life people are living, we don’t have adequate time to give to our family, friends and relatives. In today’s techno-savvy world, each citizen is trying to update their lifestyle and to adapt to the change happening rapidly in every sector. People because of their busy schedules can’t spend enough time with their families. Taking care of their parents and kids becomes a tedious and time-consuming affair that people can’t afford in this competitive world.

While adopting these changes in their lifestyle people don’t have time to look after their kids, old parents and physically challenged people because of their busy schedule.

To overcome this problem, we are making a multi-purpose robot that will take care of all these things.

1.2 Objectives

The main objective of this project is to develop a robot capable to support human beings in all those activities which require the ability to interact actively and safely with the environment.

Since the robot is supporting and assuring security to the user, people will tend to work more efficiently at their workplaces.

- It is a multipurpose robot that can be used by kids, adults and physically challenged people.
- It is a personal digital assistant which makes their day to day life easy. It is a friend to the kids and companion to an adult.
- It can Interact with the user.
- Recognize faces for security purposes.
- It can detect the fall of older adults and physically challenged people.
- We can set schedules and reminders on it.
- It can detect obstacles coming in between.
- It can teach kids.

1.3 Purpose, Scope, Applicability (Feasibility Study)

Purpose:

In today's techno-savvy world, everyone is trying to update their lifestyle and to adapt to the change happening rapidly in all sectors. People because of their busy schedules can't spend enough time with their families. Taking care of their parents and kids becomes a tedious and time-consuming affair that people can't afford in this competitive world.

While adopting these changes in their lifestyle people don't have time to look after their kids, old parents and physically challenged people because of their busy schedule.

To overcome this problem, we are making a multi-purpose robot that will take care of all these things. The robot is designed to provide an integrated solution for human beings to make their daily activities simple, effortless, safe, secure and smart. It is available for a person when someone can't.

- It can perform tasks of the person actually responsible for them.
- To make our robot a part of our day to day life.
- To add some advanced features that will make users feel more comfortable with it.
- To perform various roles in our life.

Scope:

The robot which we are making is not only for older adults or physically challenged people or kids. It can be used by anybody.
In future we would like to add these things to our robot:

- Emotion recognition
- Connect other IoT devices
- Advance interaction wherein a robot can have a good conversation with humans, similar to talking with a human being.
- Automatic charging

Chapter 2 Survey of Technologies

ARDUINO UNO

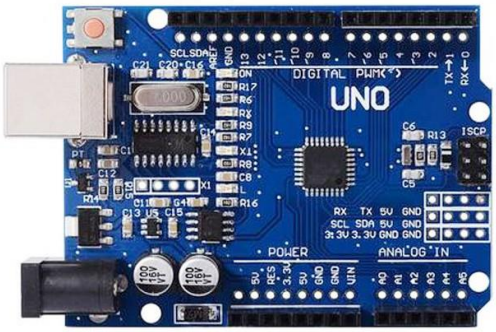

Figure 1: Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip Atmega 382p microcontroller and developed by Arduino cc. Specifications, Microchip Atmega 382p microcontroller, Operating Voltage: 5 Volt, Digital I/O Pins: 14 (of which 6 provide PWM output), Analog Input Pins: 6, RAM 2kb, ROM 1kb. We went through all the specifications of Arduino UNO and it seemed to be the best way to get started with our project. But the only problem is we must buy a WI-FI shield separately which costs approximately 500 INR. Whereas NODEMCU is only for 350 INR.

RASPBERRY PI:

Figure 2: Raspberry Pi

Raspberry Pi is a series of small single-board computers developed in the United

Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. It is the smallest and cheapest CPU available, with Broadcom BCM2837, 1.2 GHz quad-core ARM Cortex A53,

Broadcom Video Core, USB ports: 4 and 40 GPIO pins. It has its own Operating system "RASPBIAN". It is integrated with python ide. It is probably the best option available when it comes to IoT. It cost's approximately 3500. But it contains in-built Wi-Fi, you don't need to buy a separate Wi-Fi module.

	Arduino Uno	Raspberry Pi Model B
Price	$30	$35
Size	7.6 x 1.9 x 6.4 cm	8.6cm x 5.4cm x 1.7cm
Memory	0.002MB	512MB
Clock Speed	16 MHz	700 MHz
On Board Network	None	10/100 wired Ethernet RJ45
Multitasking	No	Yes
Input voltage	7 to 12 V	5 V
Flash	32KB	SD Card (2 to 16G)
USB	One, input only	Two, peripherals OK
Operating System	None	Linux distributions
Integrated Development Environment	Arduino	Scratch, IDLE, anything with Linux support

Table 1: Comparison between Arduino and Raspberry Pi

Comparison of Programming Languages:

Python	C++
It is a flexible, object-oriented, and open source programming language designed to raise development quality expectations in the scripting domain.	It is a general purpose programming language which is best suited for resource-constrained applications, such as those found in software infrastructures.
The inbuilt garbage collection system ensures efficient memory management in Python.	C++ does not need a garbage collector because it has no garbage.
It is both dynamically typed and strongly typed language in which type checking is done at run-time.	It is a statically typed language in which variable types are explicitly declared and are determined at compile-time.
It is easier to learn and write code in Python than C++.	It is less versatile and more difficult to learn than Python.
Rapid prototyping is possible due to small size of the code.	Rapid prototyping is not possible due to the large size of the code.

Table 2: Comparison between Python and C++

Chapter 3 Requirements and Analysis

3.1 Problem Definition

Considering the fast-paced life people are living, we don't have adequate time to give to our family, friends and relatives. People because of their busy schedules can't spend enough time with their families. While adopting these changes in their lifestyle people don't have time to look after their kids, old parents and physically challenged people because of their busy schedule. To overcome this problem, we are making a robot which will take care of all these things.

3.2 Requirement Specification

It is a multipurpose robot that can be used by kids, adults and physically challenged people. It is a personal digital assistant which makes their day to day life easy. It is a friend to the kids and companion to an adult. It can Interact with the user. Recognize faces for security purposes. It can detect the fall of older adults and physically challenged people. We can set schedules and reminders on it. It can detect obstacles coming in between. It can teach kids.

3.2.1 Functional Requirement

- Software requirements specification document
- Use cases
- Work Breakdown Structure (WBS) (functional decomposition)
- Prototypes
- Models and diagrams

3.2.2 Non-Functional Requirement

- Usability
- Security
- Efficiency
- Reliability
- Performance
- Availability
- Scalability

3.3 Planning and Scheduling

3.3.1 SDLC Model

- SDLC is a process followed for a software project, within a software organization. It consists of a detailed plan describing how to develop, maintain, replace and alter or enhance specific software. The life cycle defines a methodology for improving the quality of software and the overall development process.
- The following figure is a graphical representation of the various stages of a typical SDLC.

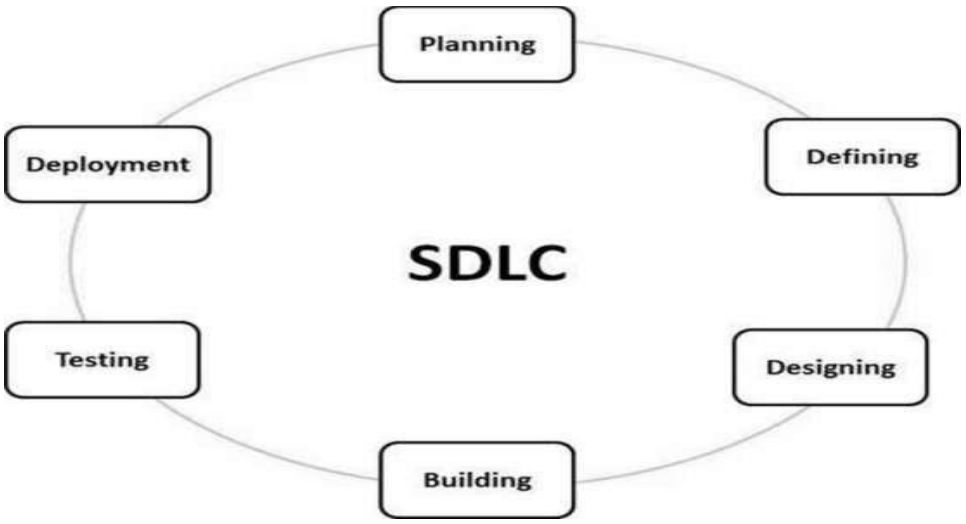

Figure 3: SDLC

- A typical Software Development Life Cycle consists of the following stages −

- Stage 1: Planning and Requirement Analysis
- Requirement analysis is the most important and fundamental stage in SDLC. It is performed by the senior members of the team with inputs from the customer, the sales department, market surveys and domain experts in the industry. This information is then used to plan the basic project approach and to conduct a product feasibility study in the economical, operational and technical areas.
- Planning for the quality assurance requirements and identification of the risks associated with the project is also done in the planning stage. The outcome of the technical feasibility study is to define the various technical approaches that can be followed to implement the project successfully with minimum risks.

- Stage 2: Defining Requirements
- Once the requirement analysis is done the next step is to clearly define and document the product requirements and get them approved from the customer or the market analysts. This is done through an **SRS (Software Requirement Specification)** document which consists of all the product requirements to be designed and developed during the project life cycle.

- Stage 3: Designing the Product Architecture
- SRS is the reference for product architects to come out with the best architecture for the product to be developed. Based on the requirements specified in SRS, usually, more than one design approach for the product architecture is proposed and documented in a DDS - Design Document Specification.
- This DDS is reviewed by all the important stakeholders and based on various parameters as risk assessment, product robustness, design modularity, budget and time constraints, the best design approach is selected for the product.
- A design approach clearly defines all the architectural modules of the product along with its communication and data flow representation with the external and third party modules (if any). The internal design of all the modules of the proposed architecture should be clearly defined with the minutest of the details in DDS.

- Stage 4: Building or Developing the Product
- In this stage of SDLC, the actual development starts and the product is built. The programming code is generated as per DDS during this stage. If the design is performed in a detailed and organized manner, code generation can be accomplished without much hassle.
- Developers must follow the coding guidelines defined by their organization and programming tools like compilers, interpreters, debuggers, etc. are used to generate the code. Different high-level programming languages such as C, C++, Pascal, Java and PHP are used for coding. The programming language is chosen with respect to the type of software being developed.

- Stage 5: Testing the Product
- This stage is usually a subset of all the stages as in the modern SDLC models, the testing activities are mostly involved in all the stages of SDLC. However, this stage refers to the testing only stage of the product where product defects are reported, tracked, fixed and retested, until the product reaches the quality standards defined in the SRS.

- Stage 6: Deployment in the Market and Maintenance
- Once the product is tested and ready to be deployed it is released formally in the appropriate market. Sometimes product deployment happens in stages as per the business strategy of that organization. The product may first be released in a limited segment and tested in the real business environment (UAT- User acceptance testing).
- Then based on the feedback, the product may be released as it is or with suggested enhancements in the targeting market segment. After the product is released in the market, its maintenance is done for the existing customer base.

