CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Robotics encompasses the field of engineering and technology focused on the design, manufacture, application, and arrangement of robots. In rapidly advancing societies, optimizing time and manpower is a fundamental concern. Automation plays a crucial role in reducing human effort. Today's industries increasingly rely on computer-based automation to boost productivity and ensure uniform product quality. Incorporating robots into industrial processes enhances production rates, particularly for simple repetitive tasks. Robots, programmable devices comprised of electronic, electrical, and mechanical components, function as self-controlled machines, akin to live agents.

The advantages of using robots over humans are manifold: they do not fatigue, can operate in uncomfortable or hazardous conditions, including airless environments, and are not susceptible to boredom or distraction from repetitive tasks. The term "robot" first appeared in Karel Capek's Czechoslovakian satirical play, "Rossum's Universal Robots," in 1920. Early in the 1800s, mechanical puppets entertained audiences in Europe, driven by linkages, cams, and controlled by rotating drums.

The advent of industrial robots can be traced to Unimates, developed by George Devol and Joe Engelberger in the late 1950s and early 1960s. Devol secured the first patent, while Engelberger established Unimation, the first robot manufacturer, earning him the title "Father of Robotics." George Devol Jr. developed multi-jointed artificial arms in 1954, paving the way for modern robots. In 2000, Swarm bots, resembling insect colonies, emerged, consisting of numerous simple robots interacting to perform complex tasks. Autonomous robots continue to evolve.

Isaac Asimov envisioned robots as humanoids devoid of emotions in many of his stories. His robots were fail-safe machines, their behaviour governed by human-controlled ethical rules. Asimov formulated the "Three Laws of Robotics," which remain relevant today: a robot must not harm a human being or, through inaction, allow harm to come to a human; a robot must obey orders from humans, except where it conflicts with the first law; a robot must protect its own existence, except where it conflicts with the first or second law.

A human-following robot, rather than a line-following robot, is a robotic prototype designed for material handling purposes. It tracks and follows humans along a predetermined path marked by high-contrast colours on the floor. Algorithms and programming enable seamless operation, with various movement systems facilitating turns. The robot's movement is controlled by different types of sensors, such as V2X sensors, which act as digital compasses.

Robotic arms, manipulators resembling human arms, can be autonomous or manually operated, performing tasks with precision. In pick-and-place line follower robots, both hardware and software components undergo continuous improvement. Microcontrollers, such as Arduino Uno, and sensory systems are integrated for enhanced operational efficiency. Algorithms facilitate object detection and precise manipulation using a claw mechanism.

CHAPTER 2

LITERATURE SURVEY

Development Of Robotic Arm Using Arduino UNO by 1Priyambada Mishra,2Riki Trushit Upadhyaya, 2Arpan Desai:-

In this paper, they have used 4 servo motors to make joints of the robotic arm and the movement will be controlled with the help of potentiometer. The controller used is Arduino UNO. The analogue input signals of the Arduino's is given to the Potentiometer. The arm has been built by the Cardboard and individual parts are attached to the respective servo motors. The arm is specifically created to pick and place light weight objects. So low torque servos, with a rotation of 0 to 180 degrees have been used. Programming is done using Arduino 1.6.10. Thus the paper basically focuses on creating a robotic arm with non useful materials and its application on small purposes.

Design of Robotic Arm with Gripper and End effector for spot welding' by Puran Singh, Anil Kumar, Mahesh Vashishth-

According to the paper the robotic arm consists of 2 degrees of freedom is being made for the purpose of spot welding, gripper will be used in the arm. The end effector consists of an arrangement of spur gears and threaded shafts along with an AC motor. Aims considered while building the robotic arm are1.To have a rigid structure. 2.Movement of parts to defined angles. 3.To attain consumption of power at optimum level. 4.To perform spot welding operation with the help of end effectors. The material used for manufacturing the bottom of robotic arm was plywood which has the dimensions as follows

Length-48 cm,
Breadth-28 cm,
Thickness-2 cm.

Arm manipulator will be made up of plastic and has the following description-

- Weight=(30)2=60 g for big arm and (10)2=20 g for small arm.
- Length=25 cm for big arm And 5cm for small arm.

At the assembly point of wrist and end effector, 2 end effectors are used, in which one end effector is fixed and the other is movable, the end effector assembly has meshing of spur gears and worm gears which are connected to a 9 V stepper motor.

The stepper motor has a step angle of 1.8 degrees and a speed of 100rpm. Force calculation on joints is done. This design of the robotic arm has two depth of field which performs the function of lifting, and for each linkage the centre of mass was acting at the half of the length. Since there are many possible configurations for the robotic arm, the maximum degrees of rotation of each joint is 180 degrees.

All the locations of the End Effector to which it can reach so that the workspace required can be calculated. This type of technology which is used in robotic arms can help in doing spot welding operation more efficiently. The material handling was carried out easily by picking and placing of the desired object. We can change the variation in the robot arm structure and their angle of movement.

Review on Object-Moving Robot Arm base don Colour By Areepen Sengsalonga, Nuryono Satya Widodo

The objective of this finding is to make a manipulator which can sort objects on basis of colour using specific motors and photodiode sensors programmed with a Arduino Mega series microcontroller. The light photodiode sensor can identify RGB colours. In this system the output of Arduino Mega 2560 is displayed on a LCD screen which is an indication of the observed colour. The first step of object moving process is by distinguishing the RGB colour. The gripper of robotic arm will move to pick objects based on colour, depending on the colour input given by the light photodiode sensor. Arduino Mega 2560 is a microcontroller that uses ATmega2560 which is installed in robotic arm having 54 digital i/o ports segregated into different types. In this paper a colour sensor testing is also carried out ,having a target to determine the ability of Photodiode sensor for distinguishing of colour .The resultant voltage from photodiode will be sent to ADC to process and show result on the LCD screen provided

Punetha,D, Kumar,N & Mehta,V, “Development and Applications of Line Following Robot Based Health Care Management System”, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET),Vol. 2, Issue 8, ISSN: 2278 – 1323, 2013

This project focuses on the development of a line follower algorithm for a Two Wheels Balancing Robot. In this project, ATMEGA32 is chosen as the brain board controller to react towards the data received from Balance Processor Chip on the balance board to monitor the changes of the environment through two infra-red distance sensor to solve the inclination angle problem. Hence, the system will immediately restore to the set point (balance position) through the implementation of internal PID algorithms at the balance board. Application of infra-red light sensors with the PID control is vital, in order to develop a smooth line follower robot. As a result of combination between line follower program and internal self balancing algorithms, we are able to develop a dynamically stabilized balancing robot with line follower function.

Nor Maniha Abdul Ghani, Faradila Naim, Tan Piow Yon , “Two Wheels Balancing Robot with Line Following Capability”, World Academy of Science, Engineering and Technology, pp. 634-638, 2011

It shows a prototype development of an intelligent line follower mini-robot system, the objective is to recognize, understand and modify the actual performance of the movements of the robot during its pathway by way of getting information in real time from different magnetic sensors implemented in the system and based in a V2X digital compass, microcontroller and odometric measurements. The paper shows as well, the system characterization of the V2X sensor (digital compas) and the cost-benefit of the prototype implementation and performance. The programming techniques and easy operation is detailed too.

CHAPTER-3

EXISITING SYSTEM

3.1 INTRODUCTION

The existing robotic system under consideration represents a significant advancement in the field of robotics, aiming to bridge gap between human mobility and autonomous navigation. Designed to autonomously track and follow a human, this system offers various applications ranging from assisting individuals in crowded environment to enhancing surveillance and security measures. The primary purpose of the human-following robot system is to provided a mobile platform capable of autonomously tracking and follow a human in real-time. It can used to as assistance in public spaces, for industrial application and for security.

The Human-following robot perform three operations to follow the human and to keep a safe distance between the robot and object. And it uses the proportional algorithm to follow the human and the proportional algorithm contains Error calculation, proportional control output (Kp), Actuator control, Feedback loop. And obstacle Avoidance algorithm is used to detect the obstacle with in the environment and to keep a safe distance between the robot and obstacle.

The human-following robot may struggle to operate effectively in environments with dynamic lighting conditions, changing in terrain or unpredictable obstacles. And the sensors that are used in the robots has limited range and it perform depend on the weather conditions. If the people walking in the group or crossing path it will be difficult to track the specific individual. The main limitation of the human-following robot is if it loose the track or the object the robot is fallen down the it need a person to keep in track or the place the object the is fallen down.

The disadvantages of existing system are:

- **Limited Autonomy**: Human-following robots typically rely on sensors to detect and track humans, which limits their autonomy. They may struggle to operate independently in complex or unpredictable environments without human intervention
- **Vulnerability to Environmental Factors**: Human-following robots are susceptible to environmental factors such as lighting conditions, obstacles, and terrain variations. Changes in the environment can affect sensor readings and hinder the robot's ability to accurately detect and track humans.
- **Limited Speed and Agility**: Human-following robots may not be able to match the speed and agility of humans, especially in situations requiring rapid movement or manoeuvreing through tight spaces. Their movement capabilities may be restricted by factors such as motor speed, weight distribution, and navigation algorithms.
- **Dependency on Human Presence**: Human-following robots rely on the presence of humans to function effectively. They may struggle to operate in environments where humans are absent or unwilling to interact with the robot, limiting their applicability in certain scenarios.

3.2 BLOCK DIAGRAM:

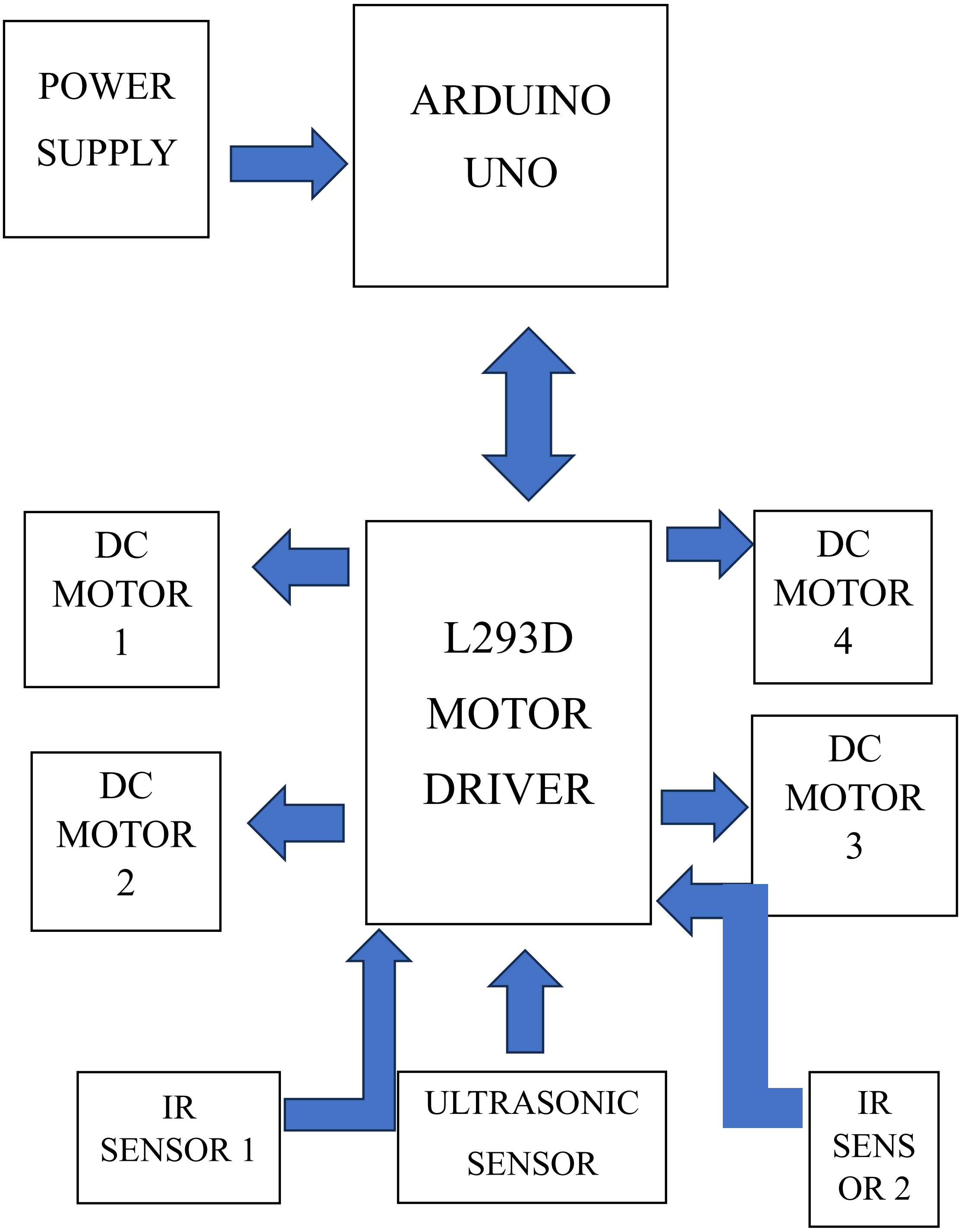

Fig:3.2 Block Diagram of Existing System

3.3 Arduino UNO R3 V1.0

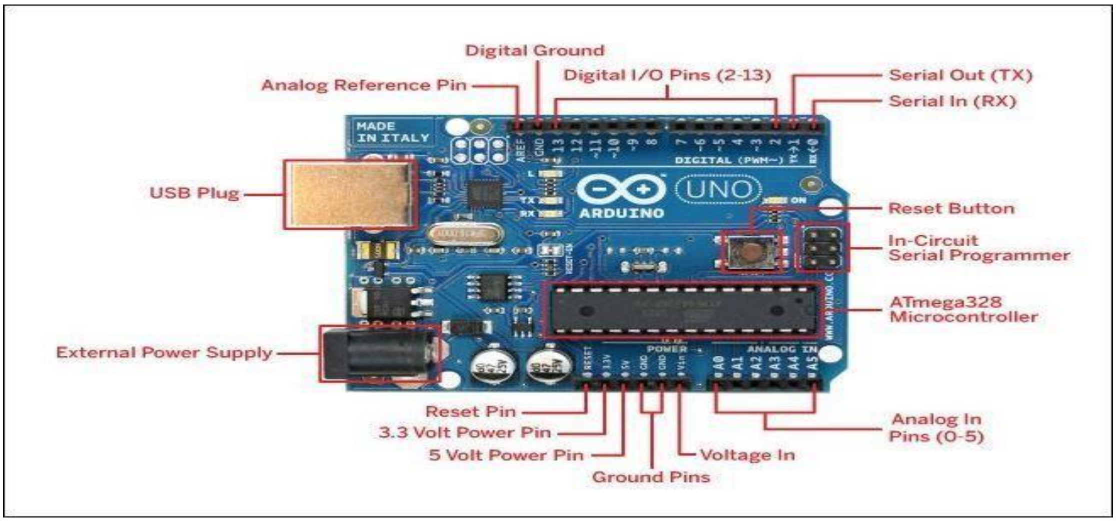

Fig: 3.3 Arduino Uno R3 Board

The Arduino Uno is a popular microcontroller board based on the ATmega328P microcontroller. It's widely used in hobbyist projects, educational settings, and prototyping due to its simplicity, versatility, and affordability. The Arduino UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family.

