3.1 The Raspberry Pi

Raspberry Pi is a credit-card sized computer originally designed for education, inspired by the 1981 BBC Micro. Creator Eben Upton's goal was to create a low-cost device that would improve programming skills and Hardware understanding. The Raspberry Pi is slower than a modern laptop or desktop computer but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-power Consumption level.

The main operating system for the Pi is Raspbian and it is based on Debian. It is a distribution of Linux .Even though the main supported operating system is Raspbian, you can install other operating systems such as Ubuntu mare, Ubuntu Core, OSMC, RIS OS, Windows 10 IOT and much more.

3.1.1 Raspberry Pi Zero

The Pi Zero is the smallest and cheapest of the entire Pi's currently available.

Here summary of the features of the Pi zero:-

- 1 GHz, Single-core CPU.
- 512MB RAM.
- Mini HDMI.
- Micro USB Port.
- Micro USB power.
- Micro SD Card Port.

- Composite video and reset headers.

3.1.2 Raspberry Pi 1

The Raspberry PI 1 is the first generation of PI. Here summary of the features of the Raspberry Pi:-

- 700 MHz single core CPU.
- 512 MB of RAM.
- 40 pin GPI.
- 4x USB 2.0 ports.
- HDMI Port.
- CSI (Camera serial Interface) and DSI (Display Serial Interface) ports.
- Micro SD card slot.
- Micro USB power.

3.1.3 The Raspberry Pi 2

The Raspberry Pi 2 is the second generation of pi that is the replacement of the B+. Here summary of the features of the Raspberry Pi 2:-

- 900 MHz quad core CPU.
- 1GB of ram.
- 40 pin extended GPI.
- 4x USB 2.0 ports.
- Stereo out and composite video port.
- HDMI Port.

- CSI (Camera Interface Interface) and DSI (Display Serial Interface) ports.
- Micro SD card slot.
- Micro USB power.

3.1.4 Raspberry Pi 3

The Raspberry Pi 3 is the third generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B**.** Here summary of the features of the Raspberry Pi 3:-

- A 1.2GHz 64-bit quad-core ARMv8 CPU.
- 802.11n Wireless LAN.
- Bluetooth 4.1.
- Bluetooth Low Energy (BLE).
- 1GB RAM.
- 4 USB ports.
- 40 GPIO pins.
- Full HDMI port.
- Ethernet port.
- Combined 3.5mm audio jack and composite video.
- Camera interface (CSI).
- Display interface (DSI).
- Micro SD card slot (now push-pull rather than push-push).
- Video Core IV 3D graphics core.

