# DAYALBAGH EDUCATION INSTITUTE

## SOFTWARE ENGINEERING PROJECT FILE

## IOT605


**Submitted To:**

**MISS. VANDNA AKELLA**

**Submitted By:**

**Km.Deepali(1904688)**

**Shivani Baghel (1904719)**

**Name-Kanchan Pal(1904700)**

# PROJECT REPORT ON

# HUMAN FOLLOWING ROBOT USING ARDUINO


## ACKNOWLEDGEMENTS

No volume of words is enough to express our gratitude towards our guide mam Mrs. Vandana Akella. Department of Physics and Computer Science who has been very concerned and guided for all the ideas and solve quires in the preparation of this project. They have been very cooperative and sincere us through to see our hard work become fruitful. We are very thankful to Mrs. Vandana Akella, project coordinator for giving us the opportunity to carry out this project. Also we are very much thankful to the Mr. Amarjeet Singh Chauhan for providing the required components and for providing every details and working of parts and components.


## ABSTRACT


A robot which can help us in many fields like carrying items, work with more accuracy in lesser time in every kind of works. A robot that can help us in a hospital or bringing medical items in any emergency case will be more helpful for a doctor in emergency cases. This type of robot having so many benefits and it will be helpful in the future. This type of robot can be close to humans is much possible. This useful project is made to attempts to follow the right human or obstacle. In this robot, Infrared sensors are used to move the robot in both the direction and ultrasonic sensor for both the forward and reverse direction. We used the Arduino Uno microcontroller as the brain of this project. This robot is driven with four Dc motors and it is controlled by a motor driver shield with ATmega L293d . The main objective of designing this useful project is to make our life better and luxurious. In this project robotic car sense the human by IR sensor automatically and follow the human and obstacles. This type of robot will be more useful and it will be a trend in the future.



**Keywords**: Arduino, DC gear motor, Infrared sensor, Microcontroller, Ultrasonic sensor, Robot.


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# I. INTRODUCTION

In this high technology, a robot must be able to detect and follow humans. A robot that can detect and follow human or obstacle within a specific range is called ‘Human Following Robot’. Robots are used to change

people's lives and make people's life luxurious. A robot that can use in shopping time which carries items, and follow human without any remote more useful .A robot that can use in the hospital to bringing medicine with more accuracy and fast. The human following robot has many works like work as trolley structure in hospital, and a small basket with a car and so on. Now in this changing world, people are started to lives with robot-like humans following robots for their luxurious life. This project named called human following robot because it can follow humans with the help of IR sensors and can co-exist with humans and help humans in any kind of work with more accuracy and in lesser time. The human following robot can use in the defines sector also to carry weapons for the soldiers. This type of robot can sense obstacles and humans automatically and it can use in the future in our cars. An human following robot can be modified in the future with more developed components and can make it more advance. This robot can be enhanced by structure by adding more components like camera , tracking device and make it more beautiful and workable . This robot will be more trend in our future.

# CHAPTER 1

# INTRIDUCTION

## 1.1 Problem Definition

The aim of this project is to develop a prototype HUMAN FOLLOWING ROBOT The focus will be placed on designing a system that will accurately monitor and follow to the human By monitoring the motion the symptoms of human motion The analysis of the motion of the human motion is a popular research area with applications such as moment recognition, virtual and hardware tools, and human identification security systems. This project is focused on the localization of the motion of the human which involves looking at the entire human motion and determining the position of the human by a self-developed motion-processing algorithm. Once the position of the human is located, the system is designed to determine whether the human are opened or detect the human motion.

## 1.2 Existing System

Significant factor in a large number of luggage lost. Recent statistics estimate that annually 1,20000 luggage lost and the old persons can’t carry luggage. The development of technologies for detecting or detecting human motion drowsiness at the wheel is a major challenge in the field of luggage missing avoidance systems.

## 1.3 Proposed System

The proposed system will try to accomplish the following tasks:

A. The motion detection frames is the first capture.

B. Captured frames will be pre-processed before the application of the algorithms.

C. After pre-processing, motion of the human will be detected.

### 1.4 Scope of Project

Currently, some luggage system are present that are automatic and follow the things that are in motion. the So we are looking for an approach to easily detect tilted human so that the application can be practically used.

DOCUMENT CONVENTIONS

**Main Heading Font size: 24 (bold fonts)**
**Sub-headings Font size: 16 (bold fonts)**
**Sub-headings Content Font size: 14 (normal fonts)**
**Font-(New Time Roman)**

# CHAPTER 2

# LITERATURE OVERVIEW

### 2.1 Overview

Industrialized countries forgotten and heavy goods has been estimated to be involved in 50% to 60% of all missed luggage.

Increase in such fatal missed luggage has urged many automobile companies now-a-days to build their own software that will detect the motion of human well in advance. We have thus build a system that will detect where is the human going.

### 2.2 Existing System

Human is forget large number of luggage. Recent statistics estimate that annually 1,200 deaths and 76,000 luggage missed. The development of technologies is reduce luggage missing.

# CHAPTER 3

# SOFTWARE PROJECT MANAGEMENT PLAN

# (SPMP)

## 3.1 Introduction

This introduction provides background information for the rest of the document. It briefly describes the project, the client deliverables, the project milestones, and expected document changes.

## 3.2 Project overview

The system will capture the motion will continuously capture motion frames from. After capturing the frames, they are pre-processed before the application of algorithms. After pre-processing, motion of the human detected. There is already a template which is stored in the database and if the system detect the motion of the human for more than specified period of time then the robot will follow the human.

**Evolution of this document**

This document will be updated as the project progresses. Updates should be expected in the following sections:

References - updated as necessary

Definitions, acronyms, and abbreviations - updated as necessary

Organizational Structure will be updated as the team leaders are assigned for each phase.