3.4 Arduino Uno Pin Diagram

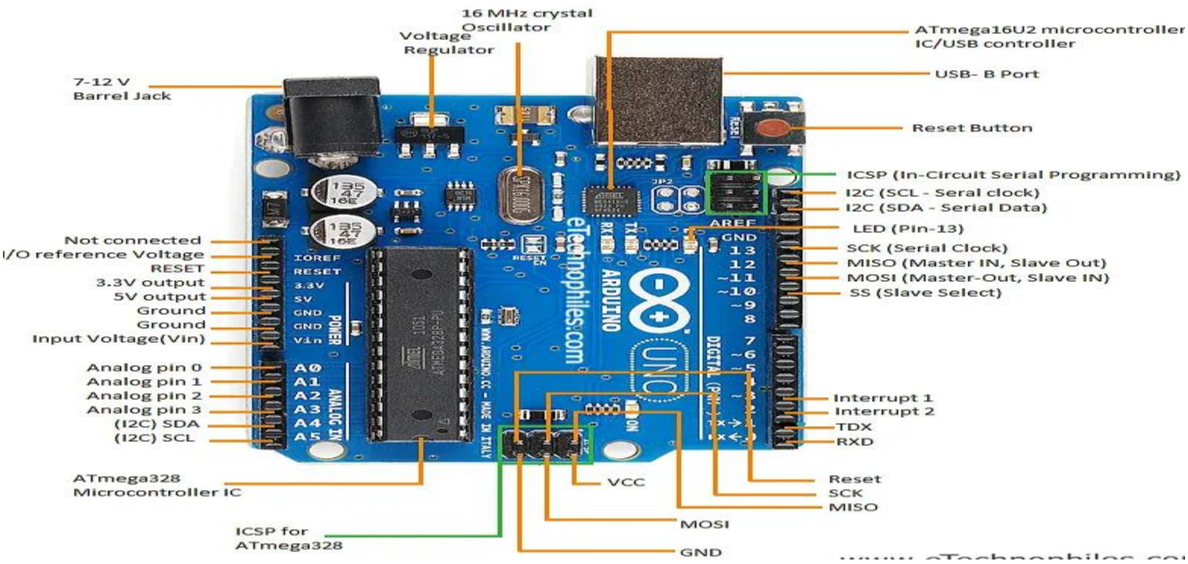

Fig: 3.4 Arduino uno Pin diagram

- **Microcontroller**: The Arduino Uno is powered by the Atmel ATmega328P microcontroller clocked at 16 MHz. It has 32KB of flash memory for storing code (of which 0.5KB is used by the bootloader), 2KB of SRAM, and 1KB of EEPROM.
- **Digital I/O Pins**: The Arduino Uno has a total of 14 digital input/output pins, of which 6 can be used as PWM outputs. These pins can be used for interfacing with various sensors, actuators, LEDs, and other digital devices.
- **Analog Input Pins**: It has 6 analog input pins, labelled A0 through A5, which can measure voltages between 0 and 5 volts. These pins are commonly used for reading analog sensors such as temperature sensors, light sensors, and potentiometers.
- **Operating Voltage**: The Arduino Uno operates at 5 volts, which means that it's compatible with a wide range of sensors, modules, and peripherals that operate at this voltage level.
- **USB Interface**: It features a USB interface for programming the board and for serial communication with a computer. The USB connection also provides power to the board, eliminating the need for an external power supply in many cases.
- **Power Jack**: The Arduino Uno can also be powered via an external power supply connected to the DC power jack. The recommended input voltage range is 7 to 12 volts.
- **Reset Button**: It has a reset button that allows you to restart the microcontroller and rerun the sketch uploaded to the board.
- **Compatibility**: The Arduino Uno is compatible with the Arduino IDE (Integrated Development Environment), which provides a simple and user-friendly interface for writing, compiling, and uploading code to the board. It supports the Arduino programming language, which is based on C/C++.
- **Expansion Headers**: The Arduino Uno has headers for connecting additional shields (plug-in boards) that extend its functionality. Shields are available for a wide range of purposes, including Ethernet connectivity, wireless communication, motor control, and more.

3.5 IR SENSOR

An IR (Infrared) sensor, also known as an IR module or IR detector, is a device that detects infrared radiation in its surrounding environment. It’s commonly used in various applications such as motion detection, object detection, proximity sensing, and remote controlled systems.

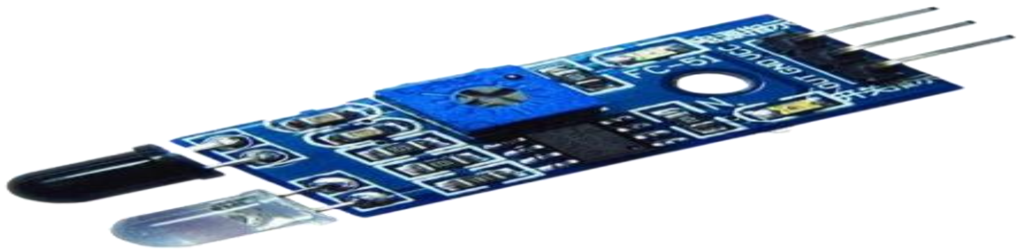

Fig:3.5 IR Sensor

- **Working Principle**: IR sensors work based on the principle of detecting infrared radiation emitted or reflected by objects in their vicinity. They typically consist of an IR emitter (LED) and an IR receiver (photodiode or phototransistor). The emitter emits infrared light, while the receiver detects any infrared radiation that reflects back from nearby objects.

- **Detection Range**: The detection range of an IR sensor depends on factors such as the power of the IR emitter, sensitivity of the receiver, and the nature of the surrounding environment. Typically, IR sensors have a detection range of a few centimeters to several meters.

- **VCC (Power)**: This is the power supply pin through which the sensor receives the voltage necessary for operation. The voltage requirements may vary depending on the sensor model, but common values are 3.3V or 5V.

- **GND (Ground):** This pin is connected to the ground of the circuit. It serves as the reference point for the power supply and signal.

- **OUT (Output):** This pin outputs the signal from the sensor. The nature of the output signal depends on the specific type of IR sensor:

  - For an IR proximity sensor, the output might be a digital signal (high or low) indicating whether an object is detected within a certain range.
  - For an IR photodiode or phototransistor, the output could be an analog signal that varies with the intensity of the detected infrared light.

3.6 ULTRASONIC SENSOR

The ultrasonic sensor is a type of sensor that uses sound waves to detect the presence or distance of objects. It emits ultrasonic sound waves (sound waves with frequencies above the human audible range) and then listens for the echo reflected back from nearby objects. By measuring the time it takes for the sound waves to travel to the object and back, the sensor can determine the distance to the object.

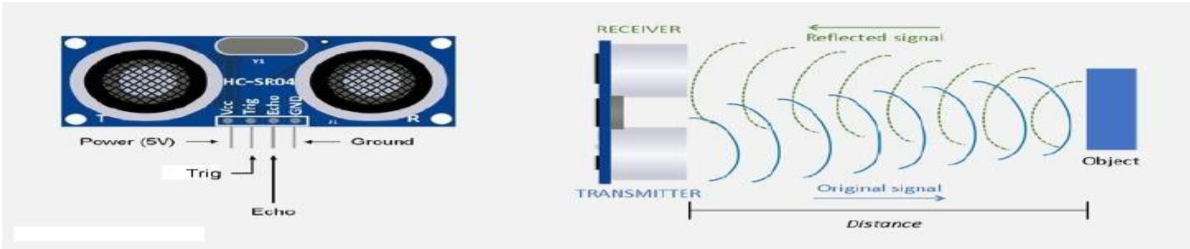

Fig:3.6 Ultrasonic Sensor

- **VCC (or VCC+)**: This pin is used to provide power to the sensor. It typically requires a DC voltage supply between 5V to 5.5V.
- **GND (or Ground)**: This pin is connected to the ground (0V) of the power supply, completing the circuit.
- **Trigger (Trig)**: The Trigger pin is used to initiate the ultrasonic signal transmission. When a short pulse (usually 10 microseconds) is sent to this pin, the sensor emits an ultrasonic burst.
- **Echo**: The Echo pin is used to detect the return signal (echo) from objects in the sensor's field of view. The duration of the high level signal on this pin is proportional to the time it takes for the ultrasonic signal to travel to the object and back. This duration can be measured to calculate the distance to the object.

3.7 DC MOTORS

DC motors are commonly used with Arduino microcontrollers for various projects involving movement, such as robotics, motorized vehicles, and automation.

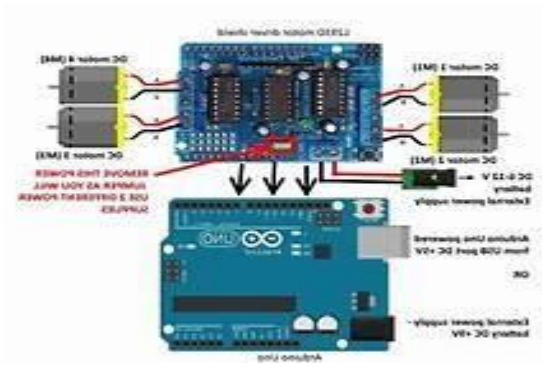

Fig: 3.7 DC Motors

- **Basic Operation**: DC motors operate by converting electrical energy into mechanical energy. When voltage is applied across the terminals of the motor, it causes the motor to rotate. By reversing the polarity of the voltage, the direction of rotation can be changed.

- **Voltage and Current Requirements**: DC motors have specific voltage and current requirements, which vary depending on the motor's specifications. It's important to match the voltage and current ratings of the motor with the capabilities of the power supply and motor driver circuitry to ensure proper operation and prevent damage to the motor or other components.

- **Motor Control**: Arduino microcontrollers can control DC motors using pulse-width modulation (PWM) signals. PWM allows you to vary the speed of the motor by adjusting the duty cycle of the PWM signal. By rapidly switching the motor on and off at varying speeds, the average voltage applied to the motor can be controlled, resulting in variable speed control .

3.8 L293D 4-CHANNEL MOTOR DRIVER

The L293D is a popular integrated circuit (IC) commonly used as a motor driver in robotics and other electronic projects. It's designed to drive small DC motors or stepper motors with bidirectional control, meaning it can control the rotation direction of the motors as well as their speed

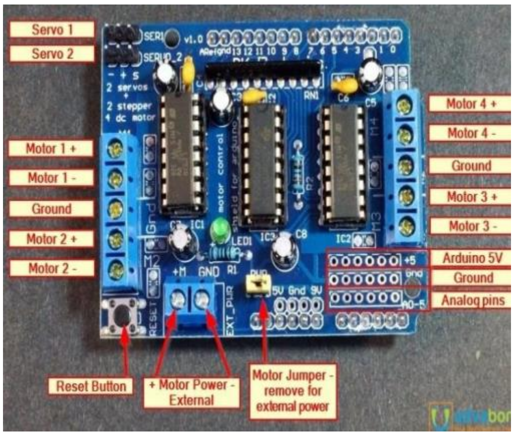

Fig:3.8 L293D 4-channel motor driver Pin diagram

- **H-Bridge Configuration**: The L293D consists of four half-H bridges, which can control up to two DC motors bidirectionally. Each half-H bridge consists of a pair of transistors configured in such a way that it can drive a motor in both directions by controlling the direction of the current flow through the motor.

- **Voltage and Current Ratings**: The L293D is typically rated for a supply voltage range of 4.5V to 36V. It can handle peak currents of up to 600mA per channel (1.2A peak) and continuous currents of up to 200mA per channel (0.4A continuous) without external heat sinking. However, with proper heat sinking, the L293D can handle higher currents.

- **Logic Compatibility**: The L293D is designed to be compatible with TTL (Transistor-Transistor Logic) and CMOS (Complementary Metal-Oxide-Semiconductor) logic levels. This means it can be controlled by microcontrollers, such as Arduino, Raspberry Pi, or other digital logic circuits.

- **Built-In Diodes**: Each half-H bridge of the L293D includes built-in diodes (also known as flyback or freewheeling diodes) for protection against voltage spikes generated by the motor when it is turned off. These diodes help prevent damage to the IC and other components in the circuit.

- **Enable Pins**: The L293D has enable pins (EN1 and EN2) for each pair of half-H bridges, which can be used to enable or disable the corresponding motor outputs. This feature allows for independent control of each motor.

- **Control Inputs**: The control inputs (IN1, IN2, IN3, IN4) determine the direction of rotation for each motor. By applying different combinations of logic levels (HIGH or LOW) to these inputs, you can control the direction and speed of the motors.

- **Servo 1 and Servo 2 pins** : In the context of an L293D-based motor driver board or module, "Servo 1" and "Servo 2" are not directly related to the L293D IC itself, as it does not directly control servo motors. Servos are typically controlled by PWM (Pulse Width Modulation) signals, which are usually generated by microcontrollers. If a board mentions "Servo 1" and "Servo 2," these might be designated connections or headers provided to facilitate connecting servo motors to the same board for convenience. These connections likely provide access to a PWM signal, ground, and power supply suitable for servo motors.

- **Motor Jumper Motor Power External:** This part of your query seems to refer to a jumper setting on a motor driver board using an L293D IC. Typically, such a jumper would be used to select the source of power for the motors. Here's how it generally works

- **Motor Jumper**: A jumper on the board that you can place or remove to choose between different modes of operation or configurations. For motor power, specifically, it can be used to select whether the motor's power supply is internal (from the same power source as the logic circuits) or external (from a separate power supply, which is generally needed when the motors require more power or a different voltage than the logic circuits).

- **Motor Power External:** This usually refers to an input on the motor driver board where you can connect an external power supply specifically for the motors. This is useful because motors often require more current or a higher voltage than what the logic power supply (the power supply for the microcontroller and other logic components) can provide. Using an external power source helps in preventing noise and voltage drops in the logic circuits caused by motor operation.

- **Motor Pin:** These are the pins or outputs on the L293D motor driver IC where you connect the wires that lead to the motors. The L293D features outputs that can handle bidirectional control of motors. For each motor, two outputs are used (one for each direction). For instance, in a typical L293D setup, you might use Pin Out1 and Out2 for Motor A, and Out3 and Out4 for Motor B. These pins directly drive the motors based on the input signals received from the microcontroller.

