

AUTOMATION OF MATERIAL SEGREGATION

Submitted in partial fulfillment of the requirements for
the award of
Bachelor of Engineering degree in Computer Science and Engineering

by

Ganesh Kumar (Reg. No. 37110222)



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC I 12B Status by

UGC I Approved by AICTE

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CHENNAI – 600 119**

MARCH - 2021



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BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **GANESH KUMAR** (Reg. No. 37110222) who carried out the project entitled "**AUTOMATION OF MATERIAL SEGREGATION**" under my supervision from **NOVEMBER 2020** to **March 2021**.

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Internal Examiner

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DECLARATION

I **GANESH KUMAR** and **PREM NARAYAN** hereby declare that the Project Report entitled "**AUTOMATION OF MATERIAL SEGREGATION**" is done by us under the guidance of **Dr. S. PRINCE MARY, M.E., Ph.D.**, Department of Computer Science and Engineering at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Computer Science and Engineering.

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PLACE: CHENNAI

SIGNATURE OF THE CANDIDATE

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ABSTRACT

The nation and world are facing a huge problem today of disposal, segregation and recycling of solid waste, and improper management of these wastes are hazardous and dangerous to human health and ecological system. There is a rapid increase in capacity and categories of solid waste as a result of urbanization, constant economic growth, and industrialization. Global Waste Management Market reported that the amount of waste generated worldwide produced is 2.02 billion tones. "Wastes are not always waste if it is segregated as it was". To properly manage the waste, it has to be handled, segregated, transported and disposed so as to reduce the risks to the public lives and sustainable environmental. The economic value of waste is best comprehended when it is segregated. Currently there is no such system employed of segregation of glass, plastic and metallic wastes at industrial level. This paper proposes an Automation of Waste material Segregation in scrap industry. This method is easy and simple solution of segregation of three types of wastes glass, metal and plastic. It is designed to sort the trash into metallic waste, plastic waste and glass waste ready to be processed separately for the next process of operation. The Method uses inductive sensors metallic items, and capacitive sensors to distinguish between wet and dry waste. Experimental results show that the segregation of waste into metallic, plastic and glass waste has been successfully implemented using the Automation of material segregation.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL VIEW

The generation and removal of waste in enormous amounts has made a more noteworthy worry over the long run for the world which is unfavorably influencing the living souls and ecological conditions. Isolation of waste is significant for appropriate removal of immense measure of trash current culture produces in an ecologically reasonable mode. Individuals become adjusted to throwing things away and never understand the results of their activity. The regular strategy for removal of the mechanical waste is by uncontrolled and spontaneous, and uncovered unloading at the waterway destinations and open territories. This technique is harmful to plants, human wellbeing and creature life. This fluid leachate produced due to ill-advised removal what's more, blended waste pollutes land, water at surface and ground that becomes a wellspring of unsafe illnesses and corrupts estimation of climate and different assets of nature.

With economic developments the globally generated wastes are increasing. The current global Municipal solid waste generation levels are approximately 1.3 billion tonnes per year and are expected to increase to approximately 2.2 billion tonnes per year by 2025. India with a population of 1.35 billion has per capita waste generation ranging from 0.12 to 5.1 kg per person and an average of 0.45kg/ capita/ day. Segregation of waste helps increase the recyclable materials and control unwanted degradation, which might result in emission of harmful gasses. In India the segregation of domestic waste is done at the municipal factories, where huge machinery is used for separating recyclable materials. Implementation of separate bins for collection of waste materials is done, but it does not yield its purpose due to lack of awareness, ignorance and negligence. The existing system for collection of municipal solid waste does have any means to verify the proper disposal or its timely maintenance. Paper contaminated with food cannot be recycled, since the paper is mixed with water in a large churner, the oil eventually separates from the paper. The oil does not dissolve in water,

instead it mixes in with the paper during the production, leading to formation of an oily layer over the paper, making unusable.

1.2 TECHNICAL BACKGROUND

It is a discrete state control system to prevent over dumping of waste in bins and to separate wastes automatically through conveyor belts. The filling level of each bin arranged at different positions, is detected using the IR sensor. Each bin will have separate sub conveyor belts and all these sub conveyor belts are connected to the main conveyor belt. The wastes from all sub conveyor belts will get collected in the main conveyor belt. The wastes from the main conveyor belt are given into dry, wet and metallic wastes. Internet of Things (IoT) used in this project is useful for counting the number of different types of wastes. Hence the quantity of each type of wastes is also noticed.

1.3 RESEARCH AND SIGNIFICANCE

Many sub conveyors which protrude to a main conveyor. At the starting portion of each sub conveyor a trash bin is kept. Wastes are being dumped into the trash bins where infrared sensors are kept at the top level. Infrared sensor actually does the function of a human eye that enables the detection of waste. As a waste comes in the vicinity of the infrared sensor by the increased number of wastes there occurs a decrease in the radiation received by the infrared receiver, which is transmitted by the infrared transmitter. This decrease in the radiation received by the infrared receiver helps in the detection of waste. Whenever a waste is detected in the sub conveyor's trash bin, it causes the trash bin to rotate thereby allowing waste to fall onto the sub conveyor. Then the sub conveyor moves and the waste reach the main conveyor. At the end of the main conveyor also an infrared sensor is kept in the waste detection. Then the segregated section begins. In the segregated section trash bins are kept where sensors which enables the separation of waste into metal, wet and dry. At first with the help of a contact type metal sensor the waste is classified to metal or non-metal. If metal the waste falls into the respective bin of the circular base kept at the bottom, which is rotated with the help of servo motor. If else the waste is classified into wet

or dry with the help of capacitive proximity sensors. If waste is detected as wet it falls onto the respective bin at the circular base and if dry the waste falls into the respective bin of the circular base. An internet of things is incorporated for the purpose of counting and monitoring of the waste.

Chapter-2

LITERATURE SURVEY

2.1 LITERATURE SURVEY

Segregation of waste helps increase the recyclable materials and control unwanted degradation, which might result in emission of harmful gasses. In India the segregation of domestic waste is done at the municipal factories, where huge machinery is used for separating recyclable materials. Implementation of separate bins for collection of waste materials is done, but it does not yield its purpose due to lack of awareness, ignorance and negligence. The existing system for collection of municipal solid waste does have any means to verify the proper disposal or its timely maintenance. Paper contaminated with food cannot be recycled, since the paper is mixed with water in a large churner, the oil eventually separates from the paper. The oil does not dissolve in water, instead it mixes in with the paper during the production, leading to formation of an oily layer over the paper, making unusable. The present recovery and utilization of waste in paper mills in India is pretty low, at 20 percent of the total paper and paper board consumed. India currently imports waste paper as raw materials for paper production. The solution needed for increasing the utilizable resources is through setting up automated bins which can identify the type of garbage dumped into the bin. This helps negate the effects of human negligence and also reduce the chances of available recyclable materials getting contaminated.

2.2 EXISTING SYSTEM

In the existing system garbage is collected and only detect the garbage, here

the garbage is separated and cleaned by human hands. Though the garbage shrinks and overflows the smell will be heavy and produces air pollution and spreads disease. This creates dirty environment, to avoid such situation we are planning to design IOT Based Garbage Management for Smart Cities. We got inspired from where the authors have spoken about different approaches to separate the different types of waste materials such as metal, plastic, and degradable waste. Using the conveyor belt the waste is brought.

2.2.1 DRAWBACKS

- Time consuming and less hygienic.
- Bad smell spreads and may cause illness to human beings.

2.3 PROPOSED SYSTEM

The system is more user-friendly and easier to operate. The model is designed such that anybody can access the machine without the need for basic knowledge. This can be used to separate metals, plastics, paper, wood, glass waste materials. Then with the help of a camera and the CNN method, the waste can be identified accordingly and can be separated. The model required waste materials as inputs and detects them which are further separated. The waste materials are carried by a conveyor belt which takes the waste materials through each sensor and finally through the camera. The outcome of this project is the waste materials which are separated into their respective categories. The inputs are sent through a conveyor belt which consists of a sensor and a camera. It identifies the waste materials and gives the output. With the help of the camera module, the waste material is detected and can be separated into its respective bins. By this, we get the separated waste materials in their respective bins.

2.3.1 ADVANTAGES

- Consumes less time and cost
- Can be implemented at any place

- Easy to operate

2.4 ABOUT THE SYSTEM

Everything's getting smarter right? So why not your trash bin? This bin has an IOT interface with autonomous and manual mode (mobile/laptop) of control. Waste separation is a big and difficult process. It requires both manpower and a huge amount of time. In this model, the first process is to detect the incoming object. The sensor detects whether the object is passed through or not. After this, the Electromagnetic separation happens. This process eliminates metals and such. Here the electromagnet is powered when the incoming object is detected. Next is the Camera module which detects the object and analyses the type of waste material using the CNN method. The camera model detects each material frame by frame which spontaneously provides the data of all the waste in the conveyor belt. Here the whole process is carried out with the help of the conveyor belt. The same can be implemented by various ways according to the place where it is executed. Then the waste is separated into different bins according to its category. Waste separation can be done faster and in an efficient way by following this method. Easy to use and can be implemented at any place along with the construction site to make a smart city.