3.1.4.1 Pin configuration of raspberry pi 3

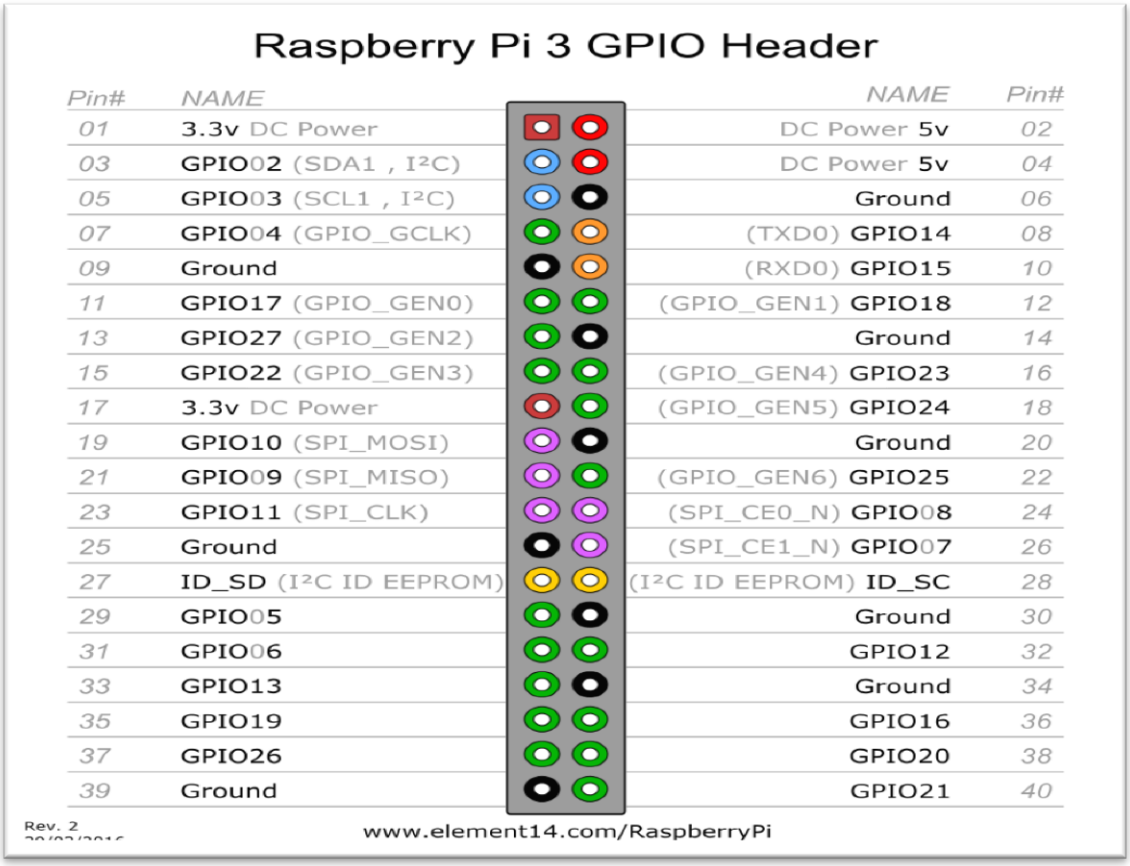

Figure 3-1: PI 3 pin configuration

- **Pin Description**

  Power - These pull power directly from the Raspberry Pi 3.

  Ground - Pins used to ground your devices.

  UART (**Universal Asynchronous Receiver / Transmitter**) : Serial pins that are used to communicate with other devices.

  I^2C (**Inter-Integrated Circuit**): Pins that allow you to connect and talk to hardware modules that support I^2C protocol.

  SPI (**Serial Peripheral Interface Bus**): Pins that allow you to connect and talk to hardware modules that support SPI protocol.

GPIO (**General Purpose Input / Output**): Standard pins that can be used to turn devices on and off.

3.1.5 Criteria of choosing Raspberry Pi

1. Powerfulness

This is the main advantage of Raspberry Pi. Pi is capable of doing multiple tasks at a time like a computer. If anyone wants to build a complex project like an advanced robot or the project where things need to be controlled from a web page over internet then Pi is the best choice. Pi can be converted into a webserver, VPN server, print server, database server etc.

Raspberry Pi is very fast, with PI, you can send mails, listen music, play videos, run internet..etc. . Also it has memory, processor, USB ports, Ethernet port etc. and it doesn't require external hardware's for most of the functions. It can be accessed via SSH and file can be easily transferred over FTP.

2. Networking

Raspberry Pi has the built in Ethernet port, through which you can directly connect to the networks. Even Internet can easily be run on Pi using some USB Wi-Fi dongles. While in Arduino as example, it's very difficult to connect to network. External hardware's need to be connected and properly addressed using code, to run network using Arduino. External Boards called "Shields" needs to be plugged in, to make Arduino, as functional as Pi, with a proper coding to handle them.

3. **Expansion capabilities**

There are numerous devices available for the Pi, all at very affordable prices. Everything from an I/O board (GPIO) to a camera, The Pi has two USB ports; however by hooking up a powered USB hub, more devices can be added.

4. Development Environment /tools

The Raspberry Pi is a full computer. While the commonly promoted language for the Raspberry Pi is Python, the flexibility of this platform lets you use a variety of languages including Ruby, PHP, and Java. Also you can run Node JS on the Raspberry Pi and develop IOT apps in Java Script.

3.2 Arduino

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board .The Uno is one of the more popular boards in the Arduino family.

