A

Project Report

On

HUMAN FOLLOWING ROBOT USING ARDUINO

Submitted to

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNLOGIES,KADAPA

in partial fulfilment of the requirements for the award of he Degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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(RGUKT KADAPA is approved by UGC,AICTE, established in 2008,provide Education opportunities for the rural people).
Vempalli,Kadapa-516330,

2019-2023

CERTIFICATE

This is to certify that the project report entitled “HUMAN FOLLOWING ROBOT USING ARDUINO” a bonafide record of the project work done and submitted by

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GUIDE Head of the Department

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INTERNAL EXAMINER EXTERNAL EXAMINER

DECLARATION

We hereby declare that the project report entitled “HUMAN FOLLOWING ROBOT USING ARDUINO” submitted to the Department of ELECTRONICS AND COMMUNICATION ENGINEERING in partial fulfillment of requirements for the award of the degree of BACHELOR OF TECHNOLOGY. This project is the result of our own effort and tha it has not been submitted to any other University or Institution for the award of any degree or diploma other than specified above

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ACKNOWLEDGEMENT

We are thankful to our guide **Prof.N.Mohan Raju** for his valuable guidance and encouragement. His helping attitude and suggestions have helped us in the successful completion of the project.

We would like to express our gratefulness and sincere thanks to **Prof. B.Madhan Mohan**, Head of the Department of ELECTRONICS AND COMMUNICATION ENGINEERING, for his kind help and encouragement during the course of our study and in the successful completion of the project work.

We have great pleasure in expressing our hearty thanks to our beloved Director **Prof.K.Sandhya Rani** for spending his valuable time with us to complete this project.

Successful completion of any project cannot be done without proper support and encouragement. We sincerely thanks to the **Management** for providing all the necessary facilities during the course of study.

We would like to thank our parents and friends, who have the greatest contributions in all our achievements, for the great care and blessings in making us successful in all our endeavors.

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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.

A human-following robot requires several techniques such as human's target detection, robot control algorithm and obstacles avoidance.
Keywords: Arduino, DC gear motor, Infrared sensor, Microcontroller, Ultrasonic sensor, Robot.

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CHAPTER 1

INTRODUCTION

1.1 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 timewhich 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,strecture 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 ime.

The human following robot can use in the defense 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 camara , tracking device and make it

more beautiful and workable . This robot will be more trend in our future.

1.2 WORKING PRINCIPLE

This project working in two modes. First is automatic &second is manually, there is switch is given to operate those two modes. In our project we used 12V charge & discharge battery for the DC motors, and also used 5V power supply for the IC's.When switch is in automatic mode then at that timeandroid camerawill works, In this project we uses android camera which sense the image at 8MP and capture the image as per 35 frames per second. Initially when image will captured on that image the image recognition & image segmentation operation of image processing will be performed. Due to segmentation, android device will take decision as per the command given in the code and send to the AVR AT mega 32 microcontrollers, through HC-05 Bluetooth module. The AVR microcontroller will perform the operation on the receivedcommandfrom android device. The DC motor driver IC-L293D is connected to port C of AVR microcontroller, which drives the DC motor as per command and controls the wheels of robot.When switch is in manual mode then at that time, ultrasonic sensors will works. We used HC-SR04 three ultrasonic sensors, which transmit & receive signals by emitting sound waves. By using distance calculation sensors will follow the person, these sensors connected to the right, left & front side of the robot. Also robot follows the person at particular [15-30cm] distance. If the distance between person and robot is below 15cm, it will detect as a obstacle and the robot will stop.

1.3 BASIC CIRCUIT DIAGRAM

An overview of the required circuit for Human following Robot is shown here.

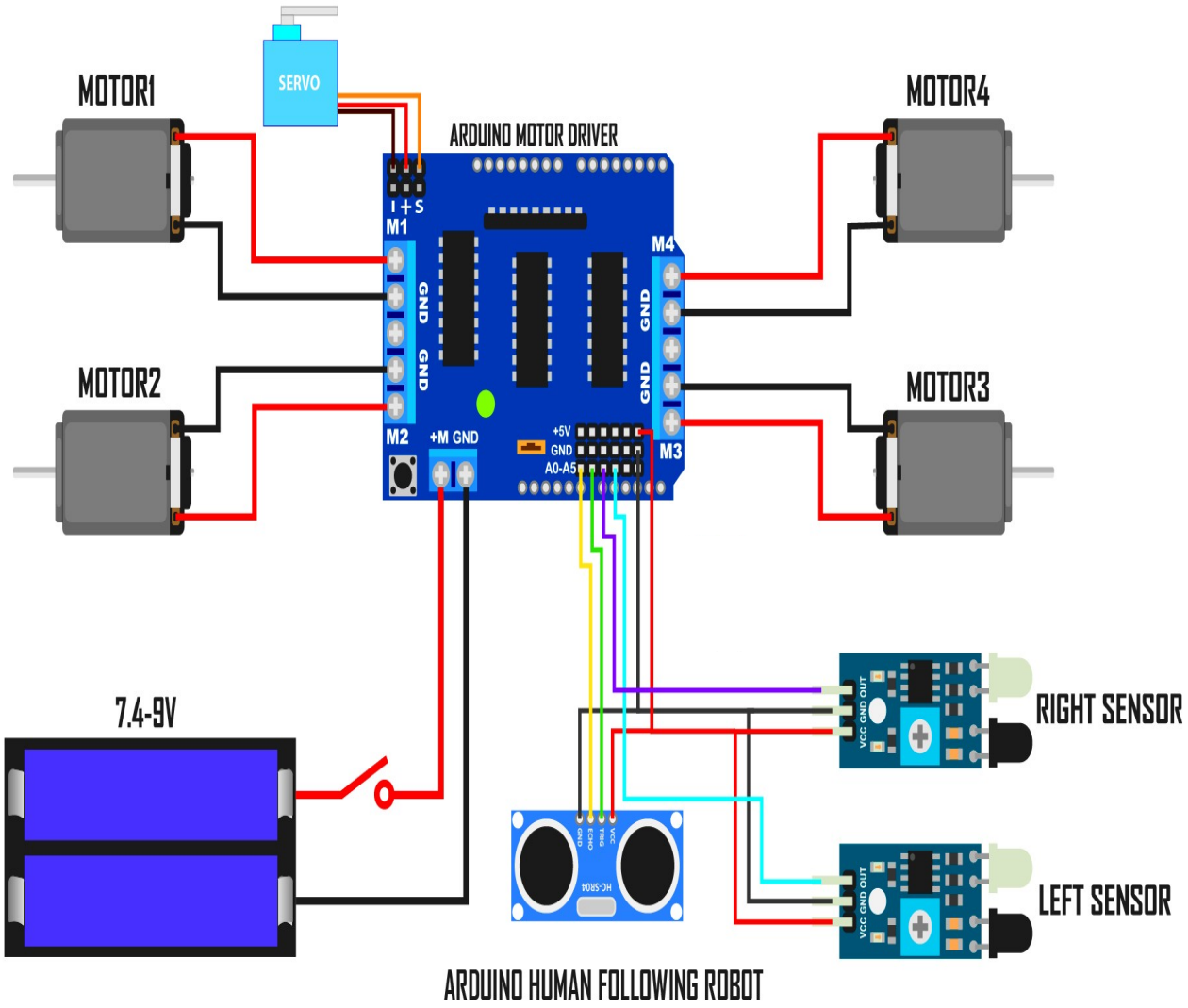


fig 1.3.1 Arduino Human Following Robot

1.4 Flowchart

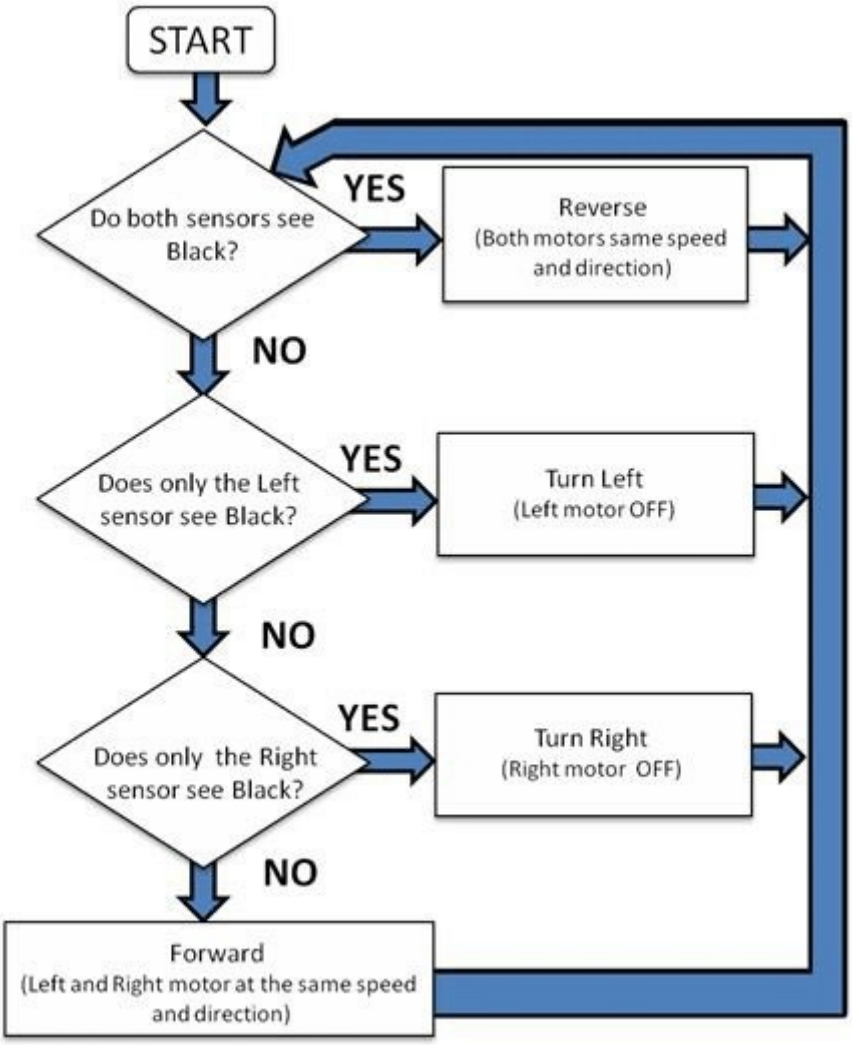


fig 1.4.1 Flowchart of Human Following Robot

CHAPTER 2
METHODOLOGY

2.1 Hardware:

First, we have to build a frame or chassis as per the requirement now arrange the component in chasis 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 arduino board, the servo motor is connected to PIN10 ofArduino. Likewise, the motor driver(L293D) has 16 pins, first, 1,8,9 and 16 pins of the motor driverare 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 shild. And now, similarly motor2 is connected to 3 and 4 pins of the motor driver shild , 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.

