CAPSTONE REPORT

On

SMART GARBAGE SEGREGATOR

Submitted in partial fulfillment of the requirement for the award of the

Degree of

BACHELOR OF TECHNOLOGY

In

Electronics and Communication Engineering

By

Sai ram Makkena (11706760)

Sidhanth Pandey (11704499)

Under the Guidance of

Prof. Shippu Sachdeva

Lovely Professional University Jalandhar-Delhi G.T Road (NH-1), Phagwara, Punjab, 144402, India.

CERTIFICATE OF GUIDANCE

This is to certify that the declaration statement made by the group of students is correct to the best of our knowledge and belief. The capstone Project Proposal based on the technology/tool learnt is fit for the submission and partial fulfilment of the condition for the award of B.Tech in Electronics and Communication engineering from Lovely Professional University, Phagwara.

Name - Shippu Sachdeva

U.ID - 16822

Designation - Professor

School of Electronics and Communication Engineering

Lovely Professional University Phagwara, Punjab

Signature of Faculty Mentor -

ACKNOWLEDGEMENT

We would like to express our deep and sincere gratitude to our capstone supervisor, Prof. Shippu Sachdeva Mam, School of Electronics Engineering, and Lovely Professional University. His wide knowledge, active indulgence and logical way of thinking have been of great value for us. His under-standing, encouraging and personal guidance have provided a good basis for the present capstone project. We are deeply grateful for her detailed and constructive comments, and for her important support throughout this work.

We are heartily thankful to Lovely Professional University, Punjab for lettings us choose such an interesting topic for our capstone project and for their support in all the problems faced by us during the project.

Name of Student - Sai ram Makkena

Registration Number - 11706760

Name of Student - Sidhanth Pandey

Registration Number - 11704499

DECLARATION

We hereby declare that the project work entitled “Smart Garbage Segregator” is an authentic record of our own work carried out as requirements of Capstone Project for the award of degree of B.Tech in Electronics and Communication Engineering from Lovely Professional University, Phagwara, under the guidance Prof. Shippu Suchdeva, during February to April, 2021.

Course Code - ECE442B

Project Group Number - EC124

Name of Student - Sai ram Makkena

Registration Number - 11706760

Name of Student - Sidhanth Pandey

Registration Number - 11704499

INDEX

ABSTRACT

Due to the spread of diseases, waste management and segregation is a much-needed process in metropolises and urban areas. Waste that is littered in the surrounding area and dumped on open lands becomes a major problem for a variety of disease-causing bacteria and viruses. As a result, waste segregation, transportation, handling, and disposal must be properly managed to reduce public and environmental risks. When mixed dry and wet waste decomposes in the lowlands, it emits harmful greenhouse gases. Segregation makes it possible to effectively use and recycle waste. This project aims to make waste separation easier.

Chapter 1

Introduction

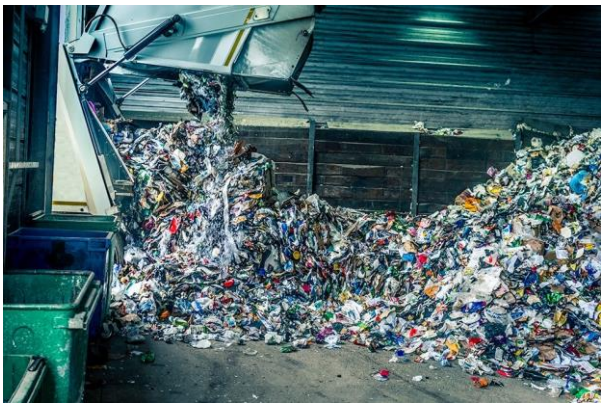
India's growing population poses serious challenges in terms of living space availability, utilisation of natural resources and raw materials, education, and employment. However, another serious risk that follows is the increasing amount of waste generated by an individual every minute. Every city is confronted with the threat of ever-increasing waste. Every day, our country generates an astounding 0.1 million tonnes of waste. Unfortunately, only 5% of this massive amount of waste is recycled. MSW collection, transportation, and disposal in India are unscientific and chaotic. Uncontrolled waste dumping on the outskirts of towns and cities has resulted in overflowing landfills that are not only impossible to reclaim due to the haphazard nature of the dumping but also have serious environmental consequences. When viewed on a larger scale, the slow recovery rate has hampered the country's growth as well as its economy.

One possible solution to this problem is to separate the waste at the disposal level. As a result, we developed a Smart Garbage Segregator that categorises waste as wet, plastic, paper, or metal. The Arduino mega board serves as the system's heart. An inductive proximity sensor is used to determine whether the waste is metal or not. To detect wet waste, a moisture sensor is used. Plastic and paper waste with varying densities are detected using an inductive capacitive sensor. The classified waste can be collected by various dust bins using a servo motor and a conveyor belt. This low-cost system is ideal for installation in apartments, colonies, and other similar settings.

2. Objectives and Hypothesis of the Study

Industrial and domestic waste is the main waste sources. This project focuses principally on domestic waste, the value of which is unrecognised because people spend no time on separating waste into their basic streams. Wet waste may be used to produce biogas, recycle metallic and dry waste and become a threat to the life of animals and plants, if metal waste is not treated. If waste is separated in the household then it can be sent directly for recycling, rather than being sent to industries for segregation, which is a huge task and is not precisely separated. As x-rays and infrared rays are utilised, the methods used for waste segregation in industry are harmful to human health. There are well-known and understood environmental risks associated with poor waste management. The main objective of the projects is to separate waste from wet, dry and metal

at a source level so that no waste is disposed of but value is understood.



For recycling we need to segregate different types waste because the mixed waste can not be recycled by any of the industry for that we need garbage segregator.

Garbage segregation must done at source level, else it will be complex to segregate and it takes time to segregate the waste. So that smart garbage segregator is use full for houses, apartments, restarents, etc.

3. Problem Statement

Waste separation is extremely important because, if all waste materials such as polythene bags, old meals, and electrical waste are mixed in the waste disposal sites, it may result in soil and water contamination by leaks of harmful atmospheric substances. Furthermore, non-segregation also affects climate change that could lead to drought. Therefore, before disposal in the landfill, it is vital to separate waste. Waste segregation is important as well as beneficial for people. Following the segregation process, the recyclable parts may be recycled into useful resources. The problem of resource shortage is very important to today's society.

4. Literature Review

- In [1] Rapid growth of solid and dangerous waste volumes and types as a result of continuous economic growth. The total amount of municipal solid waste that has been generated worldwide in 2005-06 is estimated to be around 2,02 billion tonnes, an

increase of 7% per annum since 2003. Separation, transport, handling and disposal of waste must be managed in a way which minimises the risk to patients, the public and the environment for health and safety. A cheap as well as easy-to-use solution for the household segregation system for direct deliveries to processing is offered in this paper. he waste is meant to be sorted into dry and wet waste. The AWS uses capacitive sensors to differentiate wet from dry waste. Experimental results show that the AWS is successfully used to separate waste from wet and dry waste.

Reference:-Balagugan, Raja S Maheswaran T, Savitha S "Implementation of Automated Waste Segregator at Household Level" -IJIRSET 2017.

In [2] Waste management is practically done manually, both indoor and outdoor. This is hygienic and requires substantial human resources to accomplish it. The management of external waste is to a certain extent automated. This paper discusses a proposal to fully automate indoor waste management by intelligently making the existing waste disposal points and using a mobile waste collection robot. Ultrasound caps monitor the filling of the dustbin and the Arduino Nano controller, with wireless protocol Zig bee 802.15.4, transmits data to the robot when filled to the brim. The robot is designed to track the location of the filled dustbin and recover waste in the storage part in an effective manner. In order to recognise the complete dustbin and its position based on a wave front algorithm, the RS SI value (received signal strength indicator). The value from the received message is used. The proposed system shows significant efficiency in power consumption compared to the existing systems and makes it a perfect candidate for waste management.
Reference:-Poorani Ravindhiran, Pradeep Gopal, Joseph Gladwin S, Rajavel R ". Automated Indoor Waste Management System Employing Wave Front Algorithm and Received Signal

- In [3] In last few decades garbage management has become a perilous matter in the developing country along with the rapid growth in the population and pollution. In most of the areas it is revealed that overflowed garbage bins are not emptied on time thus creating disease ridden environment and infirm countries. Collection of garbage in bins faces daily variation in quantity according to time as well. Waste picking vehicles of Municipal Corporation which are at fixed intervals has dwindling reliability and unmonitored collection system. The proposed model makes an IOT based smart garbage monitoring system which can detect the garbage level of the dustbin and via Wi-Fi and GSM the status and location of bins can be displayed on web server. This system will improve the coordination between the transportation process and garbage collection.

Reference:-"The Internet of Things' Intelligent Waste Monitoring and Clearance system IEEE international conference 2017, S. Vinoth Kumar, A. Krishna Kumar and Mahantesh Mathapati.

5. Methodology

The law can be implemented if residents and authorities are working tandem, in order to produce better results, compatibility between all stakeholders is necessary. It is the responsibility of producers or generator companies to separate waste into the three wet, dry and dangerous waste categories in the Solid Waste Management Rules, 2016. It can be handed over to licenced waste collectors or local authorities only following segregation. Dry waste contains plastic, paper, metal, wood and so on; and hazardous household waste includes servants, empty cleaning agent containers, mosquito repellents, and more. Dry waste is biodegradable. This was repeated in a January 2018 notified by the Delhi Solid Waste Management By-laws. But the majority of Delhi, whether it is households, hotels, restaurants and other waste generators, still has to segregate waste at source.

Table 1: Target for segregation at source

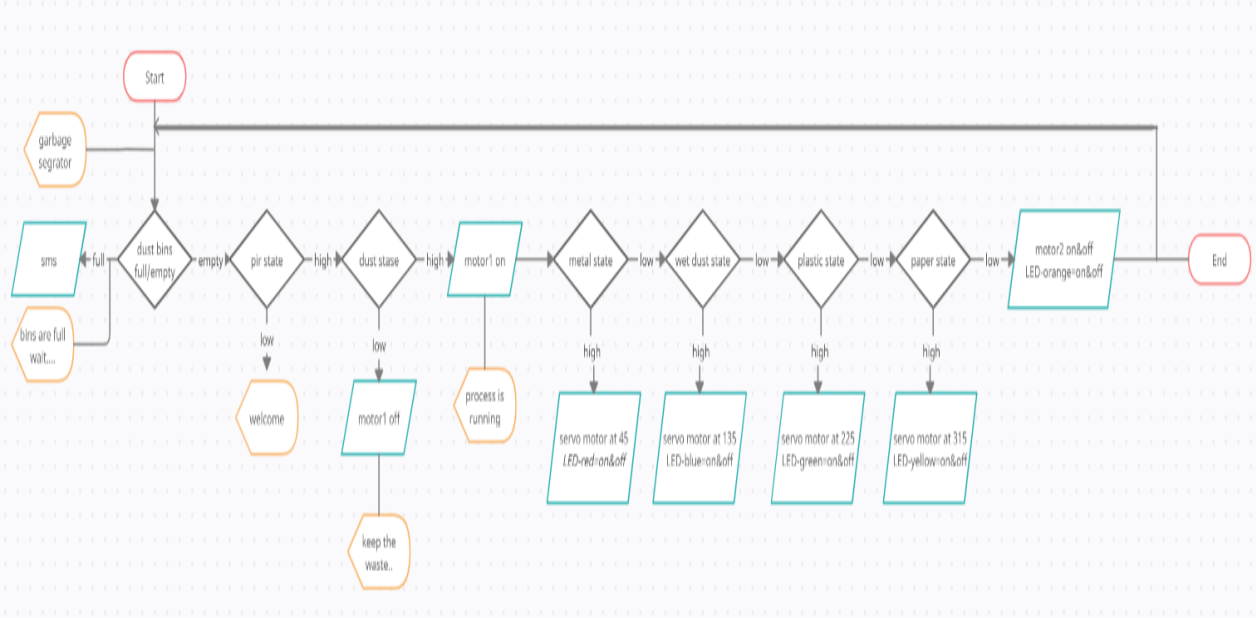
Name of urban local body	% of segregation as on date	% of segregation aimed at	Date by which to be achieved
New delhi municipal council	70	100	31/3/2019
Delhi cantonment board	50	90	31/5/2019
East DMC	Negligible	80	31/3/2020
South DMC	Negligible	80	30/9/2021
North DMC	Negligible	80	30/9/2021

Name of urban local body	Waste per day (MT)	(MT) waste processed at waste to energy plant	(MT) waste processed in compost plants	Waste being processed in decentralized plants/parks	Waste going to landfill sites (average MT)
SDMC	3600	1800	200	-	1600
North DMC	4000	1300	700	-	2,000 at bhalsa, 400 at narela
EDMC	2500	1500	-	-	1800
New delhi municipal corporation	350	300	30	20	-
Delhi cantonment board	62	28.83	2	6.5	24.67