CHAPTER 3

AIM AND SCOPE

3.1 AIM OF PROJECT

The primary aim of this proposed system i.e., “AMS” (Automation of material segregation) is to segregate the waste in such a way that they can get all be separated one by one by knowing on what material they are made of and this will help us on knowing the amount of waste generated so as we can maintain the level of garbage.

3.2 OBJECTIVES

The proposed model “AMS” (Automation of material segregation) is based on the new technologies which makes the whole process efficient. It is going to be very important and profitable for the whole society especially for the new accommodations and for the construction builders. This system will provide more accurate information like data of the garbage, quantity of the waste etc. which will be very helpful for the maintaining process of segregation and thus it will take less time to complete the process.

3.3 SCOPE

This model will help in building the strategies to prevent the environmental issues and helpful for the society, especially for the large-scale segregation plants. AMS will surely help in bringing down the day-by-day accumulation of waste and gradually in future it will make the whole country a safe place to reside.

3.4 ADVANTAGES

- Time saving as it is operated online.
- This system has database which helps in retrieving information of garbage whenever it is necessary.
- It does not need any prior technical knowledge to operate.
- This process is based on digitalization.

3.5 METHODOLOGY

In this project methodology model takes the fundamental process activities of Project Plan, specification, Analysis, Design, development, validation and evolution and represents them as separate process phases. Using a waterfall model as a project development methodology. AMG has an IOT interface with autonomous and manual mode of control. The trash is picked up using robotic arm. The picked-up trash is segregated (metallic, glass, non-metallic, paper and cardboard) and dumped into bin attached to the robot which has separate partitions of trashes. The entire operation of waste collection can be viewed by the operator through internet using a web camera attached. This is automatically operated using sensors. 2 operating modes. Manual and Autonomous. In manual mode the locomotion and trash pickup are operated. This can be controlled from anywhere in the world by the use of Internet (IOT). The trash is picked up using robotic arm made using servos. The collected trash is transferred to a trash bin attached to the robot platform. The trash bin has separate partitions for non-metallic, glass, plastic, cardboard, trashes and papers. All these are separated using a camera which uses CNN methodology to separate this and

provides output for us. Using the output from the camera module it is easy for us to differentiate the type of garbage similarly we can view that how much garbage is accumulated each day by a webpage.

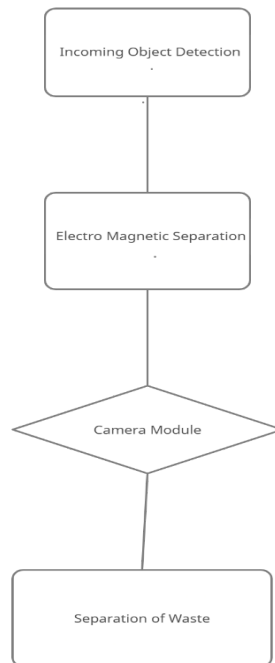


Fig. 3.1 Modules of automatic material segeragation

The Fig. 3.1 show the flow of the process from the start to the end.

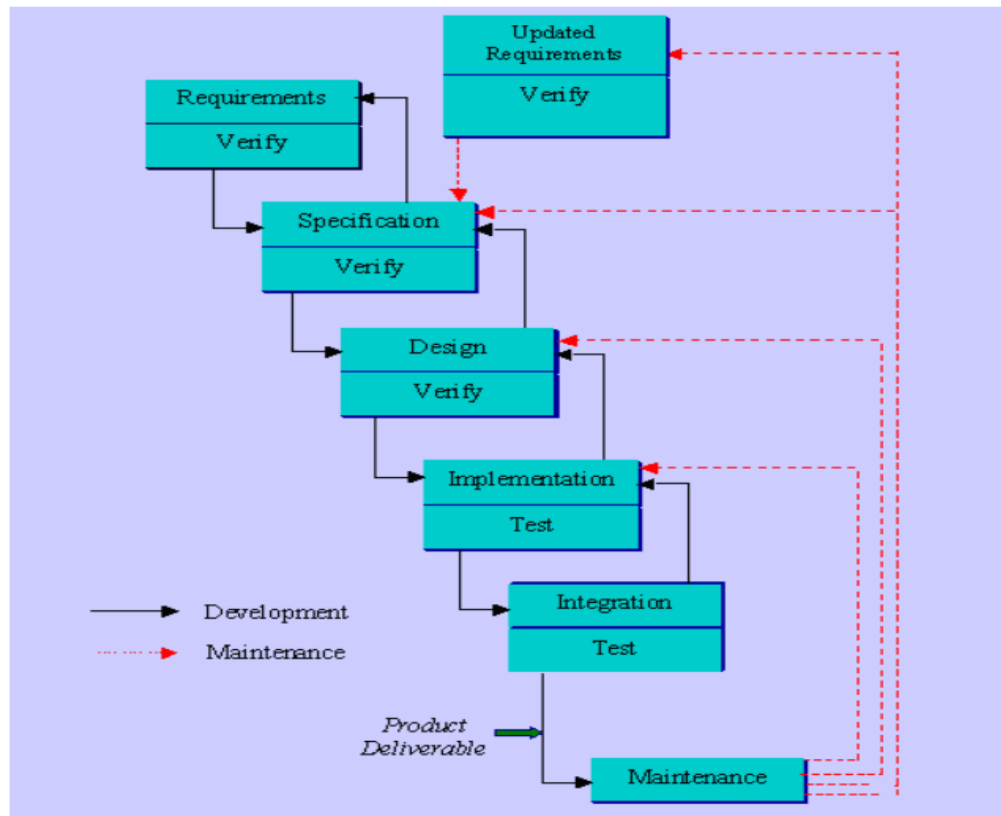


Fig. 3.2 Waterfall model

The Fig. 3.2 show the Waterfall model used for the implementation of the project.

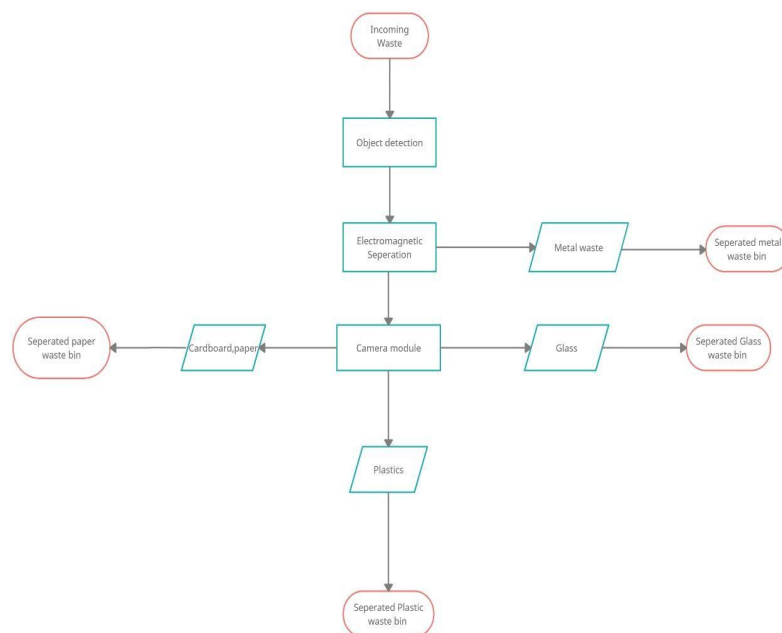


Fig. 3.3 Flow chart.

The Fig. 3.3 is the flow chart of the Automated material segregation.

CHAPTER 4

MATERIALS AND METHOD

4.1 REQUIREMENTS OF THE SYSTEM

The system needs two types of requirement.

They are:

- Hardware requirements
- Software requirements

4.1.1 HARDWARE REQUIREMENTS

I have used the following hardware to accomplish my project:

1. Arduino Uno
2. IR sensor
3. L298N Motor Driver
4. Servo motor gear MG995
6. 9V Battery
7. Jumper wires
8. USB cable
9. Electro magnet sensor
10. 10 kg DC motor

4.1.1.1 ARDUINO UNO

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 Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of

hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the microcontroller into a more accessible package. The Arduino is a microcontroller board based on the ATmega8. It has 14 digital -input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC to DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB to-serial driver chip. Instead, it features the (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2HVB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features: Pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes. Stronger RESET circuit. AT mega 16U2 replace the 8U2. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino.

Microcontroller	AT mega 328
Operating voltage	5V
Input voltage(recommended)	7-12 V
Input Voltage (Limits)	6-20 V
Digital I/O pins	14
Analog Input pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3v Pin	50 mA
Flash Memory	32 KB (AT mega 3280) of which 0.5kb used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Table 4.1 Specification of Arduino Uno

The Table 4.1 shows the specification of Arduino UNO board.

4.1.1.2 IR SENSOR



Fig 4.2 IR sensor

The IR sensor module consists mainly of the IR Transmitter and Receiver, OP amp, Variable Resistor (Trimmer pot), output LED in brief which can be seen in Fig. 4.2.

IR LED Transmitter IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range.

IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. to few centimeters to several feet. It depends upon the type of IR transmitter and the manufacturer. Some transmitters have the range in kilometers. IR LED white or transparent in color, so it can give out amount of maximum light.