Gantt Chart:

	Semester V													
	June		July				August			September			October	
Activities	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Project Idea Finalization														
Requirements														
Survey of data/ need (Literature Review)														
Feasibility and need validation														
Scope Freezing														
Requirements Detailing														
Use Case Diagrams														
Static User Interface Prototype														
Design														
Database Design/ Block Diagram (ER Diagram, Key Data Structures)														
Other UML Diagrams (Sequence, Activity, Flow Chart etc.)														
Class Diagrams														
Hardware Design - [for embedded/ IoT projects]														
Evaluate Technology options														
Prototype														
Key Technical issue defination														
Build basic Working Prototype														
Planning & Review														
Overall Project Plan														
Weekly Review/ Discussion with Guide														

Table 3: Gantt Chart

PERT:

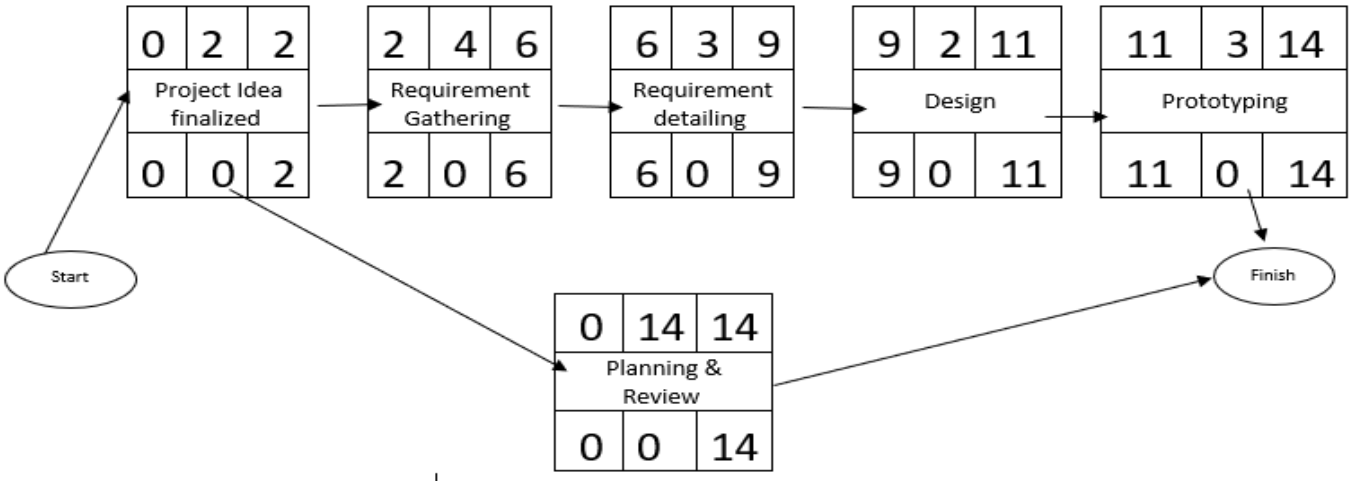

Table 4: PERT

3.4 Software and Hardware Requirement

3.4.1 Software Requirements

- Android studio
- Python programming
- Raspbian OS
- Various libraries of AI and ML

3.4.2 Hardware Requirement

- **Raspberry Pi (processor):**

Figure 4: Raspi

The **Raspberry Pi** is a series of small single-board computers developed by the Raspberry Pi Foundation to promote the teaching of basic computer science. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics.

Raspberry Pi 3 Model B was released in February 2016 with a 1.2 GHz 64-bit quad-core processor, onboard 802.11n Wi-Fi, Bluetooth and USB boot capabilities. On Pi Day 2018 the **Raspberry Pi 3 Model B+** was launched with a faster 1.4 GHz processor and a three-times faster gigabit Ethernet (throughput limited to ca. 300 Mbit/s by the internal USB 2.0 connection) or 2.4 / 5 GHz dual-band 802.11ac Wi-Fi (100 Mbit/s). Other features are Power over Ethernet (PoE) (with the add-on PoE HAT), USB boot and network boot (an SD card is

no longer required). All SoCs used in Raspberry Pi's are custom-developed under the collaboration of Broadcom and Raspberry Pi Foundation.

Specifications:

- A **1.4GHz** 64-bit quad-core ARM Cortex-A53 CPU
- Dual-band **802.11ac** wireless LAN and Bluetooth 4.2
- **Faster Ethernet** (Gigabit Ethernet over USB 2.0)
- Power-over-Ethernet support (with separate PoE HAT)
- Improved PXE network and USB mass-storage booting
- Improved thermal management

Alongside an increase of 200MHz CPU clock speed, there is 3X faster Ethernet, Dual-Band Wi-Fi and Bluetooth Ver4.2.

- **NodeMcu:**

Figure 5: Node MCU

Developer	ESP8266 Opensource Community
Type	Single-board microcontroller
Introductory price	$5
Operating system	XTOS
CPU	ESP8266[1](LX106[2])
Memory	128kBytes
Storage	4MBytes[3]
Power	USB

NodeMCU is a low-cost open-source IoT platform. It initially included firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware which was based on the ESP-12 module. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).

A "core" is the collection of software components required by the Board Manager and the Arduino IDE to compile an Arduino C/C++ source file for the target MCU's machine language.

The Development Kit based on ESP8266 integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board. Power your development in the fastest way combining with NodeMcu Firmware!

- **Ultrasonic Sensor:**

Figure 6: Ultrasonic Sensor

The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. It comes complete with ultrasonic transmitter and receiver modules.

Features:

Here's a list of some of the HC-SR04 ultrasonic sensor features and specs:

- Power Supply: +5V DC
- Quiescent Current: <2mA
- Working Current: 15mA
- Effectual Angle: <15°
- Ranging Distance: 2cm – 400 cm/1″ – 13ft
- Resolution: 0.3 cm
- Measuring Angle: 30 degree
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm
- Trig: Trigger (INPUT)
- Echo: Echo (OUTPUT)

- **Raspberry Pi 7-inch HDMI LCD HDMI Interface:**

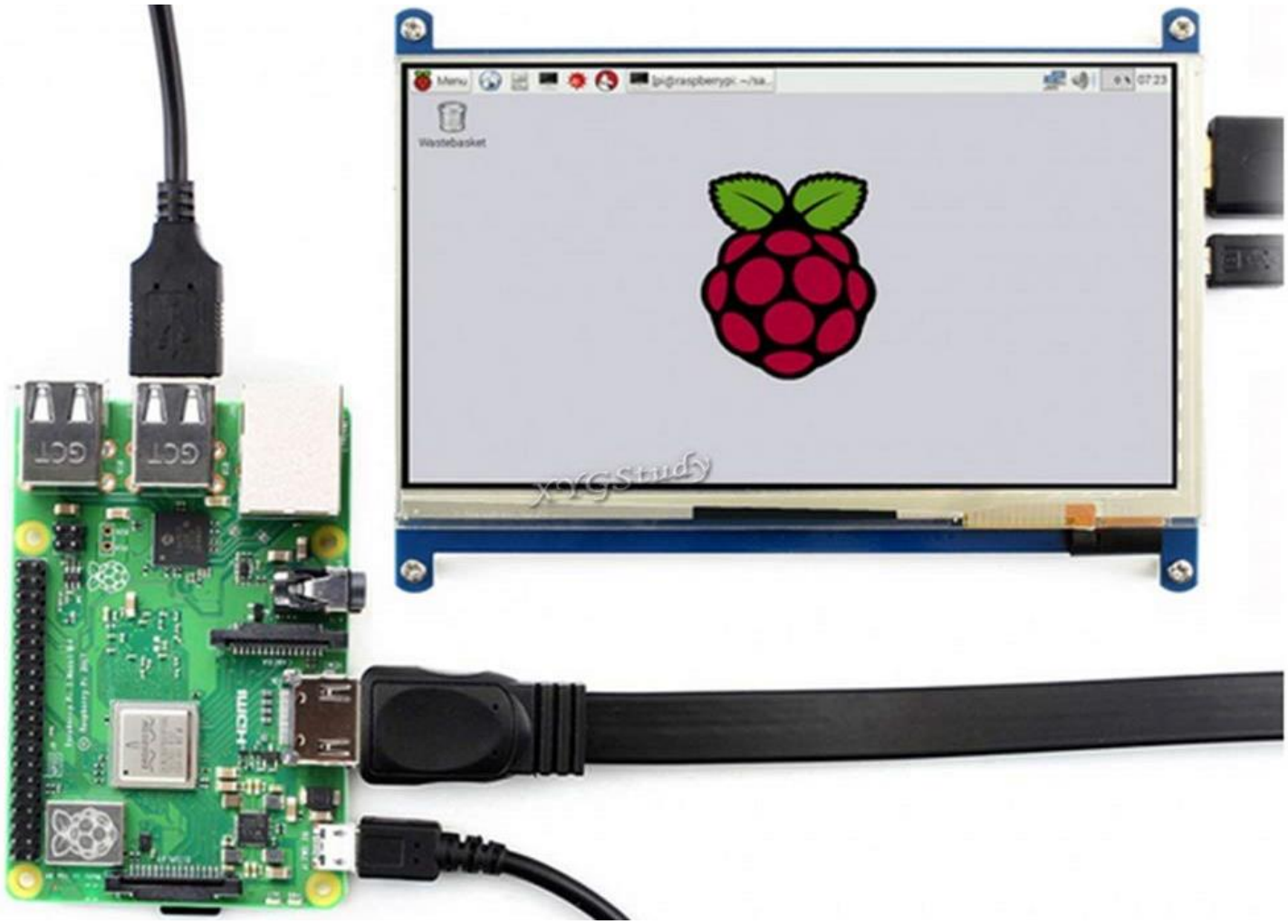

Figure 7: LCD screen

- This 7" Touchscreen Display for the Raspberry Pi is perfect for creating portable and embedded projects where a keyboard and Mouse would be in the way.
- The full-color display outputs up to 800 x 480 and features a capacitive touch sensing capable of detecting 10 fingers.
- Only two connections from the Pi TO the Display are necessary; power from GPIO (or USB) connection to the DSI port. The adapter board handles power, signal conversion, and touch input conversion.

- **IR Sensor:**

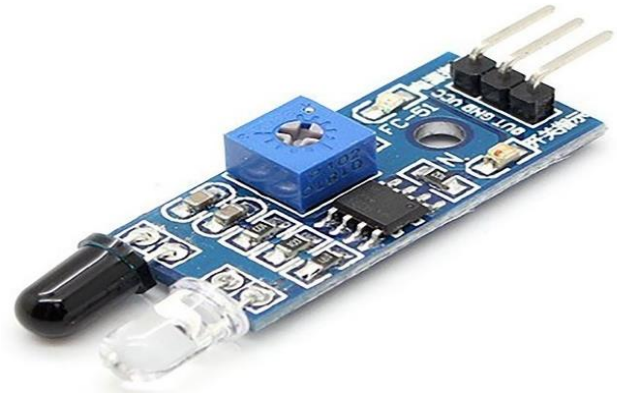

Figure 8: IR sensor

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

- **DC motors:**

Figure 9: DC motor

The electric motor operated by dc is called dc motor. This is a device that converts DC electrical energy into mechanical energy.

When a current-carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. In other words, when a magnetic field and an electric field interact,

a mechanical force is produced. The **DC motor** or **direct current motor** works on that principle. This is known as motoring action. Small DC motors are used in tools, toys, and appliances. We have used 4 DC motors with gears.

- **Battery(12v):**

Figure 10: 12V Battery

- **Motor Drivers(L239D):**

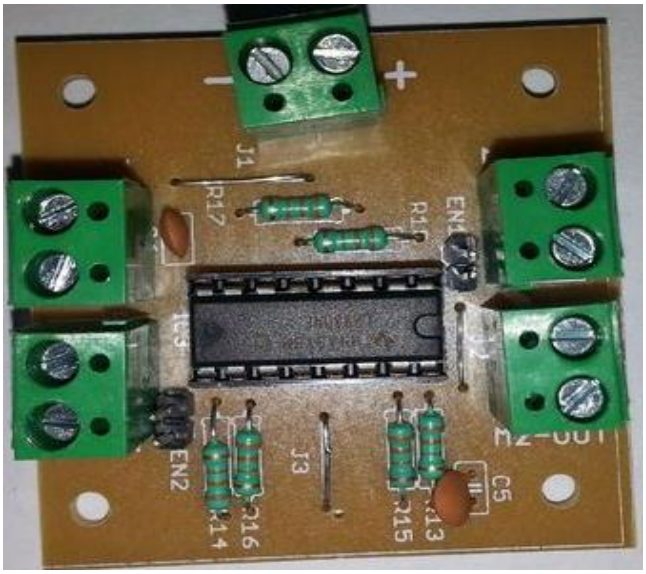

Figure 11: Motor Driver

This is a very useful chip. It can actually control two motors independently. We are just using half the chip in this lesson, most of the pins on the right-hand side of the chip are for controlling a second motor, but with the Raspberry Pi, we only have one PWM output.

