Team C-Helix

Trash splitter

Proposed by:

Executive Members:

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Introduction:

Waste disposal is a huge cause for concern in the present world. The disposal method of a voluminous amount of generated waste has had an adverse effect on the environment. Unplanned open dumping at landfill sites made by municipal is a common method of disposal of waste. Human health, plant and animal life are affected due to this method.

The harmful method used for waste disposal generates harmful chemicals which contaminate surface and groundwater. It can give rise to disease vectors which spread harmful diseases. This also degrades the aesthetic value of natural environment can degrade the aesthetic value of the natural environment and it is an unavailing use of land resources.

In India, rag pickers play an important role in the recycling of urban solid waste. Rag pickers and conservancy staff have higher morbidity due to infections of the skin, respiratory, gastrointestinal tract and multisystem allergic disorders, in addition to a high prevalence of bites of rodents, dogs and other vermin. Dependency on the rag-pickers can be diminished if segregation takes place at the source of municipal waste generation.

The economic value of the waste generated is not realized unless it is recycled completely. Several advancements in technology have also allowed the refuse to be processed into useful entities such as Waste to Energy, where the waste can be used to generate synthetic gas (syngas) made up of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam; Waste to Fuel, where the waste can be utilized to generate biofuels.

When the waste is segregated into basic streams such as wet, dry and metallic, the waste has a higher potential of recovery and consequently recycled and reused. The wet waste fraction is often converted either into compost or methane-gas or both. Compost can replace demand for chemical fertilizers, and biogas can be used as a source of energy. The metallic waste could be reused or recycled.

Even though there are large-scale industrial waste segregators present, it is always much better to segregate the waste at the source itself. The benefits of doing so are that a higher quality of the material is retained for recycling which means that more value could be recovered from the waste. The occupational hazard for waste workers is reduced. Also, the segregated waste could be directly sent to the recycling and processing plant instead of sending it to the segregation plant than to the recycling plant. Currently, there is no efficient system of segregation of dry, wet and metallic wastes at a household level. The purpose of this project is the realization of a compact, low cost, and user-friendly segregation system for urban households to streamline the waste management process.

Technical background

The mixed waste is sorted based on the following methods at the industrial level. Larger items are removed by manual sorting. Then the refuse is sorted based on its size by using large rotating drums which are perforated with holes of a certain size. Materials smaller than the diameter of the holes will be able to drop through, but larger particles will remain in the drum. For metallic objects electromagnets or eddy, current based separators can be used. Near-infrared scanners are used to differentiate between various types of plastics based on the ability

of the material to reflect light. X-rays can also be used to segregate materials based on their density. The methodology adopted in this paper to resolve the issue of waste segregation is by making the entire process automated and to the reduce cost such that it could be adapted in a household level.

Design Circuit:

Block Diagram:

Input Section   **Output Section**
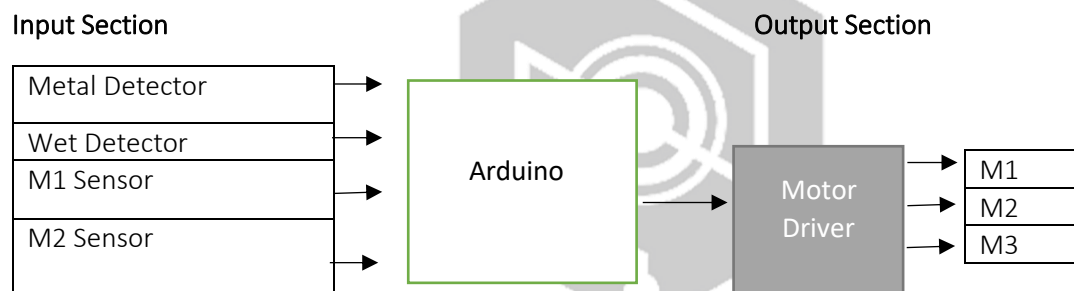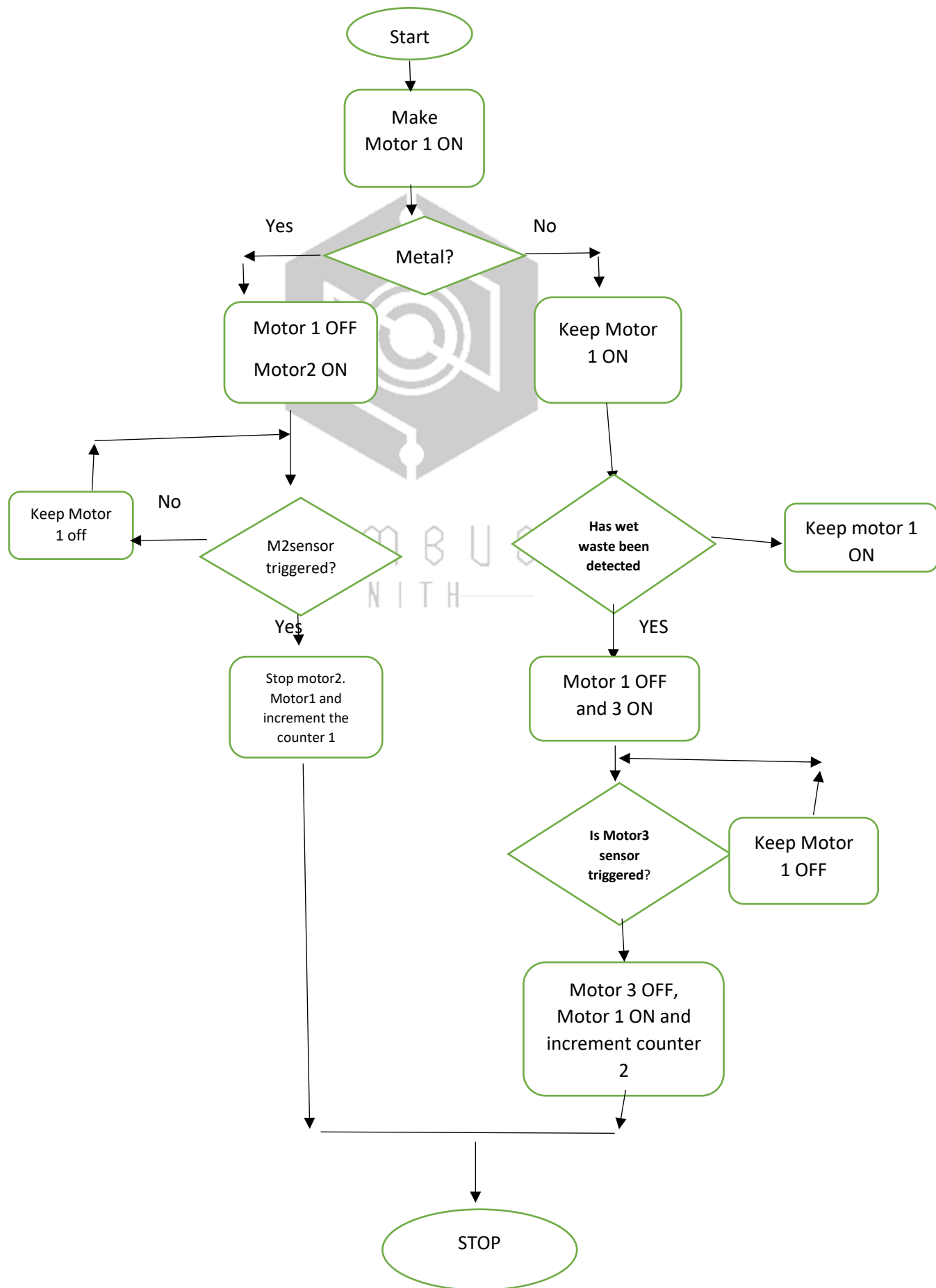