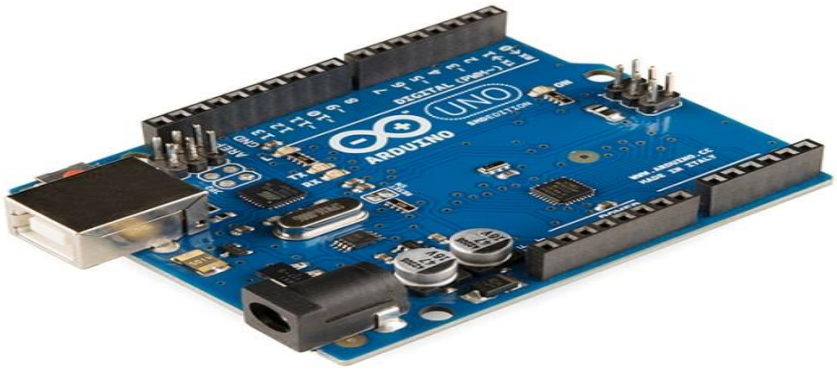

Figure 3-2: Arduino UNO

3.2.1 Pin Configuration

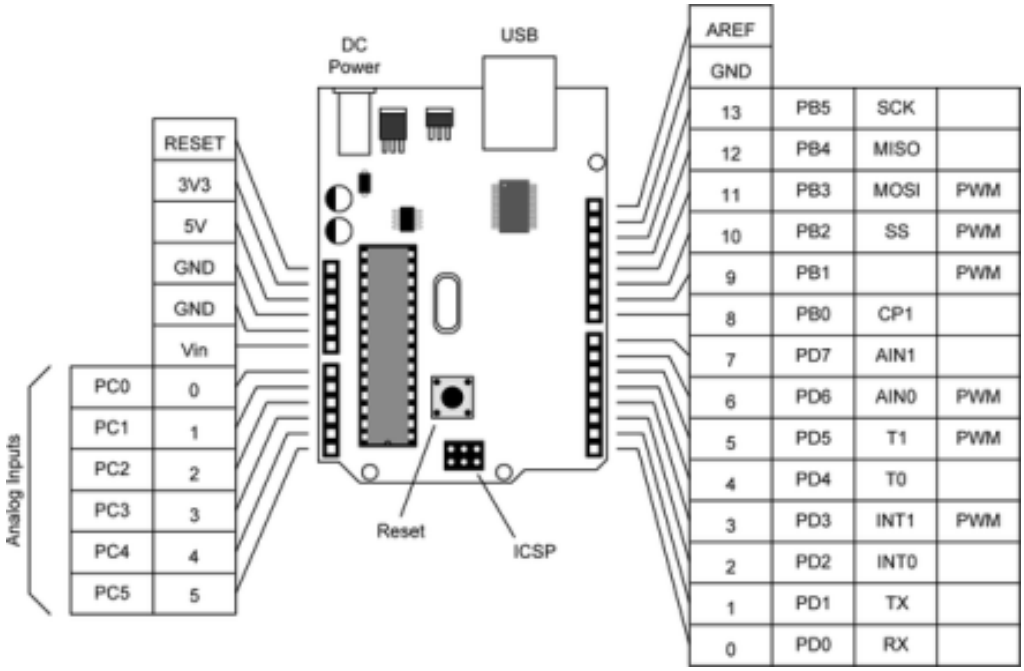

Figure 3-3: Arduino Pin Configuration

3.2.1.1 Pin Description

Input and Output:-

Each of the 14 digital pins on the Arduino Uno can be used as an input or output. 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 20-50 k Ohms.

Some pins have specialized functions:-

***Serial*:** pins 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 ATmega8U2 USB-to-TTL Serial chip.

***External Interrupts*:** pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

***PWM*:** 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

***SPI*:** 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

***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.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they

measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF PIN.

***TWI*:** A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

***AREF*.** Reference voltage for the analog inputs.

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.

3.2.2 Serial Communication

The serial communication process consist of transmitting one bit at a time , sequentially on a communication channel or a computer bus , in contrast to parallel communication where the data sent in a link comprised of multiple channels .

Serial communication technique used originally to interface peripherals and devices such as printers , terminals and modems , these peripherals and devices are manufactured by various manufacturers , so a common understanding and agreement among these manufacturers is needed to govern the way the technology is manufactured and delivered to the end users .

In general, when using voltage for transmission a standard known as RS-232C is used for this purpose. In telecommunications, RS-232 is a standard for serial communication transmission of data. It formally

defines the signals connecting between a *DTE* (*data terminal equipment*) such as a computer terminal, and a *DCE* (*data circuit-terminating equipment* or *data communication equipment*), such as a modem. The RS-232 standard is commonly used in computer serial ports. The standard defines the electrical characteristics and timing of signals, the meaning of signals, and the physical size and pin out of connectors.

