ABSTRACT:

Technology has played a very significant role in improving the quality of life. This can be done by automating several tasks using complex logic to simplify the work. The increase in human-machine interactions in our daily lives have made user-machine interface technology progressively more important. Physical gestures as intuitive expressions will greatly ease the interaction process and enable humans to more naturally command computers or machines. The objective of this project is to build a gesture-controlled a robot that can be controlled by the gesture of the user wirelessly. The user can control directions of the Robotic car by wearing the controller glove and performing predefined gestures. This project provides a basic platform for many potential applications such as wireless controlled car racing games, gesture human-machine interfacing, etc.

CONTENTS:

Chapter 1

1.1 INTRODUCTION

Technology is the word coined for the practical application of scientific knowledge in the industry. The advancement in technology cannot be justified unless it is used for leveraging the user's purpose. Technology, is today, imbibed for the accomplishment of several tasks of varying complexity, in almost all walks of life. Society as a whole is exquisitely dependent on science and technology. Now a day's robots are controlled by remote or cell phone or by a direct wired connection. If we thinking about cost and required hardware's all this thing increases the complexity, especially for low-level applications.

A Robot is an electro-mechanical system that is operated by a computer program. Some of the most commonly used control systems are voice recognition, tactile or touch-controlled. One of the frequently implemented motion-controlled robots is a Hand Gesture Controlled Robot.

In this project, we have designed a simple Hand Gesture Controlled Robot using Arduino boards. This Hand Gesture Controlled Robot is based on Arduino Nano, Arduino UNO, Micro Electro Mechanical Sensor (MEMS), Zigbee module for communication and L293D Motor Driver circuit. MEMS is a 3-axis Accelerometer and 3-axis Gyroscope sensor used to detect the moment of the hand.

Instead of using a remote control with buttons or a joystick, the gestures of the hand are used to control the motion of the robot. The project is based on wireless communication, where the data from the hand gestures is transmitted to the robot over Zigbee communication (Zigbee Transmitter – Receiver pair).The project is divided into the transmitter and receiver sections. The circuit diagram and components are explained separately for both transmitter and receiver sections.

1.2LITERATURE SURVEY

Gesture controlled robot using Arduino by Rashmi vashisth, Akshit Sharma, Shantanu Malhotra, Saurabh Deswal, Aman Budhraja [2017] they are introducing a robot with a gesture controlled 3-axis accelerometer (ADXL335) with an ATmega16 microcontroller. The gestures can be interpreted from any kind of physical movement or condition, but usually arise from a person. Gesture recognition can be explained as a method by which a computer can understand the language of the human body, thereby creating a communication bridge between humans and machines than normal text based or a terminal user interfaces or even graphical user interfaces (GUIs) that still restrict most of the mouse and keyboard inputs.