3.9 DISADVANTAGES OF EXISITING SYSTEM

- **Limited Autonomy**: Human-following robots typically rely on sensors to detect and track humans, which limits their autonomy. They may struggle to operate independently in complex or unpredictable environments without human intervention
- **Vulnerability to Environmental Factors**: Human-following robots are susceptible to environmental factors such as lighting conditions, obstacles, and terrain variations. Changes in the environment can affect sensor readings and hinder the robot's ability to accurately detect and track humans.
- **Limited Speed and Agility**: Human-following robots may not be able to match the speed and agility of humans, especially in situations requiring rapid movement or manoeuvering through tight spaces. Their movement capabilities may be restricted by factors such as motor speed, weight distribution, and navigation algorithms.
- **Dependency on Human Presence**: Human-following robots rely on the presence of humans to function effectively. They may struggle to operate in environments where humans are absent or unwilling to interact with the robot, limiting their applicability in certain scenarios.

CHAPTER-4

PROPOSED SYSTEM

4.1 INTRODUCTION

We proposed that we are using a customized Pulse Width Modulation Servo Control Module is a device that allows to control the servo motors using PWM signals. It control the amount of power delivered to electronic devices by varying the width of the pulse. In our project using PWM module to connect the Robot arm and human-following robot. And we are using the HC-05 Bluetooth module to control the moment of the robot arm through the smart phones.

The addition of a robot arm to the human-following robot system can greatly enhance its functionality and versatility. The robot arm can be used for tasks such as object manipulation, picking up items or even can act as a assistance to individuals in needs. PWM servo motor control modules into the system allows for precise control of the robot arm's movements. Servo motors are commonly used in robotic applications due to their accuracy and ease of control. By using PWM signals, the position and movement of the servo motors can be adjusted with high precision, enabling smooth and precise manipulation of the robot arm. The HC-05 module is a Bluetooth serial communication module that can be used to establish wireless communication between the human-following robot system and external devices such as smartphones or tablets. By integrating the HC-05 module into the system, it becomes possible to remotely control and monitor the robot's actions, providing greater flexibility and control over its operation

With these enhancements, the proposed system not only retains its ability to autonomously track and follow a human but also gains the capability to interact with the environment using the robot arm. This expanded functionality opens up a wide range of potential applications for the system, including assistance in public spaces, industrial applications, and security, while also addressing some of the limitations mentioned, such as the ability to interact with obstacles or objects in dynamic environments. A pick and place robot is designed to automate the process of picking up objects from one location and placing them in another. At its core, this robot consists of a robotic arm with multiple joints, often equipped with a versatile gripper or end effector for grasping objects of various shapes and sizes. To perceive its environment and locate objects, the robot is equipped with sensors such as cameras, LiDAR, or depth sensors. Safety is paramount in the operation of pick and place robots. Collision detection systems, utilizing sensors, prevent accidental collisions with objects or humans in the robot's vicinity. An emergency stop mechanism is also implemented to immediately halt robot movement in critical situations, ensuring the safety of both the robot and its surroundings. The software of a human following robot encompasses various functionalities, including human recognition algorithms to distinguish the target individual from other objects or individuals in the environment. Natural language processing (NLP) capabilities enable the robot to understand and respond to verbal commands or inquiries from the followed human. Localization and mapping algorithms allow the robot to map its surroundings and accurately localize itself relative to the human target. Additionally, learning and adaptation algorithms may be employed to improve the robot's performance over time based on user interactions and feedback.

4.2 BLOCK DIAGRAM

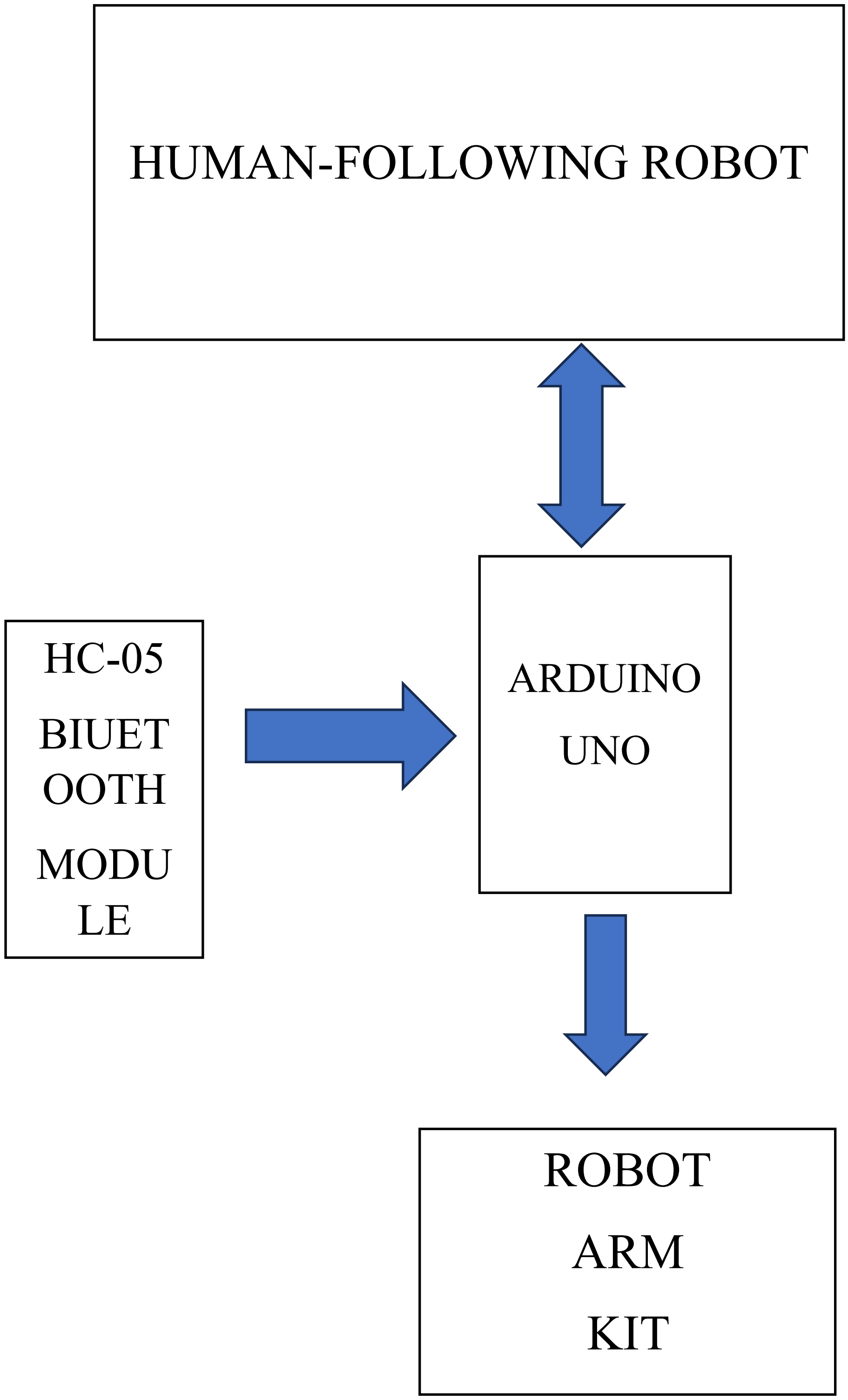

Fig: 4.2 Block Diagram of Proposed System

4.3 ARDUINO UNO

The Arduino UNO is the best board to get started with electronics and coding. Ifthis is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family.

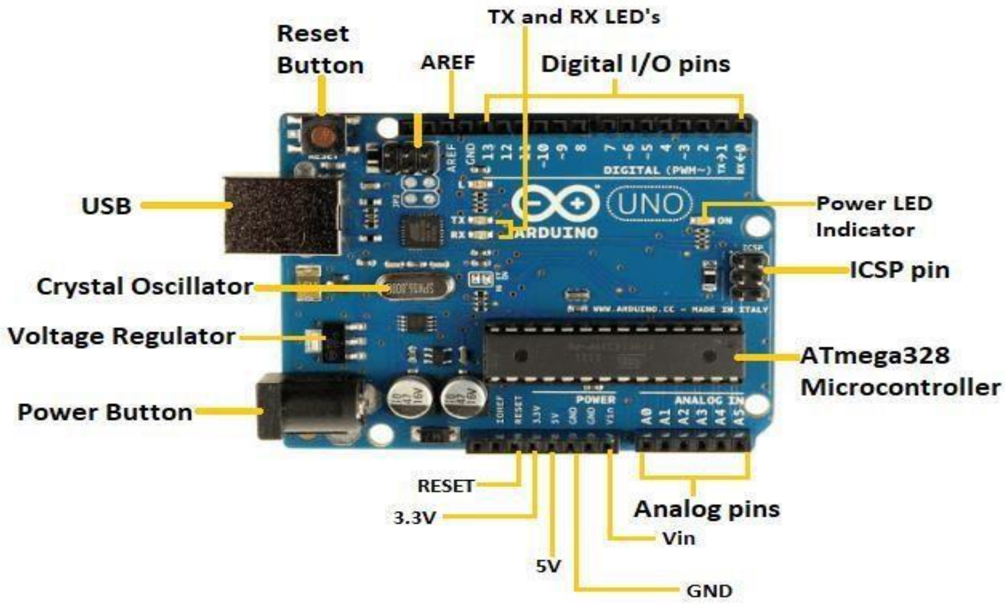

Fig : 4.3 ARDUINO UNO

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board. Arduino UNO is based on an ATmega328P micro controller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits. The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms. The IDE is common to all available boards of Arduino.

Let's discuss each component in detail.

- **ATmega328 Microcontroller**- It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.

- **ICSP pin** - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- **Power LED Indicator**- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.
- **Digital I/O pins**- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- **TX and RX LED's-** The successful flow of data is represented by the lighting of these LED's.
- **AREF-** The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- **Reset button**- It is used to add a Reset button to the connection.
- **USB**- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- **Crystal Oscillator**- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- **Voltage Regulator**- The voltage regulator converts the input voltage to 5V.
- **GND**- Ground pins. The ground pin acts as a pin with zero voltage.
- **Vin**- It is the input voltage.
- **Analog Pins**- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

4.3.1 ARDUINO UNO STRUCTURE

Let's discuss each pin in detail.

- **ATmega328 Micro controller**

It is a single chip Micro controller of the ATmega family. The processor core inside it is of 8bit. It is a low-cost, low powered, and a simple micro controller. The Arduino UNO and Nano models are based on the ATmega328 Micro controller.

- **Voltage Regulator**

Voltage regulator converts the input voltage to 5V. The primary function of voltage regulator is to regulate the voltage level in the Arduino board. For any changes in the input voltage of the regulator, the output voltage is constant and steady.

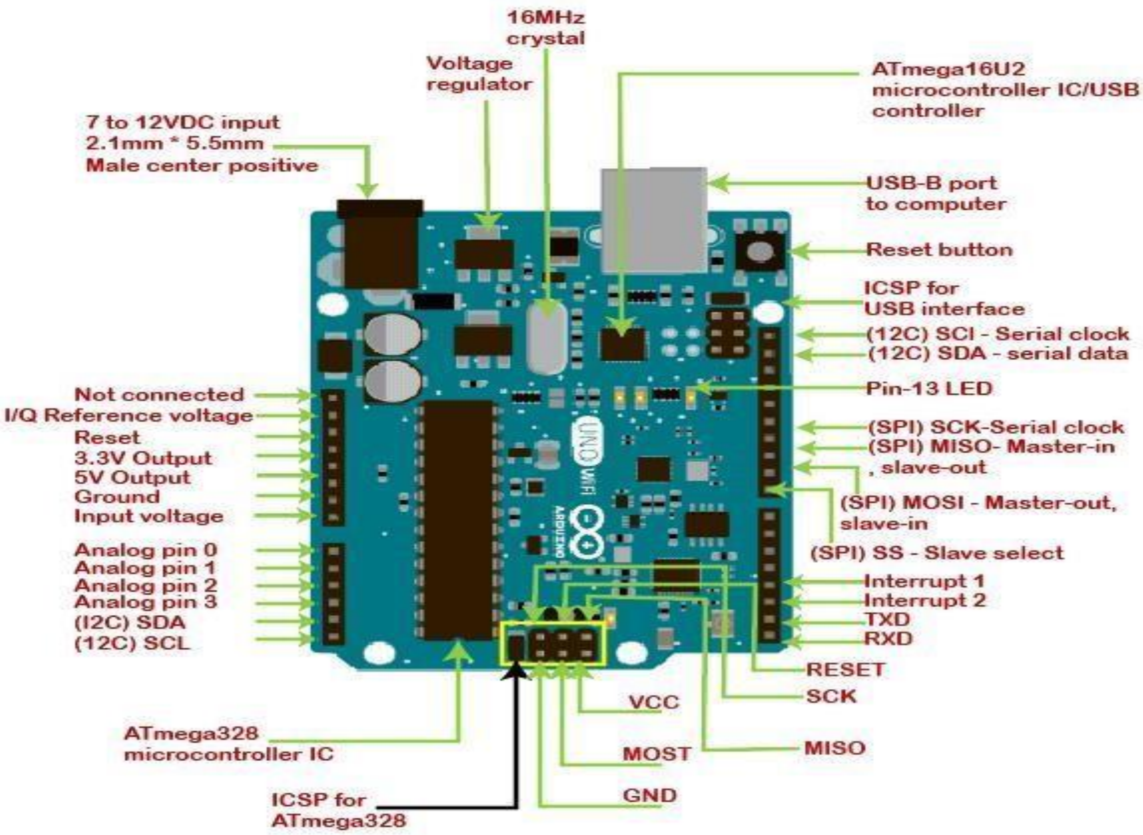

Fig : 4.3.1 ARDUINO UNO Structure

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Voltage regulator converts the input voltage to 5V. The primary function of voltage regulator is to regulate the voltage level in the Arduino board. For any changes in the input voltage of the regulator, the output voltage is constant and steady.

- **GND**

Ground pins. The ground pins are used to ground the circuit.

- **TXD and RXD**

TXD and RXD pins are used for serial communication. The TXD is used for transmitting the data, and RXD is used for receiving the data. It also represents the successful flow of data.

- **USB Interface**

The USB Interface is used to plug-in the USB cable. It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.

- **RESET**

It is used to add a Reset button to the connection.

- **SCK**

It stands for Serial Clock. These are the clock pulses, which are used to synchronize the transmission of data.

- **MISO**

It stands for **Master Input/ Slave Output**. The save line in the MISO pin is used to send the data to the master.

- **VCC**

It is the modulated DC supply voltage, which is used to regulate the IC's used in the connection. It is also called as the primary voltage for IC's present on the Arduino board. The Vcc voltage value can be negative or positive with respect to the GND pin.

- **Crystal Oscillator**

The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.

4.3.2 ICSP

It stands for In-Circuit Serial Programming. The users can program the Arduino board's firmware using the ICSP pins. The program or firmware with the advanced functionalities is received by micro controller with the help of the ICSP header. The ICSP header consists of 6 pins. The structure of the ICSP header is shown below:

Fig : 4.3.2 Structure of ICSP

It is the top view of the ICSP header.