In many cases, serial is cheaper to implement than parallel. Many ICs have serial interfaces, as opposed to parallel ones, so that they have fewer pins and are therefore less expensive.

3.3 LM35 Sensor

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ^{o}C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ^{o}C ambient temperature . it's scale factor is 0.01V/ ^{o}C.

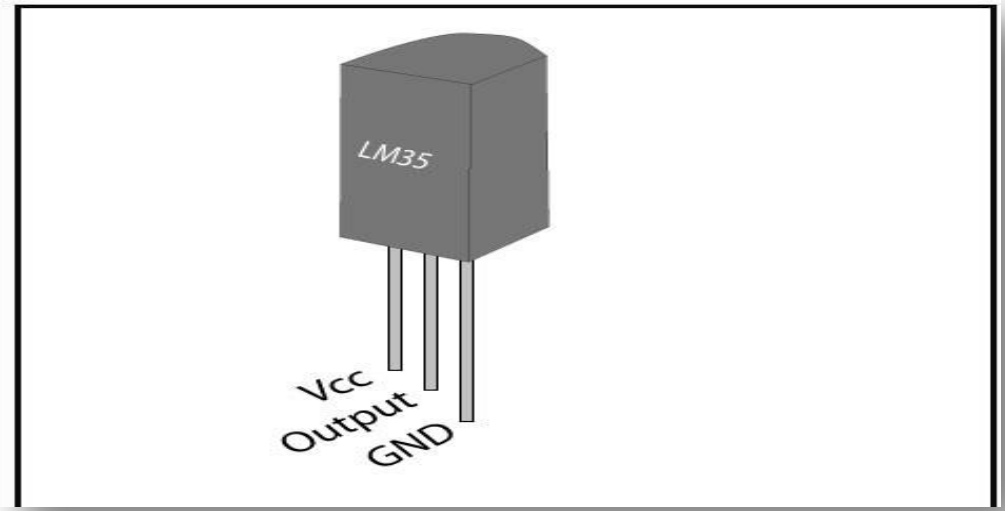

Figure 3-4: LM35 Sensor.

Pin Configuration

VCC: Supply voltage; 5V (+35V to -2V).

Output: Output voltage (+6V to -1V).

GND: Ground (0V).

3.4 LDR Sensor

It stands for Light Dependent Resistor, which is a passive electronic component, basically a resistor which has a resistance that varies depending of the light intensity. When fully illuminated, the LDR has no resistance and current flows freely, but with darkness the resistance increases and current flow stops. In most circuit designs, the LDR acts like an on/off switch based on how much light shine.

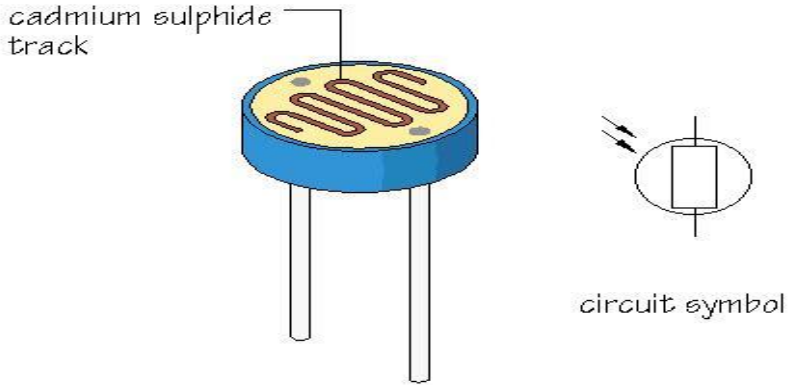

Figure 3-5: LDR

3.5 IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor .The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light.