Technical Process - this section will be revised appropriately as the requirements and design decisions become clearer

Schedule – as the project progresses, the schedule will be updated accordingly

Table 3.1 Documentation Revision History

| Revision | Date | Updated By | Update Comments |
|---|---|---|---|
| 1.0 | 1th April | Km.Deepali<br>Kanchan pal<br>Shivani Baghel | Additional functionalities added. |
| 2.0 | 14th May | Km.Deepali<br>Kanchan pal<br>Shivani Baghel | Final Project Plan. |

### 3.3References

K. Morioka, J.-H. Lee, and H. Hashimoto, “Human-following mobile robot in a distributed intelligent sensor network,” IEEE Trans. Ind. Electron., vol. 51, no. 1, pp. 229–237, Feb. 2004.

### 3.2.1 Process model

The process used for this project will be a Feature Human Development Model such that each prototype allows us to update the project plan and other deliverables for missing areas or correctness.

### 3.2.3 Organizational boundaries and interfaces

Team leaders during each phase will be responsible for coordinating team meetings, updates, communications, and team deliverables

### 3.2.4 Project responsibilities

Entire project team is responsible for the successful delivery of the product.

Team member assignments per deliverable according to expertise

1. Preliminary Project Plan
2. Presentation
3. Software Project Management Plan
4. Software Requirement Specification
5. motion Detection Module
6. Human  Detection Module
7. System Test Document
8. Software Design Document
9. Algorithm Module
10. Demo
11. Synopsis

## 3.3 Managerial Process

### 3.3.1 Management objectives and priorities

The objective of the project is to develop a Human Following Robot System that functions as per overview defined above.

### 3.3.2 Assumptions, dependencies, and constraint

The project assumptions, dependencies and constraints are as follows

- Team of 2
- Equipment/Hardware and software availability

### 3.3.3 Risk management

- Application Crash risk

- Anaylsis risk

### 3.3.4 Monitoring and controlling mechanisms

- Weekly project status meetings
- Shared document repository (Google Drive/Email services)
- Project tracking
- Tracking utilizing baselines

## 3.4 Technical Process

### 3.4.1 Methods, tools, and techniques

The project will be implemented utilizing prototype model methodology, and tools such as Computer/Laptop, Ultrasonic Sensor, Arduino etc.

### 3.4.2 Software documentation

Documentation such as Software Requirement Specification ,Test Plan.

### 3.4.3 Project support functions

All project support documents will be completed in applicable phases.

# CHAPTER 4

# SOFTWARE REQUIREMENT SPECIFICATION

# (SRS)

## 4.1 Introduction

### 4.1.1 Purpose

The Software Requirements Specification (SRS) will provide a detailed description of the requirements for Human Following Robot. This SRS will allow for a complete understanding of what is to be expected of the system to be constructed. The clear understanding of the system and its functionality will allow for the correct

software to be developed for the end user and will be used for the development of the future stages of the project. It will provide the foundation for the project. From the recorded specifications, the Human Following Robot can be designed, constructed, and finally tested.

### 4.1.2 Document Scope

Human Following Robot has been developed, using intrusive machine vision based concepts. The system uses a small monochrome security Ultrasonic Sensor that points directly towards the human's monitors the human in order to detect fatigue. In such a case when fatigue is detected, A human motion and follow it. This report describes how to find the motion, and also how to determine if the motion and not in motion. The algorithm developed is unique to any currently published papers, which was a primary objective of the project. The system deals with using information obtained for the binary version of the image to find the edges of the face, which narrows the area of where the human motion may exist. Once the motion is found, the eyes are found. Once the motion are located, measuring the distances between the intensity changes in the eye area determine whether the eyes are open or closed. A large distance corresponds to Human closure.

### 4.2.2 Product Functions

The system will perform the following functions:

- System will capture the Ultrasonic sensor i.e. the system will continuously capture motion frames from the Ultrasonic sensor.
- After capturing the frames, the captured frames are pre-processed before the application of the algorithms.
- After pre-processing, face and motion of the user are detected.
- There is already a template in the database which is compared with motion of the human and if the system detect the motion or start follow the human

# CHAPTER 5

# SOFTWARE DESIGN DOCUMENT

# (SDD)

## 5.1 INTRODUCTION

### 5.1.1 Design Overview

This document is a high-level overview defining our testing strategy for the Human Following Robot. Its objective is to communicate project-wide quality standards and procedures. It portrays a snapshot of the project as of the end of the planning phase. This document will address the different standards that will apply to the unit, integration and system testing of the specified application.

### 5.1.2 Requirements Traceability Matrix

The following is a table depicting which components are expected to satisfy which requirements.

Table 5.1 Traceability Matrix

| Components Requirements | User | Input(Ultrasonic sensor) | System | Output |
|---|---|---|---|---|
| Face Detection | | | X | X |
| Human Detection with Left Motion | | | X | X |

| | | | | |
|---|---|---|---|---|
| Human Detection with Right Motion | | | X | X |
| Motion Detection of the Human | | | X | X |
| Start | X | X | X | |