The components of the proposed system are:

- *M1: Motor driving the conveyer belt.*

- *M2: Motor driving the segregator to put metal waste into the bin.*

- *M3: motor driving the segregator to put the wet waste into the bin.*

Once the input waste is placed on the conveyer belt, the conveyer belt starts moving and all the sensors are turned on and the sensing and segregation start. The metal sensor, the moisture sensor, the feedback sensors and the motor sensors that are used to get the segregators in place are given as input to Arduino UNO. The output is the final segregated wastes into different bins.

Algorithm of the project:

1. When the waste is put in the conveyer belt, the motor turns on and the belt starts moving.
2. Then the microcontroller, motors and sensors are turned on.
3. The waste is detected by the inductive proximity sensor, at first, and senses if it's a metal or not. If it is a metal, then M1 is turned off and M2 is turned on and the waste is pushed into the metal waste bin.
4. If it is not a metal, M1 is turned on so that when the waste is in its contact, the mosture from the waste can be detected. If the humidity is there, then the waste is assigned as wet and it is pushed into the wet waste bin.
5. If the waste is dry, M1 is on and then the it is dropped into the dry waste bin at the end of the conveyer belt.
6. Finally, the wastes are dropped into the respective bins and the segregation process is completed.

```
                    ┌──────────┐
                    │  Start   │
                    └────┬─────┘
                         │
                   ┌─────▼─────┐
                   │   Make    │
                   │ Motor 1 ON│
                   └─────┬─────┘
                         │
   Yes               ◇ Metal?              No
 ◄───────────────────/        \────────────────────►
         │                                      │
   ┌─────▼─────┐                          ┌─────▼─────┐
   │ Motor 1 OFF│                         │ Keep Motor │
   │            │                         │   1 ON    │
   │ Motor2 ON  │                         └─────┬─────┘
   └─────┬─────┘                                │
         │                                      │
  ┌──────────┐     No        ◇ M2sensor        ◇ Has wet         ┌────────────┐
  │Keep Motor │◄──────────────  triggered?      waste been ──────►│ Keep motor 1│
  │  1 off    │                                 detected          │    ON      │
  └──────────┘                 │ Yes                │ YES          └────────────┘
                         ┌──────▼──────┐      ┌──────▼──────┐
                         │ Stop motor2.│      │ Motor 1 OFF │
                         │ Motor1 and  │      │  and 3 ON   │
                         │increment the│      └──────┬──────┘
                         │  counter 1  │             │
                         └──────┬──────┘      ◇ Is Motor3      ┌────────────┐
                                │              sensor ────────►│ Keep Motor │
                                │              triggered?       │   1 OFF    │
                                │               │              └────────────┘
                                │        ┌──────▼──────┐
                                │        │ Motor 3 OFF, │
                                │        │ Motor 1 ON and│
                                │        │increment counter│
                                │        │      2       │
                                │        └──────┬──────┘
                                └──────────┬────┘
                                      ┌────▼────┐
                                      │  STOP   │
                                      └─────────┘
```

Inductive Proximity Sensor: Proximity actually meaning is nearness, so the proximity sensor is a sensor able to detect the presence of nearby objects by generating frequency without any contact with the object. Electromagnetic radiation is emitted by proximity sensor for instance and looks for changes in the field or return signal.