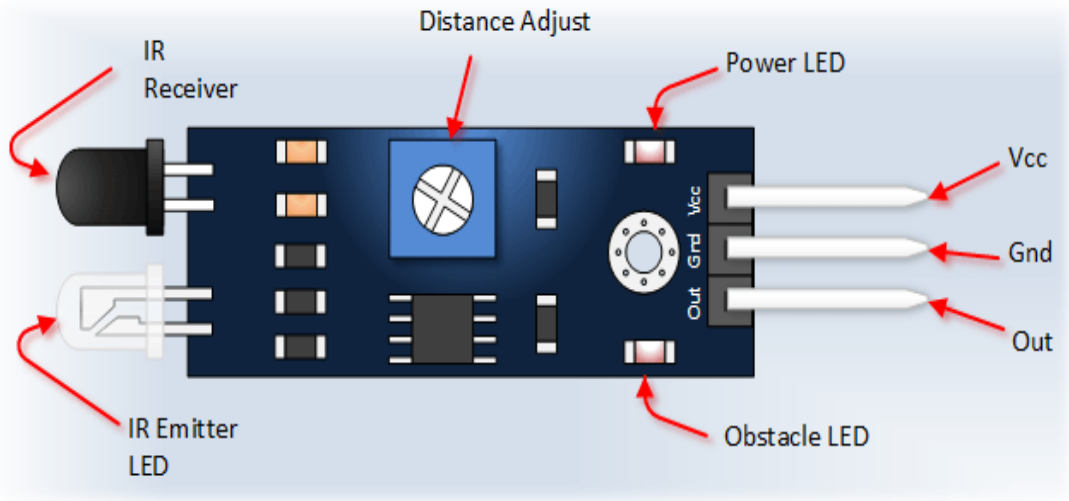

Figure 3-6: IR Sensor

3.6 PIR Sensor

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation isn't visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

The term *passive* in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object.

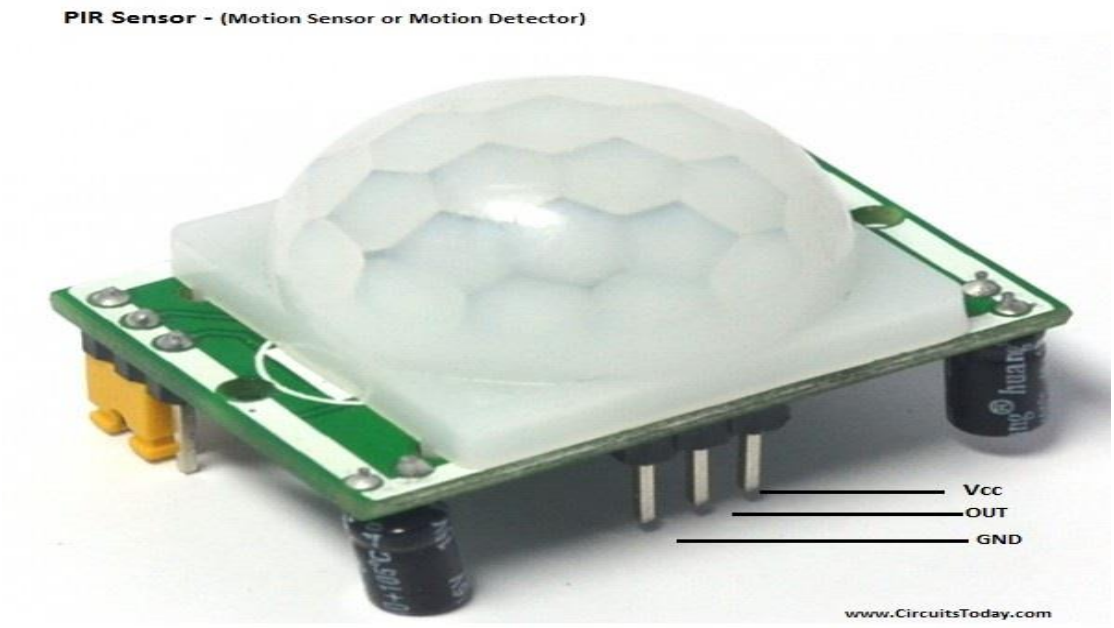

Figure 3-7: PIR Sensor

3.7 Gas Detector Sensor

Gas detectors measure and indicate the concentration of certain gases in an air via different technologies. Typically employed to prevent toxic exposure and fire, gas detectors are often battery operated devices used for safety purposes

As detectors measure a specified gas concentration, the sensor response serves as the reference point or scale. When the sensors response surpasses a certain pre-set level, an alarm will activate to warn the user.