Photodiode Receiver Photodiode acts as the IR receiver as it conducts when light falls on it. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it starts conducting the current in reverse direction when light falls on it, and the amount of current flow is proportional to the amount of light. This property makes it useful for IR detection. Photodiode looks like a LED, with a black color coating on its outer side, Black color absorbs the highest amount of light.

LM358 OP amp LM358 is an Operational Amplifier (Op-Amp) is used as voltage

comparator in the IR sensor. the comparator will compare the threshold voltage set using the pre-set (pin2) and the photodiode's series resistor voltage (pin3). Photodiode's series resistor voltage drop > Threshold voltage = OP amp output is High.

Photodiode's series resistor voltage drop < Threshold voltage = OP amp output is Low.

When OP amp's output is high the LED at the OP amp output terminal turns ON (Indicating the detection of the object).

Variable Resistor

The variable resistor used here is a preset. It is used to calibrate the distance range at which the object should be detected.

IR Sensor Module Features:

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole

Table 4.2 Specification of IR sensor:

PIN NAME	DESCRIPTION
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output

The Table 4.2 shows the specification of IR sensor.

4.1.1.3 L298N MOTOR DRIVER

The L298N is an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver de-signed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device 19 independently of the in-put signals. The emitters of the lower transistors of each bridge are connected together rand the corresponding external terminal can be used for the connection of an external sensing resistor. An additional Supply input is provided so that the logic works at a lower voltage.

Features:

- High operating voltage, which can be up to 40 volts.
- Large output current, the instantaneous peak current can be up to 3A.
- Two built in H-bridge, high voltage, large current, full bridge driver, which can be used to drive DC motors, stepper motors, relay coils and other inductive loads.
- Able to drive a two-phase stepper motor or four-phase stepper motor.
- Adopt a high-capacity filter capacitor and a freewheeling diode that protects devices in the circuit from being damaged by the reverse current of an inductive load, enhancing reliability.
- 6) The module can utilize the built-in stabile tube 78M05 to obtain 5v from the power supply. But to protect the chip of the 78M05 from damage, when the drive voltage is greater than 12v, an external 5v logic supply should be use

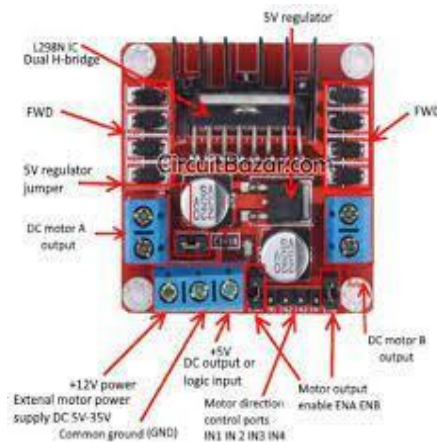


Fig. 4.3 L298n motor driver

The Fig. 4.3 is the L298n Motor Driver.

- 1.DC motor 1 "+" or stepper motor A+
- 2. DC motor 1 "-" or stepper motor A-
- 3. 12V jumper - remove this if using a supply voltage greater than 12V DC.
This enables power to the onboard 5V regulator
- 4. Connect your motor supply voltage here, maximum of 35V DC. Remove 12V jumper if >12V DC
- 5. GND
- 6. 5V output if 12V jumper in place, ideal for powering your Arduino (etc.)
- 7. DC motor 1 enable jumper. Leave this in place when using a stepper motor.
Connect to PWM output for DC motor speed control.
- 8. IN1
- 9. IN2
- 10. IN3
- 11. IN4
- 12. DC motor 2 enable jumper. Leave this in place when using a stepper motor.
Connect to PWM output for DC motor speed control.
- 13. DC motor 2 "+" or stepper motor B "+"
- 14. DC motor 2 "-" or stepper motor B "-"

4.1.1.4 SERVO MOTOR GEAR MG995



Fig. 4.4 Servo motor

Servo motor in Fig. 4.4 implies an error sensing feedback control which is utilized to correct the performance of a system. It also requires a generally sophisticated controller, often a dedicated module designed particularly for use with servomotors. Servo motors are DC motors that allows for precise control of angular position. They are actually DC motors whose speed is slowly lowered by the gears. The servo motors usually have a revolution cutoff from 90° to 180° . A few servo motors also have revolution 22 cutoff of 360° or more. But servo motors do not rotate constantly. Their rotation is limited in between the fixed angles. The servo motor is actually an assembly of four things: a normal DC motor, a gear reduction unit, a position-sensing device and a control circuit. The DC motor is connected with a gear mechanism which provides feedback to a position sensor which is mostly a potentiometer. From the gear box, the output of the motor is delivered via servo spline to the servo arm. For standard servo motors, the gear is normally made up of plastic whereas for high power servos, the gear is made up of metal. A servo motor consists of three wires- a black wire connected to ground, a white/yellow wire connected to control unit and a red wire connected to power supply. The function of the servo motor is to receive a control signal that represents a desired output position of the servo shaft and apply power to its DC

motor until its shaft turns to that position. It uses the position sensing device to figure out the rotational position of the shaft, so it knows which way the motor must turn to move the shaft to the instructed position. The shaft commonly does not rotate freely around similar to a DC motor, however rather can just turn 200 degrees. From the position of the rotor, a rotating magnetic field is created to efficiently generate torque. Current flows in the winding to create a rotating magnetic field. The shaft transmits the motor output power. The load is driven through the transfer mechanism. A high-function rare earth or other permanent magnet is positioned externally to the shaft. The optical encoder always watches the number of rotations.

Advantages

- If a heavy load is placed on the motor, the driver will increase the current to the motor coil as it attempts to rotate the motor. Basically, there is no out-of-step condition.
- High-speed operation is possible.
- Disadvantages
- Since the servomotor tries to rotate according to the command pulses, but lags behind, it is not suitable for precision control of rotation.
- Higher cost.
- When stopped, the motor's rotor continues to move back and forth one pulse, so that it is not suitable if you need to prevent vibration.

4.1.1.5 9V BATTERY



Fig. 4.5 9v battery

A 9-volt motorcycle battery shown in Fig. 4.5 is made up of a plastic case containing six cells. Each cell is made up of a set of positive and negative plates immersed in a dilute sulfuric acid solution known as electrolyte, and each cell has a voltage of around 2.1 volts when fully charged. The six cells are connected together to produce a fully charged battery of about 9 volts. That's great, but how does sticking lead plates into sulfuric acid produce electricity? A battery uses an electrochemical reaction to convert chemical energy into electrical energy. Let's have a look. Each cell contains plates resembling tiny square tennis rackets made either of lead antimony or lead calcium. A paste of what's referred to as "active material" is then bonded to the plates; sponge lead for the negative plates, and lead dioxide for the positive. This active material is where the chemical reaction with the sulfuric acid takes place when an electrical load is placed across the battery terminals.

4.1.1.6 JUMPER WIRES



Fig. 4.6 Jumper Wires

Jump wires (also called jumper wires) in Fig. 4.6 is used for solderless breadboarding can be obtained in ready-to-use jump wire sets or can be manually manufactured. The latter can become tedious work for larger circuits. Ready-to-use jump wires come in different qualities, some even with tiny plugs attached to the wire ends. Jump wire material for ready-made or homemade wires should usually be 22 AWG (0.33 mm²) solid copper, tin-plated wire - assuming no

tiny plugs are to be attached to the wire ends. The wire ends should be stripped $\frac{3}{16}$ to $\frac{5}{16}$ in (4.8 to 7.9 mm). Shorter stripped wires might result in bad contact with the board's spring clips (insulation being caught in the springs). Longer stripped wires increase the likelihood of short-circuits on the board. Needle-nose pliers and tweezers are helpful when inserting or removing wires, particularly on crowded boards.

4.1.1.7 USB CABLE

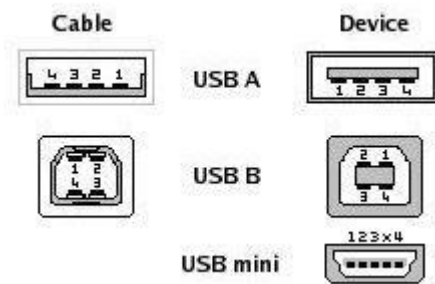


Fig. 4.7 USB Cable

The term USB stands for "Universal Serial Bus". USB cable in Fig. 4.7 assemblies are some of the most popular cable types available, used mostly to connect computers to peripheral devices such as cameras, camcorders, printers, scanners, and more. Devices manufactured to the current USB Revision 3.0 specification are backward compatible with version 1.1. Detail of USB Cable Construction.