1.3 BLOCK DIAGRAM AND WORKING

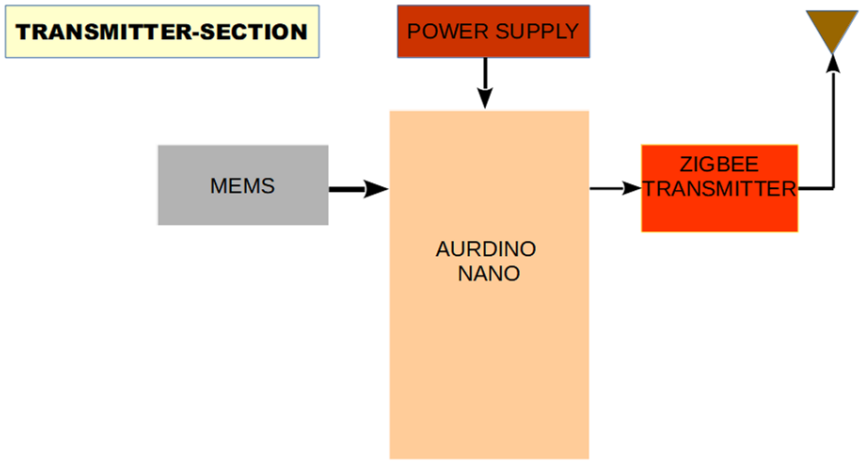


Figure 1.1 Transmitter section

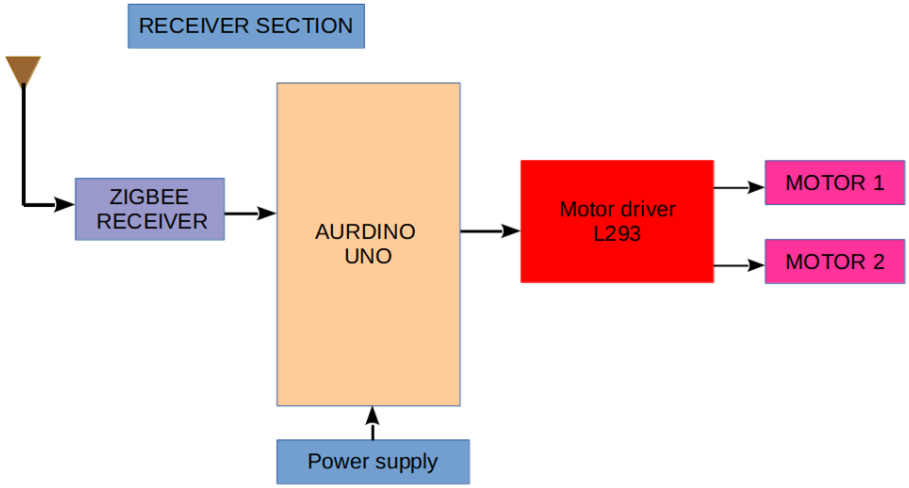


Figure 1.2 Receiver section

Working of Hand Gesture Controlled Robot

In order to understand the principle of operation of Hand Gesture Controlled Robot, let us divide the project in two parts.

1) Transmitter part.

The transmitter circuit is mounted on the gloves which will be wearied by the user. On this glove, we are going to mount the Arduino NANO board. Along with that MEMS (Accelerometer) sensor, ZigBee transmitter and connection for power supply is connected. MEMS works on the principle of acceleration. This will sense the motion of the hand by three angles of the axis. MEMS output is given to the Arduino Nano board. This contains the predefined actions to be performed. Through the ZigBee, the transmitter command will be transmitted to the ZigBee receiver. Where ZigBee receiver is placed on the robotic car. ZigBee is the wireless communication module.

2) Receiver part

In this part, the command is received from the transmitter. This data is given to the Arduino UNO board. The microcontroller will fetch the data and give it to the motor driver circuit. The motor driver circuit will give the $+V_{CC}$ voltage and GND to the DC gear motors. That means the motor driver circuit will give rotations (clockwise or anti-clockwise) direction to DC gear motor to move the robot in four directions. According to the tilting of the hand, the robot will move in any of the four direction.

For example, if we tilt our hand in the front direction the robot will move in a forward direction, if we tilt our hand in the back direction it will move backward direction. If our hand is in stable condition the robot will stop moving. Similarly, to move the robot in a left or right direction we have to tilt our hand in the left and right direction respectively. The gesture motion of the hand is shown in the below images.

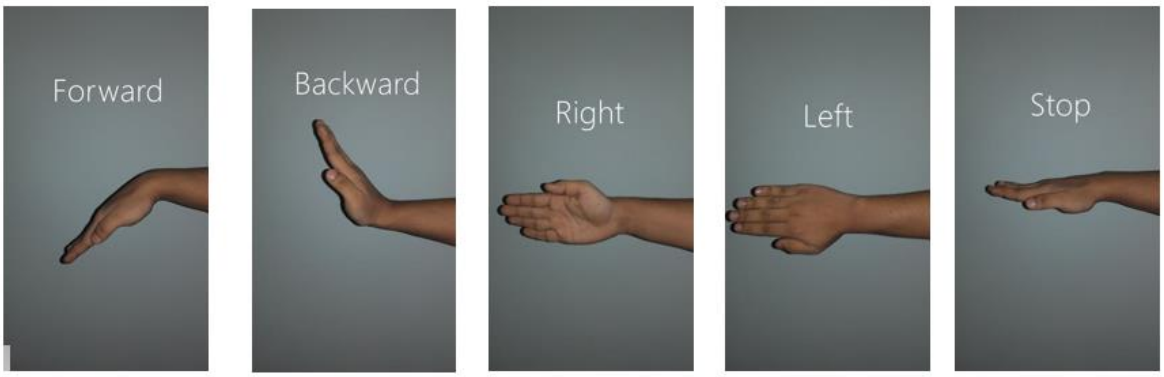


Figure 1.3 Hand gesture images

Photographs of the project

CHAPTER 2

HARDWARE REQUIREMENTS

2.1 MEMS TECHNOLOGY

MEMS stands for Micro-electro-mechanical-systems, is a technology used for the micro fabrication of electrical and mechanical components on a single wafer. This term is originated in the United States in 1990s, also referred as micro systems in Europe and labelled as micro machines in Japan.

Prior to this technology was referred as silicon micro machining. MEMS technology provides a new functionality that previously could not be offered by the semiconductor devices.

In other words, MEMS is a precision device in which mechanical parts and micro sensors along with the signal conditioning circuits are fabricated on a small piece of silicon. The letter S in the MEMS acronym indicates the systems which reflect that this technology contributes the creation of new system solutions.