Inductive sensor can detect a target from 0.5 millimeters to 40 millimeters. They only detect metallic targets and therefore use a magnetic field to its presence. The inductive sensor consists of sensing coil which is ferromagnetic coil having copper turns.
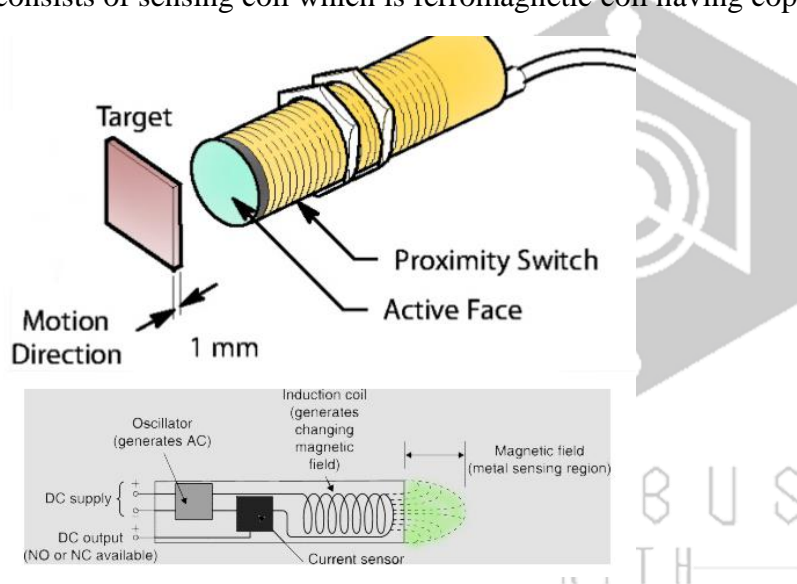
Implementation of the proposed Automated Waste Segregator system

Arduino UNO

The Arduino Uno is a popularly used open-source micro-controller board that runs on ATmega 328P micro-controller. This board is developed by Arduino.cc which is an Italy based hardware company. This board contains a set of digital and analog I/O data pins that are used to interface this board with other electronic components. Arduino Uno consists of 14 digital pins and 6 analog pins. This board can be programmed with the help of Arduino IDE (Integrated Development Environment) that supports embedded C, its back-end is constructed using JAVA. Uno consists of an USB port through which the code can be uploaded on to the board. This post can also be used to power the board by connecting it to a laptop, PC, etc. Along with a USB port, it also has a DC input power jack. An external battery of 9V can also be used to power Arduino board.
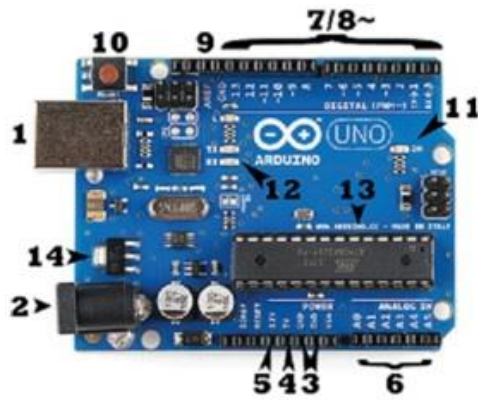
Technical Specifications:

1.Operating Voltage: 5V

2.Input Voltage: 7-20V

3.DC current per I/O pin: 20 mA

4.Flash Memory: 32 KB

5.Clock Frequency: 16 MHz.

6.No. of digital pins: 14

7.No. of analog pins: 6

- ▪ *General Pin Functions:*

1. LED- Arduino Uno contains an onboard built-in LED that is connected to digital pin 13. When this pin is HIGH, the LED glows.

2. IN- When powering the Arduino using an external power supply, this pin has to be used.

3. 5V- This pin supplies the board a regulated voltage of 5V via the voltage regulator. Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.