## 5.2 SYSTEM ARCHITECTURAL DESIGN

### 5.2.1 Chosen System Architecture

### Used Tools

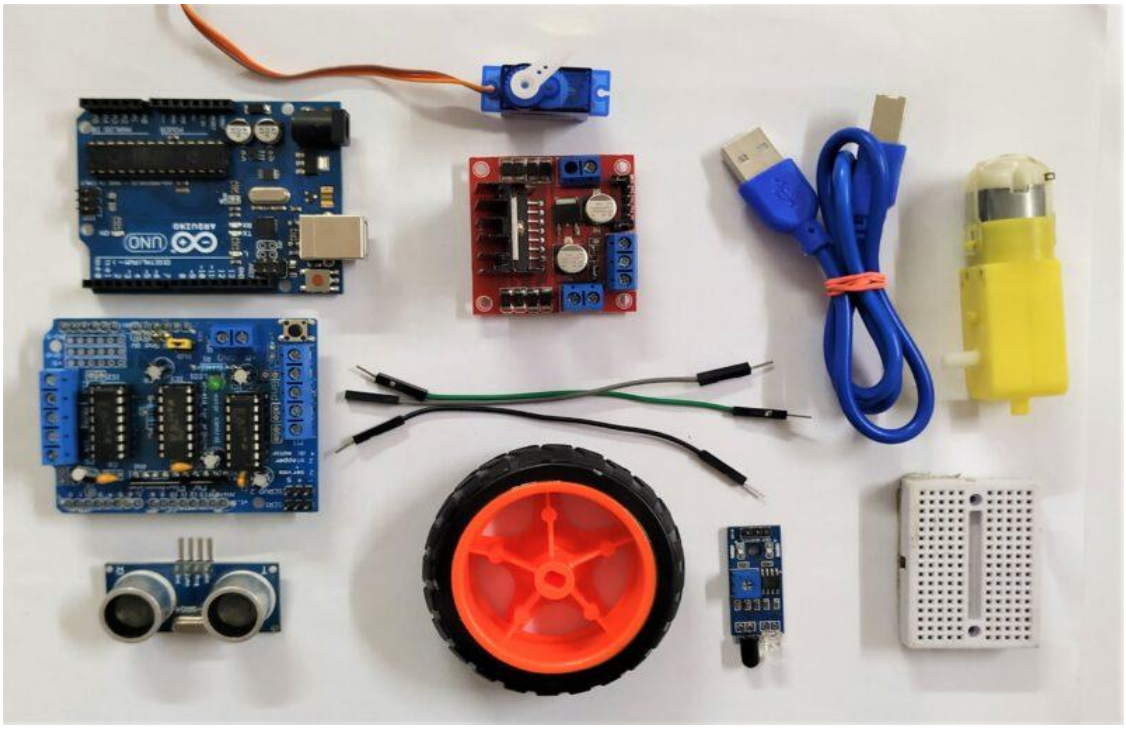

**Figure 1.1**

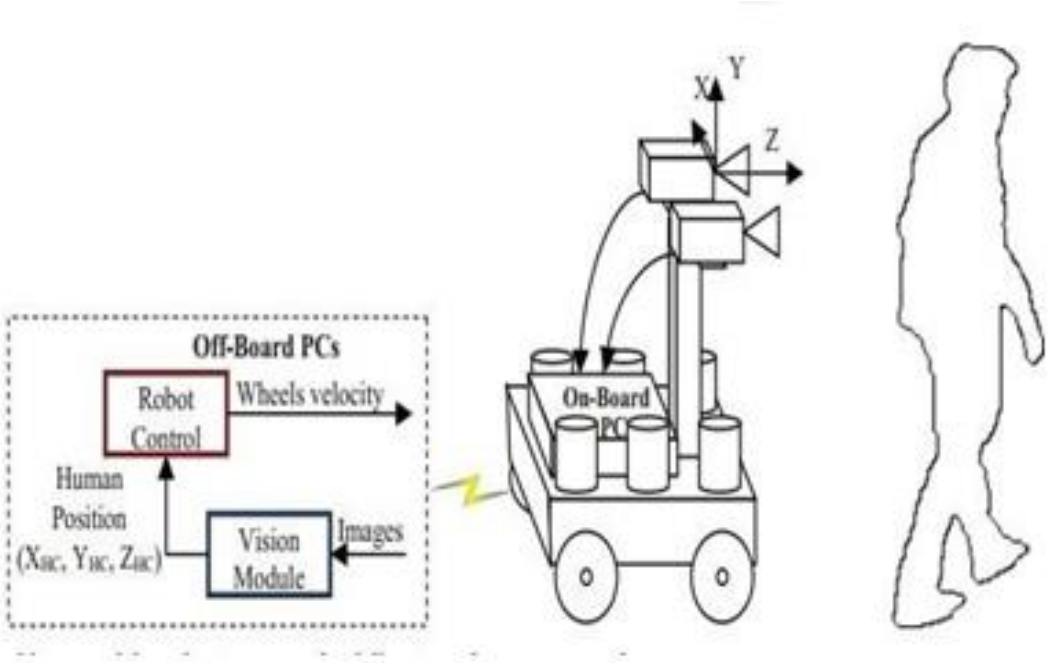
Off-Board PCs
Robot Control
Wheels velocity
Human Position
(XHC, YHC, ZHC)
Vision Module
Images
On-Board PC
X
Y
Z