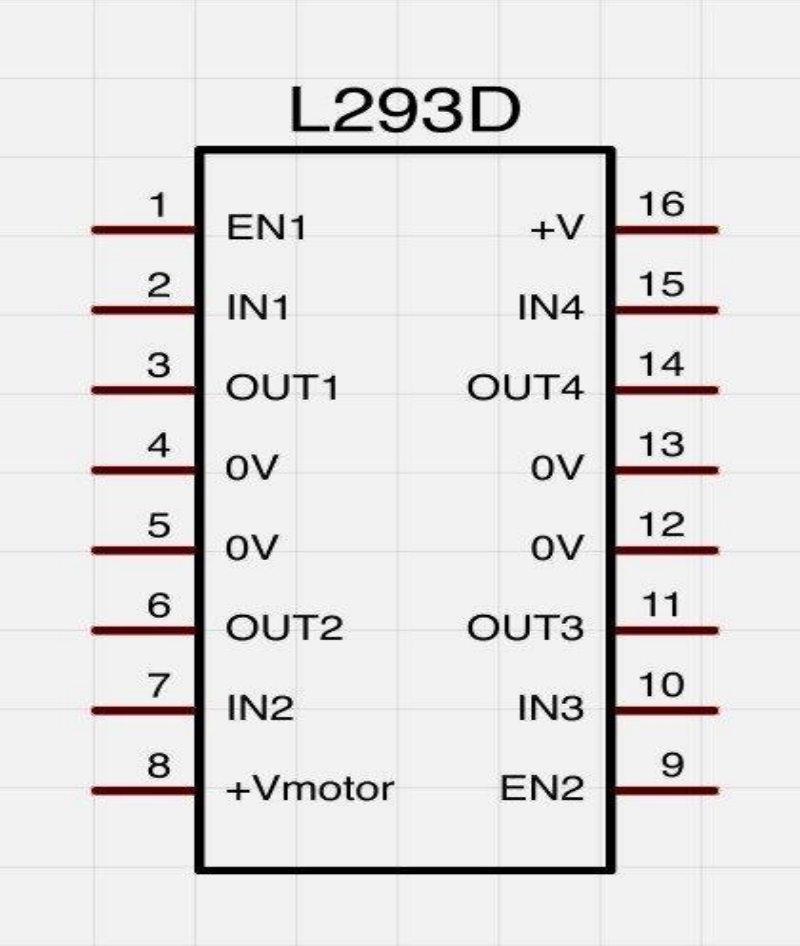

Figure 12: Pin Diagram

The L293D has two +V pins (8 and 16). The pin '+Vmotor (8) provides the power for the motors, and +V (16) for the chip's logic. We have connected pin 16 to the 5V pin of the Pi and pin 8 to a battery pack.

- **Basic Electronic Components:**

Resistors, Capacitors, Voltage Regulators, Potentiometer, Transistors, LED's, Buttons & Jumper wires, Breadboard, Relay.

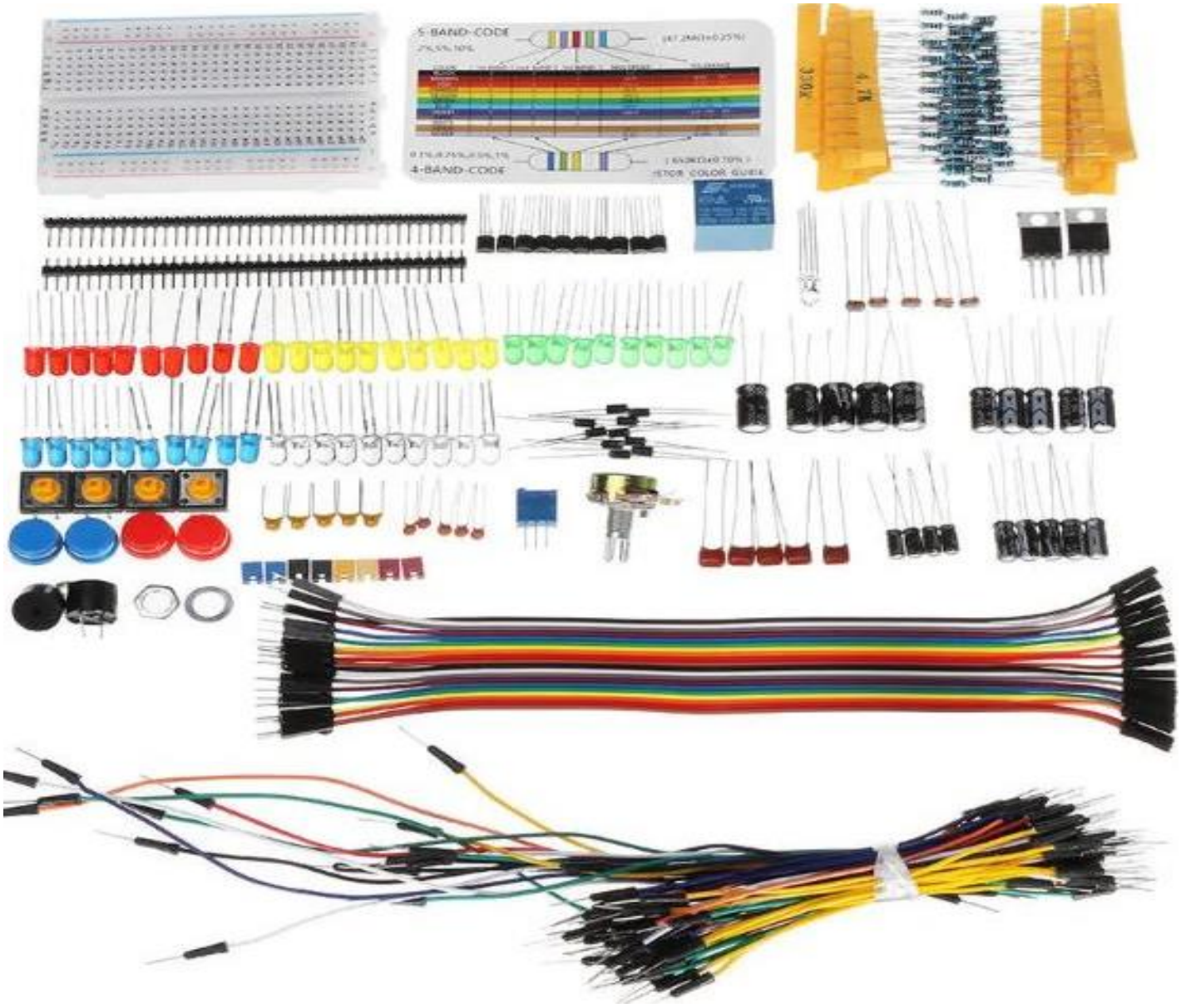

Figure 13: Basic Components

The model used in this project is The WATERFALL MODEL.

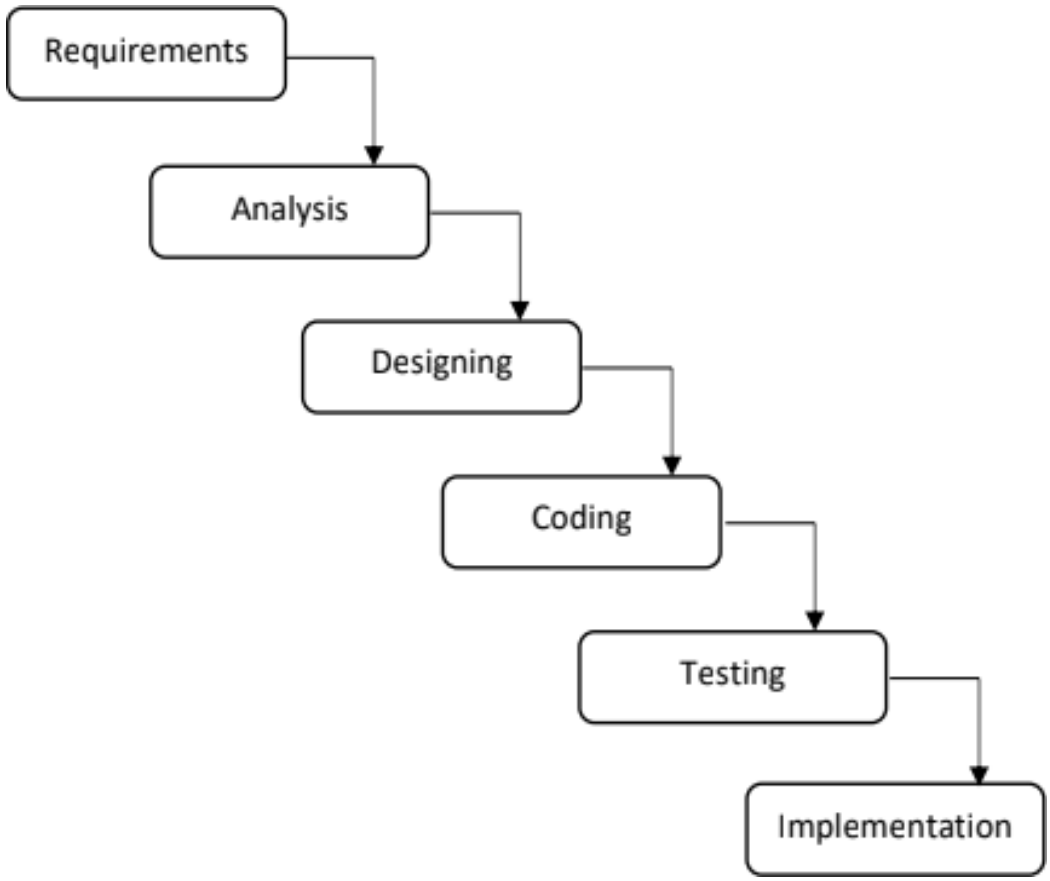

Figure 14: Waterfall Model

Requirements:

In this phase business analysts will collect the requirements with an interaction of client and collected requirements will be documented.

Analysis:

In this phase system analyst will study the client requirements and prepare the system requirement specification.

Designing:

In this phase, design architecture is responsible to decide the architecture of an application in order to fully, fill the client requirements.

Coding:

In this phase, developers will write the program using programming languages or scripting languages in order to develop the application.

Testing:

Initially, developers will perform unit testing and integration testing using white box testing, after that separate team will be performing system testing using black-box testing.

Implementation:

After the testing client is satisfied with the work product then we deliver the application to the customer to use in the live environment.