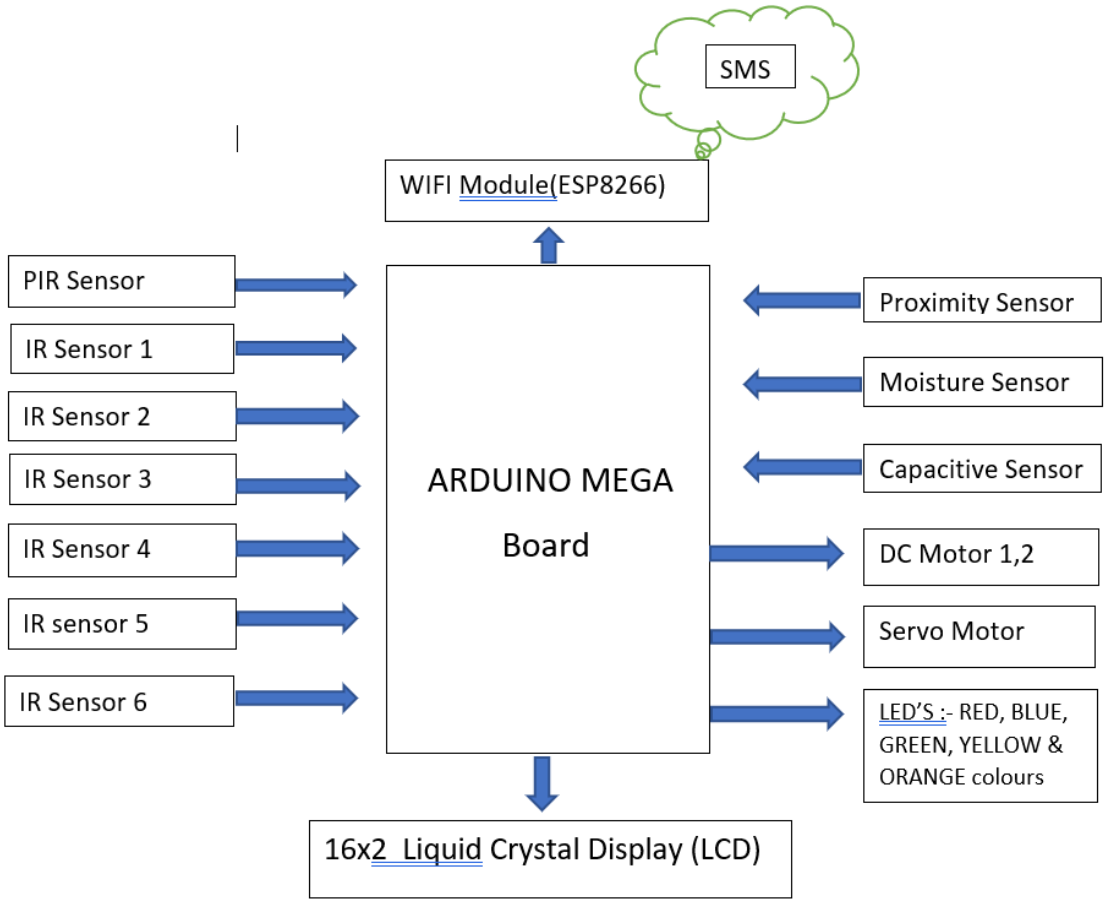
Now when segregation at the source (generators households) is being becoming ground reality in upcoming years all the stakeholders (ULB, corporate and people) of can adopt different measures for segregated waste.

5.1 Design Methodology

5.1.1 Flow chart:



5.1.2 Block Diagram:



6. Components Required:

6.1 Arduino MEGA Board:

Arduino is an open-source, hardware and software-based electronics platform. Arduino boards are able to read and turn input sensor light, finger button or Twitter message to activate engine power, LED, and publish something online. Input can also be read from Arduino boards. You can tell your board what to do by sending the microcontroller on the board a series of instructions. You use the programming language for Arduino (based on wiring) and the processing-based software for Arduino (IDE).

The Arduino Mega 2560 is an ATmega2560 microcontroller (datasheet). The system consists of five digital input/output pins, of which there are fourteen are available to use as PWM outputs, sixteen analogue inputs, three UART ports, 16 MHz crystal oscillator, a USB connection, an ICSP and a reset button. It contains everything you need to support the microcontroller; simply connect it to a USB cable computer or power it to start up with an AC-to-DC adapter or battery. The Mega is compatible with the most Arduino Duemilanove or Decimal shields.

The Mega 2560 is a replacement update of the Arduino Mega.

Summary:

Microcontroller ATmega2560

Operating Voltage 5V

Input Voltage (recommended) 7-12V

Input Voltage (limits) 6-20V

Digital I/O Pins 54 (of which 14 provide PWM output)

Analog Input Pins 16

DC Current per I/O Pin 40 mA

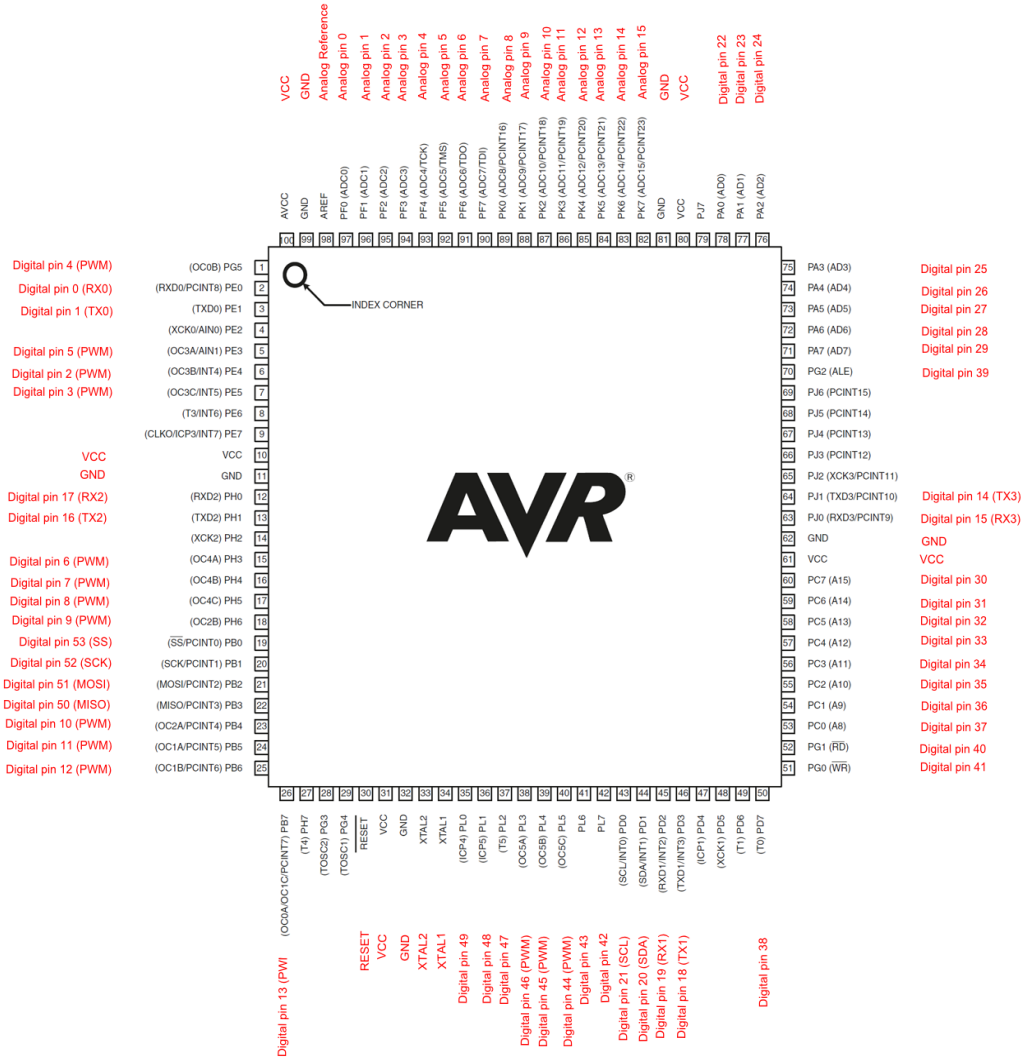
DC Current for 3.3V Pin 50 mA

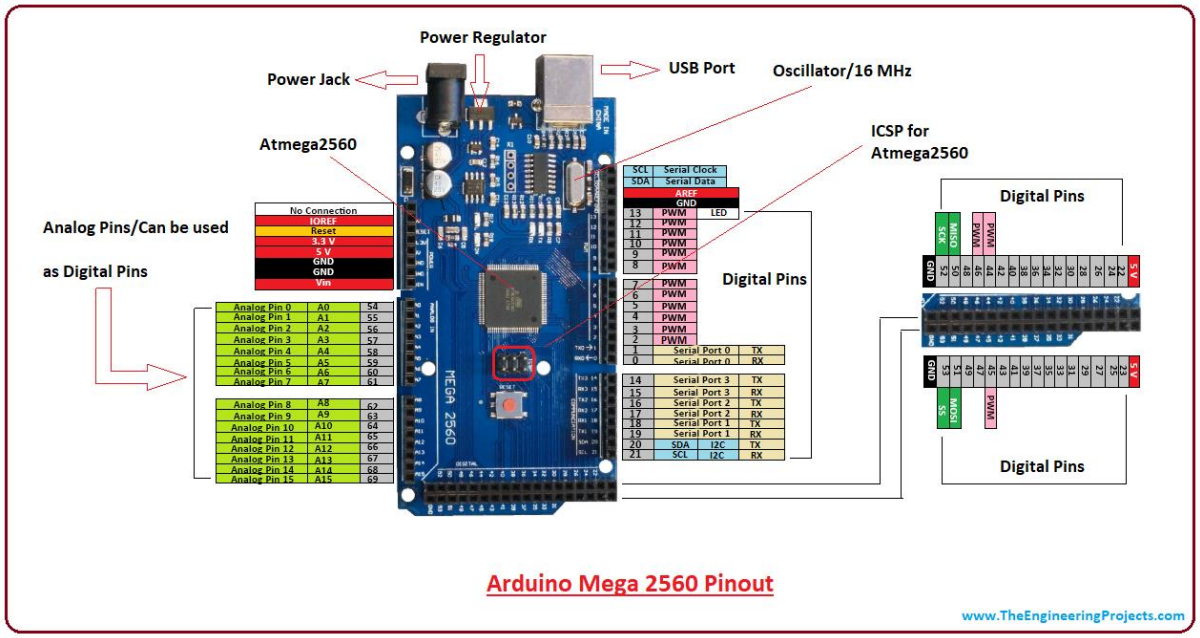
Flash Memory 256 KB of which 8 KB used by bootloader

SRAM 8 KB

EEPROM 4 KB

Clock Speed 16 MHz


INDEX CORNER
AVR
Digital pin 4 (PWM)
Digital pin 0 (RX0)
Digital pin 1 (TX0)
Digital pin 5 (PWM)
Digital pin 2 (PWM)
Digital pin 3 (PWM)
VCC
GND
Digital pin 17 (RX2)
Digital pin 16 (TX2)
Digital pin 6 (PWM)
Digital pin 7 (PWM)
Digital pin 8 (PWM)
Digital pin 9 (PWM)
Digital pin 53 (SS)
Digital pin 52 (SCK)
Digital pin 51 (MOSI)
Digital pin 50 (MISO)
Digital pin 10 (PWM)
Digital pin 11 (PWM)
Digital pin 12 (PWM)
Digital pin 25
Digital pin 26
Digital pin 27
Digital pin 28
Digital pin 29
Digital pin 39
Digital pin 14 (TX3)
Digital pin 15 (RX3)
GND
VCC
Digital pin 30
Digital pin 31
Digital pin 32
Digital pin 33
Digital pin 34
Digital pin 35
Digital pin 36
Digital pin 37
Digital pin 40
Digital pin 41
Digital pin 13 (PWM)
RESET
VCC
GND
XTAL2
XTAL1
Digital pin 49
Digital pin 48
Digital pin 47
Digital pin 46 (PWM)
Digital pin 45 (PWM)
Digital pin 44 (PWM)
Digital pin 43
Digital pin 42
Digital pin 21 (SCL)
Digital pin 20 (SDA)
Digital pin 19 (RX1)
Digital pin 18 (TX1)
Digital pin 38


Power Regulator
Power Jack
USB Port
Oscillator/16 MHz
Atmega2560
ICSP for Atmega2560
Analog Pins/Can be used as Digital Pins
Digital Pins
Digital Pins
Digital Pins
MEGA 2560
Arduino Mega 2560 Pinout
www.TheEngineeringProjects.com

6.2 NodeMCU ESP8266:

NodeMCU is a Lua-based open-source firmware and design board specifically intended for applications based in IoT. This includes firmware running on Espressif Systems' ESP8266 Wi-Fi SoC and hardware running on the ESP-12 module.