The elements that are integrated on the silicon chip using MEMS technology include micro sensors, mechanical structures, microelectronics and micro actuators as shown in figure 2.1.1.

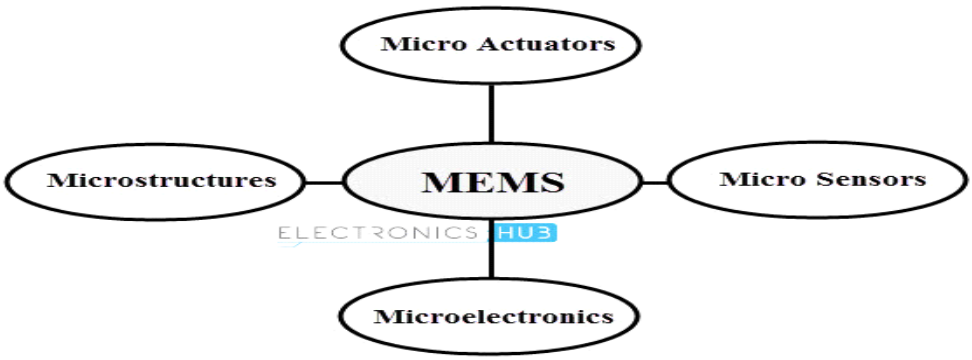


Figure 2.1.1 Elements of the MEMS

- Acceleration is a process in which velocity is changed with respect to time and it is a vector quantity. Similarly, velocity is a speed and direction. There are two ways for explaining acceleration of anything first one is change in speed and second one is change in direction. Sometimes both are changed simultaneously.
- If we talk about ADXL 335 accelerometer, then this accelerometer is a device that is used for measuring acceleration of any object. It measures the acceleration in the form of analog inputs inthree-dimension direction such as X, Y and Z. It is low noise and less power consume device.

- When it is used for acceleration measure purposes then it is interfaced with any type of controller such as microcontroller or Arduino etc. It is mostly used in construction working machines such as drilling,driving piles and demolition etc., human activities machines such running, walking, dancing and skipping etc. It is easily available in market or online shop. A simple ADXL 335 accelerometer is shown in figure 2.1.2

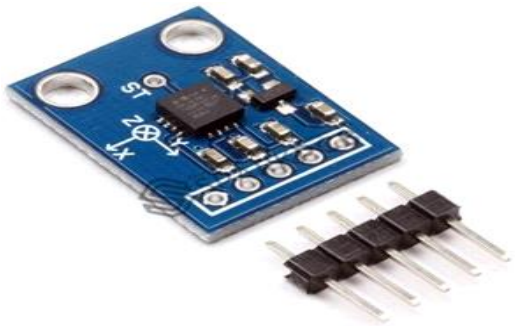


Figure 2.1.2 MEMS

Pin description

VCC: Power supply pin i.e. connect 5V here.

X_OUT: X axis analog output.

Y_OUT: Y axis analog output.

Z_OUT: Z axis analog output.

GND: Ground pin i.e. connect ground here.