The USB cable standard allows for these advantages over serial cable types:

- USB cables are "Hot Pluggable", in other words you can connect and disconnect the cables while the computer is running without fear of freezing the computer
- USB cables are fast, transferring up to 480Mbps. Compare that to serial communication which transfers data at about 20Kbps
- USB cables carry power as well as signals. This allows for "USB powered" gadgets as well as recharging batteries in cameras and other USB peripherals
- USB cables are designed with several distinct connector types, making it easy to identify which plug goes into the computer and which plug goes into the peripheral device
- USB cables are a universal standard and are fairly easy to find and to afford

4.1.1.8 ELECTRO MAGNET



Fig. 4.8 Electro magnet

The electro magnet in Fig. 4.8 is commonly used in many automation applications. They're used to sense the presence of objects and don't require physical contact with the target or object being sensed, which is why they're often referred to as non-contact sensors. Common proximity sensor types include photoelectric, capacitive, and inductive sensors. Inductive sensors operate on the basis of Faraday's Law. One way to state Faraday's Law is that a change in magnetic flux in a coil of wire will induce a voltage in a nearby coil. This is applied in inductive proximity sensors in the following way: The sensor itself contains an oscillator circuit and a coil from which an electromagnetic field radiates out and induces eddy currents in any nearby metallic objects. The eddy currents have the effect of attenuating the oscillations from the amplifier. This reduction in oscillations is registered as the presence of a metallic object. Because only metallic objects have inductive properties, inductive sensors can't be used to detect plastic or cardboard or other non-metallic objects. However, different metals have different inductive properties and the type of metal being sensed will influence the sensing distance. For instance, ferromagnetic materials like steel generally have the longest sensing distance, while non-ferrous metals such as aluminum or copper have much shorter sensing distances. In general, inductive proximity sensors are well suited to shorter-range applications as the inductive effect wears off with growing distance between the sensor and object to be detected. Inductive proximity sensors hold up well in dirty environments where contaminants don't interfere with the sensor's ability to detect metallic objects. For example, they're resistant to dirt, dust, and smoke in the environment between the sensor and the object to be detected. As for build-up of contaminants on the

sensor face such as dirt and dust, oil, grease or soot, these don't affect the inductive sensing. However, metallic contaminants such as metal chips in machining applications will impact sensor operation. The key is to be sure to understand what type of contaminants an application contains in order to select the correct type of sensor that can.

4.1.1.9 USB WEB CAMERA



Fig. 4.9 USB Camera

A USB webcam shown in Fig. 4.9 is a camera that connects to a computer, usually through plugging it in to a USB port on the machine. The video is fed to the computer where a software application lets you view the pictures and also transfer them to the Internet. The software you choose can be set to upload images on a time interval using FTP 28 (file transfer protocol) to a website, or it can be set to provide a live feed for displaying on a remote machine or again in a website. When FTP is used the picture on the website is a static one which is updated regularly at intervals minute by minute, hour by hour or even longer. This is very easy to set up but the image delay means they are nowhere near as interesting to watch as a live feed. USB webcam software can also be used to provide a live feed directly from the computer to your website or even fed to the ComScore streaming service to allow large numbers of visitors to your website to see the feed at the same time. USB webcams can be the small internal type you usually see for web conferencing and personal use etc. right up to professional quality outdoor weather proof webcams. The downside to any USB type of webcam is the fact that you must have a PC switched on at the location of the camera to enable the images or video feed to be sent to a website.

4.1.1.10 10KG DC MOTOR



Fig. 4.10 10 kg dc motor

Motor1 shown in Fig. 4.10 is a 9V DC geared motor with a .25" motor output shaft and a 2mm rear encoder shaft. The 2mm shaft works with our ENC300 quadrature encoder to allow the motor to be used in position control applications. Motor controllers that are rated for 9V@2A are ideal for controlling this motor. However, motor controllers with lower current ratings can also be used if they have over-current and overtemperature protection.

Features:

1. 12V – 200RPM –
2. 3.6KG•CM torque DC gearhead motor
3. 30:1 Gear Ratio
4. 2mm rear encoder shaft
5. Good compromise between speed and torque for small robotic designs.

4.1.2 SOFTWARE REQUIREMENTS

I used the following software to accomplish my project

- 1.Arduino IDE
- 2.Python

4.1.2.1 ARDUINO IDE

Arduino software is used to put the instruction of whole functions of this system to the microcontroller. Here we use programming language 'C' for coding. The program for executing this project has been written in C language. The

program is burnt in the microcontroller using burner software. The program is stored in the EEPROM of the microcontroller, which is present in the Arduino board. By this software we put the data and instruction for forward, backward, left, right operation of this system. In android application when we press a button, a corresponding signal is sent through the Bluetooth-to-Bluetooth module (HC-05) which is connected with the Arduino board. When signal data arrives the Arduino the pin which corresponds to the particular input is set to high. Now that pin gives the output to the motor driver section. Motor driver switches accordingly the data bit, if the data bit is low then the corresponding pin of the motor driver doesn't work else high bit then the corresponding pin of the motor driver is on. We have used Arduino IDE version 1.8.1 for writing program for Arduino. There are two steps of the programming. First set up section where we define all the variables. Second loop part where the program runs continuously.

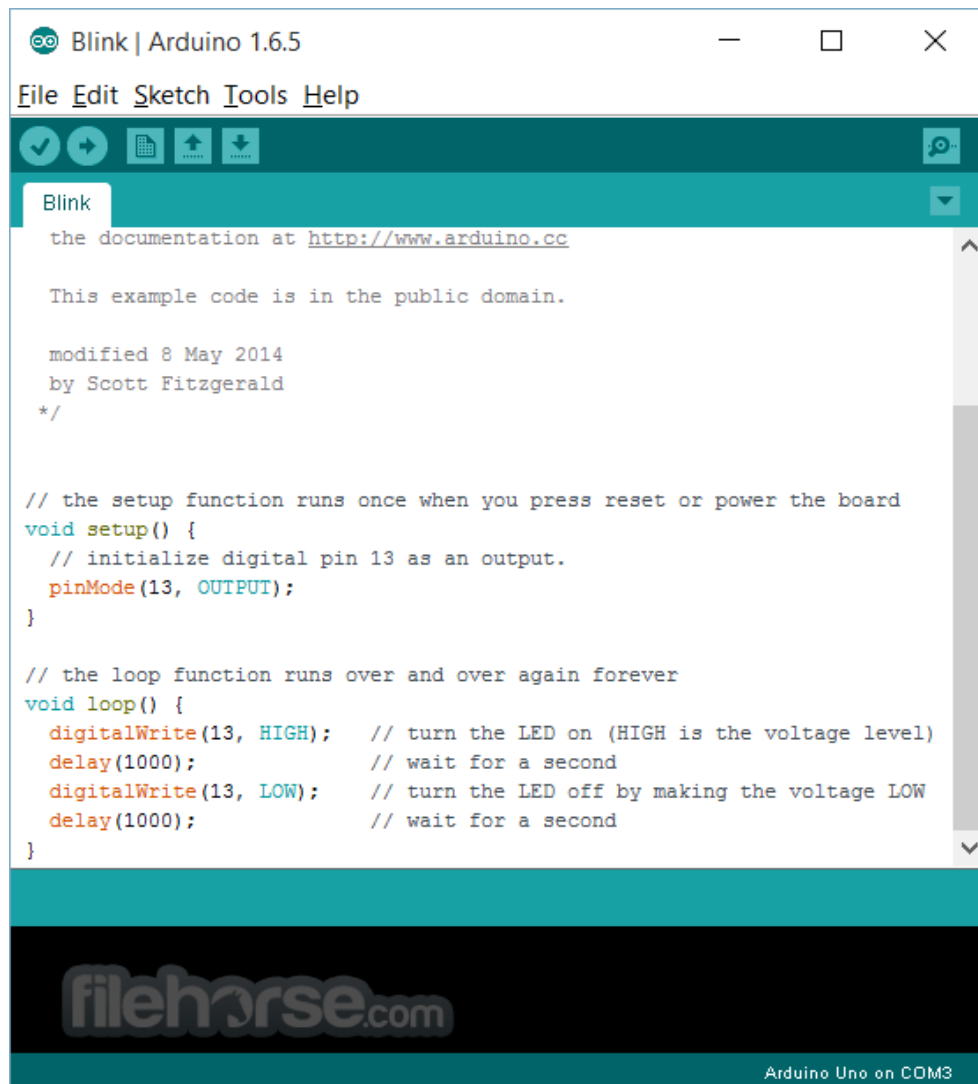


Fig. 4.11 Arduino software

4.1.2.2 PYTHON

Python is a deciphered, significant level and broadly useful programming language. Python's plan reasoning accentuates code lucidness with its remarkable utilization of critical space. Its language develops and object-situated methodology plan to assist software engineers with composing, legitimate code for little and enormous scope projects. Python is progressively composed and trash gathered. It upholds various programming ideal models, including organized (especially, procedural), object-arranged and practical programming. Python is frequently depicted as a "batteries included" language because of its complete standard library. Guido van Rossum started chipping away at Python in the last part of the

1980s, as a replacement to the ABC programming language, and first delivered it in 1991 as Python 0.9.0. Python 2.0 was delivered in 2000 and presented new highlights, for example, list comprehensions and a trash assortment framework utilizing reference checking and was ceased with variant 2.7.18 in 2020. Python 3.0 was delivered in 2008 and was a significant modification of the language that isn't totally in reverse viable and much Python 2 code doesn't run unmodified on Python 3. Python was considered in the late 1980s by Guido van Rossum at Centrum Wiskunde and Informatica (CWI) in the Netherlands as a replacement to ABC programming language, which was roused by SETL, equipped for special case taking care of and interfacing with the Single adaptable cell working system. Its execution started in December 1989. Van Rossum bore sole duty regarding the undertaking, as the lead engineer, until 12 July 2018, when he reported his "lasting excursion" from his duties as Python's Kind Tyrant Forever, a title the Python people group gave to him to mirror his drawn-out responsibility as the task's main choice maker. He currently shares his initiative as an individual from a five-man controlling council. In January 2019, dynamic Python center designers chose Brett Cannon, Scratch Coghlan, Barry Warsaw, Ditty Willing and Van Rossum to a five-part "Directing Gathering" to lead the project.[46] Guido van Rossum has from that point forward removed his designation for the 2020 Controlling council. Python 2.0 was delivered on 16 October 2000 with many major new highlights, including a cycle-recognizing trash specialist and backing for Unicode.