NodeMCU Development Board Pin out Configuration:

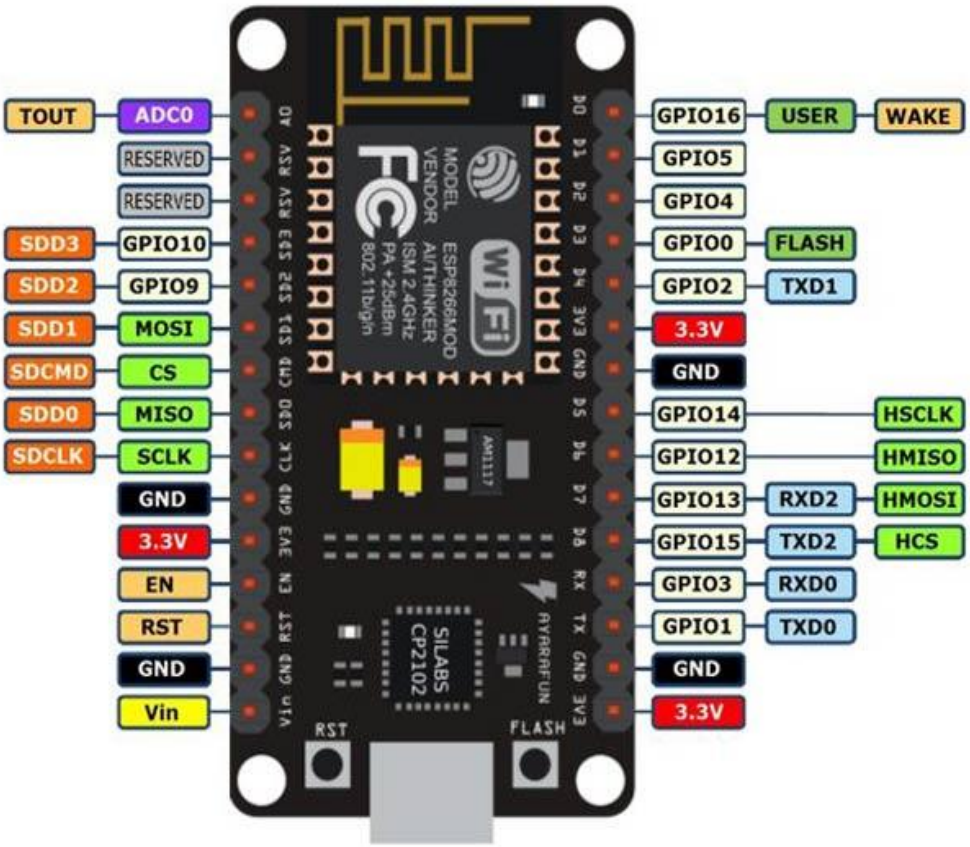
Pin Category	Name	Description
Power	Micro-USB, 3.3V, GND, Vin	**Micro-USB:** NodeMCU can be powered through the USB port **3.3V:** Regulated 3.3V can be supplied to this pin to power the board **GND:** Ground pins **Vin:** External Power Supply
Control Pins	**EN, RST**	The pin and the button resets the microcontroller
Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V
GPIO Pins	GPIO1 to GPIO16	NodeMCU has 16 general purpose input-output pins on its board
SPI Pins	SD1, CMD, SD0, CLK	NodeMCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0, TXD2, RXD2	NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.
I2C Pins		NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C.

NodeMCU ESP8266 Specifications & Features

- Microcontroller: Ten silica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

Other Espressif Boards

ESP8266, ESP12E, ESP32

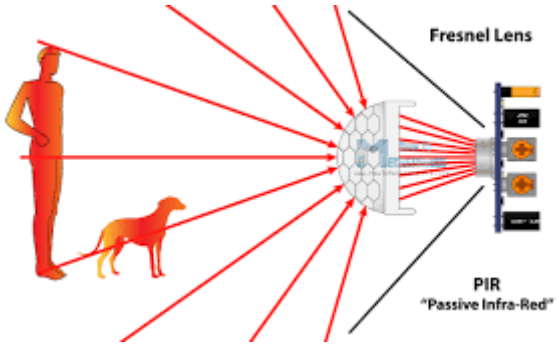


6.3 Passive Infrared Sensor (PIR sensor):

An electronic sensor that measures infrasound (IR) light from objects within its field of vision is the passive infrared sensor (PIR sensor). They are usually used in motion detectors based on PIR. In safety alarm and automatic lighting systems, PIR sensors are commonly used.

PIR sensors detect the overall movement, but don't tell about who or what is moved. A picture IR sensor is required for this purpose.

For "passive infrared detectors," PIR sensors are generally simply called "PIR" or, sometimes, "PID." Passive refers to the lack of energy from PIR devices for detection purposes. The infrasound radiation (radiant heat) that is emitted or reflected from objects is detected entirely.

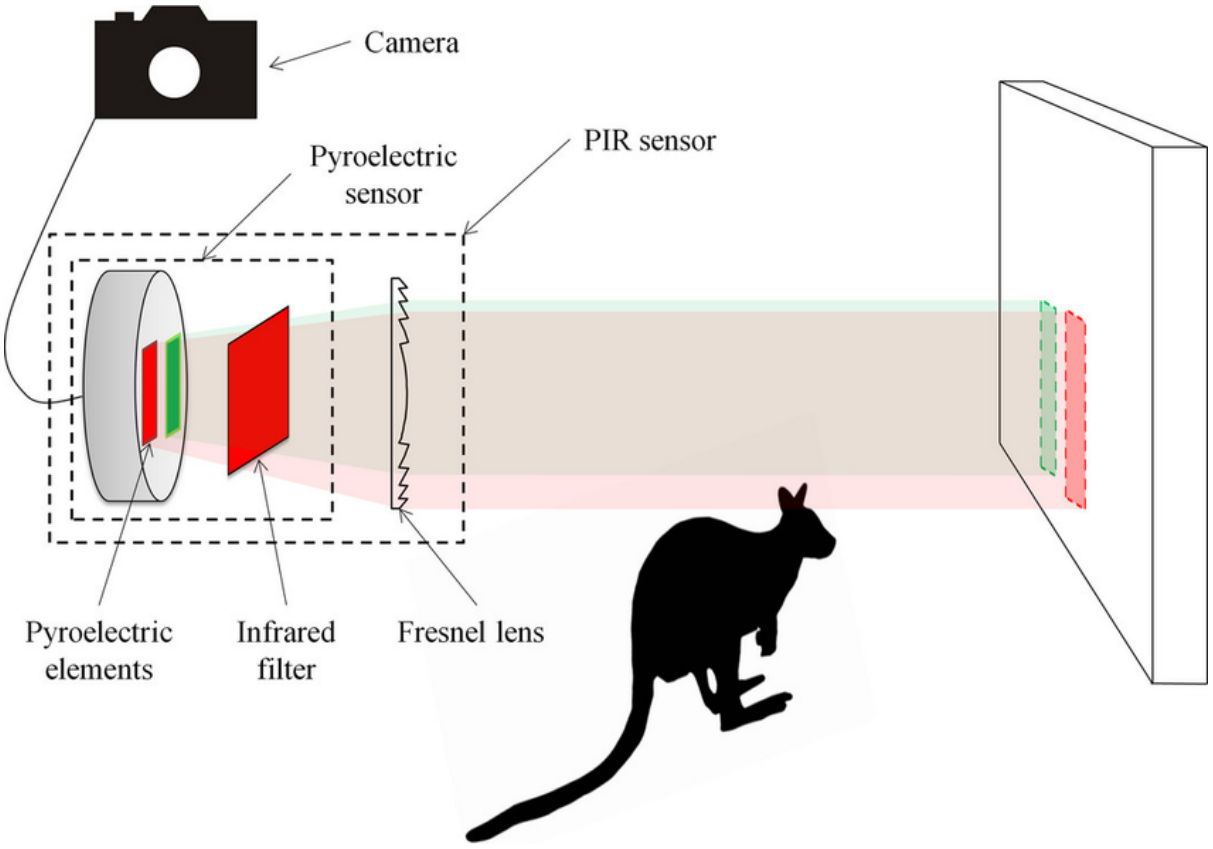


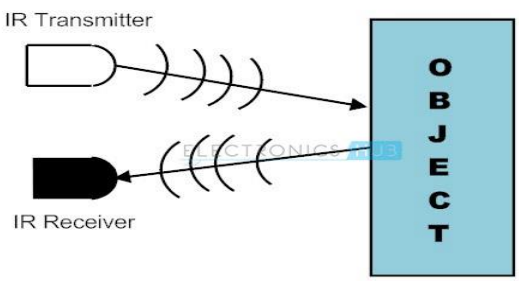
If the sensor is idle, the ambient amount radiated from the room or from the wall or from the outside will be detected by both slots. If a warm human or animal-like body passes by, it intercepts one half of the PIR sensor, which changes the two halves positively.

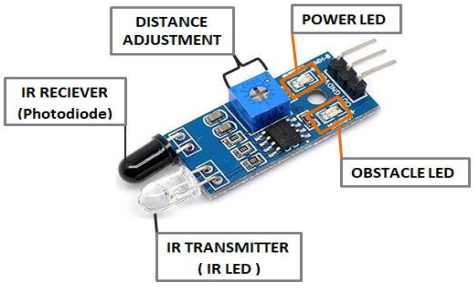
6.4 Infrared Sensor (IR sensor):

An infrared sensor (IR) is an electronic equipment used in its environment to monitor and detect infrared radiation. An astronomer named William Herschel accidentally discovered infringement radiation in 1800. While measuring each colour of light temperature (separated from a prism), he realised that the temperature was higher, right after the red light. IR for the human eye is invisible since it has a long wavelength than visible light (though it is still on the same electromagnetic spectrum). Anything emitting heat (all things over five degrees Celvin temperature) produces infrared radiation.

Two types of infrared sensors are available: active and passive. Infrared sensors both emit and detect radiation infrared. Active IR sensors have two parts: an LED and a receiver. The LED's infrared light reflects the object near the sensor and is detected by a receiver. When the object comes near the sensor Active IR sensors are used as proximity sensors in obstacle detection systems (such as in robots).







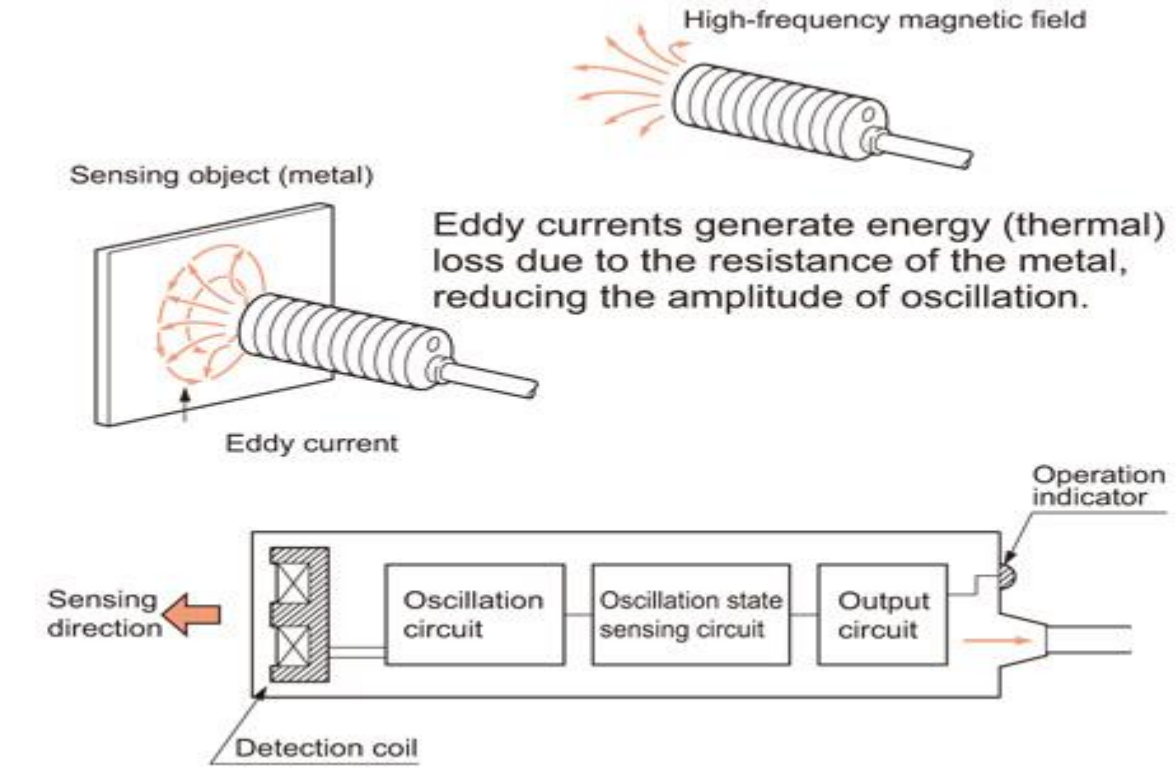
7.5.Inductive Proximity Sensor:

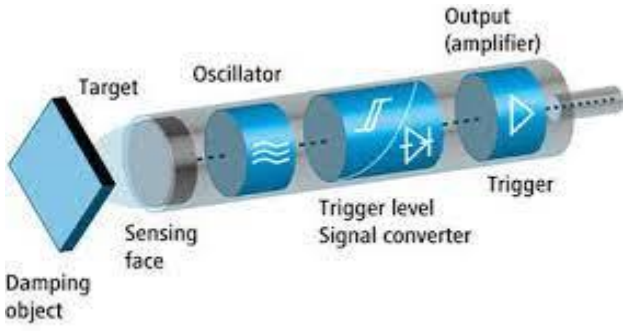
A non-contact electronic proximity sensor is an inductive sensor. It is used to position metal objects and to detect them. Depending on how the metal is detected the sensing range of the inductive switch. The sensor is composed of a detector or an induction loop.

Principle of inductive proximity sensor:

A high frequency magnetic field is produced by the detection coil at the frontier end of the sensor, as shown in the following figure. In this magnetic field the induced currents flow into the metal when an object (metallic) comes closer and thermal loss causes and oscillation reduction or stoppage.

This state shift is detected through a sensing circuit for oscillation state which then runs the output circuit.