2.2 ARDUINO UNO

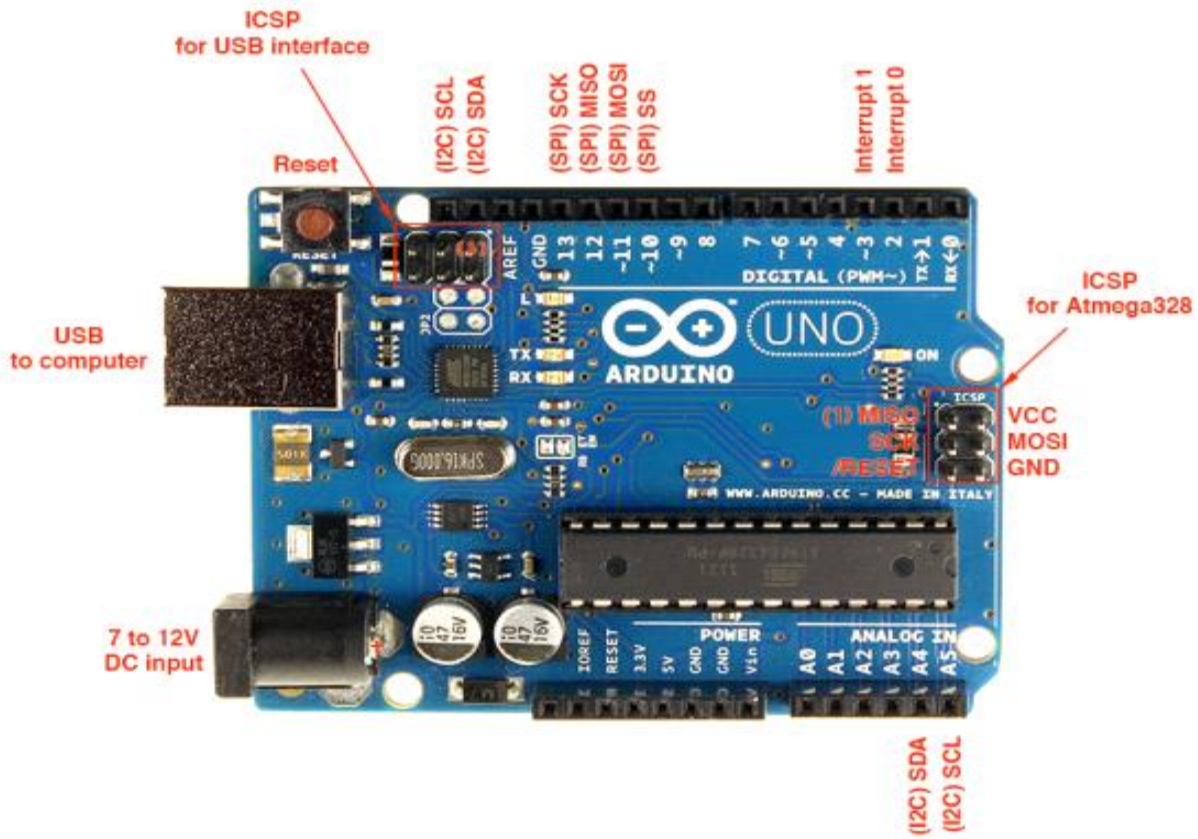


Figure 2.2.1 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digitalinput/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a resetbutton etc. It contains everything needed to support the microcontroller; simply connect it to acomputer with a USB cable or power it with a AC-to-DC adapter or battery to get started.It features the Atmega328 programmed as a USB-to-serial converter."Uno" means one in Italian and the name is given like to mark the upcoming release of Aurdino1.0. TheUno and version 1.0 will be the reference versions of Arduino moving forward. The Unois the latest in a series of USB Arduino boards.

Summary: -

Microcontroller	ATmega328
Operating Voltage	5v
Input voltage(recommended)	7-12
Input voltage	6-20
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40ma
DC Current for 3.3V Pin	50ma
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.
The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from V_{IN} via an on-board regulator, or supplied by USB or another regulated 5V supply.
- **3V.** A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

Memory3

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader) flash memory. It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library.)

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pin digital Write, and digital Read functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20 to 50 Ohm. In addition, some pins have specialized functions.

The Uno has 6 analog inputs, labelled A_0 through A_5, each of which provide 10 bits of resolution (i.e. 1024 different values).

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega328 USB-to-TTL Serial chip.
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on alow value, a rising or falling edge, or a change in value. See the attach
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication using the SPIlibrary.
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH
  value, the LED is on, when the pin is LOW, it's off.
- **I^2C: A4 (SDA) and A5 (SCL).** Support I^2C (TWI) communication using the Wire library.There are a couple of other pins on the board:
- **AREF.** Reference voltage (**0 to 5V only**) for the analog inputs. Used with analog Reference().
- **Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.See also the mapping between Arduino pins and ATmega328 ports.