Python 3.0 was delivered on 3 December 2008. It was a significant modification of the language that isn't totally in reverse compatible. A large number of its significant highlights were backported to Python 2.6.x and 2.7.x rendition arrangement. Arrivals of Python 3 incorporate the 2 to 3 utility, which mechanizes (in any event part of the way) the interpretation of Python 2 code to Python 3.

Python 2.7's finish of-life date was at first set at 2015 at that point deferred to 2020 out of worry that a huge group of existing code couldn't undoubtedly be forward-ported to Python 3. No greater security patches or different enhancements will be delivered for it. With Python 2's finish of-life, just Python 3.6.x and later are

upheld.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 SIMULATION RESULT OF IR SENSOR AND SERVO MOTOR

The Distance of the object and conveyor belt was measured using Arduino IDE serial monitor. It was computed using formula for the distance of the electromagnetic waves emitted by IR sensor.

$$\text{Distance(cm)} = (\text{time} / 2) / 29.1$$

Equation 1. Distance formula Manipulating the formula, the response time can be obtained shown in Equation 2

$$\text{Time} = 2(\text{distance(cm)}) / 29.1$$

Equation 2. Time formula

Table 5.1 Computed time from the acquired distance

DISTANCE (MM)	TIME (μS)
2	116.4
4	232.8
6	349.2
8	465.6
10	582

The Table 5.1 shows the details of computed time from the acquired distance.

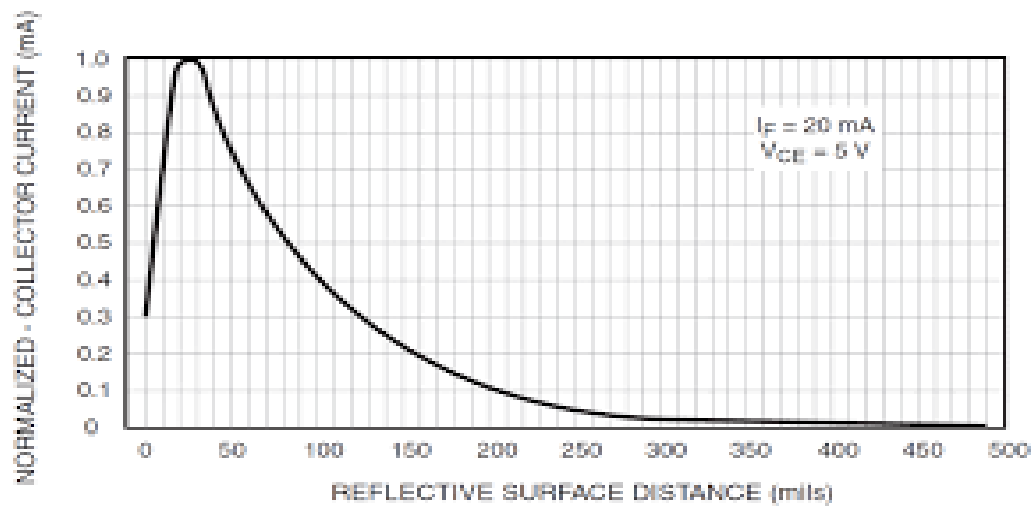


Fig. 5.1 Reflective vs current

The Fig. 5.1 shows the graph between Reflective surface distance and Normalized collector current.

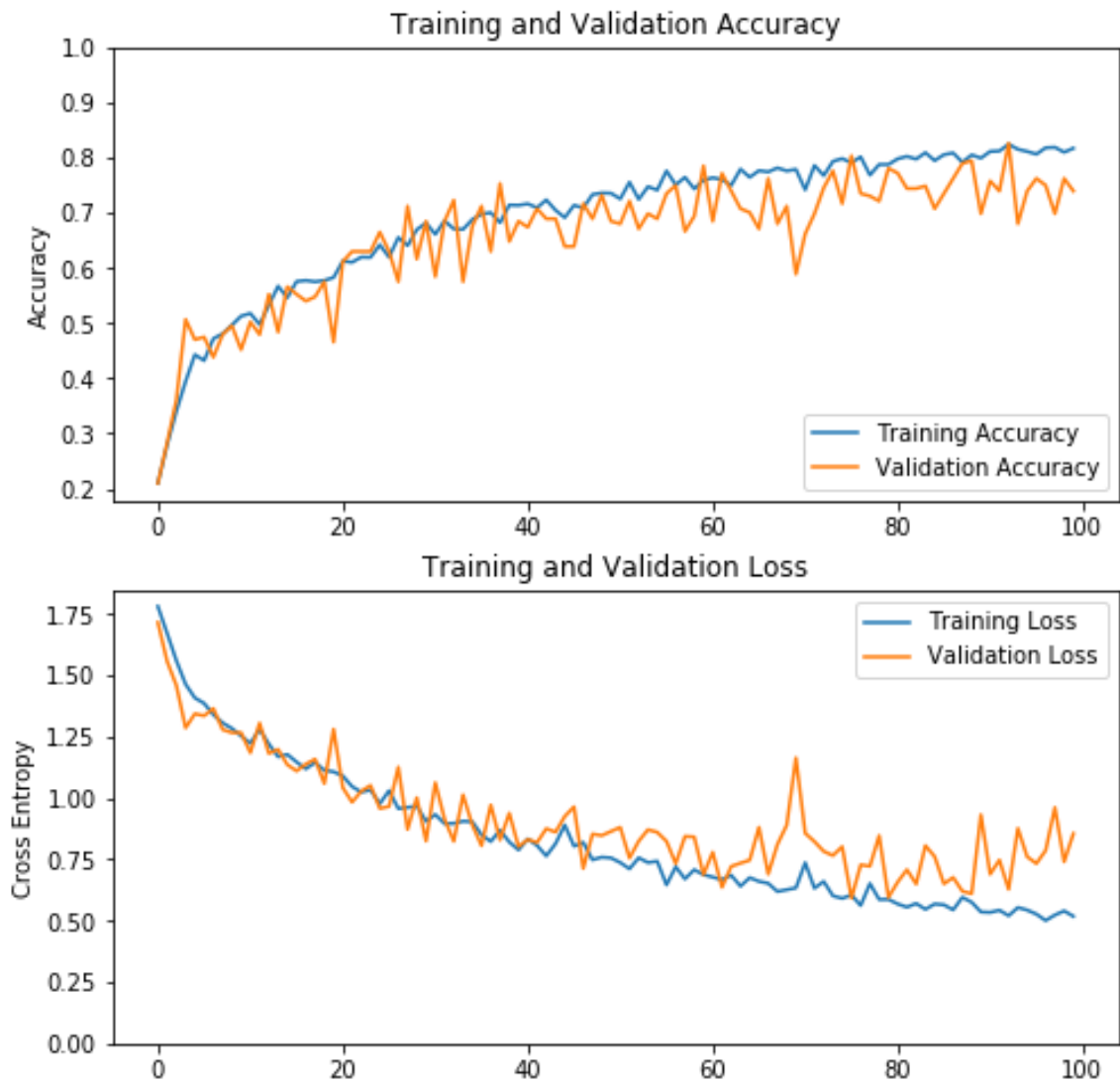


Fig. 5.2 Accuracy and loss

The Fig 5.3 gives us the Accuracy and Loss. As we can see the Training and Validation Accuracy in the first graph. The Accuracy steadily increases. The next graph shows the Training and Validation Loss. The Loss decreases steadily.