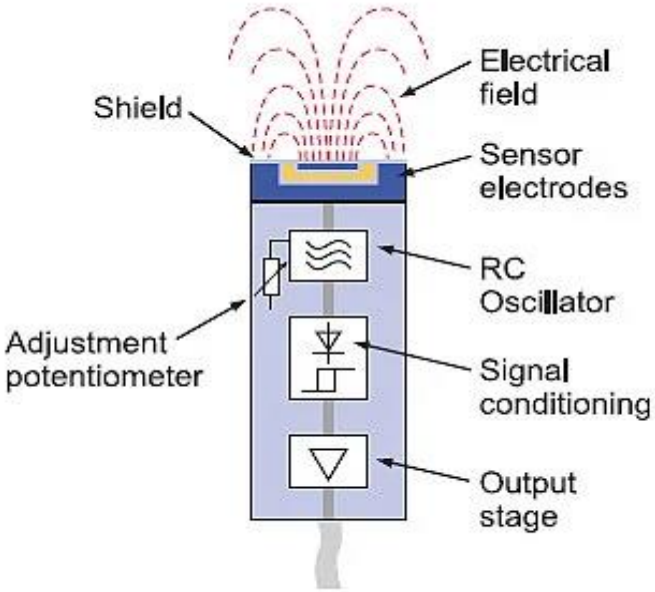




6.6 Capacitive Proximity Sensor:

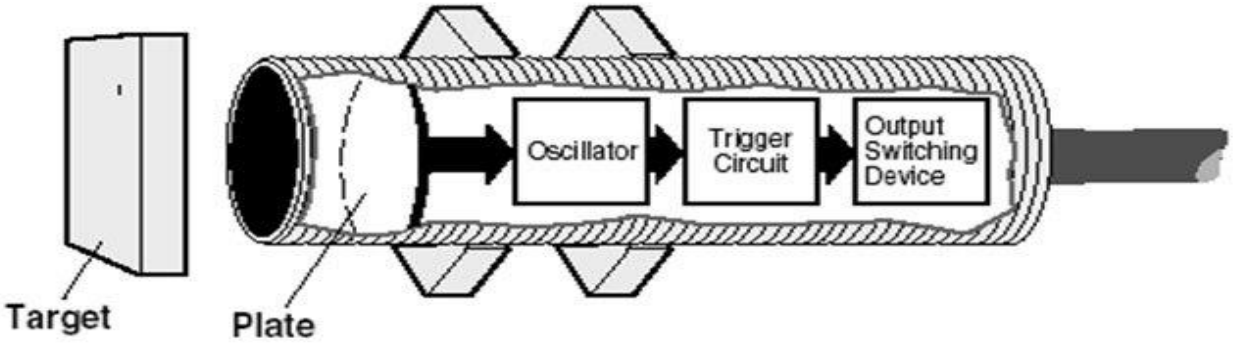
Sensors detect capability changes between the sensing object and the sensor. Capacitive proximity sensors According to the name, the capacitance changes read by the sensor are recorded by capacitive proximity sensors.

Depending on the size and distance of the sensing object the capacitance varies. An common capacitive closeness sensor is similar to a condenser with two parallel plates that detect the capacity of the two plates.



Working Principle of Capacitive Proximity Sensor:

A high frequency oscillator with a sensing surface formed by two metal electrodes is the capacitive proximity sensor. When an object approaches the sensing surface, the object enters the electrode field and changes the oscillator capacitance.



Consequently, when the oscillator circuit reaches certain amplitude, it switches oscillations and changes the output of the sensor. When the object moves away from the sensor, the amplitude of the oscillator decreases and the sensor returns to its initial state.

6.7 Moisture Sensor:

The soil moisture sensor is a sensor for measuring the volumetric water content in the soil. Since the gravimetric dimension of soil humidity needs to be removed, dried and sampled. These sensors do not measure the volumetric water level directly using other ground rules such as dielectric constant, electrical resistance, otherwise neutron interaction and moisture content replacement.

It is necessary to adjust the relation between the calculated property and the soil moisture based upon ecological factors such as the temperature, type of soil, or electrical conductance. The reflected microwave emission can be influenced by soil humidity, and mainly used in agriculture and hydrological remote sensing.

The sensors are normally used for the control of volumetric water and another group of sensors calculate a new moisture property in soils called water potential. These sensors are generally referred to as sensors of soil water potential, such as gypsum blocks and tensiometers.

Working Principle

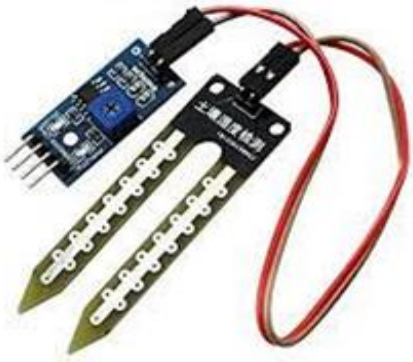
The main purpose of this sensor is to measure the soil's water content (dielectric permittivity). This sensor may be operated by adding this sensor into the ground and indicating in the form of one percent the status of the water content in the soil.

Within science, such as environmental science, agriculture, biology, soil, botany and horticulture, it is ideal to conduct experiments within this sensor.

Specifications

The following is included in the sensor specification:

- The voltage required to operate is 5V
- The current required to operate is <20mA
- Analog interface type
- This sensor requires 10°C ~ 30° to operate.



6.8 DC Motor & DC Gear Motor:

A DC motor is an electrical rotating device converting direct current, electrical energy, into mechanical energy. An induction (coil) within the DC engine generates a magnetic field which creates movement, as its terminal is equipped with the DC voltage. There is an iron shaft inside the engine wrapped in a wire spindle. This shaft contains two fixed magnets on both sides, north and south, which in turn produces repulsive and attractive force. ISL Products design and produce brushless DC motors and DC motors. We adapt the size and performance of our DC engines to suit your specifications.

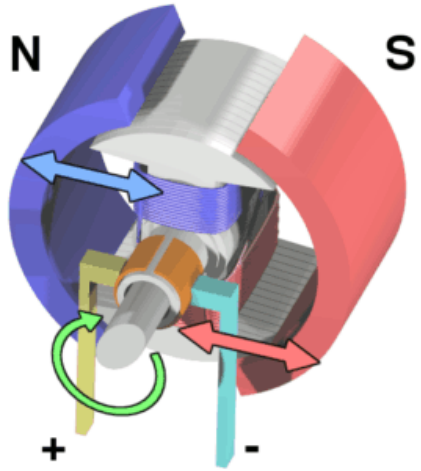


Figure 1 - Inside the DC Motor

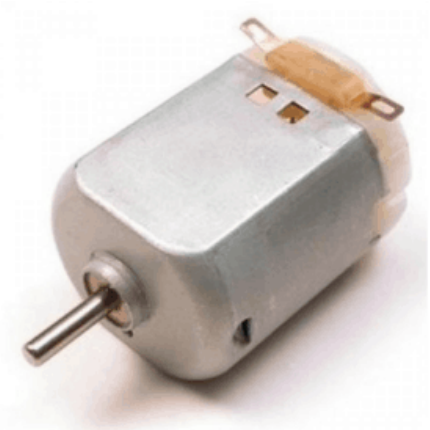


Figure 2 - DC Motor

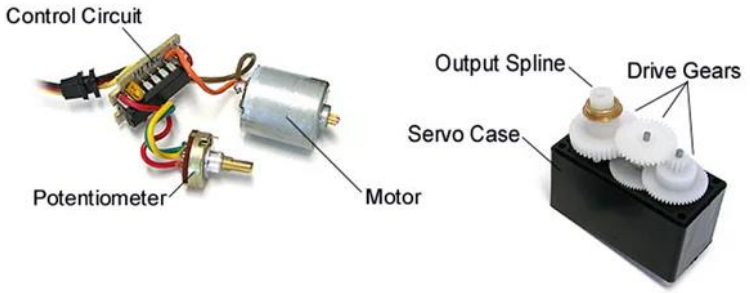
An all-in-one combination of the engine and the gearbox is a gear engine. Adding a gearhead to an engine reduces speed and the torque output increases. Speed (rpm), torque (lb-in) and efficiency are the main parameters for gear motors (percent). You must first calculate the load, speed and torque requirements for your application to select the most appropriate gear motor for your application. In order to meet all application requirements, ISL Processes offers a range of gear motors, Planetary Gear and Worm Gear engines. Most of our DC engines are supported by one of our unique gearboxes which offers you a very efficient gear engine solution.

6.9 Servo Motor:

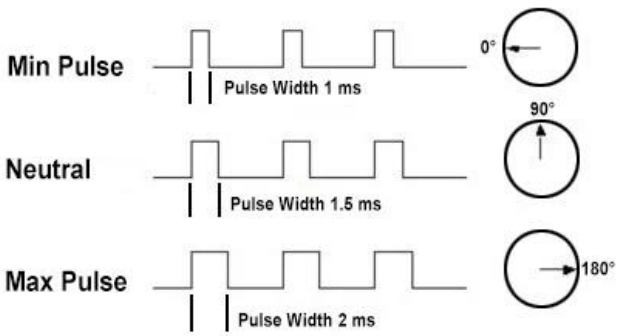
The servo engine is a closed loop system with position feedback to control the speed and position of rotation or linearity. The motor is controlled by an analogue or digital electrical signal which determines the movement amount representing the shaft's final control position.

For many applications, servo motors have been around for a long time. They are small, but they have a big punch and are very efficient in energy. These features enable them to operate toy cars, robots and aircraft remotely controlled or radio controlled. In industrial applications as well as in robotics, in line production, pharmaceutical services and food services, servo motors are also used.

The servo circuitry has a positioning shaft right inside the motor system, normally equipped with a gear (as shown below). The engine is controlled by an electrical signal to determine how much the shaft moves.



Servos are controlled by the transmission via the control wire of a variable width electric pulse, or PWM modulation. A low pulse, maximum pulse and repetition rate are available. Usually only a servo engine can turn 90° in either direction with a total movement of 180°. The neutral position of the engine is defined as where both clockwise or counter clockwise the servo has the same volume of potential rotation. In accordance with the push life of the pulses sent by the control wire, the PWM sent to the motor determines the location of the shaft. A pulse every 20 milliseconds is expected from the servo motor, so that the length of the pulse determines how far the motor turns.



6.10 Light Emitting Diode (LED):

A diode for light emissions (LED) is an electrically transmitted semiconductor system that transmits light. Light comes from the combination of the particles carrying the current (known as electrons and holes) within the semiconductor material.

LEDs are described as solid state devices because the light is generated within the solid semiconductor material. This lighting technology distinguishes it from other sources using heated filament (incandescent and tungsten halogen lamps) or gas dumping, which is also known as solid state light, which includes organic LEDs (fluorescent lamps).

Different colors:

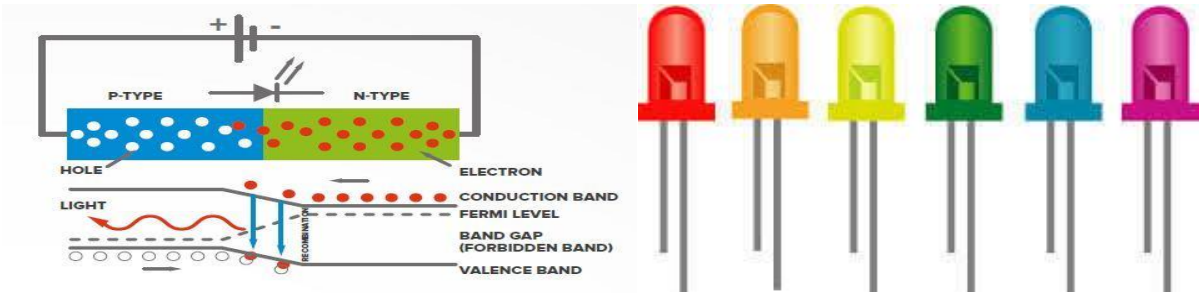
The electrons and holes are inside the semi-conductive material of the LED. The separation of strips (i.e. a bandgap) determines the power of the LED-emitting photons (light particles).

The photon energy determines the wavelength and therefore the colour of the emitted light. Various semiconductor materials with various band gaps produce different light colors. By changing the composition of light emitting region, or active region, the precise wavelength (color) can be tuned.

LED materials:

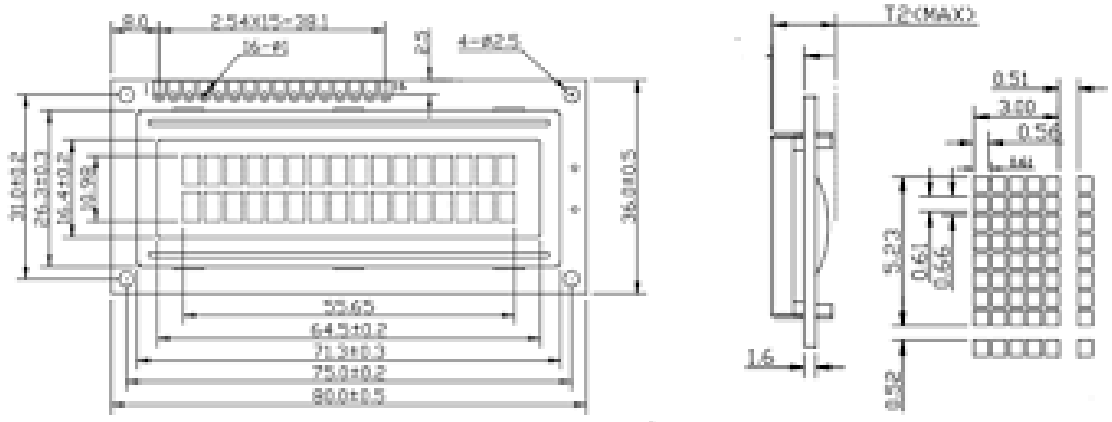
The main semiconductor materials used to manufacture LEDs are:

- **Indium gallium nitride (InGaN):** blue, green and ultraviolet high-brightness LEDs
- **Aluminum gallium indium phosphide (AlGaInP):** yellow, orange and red high-brightness LEDs
- **Aluminum gallium arsenide (AlGaAs):** red and infrared LEDs
- **Gallium phosphide (GaP):** yellow and green LEDs



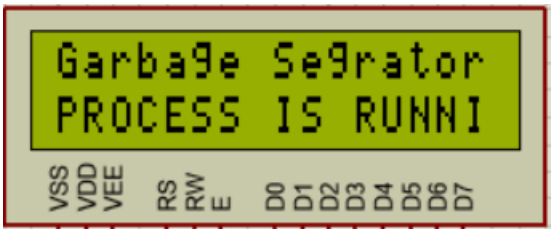
6.11 Liquid Crystal Display (LCD 16x2):

A 16x2 LCD display is a basic module that is widely used in different devices and circuits. A 16x2 LCD means that 16 characters can be displayed per line, and two of the lines are present. Each character in this LCD is shown in a matrix of 5x7 pixels. The 16 x 2 alphanumeric smart dot matrix display shows 224 characters and symbols. This LCD has the command and data, two registers.