2.3ARDUINO NANO

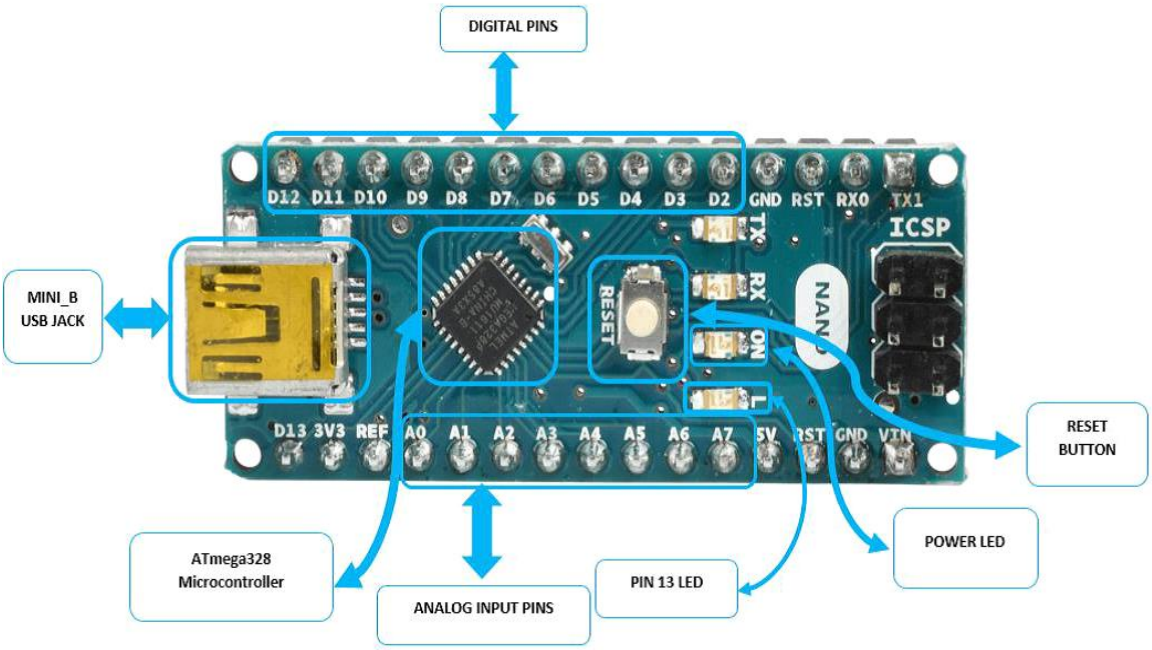


Figure 2.3.1 Arduino NANO

INTRODUCTION

Arduino Nano differ from other Arduinos as it is very small so it suitable for small sized projects and it supports breadboards so it can be plugged with other components in only one breadboard.

ARDUINO NANO PHYSICAL COMPONENTS

Microcontroller

In Arduino Nano 2.x version, still used ATmega168 microcontroller while the Arduino Uno version already used ATmega328 microcontroller.

ATmega168 Microcontroller

ATmega168 is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture.

Features of Arduino NANO

1. Advanced RISC Architecture
2. 131 Powerful Instructions
3. Most Single Clock Cycle Execution
4. 32 x 8 General Purpose Working Registers
5. Fully Static Operation
6. Up to 20 MIPS Throughput at 20MHz

7. On-chip 2-cycle Multiplier

ARDUINO NANO PIN CONFIGURATION

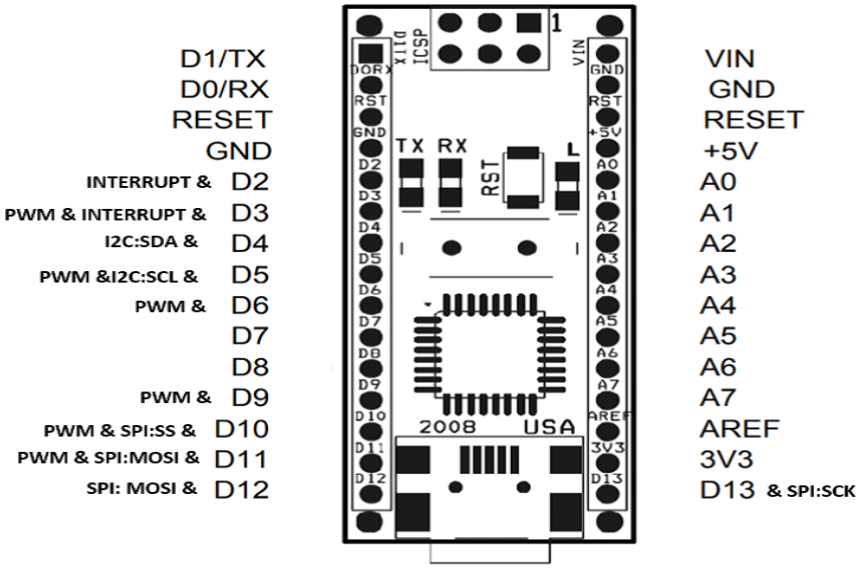


Figure 2.3.3 Outline of Arduino NANO

Arduino Nano Specifications

Microcontroller	Atmel ATmega168 or ATmega328
Operating Voltage (logic level)	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8
DC Current per I/O Pin	40 ma
Flash Memory	16 KB (ATmega168) or 32 KB(ATmega328) of which 2 KB used by boot loader.
SRAM	1 KB (ATmega168) or 2 KB (ATmega328)
EEPROM	512 bytes (ATmega168) or 1 KB (ATmega328)
Clock speed	16 MHz
Dimensions	0.73″ x 1.70″
Length	45 mm
Width	18 mm

Weight	5 g

2.4 ZIGBEE MODULE:

ZigBee is based on IEEE (Institute of Electrical & Electronics Engineers) 802.15.4 Standard which lays down specifications for the low rate wireless personal area network. ZigBee is primarily used for two-way communication between a sensor and a control system. Like Bluetooth and Wi-Fi, it is a short-range communication and offers connectivity up to 100 meters. On the other end, Wi-Fi and Bluetooth are high data rate standards which support the transfer of media files, software, etc.