- **SDA**: It stands for **Serial Data**. It is a line used by the slave and master to send and receive data. It is called as a **data line,** while SCL is called as a clock line.
- **SCL**:It stands for **Serial Clock**. It is defined as the line that carries the clock data. It is used to synchronize the transfer of data between the two devices. The Serial Clock is generated by the device and it is called as master.

- **SPI**: It stands for **Serial Peripheral Interface**. It is popularly used by the microcontrollers to communicate with one or more peripheral devices quickly. It uses conductors for data receiving, data sending, synchronization, and device selection (for communication).
- **MOSI**: It stands for Master Output/ Slave Input. The MOSI and SCK are driven by the Master.
- **I2C**: It is the two-wire serial communication protocol. It stands for Inter Integrated Circuits. The I2C is a serial communication protocol that uses SCL (Serial Clock) and SDA (Serial Data) to receive and send data between two devices. 3.3V and 5V are the operating voltages of the board.

4.3.3 INFRARED SENSOR

An IR (Infrared) sensor, also known as an IR module or IR detector, is a device that detects infrared radiation in its surrounding environment. It's commonly used in various applications such as motion detection, object detection, proximity sensing, and remote control systems.

- **Working Principle**: IR sensors work based on the principle of detecting infrared radiation emitted or reflected by objects in their vicinity. They typically consist of an IR emitter (LED) and an IR receiver (photodiode or phototransistor). The emitter emits infrared light, while the receiver detects any infrared radiation that reflects back from nearby objects.

- **Detection Range**: The detection range of an IR sensor depends on factors such as the power of the IR emitter, sensitivity of the receiver, and the nature of the surrounding environment. Typically, IR sensors have a detection range of a few centimeters to several meters.

- **VCC (Power)**: This is the power supply pin through which the sensor receives the voltage necessary for operation. The voltage requirements may vary depending on the sensor model, but common values are 3.3V or 5V.

- **GND (Ground):** This pin is connected to the ground of the circuit. It serves as the reference point for the power supply and signal.

- **OUT (Output):** This pin outputs the signal from the sensor. The nature of the output signal depends on the specific type of IR sensor:

  - For an IR proximity sensor, the output might be a digital signal (high or low) indicating whether an object is detected within a certain range.
  - For an IR photodiode or phototransistor, the output could be an analog signal that varies with the intensity of the detected infrared light.

4.3.4 ULTRASONIC SENSOR

The ultrasonic sensor is a type of sensor that uses sound waves to detect the presence or distance of objects. It emits ultrasonic sound waves (sound waves with frequencies above the human audible range) and then listens for the echo reflected back from nearby objects. By measuring the time it takes for the sound waves to travel to the object and back, the sensor can determine the distance to the object .

- **VCC (or VCC+)**: This pin is used to provide power to the sensor. It typically requires a DC voltage supply between 5V to 5.5V.
- **GND (or Ground)**: This pin is connected to the ground (0V) of the power supply, completing the circuit.
- **Trigger (Trig)**: The Trigger pin is used to initiate the ultrasonic signal transmission. When a short pulse (usually 10 microseconds) is sent to this pin, the sensor emits an ultrasonic burst.
- **Echo**: The Echo pin is used to detect the return signal (echo) from objects in the sensor's field of view. The duration of the high level signal on this pin is proportional to the time it takes for the ultrasonic signal to travel to the object and back. This duration can be measured to calculate the distance to the object.

4.3.5 MOTOR DRIVER:

The L298N Dual Motor Driver is a widely used module for controlling DC and stepper motors. It is based on the L298N integrated circuit, which is a dual H-bridge motor driver capable of driving a pair of DC motors or a single stepper motor. The L298N chip can handle high current loads and is typically used in robotics, CNC machines, and other applications requiring motor

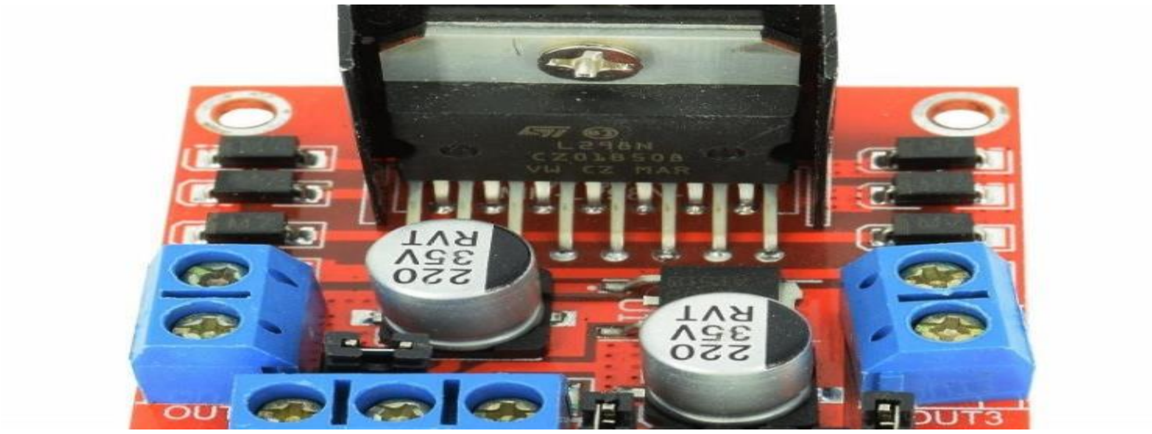


Fig:4.3.5 L298N Dual motor driver

- **Dual H-Bridge**: The L298N has two H-bridges, which allows it to independently control two DC motors, or to drive one bipolar stepper motor.
- **Voltage and Current:** The driver can typically handle supply voltages from 5V to 35V (up to 46V maximum) and can deliver up to about 2A per channel in continuous operation, with peak currents up to 3A per channel, making it suitable for a variety of medium-sized motors.

- **Heat Management:** It includes large heat sinks to dissipate heat during high current operation, which is crucial to prevent thermal shutdowns.
- **Input Voltage**: The board can be powered through an onboard 5V regulator with an input range usually from 7V to 35V. This onboard regulator can also supply 5V out if needed, provided the input voltage is high enough (usually above 12V).
- **Control Inputs:** The L298N module typically features four input pins per channel for controlling the direction and speed of each motor. These inputs are compatible with standard TTL (Transistor-Transistor Logic) and CMOS levels, which means they can be directly driven by microcontrollers like Arduino.
- **Enable Pins:** It has enable pins for each channel which can be used to enable or disable the motor quickly. These pins can also be used for PWM (Pulse Width Modulation) input to control motor speed.

4.3.6 DC MOTORS

DC motors are commonly used with Arduino microcontrollers for various projects involving movement, such as robotics, motorized vehicles, and automation.

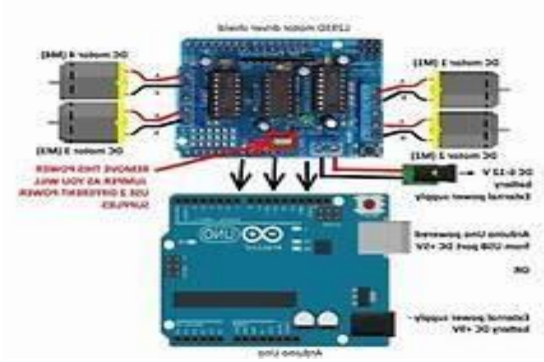


Fig: 4.3.6 Dc Motors

- **Basic Operation**: DC motors operate by converting electrical energy into mechanical energy. When voltage is applied across the terminals of the motor, it causes the motor to rotate. By reversing the polarity of the voltage, the direction of rotation can be changed.
- **Voltage and Current Requirements**: DC motors have specific voltage and current requirements, which vary depending on the motor's specifications. It's important to match the voltage and current ratings of the motor with the capabilities of the power supply and motor driver circuitry to ensure proper operation and prevent damage to the motor or other components.
- **Motor Control**: Arduino microcontrollers can control DC motors using pulse-width modulation (PWM) signals. PWM allows you to vary the speed of the motor by adjusting the duty cycle of the PWM signal. By rapidly switching the motor on and off

at varying speeds, the average voltage applied to the motor can be controlled, resulting in variable speed control.

4.3.7 HC-05 MODULE

The HC-05 is a Bluetooth module commonly used for wireless communication in electronic projects.

Fig:4.3.7 HC-05 Module

1. **Bluetooth Version**: The HC-05 module typically implements Bluetooth version 2.0 + EDR (Enhanced Data Rate). It supports the Serial Port Profile (SPP), allowing for easy serial communication between devices.

2. **Communication Range**: The effective communication range of the HC-05 module is usually around 10 meters (approximately 33 feet) under typical conditions. However, the range can vary depending on environmental factors such as obstacles and interference.

3. **Operating Voltage**: The HC-05 module typically operates at 3.3 volts (VCC).

However, some modules are designed to be compatible with both 3.3V and 5V systems.

4. **Serial Communication Interface**: The HC-05 module communicates with other devices (such as microcontrollers like Arduino) using serial communication. It has pins for RX (Receive), TX (Transmit), VCC (Power), GND (Ground), and optional pins for state indicators (such as LED indicators).

5. **Master and Slave Modes**: The HC-05 module can operate in both master and slave modes. In master mode, it can initiate connections with other Bluetooth devices, while in slave mode, it can accept connections initiated by other devices

4.3.8 ROBOT ARM

A robot arm is a mechanical device typically used for manipulating objects or performing tasks in various applications such as manufacturing, assembly lines, research, and even hobbyist projects. Robot arms come in different configurations and designs, but they generally consist of several key components, including DC motors, gears, and grippers.

Fig:4.3.8 Robot Arm

- **DC Motors**: DC motors are commonly used to drive the joints of the robot arm. These motors convert electrical energy into mechanical motion, allowing the robot arm to move its joints in different directions. The number of DC motors in a robot arm depends on its degree of freedom (DOF) or the number of joints it has. Each motor is typically controlled independently to achieve precise motion control.
- **Gears**: Gears are often used in robot arms to transmit motion and torque from the DC motors to the various joints of the arm. Gears help to increase or decrease the speed of motion, provide mechanical advantage, and improve the overall efficiency of the system. Gearboxes are commonly used to control the speed and torque output of the DC motors, allowing for precise control of the robot arm's movement.
- **Gripper**: The gripper, also known as an end effector or end-of-arm tooling, is the part of the robot arm that interacts with objects or performs tasks. Grippers come in various designs, including pneumatic, hydraulic, electric, or mechanical grippers, depending on the application requirements. The gripper may consist of jaws, fingers, or suction cups

  to grasp, lift, manipulate, or release objects. The gripper is often attached to the end of the robot arm and may be interchangeable to accommodate different tasks

CHAPTER 5

ADVANTAGES AND APPLICATIONS

5.1 ADVANTAGES OF PROPOSED SYSTEM:

- **Enhanced Efficiency**: By integrating pick and place capabilities with a human-following feature, the remote grip rover can efficiently perform tasks in dynamic environments. It can autonomously navigate through spaces, follow humans to designated locations, and execute pick and place operations with precision, reducing manual effort and time spent on repetitive tasks.
- **Flexible Operation**: The versatility of the remote grip rover allows it to adapt to various scenarios and tasks. It can switch between pick and place mode and human-following mode seamlessly, providing flexibility in operation based on the requirements of the environment or task at hand.
- **Safety**: Incorporating human-following capabilities ensures safe interaction between the robot and its human operators or collaborators. The rover can maintain a safe distance from humans while following them, reducing the risk of collisions or accidents in shared workspaces.
- **Adaptability to Changing Environments**: The remote grip rover's ability to follow humans allows it to adapt to dynamic environments where layouts or obstacles may change. It can navigate around obstacles, adjust its path, and continue operations without human intervention, ensuring uninterrupted workflow even in unpredictable conditions
- **Collaborative Workflows**: The integration of pick and place capabilities with human-following features promotes collaborative workflows between humans and robots. The rover can work alongside human operators, assisting them in tasks that require precision or strength, fostering a synergistic relationship that maximizes productivity and efficiency.

5.2 APPLICATIONS OF PROPOSED SYSTEM

- **Warehouse Logistics**: The remote grip rover can navigate through warehouses, follow human pickers, and assist in picking and placing items onto shelves or into order bins, optimizing inventory management and order fulfillment processes.

- **Construction Sites**: In construction environments, the rover can accompany workers, transporting tools or materials to different locations on-site, assisting in assembly tasks, or aiding in debris removal, thereby improving productivity and safety.

- **Disaster Response and Search-and-Rescue**: In emergency situations, such as natural disasters or search-and-rescue operations, the rover can accompany rescue teams, carrying supplies, tools, or communication equipment to remote or inaccessible locations, aiding in relief efforts and enhancing coordination among responders.

- **Healthcare Facilities**: In hospitals or clinics, the rover can follow medical staff, transporting medical supplies, equipment, or patient records between different departments, improving workflow efficiency and reducing wait times.

- **Agricultural Harvesting**: On farms, the rover can follow farmworkers during harvesting operations, collecting fruits, vegetables.

CHAPTER 6

TOOLS

SOFTWARE REQUIREMENTS:

6.1 ARDUINO IDE :

The Arduino software (IDE) is anything but difficult to-use for fledglings, yet sufficiently adaptable for cutting edge clients to exploit too. for instructions, it's helpfully in view of the processing programming condition ,so understudies figuring out how to program in that condition will be acquainted with how the Arduino IDE functions .Arduino is a model stage (open-source) in perspective of an easy to-use gear and programming. it includes a circuit board, which can be tweaked (suggested as a microcontroller) and a moment programming called Arduino IDE (Integrated development Environment),which is used to make and exchange the PC code to the physical board.

The key highlights are:

1. Arduino sheets can read straightforward or propelled data signals from different sensors and change it into a yield, for instance, starting a motor, turning LED on/off, connect with the cloud and various distinctive exercises.

2.unlike most past programmable circuit sheets, Arduino does not require an extra piece of gear (considered a product build) with a particular ultimate objective to stack another code onto the board.you can simply use a USB interface.

3.Additionally, the Arduino IDE uses a streamlined interpretation of C++,making it less requesting to make sense of how to program.

4.Finally,Arduino gives a standard edge factor that breaks the components of the scaled down scale controller into a more open package.

