

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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A Mini Project Report on

## "AUTOMATED WASTE SEGREGATION"

Submitted in partial fulfilment of the requirements for 5<sup>th</sup> Semester  
**BACHELOR OF ENGINEERING**

IN

## ELECTRONICS & COMMUNICATION ENGINEERING

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**DEPARTMENT OF ELECTONICS & COMMUNICATION ENGINEERING**

**BHALKI-585 328**

**2024 - 2025**

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY**

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## CERTIFICATE

This is to certify that the project "**AUTOMATED WASTE SEGREGATION**" has been successfully carried out by '**Shubham(3RB22EC070), Varun(3RB22EC088) and Vijay(3RB22EC091)**' in partial fulfilment of the requirements for the 5<sup>th</sup> semester of Bachelor of Engineering in Electronics & Communication Engineering of Visvesvaraya Technological University, Belagavi, during the academic year 2024-2025. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in Report deposited in departmental library. The project has been approved as it satisfies the academic requirements in respect of Mini Project work prescribed for the Bachelor of Engineering Degree.

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## **DECLARATION**

We **SHUBHAM-(3RB22EC070), VARUN-(3RB22EC088) & VIJAY(3RB22EC091)**, students of 5<sup>th</sup> Semester **Bachelor of Engineering**, in the **Department of Electronics & communication Engineering, Bheemanna Khandre Institute of Technology, Bhalki** declare that the Mini project on "**AUTOMATED WASTE SEGREGATION**" has been carried out by us and submitted in practical fulfilment of course requirements for the 5<sup>th</sup> semester of degree in Bachelor of Engineering in Electronics & communication Engineering of Visvesvaraya Technological University, Belagavi during the academic year 2024-2025. The matter embodied in this report has not been submitted to any other university or institution for the award of any other degree or diploma.

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Last but definitely not the least, we would like to thank all of our teachers, including our parents, for all that they have ever taught us; and our project team for working long hours to make this project a success.

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## ABSTRACT

Waste Management and segregation is a much-needed process in metro cities and urban areas due to spreading of diseases. It is estimated that India produces 42.0 million tons of municipal solid waste annually at present. Waste lying littered in the surrounding, dumped on open lands, becomes a major problem for various types of disease-causing bacteria and viruses hence, segregation, transport, handling and disposal of waste must be managed properly to minimize the risks of the public and environment. When mixed dry and wet waste breaks down in lowland, it creates nasty greenhouse gases. Segregation makes it attainable to utilize and recycle the waste effectively. This waste segregator system can easily segregate waste. When waste is thrown in the pipe, IR sensor will sense the waste. Waste is divided into three categories namely Wet, Dry and Metallic. Another sensor will sense the garbage category. As per the algorithm used, if the waste is metallic then the mechanism will bring the metal collecting bin below the pipe and with the help of servo motor the waste will fall into the metal bin. Similarly, the process will repeat if wet waste is sensed. If the sensor doesn't activate the sensor category, then the waste will be considered to be a dry waste. Segregation system for household use, so that it can be sent directly for processing. It is designed to sort the refuse into metallic waste, wet waste and dry waste. The AWS employs parallel resonant impedance sensing mechanism to identify metallic items, and capacitive sensors to distinguish between wet and dry waste. Experimental results show that the segregation of waste into metallic, wet and dry waste has been successfully implemented.

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1. INTRODUCTION**

Garbage is an important issue that needs to be handled wisely. We separate household waste for easy disposal and recycling. We've seen garbage trucks come to homes badly and cause chaos in families.

This is why many citizens are packing too many containers in the open. This increases environmental pollution. Waste is a problem and we cannot ignore it. Garbage is the home of all insects that cause food poisoning and many other diseases.

Waste control refers to the techniques, strategies and technologies used to manipulate the collection, transportation, disposal and recycling of waste.