ZigBee technology supports the transfer of data coming from the sensors at a rate of about 250 kbps. It operates at various frequencies such as 868 MHz, 902 – 968 MHz, and 2.4 GHz. Since it requires low power from the device, the battery life is significantly improved.

Pin Description of ZigBee module:

- VDD: 3.3V or 5V power supply positive
- GND: Power negative
- TXD: serial output module, connected microcontroller or USB to serial RXD
- RXD: module serial input connected microcontroller or USB to serial TXD
- CMD: enter upgrade mode or AT mode pin, active low

Figure 2.4 ZigBee Module

2.5 DC GEAR MOTOR:

Geared DC motors can be defined as an extension of DC motor which already had its Insight details demystified. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

External Structure

At the first sight, the external structure of a DC geared motor looks as a straight expansion over the simple DC ones in figure 2.5.1.

Figure 2.5 Geared motor

Features of DC Gear Motors

- Gear materials: Plastic or metal.
- Connection types: Shunt, series and compound connections.
- Speed control and reversibility: Smoothly control a speed down to zero without power circuit switching, even after accelerating in the opposite direction.
- Dynamic braking and regenerative braking: Ideal for applications that require quick stops so you don’t need a mechanical brake.

- Magnet types: Rare earth, ceramic or ferrite magnets.
- Winding resistance: Choose a motor that doesn't adversely affect the Km.
- Gear ratios: Several varieties available, such as 28:1 or 18:1.
- Environment: Motors are available for indoor or outdoor use.
- Torque multiplication: Generate a large force at a low speed.
- **Custom-built:** You can have a DC gear motor designed and manufactured to suit your size, power, torque and mounting needs.

2.6 L293D (MOTOR DRIVER)

Generally, L293D motor driver can control two motor at one time or called is a dual H-Bridge motor driver. By using this IC, it can interface DC motor. which can be controlled in both clockwise and counter clockwise direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Below figure 2.6.1 the pin diagram of L293D motor driver and the pin description of L293D motor driver.

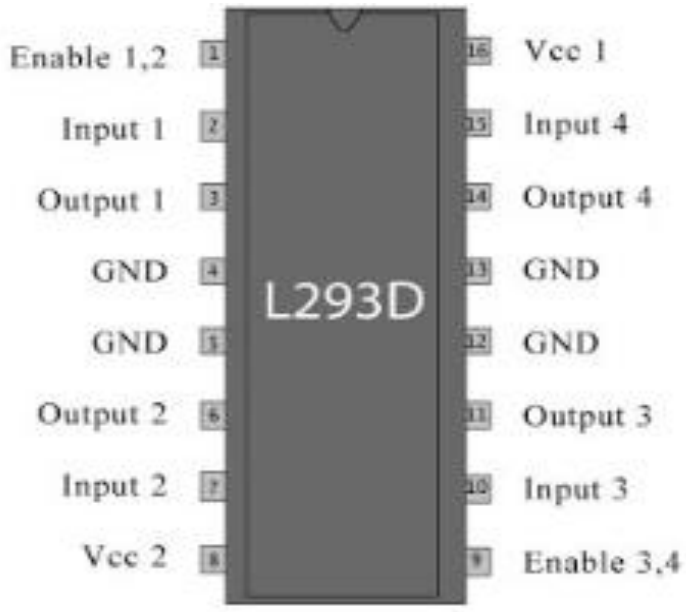


Figure 2.6.1

Besides that, with this L293D driver motor it will control four DC motors at one time but with fix direction of motion. L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover for protection of circuit from back EMF output diode are included within the L293D. The output supply is external supply has a wide range from 4.5V to 36V which has made L293D a best choice for DC motor driver. A simple schematic for interfacing a DC gear motor using L293D driver motor is shown in figure 2.6.2.