6.2 Operation Demo:

STEP 1: INSTALL THE ARDUINO SOFTWARE (IDE)

Download the most recent variant from this page:http://arduino.cc/en /main/software next, continue with the establishment and please permit the driver establishment process

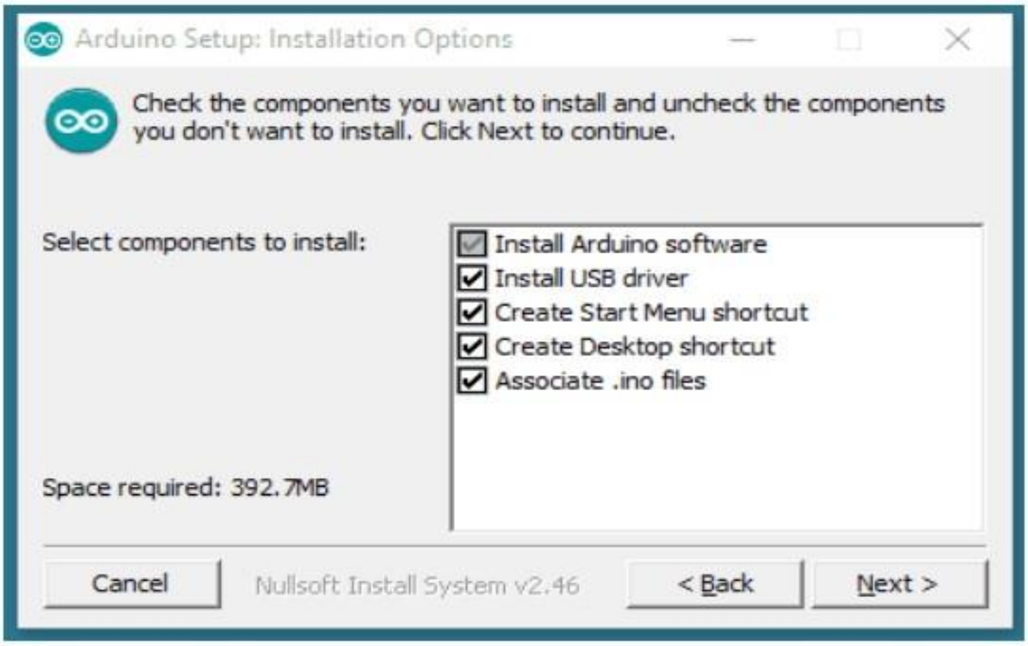


Fig. 6.2.1 Arduino setup-installation options

Pick the parts to introduce and click “next”catch

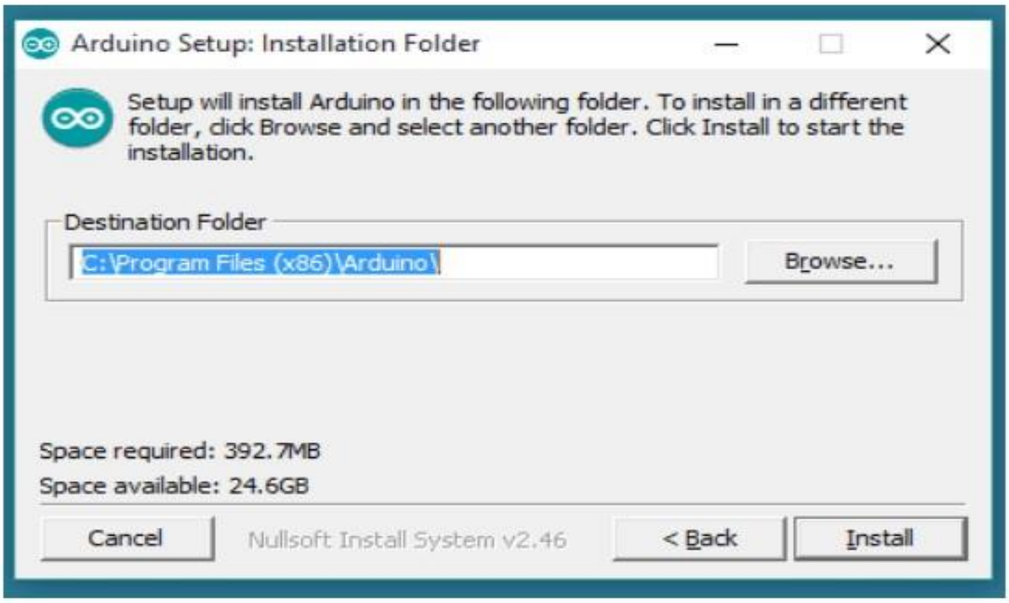


Fig.6.2.2 Arduino setup installation folder

Pick the establishment index.

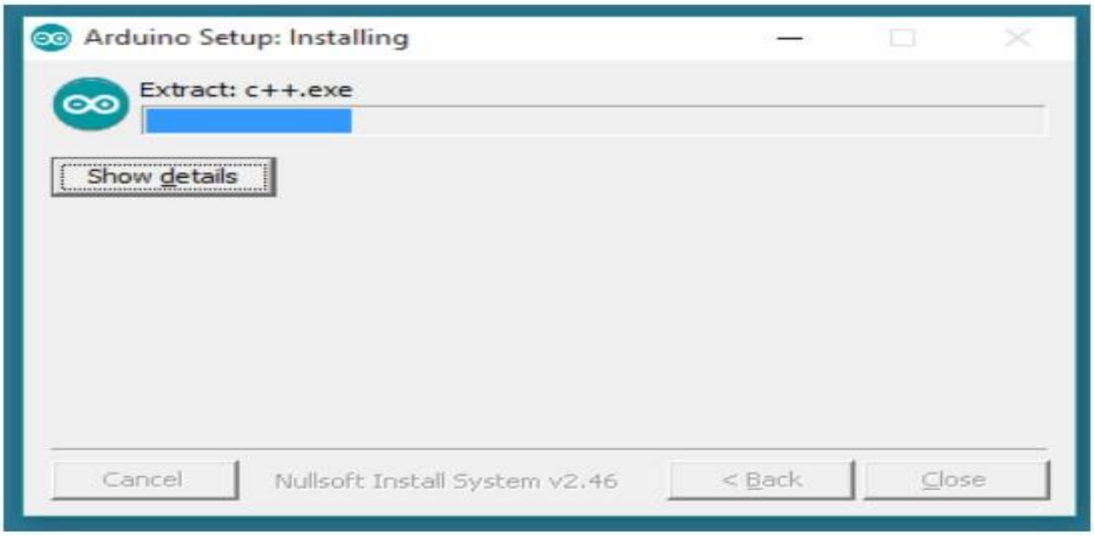


Fig.6.2.3 Arduino setup-installing

The procedure will separate and introduce all the expected documents to execute legitimately the Arduino software (IDE)

STEP 2: GET AN UNO R3 AND USB CABLE

In this instructional exercise, you're utilizing an Uno R3. You additionally require a standard USB link (A fitting to B plug): the kind you would associate with a USB printer, for instance.

Fig. 6.2.4 USB cable UNO R3 board

STEP 3: CONNECT THE BOARD

The USB association with the PC is important to program The USB association with the PC is important to program the board and not simply to control it up. The Uno and Mega consequently draw control from either the USB or an outside power supply. Associate the board to your PC utilizing the USB link.

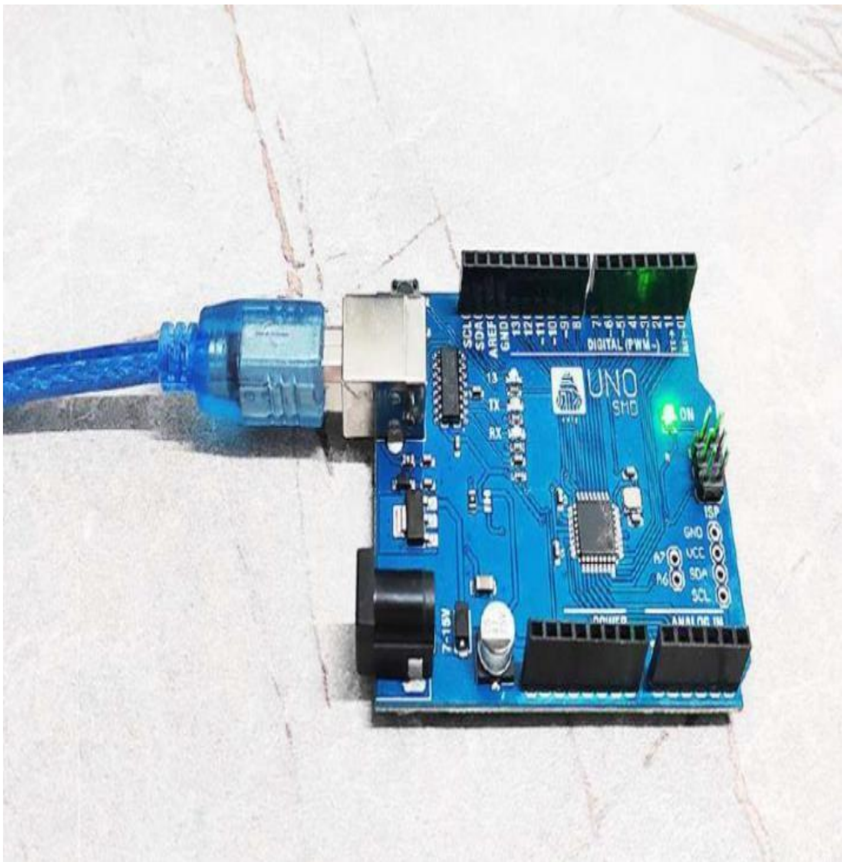


Fig. 6.2.5 Represents how to connect USB cable with UNO board

STEP 4: OPEN LESSON 1: LED BLINK

Open the LED blink example sketch: CD > For Arduino Demo Code>Lessonl- LED bink>led.

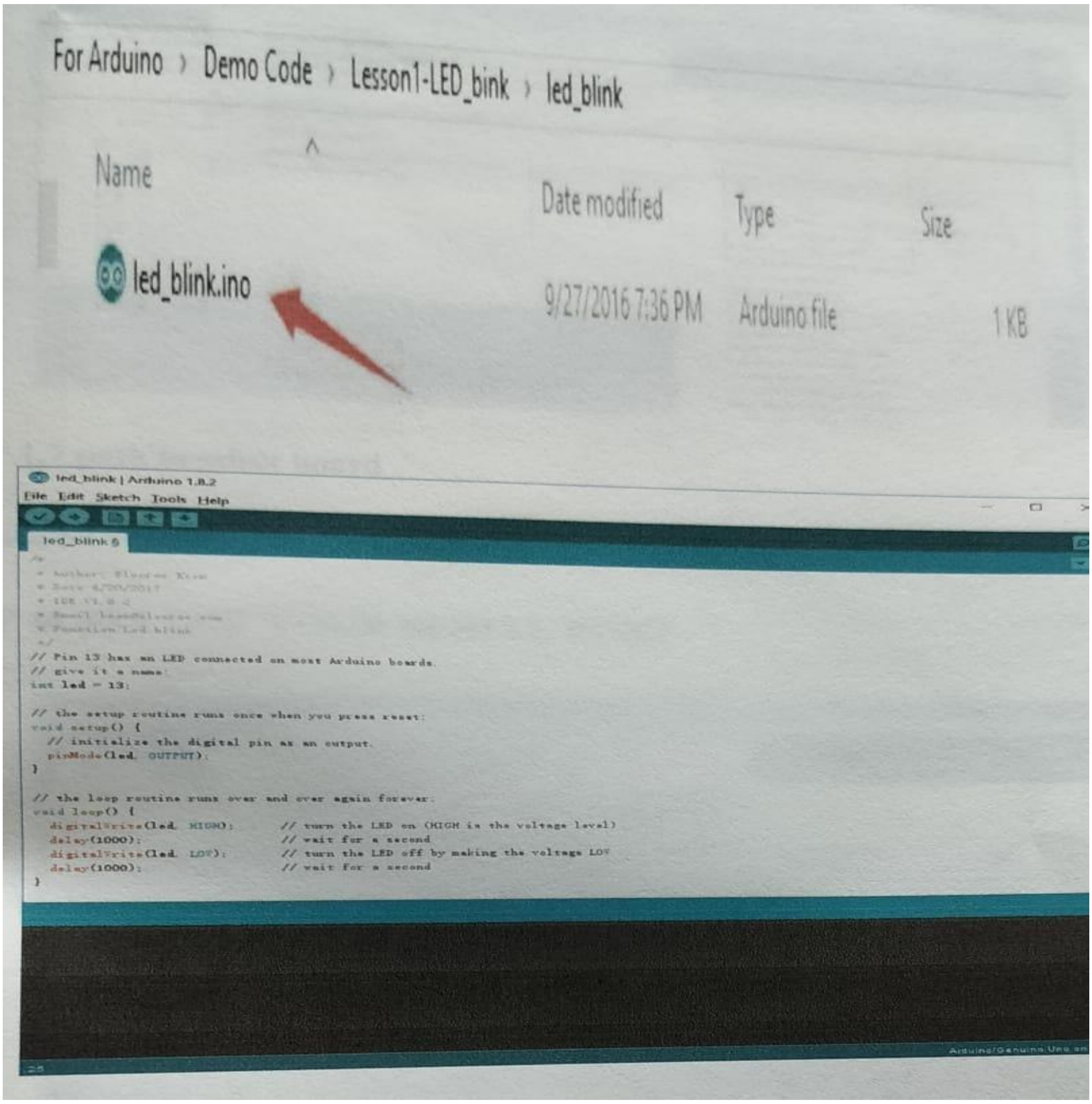


Fig. 6.2.6 LED valve and program to blink LED

STEP 5: SELECT YOUR BOARD

You'll need to select the entry in the Tools > Board menu that corresponds to your Arduino board.