2.2 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.there fore 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

CHAPTER 3
HARDWARE MODEL AND REQUIREMENTS

3.1 BLOCK DIAGRAM OF HUMAN FOLLOWING ROBOT

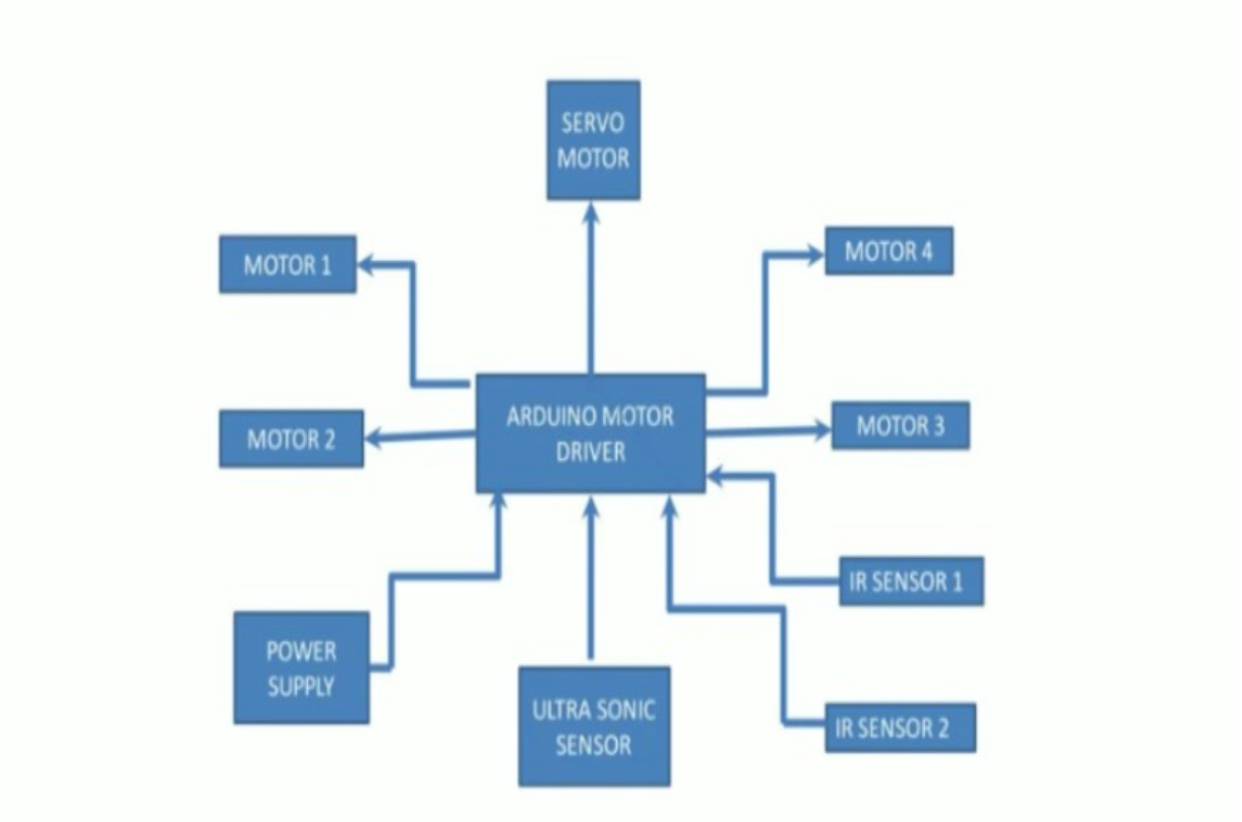


fig 3.1.1 Block Diagram of Human Following Robot

3.1.1 EXPLANATION OF THE BLOCK DIAGRAM:

Here firstly, we chose a configuration to develop a Human follower only using two infrared sensors with connection of Arduino Uno through motor driver IC. We followed a block diagram on the regard.The block diagram illustrates the connection for the development of the Human follower which follows a black line on white surface.

After that, we have used the following block diagram for connecting two sensors with our Human follower for obstacle detection purpose for our Human follower.

Our system consists of a four wheel robotic vehicle mounted with a separate microprocessor and control unit along with different sensors and modules i.e. ultrasonic sensor, infrared sensors which helps them to move with respect to people and objects in their surroundings. The above sensors work in unison with each other and helps the robot in its operation and to

navigate its path by avoiding the obstacles and maintaining a specific distance from the object. We used ultrasonic sensor for obstacle avoidance and to maintain a specific distance for the object. The ultrasonic sensor works accurately works accurately within a range of 4 meters.

3.2 REQUIRED COMPONENTS

3.2.1 ARDUINO UNO

The **Arduino Uno** is a microcontroller board based on the ATmega328. Arduino is an open-source, prototyping platform and its simplicity makes it ideal for hobbyists to use as well as professionals. The Arduino Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Arduino Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 microcontroller chip programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Arduino Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

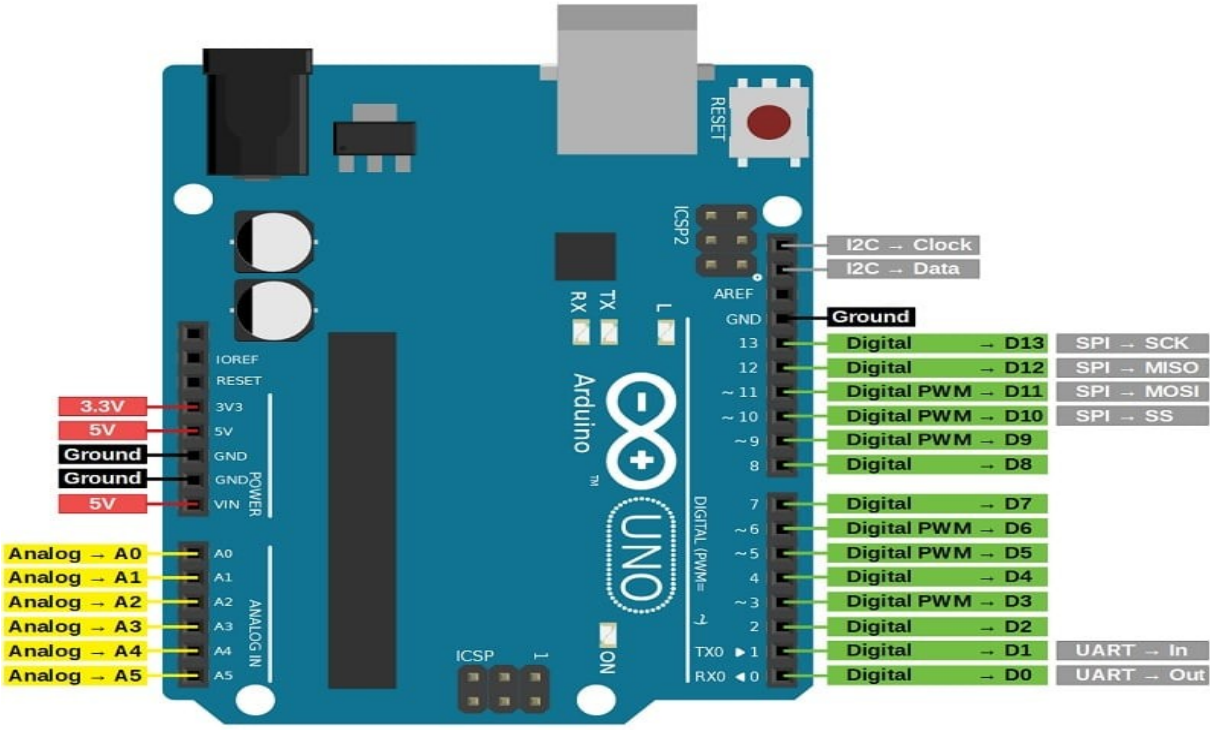


fig:3.2.1.1 Arduino uno

Pin layout of ATmega328p is showed below:

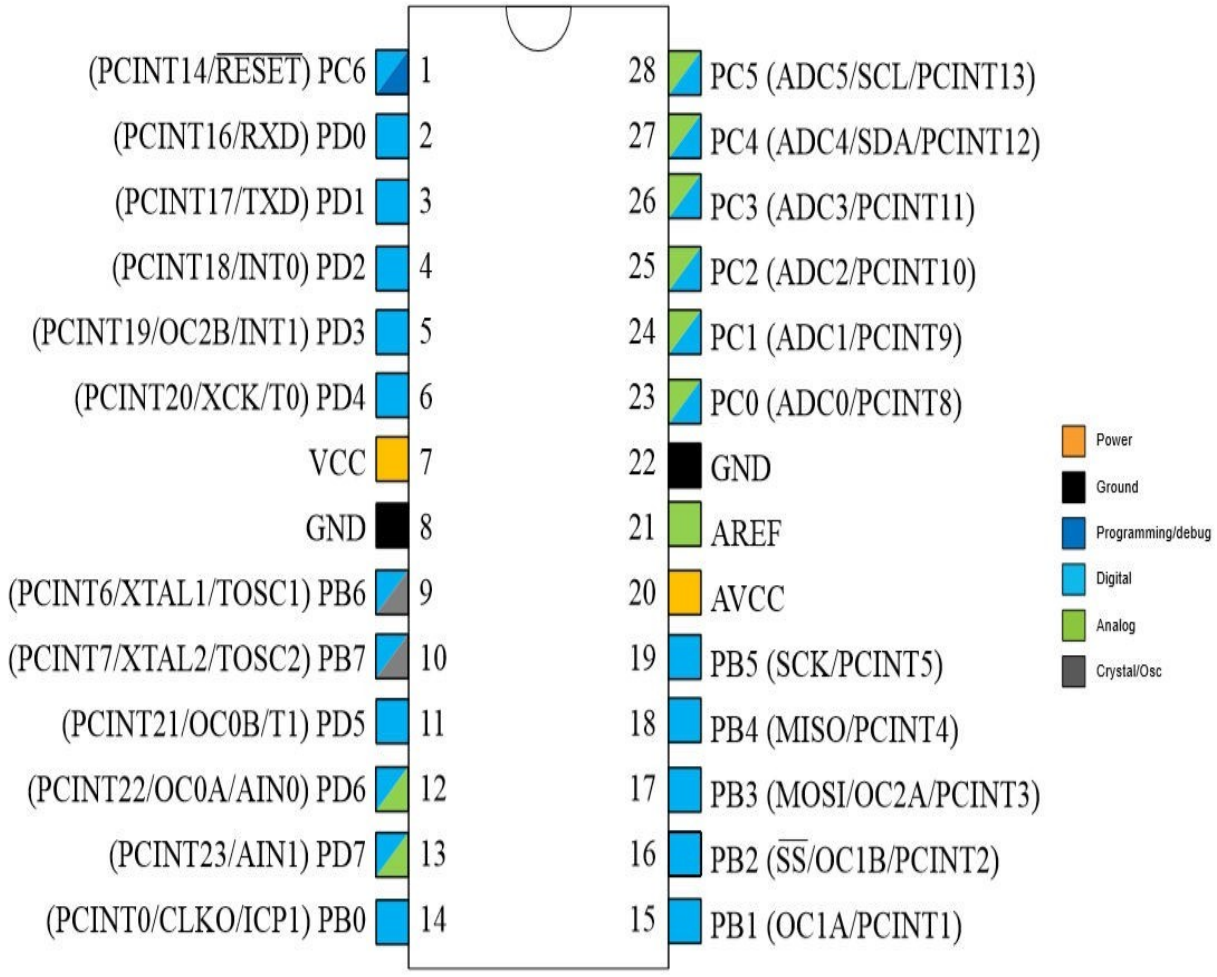


fig:3.2.1.2 Pin layout

FEATURES OF ARDUINO UNO

Microcontroller: ATMEGA 328P

The Atmel pico power is a low power CMOS 8-bit microcontroller based on the AVR architecture.