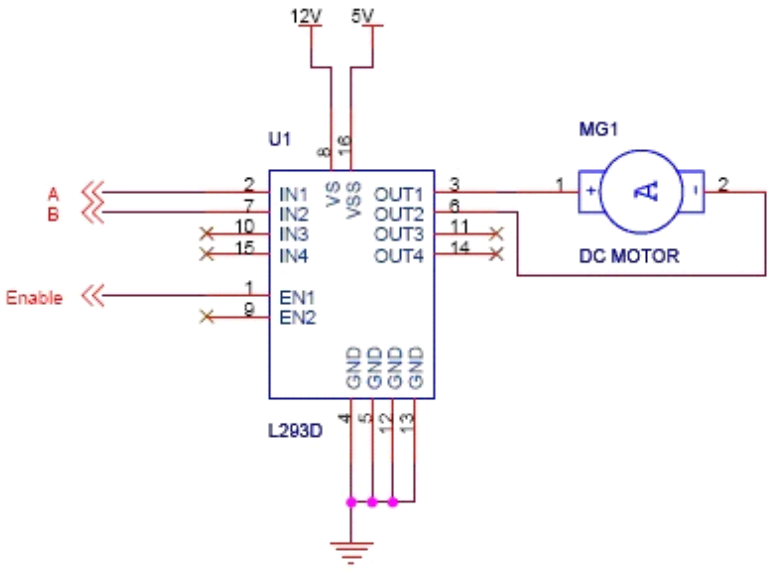


Figure 2.6.2

Truth table for motor driver circuit

A	B	Description
0	0	Motor stops
0	1	Motor runs clockwise
1	0	Motor runs anti-clockwise
1	1	Motor stops

From the above truth table, the Enable has to be set to 1 and motor power used is 12V but it is depending on motor power that used (range 4.5V to 36V). The rotation of the DC motor can be control by combinations of A and B in programming assembling and from the truth table it is clear to explain the rotations of the motor.

2.7 7805 REGULATED POWER SUPPLY

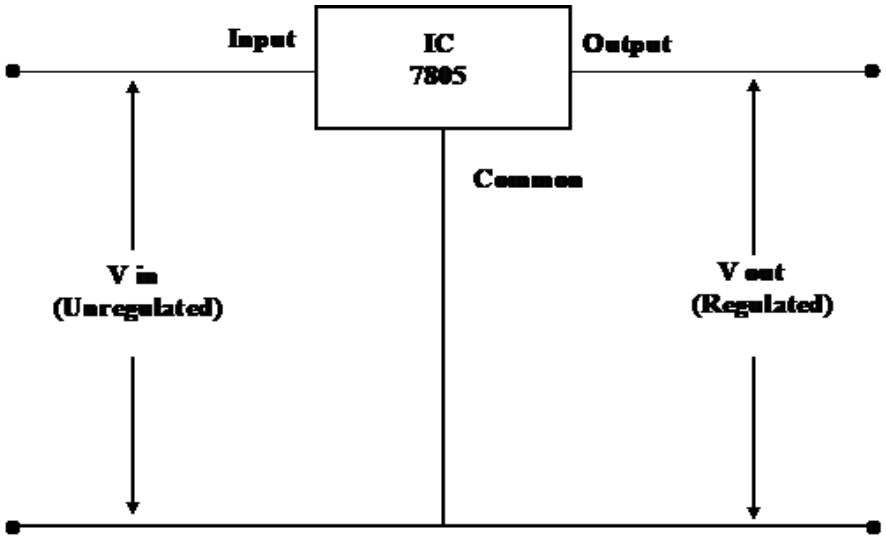


Figure 2.7.1 circuit diagram

A DC power supply system, which maintains constant voltage irrespective of fluctuations in the main supply or variation in the load, is known as Regulated Power supply.

The 7805IC referred to fixed positive voltage regulator, which provides fixed voltage 5 volts. The 7805 regulator is known as fixed voltage regulator. 3-terminal regulators are very easy to use.

Fixed –Voltage regulator design has been greatly simplified by the introduction of 3-terminal regulator ICs such as the 78xx series of positive regulators and the 79xxx series of negative regulators, which incorporate features such as built-in fold back current limiting and thermal protection, etc.

These ICs are available with a variety of current and output voltages ratings, as indicated by the ‘xxx’ suffix; current ratings are indicated by the first part of the suffix and the voltage ratings by the last two parts of the suffix. Thus, a 7805 device gives a 5V positive output at a 1a rating, and a 79L15 device gives a 15V negative output at a 100mA rating.