The Command Registry stores different display commands. The data log saves the displayed data. Data which forms the image of that that you want displayed in data registers are placed in the display checking process and directions are then placed into the instructions register.

The word LCD is for display of fluid crystal. It is a type of electronic display module used for a wide range of applications such as mobile phones, calculators, computers, TV sets and other devices. This display is preferred primarily for light-emitting multi-segment diodes and seven sectors. The main advantages of using this module are cheap, programmable, animation and the display of custom characters, special and even animation is not limited.

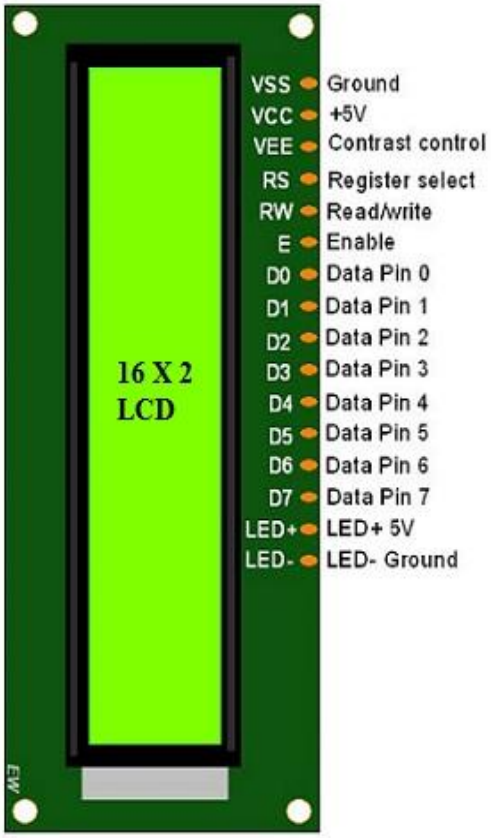


LCD 16×2 Pin Diagram:

The 16×2 LCD pin out is shown below:

- Pin1 this is a Display GND pin for the connection to the microcontroller GND terminal or power source. Pin1 is a GND pin.

- Pin2 (VCC/Source Pin): This is a display voltage pin used to connect a power source supply pin.
- Pin3 This pin adjusts the display difference used to connect a changeable POT which can deliver 0 to 5V. • Pin3:
- pin 4 which is used for connecting a microcontroller unit pin to 0.1 or.0 (0 = data mode, and 1 = command mode): this pin toggles between command and data register.
- Pin5 (read/write/control pin): This pin turns the display on the read or write operation to either 0 or 1 (0 = write operation and 1 = read operation), and is connected with the micro-control pin.
- Pin 6 This pin should be kept high for reading / writing and connected to the microcontroller unit and held high constantly.
- Data Pins 7-14 these pins are used for transmitting information to the display. The two-wire pins are connected in 4-wire and 8-wire mode. The microcontroller unit is connected to only four pines as 0 to 3 in 4-wire mode, whereas the 8-pin unit is connected to the 0 to 7 in 8-wire mode.
- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.



Features of LCD16x2:

The features of this LCD mainly include the following:

- This LCD has 4.7V-5.3V operating voltage.
- Two rows where 16 characters can be created in each row.
- The current usage is 1mA without backlight
- A 5x8 pixel box can be constructed for every character
- LCD alphanumeric literature & numbers
- The display can operate with two modes, 4-bit and 8-bit.
- Available in Blue & Green Backlight
- Shows a few custom characters

Registers of LCD:

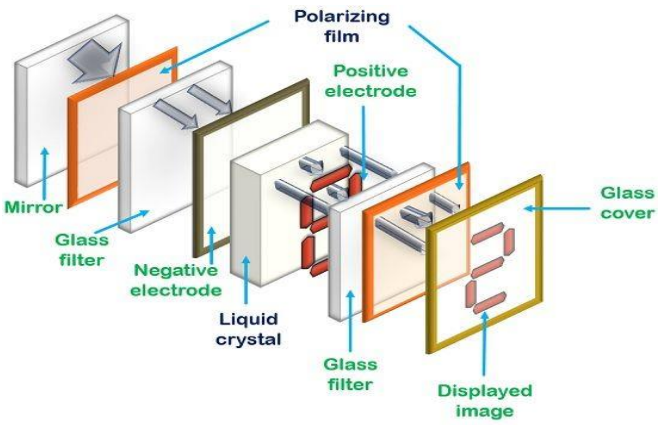
Two records, including a data record and command register, are available for a 16/2 LCD. The RS (selection of register) is mainly used to switch between registries. Where the set of registers is '0' the register is called the register of commands. The register set is also known as '1' data registry if the register set is '1'

Command Register:

The primary function of the register of command is to store the command instructions provided for the display. For pre-defined tasks such as display clearance, initialization, cursor place setting and display control can be performed. The processing of commands may take place in the register here.

Data Register:

In the Data Register the information to be displayed on the LCD screen is mainly stored. In this case, information that should be displayed on the LCD screen is the ASCII value of the character. Whenever the information is sent to LCD, it is transmitted to the data register and the process starts at that point. The data register will be selected for the set of registration =1.



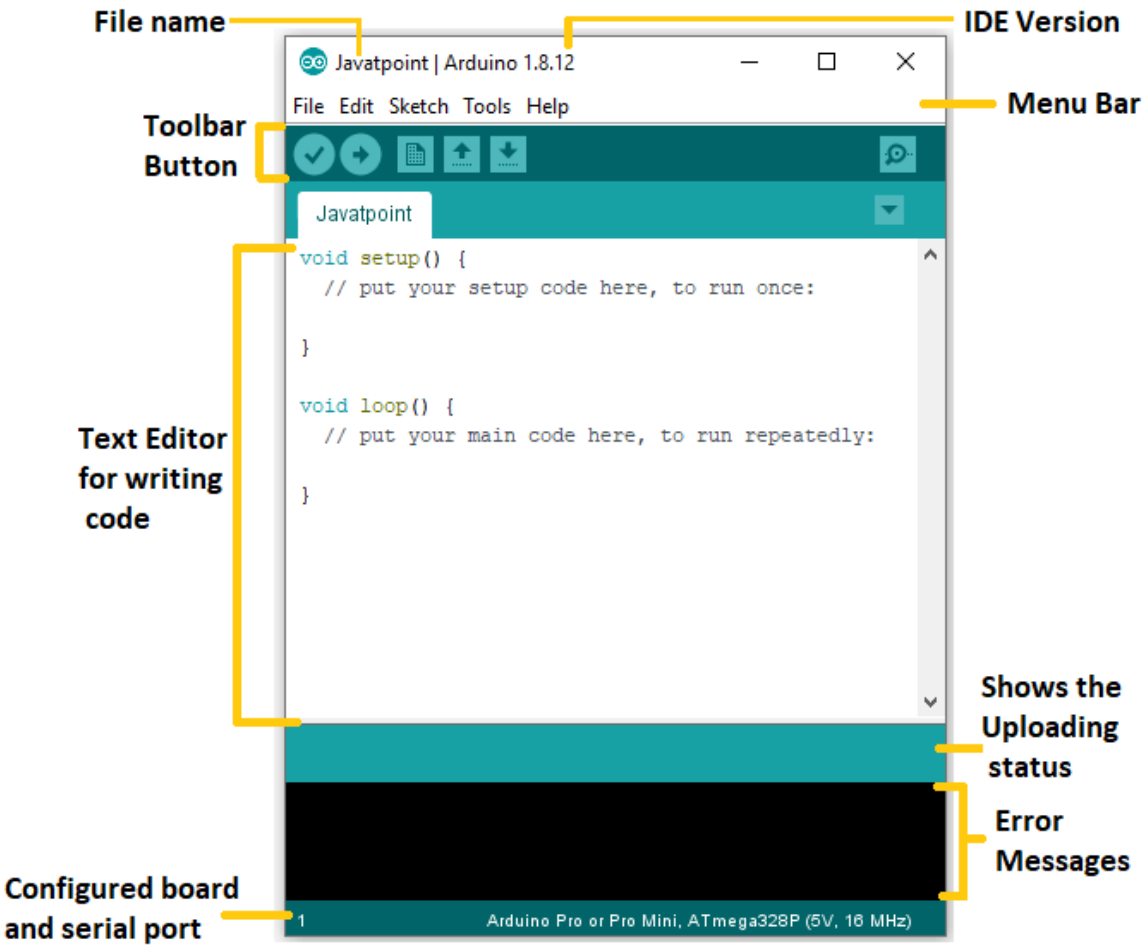
Important command codes for LCD:

Sr.No.	Hex Code	Command to LCD instruction Register
1	01	Clear display screen
2	02	Return home
3	04	Decrement cursor (shift cursor to left)
4	06	Increment cursor (shift cursor to right)
5	05	Shift display right
6	07	Shift display left
7	08	Display off, cursor off
8	0A	Display off, cursor on
9	0C	Display on, cursor off
10	0E	Display on, cursor blinking
11	0F	Display on, cursor blinking
12	10	Shift cursor position to left
13	14	Shift cursor position to right
14	18	Shift the entire display to the left
15	1C	Shift the entire display to the right
16	80	Force cursor to beginning (1st line)
17	C0	Force cursor to beginning (2nd line)
18	38	2 lines and 5×7 matrix

7. Software Required:

7.1 Arduino IDE:

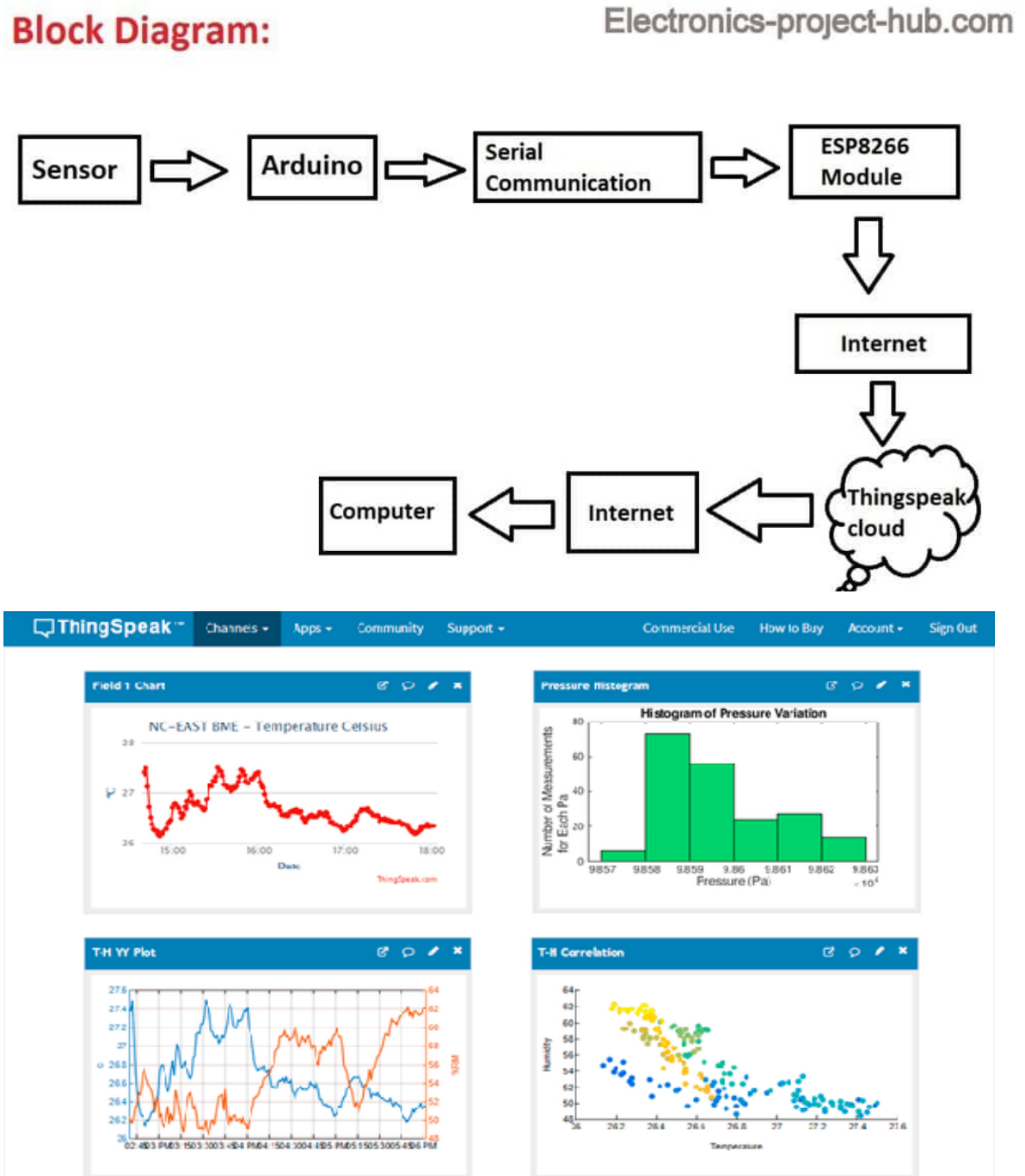
A cross-platform application (Windows, macOS, Linux) that is written for C and C++ functions is Arduino Integrated Development Environment (IDE). It is used for writing and uploading program to boards that support Arduino, but also to boards of other vendors with the aid of third-party cores.