**Figure 1.2**

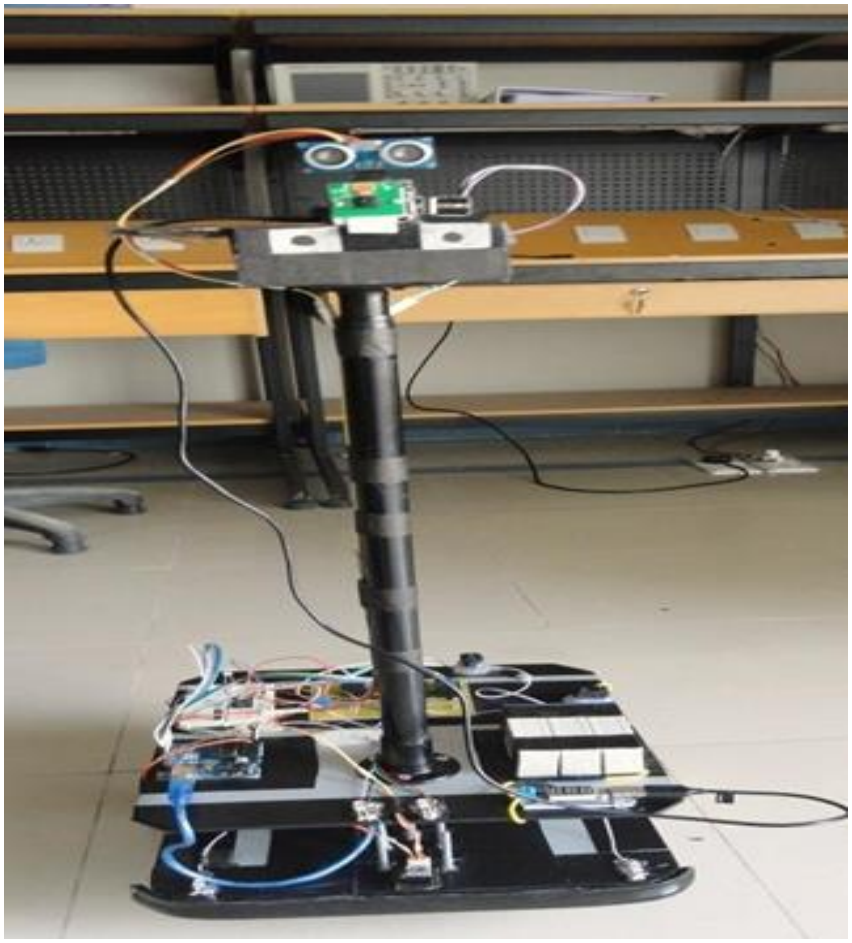

**Figure 1.3**

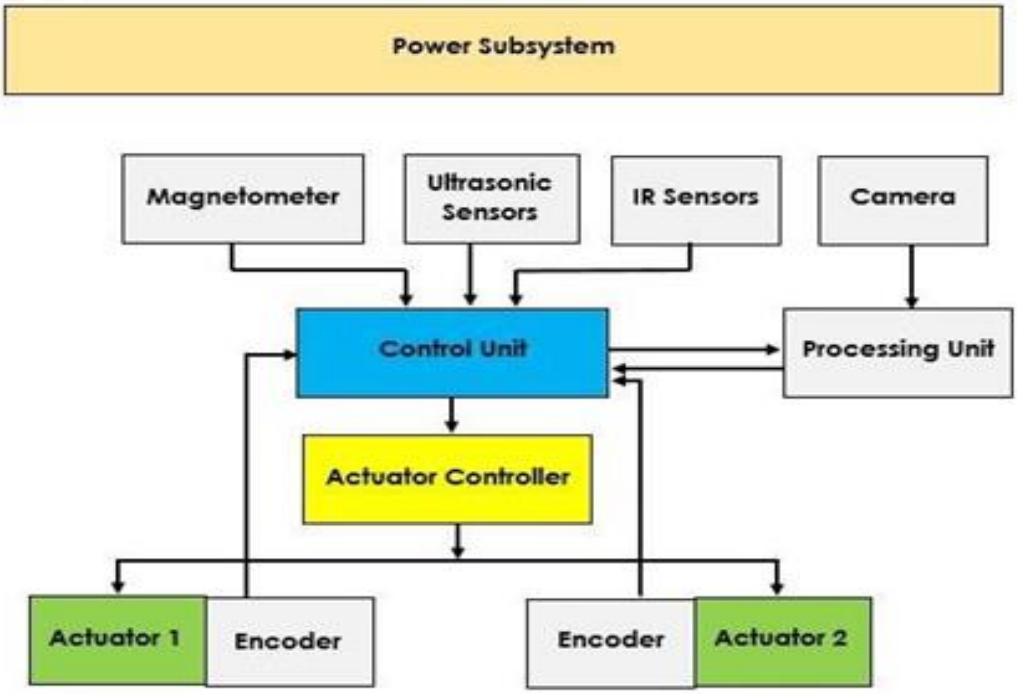


**Figure 1.4**

Flow Diagram

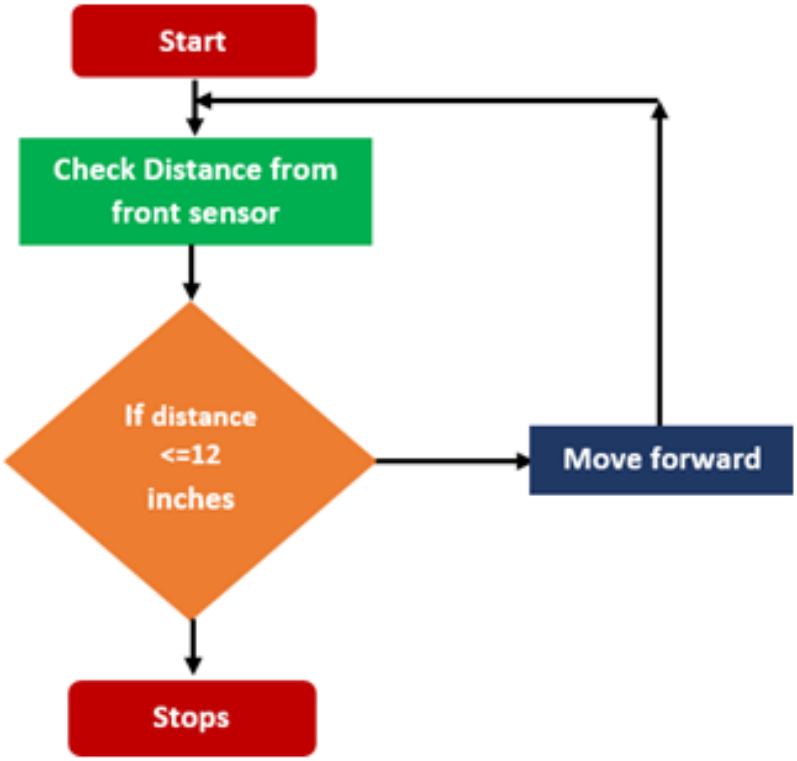

**Figure 1.4**

## $0^{th}$ level DFD 5.1

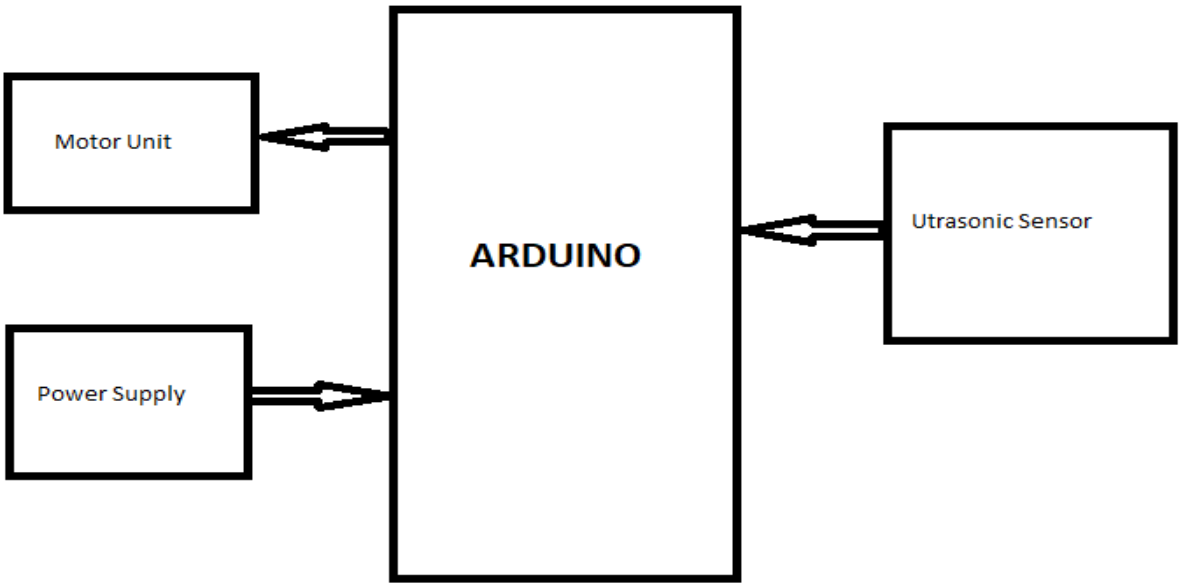