FEATURES:

High Performance, Low Power Atmel AVR 8-Bit Microcontroller Family

- Advanced RISC Architecture

131 Powerful Instructions

Most Single Clock Cycle Execution

32 x 8 General Purpose Working Registers

Fully Static Operation

Up to 20 MIPS Throughput at 20MHz

On-chip 2-cycle Multiplier

- High Endurance Non-volatile Memory Segments

32KBytes of In-System Self-Programmable Flash program Memory

1KBytes EEPROM

2KBytes Internal SRAM

Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

Data Retention: 20 years at 85°C/100 years at 25°C(1)

Optional Boot Code Section with Independent Lock Bits

- In-System Programming by On-chip Boot Program
- True Read-While-Write Operation

DC Current for 3.3V Pin: 50 mA

Flash Memory: 32 KB of which 0.5 KB used by bootloader SRAM: 2 KB

Clock Speed: 16 Mhz

ADC CONCEPT IN ARDUINO UNO

Arduino uno board has 6 ADC input ports. Among those any one or all of them can be used as inputs for analog voltage. The **Arduino Uno ADC** is of 10 bit resolution (so the integer values from (0-(2^10) 1023)). This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. So, for every (5/1024= 4.9mV) per unit.

The UNO ADC channels have a default reference value of 5V. This means we can give a maximum input voltage of 5V for ADC conversion at any input channel. Since some sensors provide voltages from 0-2.5V, with a 5V reference we get lesser accuracy, so we have a instruction that enables us to change this reference value. So for changing the reference value we have ("analogReference();").

As default we get the maximum board ADC resolution which is 10bits, this resolution can be changed by using instruction ("analogReadResolution(bits);").

Arduino UNO is neither a microprocessor nor a microcontroller. It is actually a development board that uses a microcontroller called Atmega328p to perform various functions. You can say, atmega328p is the brain of the Arduino UNO development board.

Microcontroller VS Development board

Microcontroller:A microcontroller is made up of a Microprocessor and other units required to perform certain functions like Memory units, Inputs/Outputs, ADCs, etc. That's why a Microcontroller can execute commands by itself. But it's not easy to program a Microcontroller directly due to the absence of a USB port, GPIO header, etc., and hence it is not recommended to beginners.

Development board:A development board makes it easy to connect the external peripherals to the Microcontroller. It is easy to program and createprojects using a development board like the ArduinoUNO.

3.2.2 L293D Motor Drive Shield:

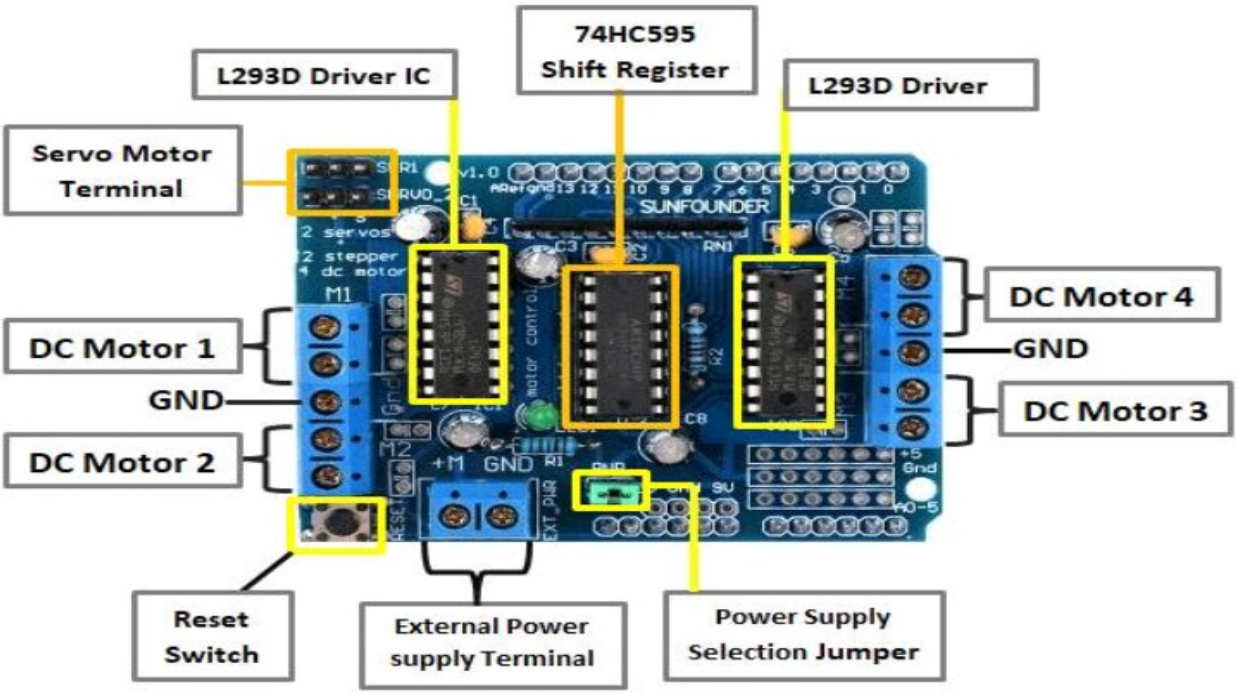


fig:3.2.2.1 L293D Motor Drive Shield

The Motor Shield is a driver module for motors that allows you to use Arduino to control the working speed and

direction of the motor. . The Motor Shield can either be powered by Arduino directly or by an external 6V~15V power

supply via the terminal input. Here Motor Driver Board is designed to Work with L293D IC.

L293d motor driver IC

The L293D is a dual-channel H-Bridge motor driver. A single IC is able to control two DC motors or one stepper motor. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. and Peak Output Current 1.2 A Per Channel. This IC has two enable inputs, these are provided to enable or disable the device independently of the input signals. The motor driver shield has two L293D motor driver IC. So, the L293d shield able to control four DC motors or one stepper motor.

74HC595 shift register IC

The 74HC595 is a shift resistor IC. This IC has an 8-bit shift register and an 8-bit D-type latch with three state parallel outputs. This shift register can accept serial data and provides a serial output. Also, it can provide parallel data to the 8-bit latch. The shift register and latch have independent clock inputs.

The shield has a 74HC595 shift register that extends Arduino 4 digital pins to the 8 direction control pins of two L293D chips.

Reset Switch

The RESET is nothing but the Arduino reset button. This switch works same as the Arduino reset and it is used to reset the Arduino board. It just brought up top for easy to use purpose.

Power LED

The on-board Power LED indicates the motor's power supply. If the power supply is on the LED is turned on, the motor will work well. If the LED will not ON, it means the power supply is OFF. So, the motors will not be working.

Resistor Array

The shield comes with a pulldown resistor array, that keeps motors switched off during power-up.

External Power Supply

The shield has a 2-pin terminal block for External Power Supply. It used to DC power supply for motors.

It also can be used to the power supply to the Arduino board, it possible by the "Power Supply Selection Jumper".

Power Supply Selection Jumper

•Single DC power supply for both Arduino and motors

If you want to provide a single DC power supply for both Arduino and motors. So, Place the power jumper on the motor shield. Now you can simply connect the power supply to the DC jack on the Arduino or the 2-pin External Power Supply terminal block on the shield. But, this method only used when the motor supply voltage is less than 12V.

•Arduino powered through USB and motors through an External Power Supply pin

If you want to powered the Arduino board through the USB and the motors powered through the DC power supply. At first, plug in the USB cable, then connect the motor supply to the external Power. Now you can turn on the power supply one by one (first the Arduino power supply then the motor power supply). In this condition do not place the jumper on the shield.

•Two separate DC power supplies for the Arduino and motors

If you want to use two separate power supplies for the Arduino boards and motors. So, at first, you need to connect the power supply to the DC jack on the Arduino, Then connect the motor power supply to the 2-pin External Power Supply terminal block on the shield. Make sure the jumper is removed from the motor shield.

L293D Motor Driver Shield PinOut:

•PinOut for DC motors

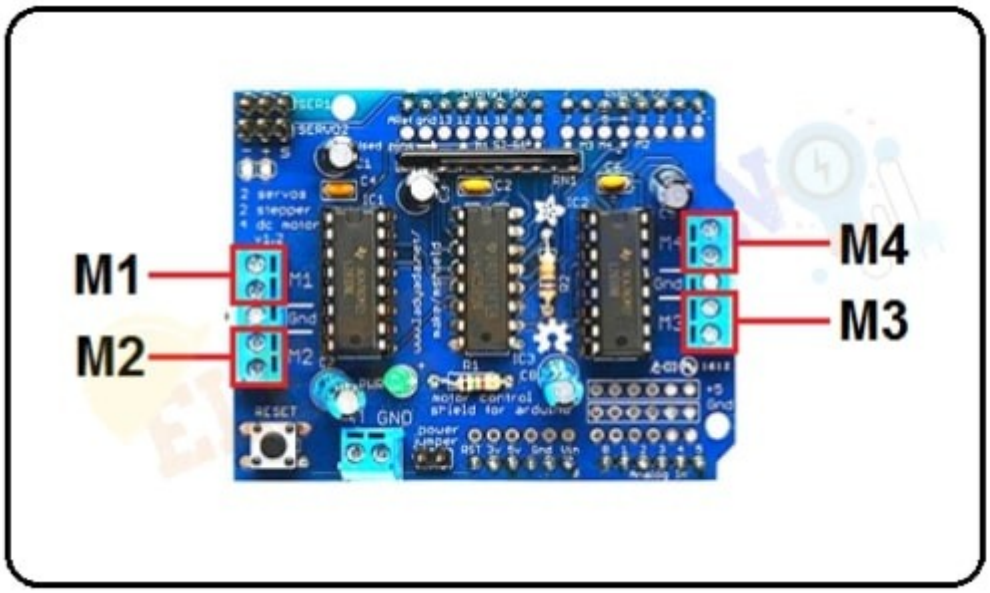


fig:3.2.2.2 pinout for DC Motors

PinOut for Stepper motors

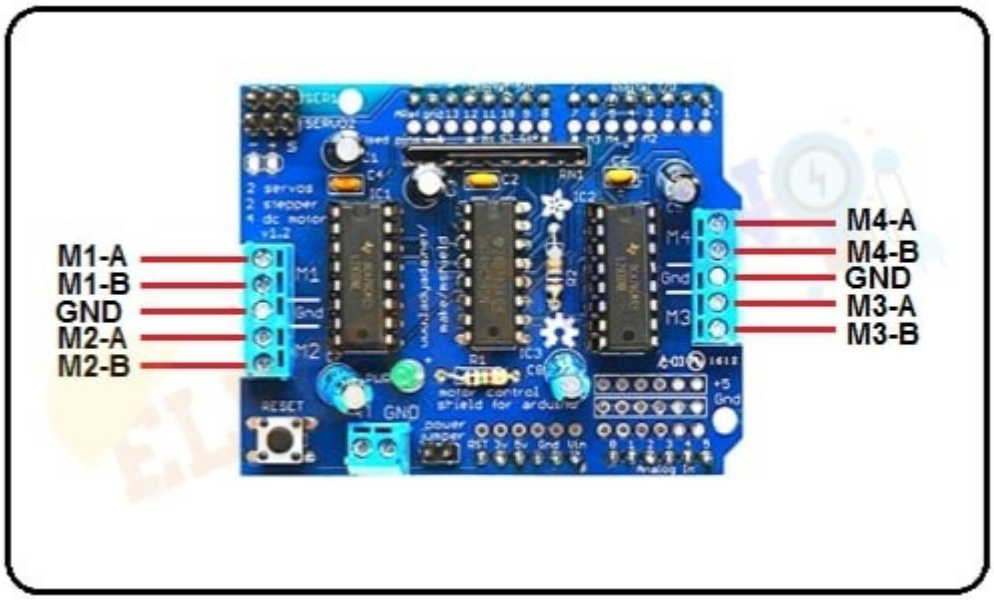


fig:3.2.2.3 pinout for stepper Motors

SL. NO	Pin Name	Description
1	**M1-A, M1-B, GND, M2-A, M2-B**	Output for**Stepper Motor 1**, connect stepper motors (unipolar or bipolar) with single coil, double coil, or interleaved stepping
2	**M3-A, M3-B, GND, M4-A, M4-B**	Output for**Stepper Motor 2**, connect stepper motors (unipolar or bipolar) with single coil, double coil, or interleaved stepping

•PinOut for Servo motor

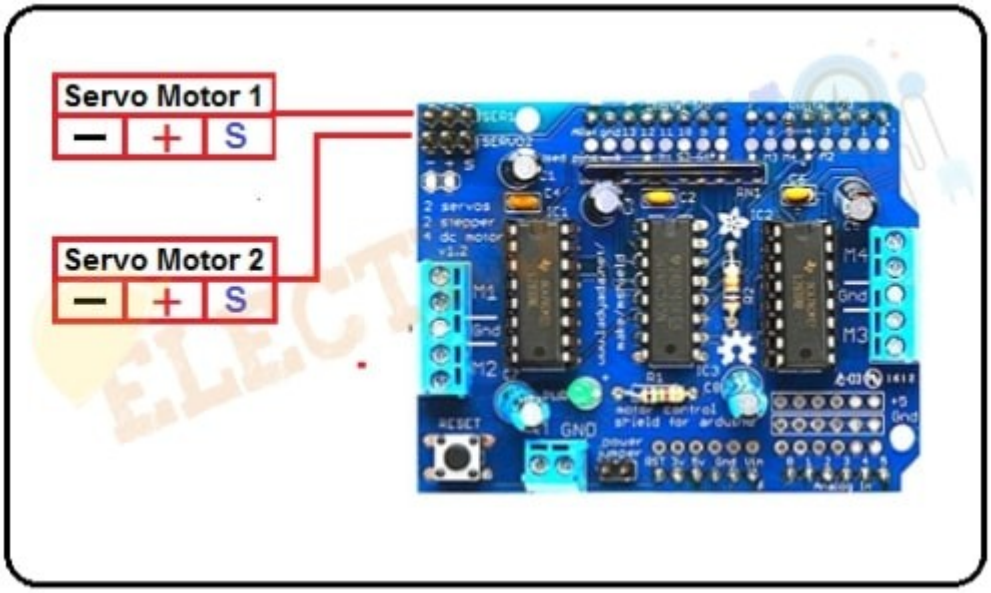


fig:3.2.2.4 pinout for servo motor

SL. NO	Pin Name	Description
1	**Servo 1 Pin (-, +,s)**	Output for **Servo motor 1,**Connect the servo motor pin **GND, VCC, SIGNAL**respectively
2	**Servo 2 Pin (-, +,s)**	Output for**Servo motor 2,**Connect the servo motor pin**GND, VCC, SIGNAL**respectively

Note: Digital pins**D2, D13**and analog pins**A0-A5**are not used by the shield. It can be used to connect other sensors or circuits.

Motor Driver Shield Features

•2 connections for 5V ‘hobby’ servos connected to the Arduino’s high-resolution dedicated timer

•4 H-Bridges: L293D chipset provides 0.6A per bridge (1.2A peak) with thermal shutdown protection, internal kickback protection diodes. Can run motors on 4.5VDC to 25VDC.

•Up to 4 bi-directional DC motors with individual 8-bit speed selection (so, about 0.5% resolution)

•Up to 2 stepper motors (unipolar or bipolar) with single coil, double coil, or interleaved stepping.

•Pull-down resistors keep motors disabled during power-up

•Big terminal block connectors to easily hook up wires (18-26AWG) and power

•Arduino reset button brought up top

•2-pin terminal block and jumper to connect external power, for separate logic/motor supplies

•Tested compatible with Arduino Mega 1280 & 2560, Diecimila, Duemilanove, and UNO

Applications

•DC motors Control.

•Stepping motors Control.

•Servo Motor Control.

•In many Robotics projects.

•CNC projects.

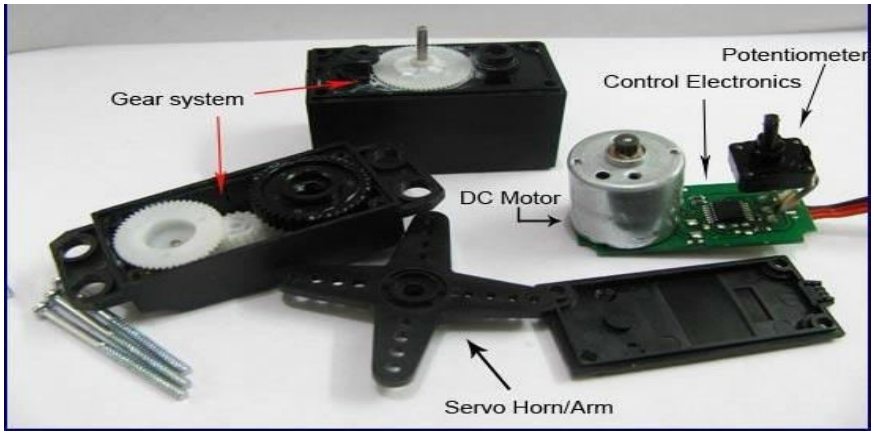
3.2.3 Servo Motor:

A DC servo motor consists of a small DC motor, feedback potentiometer, gearbox, motor drive electronic circuit and electronic feedback control loop. It is more or less similar to the normal DC motor.

The stator of the motor consists of a cylindrical frame and the magnet is attached to the inside of the frame.

A brush is built with an armature coil that supplies the current to the commutator. At the back of the shaft, a detector is built into the rotor in order to detect the rotation speed.

With this construction, it is simple to design a controller using simple circuitry because the torque is proportional to the amount of current flow through the armature.



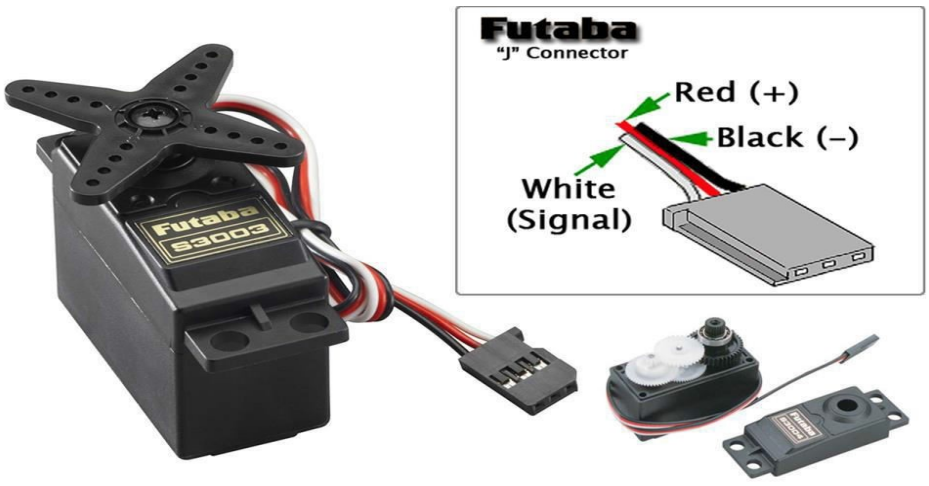


Fig.3.2.3.1 Servo Motors

A **servo motor** is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a

simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the DC servo motor working.Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, 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 motors 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.

Servo Motor Working Mechanism

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed-loop system where it uses a positive feedback system to control motion and the final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.Here reference input signal is compared to the reference output signal and the third signal is produced by the feedback system. And this third signal acts as an input signal to the control the device. This signal is present as long as the feedback signal is generated or there is a difference between the reference input signal and reference output signal. So the main task of servomechanism is to maintain the output of a system at the desired value at presence of noises .

Servo Motor Working Principle

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly, and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase torque of the motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from the potentiometer and another comes from other sources, will be processed in a feedback mechanism and output will be provided in terms of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with the potentiometer and as the motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

InterfacingServoMotors with Microcontroller:

Interfacing hobby Servo motors like s90 servo motor with MCU is very easy. Servos have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU. An MG995 Metal Gear Servo Motor which is most commonly used for RC cars humanoid bots etc. The picture of MG995 is shown below:

The color coding of your servo motor might differ hence check for your respective datasheet.All servo motors work directly with your +5V supply rails but we have to be careful on the amount of current the motor would consume if you are planning to use more than two servo motors a proper servo shield should be designed.

Controlling Servo Motor:

All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.

Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

Servo motor works on PWM (Pulse width modulation) principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less. The potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on the required angle.

Servo motor can be rotated from 0 to 180 degrees, but it can go up to 210 degrees, depending on the manufacturing. This degree of rotation can be controlled by applying the Electrical Pulse of proper width, to its Control pin. Servo checks the pulse in every 20 milliseconds. The pulse of 1 ms (1 millisecond) width can rotate the servo to 0 degrees, 1.5ms can rotate to 90 degrees (neutral position) and 2 ms pulse can rotate it to 180 degree.

All servo motors work directly with your +5V supply rails but we have to be careful about the amount of current the motor would consume if you are planning to use more than two servo motors a proper servo shield should be designed.

Servo Motor – Working, Advantages & Disadvantages

Servo implies an error sensing feedback control which is utilized to correct the performance of a system. It also requires a generally sophisticated controller, often a dedicated module designed particularly for use with servomotors. Servo motors are DC motors that allow for precise control of the angular position. They are DC motors whose speed is slowly lowered by the gears. The servo motors usually have a revolution cut off from 90° to 180°. A few servo motors also have a revolution cutoff of 360° or more. But servo motors do not rotate constantly. Their rotation is limited between the fixed angles.