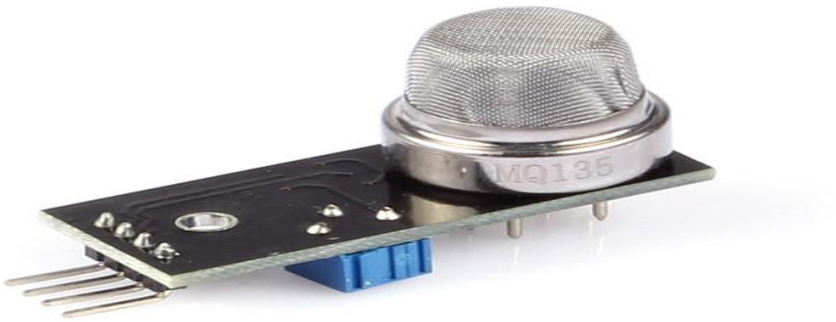

Figure 3-8: Gas Detector

3.8 Buzzer

A buzzer is a device which makes a buzzing or beeping noise. There are several kinds; the most basic is a piezoelectric buzzer, which is just a flat piece of piezoelectric material with two electrode**.**

Figure 3-9: Buzzer

3.9 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

3.9.1 Driver Circuit L293D

A driver circuit is an electrical circuit used to control another circuit or component, such as a high power transistor. They are usually used to regulate current flowing through a circuit.

L293D is a typical motor driver IC which allows DC motors to drive on either direction. It's a 16 pin IC which can control a set of two DC motors simultaneously in any direction.

3.9.1.1 Concept

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction which is mean changes its direction for being able to rotate the motor in clockwise or anticlockwise direction.

The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. It designed to drive inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

3.9.1.2 Pins Layout

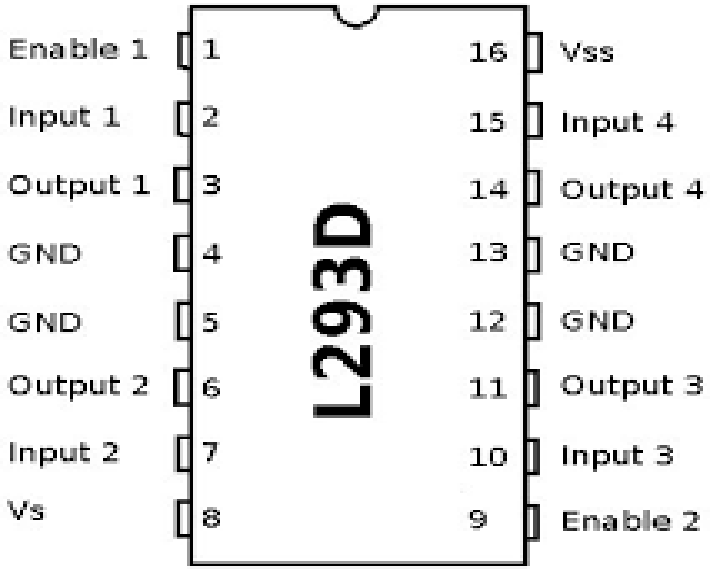

Figure 3-10: L293D Pins Configuration

Pin Description

Pin1: enable pin for motor 1.

Pin2: input 1 for motor 1.

Pin3: output 1 for motor 1.

Pin4, 5,12and13: ground.

Pin6 : output 2 for motor 1.

Pin7: input 2 for motor 1.

Pin8: supply voltage for motors.

Pin9: enable pin for motor 2.

Pin10: input 1 for motor 2.

Pin11: output 1 for motor 2.

Pin14: output 2 for motor 2.

Pin15: input 2 for motor 2.

Pin16: Supply voltage.

3.9.1.3 Description

All inputs are TTL compatible. Drivers are enabled in pairs, with drivers 1 and 2 enabled by pin1, and drivers 3 and 4 enabled by pin9 , when an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs, When the enable input is low, those drivers are disabled and their outputs are off and in the high impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. External high-speed output clamp diodes should be used for inductive transient suppression , pin16 separate from pin8 , is provided for the logic inputs to minimize device power dissipation (Robotics).

3.9.1.4 L293D Features

Characterized for operation from 0°C to 70°C.

Output current: 600mA.

Peak output current: 1.2A per channel.

Wide supply voltage range: 4.5 to 36V.

3.10 Android Studio IDE

An integrated development environment (IDE) is a software application that provides comprehensive facilities to computer programmers for software development. An IDE normally consists of a source code editor, build automation tools and a debugger.