Waste control is designed to make sure that waste is disposed of in a safe and environmentally sound manner while promoting the conservation of assets and decreasing the poor impact of waste on public health, cleanliness and the environment.

A typical waste management system includes many components, including waste collection, transportation, treatment and disposal. Garbage collection involves collecting waste from homes, businesses and other places and transporting it to waste treatment plants. Waste transportation involves transporting waste from collection points to treatment plants, usually using specialized trucks and equipment.

Waste treatment involves sorting, sorting and treating waste to facilitate recycling, composting or disposal. Recycling involves turning waste into new products, while composting breaks down organic waste into valuable nutrients that can be used as fertilizer. Waste disposal usually involves burial in landfills or power plants that convert waste materials into energy.

Typical, a nicely-designed waste control gadget can help reduce pollution, preserve natural resources and help sustainable development. Proper waste control requires the cooperation of individuals, agencies and government businesses at all stages to ensure that waste is disposed of in a green and environmentally sound manner.

### **1.2 Definition of Waste Segregation**

Waste segregation is the separating and sorting of waste to facilitate recycling and, when sorted, waste is more easily recycled thereby saving you money and time.

### **1.3 Waste Segregation in developed countries: -**

- Most of the developed countries like Germany, Netherland, USA etc are using advanced management techniques (Enhanced Resolution, Mobile sorting) that are proving to be very helpful in eluding the waste as well as creating a better probability of recycling and reuse.
- Use of such techniques in Germany has resulted in increasing the level of recycling to 62% by 2010, and land filling was almost reduced to zero by that time.
- Although, adequate laws are required to run a country waste free as Germany put a ban on land filling MSW by defining requirements to the organic content.
- This initiative has made a boon in the development of Mechanical biological treatment plants (MBTs) that redirects the biodegradable material to fermentation and composting plants for the production of biogas

### **1.4. Waste Management**

#### **Wet Waste**

Wet waste refers to food, contaminated food, hygiene products, garden waste, all organic materials such as wipes and paper towels, and other products. Dirt that can be recycled. Used for wet waste composting. It's far vital to split wet and dry waste because dry waste need to be freed from contamination for recycling. Wet waste, also known as organic waste, is biodegradable waste that contains organic compounds such as food waste, garden waste, and animal waste. Such waste usually has a high moisture content and is easy to decompose. moist waste is frequently separated from other types of waste along with plastic and paper and can be used for composting or shredding to supply biogas and compost. Proper management of wet waste is important to reduce carbon monoxide emissions and conserve natural resources.

#### **Dry Waste**

Dry waste contains paper, glass, plastic, cardboard, rubber, metallic, food packaging cloth, and many others. Even milk cartons and packets pass right into a dry waste bin. Dry waste is recyclable however could be rejected if it's far infected or dirty. In dry there have been many cloths that may be recycled and reuse a number of them are paper and steel. Dry waste refers to non-biodegradable waste that does not decompose easily, such as plastic, metal, glass, and paper. Unlike wet waste, dry waste does not contain organic compounds and has a low moisture content. Dry waste is usually recycled and can be processed into new products such as paper or plastic. However, if not managed properly, dry waste can have adverse environmental impacts, including pollution and resource use. Therefore, it is important to separate dry waste from wet waste for easy recycling and proper disposal.

## **Metal Waste**

Scrap metal refers to scrap metal products and materials that are no longer useful or desirable. This includes materials such as steel, aluminium, copper, brass and copper. Metal waste comes from many sources, together with groups, production websites and families. Recycling steel waste is vital because it enables preserve natural sources and decrease waste despatched to landfills. steel recycling includes sorting and separating exclusive varieties of metals, casting off impurities and melting them to make new merchandise. Recycling scrap steel additionally enables lessen greenhouse gasoline emissions because producing new metallic from ore requires extra strength than recycling existing metal Ferrous and non-ferrous metals, together with but not restrained to steel roofing, rebar, coatings, pipes manner substances. window frames, doors, stoves, pipes, wires, cables, showers, fences, bicycle frames, auto body parts, machinery, garbage, metal furniture. In dry waste, we must distinguish between metals and non-metals. We consider all non-metallic materials as non-ferrous metals