Chapter 4 System Design

4.1 Basic Modules

- Face Detection
- Obstacle detection
- Fall Detection
- Live feed
- Scheduling and Reminders
- Interaction
- Teaching Module

4.2 Data Design (Table Design)

4.2.1 Schema Design

Circuit Diagram:

Edge detection:

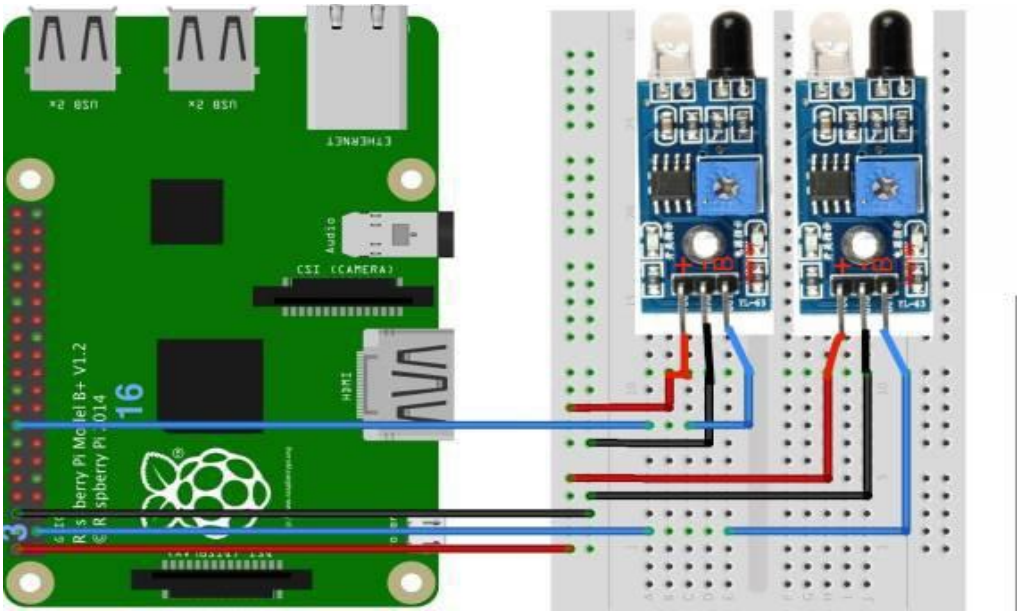

Figure 15: edge detection

Turning Mechanism for movement:

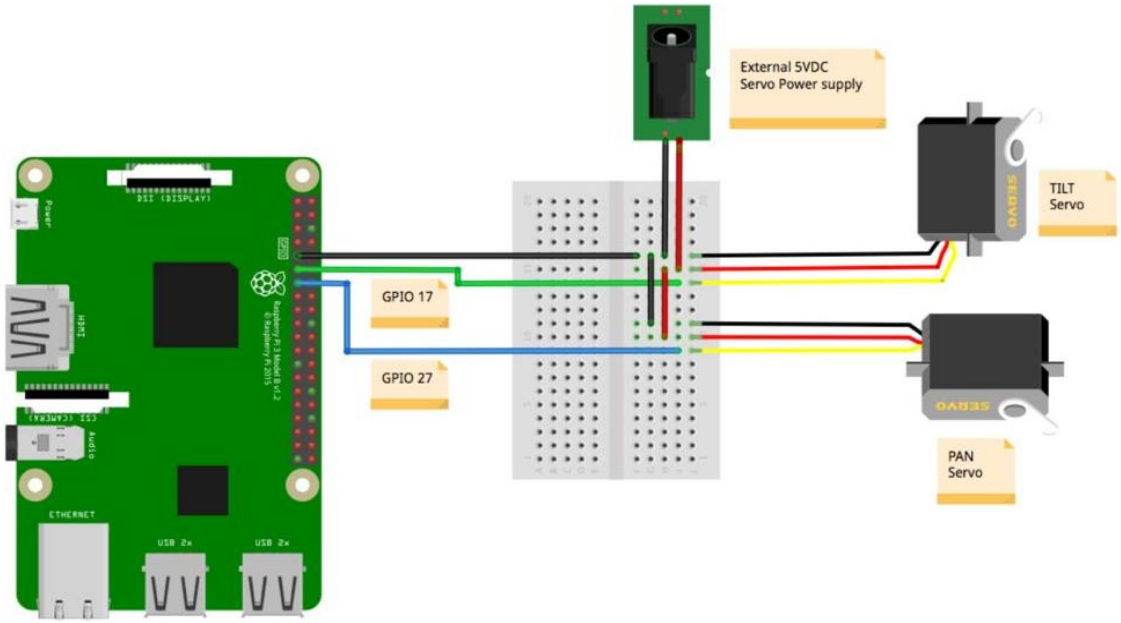

Figure 16: Servo motors

Movement of a robot:

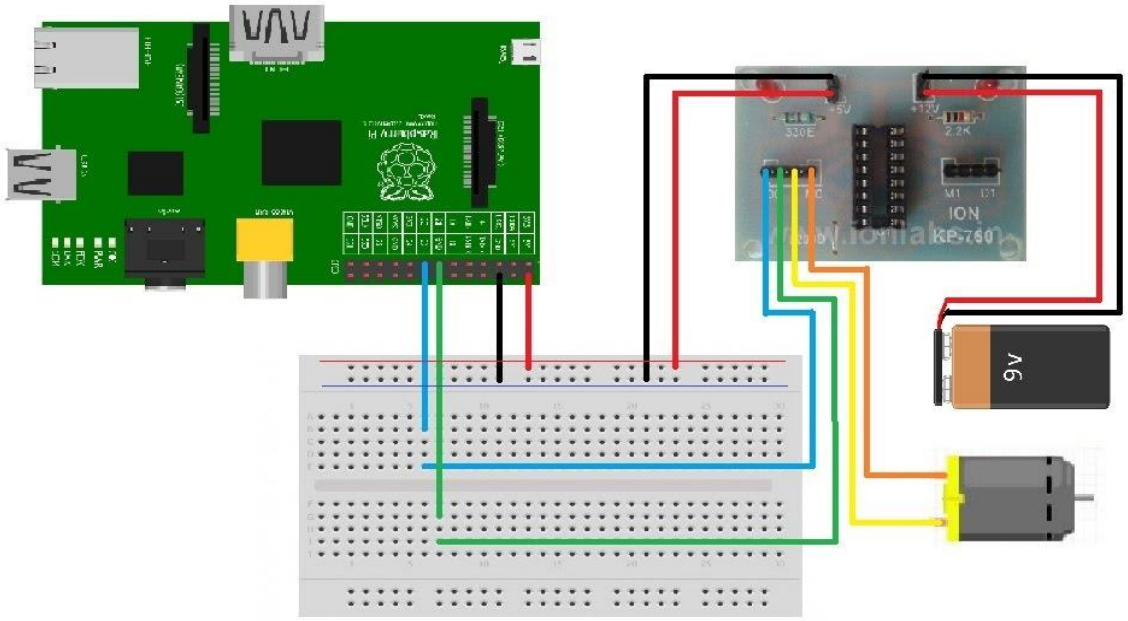

Figure 17: Movement of Robot

4.3 Diagrams

4.3.1 E-R Diagram /Block Diagram

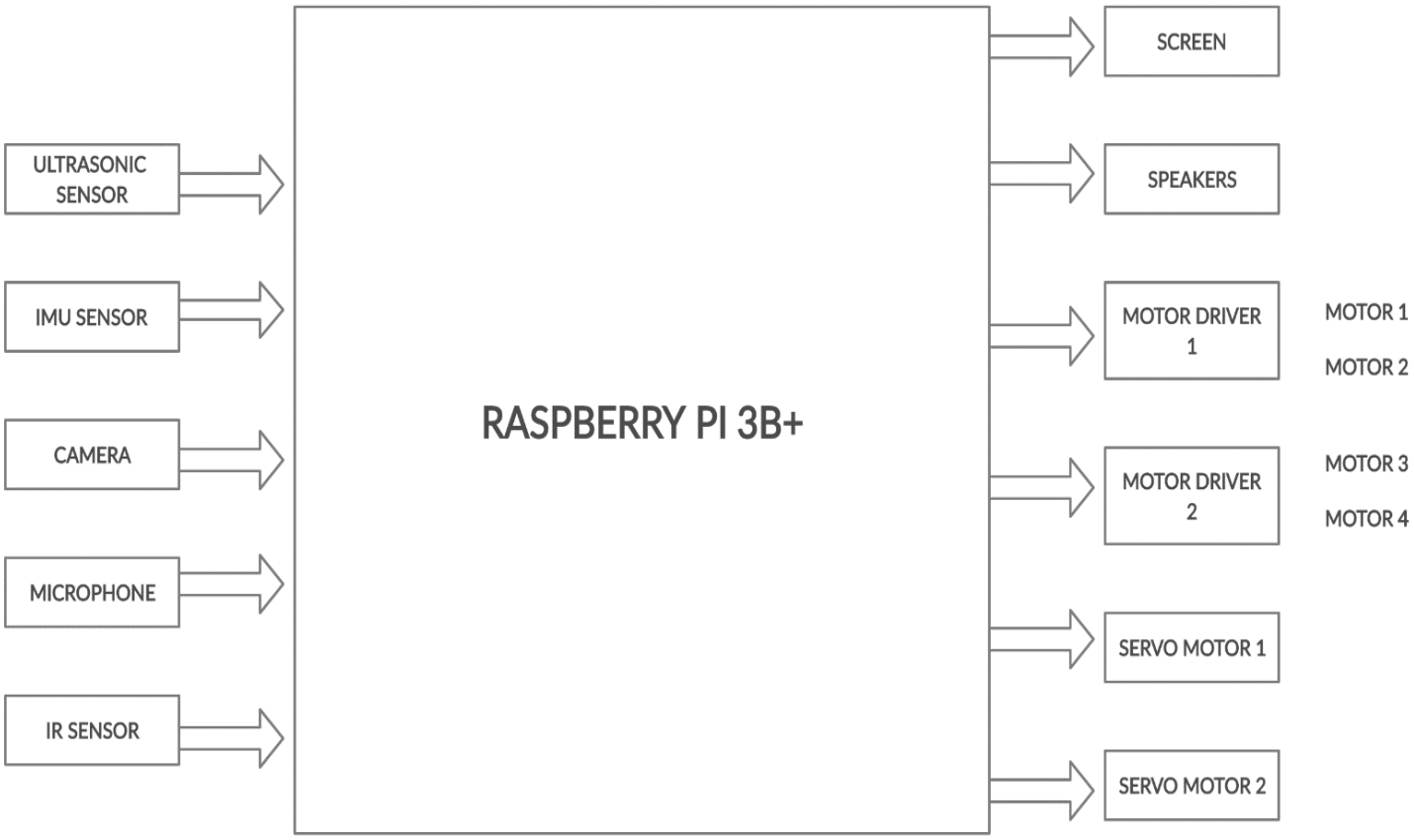

Figure 18: Block Diagram

4.3.2 Use Case Diagram

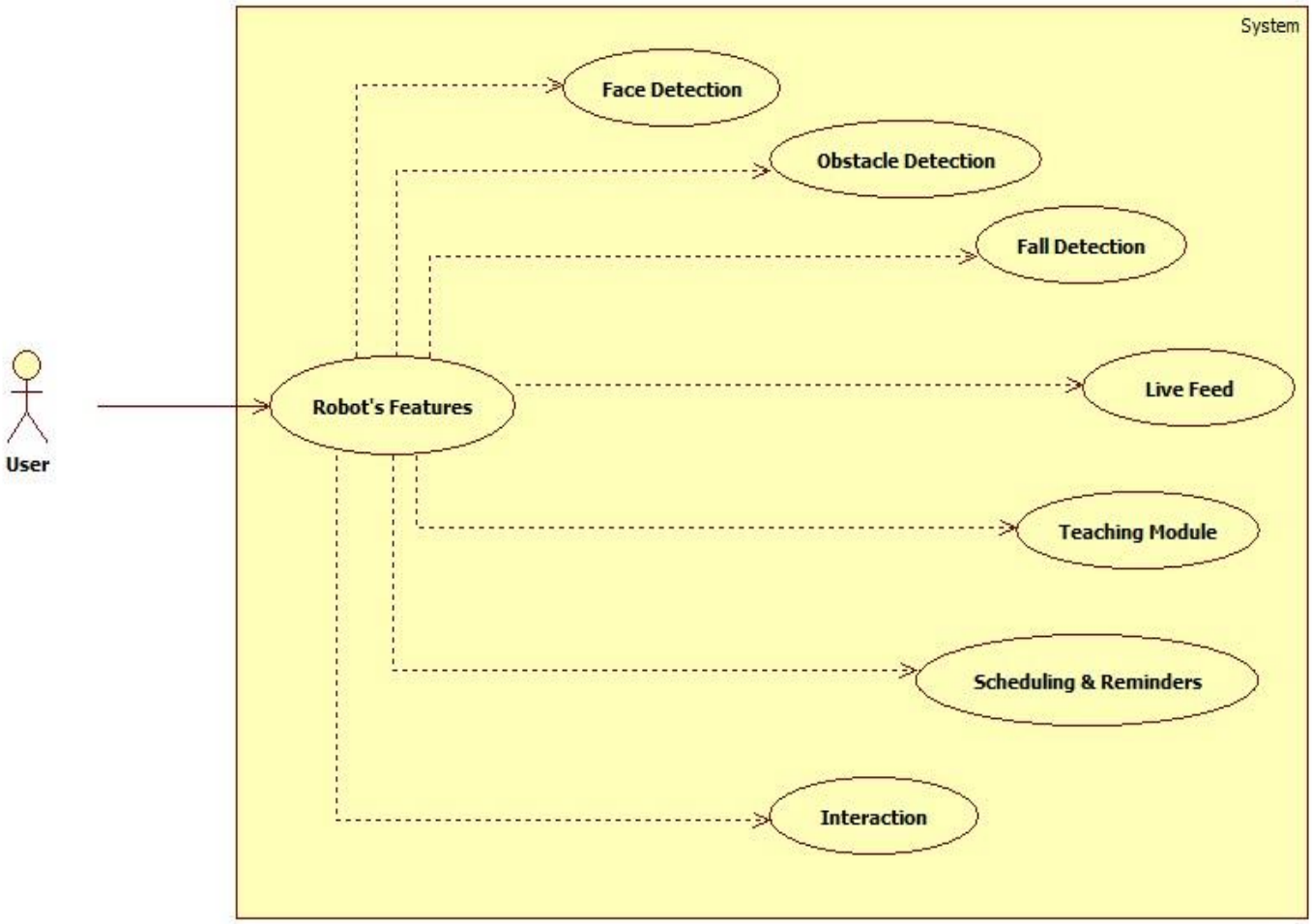

Figure 19: Use Case Diagram

4.3.3 Sequence Diagram

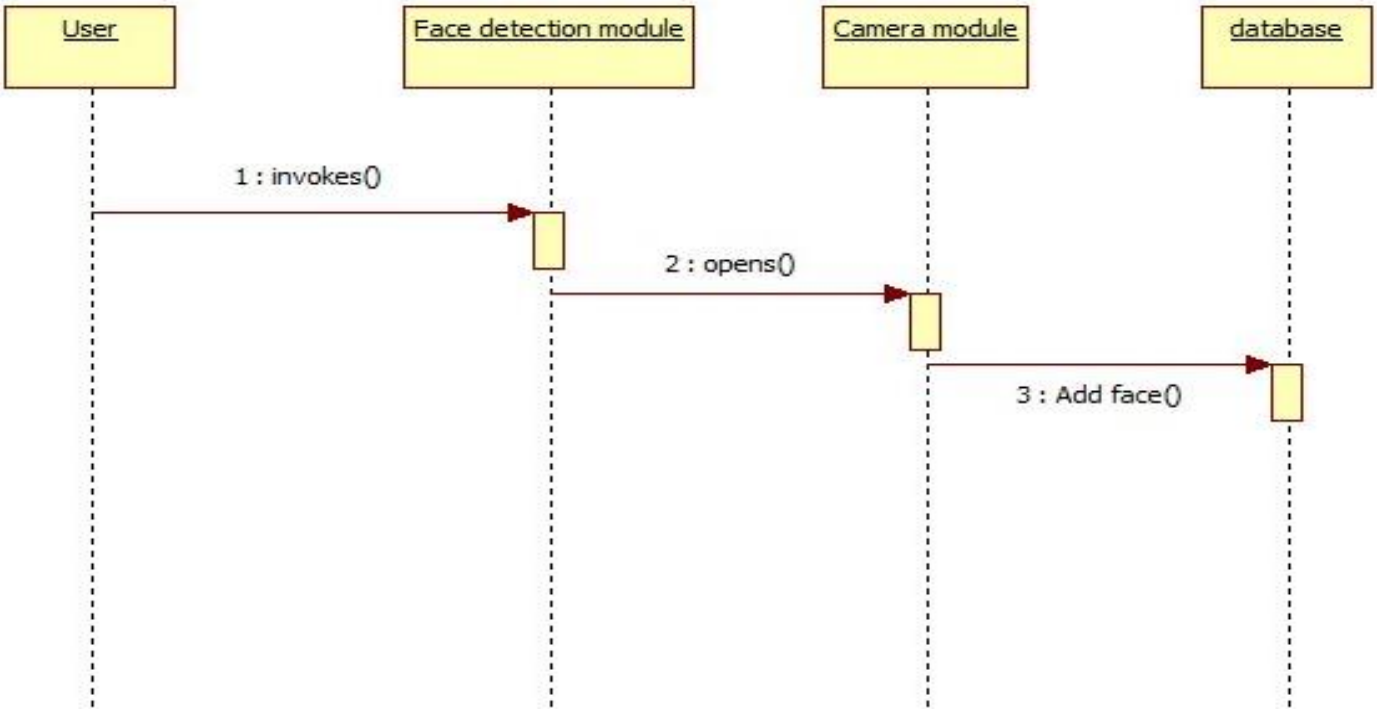

Figure 20: Face detection

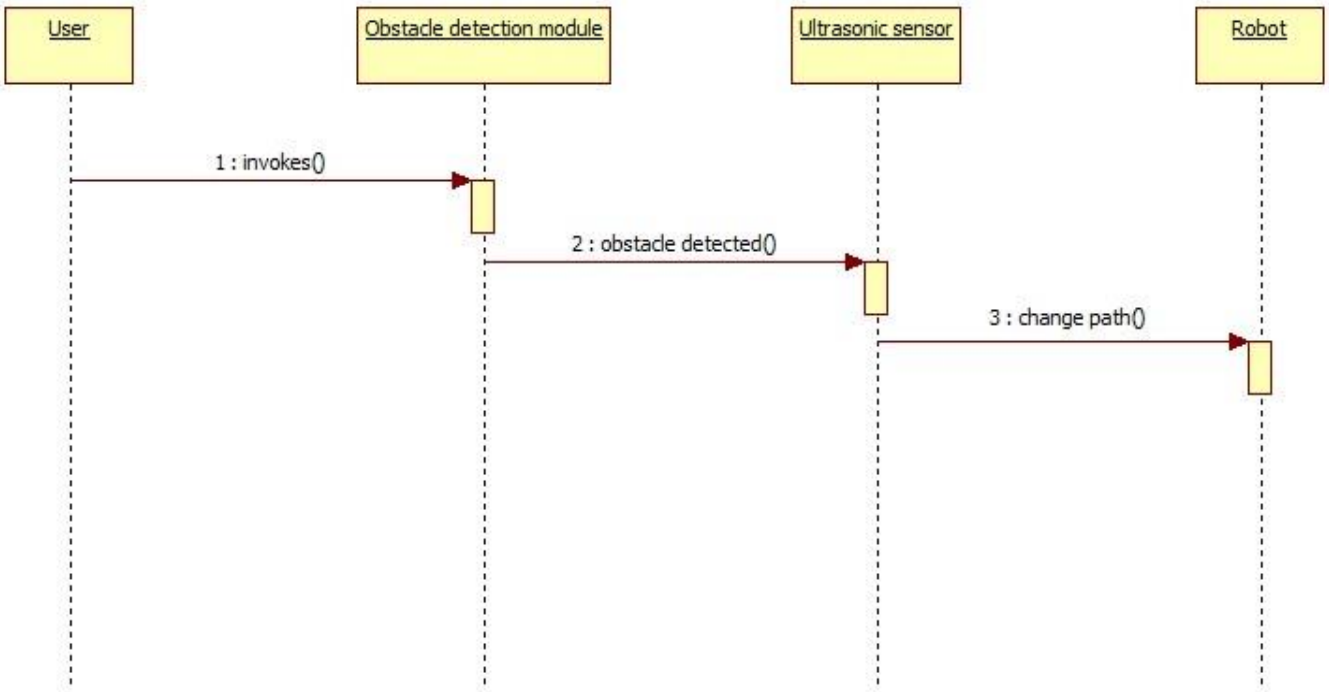

Figure 21: Obstacle Detection

4.3.4 Activity Diagram

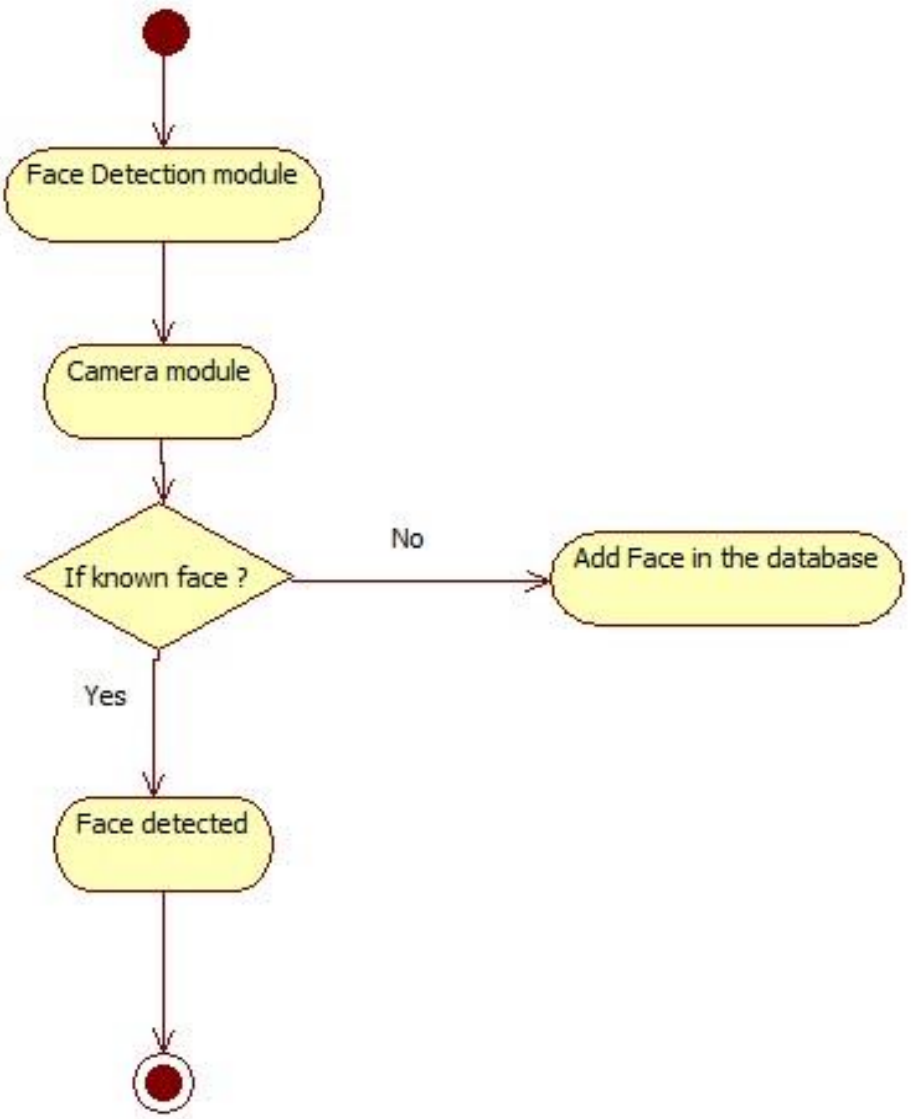

Figure 22: Face detection

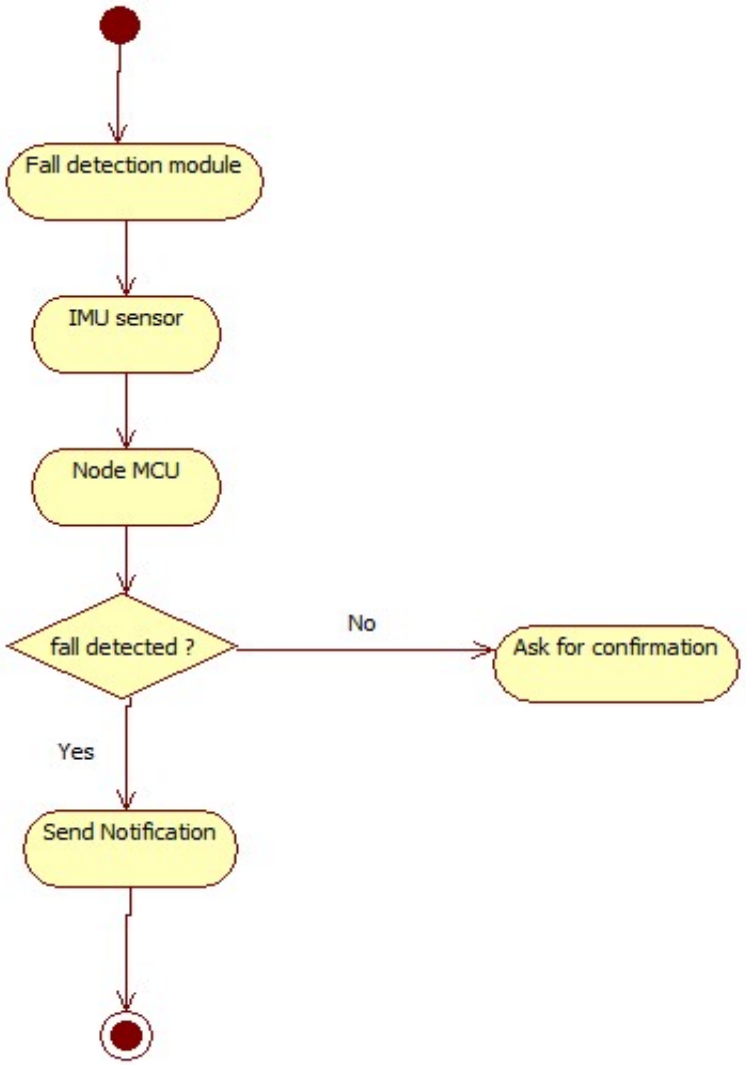

Figure 23: Fall Detection

4.3.5 Component Diagram

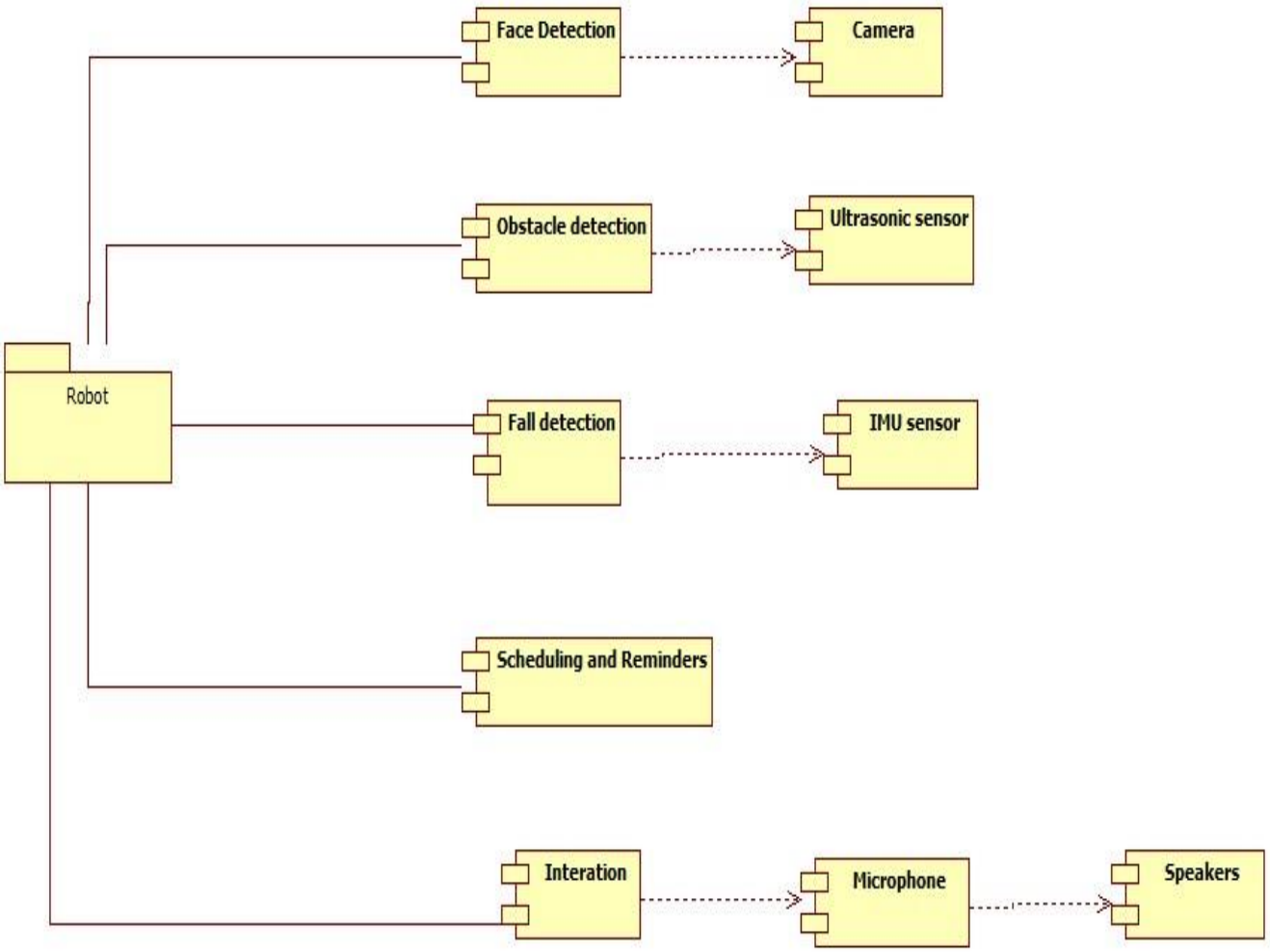

Figure 24: Component Diagram

4.3.6 Event Table

Event	Trigger	Source	Use Case	Response	Destination
Watching Face	Camera	User	Face Detection	Detect faces	User
Identifying obstacle	Ultrasonic sensor	Obstacle	Obstacle Detection	Detects obstacle and change path accordingly	Correct path
On click of display	Camera	User	Live Feed	Provide the live feed	User
Onset	Reminders	User	Scheduling and reminders	Giving reminders	User
On Listening	Microphones	User	Interaction	Interact with the user	User
Detecting fall	IMU sensor	User	Fall Detection	Send notification to the relatives	User
Teaching	Speakers	User	Teaching Module	Will teach	User

Table 5: Event Table

4.3.7 User Interface Design

Figure 25: User Interface

4.3.8 Test Cases Design

Levels of Testing:

To uncover the errors, present in different phases we have the concept of levels of testing. The basic levels of testing are:

- Client Needs Acceptance Testing
- Requirements System Testing
- Design integration Testing
- Code unit Testing

A series of Testing is done for the proposed system before the system is ready for user acceptance testing.

The steps involved in Testing are:

1. Unit Testing:

Unit Testing focuses on verification efforts on the smallest unit of the software design, the module. This is also known as "Module Testing". The modules are tested separately. This Testing was carried out during the programming stage itself. In this Testing, each module was found to be working satisfactorily as regards to the expected output from the module.

2. Integration Testing:

Data can be grossed across an interface; one module can have adverse efforts on another. Integration Testing's systematic Testing for construction of the program structure while at the same time conducting tests to uncover errors associated with the interface. The objectives to take unit tested modules and build a program structure. All the modules are combined and tested. Here corrections difficult because of the isolation of causes complicate by the vast expense of the entire program.

3. System Testing:

After integration, the whole program will again be tested. Case studies will again be applied with integrated software.

4. The methodology used for testing:

The testing methodology implemented for testing the project is Black Box testing. In the black box testing, the internal logic of the system under testing is not considered and the test cases are decided to form the specification or the requirements. It is often called functional testing. It aims to test functionality according to the requirements. Equivalence class portioning, boundary value analysis, and because effecting graphing are examples of methods for selecting test cases for black-box testing. State-based testing is another approach in which the system is modeled as a state machine and then this model is used to select test cases using some transaction or path-based coverage criteria, state-based testing can also be viewed as grey-box testing in that it often requires more information than just the requirements.