**Figure 5.1**

**1th level DFD 5.2**

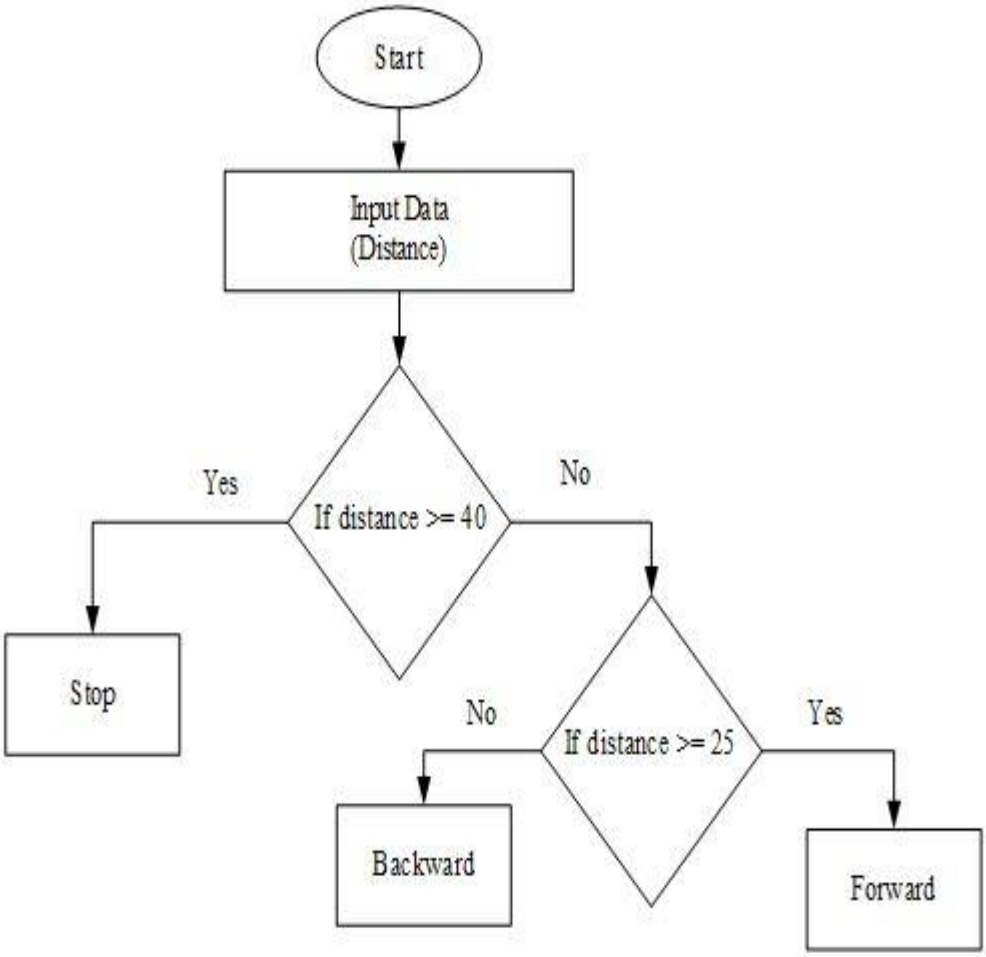


**Figure 5.3**

## 5.2.2.2 Software Interfaces

The system will consist various interfaces between the above mentioned software components. These interfaces will be built using standard tools.