4. GND- Arduino Uno consists of 3 ground pins.
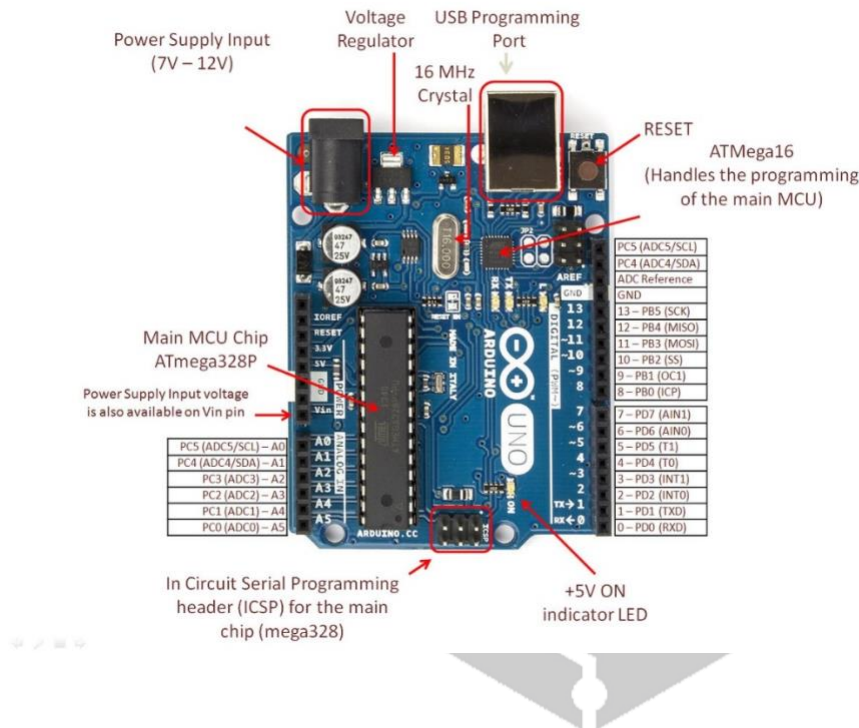
IR Sensor

IR sensor is one of the most commonly used sensors in the field of electronics, it has a large number of applications at the domestic as well as at the industrial level. IR module is a sensor module that consists of both IR transmitter and a receiver. Operating voltage of this module is 5 volts and the obstacle detection range is 5 cm that can be increased by 15 cms. An IR sensor can detect the heat of an object as well any motion in the surrounding. The functioning of an IR module is pretty straightforward. As the module contains both transmitter and receiver. When powered, IR transmitter starts to transmit continuous IR waves, if an obstacle is placed in the path of the waves, they get reflected back from the obstacle and are received by the receiver.
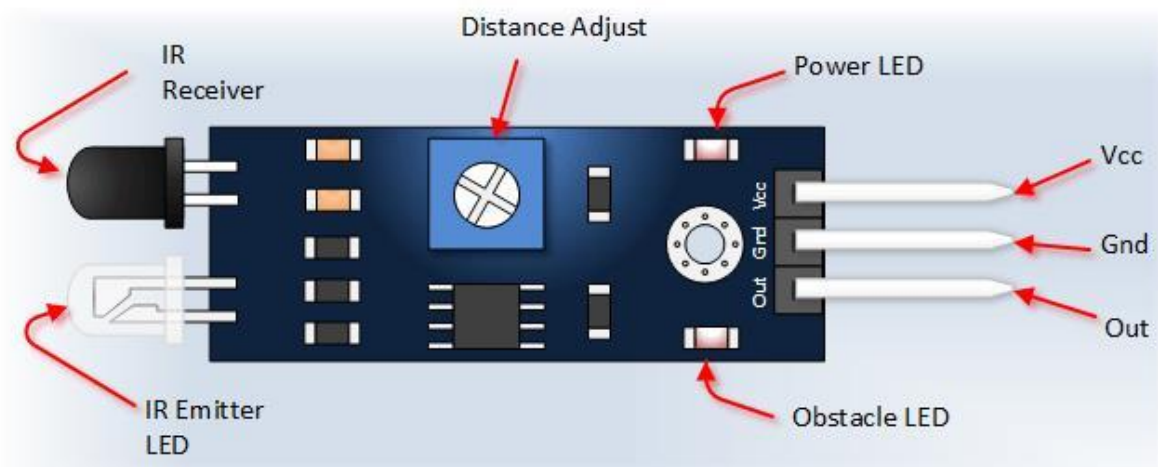
Technical Specifications:

1.Operating Voltage: 5V 2.Minimum Distance: 2-5 cms 3.Maximum Distance: 10-15 cms

- *Circuit Description: The circuit of an infrared sensor contains the following components-*

1.LM358 IC two IR transmitter and receiver pair.

2.Resistors in the kilo ohms range

3.Variable resistors

4.Light emitting diode

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus, the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus, the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 is used to adjust the output terminals. Resistor VR1is used to set the sensitivity of the circuit Diagram.

Metal Sensor

An Inductive Proximity Sensor is a non-contact electronic proximity sensor used for the detection of metals. Sensing range of this sensor completely depends upon the metal being detected. Their working principle is based on a coil and an oscillator that generates an electromagnetic field in the surrounding of the sensing range. Presence of any metallic substance in the sensing range causes dampening of oscillation amplitude.

Rise and fall of amplitudes is detected by a threshold circuit that causes a corresponding change in the output of the sensor. If a metal contains some percentage of ferrous, the sensing range is longer, while non-ferrous metals like copper reduce the sensing range by 60 percent. There are two possible outputs of this sensor, hence it is also called inductive proximity switch. Common applications of inductive sensors include metal detectors, traffic lights, etc and a plethora of industrial automated processes.
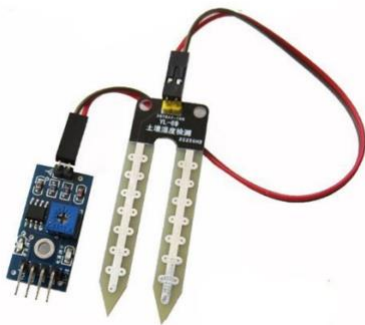
Technical *Specifications:*

1. Operating Voltage: 5V

2. Sensing Range (In case of ferrous waste): 5-3 cms

3. Sensing Range (Absence of ferrous waste) : 1-1.5 cms

Moisture Sensor:

As the name indicates, this sensor is used to measure the moisture content in a given material. These sensors use the volumetric water content indirectly by making use of some other properties like electrical resistance, dielectric constant. In general cases, the sensor generates a voltage proportional to the dielectric permittivity and therefore measures the moisture content of a material

Technical Specifications

Parameter	Minimum	Typical	Maximum	Unit
Working voltage	2.1	5	5.5	VDC
Analog Output Voltage(VCC=5V)	0	Vout	5	V
The digital Output voltage(VCC=5V)	0	–	5	V
Working Current(VCC=5)	–	5	–	mA

Threshold Hysteresis(Uth)	–	VCC*0.09	–	V

Software

Arduino IDE

Arduino IDE (Integrated Development Environment) is a software platform that enables a user to program Arduino or any controller of the ATmega family. The back-end of this software is developed using JAVA. This IDE provides a user the liberty to program an Arduino using C language. It connects to the Arduino and hardware to upload programs and communicate with them. The IDE consists of two main parts viz.

- void setup (): This is the location where a user can initialize all the variables that will be required during the course of programming a system. As the name suggests, this function is used to set up an Arduino before interfacing it with other circuits. This area can also be used to include libraries of various sensors. The popularly used functions in void setup are:

- pinMode: This function is used to declare pins of Arduino as input or output.

- serial.begin: This function is used when Arduino is communicating with other sensors or devices. This enables a user to set a specific baud rate for communication purpose.

- void loop (): The code written in this space will run over and over again unless Arduino is interrupted using an interrupt or the USB cable is disconnected from the USB port. The different functions that are often used in void loop are:

- digitalWrite: This function is used to make a specific pin on Arduino logically HIGH or LOW.

- digitalRead: This function is used when there is a need to read digital data from a sensor or when we have to control something using a switch/ push button.

- AnalogRead: This function comes in handy when we have to read analog data from a sensor eg. Analog read is used when there is a need to read data from a potentiometer.

- AnalogWrite: This function is used when a user wants to supply analog voltages to a component. The best example of analog write is when the intensity of LED is controlled using a potentiometer and analog write function.