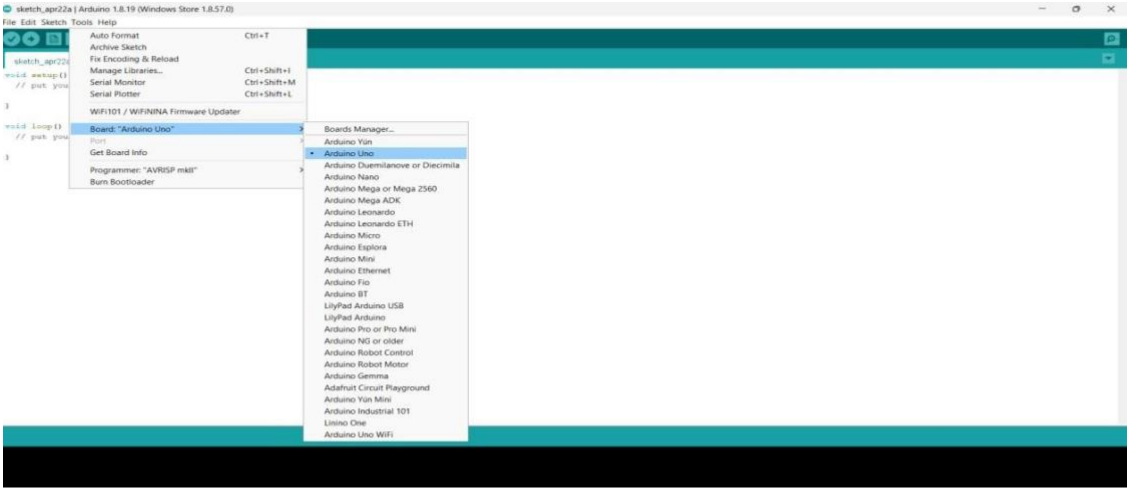


Fig. 6.2.7 path to select board

Selecting an Arduino/Genuine Uno

STEP 6: SELECT YOUR SERIAL PORT

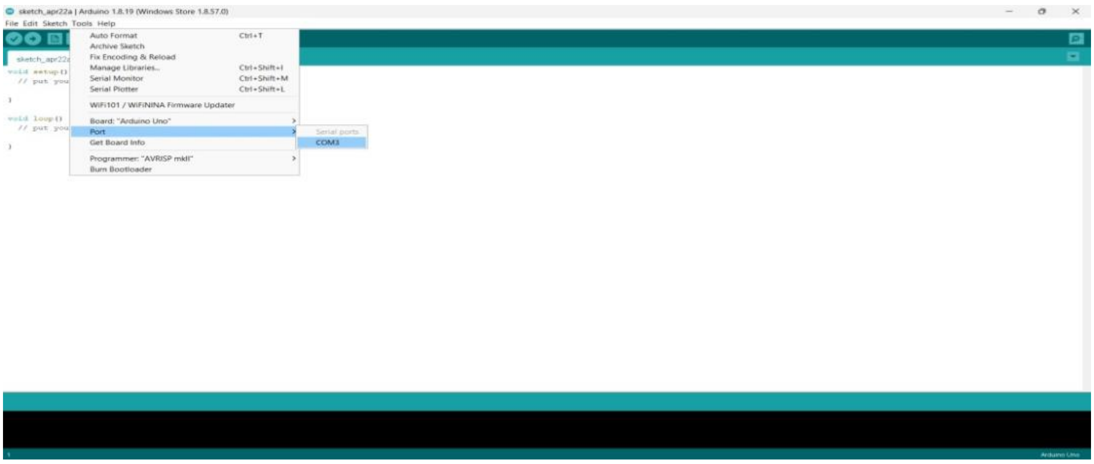


Fig. 6.2.8 path to select serial port

Select the serial gadget of the board from the Tools | Serial Port menu. This is probably going to be COM3or higher (COMlandCOM2are generally held for equipment serial ports). To discover, you can detach your board and re-open the menu; the passage that vanishes ought to be the Arduino board. Reconnect the board and select that serial port.

STEP 7: UPLOAD THE PROGRAM

Presently, essentially tap the "Transfer" catch in the earth. Hold up a couple of moments - you should see the RX and TX leds on the board blazing. On the off chance that the transfer is fruitful, the message "Done transferring." will show up in the status bar.

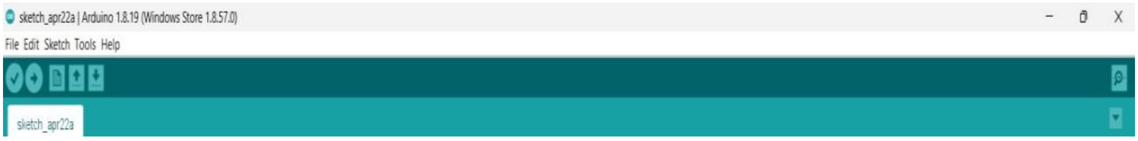


Fig. 6.2.9 path to upload

STEP 8: RESULT

A few seconds after the upload finishes, you should see the pin 13 (L) LED on the board start to blink (in orange). If it does, congratulations! You've gotten Arduino up-and- running.

6.2.10 Arduino Interface Introduction

Fig. 6.2.10 Tools in Arduino interface software

A->Compile
B->Upload
C->New
D->Open
E->Save
F->Serial monitor

6.2.11 Arduino UNO R3 Hardware Introduction

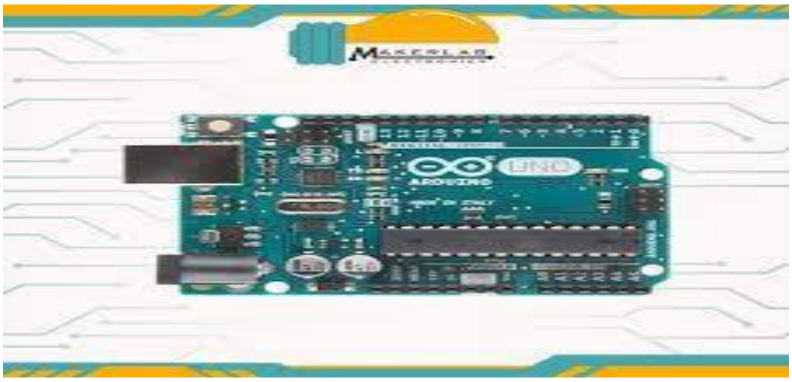


Fig. 6.2.11 UNO with hardware

6.2.12 HOW TO ADD LIBRARY FILES

Step 1:

Add library file: Sketch>Include Library>Add.ZIP Library

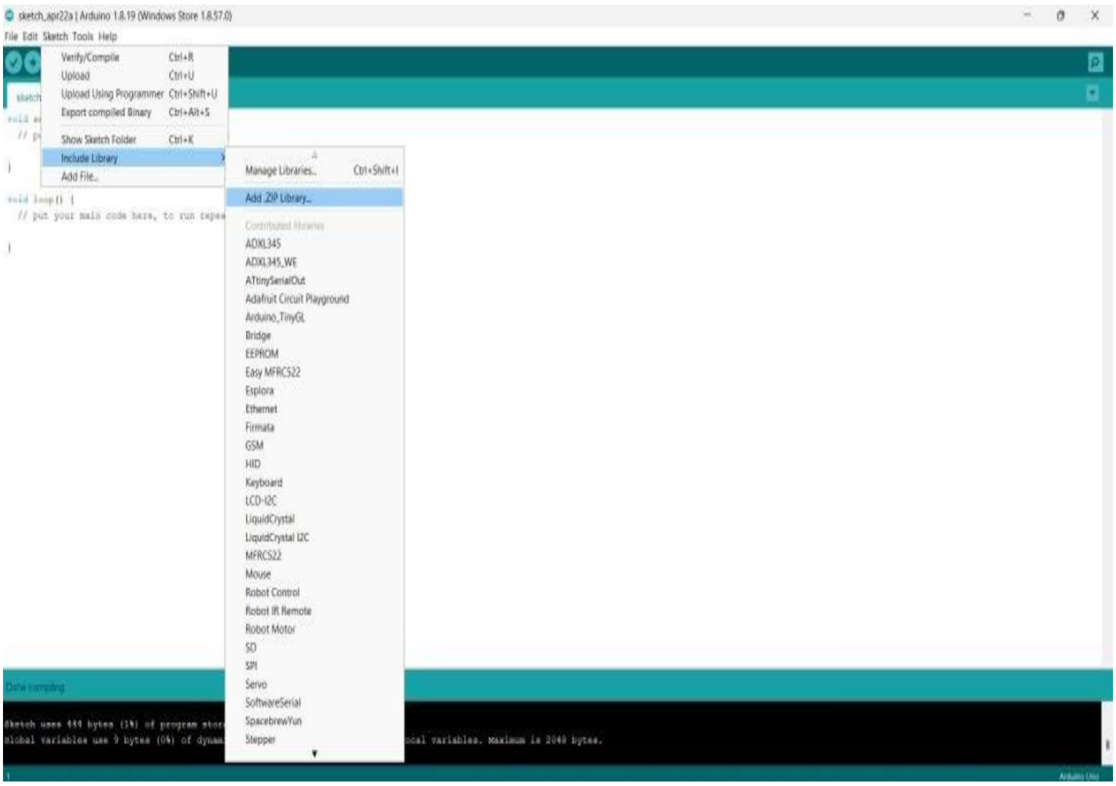


Fig. 6.2.12 path to add library files

STEP 2:

SELECT YOUR LIBRARY FILE COMPRESSION PACKAGE ON THE DEMO CODE FILE, AS FOLLOWS:

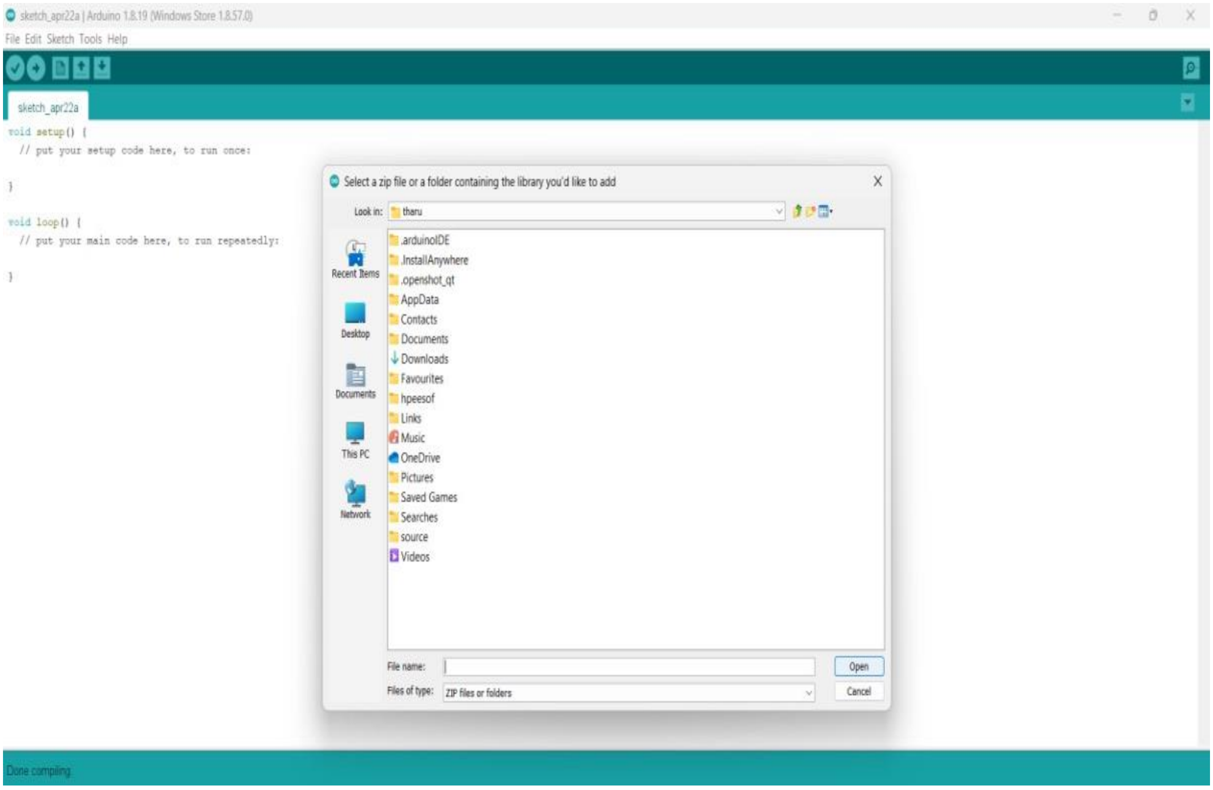


Fig.6.2.13 selecting the file to Arduino

6.3 SOURCE CODE

```
const int trigPin = 4;
const int echoPin = 5;
long duration; int
distance;

int mr1=8;
int
mmr2=9;
int ml1=6;
int ml2=7;

int irl=2;
int irr=3;
int
irldata;
int
irrdata;
void
setup() {
Serial.beg
in(9600);
pinMode(
trigPin,
OUTPUT
);
pinMode(
echoPin,
```

```
INPUT);
pinMode(
8,OUTP
UT); //
put your
setup
code
here, to
run once:
  pinMode(9,OUTPUT);
pinMode(6,OUTPUT);
pinMode(7,OUTPUT);
pinMode(2,INPUT);
pinMode(3,INPUT);
}

void loop() {
irldata=digitalRead(2);
irrdata=digitalRead(3);



  digitalWrite(trigPin, LOW);// Clears the trigPin delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);// Sets the trigPin on HIGH state for 10 micro
seconds delayMicroseconds(10);   digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);// Reads the echoPin, returns the sound wave travel
time in microseconds   distance= duration*0.034/2;// Calculating the distance
  Serial.print("Distance: ");// Prints the distance on the Serial Monitor
  Serial.println(distance);
```

```
  //delay(1000);

  if(irldata==0)   {
analogWrite(8,0);
analogWrite(9,60);
analogWrite(6,60);
analogWrite(7,0);}

  if(irrdata==0)   {
analogWrite(8,0);
analogWrite(9,60);
analogWrite(6,60);
analogWrite(7,0);}

   if(distance<15)
   {
analogWrite(8,0);
analogWrite(9,60);
analogWrite(6,60);
analogWrite(7,0);

}



     }
   #include        <Servo.h>
Servo sholder;
Servo arm;
```

```
Servo   base;         char
incoming_value=0;
  int      buz=7;
int Relay=6;



 void setup()
{
  Serial.begin(9600);
pinMode(7,OUTPUT);
pinMode(6,OUTPUT);
  sholder.attach(9);
arm.attach(10);
base.attach(8);

 }

 void loop()

 {
if(Serial.available()>0)
  {incoming_value=Serial.read();
  Serial.print(incoming_value);

    if(incoming_value=='2')
   {
   digitalWrite(6,1);}
```

```
 if(incoming_value=='3')
{
digitalWrite(6,0);}

if(incoming_value=='1')
{
digitalWrite(7,1);//PICK

base.write(100);          // right    delay(1500);

 sholder.write(0);         // down
delay(1500);
arm.write(40);                //open
delay(1500);          arm.write(0);
//    close               delay(1500);
sholder.write(60);               //up
delay(1500);

}

 else   if(incoming_value=='0')
{ digitalWrite(7,0);//PLACE
base.write(
  '6,00);         //left
 delay(1500);
sholder.write(0);          // down
delay(1500);      arm.write(40);
//open                delay(1500);
```

```
sholder.write(60);          //up
delay(1500);     arm.write(0);
// close   delay(1500);
 }
 }}
```

CHAPTER 7
EXPERIMENTAL SETUP

7.1 REPRESENTATION OF THE PROJECT

Fig 7.1: Experimental setup of remote grip rover

The electrical items include DC and stepper motors, actuators, electrical grips, clutches and their control. The electronics part involves remote control, sensors (touch sensor, light sensor, collision sensor, etc), their interface circuitry and a microcontroller for overall control function. The structural part involves use of frames, beams, linkages, axles, etc. The mechanical parts/accessories comprise various types of gears. The influential part of the robotic rover design is the gripper arm capable of picking up an object and doing functions of opening and closing the arm and following the human.