The figure 2.7.1 shows the image of 7805 regulator IC

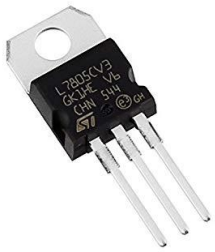


Figure 2.7.1 7805 Voltage Regulator

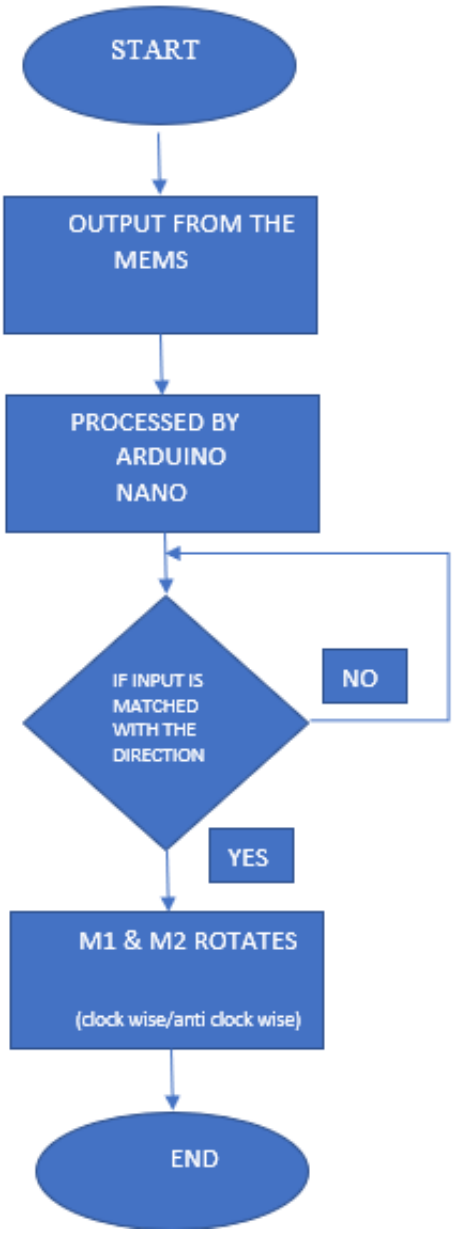
2.8 12V Battery

Nearly all car, motorcycle and tractor batteries are using 12-volt, lead-acid batteries. These batteries can provide hundreds of amps of electrical current for a short period of time. This is why these batteries are commonly used in automotive applications.

We are using it to provide the power supply for the robotic car.

Chapter 3
SOFTWARE IMPLEMENTATION

3.1 Flow chart

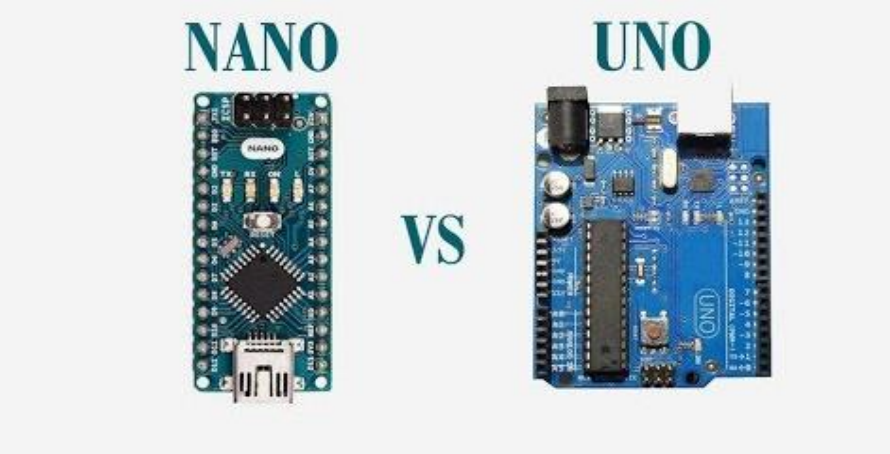


3.2 ARDUINO IDE SOFTWARE

Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino micro and many more. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.

Chapter 4

4.1 Difference between Arduino UNO and Arduino NANO



Specifications	Arduino Uno	Arduino Nano
Processor	ATmega328P	ATmega328P
Input Voltage	5V / 7-12V	5V / 7-12V
Speed of CPU	16 MHz	16 MHz
Analog I/O	6 / 0	8 / 0
Digital IO/PWM	14 / 6	14 / 6
EEPROM / SRAM [kB]	1 / 2	1 / 2
Flash	32	32
USB	Regular	Mini
USART	1	1

4.2 APPLICATION

Using hand gesture movements, we can control the robot in four directions.

4.3 ADVANTAGES

- Easy to control.
- It's helpful for physically challenged persons.
- It isolates electric shock.

4.4 DISADVANTAGES

- The main drawback is that the land-rover can controlled only 4-directions, so better sensing device is required.
- No feedback so can't verify whether land-rover is moving in correct direction or not.
- The robot can control only in line of sight (15 to 20 meters).

5.1 CONCLUSION

The gesture-controlled robot using Arduino has been successfully implemented. This project is secure, user friendly and we are concluding that the advancement in technology cannot be justified unless it is used for leveraging the user's purpose. Technology has played a very significant role in improving the quality of life.

We achieved our objective of this project without any hurdles i.e., the control of a robot using gestures. The robot is showing proper response whenever we move our hand in four directions.

5.2 Future development

In future we can implement this project as given below

- Physically challenged person can use by wheelchair.
- Robotic vision development.
- Exploration robots.
- Can be used for Industry application.
- Firefighting robot.
- Various military applications.
- Gaming.

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