Motor Driver Circuit
L293D is a motor driver circuit that is connected with a motor when the required current for a motor is more than what is specified. Hence, motor drivers act as a current amplifier. L293D is a 16-pin IC which can control two DC motors simultaneously. It works on the principle of H-bridge. H-bridge is a circuit which allows the voltage to be applied in either direction. In a single L293D chip there are two h-Bridge circuits which can rotate two dc motors independently. The pin diagram of L293D is as follows:
- *Working Principle: There are 4 input pins for l293d, pin 2,7 on the left and pin 15 ,10 on the right. Left pins will control the rotation of the motors connected on the left side and the right*

pins will control the rotation of motors connected to right side. The motors rotate depending upon the input provided to the pins. The logic table for L293D is as follows:
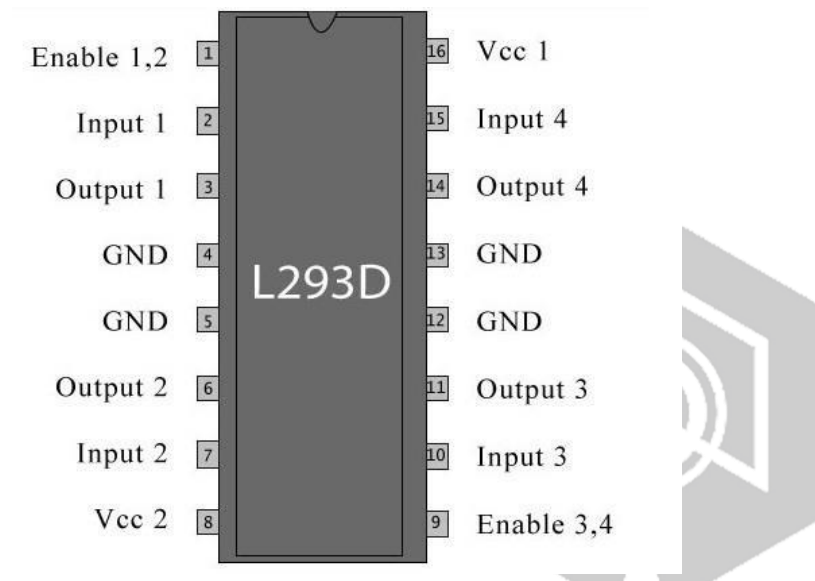
1.Pin 2 = Logic 1 and Pin 7 = Logic 0 — Clockwise Direction

2.Pin 2 = Logic 0 and Pin 7 = Logic 1 — Anticlockwise Direction

3.Pin 2 = Logic 0 and Pin 7 = Logic 0 — Idle [No rotation]

4.Pin 2 = Logic 1 and Pin 7 = Logic 1 — Idle [No rotation]

DC Motor

It stands for the direct current motor. It is an electrical machine that converts direct current electrical energy into mechanical energy. Mostly all types of DC motors have an internal mechanism to reverse the direction of current flow in part of the motor. Smaller versions of this motors are exercised in toys and also many home appliances. Larger DC motors are used in the propulsion of electric vehicles, elevator, and hoists, or in drives for steel rolling mills. DC motors are of two types viz. Brushed and Brushless DC motors.

- Brushed DC Motors: This type of motor generates torque directly from the DC power supplied to the motors by using stationary magnets and rotating electromagnets. There are many advantages of brushed DC motor some of them are high reliability, good control of motor speed. The drawbacks of this type of DC motor is that it requires high maintenance. Brushes are constructed using graphite or carbon, often dispersed copper is also used to increase the conductivity.

- Brushless DC Motors: Brushless DC motors use one or more than one permanent magnets in the rotor and electromagnets covering the stator. The mechanical design of brushless DC motors is easier to understand than that of brushed DC motors. The motor controller can sense the rotor's position with help of hall effect sensors and can precisely control the timing, phase, etc.

Liquid Crystal Display

This is a flat panel display that uses properties of liquid crystals. LCD displays do not emit light directly, instead, they use a backlight to develop images in single color. LCD displays are used in a wide range of applications like television panel, computer monitors and instrument panels as well. A 16 X 2 LCD means it can display16 characters per line and there are 2 such lines. In this display, each character is displayed using a 5×7 pixel matrix. This LCD has two pivotal registers that are:

- Command Register: The command register stores the command given to the LCD by a micro-controller.
- Data Register: The data register stores the data to be displayed on the LCD. The data that is displayed on the LCD screen, is actually the ASCII value of the characters that are to be displayed.
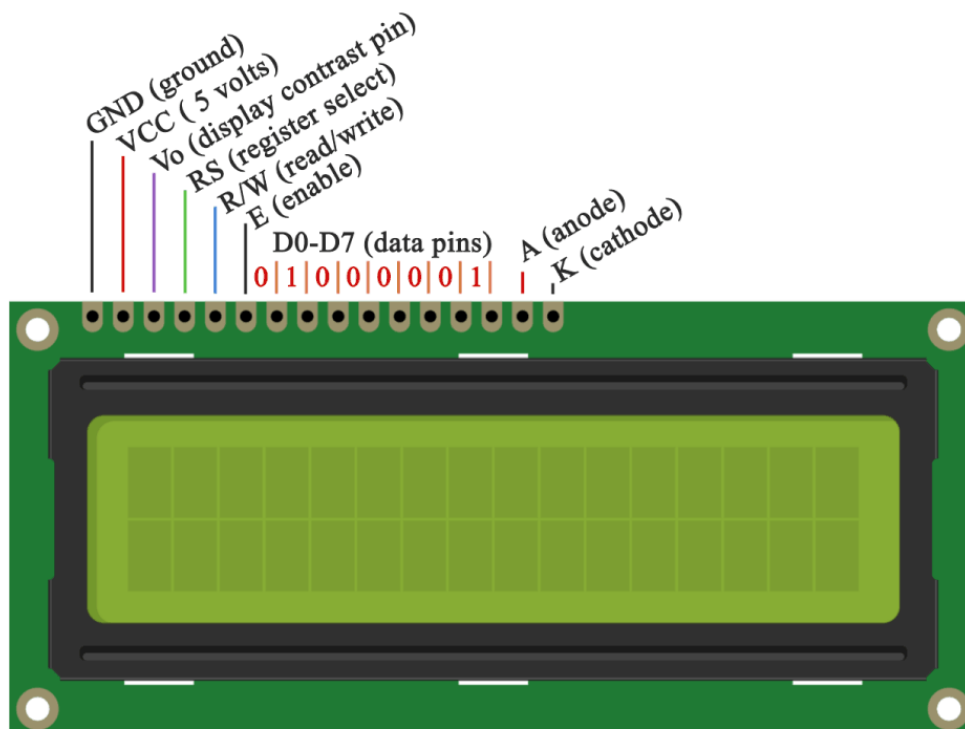
Table 4.2: LCD Pin Configuration