CHAPTER- 8
RESULTS AND DISCUSSIONS

CASE-1:

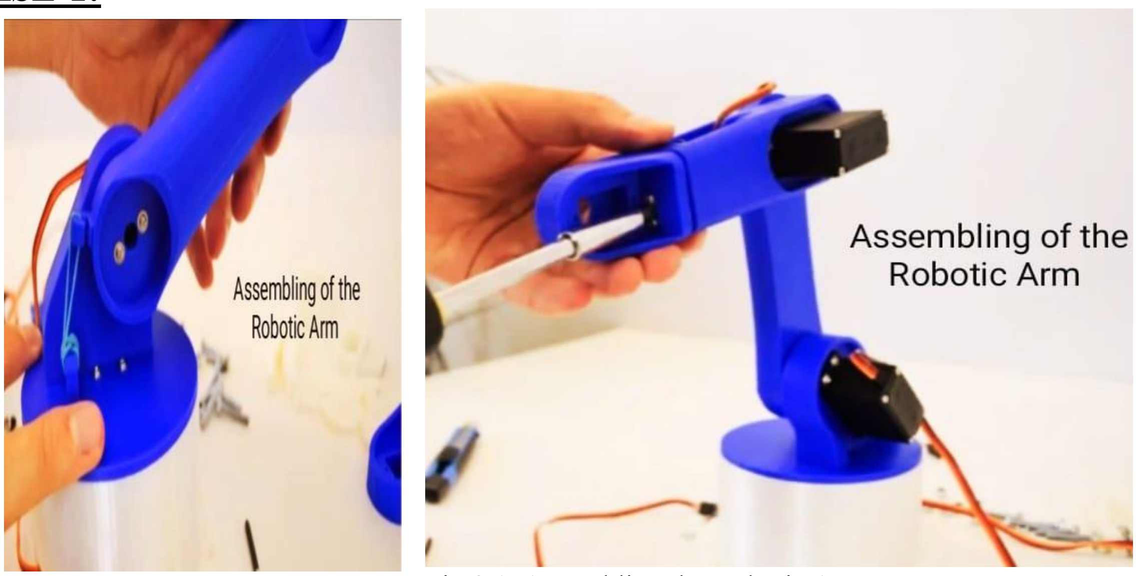


Fig 8.1: Assembling the Robotic Arm

The mechanical design of a robotic arm, which was inspired by the human hand, consists of several connections that together comprise a kinematic chain. The joints that connect the links provide the system with its rotational and translational movement capabilities. An end effector is also usually added to the end of the wrist-joint where a human hand would be on a human arm.

3D REPRESENTATION:

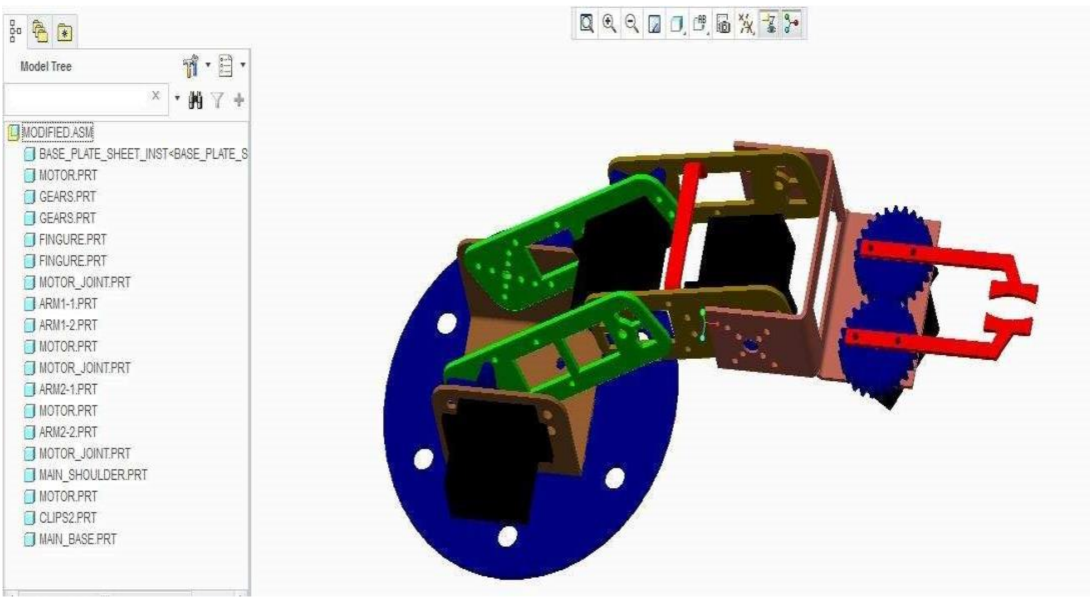


Figure 8.2: 3D view of full Assembly

*CASE-2:

INVERSE KINEMATICS ANALYSIS

In order to control the position and orientation of end- effector of a robot arm to reach its object, the inverse kinematics solution is more important. In this project, inverse kinematics problem is solved by RoboAnalyzer 3D Model Based Robotics Learning Software.

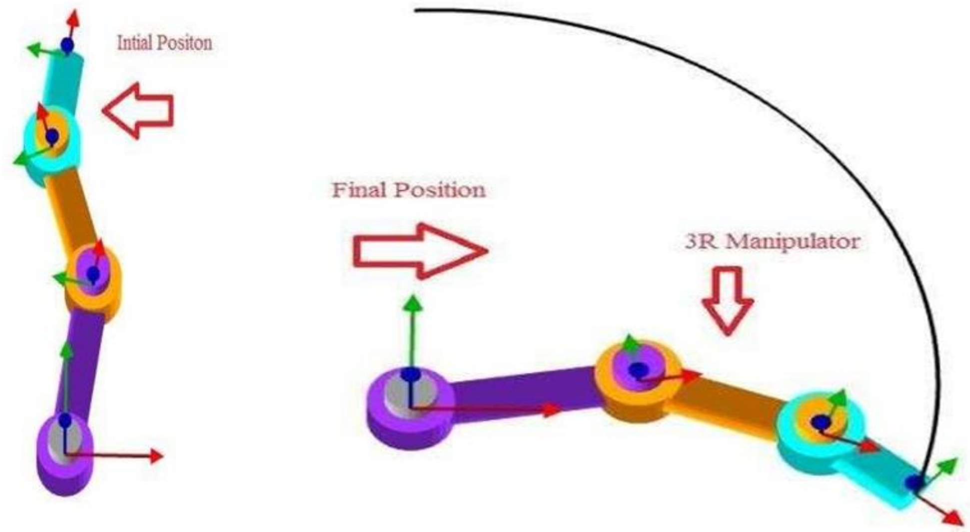


Figure 8.3: Initial and final position of Robotic arm**.**

The position and orientation of the end-effector in terms of given joint angles is calculated using a set of equations and this is forward kinematics. This set of equations is formed using DH parameters obtained from the link coordinate frame assignation. The parameters for the manipulator, where is the rotation about the Z-axis, α rotation about the X-axis, d transition along the Z-axis, and   transition along the X-axis.

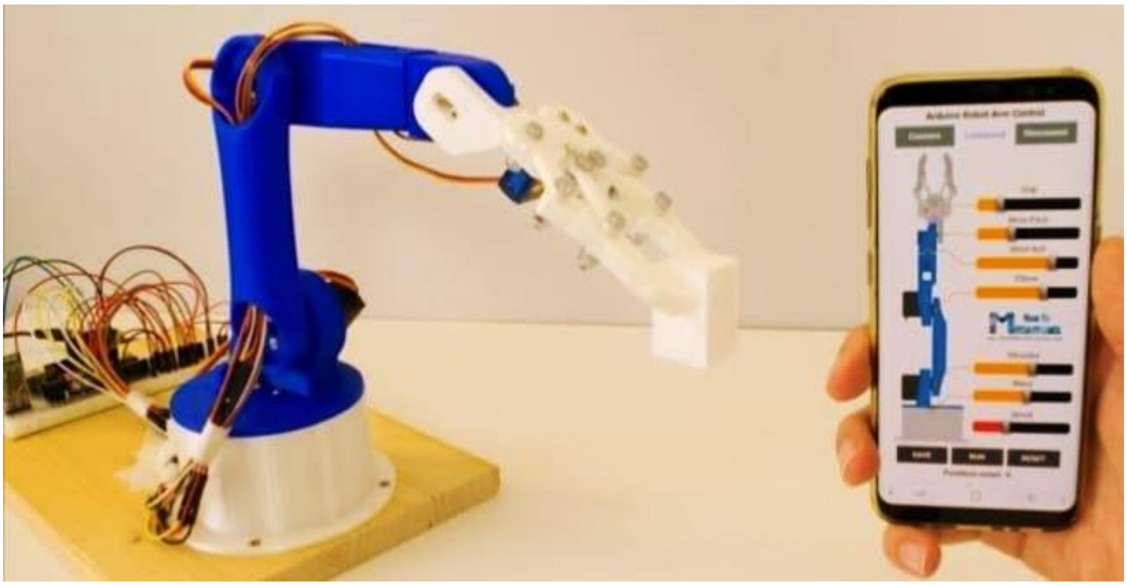


Fig 8.4: Building of the Robotic Arm

CASE-3:

Fig 8.5: Connecting the project with MIT AI2 Companion app

Here the robot is connected to MIT AI2 Companion app by downloading it through the Google Playstore.

After the app gets installed, there are 2 options shown such as Connect with Code and Scan the QR code.

Here we have connected by the process of scanning the QR CODE.

CASE-3:

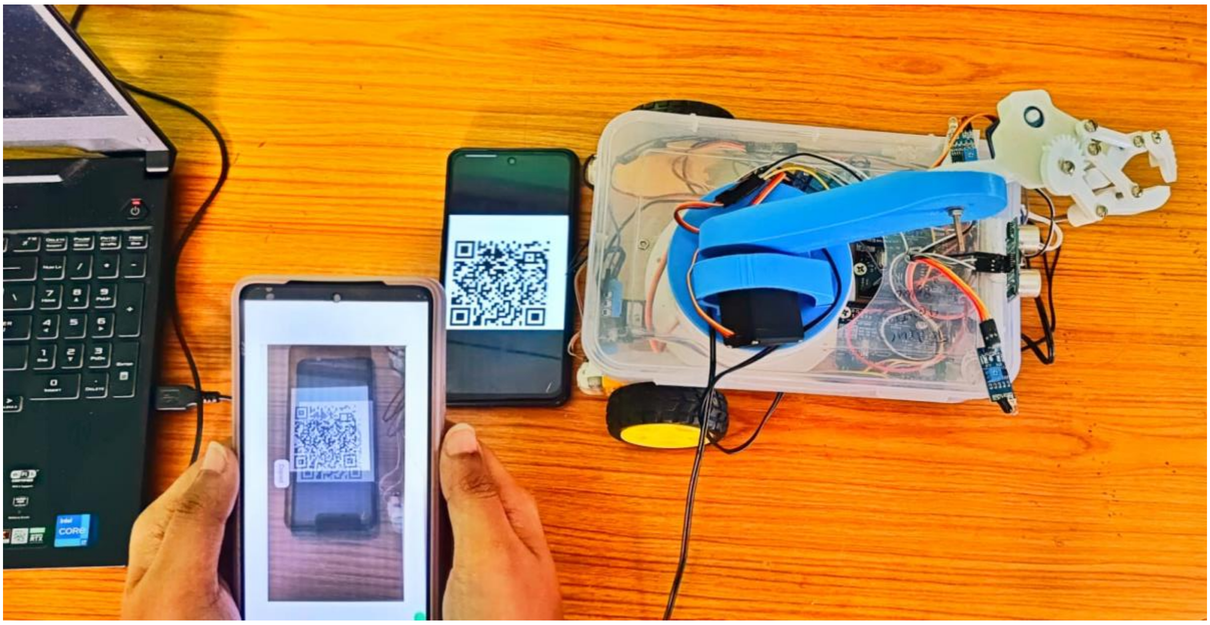
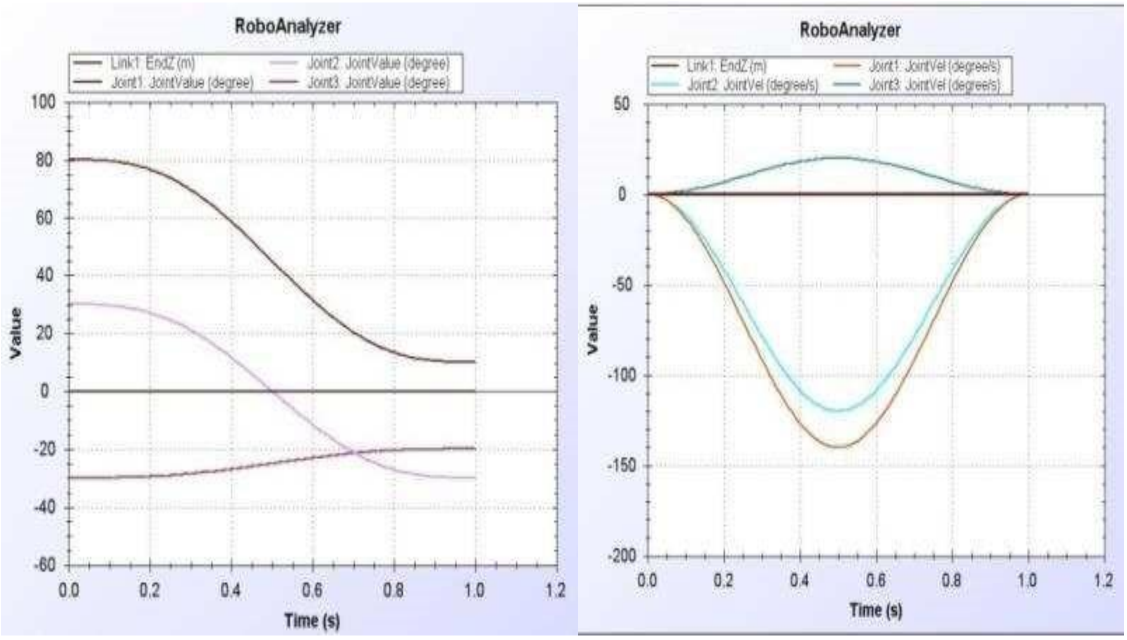


Fig 8.6: Scanning the QR code to connect

Steps	Operations	Time taken to complete (sec)
Step 1	Release of Gripper arm	15
Step 2	Down	4
Step 3	Grip (object)	11
Step 4	Up	5
Step 5	Right/left	5
Step 6	Down	3
Step 7	Release	12
Step 8	Up	5
Step 9	Grip (empty)	15
Step 10	Left/right	5

Table 8.1: Operation versus time taken to complete different tasks"

The robotic rover functionality comprises of some basic steps which were made fully autonomous using embedded C programming. The RF module was used to switch on/off the rover. Firstly, the release of empty gripper arm has taken a considerable time of 15 sec followed by down movement of 4 sec. Due to presence of gravity of earth, down movement took minimum time among all other operations. Thenceforth, the object was grasped by the gripper arm covering a total of 11 sec. The gripping and releasing operations done by gripper arm clutched substantial seconds as shown in table 1. Hereafter, the up movement of gripper arm took place with 5 seconds and positioning the object left/right. The object was then placed by a down release of 3 seconds since both the law of gravity and the weight of object exerted a downward force. Placing the object at proper place was the most momentous task. It took a second highest time of 12 sec with release operation of the arm. Consequently, the arm was moved in upward direction with gripping of the arm. These operations were continued until and unless an object of interest was discovered. Some Graphs output come out from Robo Analyzer Software by providing initial positions and final positions in term of joint angle as below:



Joint Value Vs Time **Joint Velocity Vs Time**

Fig 8.7: Graphical representation

CASE-4:

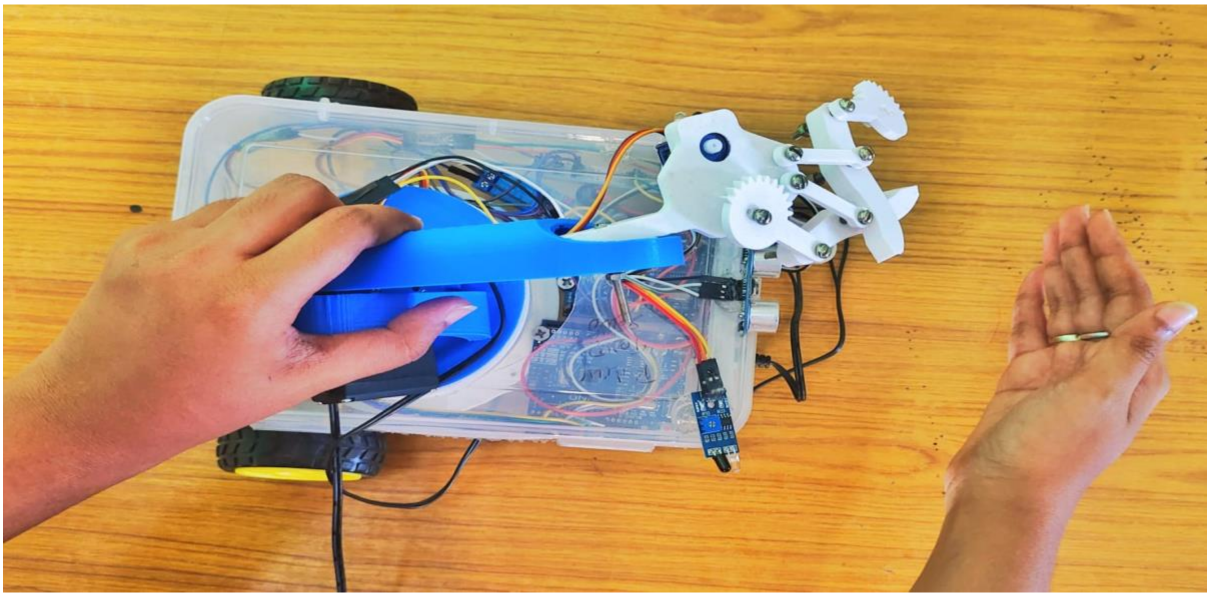


Fig 8.8: Remote Grip Rover doing Human following operations

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Here, it is observed that the remote grip rover is performing the human following operations in an appreciative manner. We have move forward and design our autonomous robot. This robot will follow any object or human coming in front of it within a range of 5-10 cm. We have used two IR sensors (proximity sensors), which will detect objects in front of them and send a signal to the robot. Both sensors will be attached in the front of the robot, one on the left side and one on the right side.

CASE_5:

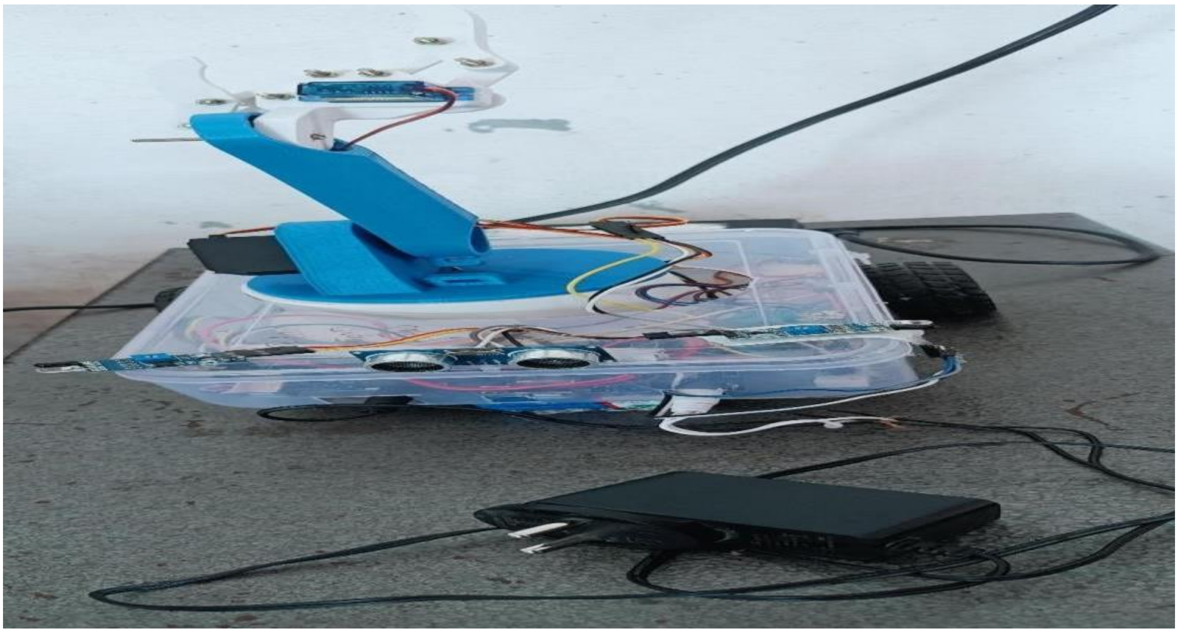

Fig 8.9: Remote Grip Rover performing both pick and place and human following operations

In the successful experiments, Remote grip rover created a place by performing the pick and place as well as the human following operations successfully.

COMPARISON BETWEEN EXISTING & PROPOSED SYSTEM

EXISTING SYSTEM	PROPOSED SYSTEM
It is only human and object following robot which follows the corresponding objects as well as humans.	It has both human -object following robot as well as the pick and place robot which consists of robotic arm for the functioning.
4 channel motor driver is used.	2 channel motor driver is used.
There is no use of HC-05 & robot arm in the existing system.	There is use of HC-05 & robot arm in the proposed system so as to perform the pick and place operations.
It can do single function like object following or human following.	It can do multi functions like object following, human following, pick & place operations.

Table 8.2: Comparison between Existing system ad proposed system

CHAPTER 9

CONCLUSION AND FUTURE SCOPE

9.1 CONCLUSION:

This project is working fine, getting the parameters envisaged during the conceptual stage. Also, components were selected keeping in mind their availability and cost.It was a very interesting process of developing the prototype. While designing same as which constructing, greater care has been taken up to final stage. And we go through a large no. of books and internet to know about the data of components. We have developed the concept by using new things like HC-05 module, and robot arm and smart development technology. Finally, our project satisfy us because it will be useful for people who are working in risky places like quarry and in factories. With this project we can reduce the risk to the people. We have faced many problems with the robot arm and for the moment of the wheels. An attempt has been made to make Remote Grip Rover with efficiency and affordable price. The design of Remote Grip Rover would significantly help in reducing the risk to the people and can act as a personal assistant in any work to the client. This paper has bestowed an overview of the proposed robotic rover which can be used for sensing and navigation. It can be made fully autonomous with in-built camera,high performance controller, ultrasound sensors for future work. These enhancements will foster its capability for long range navigation. Being a latest technology in India, it would be benefaction for our space and defence applications.

9.2 FUTURE SCOPE

The Remote Grip Rover can be further developed by integrating with machine learning algorithms for advance object and human recognition, enabling the robot arm to identify and manipulate a wider range of objects with varying shapes and sizes. Implement algorithms for adaptive grasping and manipulation techniques to enhance the robot arm's ability to interact with objects in diverse environments.

Develop algorithms for collaborative task execution, allowing the human-following robot system to work alongside humans in shared workspaces efficiently and safely. Explore the potential for intuitive human-robot interfaces, such as gesture recognition or voice commands, to facilitate seamless interaction between users and the robot arm.

Implement adaptive learning algorithms to enable the system to learn from user interactions and optimize its performance over time. Explore reinforcement learning techniques to enable the robot arm to learn and refine its manipulation skills through trial and error in real-world scenarios.

Integrate the system with IoT devices and cloud services to enable seamless data exchange and remote monitoring/control capabilities. Explore opportunities for data analytics and predictive maintenance to enhance the system's reliability and performance over extended periods of operation.

. Both pick and place robots and human following robots have promising future scopes, particularly in industries such as manufacturing, logistics, healthcare, and even in everyday environments like homes and public spaces. Here's a breakdown of the future potential for each:

1. **Pick and Place Robots**:
   - **Advanced Automation**: As industries continue to seek greater efficiency and productivity, pick and place robots will become more advanced and capable. They'll likely integrate with other technologies like AI, machine learning, and computer vision to enhance their capabilities.
   - **Customization and Flexibility**: Future pick and place robots may be designed to handle a wider variety of items with different shapes, sizes, and materials. Customization features may allow them to adapt quickly to changing production needs.
   - **Collaborative Robotics**: Collaborative robots, or cobots, will likely become more prevalent. These robots can work alongside human workers safely, enhancing productivity and efficiency while also ensuring workplace safety.
   - **Integration with IoT**: Integration with the Internet of Things (IoT) will enable pick and place robots to communicate with other machines and systems in the production line, allowing for smoother coordination and optimization of manufacturing processes.

- **Sustainability**: There might be a shift towards more eco-friendly materials and energy-efficient designs in pick and place robots, aligning with growing sustainability concerns.

2. **Human Following Robots**:

    - **Assistance in Public Spaces**: Human following robots could become common in public spaces like airports, malls, and hospitals, assisting people with navigation, carrying items, or providing information.
    - **Elderly Care**: With aging populations in many parts of the world, there's a growing need for technologies that can assist with elderly care. Human following robots could help elderly individuals with tasks like fetching items, reminding them of medication schedules, or providing companionship.
    - **Education and Entertainment**: In educational settings or entertainment venues, human following robots could serve as interactive guides, providing information in a fun and engaging way.
    - **Personalization and Safety**: Future human following robots may incorporate AI algorithms to better understand and adapt to the needs and preferences of the individuals they're following. Safety features will also be enhanced to prevent accidents in crowded environments.
    - **Integration with Smart Environments**: Human following robots may integrate with smart home systems and other IoT devices to provide seamless assistance and communication within smart environments.

Overall, both pick and place robots and human following robots are poised to play significant roles in shaping the future of automation, enhancing productivity, efficiency, and quality of life in various domains.

CHAPTER 10

REFERENCE

- Punetha,D, Kumar,N & Mehta,V, “Development and Applications of Line Following Robot Based Health Care Management System”, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET),Vol. 2, Issue 8, ISSN: 2278 – 1323, 2013.
- Roman Osorio, “Intelligent Line Follower Mini-Robot System”, International Journal of Computers Communication and Control, Vol.1, No.2, pp. 73-83, 2006
- B.O. Omijeh, R. Uhunmwangho, M. Ehikhamenle, “Design Analysis of a Remote Controlled Pick and Place Robotic Vehicle”, International Journal of Engineering Research and Development, Volume 10, PP.57-68, May 2014.
- Elias Eliot, B.B.V.L. Deepak, D.R. Parhi, and J. Srinivas, “Design & Kinematic Analysis of an Articulated Robotic Manipulator”, Department of Industrial Design, National Institute of Technology-Rourkela.
- Sanjay Lakshminarayan, Shweta Patil, “Position Control of Pick and Place Robotic Arm”, Department of Electrical Engineering MS Ramaiah Technology, Bangalore, India.
- Mohamed Naufal Bin Omar, “Pick and Place Robotic Arm Controlled By Computer”, Faculty of Manufacturing Engineering, April 2007.
- Ankit Gupta, Mridul Gupta, NeelakshiBajpai, Pooja Gupta, Prashant Singh, “Efficient Design and Implementation of 4-Degree of Freedom Robotic Arm”, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, June 2013.
- Thomas, G.; Gade, R.; Moeslund, T.B.; Carr, P.; Hilton, A. Computer vision for sports: Current applications and research topics. *Comput. Vis. Image Underst.* **2017**, *159*, 3–18.
- Trautman, P.; Ma, J.; Murray, R.M.; Krause, A. Robot navigation in dense human crowds: Statistical models and experimental studies of human–robot cooperation. *Int. J. Robot. Res.* **2015**, *34*, 335–356.
- Schlegel, C.; Illmann, J.; Jaberg, H.; Schuster, M.; Wörz, R. *Vision Based Person Tracking with a Mobile Robot*; BMVC: London, UK, 1998; pp. 1–10.
- An, N.; Sun, S.Y.; Zhao, X.G.; Hou, Z.G. Online context-based person re-identification and biometric-based action recognition for service robots. In Proceedings of the 2017 29th Chinese Control And Decision Conference (CCDC), Istanbul, Turkey, 12–15 October 2017; pp. 3369–3374.
- Bellotto, N.; Hu, H. Multisensor-based human detection and tracking for mobile service robots. *IEEE Trans. Syst. Man Cybern. Part B* **2008**, *39*, 167–181.
- Choi, M.T.; Yeom, J.; Shin, Y.; Park, I. Robot-Assisted ADHD Screening in Diagnostic Process. *J. Intell. Robot. Syst.* **2019**, *95*, 351–363.

- Oishi, S.; Kohari, Y.; Miura, J. Toward a robotic attendant adaptively behaving according to human state. In Proceedings of the 2016 25th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), New York, NY, USA, 26–31 August 2016; pp. 1038–1043.
- Ferrer, G.; Zulueta, A.G.; Cotarelo, F.H.; Sanfeliu, A. Robot social-aware navigation framework to accompany people walking side-by-side. *Auton. Robot.* **2017**, *41*, 775–793. [CrossRef]
- Koide, K.; Miura, J. Identification of a specific person using color, height, and gait features for a person following robot. *Robot. Auton. Syst.* **2016**, *84*, 76–87. [CrossRef]
- Brunetti, A.; Buongiorno, D.; Trotta, G.F.; Bevilacqua, V. Computer vision and deep learning techniques for pedestrian detection and tracking: A survey. *Neurocomputing* **2018**, *300*, 17–33. [CrossRef]
- Zhao, Z.Q.; Zheng, P.; Xu, S.T.; Wu, X. Object detection with deep learning: A review. *IEEE Trans. Neural Netw. Learn. Syst.* **2019**. [CrossRef]
- www.google.com
- http://en.wikipedia.org/wiki
- http://chatgpt.ai.com
- https://www.youtube.com