Working of a Servo Motor:

Servo Motor consists of a DC Motor, a Gear system, a position sensor, and a control circuit.The DC motors get powered from a battery and run at high speed and low torque. The Gear and shaft assembly connected to the DC motors lower this speed into sufficient speed and higher torque. The position sensor senses the position of the shaft from its definite position and feeds the information to the control circuit. The control circuit accordingly decodes the signals from the position sensor and compares the actual position of the motors with the desired position and accordingly controls the direction of rotation of the DC motor to get the required position. Servo Motor generally requires a DC supply of 4.8V to 6 V.

3.2.4. TT GEAR MOTOR

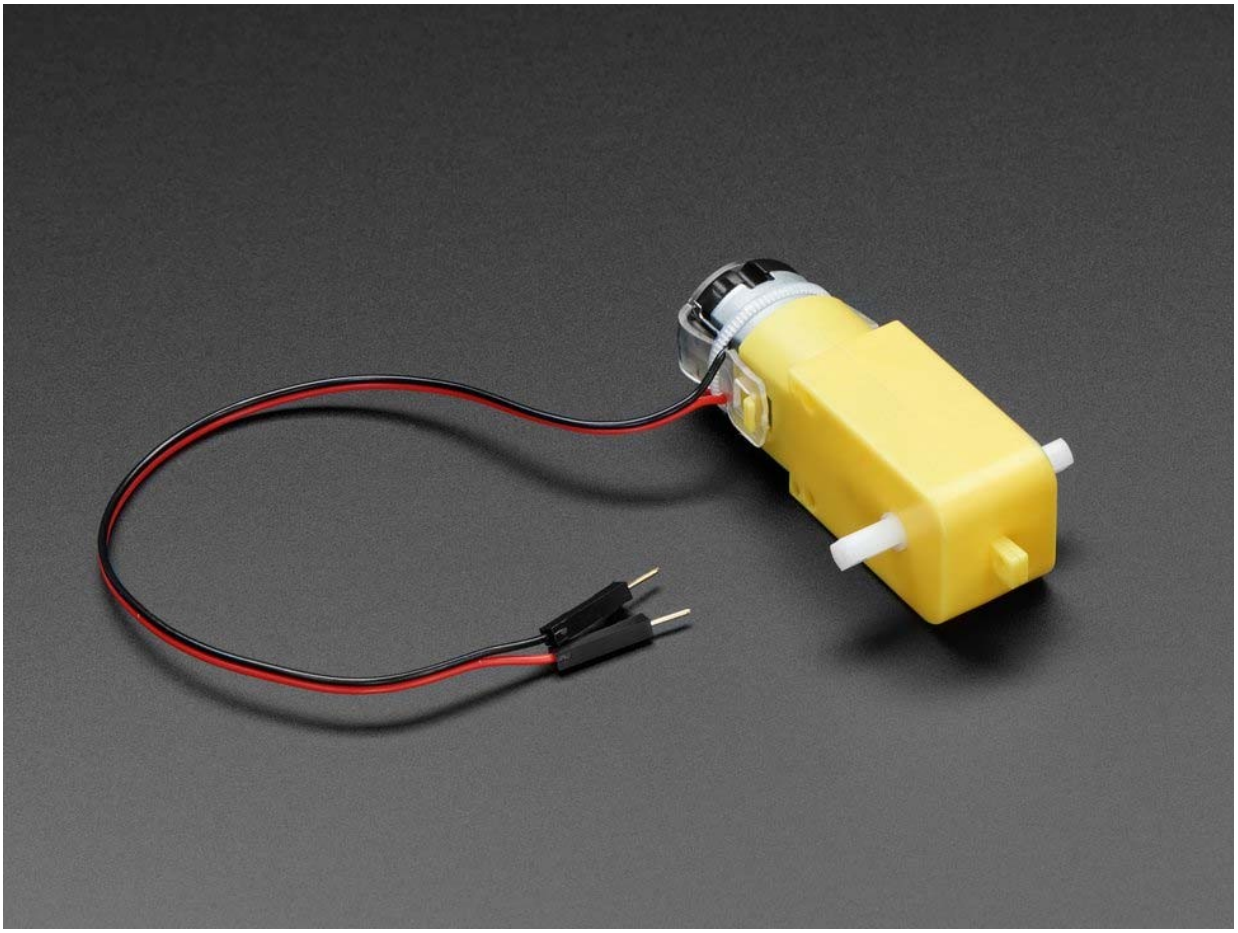


fig:3.2.4.1 TT Gear Motor

Perhaps you've been assembling a new robot friend, adding a computer for a brain and other fun personality touches. Now the time has come to let it leave the nest and fly on its own wings– err, wheels!

These durable (but affordable!) plastic gearbox motors (also known as 'TT' motors) are an easy, low-cost way to get your projects moving. This is a TT DC Gearbox Motor with a gear ratio of 1:48, and it comes with 2 x 200mm wires with breadboard-friendly 0.1" male connectors. Perfect for plugging into a breadboard or terminal blocks.

You can power these motors with 3VDC up to 6VDC, they'll of course go a little faster at the higher voltages. We grabbed one motor and found these stats when running it from a bench-top supply.

At 3VDC we measured 150mA @ 120 RPM no-load, and 1.1 Amps when

stalled

At 4.5VDC we measured 155mA @ 185 RPM no-load, and 1.2 Amps when

stalled

At 6VDC we measured 160mA @ 250 RPM no-load, and 1.5 Amps when

stalled

Note that these are very basic motors, and have no built-in encoders, speed control or positional feedback. Voltage goes in, rotation goes out! There will bevariation from motor to motor, so a separate feedback system is required if you need precision movement.

Comes 1 x per order, with just the motor + wires. You cannot drive these directly from a microcontroller, a high-current motor driver is required! We recommend our DRV8833 motor driver for these motors, as it works well down to 3V and can be set up with current limiting since the stall current on these can get high. The TB6612 can also be used, it's on our shields and wings, but you'll

need to supply at least 4.5V - which is what you'll likely want to run these motors at anyhow! We have a range of wheels, add-ons and accessories for these motors so you can bling out your bot just the way you like.

TECHNICAL DETAILS

Rated Voltage: 3~6V

Continuous No-Load Current: 150mA +/- 10%

Min. Operating Speed (3V): 90+/- 10% RPM

Min. Operating Speed (6V): 200+/- 10% RPM

Torque: 0.15Nm ~0.60Nm

Stall Torque (6V): 0.8kg.cm

Gear Ratio: 1:48

Body Dimensions: 70 x 22 x 18mm

Wires Length: 200mm & 28 AWG

Weight: 30.6g

Product Weight: 30.6g / 1.1oz

3.2.5 IR SENSOR

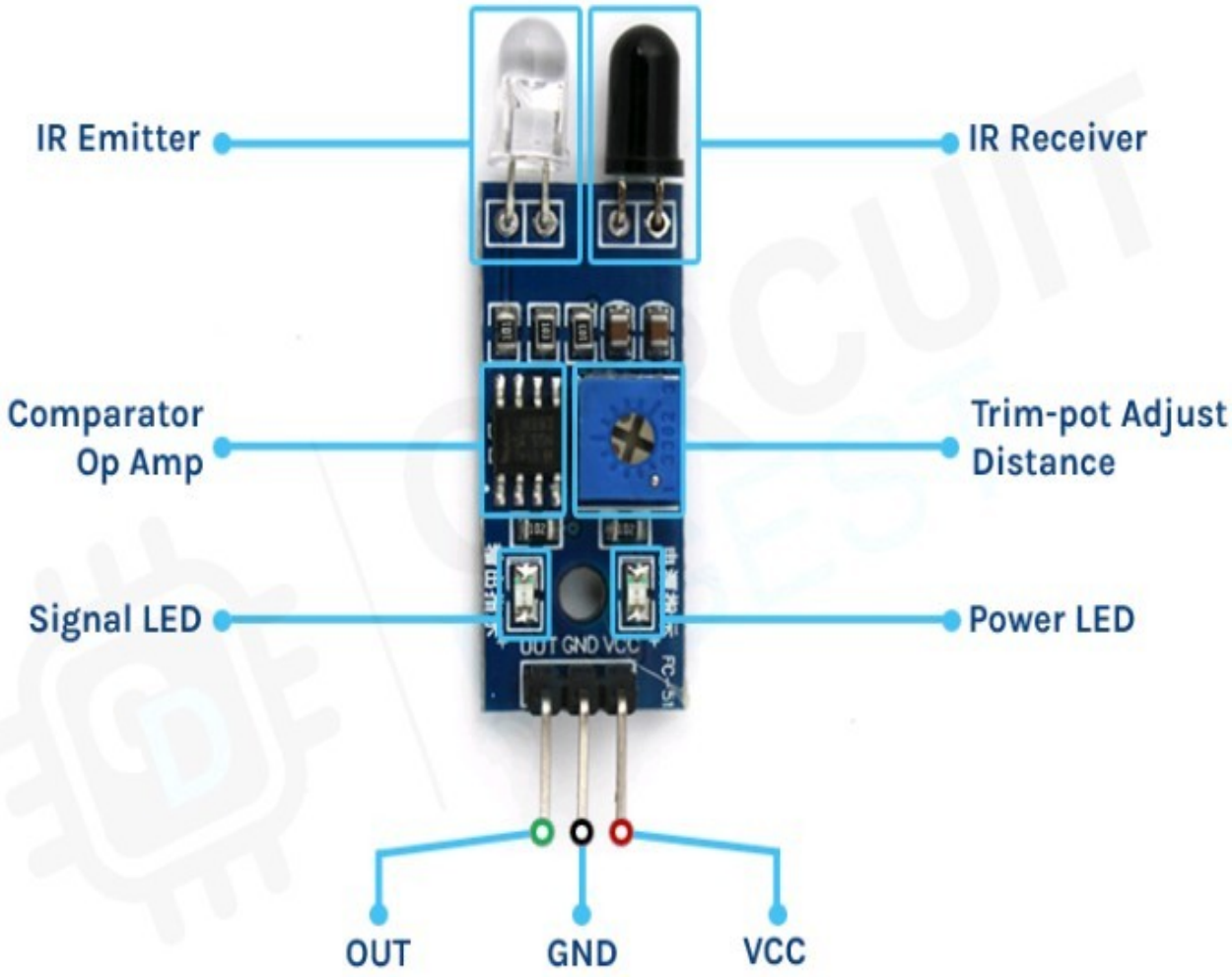


fig3.2.5.1 IR Sensor

Infrared Ray Sensors are used to find out the position of a human follower with respect to the robot position. For human sensing operation, IR sensors are the one which are widely used for the development of a human follower robot. There are some basic things to follow where white surface of the black line reflects light and the black line receives it after the transmission. Two resistors R1 and R2 are used which limits current. Other resistors (R3,R5,R6,R8) forms individual voltage divider networks which is in connection with the designed LDR's.When the sensor is properly classified, both LED/LDR pairs will run over the white surface.