The testing methodology implemented for testing of the project is the black box testing. Refer to the above paragraph for explanation.

5. Test Cases:

The forms were tested for their functionality and error messages displayed wherever the input does not meet the required requirements. For the project, we need testing to make it successful. If each component works properly in all respect and gives the desired output for all kinds of inputs, then projects said to be successful.

Each hardware parts will be tested for their functionality according to the test cases given below:

Modules	Pre-condition	Test data	Priority
Fall Detection	The module should be on and connected to the internet in order to receive the notification	If the person has fallen it will ask “Hey are u ok?” if the answer is YES it will send the notification	High
Face Detection	The camera will be on	It will detect that the face is known or unknown	High
Obstacle Detection	All four ultrasonic sensors will be on and the robot will be in moving state	If any obstacle is detected it will change its path accordingly	High
Live Feed	In order to see the live feed, the application should be open	Live feed can be seen whenever the user wants	High
Scheduling and Reminders	Set the reminder using the touch screen	It will show as well as speak the reminder	High
Talk	The application should be open	It will answer according to the data received	High
Controlling Household Appliances	The device should be plugged in	We can control the appliance which is connected to the device	High

Table 6: Test case design

Chapter 5 Implementation and Testing

5.1 Implementation Approaches

Sr No	Implementation Plan	Action
1.	Module	1. Face Detection 2. Obstacle detection 3. Fall Detection 4. Live feed 5. Scheduling and Reminders 6. Talk 7. Controlling household appliances
2.	Percentage Completed	1. Face Detection: 80% 2. Obstacle detection: 80% 3. Fall Detection: 90% 4. Live feed: 100% 5. Scheduling and Reminders: 100% 6. Talk: 100% 7. Controlling household appliances: 100%
3.	Status	Completed
4.	Day Started	13th March 2019
5.	Day to be Completed	15th October 2019
6.	Actual Completion Date	30th September 2019

7.	Module Assignment	1. Face Detection: Nishant Ambre 2. Obstacle detection: Nishant Ambre and Srushti Nangare 3. Fall Detection: Nishant Ambre and Srushti Nangare 4. Live feed: Nishant Ambre 5. Scheduling and Reminders: Srushti Nangare 6. Talk: Srushti Nangare 7. Controlling household appliances: Nishant Ambre and Srushti Nangare
8.	Importance of Module	1. Face Detection: High 2. Obstacle detection: High 3. Fall Detection: High 4. Live feed: High 5. Scheduling and Reminders: High 6. Talk: High 7. Controlling household appliances: High

Table 7: Implement Approach

5.3 Testing approaches

Functional Testing is a testing technique that is used to test the features and the functionality of the system and the software covers all the scenarios including failure paths and boundary cases.