7.2 Thing Speak:

ThingSpeak is an open-source IoT-application and API for storing and recovering data via the Internet or through the local area network from items using the HTTP and MQTT protocols. ThingSpeak allows the creation of sensors, tracking applications, and a social network with status updates.

ThingSpeak offers immediate views of the data that are posted to ThingSpeak via your devices. You can perform online analysis and processing of the data as it is entered by means of the capacity to perform MATLAB® code in ThingSpeak. ThingSpeak is often used to prototype IoT systems that require analytics and proof of concept.



7.3 IFTTT (If This Then That):

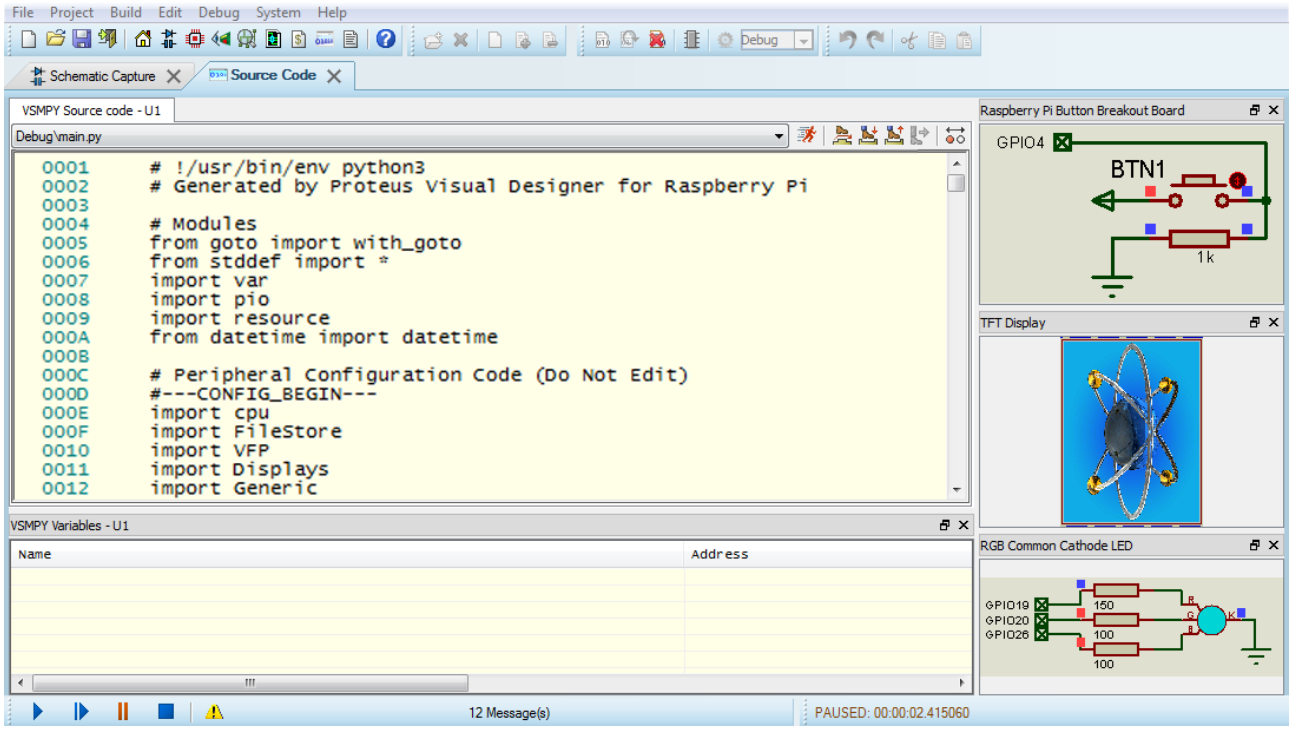
IFTTT derives its name "if this, then that" from the programming condition. The company provides an app, device, and service-connected software platform for one or more automations that include apps, devices, and services from different developers.

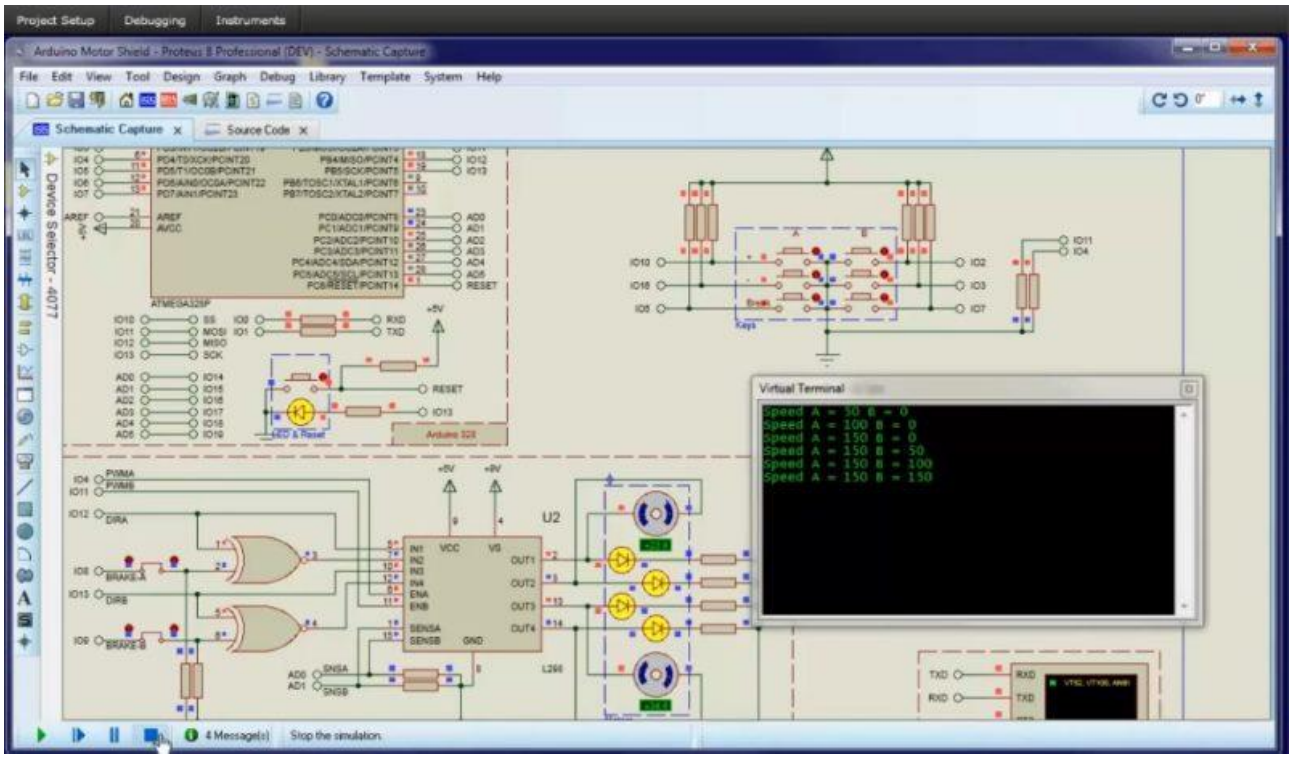
"If this is a service that enables a user to program an answer to events of various kinds in the world. There is a long list of events for IFTTT to respond to, all of which can be detected via the Internet.

8.4 Proteus Software:

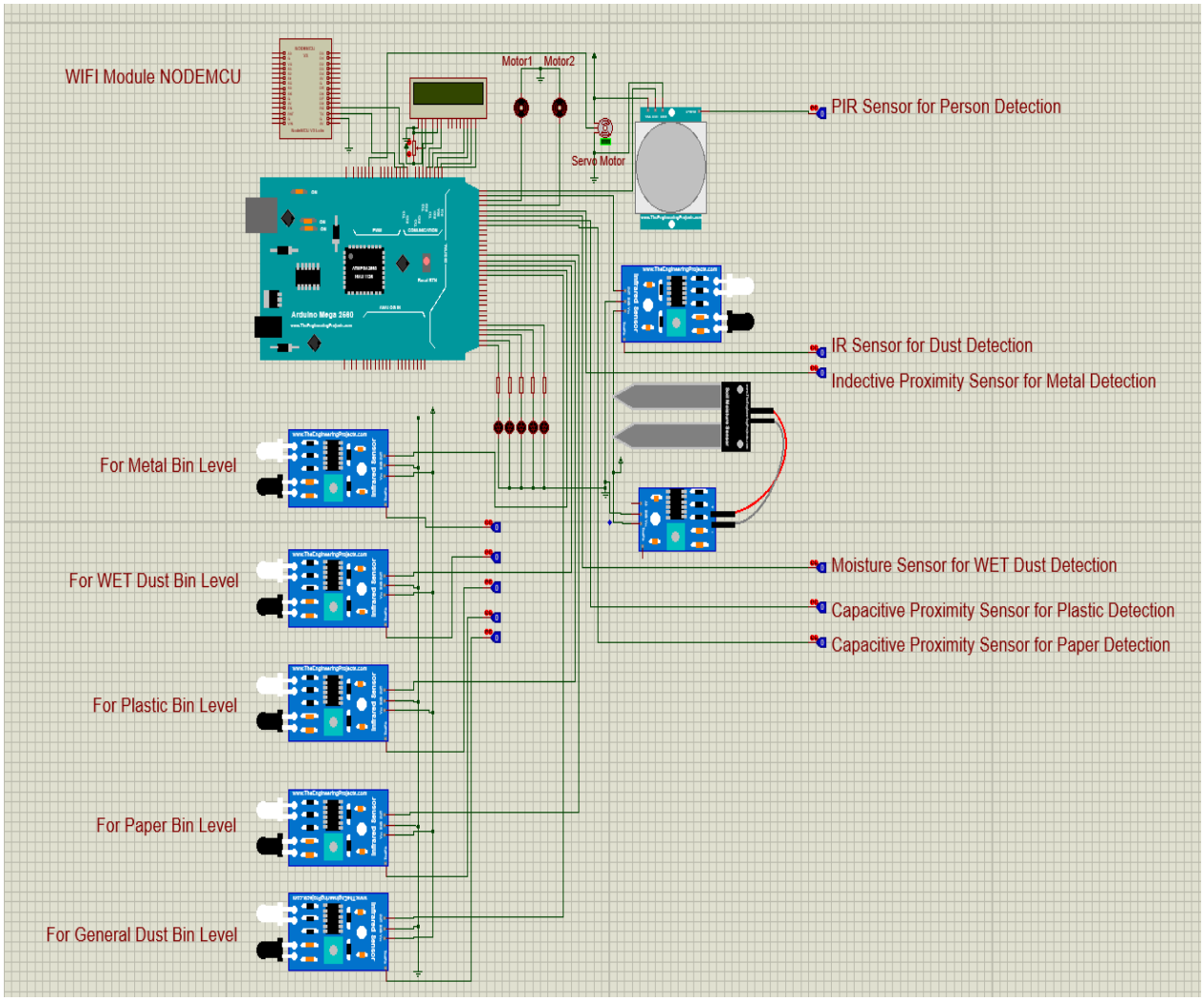
Proteus is a tool for simulating and designing electronic circuit design developed by the Labcenter Electronics. The CAD 2D drawing function is also available.

It is a software suite with a pattern, simulation and PCB design.