Pin No.	Function	Name
1	Ground (oV)	GND
2	Supply voltage; 5V (4.7V 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	Vee
4	Selects command register when low; and data register when high	Register select
5	Low to write to the register; High to read from the register	Read/Write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pin	DB0
8	8-bit data pin	DB1
9	8-bit data pin	DB2
10	8-bit data pin	DB3
11	8-bit data pin	DB4
12	8-bit data pin	DB5
13	8-bit data pin	DB6
14	8-bit data pin	DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (oV)	Led-

Advantages:

1. **Decreased manual load:** The sorting of waste requires a lot of work strength. It is a manual process. With this automated system the number of work strength can be substantially reduced.
2. **Saving money:** Because the work strength required for manual sorting of the waste, the money required is also more. And the system we are proposing helps to reduce the money required for the purpose.
3. **Saves time:** The manual sorting of waste is proportional to the work strength i.e. the more the workers the faster will be the sorting. But more work force means more spending, therefore the automated system helps in saving a lot of time.
4. **Efficiency:** It can handle a variety of materials and recognize their type from the basis of the material.
5. **Pollution free environment:** Pollution is a hazard for the society. Automated sorting can make it easier to reduce the pollution in the environment. Hence benefiting the environment as well as the society.
6. **Fatigue of sorters:** Due to having a long shift the sorters may fatigue because of the fact that their work is really repetitive and boring.

Disadvantages:

1. The problem with this machine is that it relies almost solely on the visual inspection of the commingled waste passing on the conveyer. Material search could occur, thus not giving time for a sorter to grasp all the material assigned.
2. **Slow rate of movement:** The conveyer belt has to move at a slow rate to allow time for materials to be visually identified.

3. **Inefficiency in identification:** The waste material passing on the conveyer belt is sometimes mixed. It might be difficult for the sorter to identify different kinds of materials present in it.

Future Aspects:

 Currently the system of sorting is less automated and more manual. More over in India with the accelerating problem of solid wastes it is becoming difficult for India to get rid of waste material. The future is here Artificial Intelligence and Robotics are reaching the capabilities that the media has romanticized for years. Simple robotic arms used for repetitive functions have been a staple of the manufacturing industry since their introduction in the early 1960s. Fast forward nearly 60 years later, manufacturing and other industrial processes are about to take another significant leap forward. Based on the development of AI, robots can now think for themselves.

But have no fear—contrary to science fiction lore, these robots powered by artificial intelligence are not capable of conquering the world. They will, no doubt, take over a great many manual labour jobs however.

The key to the efficient use of robotics is the pre-sorting distribution of the product. Large bulky items that can be mechanically sorted through a standard conveyor system eliminates the amount of waste that the robot must sort through. In addition, waste that is evenly distributed on the conveyor as it enters the robotic area makes it easy for the sensors to select items for the robotic arm to pick up and sort.

The Future of Robotic Automation:

The future of AI is very close to becoming a reality and the time is near when the processing of waste will become fully automated. Waste will be sorted by robot pickers, AGVs will transport bins full of sorted material to the compactor where it is automatically compressed and bundled, and from there it will be transported to the shipping docks where an AGV proficiently loads the trailer of an 18-wheeler.

Conclusion:

Implementation of this system at a local level like societies, educational institutes, etc. can reduce the burden on the local authorities. The automatic waste segregator is one small step towards building an efficient and economic waste collection system with a minimum amount of human intervention and also no hazard to human life. Using a conveyor belt makes the system far more accurate, cost-effective and also easier to install and use at a domestic level. Segregating all these wastes at a domestic level will also be time-saving. While implementing our system we came across many problems like the sensing range of inductive proximity sensor, the accuracy of the moisture sensor, adjusting the range of IR sensors and some more,