5.3.1 Unit Testing

- Unit testing deals with testing a unit or module as a whole. It is a method by which individual units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures, are tested to determine if they are fit for use.

- Its implementation can vary. Unit testing first focuses on the individual modules, independently one after another, to locate errors. This enables the tester to detect errors in coding and logical errors that are contained within that module alone. The resulting from the interaction between modules are initially avoided.

- So, while doing unit testing, we inserted the bug-free code into our Arduino board to check its working properly and give us the expected output. We had tested all the components individually one after another and found that all the individual component works properly and give us the expected output.

- Unit tests are typically written and run by software developers to ensure that code meets its design and behaves as intended, but in our case, we are only the developer so the unit testing is performed by us.

5.3.2 Integration Testing

- Integration testing is a systematic technique for constructing the program structure while at the same time to uncover the errors associated with interfacing.

- It brings all the modules together into a special testing environment, then it checks for errors, bugs and interoperability. It deals with tests for the entire application

- The objective is to take a unit-tested module and build a program structure. During integration, several tests were conducted at each integrated module before and after integration.

- On completion of integrating all the components, then it is finally tested once again for any other error occurring after integrating and it also checks that each module is working properly.

5.4 Modification and Improvements

- **Controlling household appliances:**

Buying an IoT product is a bit costlier. So, we have made a device(switch) that will make any device like a fridge, microwave oven, fan, tube light, etc an IoT device. Basically, it is an IoT module to control any household appliances through an app or with the help of a Robot.

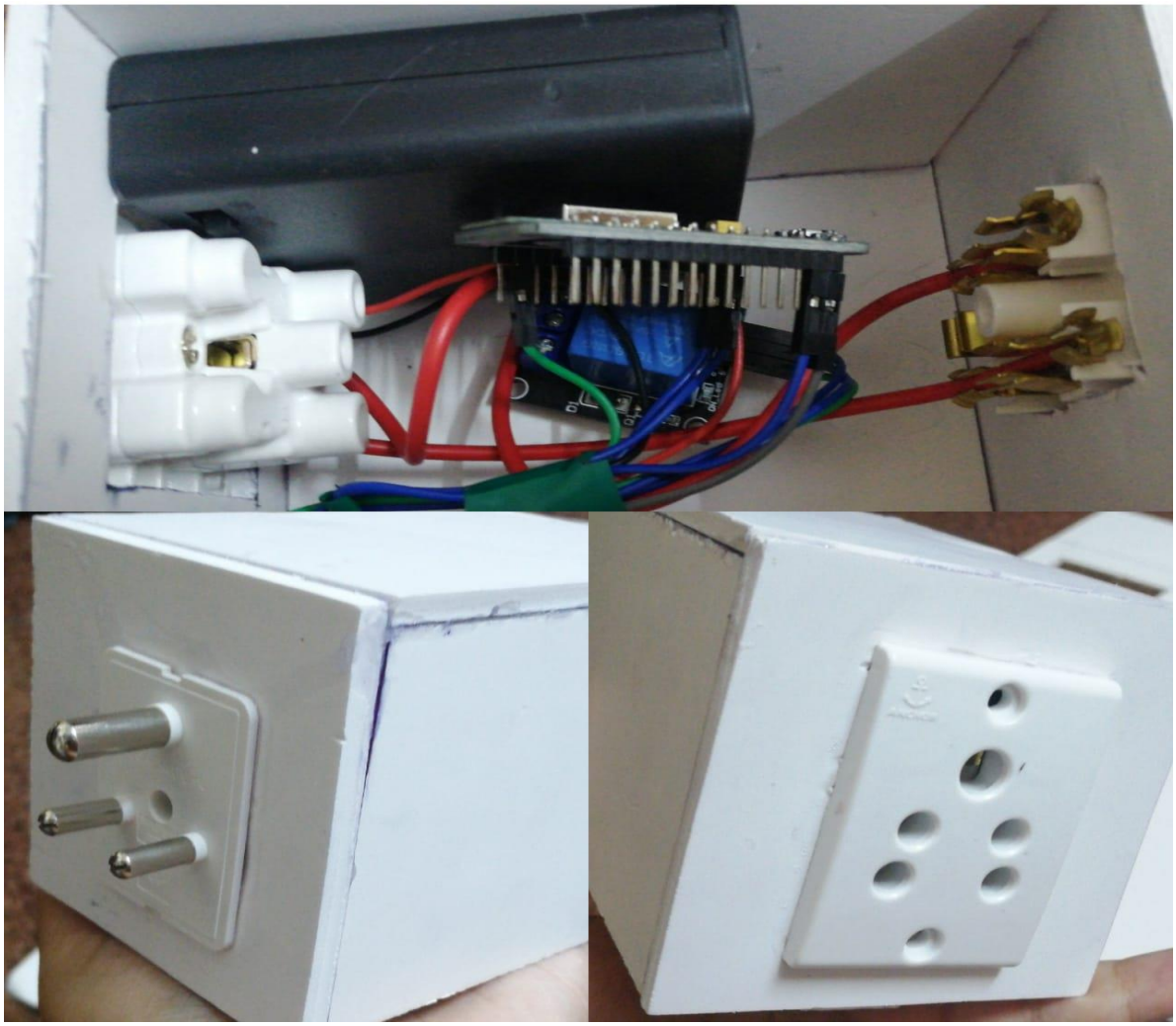

Figure 26: IOT Module

Chapter 6 Results and Discussion

6.1 Test Reports

Sr No.	Test Cases	Expected Output	Result
1	Face Detection	Known or unknown face should be detected	Successful
2	Obstacle detection	The obstacle should be detected and the robot should change its path	Successful It cannot detect a cloth as an obstacle since the rays penetrate through it
3	Fall Detection	Fall should be detected and notification should be sent	Successful
4	Live feed	The application should show the live feed	Successful
5	Scheduling and Reminders	The robot should speak the reminder	Successful
6	Talk	It should reply(speak) to the question asked by the user	Successful But for the time being, it can only answer the questions which are available in the dataset
7	Controlling household appliances	It should control the appliance through an app or through voice commands	Successful

Table 8: Test Results

6.2 User Documentation

To start the Robot, turn on the power button which is located at the backside of the robot.

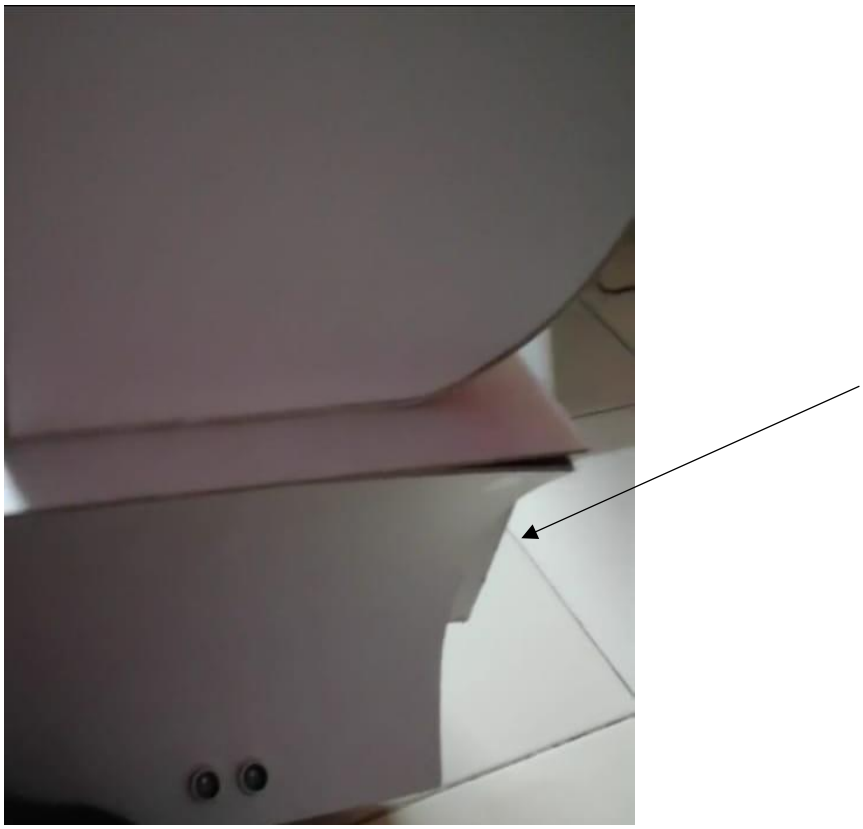

Figure 27: Power Button

The screen will be on

Figure 28: Robot's Screen

Our robot can talk, walk, see and listen just like humans and as the name of the project suggests a smart robot companion, it has some smart features like:

*** Scheduling and Reminders** – Old people usually tend to forget important things like taking medicines, to remind them we can set reminders on our robot using the touch interface and it will remind them accordingly.
We have created a user-friendly GUI to set the reminder.

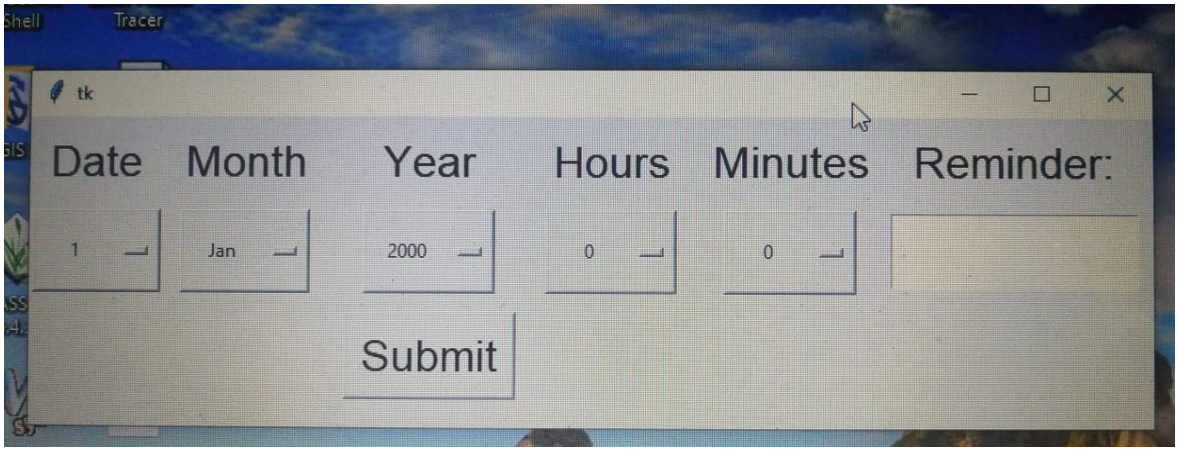

Figure 29: Reminder GUI

It will speak as well as notify you about the reminder

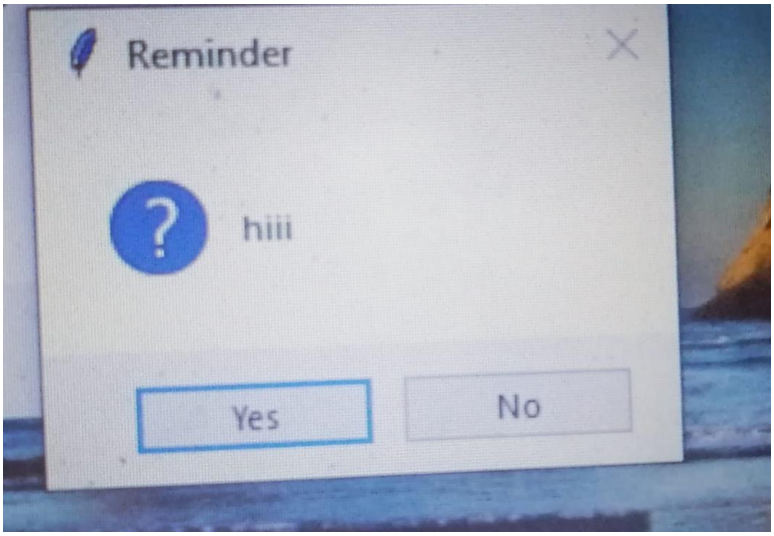

Figure 30: Reminder Notification

*** Live-feed -** This feature is basically for the working parents who cannot be physically present to look after their kids all the time and even if they install a CCTV camera, it will be fixed in one place, it cannot cover every nook and corner of the house. Our robot will provide the live feed to the parents on an app we have made whenever they want to see what their kids are doing.