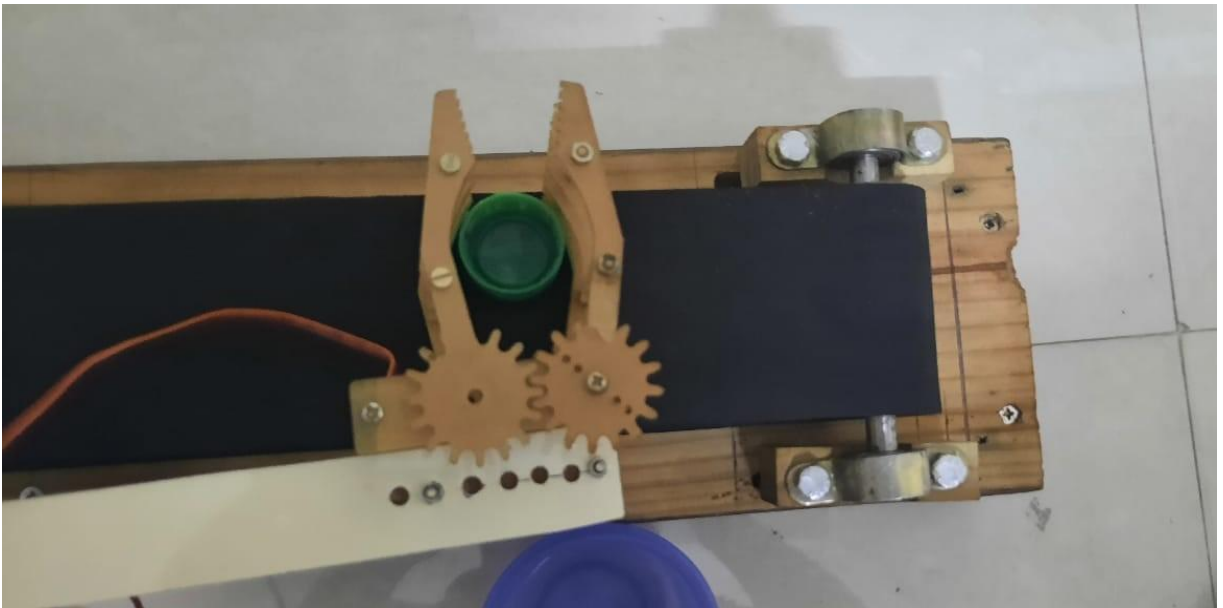


Fig. 5.3 Plastic cap on conveyor belt

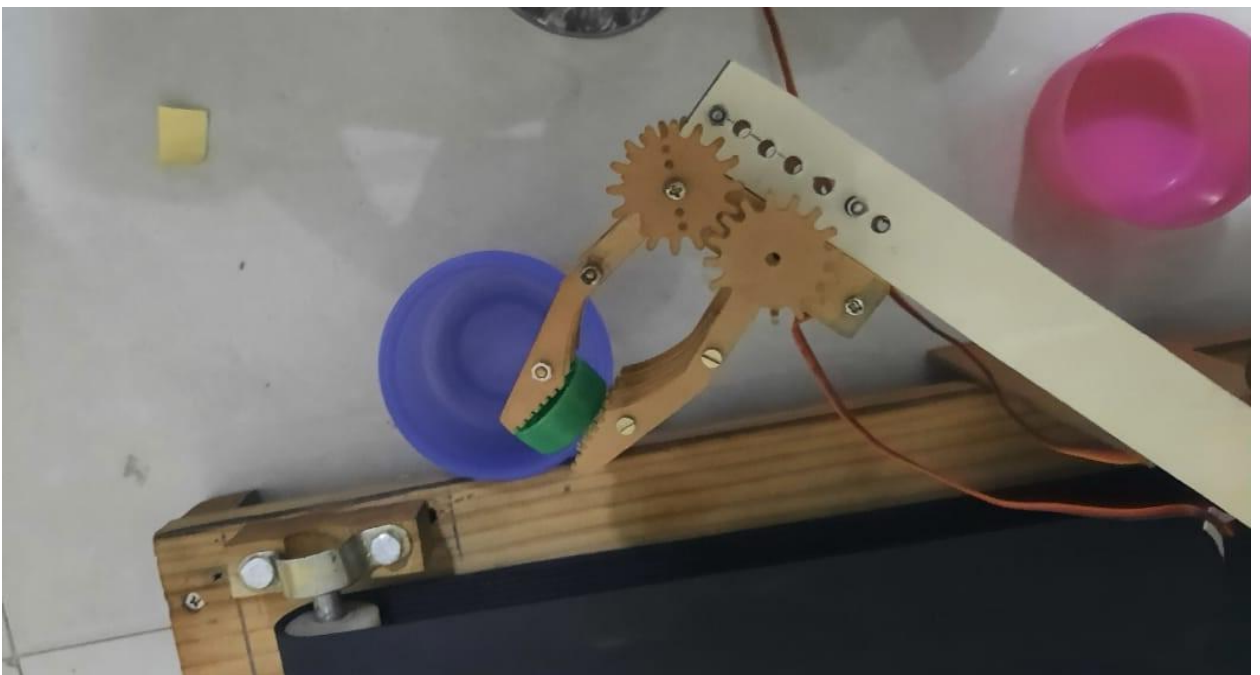


Fig. 5.4 Plastic cap separated.

The above is the picture of a plastic garbage that is being taken by the robotic arm and separately placed in the plastic bin with the help on the robotic arm which is attached to the servo motor which is activated when it receives the signal from the camera module the input signal help to separate the garbage as it is providing

a digital information as output which then is been received by the Arduino uno and will initialize the servo motor.

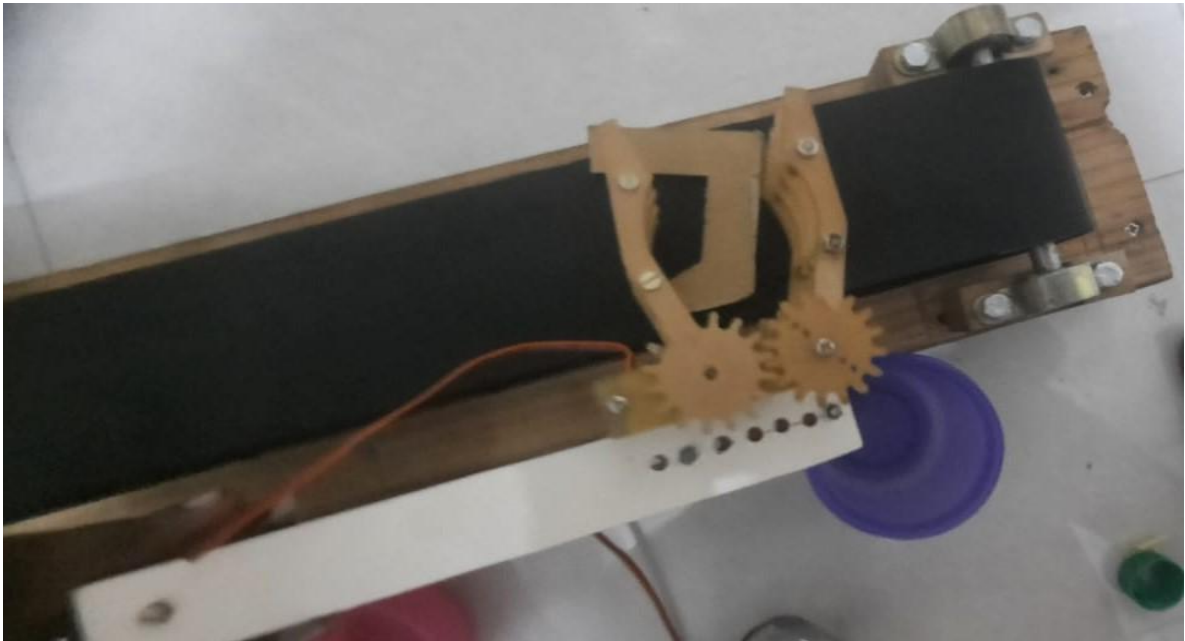


Fig. 5.5 Cardboard on conveyor belt

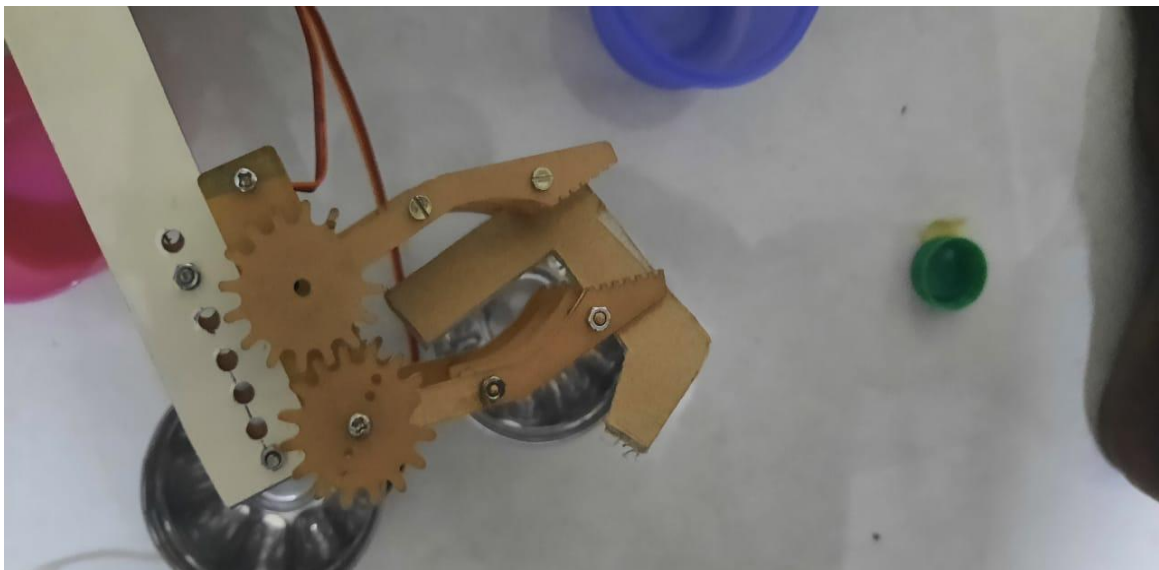


Fig. 5.6 Cardboard been separated

The above is the picture of a cardboard garbage that is being taken by the robotic arm and separately placed in the cardboard bin with the help on the robotic arm which is attached to the servo motor which is activated when it receives the signal from the camera module the input signal help to separate the garbage as it is providing a digital information as output which then is been received by the

Arduino uno and will initialize the servo motor.