but using some modifications we tried the make the system as reliable as possible but not completely perfect.
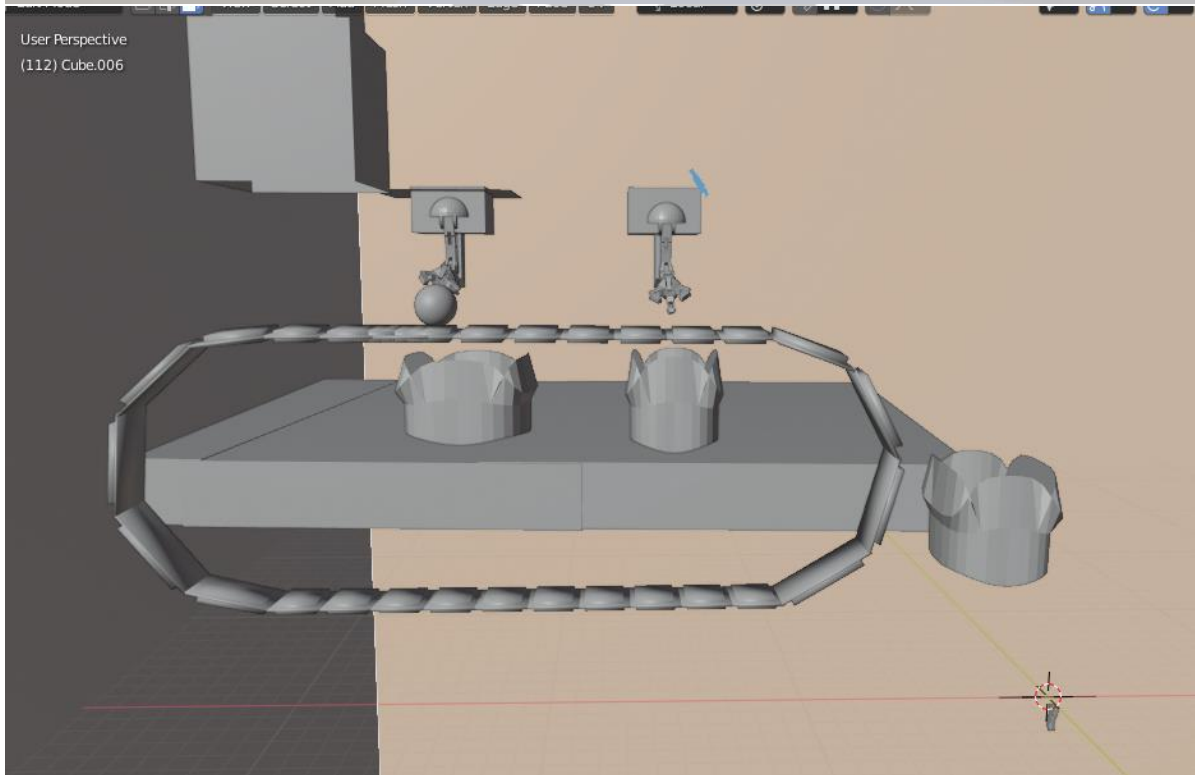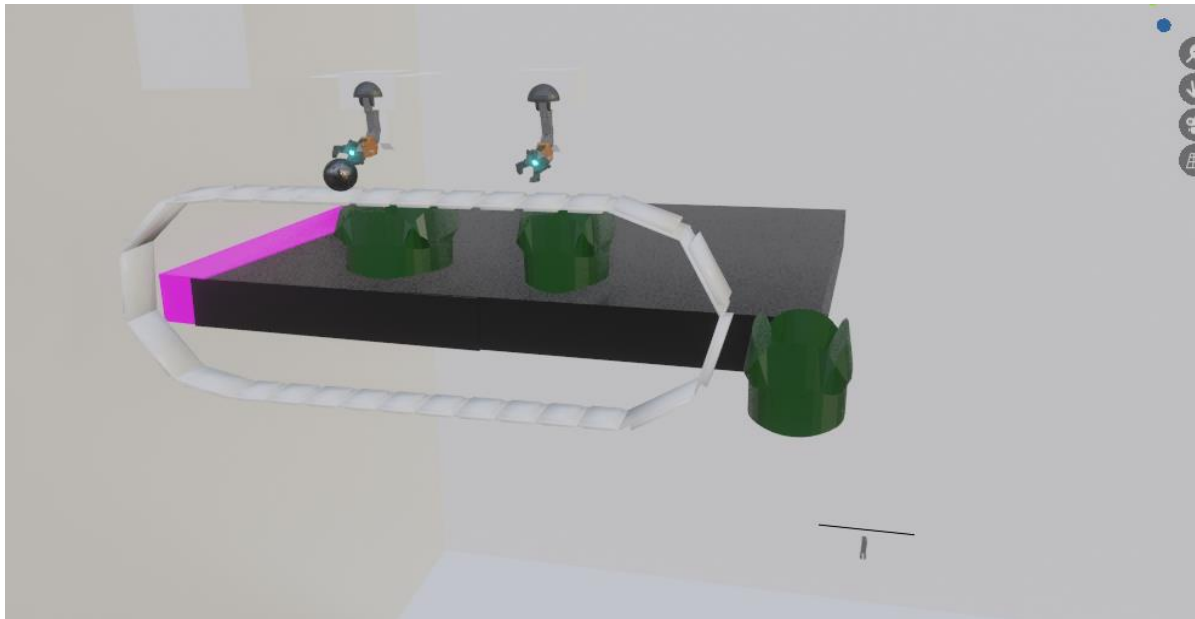
Social benefits:

*This project will benefit a lot to the mankind and mother Earth. Earth is seeing a lot of pollution on daily basis. The garbage sorting is one of the most difficult tasks physically, and therefore a lot of efforts can be reduced by the installation of such a system.

*The system helps in making recycling process faster as it sorts out all the matter while it passes through the system.
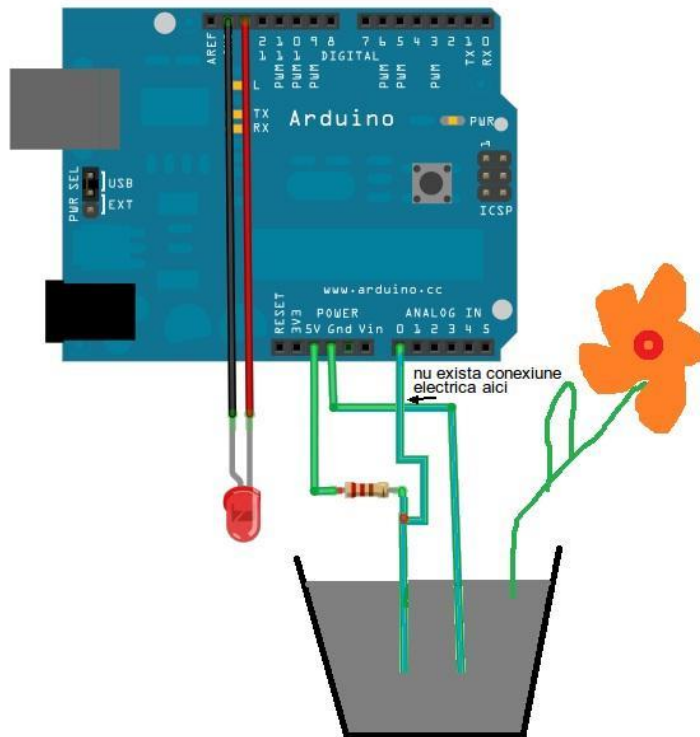
Constructed Model:

Circuit Diagrams with Arduino:

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NIMBUS NITH

Proximity sensor

DC motor

FE_SRly

Relay
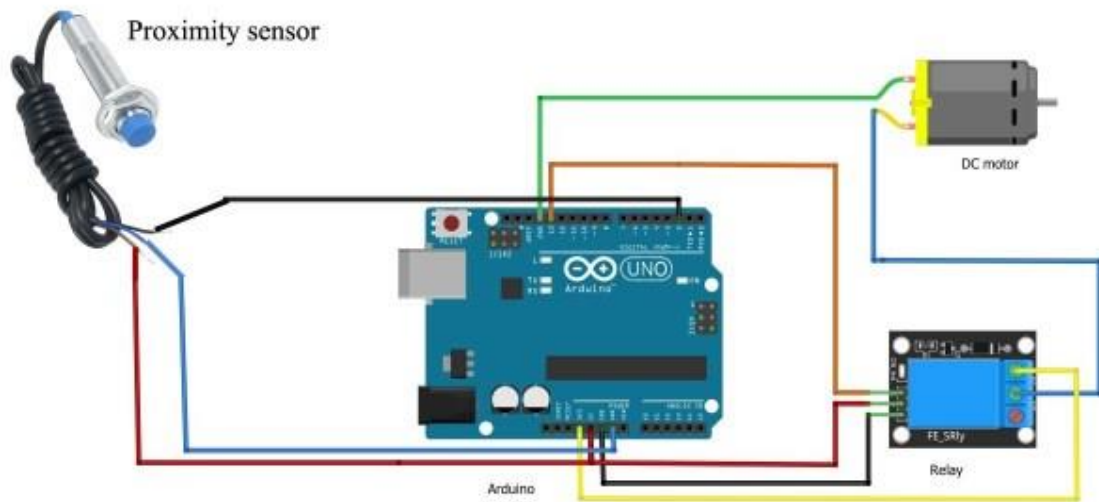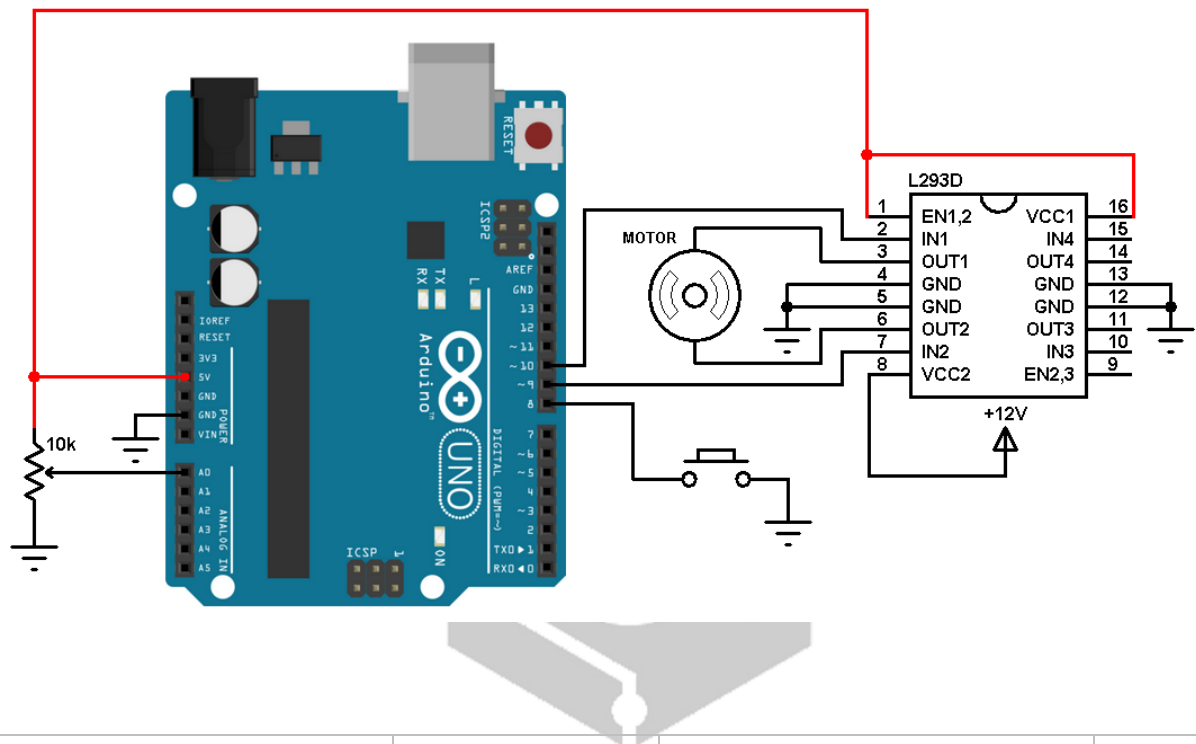
Arduino

S.No.	Components	Quantity	Specifications	Cost (Rs)
1.	Arduino Uno	24	Arduino Uno Kit	4400
3.	Battery	4	Power Bank (5V)	600
4.	Sensor RokoSn04	1	-	250
5.	Sensor light LDR.	1	ESP-01 ESP8266 Serial WIFI Wireless	70
6.	Connecting Wires	Jumping wires	6 Packets	360
7.	Inductive Proximity Sensor	1	Metal detect	600
8.	L293d motor driver	8		**299**
9.	Moisture Sensor	2	HC-SR04	58
10.	Breadboard	1		69
11.	LED	6		60
12.	LCD	1	16*2	165
13.	1000uF Capacitor	12		864
14.	100nF Capacitor	12		96
15.	10K pot- Variable Resistor	4		135

16.	5V Power Supply	6		570
18.	Cable for Arduino Uno/mega	5		645
	Total			12067

Thank you!