The line sensors are made using LDR and LED for making a hunam follower robot. A 1K resistor across the LED, a series connection of 10K resistor and 10K variable with the LDR are major resistive and sensor connections. These sensors are soldered in a board (Chassis) and then we use that for our system. It is powered by (4*1.5)V battery.

In this condition, sufficient amount of light gets reflected back to the LDRs. So, their resistance will be low. So the voltage dropped across the LDR will be low. When the robot is drifted to one side, the sensor in the opposite side falls over the black line and the intensity of light reflected back to the corresponding LDR will be low. As a result, the resistance of the LDR shoots up and the voltage dropped across it will be high. The voltages dropped across the right and left LDRs (nodes marked R and L in the above circuit) are given as input to the analogue input pins A3 and A4 of the Arduino board.

Types of Infrared Sensor

Infrared sensors are classified into two types like active IR sensor and passive IR sensor.

Active IR Sensor

This active infrared sensor includes both the transmitter as well as the receiver. In most of the applications, the light-emitting diode is used as a source. LED is used as a non-imaging infrared sensor whereas the laser diode is used as an imaging infrared sensor.

These sensors work through energy radiation, received & detected through radiation. Further, it can be processed by using the signal processor to fetch the necessary information. The best examples of this active infrared sensor are reflectance and break beam sensor.

Passive IR Sensor

The passive infrared sensor includes detectors only but they don’t include a transmitter. These sensors use an object like a transmitter or IR source. This object emits energy and detects through infrared receivers. After that, a signal processor is used to understand the signal to obtain the required information.

The best examples of this sensor are pyroelectric detector, bolometer, thermocouple-thermopile, etc. These sensors are classified into two types like thermal IR sensor and quantum IR sensor. The thermal IR sensor doesn’t depend on wavelength. The energy source used by these sensors is heated. Thermal detectors are slow with their response and detection time. The quantum IR sensor depends on the wavelength and these sensors include high response and detection time. These sensors need regular cooling for specific measurements.

3.2.6 JUMPER WIRES:

fig:3.2.6.1 Jumper Wires

Generally, jumpers are tiny metal connectors used to close or open a circuit part. They have two or more connection points, which regulate an electrical circuit board. Their function is to configure the settings for computer peripherals, like the motherboard. Suppose your motherboard supported intrusion detection. A jumper can be set to enable or disable it. Jumper wires are electrical wires with connector pins at each end. They are used to connect two points in a circuit without soldering. You can use jumper wires to modify a circuit or diagnose problems in a circuit. Further, they are best used to bypass a part of the circuit that does not contain a resistor and is suspected to be bad. This includes a stretch of wire or a switch. Suppose all the fuses are good and the component is not receiving power; find the circuit switch. Then, bypass the switch with the jumper wire. Although jumper wires come in a variety of colours, they do not actually mean anything. The wire colour is just an aid to help you keep track of what is connected to which. It will not affect the operation of the circuit. This means that a red jumper wire is technically the same as the black one. Even so, the colours can be used to your advantage to differentiate the types of connections. For instance, red as ground and black as power. Literally, what works for you.

3.2.7 Ultrasonic Sensor :

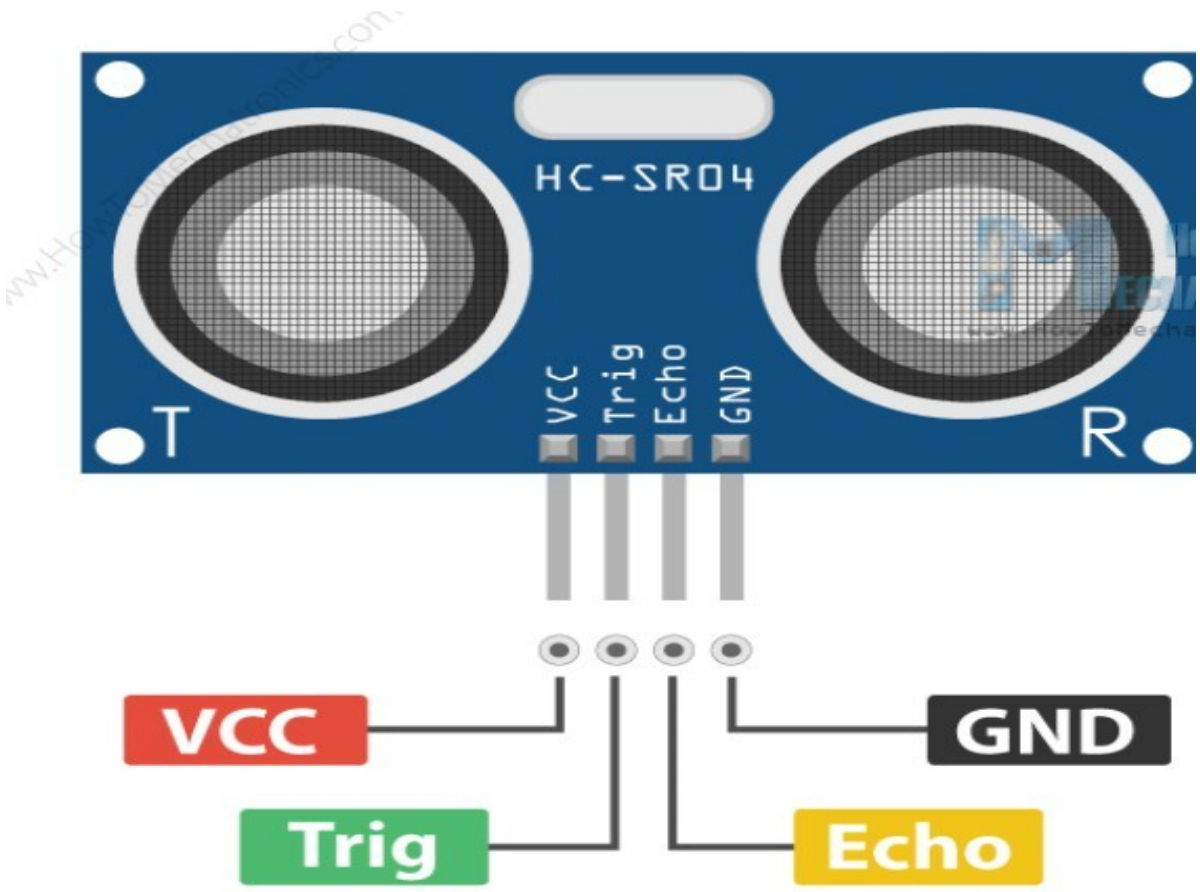


fig3.2.7.1 Ultrasonic sensor

Ultrasonic sensors work by emitting sound waves at a frequency which is too high for humans to hear.An above image shows the HC-SR-04 ultrasonic sensor which has transmitter, receiver. The pin configuration is,

VCC – +5 V supply

TRIG – Trigger input of sensor. Microcontroller applies 10 us trigger pulse to the HC-SR04 ultrasonic module.

ECHO–Echo output of sensor. Microcontroller reads/monitors this pin to detect the obstacle or to find the distance.

GND – Ground

Sound is a mechanical wave traveling through the mediums, which may be a solid, or liquid or gas.

Sound waves can travel through the mediums with specific velocity depends on the medium of

propagation. The sound waves which are having high frequency reflect from boundaries and produce

distinctive echo patterns.

Features of an Ultrasonic Sensor

1. Supply voltage: 5V (DC).
2. Supply current: 15mA.
3. Modulation frequency: 40Hz.
4. Output: 0 – 5V (Output high when obstacle detected in range).
5. Beam Angle: Max 15 degrees.
6. Distance: 2 cm – 400 cm.7. Accuracy: 0.3cm.
8. Communication: Positive TTL pulse.

Ultrasonic Sensor Working Principle:

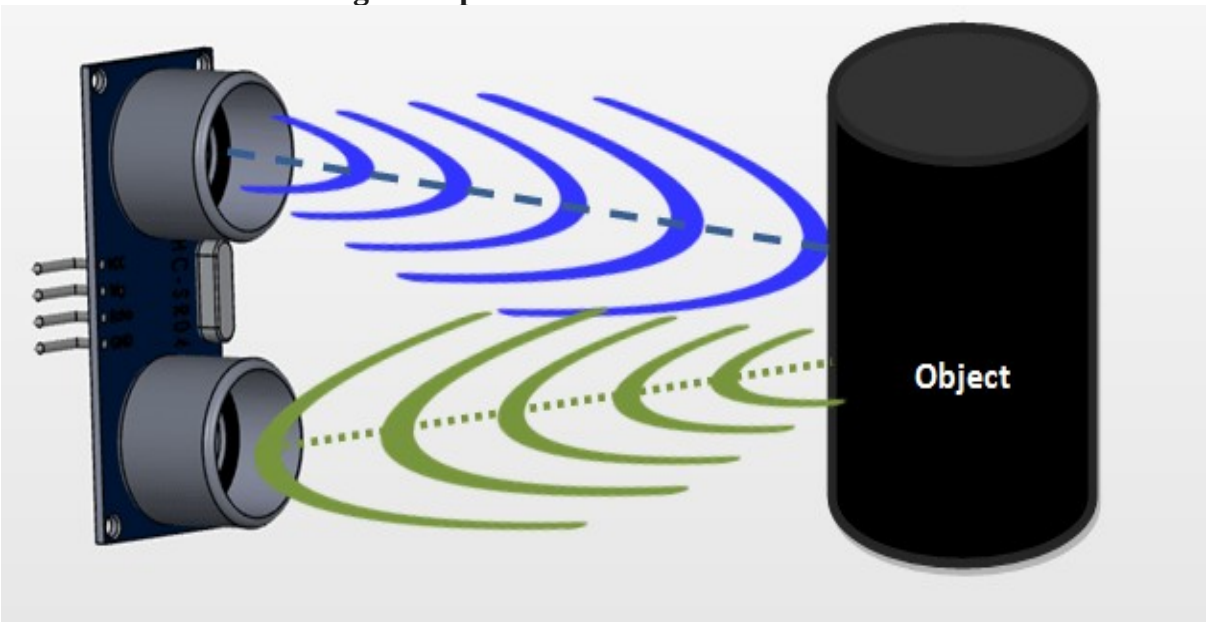


Fig:3.2.7.2 ultrasonic sensor working principle

Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they reflected back as an echo signals tothe sensor, which itself computes the distance to the target based on the time-span between emitting
the signal and receiving the echo.

An ultrasonic sensors are excellent at suppressing background interference. Virtually all materials which reflect sound can be detected, regardless of their colour. Even transparent materials or thin foils represent no problem for an ultrasonic sensor. microsonic ultrasonic sensors are suitable for target distances from 20 mm to 10 m and as they measure the time of flight they can ascertain a measurement with pinpoint accuracy. Some of oursensors can even resolve the signal to an accuracy of 0.025 mm. Ultrasonic sensors can see through dust-laden air and ink mists. Even thin deposits on the sensor membrane do not impair its function.