### 5.3.1Imag Implementation

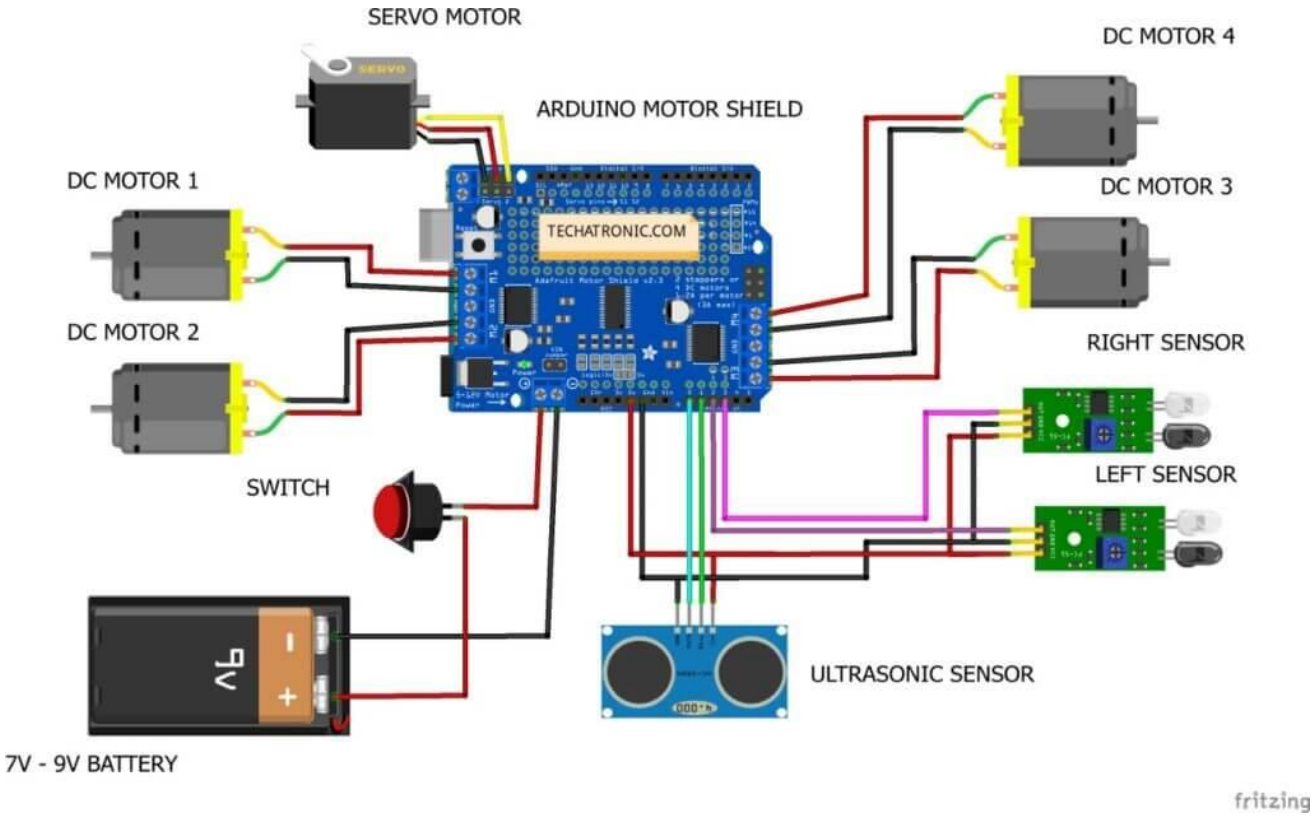


**Figure 5.4**

## 5.4 UML Diagrams

### 5.4.1 Use Case Diagram

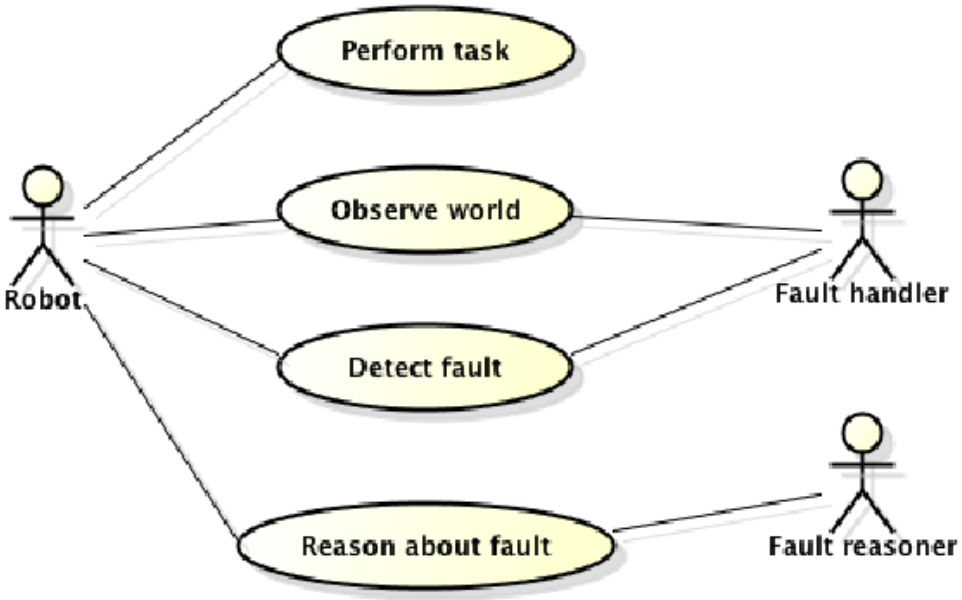

**Figure 5.6**

### 5.4.2 Activity Diagram

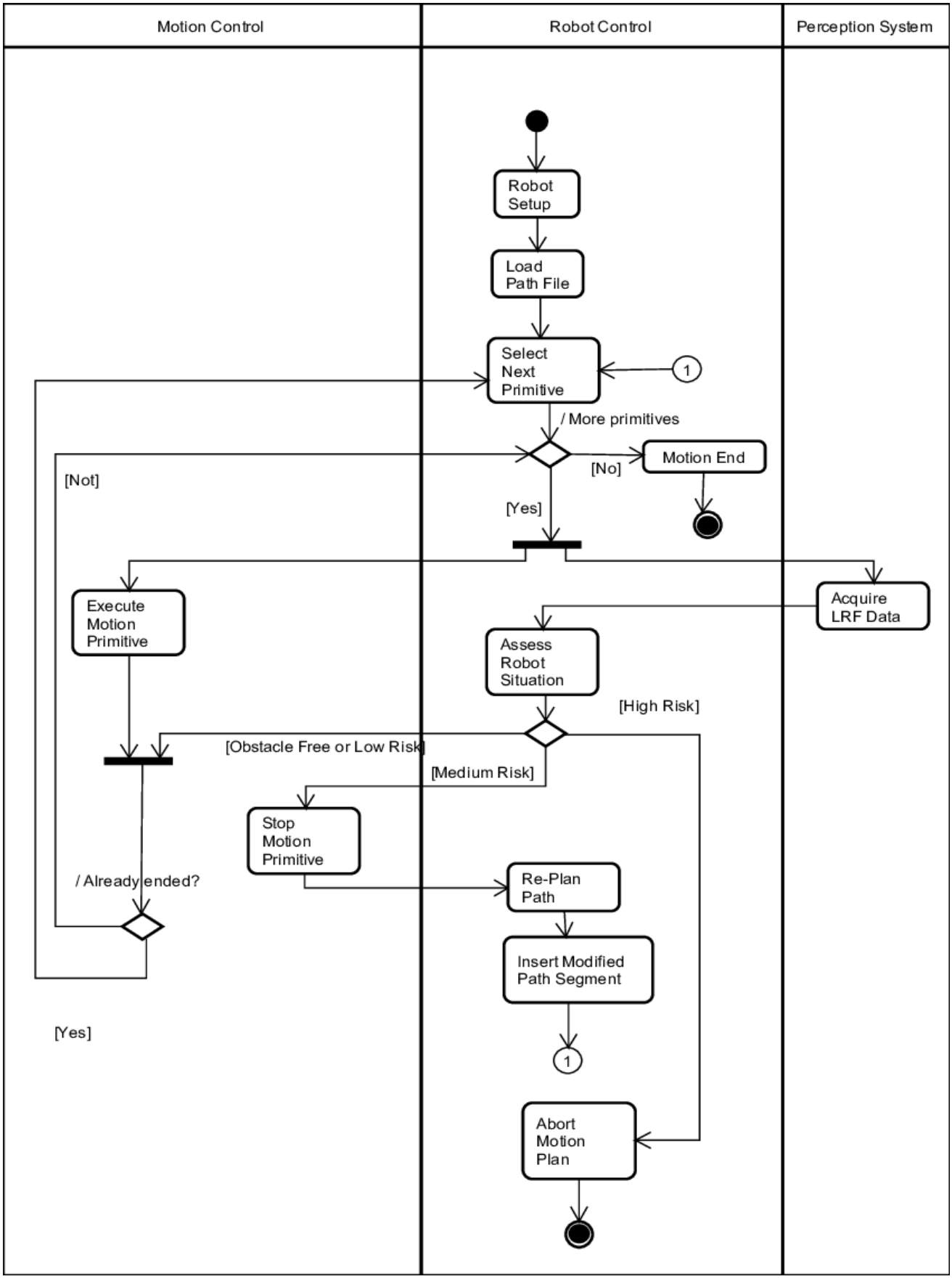

**Figure 5.7**

# CHAPTER 6

# SOFTWARE TEST DOCUMENT

# (STD)

## 6.1 Overview

This document is a high-level overview defining our testing strategy for Human Following Robot. Its objective is to communicate project-wide quality standards and procedures. It portrays a snapshot of the project as of the end of the planning phase. This document will address the different standards that will apply to the unit, integration and system testing of the specified application. This paradigm will include, but is not limited to, the testing criteria, methods, and test cases of the overall design. Throughout the testing process we will be applying the test documentation.

**Target Audience:**

The document is targeted towards the reviewing the team who will validate whether the system works as specified based on the test cases. Also the development team would remain conscious as to whether the said system meets all the specified requirements.

## 6.2 Introduction

### 6.2.1 System Overview

This System Test Document (STD) will provide a detailed description of the testing strategy for the Human Following Robot. This STD will allow for a complete understanding of what is to be expected of the system to be constructed. The clear understanding of the system and its functionality will allow for the correct software to be developed for the end user and will be used for the development of the future stages of the project. This document covers all the tests that are to be conducted to ensure that the said system meets its requirements, both functional and non-functional.

### 6.2.2 Test Approach

The objective of our testing plan is to find and report as many bugs as possible to improve the integrity of our project. Although exhaustive testing is not possible, we will exercise a broad range of tests to achieve our goal. Our user interface to utilize these functions is designed to be user-friendly. The system will only be used as a demonstration tool, but we would like to ensure that it could be run from a variety of platforms with little impact on performance or usability.

The following represents the overall flow of the testing process:

- Identify the requirements to be tested. All test cases shall be derived using the current Program Specification.