Android Studio is the official integrated development environment (IDE) for Android platform development. It was announced on May 16, 2013 at the Google I/O conference. Android Studio is freely available under the Apache License 2.0

Android Studio was in early access preview stage starting from version 0.1 in May 2013, then entered beta stage starting from version 0.8 which was released in June 2014 The first stable build was released in December 2014, starting from version 1.0 .

Figure 4.11 shows the Android Studio IDE and its tools.

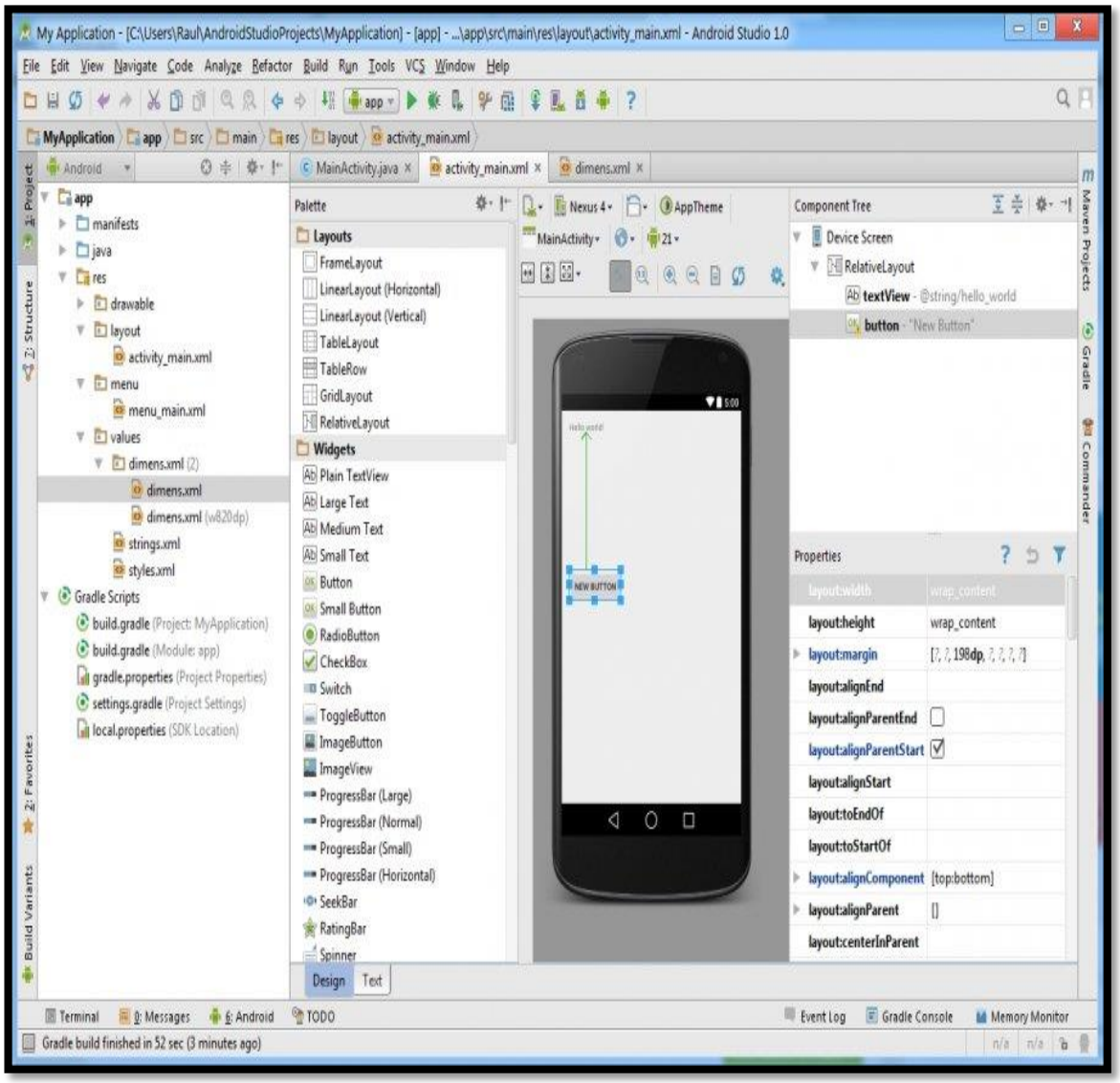

Figure 3-11: Android Studio IDE