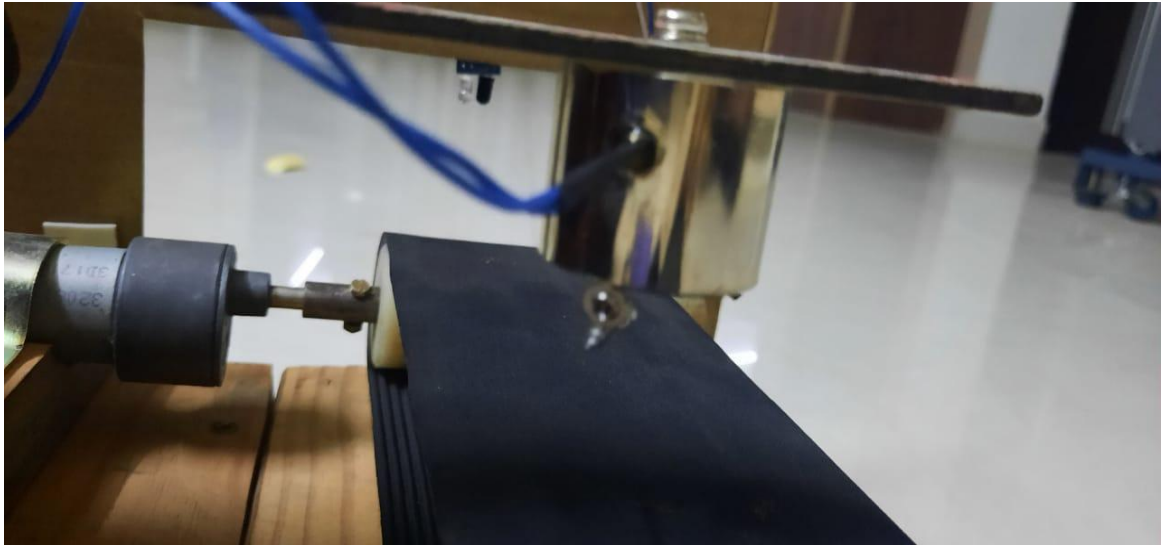


Fig. 5.7 metal waste attraction

The above is the picture of a metal waste that is being taken by the electro magnet and separately placed in the metal bin with the help on the robotic arm attached with electro magnet which is attached to the servo motor which is activated when it receives the signal from the ir sensor module the input signal help to separate the garbage as it is providing a digital information as output which then is been received by the Arduino uno and will initialize the servo motor.

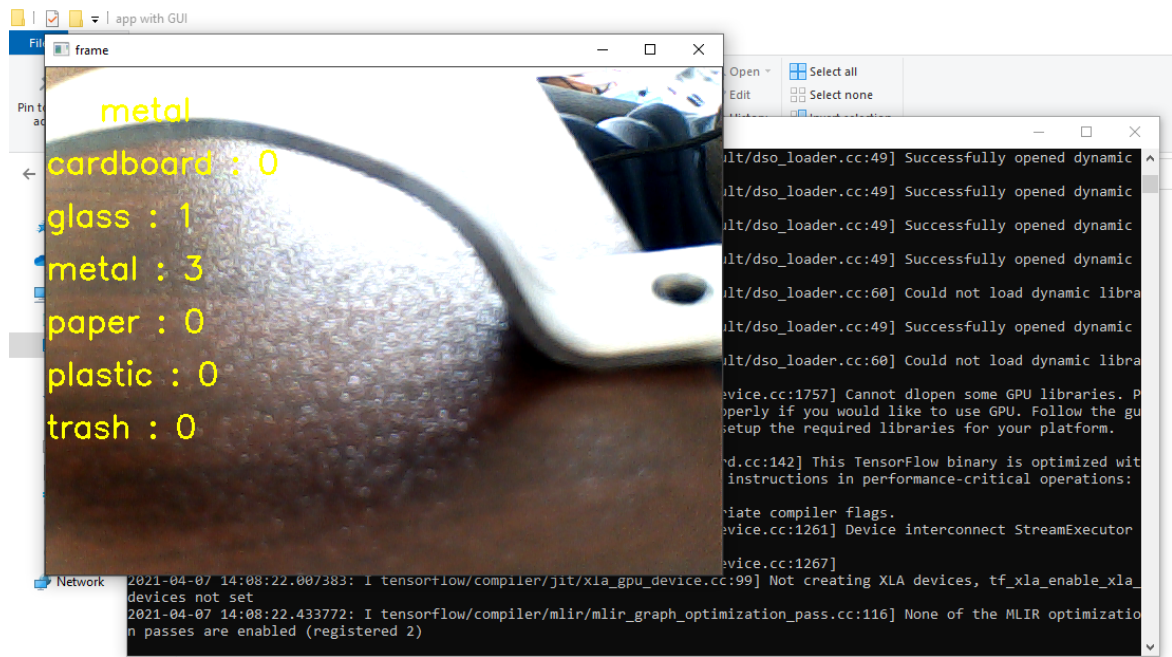


Fig. 5.8 Camera Output image

The camera output helps us to provide the details necessary for the separation of waste from the conveyor belt, it will provide us the data of what waste is been generated and what is the quantity of waste that is been generated. this will also provide the information of what are the quantities of waste that of been generated in the cover belt which sends the signal to Arduino and then will help in the working of robotic arm.

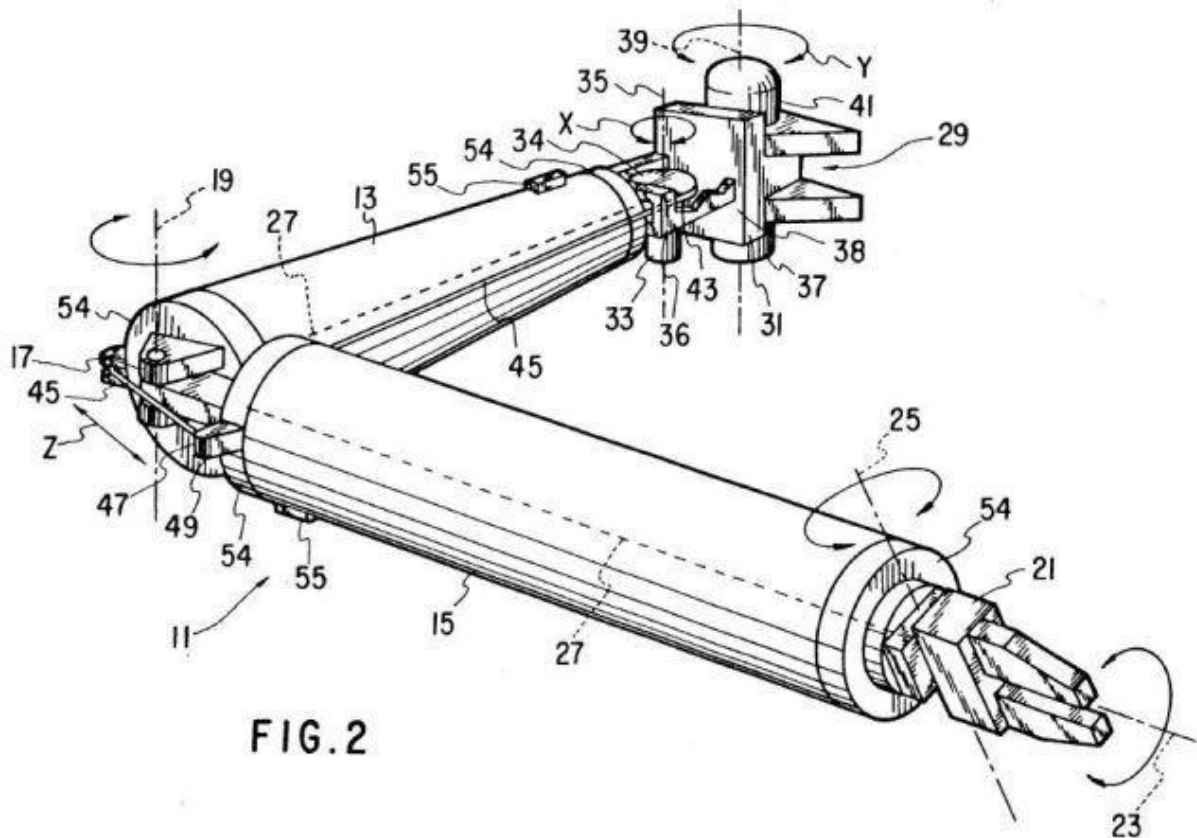


Fig. 5.9 structure of robotic arm

In this robotic arm we are going to use servo motors as servo motors gives good accuracy than any other motors. To look like a human arm, we are going to connect this using servo clamps. The servo clamps are of different types, by the help of this various clamps a robotic arm is built. To pick and object and to put it from one place to another we are going to use a gripper. This gripper is also known as an end.