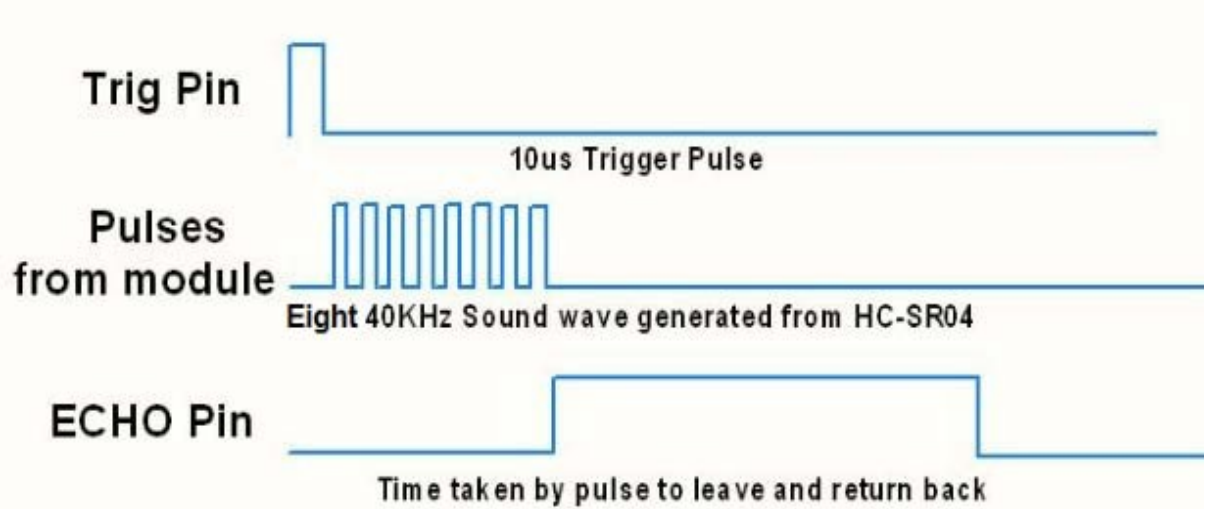


Fig:3.2.7.3 Timing diagram of ultrasonic sensor

1. First need to transmit trigger pulse of at least 10 us to the HC-SR04 Trig Pin.
2. Then the HC-SR04 automatically sends Eight 40 kHz sound wave and wait for rising edge output at
Echo pin.
3. When the rising edge capture occurs at Echo pin, start the Timer and wait for falling edge on Echo
pin.
4. As soon as the falling edge captures at the Echo pin, read the count of the Timer. This time count is
the time required by the sensor to detect an object and return back from an object.

How to calculate Distance?

If you need to measure the specific distance from your sensor, this can be calculated based on this
formula:
We know that, Distance= Speed* Time. The speed of sound waves is 343 m/s. So,
Total Distance= (343 * Time of hight(Echo) pulse)/2
Total distance is divided by 2 because signal travels from HC-SR04 to object and returns to the
module HC-SR-04.

Applications of an Ultrasonic Sensor:

• It Uses to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.
• It Used to measure the distance within a wide range of 2cm to 400cm.
• Used to map the objects surrounding the sensor by rotating it.
• Depth of certain places like wells, pits etc can be measured since the waves can penetrate through water.

3.2.8 Lithium ion Batteries :

F

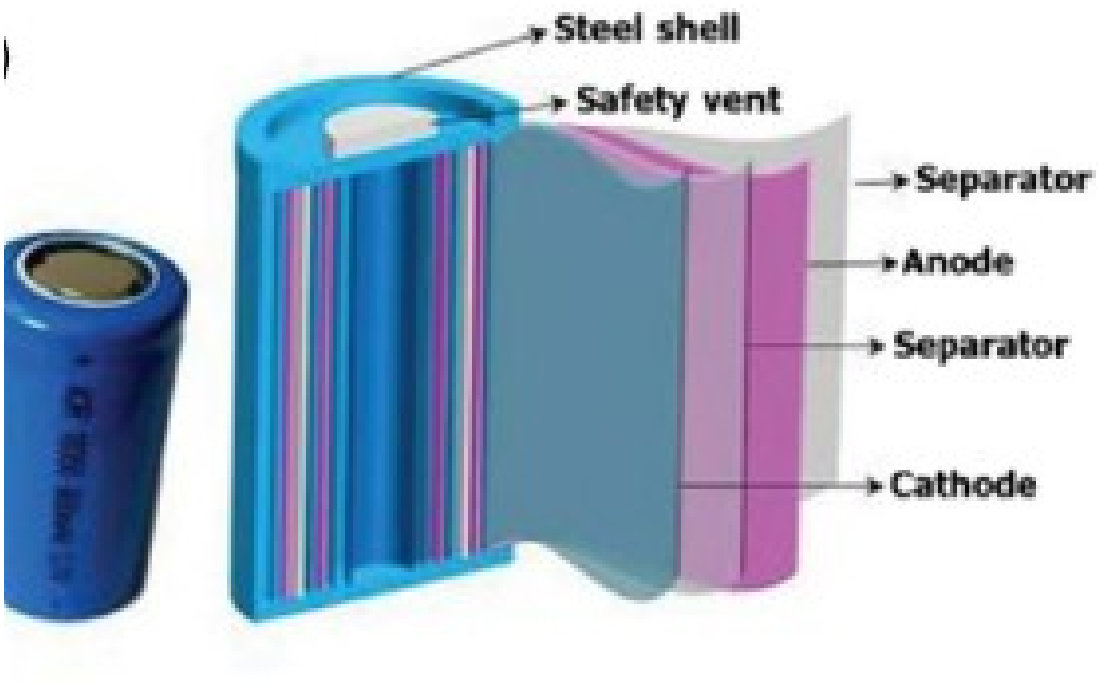


fig:3.2.8.1 Lithium ion Batteries

Lithium-ion is the most popular rechargeable battery chemistry used today. Lithium-ion batteries power the devices we use every day, like our mobile phones and electric vehicles.

Lithium-ion batteries consist of single or multiple lithium-ion cells, along with a protective circuit board.They are referred to as batteries once the cell, or cells, are installed inside a device with the protective circuit board.

Electrodes:The positively and negatively charged ends of a cell. Attached to the current collectors

- **Anode:**The negative electrode
- **Cathode:**The positive electrode
- **Electrolyte:**A liquid or gel that conducts electricity
- **Current collectors:**Conductive foils at each electrode of the battery that are connected to the terminals of the cell. The cell terminals transmit the electric current between the battery, the device and the energy source that powers the battery
- **Separator:**A porous polymeric film that separates the electrodes while enabling the exchange of lithium ions from one side to the other

How does a lithium-ion cell work?

In a lithium-ion battery, lithium ions (Li+) move between the cathode and anode internally. Electrons move in the opposite direction in the external circuit. This migration is the reason the battery powers the device—because it creates the electrical current.

While the battery is discharging, the anode releases lithium ions to the cathode, generating a flow of electrons that helps to power the relevant device.

When the battery is charging, the opposite occurs: lithium ions are released by the cathode and received by the anode.

A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry. During a discharge cycle, lithium atoms in the anode are ionized and separated from their electrons. The lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralize. The lithium ions are small enough to be able to move through a micro-permeable separator between the anode and cathode. In part because of lithium's small size (third only to hydrogen and helium), Li-ion batteries are capable of having a very high voltage and charge storage per unit mass and unit volume.

Li-ion batteries can use a number of different materials as electrodes. The most common combination is that of lithium cobalt oxide (cathode) and graphite (anode), which is most commonly found in portable electronic devices such as cellphones and laptops. Other cathode materials include lithium manganese oxide (used in hybrid electric and electric automobiles) and lithium iron phosphate. Li-ion batteries typically use ether (a class of organic compounds) as an electrolyte.

Some Advantages of lithium ion batteries

Compared to the other high-quality rechargeable battery technologies (nickel-cadmium or nickel-metal-hydride), Li-ion batteries have a number of advantages. They have one of the highest energy densities of any battery technology today (100-265 Wh/kg or 250-670 Wh/L). In addition, Li-ion battery cells can deliver up to 3.6 Volts, 3 times higher than technologies such as Ni-Cd or Ni-MH. This means that they can deliver large amounts of current for high-power applications, which has Li-ion batteries are also comparatively low maintenance, and do not require scheduled cycling to maintain their battery life. Li-ion batteries have no memory effect, a detrimental process where repeated partial discharge/charge cycles can cause a battery to 'remember' a lower capacity. This is an advantage over both Ni-Cd and Ni-MH, which display this effect. Li-ion batteries also have low self-discharge rate of around 1.5-2% per month. They do not contain toxic cadmium, which makes them easier to dispose of than Ni-Cd batteries.

3.2.9 Wheels :

fig:3.2.9.1 Wheels

A wheel is a circular component that is intended to rotate on an axle bearing,The wheel is one of the key components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labor in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel, and flywheel.

Common examples are found in transport applications. A wheel reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity or by the application of another external force or torque. Using the wheel, sumerias invented a device that spins clay as a potter shapes it into the desired object.

A drive wheel is a wheel of a motor vehicle that transmits force, transforming torque into tractive form from the tires to the road, causing the vehicle to move. The power train delivers enough torque to the wheel to overcome stationary forces, resulting in the vehicle moving forwards or backwards.

A two wheel drive vehicle has two driven wheels, typically both at the front or back, while a four wheel drive has four.

A steering wheel is a wheel that turns to change the direction of a vehicle. A trailer wheel is one that is neither a drive wheel, nor a steer wheel.Front wheel drive vehicles typically have the rear wheels as trailer wheels.

3.2.10 Battery Holder :

fig:3.2.10.1 Battery Holder

A battery holder is one or more compartments or chambers for holding a battery. For dry cells, the holder must also make electrical contact with the battery terminals. For wet cells, cables are often connected to the battery terminals as is found in automobiles or emergency lighting equipment.

A battery holder is either a plastic case with the shape of the housing moulded as a compartment or compartments that accepts a battery or batteries, or a separate plastic holder that is mounted with screws, eyelets, glue, double-sided tape, or other means. Battery holders may have a lid to retain and protect the batteries or may be sealed to prevent damage to circuitry and components from battery leakage. Coiled spring wire or flat tabs that press against the battery terminals are the two most common methods of making the electrical connection inside a holder. External connections on battery holders are usually made by contacts with pins, surface mount feet, solder lugs, or wire leads.

Where the battery is expected to last over the life of the product, no holder is necessary, and a tab welded to the battery terminals can be directly soldered to a printed circuit board.

CHAPTER 4
SOFTWARE MODEL

4.1 INTRODUCTION OF ARDUINO IDE SOFTWARE

The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. The Arduino IDE is very simple and this simplicity is probably one of the main reason Arduino became so popular. We can certainly state that being compatible with the Arduino IDE is now one of the main requirements for a new microcontroller board. Over the years, many useful features have been added to the Arduino IDE and you can now managed third-party libraries and boards from the IDE, and still keep the simplicity of programming the board. The main window of the Arduino IDE is shown below, with the simple simple Blink example.

What is the Arduino IDE?