- Identify which particular test(s) will be used to test each module.
- Review the test data and test cases to ensure that the unit has been thoroughly verified and that the test data and test cases are adequate to verify proper operation of the unit.
- Identify the expected results for each test.
- Document the test case configuration, test data, and expected results.
- Perform the test(s).
- Document the test data, test cases, and test configuration used during the testing process. This information shall be submitted via the System Test Report (STR).
- Unsuccessful testing requires a Bug Report to be generated. This document shall describe the test case, the problem encountered, its possible cause, and the sequence of events that led to the problem.
- Test documents and reports shall be submitted. Any specifications to be reviewed, revised, or updated shall be handled immediately.

### 6.3 Test Plan

The diagram below outlines the Test Process approach that will be followed.

a. Organize Project involves creating a System Test Plan, Schedule & Test Approach, and assigning responsibilities.

b. **Design/Build System Test**

involves identifying Test Cycles, Test Cases, Entrance & Exit Criteria, Expected Results, etc. In general, test conditions/expected results will be identified by the Test Team in conjunction with the Development Team. The Test Team will then identify Test Cases and the Data required. The Test conditions are derived from the Program Specifications Document.

c. **Design/Build Test Procedures**

includes setting up procedures such as Error Management systems and Status reporting.

d. **Build Test Environment** includes requesting/building hardware, software and data set-ups.

e. **Execute System Tests –** The tests identified in the Design/Build Test Procedures will be executed. All results will be documented and Bug Report Forms filled out and given to the Development Team as necessary.

**Figure 6.1** Test Process Flow

### 6.3.3 Testing tools and environment

#### 6.3.3.1 Testing Team

**Test Planner / Controller – – kanchan pal, Km.Deepali**

1. Ensure Phase 1 is delivered to schedule and quality
2. Produce expected results
3. Co-ordinate review and signoff of test conditions

**Lead Tester – Km.Deepali, Shivani baghela**

- Identify test data
- Execute test conditions and mark-off results
- Prepare software error reports
- Ensure test systems outages/problems are reported immediately and followed up.