CHAPTER 6

CONCLUSION AND FUTURE WORK

CONCLUSION

The project when implemented will help create more resources for recycling as it decreases the probability of contamination, hence increasing the resources usable for recycling. This gives out different methods and strategies used for serving the purpose of waste management. Our project provides one of the most efficient ways to keep our environment clean and green. By increasing the efficiency, a huge amount of waste can be separated in a faster method. Waste management is all those activities, actions, and works required to manage waste from its production to its final disposal. This project is designed in such a way that a system collects from different positions and segregates the wastes. As the bin fills IR sensor senses the level and the bin rotates into a conveyor waste is collected from different locations and reached the segregation part through the main conveyor belt. The timing and movement of the conveyor belt are controlled by the peripheral interface controller. As the name suggests automatic waste segregation segregates the waste into three major classes: dry, wet, metallic by using different types of sensors.

FUTURE WORK

This project helps to separate waste materials into their respective category. The waste is being separated into different bins. The waste materials are sent one by one through the conveyor belt. This can be further developed by sending more waste materials and separating them at the same time. This can also be implemented on higher scale depending on the place of implementation. The idea can be further developed with AI system to store the data of waste garbage generated daily and it provides us with a detailed report of generated garbage

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APPENDIX

A.SOURCE CODE

```
#define capPin A5
#define buz 9
#define pulsePin A4

#define inputCLK 3
#define inputDT 4

#include <Servo.h>
#define led 10

long sumExpect=0; //running sum of 64 sums
long ignor=0; //number of ignored sums
long diff=0; //difference between sum and
avgsum
long pTime=0;
long buzPeriod=0;
#include <Servo.h> // add servo motor library
Servo servo1;
int IRpin = 12; // pin for the IR sensor
int motor_angle=0;
IRrecv irrecv(IRpin);
decode_results results;
int motorPin = 3;
```

```

void setup()
{
  Serial.begin(9600);

  Serial.println("IR Remote controlled servo motor"); //
display message

  irrecv.enableIRIn(); // Start the receiver

  servo1.attach(5); // declare servo motor pin

  servo1.write(motor_angle); // move the motor to 0
deg
pinMode(motorPin, OUTPUT);
Serial.begin(9600);
while (! Serial);
Serial.println("Speed 0 to 255");

  Serial.println("Servo motor angle 0 deg");

  delay(2000);

  pinMode(pulsePin, OUTPUT);
  digitalWrite(pulsePin, LOW);

  pinMode(capPin, INPUT);

  pinMode(buz, OUTPUT);
  digitalWrite(buz, LOW);

  pinMode(led, OUTPUT);
}

void loop()
{
  int minval=1023;

  int maxval=0;

```

```

long unsigned int sum=0;
for (int i=0; i<256; i++)

while(!(irrecv.decode(&results))); // wait until no
button is pressed

if (irrecv.decode(&results)) // when button is pressed
and code is received
{
    if(results.value==2210) // check if digit 1 button is
pressed
    {
        Serial.println("servo motor angle 30 deg");
        motor_angle = 30;
        servo1.write(motor_angle); // move the motor
to 30 deg
    }
    else if(results.value==6308) // if digit 2 button is
pressed
    {
        Serial.println("servo motor angle 60 deg");
        motor_angle = 60;
        servo1.write(motor_angle); // move the motor to 60
deg
    }
    else if(results.value==2215) // like wise for all
digit buttons
    {
        Serial.println("servo motor angle 90 deg");
        motor_angle = 90;

```

```

servo1.write(motor_angle);
    }
    else if(results.value==6312)
    {
        Serial.println("servo motor angle 120 deg");
        motor_angle = 120;
        servo1.write(motor_angle);
    }
    else if(results.value==2219)
    {
        Serial.println("servo motor angle 150 deg");
        motor_angle = 150;
        servo1.write(motor_angle);
    }
    else if(results.value==6338) // if volume UP
button is pressed
    {
        if(motor_angle<150) motor_angle+=5; //
increase motor angle
        Serial.print("Motor angle is ");
        Serial.println(motor_angle);
        servo1.write(motor_angle);    // and move
the motor to that angle
    }
    else if(results.value==6292) // if volume down
button is pressed
    {
        if(motor_angle>0) motor_angle-=5; //
decrease motor angle

```

```

        Serial.print("Motor angle is ");
        Serial.println(motor_angle);
        servo1.write(motor_angle);    // and move
the motor to that angle
    }
    delay(200);    // wait for 0.2 sec
    irrecv.resume();    // again be ready to receive
next code
}

if (Serial.available())
{
    int speed = Serial.parseInt();
    if (speed >= 0 && speed <= 255)
    {
        analogWrite(motorPin, speed);
    }
}

{
    //reset the capacitor
    pinMode(capPin,OUTPUT);
    digitalWrite(capPin,LOW);
    delayMicroseconds(20);
    pinMode(capPin,INPUT);
    applyPulses();

    //read the charge of capacitor

```

```

    int val = analogRead(capPin); //takes 13x8=104
microseconds

    minval = min(val,minval);
    maxval = max(val,maxval);
    sum+=val;

    long unsigned int cTime=millis();
    char buzState=0;
    if (cTime<pTime+10)
    {
        if (diff>0)
            buzState=1;
        else if(diff<0)
            buzState=2;
    }
    if (cTime>pTime+buzPeriod)
    {
        if (diff>0)
            buzState=1;
        else if (diff<0)
            buzState=2;
        pTime=cTime;
    }
    if (buzPeriod>300)
        buzState=0;

    if (buzState==0)
    {
        digitalWrite(led, LOW);

```

```

        noTone(buz);
    }
    else if (buzState==1)
    {
        tone(buz,2000);
        digitalWrite(led, HIGH);
    }

    else if (buzState==2)
    {
        tone(buz,500);
        digitalWrite(led, HIGH);
    }
}

//subtract minimum and maximum value to remove
spikes
sum-=minval;
sum-=maxval;

if (sumExpect==0)
    sumExpect=sum<<6; //set sumExpect to expected
value
long int avgsum=(sumExpect+32)>>6;
diff=sum-avgsum;
if (abs(diff)<avgsum>>10)
{
    sumExpect=sumExpect+sum-avgsum;
    ignor=0;
}

```

```

    }
    else
        ignor++;
    if (ignor>64)
    {
        sumExpect=sum<<6;
        ignor=0;
    }
    if (diff==0)
        buzPeriod=1000000;
    else
        buzPeriod=avgsum/(2*abs(diff));
}

void applyPulses()
{
    for (int i=0;i<3;i++)
    {
        digitalWrite(pulsePin,HIGH); //take 3.5 uS
        delayMicroseconds(3);
        digitalWrite(pulsePin,LOW); //take 3.5 uS
        delayMicroseconds(3);
    }
}

import cv2, time
import numpy as np
from keras.models import load_model
from keras.preprocessing import image

```

```

font = cv2.FONT_HERSHEY_SIMPLEX

vid = cv2.VideoCapture(0)

# loading pre-trained model

model = load_model('Garbage.h5')


#label
labels = ['cardboard', 'glass', 'metal', 'paper', 'plastic',
'trash']

info = {
    "cardboard":0,
    "glass": 0,
    "metal": 0,
    "paper": 0,
    "plastic": 0,
    "trash": 0,
}

def preprocessing(frame):
    img = cv2.resize(frame, (300, 300))
    img = image.img_to_array(img, dtype=np.uint8)
    return np.array(img)/255.0

while(True):

```

```

ret, frame = vid.read()

# preprocessing
img = preprocessing(frame)

#predict
p = model.predict(img[np.newaxis, ...])
label = labels[np.argmax(p[0],axis=-1)]

#update info
info[label]+=1

#display info

cv2.putText(frame, label, (50, 50), font, 1, (0, 255,
255), 2, cv2.LINE_4)

cv2.putText(frame,"{} :
{}".format("cardboard",info["cardboard"]), (0, 100),
font, 1, (0, 255, 255), 2, cv2.LINE_4)

cv2.putText(frame,"{} :
{}".format("glass",info["glass"]), (0, 150), font, 1, (0,
255, 255), 2, cv2.LINE_4)

cv2.putText(frame,"{} :
{}".format("metal",info["metal"]), (0, 200), font, 1, (0,
255, 255), 2, cv2.LINE_4)

cv2.putText(frame,"{} :
{}".format("paper",info["paper"]), (0, 250), font, 1, (0,
255, 255), 2, cv2.LINE_4)

cv2.putText(frame,"{} :
{}".format("plastic",info["plastic"]), (0, 300), font, 1, (0,

```

```
255, 255), 2, cv2.LINE_4)

    cv2.putText(frame,"{} :
{}".format("trash",info["trash"]), (0, 350), font, 1, (0,
255, 255), 2, cv2.LINE_4)

    cv2.imshow('frame', frame)

    time.sleep(5)

    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

vid.release()

cv2.destroyAllWindows()
```