As we know we need a text/code editor to write the code, a compiler to convert that code to machine code or binary files so that the microcontroller can understand, and also programming software to load these firmware files onto the microcontroller. When we combine all these with some additional features like debugging support, console support, etc, that's what we call an IDE (Integrated Development Environment) or in simple terms the Arduino Software. Arduino IDE, as the name states, is a development IDE for the Arduino boards. It consists of a feature-rich code editor, compiler, programmer, serial console, serial plotter, and many other features. It is simple and easy to use.

Arduino IDE is cross-platform, and it can run on operating systems from Microsoft, Linux, and Windows. Furthermore, you can program the boards using the Arduino IDE and Arduino Language, which is a derivative of C/C++.

How to Install Arduino IDE?

Installing Arduino IDE is pretty straightforward. Go to Arduino IDE to download the recent version of Arduino IDE. There are multiple versions available for different operating systems such as Windows, Mac, and Linux. Not only that, nowadays Arduino IDE comes in two variants Arduino IDE 1.x and Arduino IDE 2.x. For this tutorial, we will be talking about the Classic 1.X variant. Basically, both have almost same functionality with a different GUI plus some additional features such as auto code completion.

- Download the installer for your operating system from the above-given link.
- Once the download is done open the .exe file.
- Agree to the licence agreement and select if the IDE should be installed to all users or not and click on “Next” to continue.
- Select the location in which you want the IDE to install if you want to change the location or keep it default and click on “Install”
- Wait for the installer to finish installation, and click on “Close”.

4.2 OUTPUTS:

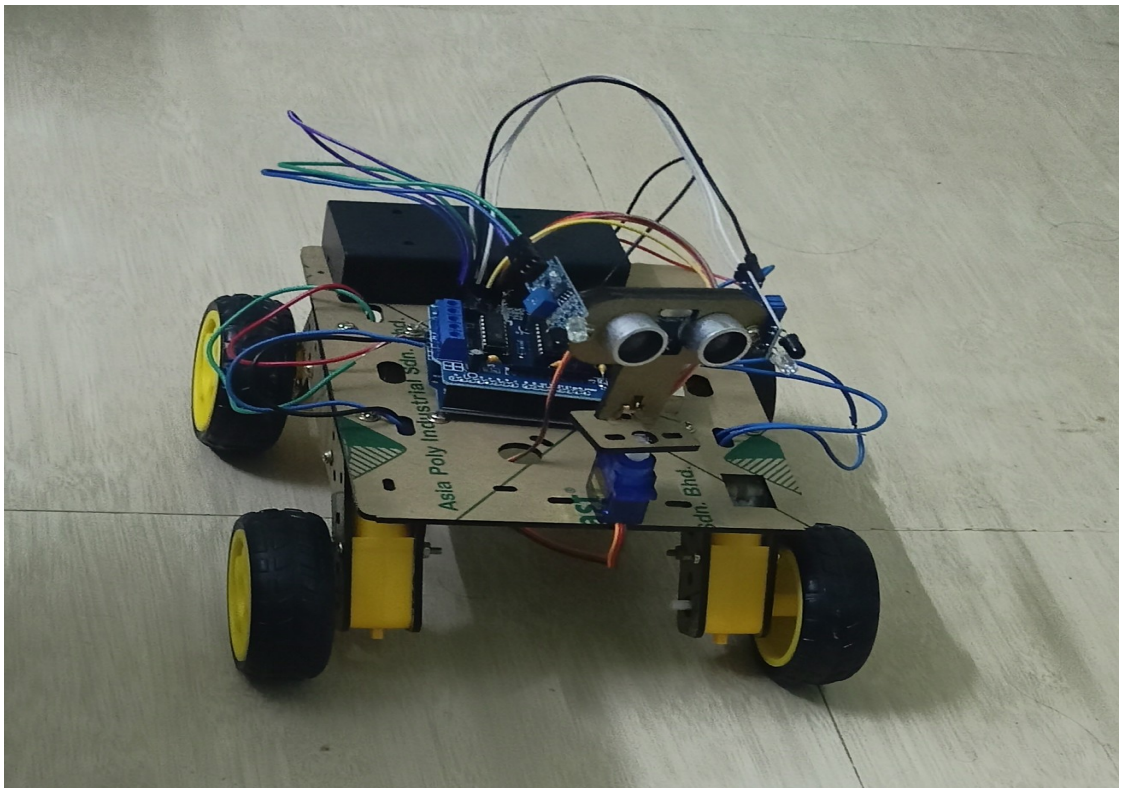


fig 4.2.1 Human following robot

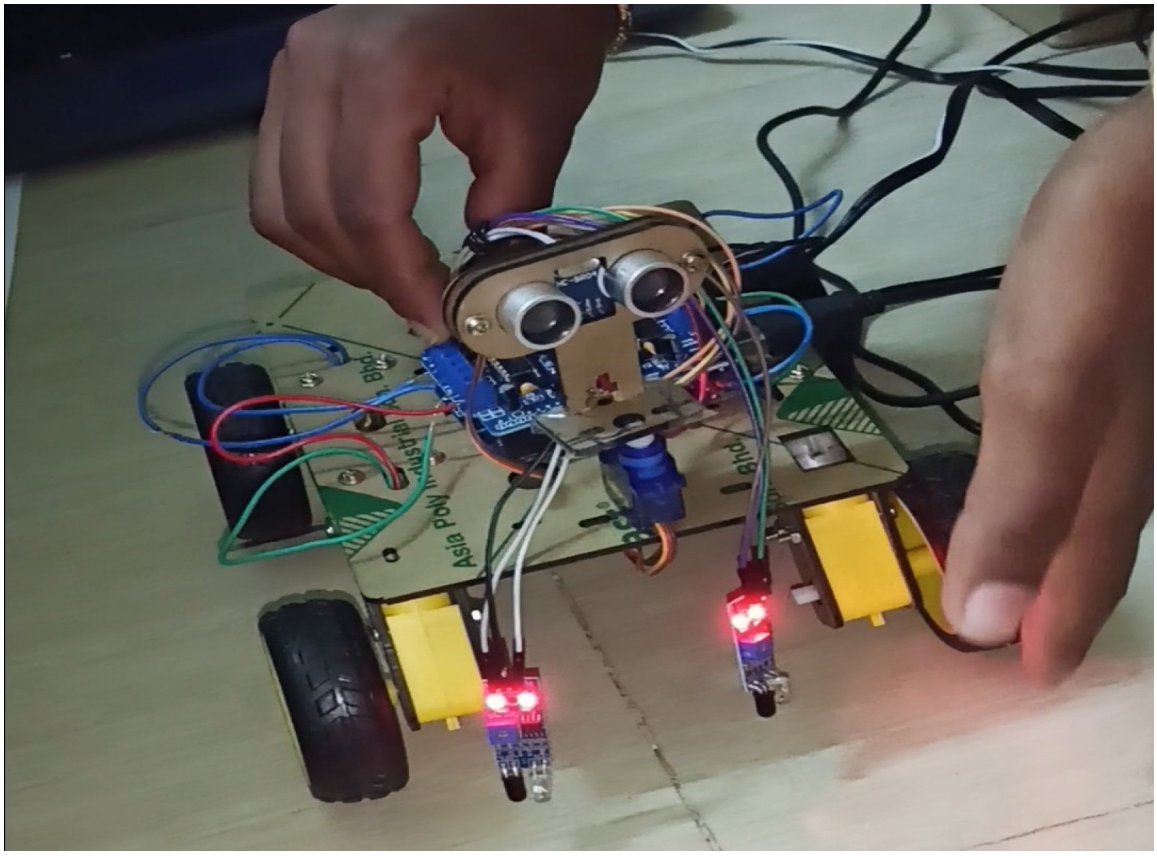


fig 4.2.2 After applying power supply

When you put your hand near to the ultrasonicsensor the robot will start forward.And if you turn your hand to the left side the Arduino robot moves to the leftside,and if you put your hand in the right,the robot will move in the right direction.

When you put your hand infront of the ultrasonic sensor then the sensor detects you and sends this information to the arduino.

The two IR Sensor,one is at the left of ultrasonic sensor and other is at the rightside of the ultrasonic sensor.

When anything comes near to the left sensor Arduino got the information that there is something is near to the left sensor and according to the code. The robot will turn to the left,and the same process for the right sensor.

CHAPTER 5
RESULTS AND ANALYSIS

5.1 BENEFITS AND DEMERITS OF HUMAN FOLLOWING ROBOT

There are several benefits that Human following robot has and which make it favourable for many uses.

Benefits:

Robot system is fit and forget that means when camera will capture an image then that image will be forget from camera after some time and the camera will capture the new image.

The robot is simple in construction there will be nodifficulties in circuit because less components are used to design a robot. And due to simplicity in construction the cost of the system is medium.

The designed robot works with android camera and due to that the movement of robot is automatic.

Demerits:

Robot always needs a path to run from the particular path.

Robot has slow speed and instability on different line thickness or hard angles.

5.2 Applications:

In Industrial application: a robot can help us carry heavy items for long distance.

In Hospital: a robot that can help nurses at hospital, or bringing the medical supplies during war to injured soldiers.

Guidance system for industrial robots moving on shop floor etc.

In Military application: in that robot can handle the heavy equipment like missiles etc. from one place to others.

5.3 Advantages:

- Code compatibility and expandability across different Arduino boards.
- Cost is less as Arduino is open source.
- The schematic of Arduino is open source. So for future enhancement of the project the board can be extended to add more hardware features.
- Ultrasonic sensor has large range and can be used in any lighting conditions.
- It can be used for home for floor cleaning.
- In hostels they are being used for the transfer of things from one place to
- another following a straight path.

5.4 OBSERVATION AND RESULTS

Different experiments were conducted and the performance of the human following robot was tested. Test was performed on the ultrasonic and infrared sensor. It was noted that the sensor was working accurately within a range of 4 meters. Then we performed the test to check whether the robot maintains a specific distance with the target object.

Then we checked the serial communication between Arduino, motor shield and various motors. On the basis of results obtained from these tests and experiments, we made the necessary changes in the processing and control algorithm. After the completion, we observed that the results produced were very satisfying the robot was perfectly following the person wherever it goes.

Hence the objective of implementing a good Human-Robot interaction was achieved.

5.5 CONCLUSION

A successful implementation of a human follower robot is illustrated in this research. This robot does not only have the detection capability but also the tracking and following ability as well. The tracking is basically performed on the tag and the human is followed on the basis of that detection. It was also kept in mind that the „following‟ capability of the robot should be as efficient as possible. The tests were performed on the different conditions to pin point the mistakes in the algorithm and correct them. The different sensors that were integrated with the robot added an additional advantage.

5.6 FUTURE SCOPE

There are many interesting applications of this research in different fields whether military or medical. A wireless communication functionality can be added in the robot to make it more versatile and control it from a large distance. This capability of a robot could also be used for military purposes. By mounting a real time video recorder on top of the camera, we can monitor the surroundings by just sitting in our rooms. We can also add some modifications in the algorithm and the structure as well to fit it for any other purpose. E-g a vehicle follower. Similarly it can assist the public in shopping malls. So there it can act as a luggage carrier, hence no need to carry up the weights or to pull that. Using this algorithm the robot will automatically follow that person.

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