**Hardware requirements**

- Arduino Uno
- Arduino Motor Driver shield
- Jumper wires

- 4 BO motors
- Hook up wires
- 9V battery
- 4 wheel
- Chassis
- Ultrasonic sensor
- 2 IR Sensor
- on-off switch
- servo motor
- Ultrasonic sensor holder

**Software requirements**

- 1. simulator
- 2. Arduino

# II. METHODOLOGY

A human following robot has two building stages: hardware and software. Hardware First, we have to build a frame or chassis as per the requirement now arrange the component in chassis as per the circuit diagram. Now connect trigger pin to A2 number pin in Arduino, now connect Echo pin to A1 of the Arduino. Likewise left IR sensor is connected to the A3 pin of the Adriano board, the servo motor is connected to PIN10 of Arduino. Likewise, the motor driver(L293D) has 16 pins, first, 1,8,9 and 16 pins of the motor driver are connected to +5 volt pin and 4,5,10 and 11 pins of the motor driver are connected to the ground pin. Similarly, PIN 2 of the motor driver is connected to the PIN 4 of Arduino, and PIN 7 of Arduino is connected to PIN 10 of the motor driver, and now PIN 8 of Arduino is connected to the PIN 15 of the motor driver pin . Likewise in motor, motor1 is connected to the 1 and 2 pins of the motor drive shield. And now, similarly motor2 is connected to 3 and 4 pins of the motor driver shield , and now motor3 connects to 5 and 6 pins of the motor driver. And last one motor4 connect to 7 and 8 of the motor driver pins.

Software- To make the hardware parts work or run, it should be programmed through the required software like Arduino IDE . Since the microcontroller at first will not be having any program, if we also build up the hard ware it will not have the capability to work or run due to lack of instructions which is provided by a program. therefore we need a software to upload the program on any microcontroller. To implement the task all three section are taking and giving information. Sensor module parts it sense data and provide it to the microcontroller chip. Microcontroller part software take all data from the all sensor and saving to the corrected path. According to the data input the microcontroller parts giving the necessary input for the motor control section to guiding and run the motor for working. Since we are using Arduino microcontroller we have to use Arduino IDE software to write and upload program in microcontroller

## III. MODELING AND ANALYSIS

### Components :

The human following robot has the following main components are:

1. Arduino Uno
2. L293D Motor driver
3. Infrared Sensors
4. Ultrasonic Sensor
5. Servo Motor
6. Four DC Geared Motors
7. Four wheels
8. Robot Chassis

9. Jumper wires
10. 18650 batteries
11. Switch
12. Tools Needed

## Tools Needed

Some tools names are given below:

1. Soldering Iron
2. Glue gun
3. Cutter
4. Knife 5
5. Screwdriver
6. Tweezer
7. Wire Strippers
8. Needle nose Pliers

# III. RESULTS

We have successfully made the human following robot which is used to follow objects as well as humans. This robot uses ultrasonic range sensors and Infrared sensors. The test was performed on the both ultrasonic sensor and infrared sensor that the sensor was working accurately within the range of 10 cm. An ultrasonic sensor is used to move the robot forward and backward. Infrared sensors are used to move the robot in the left or right direction accordingly. Then we test the serial communication of Arduino, motor shield, and various motors .

This robot took a lot of time to complete this project. We were faced lots of problems regarding the program code, as there was huge numbers of error in the code which was further rectified it and lastly it works. Motors drivers connections got interchanged which was rectified and our robot works perfectly fine. Finally, after the lots of effort and time our objective was achieved which was to implement a good Human-Robot interaction.

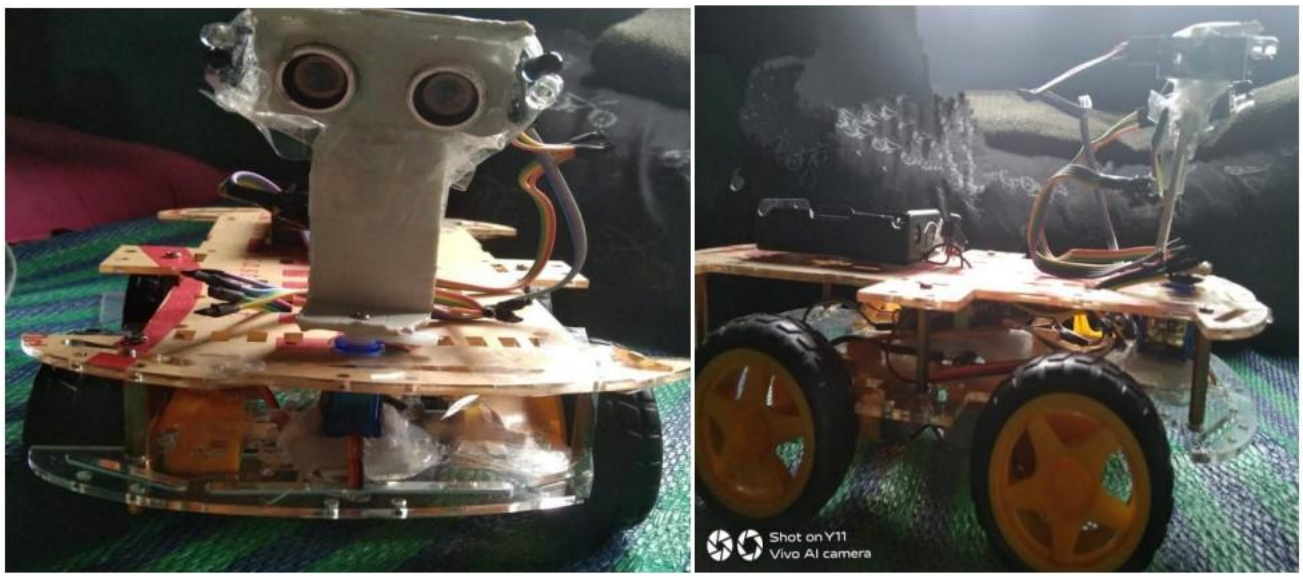


Fig-5.6

# IV. CONCLUSION

In the world the robotics generation is coming. In this Object Following Robot, we can add a GSM module that will give us the location of the robot, or we can add wireless remote controls to our robot to work as a remote controller or to work as an automatic object following the robot. My project can be used in many areas like hospitals for more accuracy and fast work in any emergency cases , in shopping malls to carry items , we can attach various sensors and cameras to get more features. This project challenged the group to co-operate, communicate, and expand

understanding of electronics, mechanical systems, and integration with programming . In this way, we completed this project by believe that our project will be helpful in future and it will help human to do any kind of works & hence my purpose will be successful.

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