File Project Build Edit Debug System Help
Schematic Capture
Source Code
VSMPY Source code - U1
Debug\main.py
0001 # !/usr/bin/env python3
0002 # Generated by Proteus Visual Designer for Raspberry Pi
0003
0004 # Modules
0005 from goto import with_goto
0006 from stddef import *
0007 import var
0008 import pio
0009 import resource
000A from datetime import datetime
0008
000C # Peripheral Configuration Code (Do Not Edit)
000D #---CONFIG_BEGIN---
000E import cpu
000F import FileStore
0010 import VFP
0011 import Displays
0012 import Generic
VSMPY Variables - U1
Name
Address
Raspberry Pi Button Breakout Board
GPIO4
BTN1
1k
TFT Display
RGB Common Cathode LED
GPIO19
GPIO20
GPIO26
150
100
100
12 Message(s)
PAUSED: 00:00:02.415060


Project Setup
Debugging
Instruments
Arduino Motor Shield - Proteus 8 Professional (DEV) - Schematic Capture
File Edit View Tool Design Graph Debug Library Template System Help
Schematic Capture
Source Code
Device Selector - 4077
Virtual Terminal
Speed A = 50 B = 0
Speed A = 100 B = 0
Speed A = 150 B = 0
Speed A = 150 B = 50
Speed A = 150 B = 100
Speed A = 150 B = 150
U2
4 Message(s)
Stop the simulation

8. Circuit Diagram:



9. Code:

Arduino MEGA Code:

```
#include <LiquidCrystal.h>
#include <Servo.h>
LiquidCrystal lcd(16,17,18,19,20,21);
Servo myservo;

int motor1=24;
int motor2=25;
int led1=53;
```

```
int led2=52;
int led3=51;
int led4=50;
int led5=49;

void setup()
{
  Serial.begin(9600);
  lcd.begin(16, 2);
  pinMode(motor1, OUTPUT);
  pinMode(motor2, OUTPUT);
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(led3, OUTPUT);
  pinMode(led4, OUTPUT);
  myservo.attach(9);
}

void loop()
{
 int pirstate=digitalRead(22);
 int duststate=digitalRead(23);
 int metalstate=digitalRead(26);
 int wetstate=digitalRead(27);
 int plasticstate=digitalRead(28);
 int paperstate=digitalRead(29);

 int metalbin=digitalRead(38);
 int wetbin=digitalRead(37);
 int plasticbin=digitalRead(36);
```

```
 int paperbin=digitalRead(35);
 int generalbin=digitalRead(39);


 lcd.setCursor(0,0);
 lcd.print("Garbage Segrator");
 if (metalbin == LOW && wetbin == LOW && plasticbin == LOW && paperbin == LOW
&& generalbin == LOW)
 {
 if (pirstate == LOW)
 {
  lcd.setCursor(4,1);
  lcd.print("WEL COME");
  delay(500);
  lcd.clear();
 }
 else
 {
   if(duststate == LOW)
  {
  digitalWrite(motor1, LOW);
  lcd.setCursor(0,1);
  lcd.print("keep the waste");
  delay(50);
  lcd.clear();
  }

  else
  {
    lcd.setCursor(0,1);
    lcd.print("PROCESS IS RUNNING");
    delay(50);
```

```
lcd.clear();
digitalWrite(motor1, HIGH);

if (metalstate == HIGH)
{
  myservo.write(56);
  digitalWrite(led1, HIGH);
  delay(30);
  digitalWrite(led1, LOW);
}

else if(wetstate == HIGH)
{
  myservo.write(80);
  digitalWrite(led2, HIGH);
  delay(30);
  digitalWrite(led2, LOW);

}

else if(plasticstate == HIGH)
{
  myservo.write(105);
  digitalWrite(led3, HIGH);
  delay(30);
  digitalWrite(led3, LOW);
 }

else if(paperstate == HIGH)
{
```

```
      myservo.write(129);
      digitalWrite(led4, HIGH);
      delay(30);
      digitalWrite(led4, LOW);
    }
    else
    {
      digitalWrite(motor2, HIGH);
      delay(20);
      digitalWrite(motor2, LOW);
      digitalWrite(led5, HIGH);
      delay(30);
      digitalWrite(led5, LOW);
    }

   }
  }
 }
else
{
  lcd.setCursor(0,0);
  lcd.print("bins are full");
  lcd.setCursor(0,1);
  lcd.print("please wait...");
  delay(50);
  lcd.clear();
}
 }
```

NodeMCU Code:

```
#include <ESP8266WiFi.h>;
```

```
#include <WiFiClient.h>;

#include <ThingSpeak.h>;

const char* ssid = "Your SSID Here"; //Your Network SSID

const char* password = "Your Password Here"; //Your Network Password

int metal;
int wet;
int plastic;
int paper;
int general;


WiFiClient client;

unsigned long myChannelNumber = YYYYYY; //Your Channel Number (Without Brackets)

const char * myWriteAPIKey = "XXXXXXXXXXXXXXX"; //Your Write API Key

void setup()

{

Serial.begin(9600);

delay(10);

// Connect to WiFi network

WiFi.begin(ssid, password);

ThingSpeak.begin(client);

}


void loop()

{

metal = digitalRead(ir1); //Read digital values and Store in ir1 variable
wet = digitalRead(ir2);  //Read digital values and Store in ir2 variable
plastic = digitalRead(ir3);  //Read digital values and Store in ir3 variable
paper = digitalRead(ir4);  //Read digital values and Store in ir4 variable
general = digitalRead(ir5);  //Read digital values and Store in ir5 variable

Serial.print(val); //Print on Serial Monitor
```

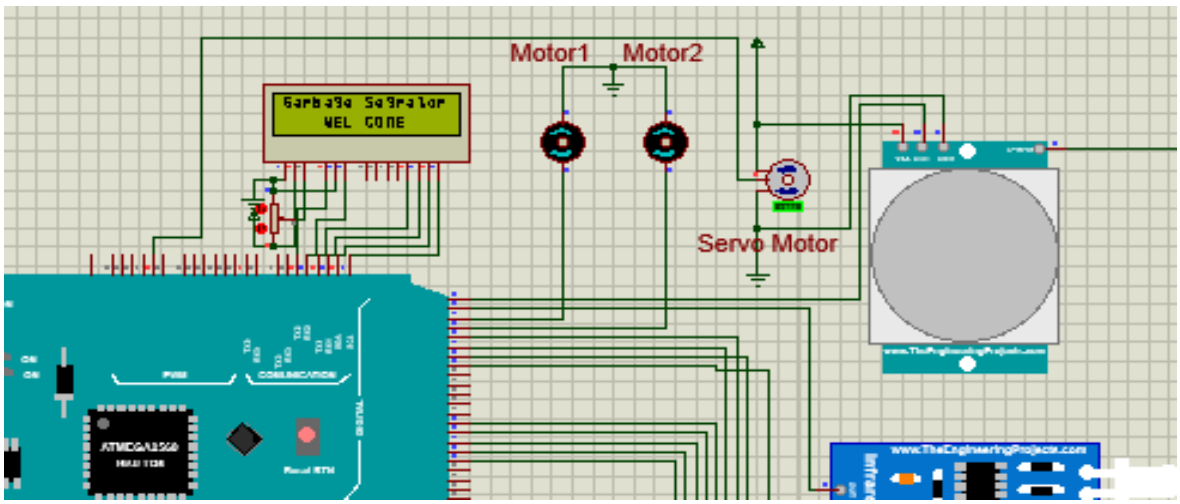
```
delay(1000);
ThingSpeak.writeField(myChannelNumber, 1,metal, myWriteAPIKey); //Update in
ThingSpeak
ThingSpeak.writeField(myChannelNumber, 2,wet, myWriteAPIKey); //Update in
ThingSpeak
ThingSpeak.writeField(myChannelNumber, 3,plastic, myWriteAPIKey); //Update in
ThingSpeak
ThingSpeak.writeField(myChannelNumber, 4,paper, myWriteAPIKey); //Update in
ThingSpeak
ThingSpeak.writeField(myChannelNumber, 5,general, myWriteAPIKey); //Update in
ThingSpeak


delay(100);

}
```

10. Working:

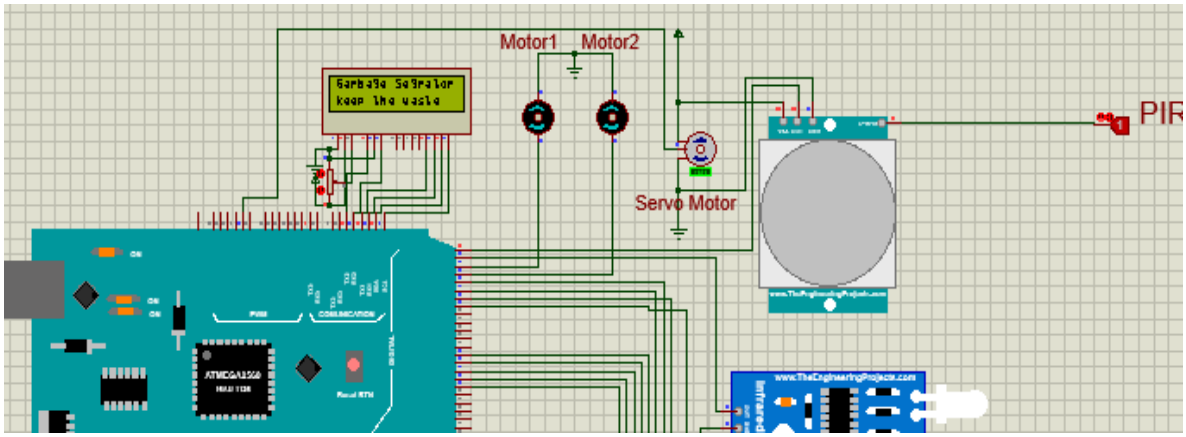
- First we have to give power supply to the Hardware, it is loaded with program. If any person is detected through the PIR sensor it will start the mechanism of the hardware and also gives directions through LCD display weather they have to keep the waste on conveyor belt or not, if any of the bin is full it will show that "bins are full please wait.." else it will show "please keep the waste on conveyor belt".
- If any of the dust particle is detected on the front side of conveyor belt through IR sensor, it will start the motor to run the conveyor belt to segregate the waste and also it will display "waste is segregating ". Else the motor of the conveyor belt is in off mode and it will display the "please keep the waste on conveyor belt" .
- Conveyor belt is running and sensors are placed sides of the conveyor belt to detect the different types waste on the conveyor belt and four different coloured dust bins are placed on the servo motor with different angles at the end of the conveyor belt so that the each bin will receive different waste particles (metal waste-red coloured bin with 45^0 angle etc..).
- If metal particle is detected by inductive proximity sensor, the servo motor will rotate the bins to 45^0. The metal particle will be placed at particular bin in 45^0 place.
- If wet particle is detected by moisture sensor, the servo motor will rotate the bins to 135^0. The wet particle will be placed at particular bin in135^0 place.
- If plastic or paper particle is detected by capacitive sensor with different densities of thickness and hardness (paper 10-40, plastic 60-100). For plastic the servo motor will the bins to 225^0, for paper the servo motor will rotate the bins to 315^0.
- If the dust particle is not detected by any of the sensor, the motor will be OFF and motor2 will be ON. Motor2 will push that dust to general bin, after that motor2 will be OFF and motor will be ON.
- At the end/start of this mechanism the bins level is measured through IR sensor, if any one of the bin is full the SMS will be sent to particular department to change the bins. Else the mechanism will continue...

11. Complete work plan with timelines:

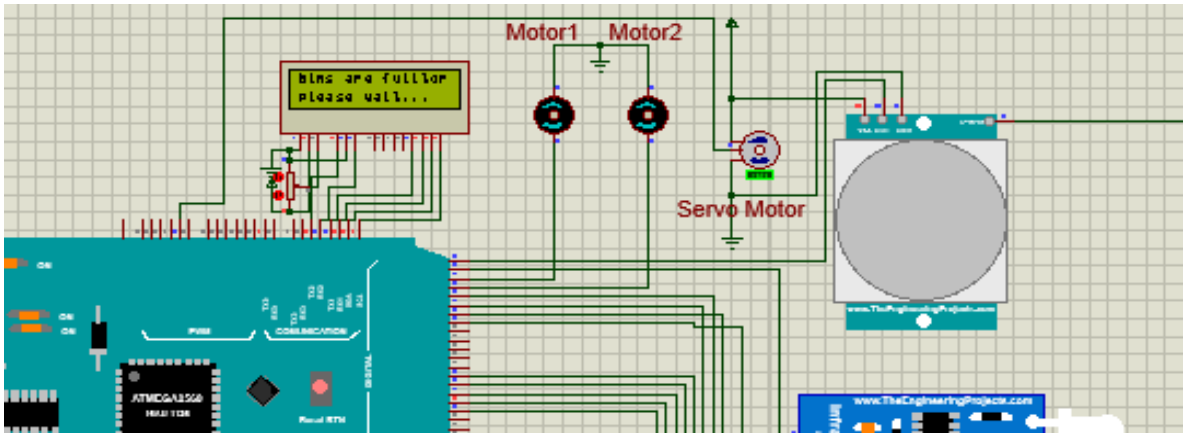
12. Experimental work done:



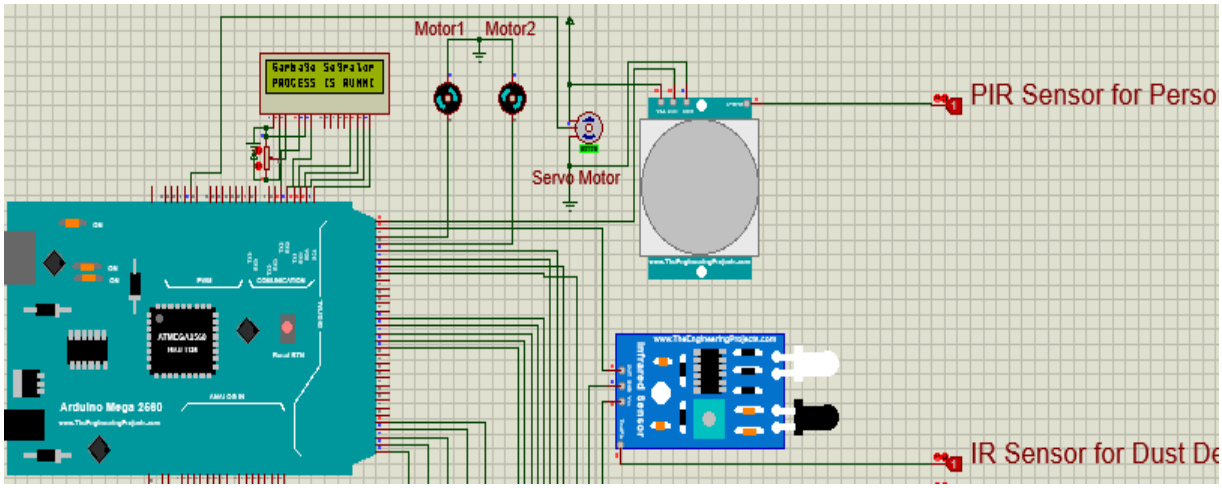
It is starting position of hardware, and the LCD display shows “Garbage Segregator” on first row, “ WEL COME ” on second row