The user needs to install the app in order to see the live feed

The camera placed at the top of the robot will provide the live feed through an app.

Figure 31: Live feed

*** Talking** – People usually tend to bond with things that look attractive and can interact. Our robot can talk with people. We can ask the current time, today's weather can greet you etc.

The user can chat or can speak with the robot through an app and it the reply to the questions accordingly. For now, it can only answer the questions which are there in the dataset.

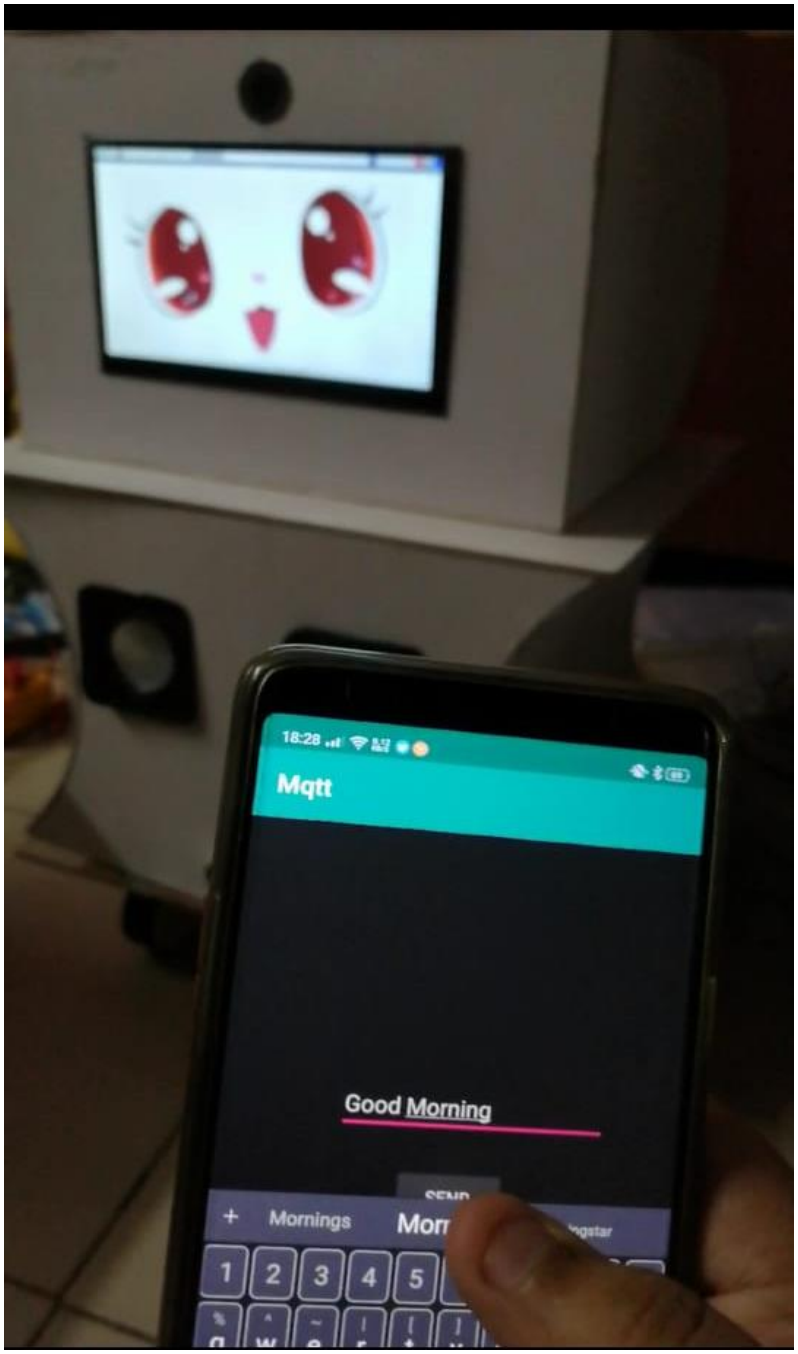

Figure 32: Talk

*** Face recognition** – Our robot can detect and recognize the faces of known people and if an unknown person is detected it will inform the user and confirm its identity saving it in the database, it's basically for security purposes.

In the picture below, the robot is recognizing the known face with its name and unknown face as unknown.

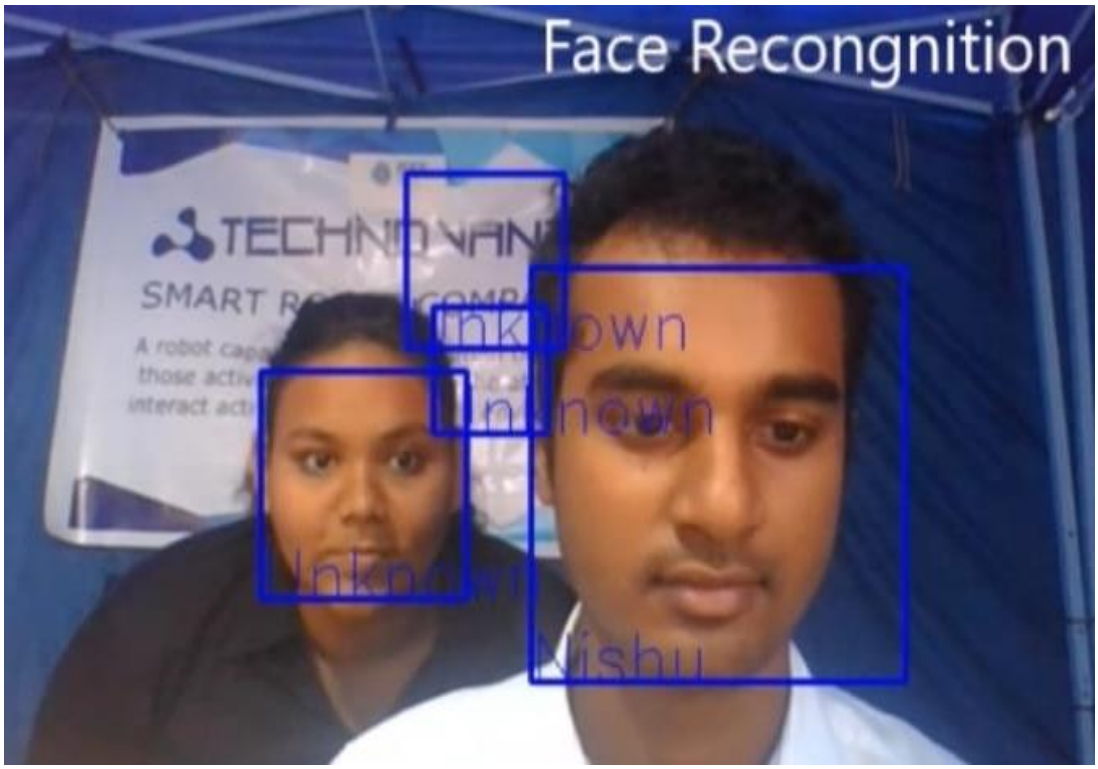

Figure 33: Face Recognition

*** Obstacle detection** – While moving there are chances that it might hit an object. Hence with the help of sensors in all four directions, it detects the obstacles in its path so that it won't bump on something and change its path accordingly.

The ultrasonic sensors are placed on all four sides of the robot to detect the obstacles.

It cannot detect a cloth as an obstacle since the rays penetrate through it

Figure 34: Obstacle Detection

*** Its own fall** – If it is moving on an elevated surface it will detect that it can fall and hence stop at the edge or it will move back.

We have used IR sensors to prevent the robot from falling. The sensors are placed at the bottom.

Figure 35: Its own fall

*** Fall detection** – Usually old people are prone to injuries due to falls. If a person falls it will ask him or her **'hey are you okay'** and if the user won't reply in 10 seconds it will send a notification through SMS to the users relative that the person has fallen.

The module is wirelessly connected to the robot.

Figure 36: Fall detection module

The module will be placed on the person's body with the help of a belt.

Figure 37: module on a person's body

If a person has fallen it will notify the relatives through an SMS.

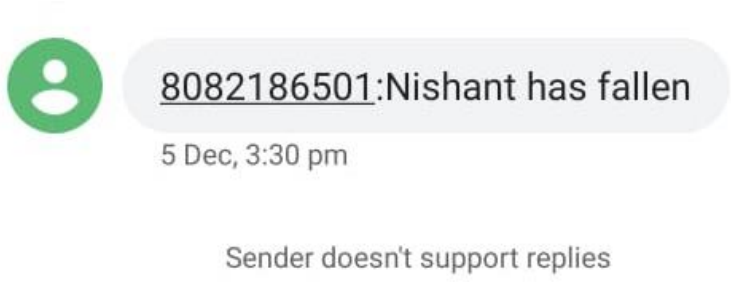

Figure 38: SMS notification for Fall

*** Controlling Household Appliances** – Buying an IOT product is a bit costlier. So, we have made a device(switch) that will make any device an IoT device. Basically, it is an IoT module to control any household appliances through an app or with the help of a Robot.

Figure 39: controlling household appliances

*** Rechargeable batteries:**

For power source, we are using 12V rechargeable batteries

Figure 40: rechargeable batteries

Chapter 7 Conclusion

7.1 Conclusion

So hereby we can conclude that making robots part of our family and daily life is useful. Robots can socialize with humans. They can be developed in a way to connect humans. It is the future of technology and human interaction. They can be reliable and secure solving a lot of problems in our daily life.

Let's make a robot a part of our day to day life.

7.2 Limitation of the system

- There are few features which need an internet connection
- The robot can only move on the flat surface
- In case of less power, the ultrasonic sensors will not detect the obstacle
- It cannot detect a cloth as an obstacle since the rays penetrate through it

7.3 Future Scope of the Project

In the future, we would like to add a few modules such as:

- **Emotion Recognition**
- **Autonomous Indoor navigation**
- **Teaching Aid**
- **Automatic Charging**

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Summary

It is a multipurpose robot which can be used for taking care of kids, senior citizens and physically challenged people. It is a personal digital assistant that can make their day to day life easy. It will be a friend to the kids and companion to the adults.

To build a robot, a wide variety of tools and techniques need to be used along with hardware and software. We are going to use hardware and software-based advanced technologies such as Android Studio, Raspberry Pi, Artificial Intelligence, Internet of Things and many algorithms for the security of the user.

Plagiarism Report

Figure 41: Plagiarism Report