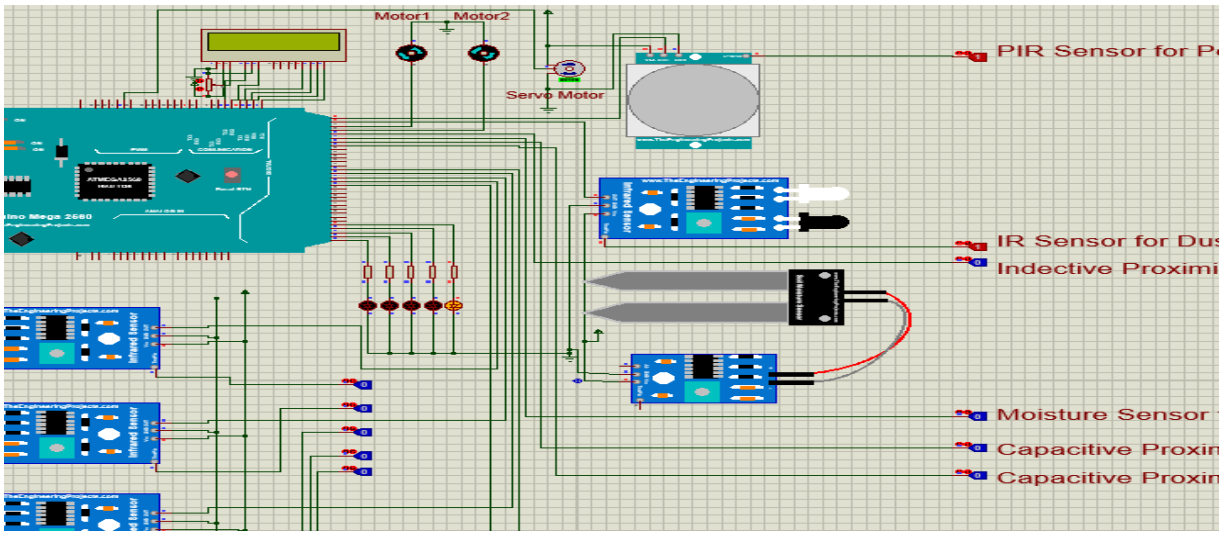
When pir state is High (if any person is detected by pir sensor) and LCD will display “KEEP THE WASTE” (it means the person has to keep the garbage on conveyor belt)



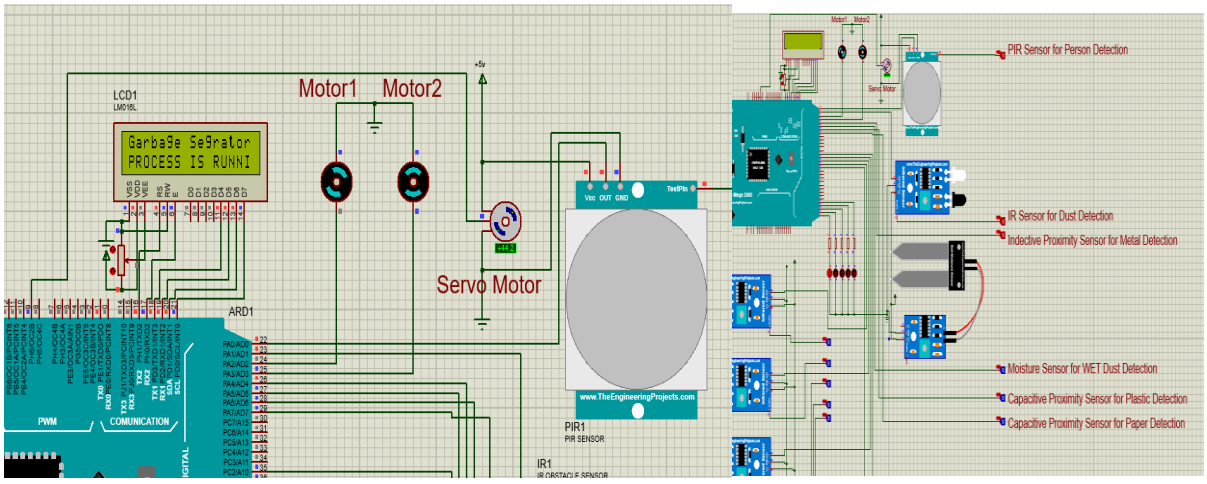
If the person is detected by PIR sensor but the dust bins are full or any one of the dust bin is full, the LCD display will display “bins are full” “please wait…”



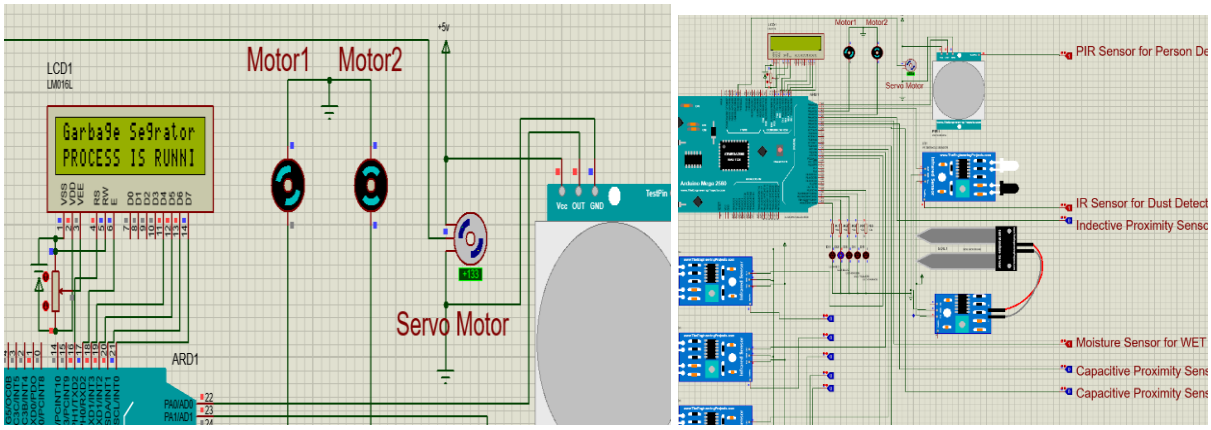
When waste is detected on conveyor belt through IR sensor, motor1 will on to move the conveyor belt, LCD will display “Process is running” on second row.



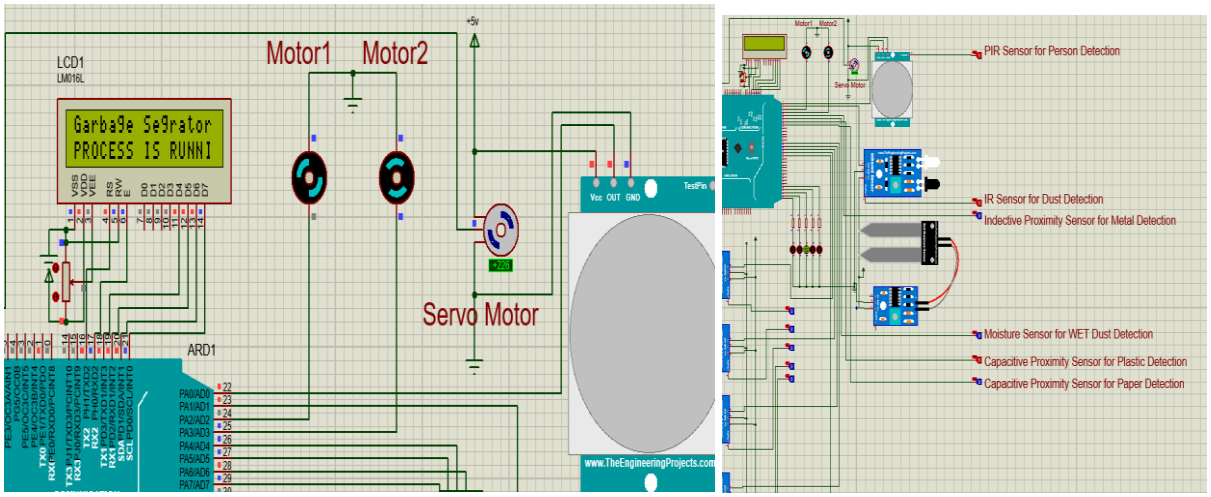
If the waste is not detected by any of the sensor then it will be considered as other material and it will be pushed to general dust bin through Motor2, the orange led will on & off wilt



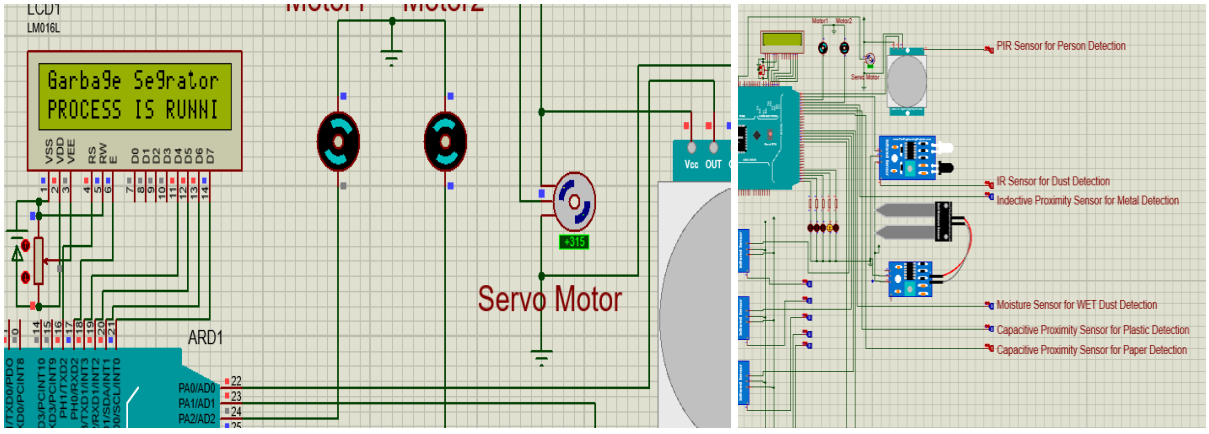
In the above figure metal waste is detected, the servo motor turns at 45^0 angle, the red led will on & off with 30ms delay



In the above figure wet waste is detected, the servo motor will turned at 135^0 angle, the blue led will on & off with 30ms delay.



In the above figure plastic waste is detected, the servo motor will turned at 225^0 angle, the green led will on & off with 30ms delay.



In the above figure paper waste is detected, the servo motor will turned at 315^0 angle, the yellow led will on & off with 30ms delay.

13. Outcomes of the study:

- Key to waste minimization
- Essential for effective waste management
- Improves public health protection
- Should be done according to specific treatment and disposal requirements
- Should be carried out by waste producer
- Should be harmonized all over the country
- Same segregation from production until disposal

14. Results & Discussion:

s.no	Waste to be segregate	Type of waste	Angle of rotation from default bin	Bin under outlet of conveyor belt
1	Book	Paper	315^0 angle	Paper bin
2	Coin	Metallic	45^0 angle	Metal bin
3	Banana peel	Wet	135^0 angle	Wet bin
4	Iron rod	Metallic	45^0 angle	Metal bin
5	Plastic pipe	Plastic	225^0 angle	Plastic bin
6	Mirror	Glass	Motor2	General bin
7	Clothes	Woolen	Motor2	General bin
8	News paper	Paper	315^0 angle	Paper bin
9	Polythene bags	Plastic	225^0 angle	Plastic bin
10	Wet handkerchief	Wet	135^0 angle	Wet bin
11	Plastic bottle	Plastic	225^0 angle	Plastic bin
12	Card Board	paper	315^0 angle	Paper bin

15. Conclusion:

The above reviews present various methods and strategies used for waste management purposes. One of the most efficient ways to maintain our environment clean and green is through our project. With this project the banal but essential parts of the urban waste management system, namely dustbin, have been upgraded.

The Smart Garbage Segregator as the name suggests, segregates the waste into five major classes: Metallic waste, Wet waste, Plastic waste, Paper waste & General Waste (glass, woollen, rubber, etc.).

16. Reference:

1. “SEGREGATION OF WASTE-A SURVEY” Bhoomika P, Sonika, Suma B, Vismitha S, Mrs. Sangeetha, FEB 2020 International Research Journal of Engineering and Technology (IRJET)

2. Shamin N, P Mohamed Fathimal, Raghavendran R, et al “Smart Garbage Segregation & Management System Using Internet of Things (IOT) & Machine Learning (ML)” 2019 1st International Conference on Innovations in Information and Communication Technology (ICIICT).
3. Smita S Pawar, Shivani Pise, Kranti Walke, Renuka Mohite “Smart Garbage Monitoring System Using AVR Microcontroller” 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA).
4. Ralph Sherwin A. Corpuz, John Clifford R. Orquiza “Utilization of Fuzzy Logic Control in a Waste Robot” 2018 Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM).
5. Jayashree Ghorpade-Aher, Anagha Wadkar, et al “Smart Dustbin: An efficient Garbage Management Approach for a Healthy Soceity”-2018 IEEE International Conference.
6. Shashika lokuliyana, Anuradha Jayakody, G.B.S Dabarera, et al “Location Based Garbage Management System with IOT for Smart city”- 2018 IEEE International Conference
7. “Smart Garbage Monitoring and Clearance System using Internet of Things” S. Vinoth Kumar, A. Krishna Kumar and Mahantesh Mathapati, et al2017 IEEE International Conference.
8. Balagugan, Raja S Maheswaran T, Savitha S “Implementation of Automated Waste Segregator at Household Level” -IJIRSET 2017.
9. Poorani Ravindhiran, Pradeep Gopal, Joseph Gladwin S, Rajavel R “. Automated Indoor Waste Management System Employing Wave Front Algorithm and Received Signal
10. Literature Review of Automated Waste Segregation System using Machine Learning:, A Comprehensive Analysis Myra G. Flores, Jose B. Tan Jr, Technological Institute of the Philippines, Manila, Philippines