## **Non – Metal waste**

Non-metal waste, paper, plastic, glass, textile, rubber, wood, etc. refers to wastes that do not contain metal, such as These materials are usually derived from natural materials and may be biodegradable or non-biodegradable. Non-metallic waste is generated from many sources, including households, businesses and industries. Recycling non-metallic waste is important for conserving natural resources, reducing energy consumption and reducing waste sent to landfills. Recycling non-metallic materials often involves sorting and sorting different materials, cleaning to remove contaminants, and making new products. Waste management is important to reduce pollution, conserve natural resources and promote sustainable practices. To distinguish metal from nonmetal, we should use 5 sensors that can distinguish metal from nonmetal. Finally, we can distinguish wet waste from dry waste, then distinguish and separate non-ferrous and non-ferrous waste.

## **CHAPTER 2**

### **REVIEW OF RELATED LITERATURE**

#### **2.1. LITERATURE REVIEW**

In Rapid increase in volume and types of solid and hazardous waste due to continuous economic growth. It is estimated that in 2005-06 the total amount of municipal solid waste generated globally reached 2.02 billion tones, representing a 7% annual increase since 2003. The segregation, transport, handling, and disposal of waste needs to be properly managed to minimize the risk to the health and safety of patients, the public, and the environment. This paper proposes an Automated Waste Segregator (AWS) which is a cheap as well as easy to use solution for a segregation system for household use, so that it can be sent directly for processing. It is designed to sort the refuse into dry and wet waste. The AWS employs capacitive sensors to distinguish between wet and dry waste. Experimental results show that the segregation of waste into wet and dry waste has been successfully implemented using the AWS.

In Waste management, both indoor and outdoor, is almost done manually. This is unhygienic, and requires significant amount of valuable human resource to get it done. Outdoor waste management is automated to an extent. Therefore, a proposal to fully automate indoor waste management, by making the existing disposal outlets more intelligent and using a movable waste collecting robot, is discussed in this paper. The filling of the dustbin is monitored by ultrasonic sensors and if it is filled to the brim, the Arduino Nano controller transmits the data to the robot with the aid of wireless Zig bee 802.15.4 protocol. The robot is designed in such a way that it effectively tracks the location of the filled dustbin and collects the waste in its storage part. The RSSI (Received Signal Strength Indicator) value from the message received is used to identify which dustbin is full and its location based on Wave Front Algorithm. In comparison with the existing systems, the proposed system exhibits appreciable efficiency in power consumption and making it an ideal candidate for waste management.

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

In This research aimed to design and develop an autonomous robot to feasibly address waste disposal issues in common indoor places. The researchers found a path to improve plan by using Fuzzy Logic Control (FLC). And also, they utilized the Microcontroller unit to control sound, input proximity and IR sensors, and output geared DC motors through machine learning and electromechanical interface. They simulated an adaptive algorithm using Mamdani-type FLC model, implemented this algorithm using C programming language, then downloaded as machine code to a real prototype. Based on test results, the waste robot accurately detects human involvement, a feature that would be pivotal in overcoming individual indifferences on waste management. This research chronicled how a waste management robot prototype was designed and developed as feasible solution to address waste disposal issues in strategic locations such as households, offices.

In An Automated Waste Control Management System (AWCMS) has been designed which includes an electronic waste detection device and a central control unit. An infrared sensor is used for sensing waste levels, GPS is used for location identification, Arduino Board having a microcontroller and GSM Module is used for sending the message which contains the information regarding the status of the bin. The central control unit consists of a receiving device which receives a message through GSM Module and sends it to the computer software using Arduino Board's microcontroller. The software has a proficiently designed GUI which helps the user to perform and monitor all the required actions for waste monitoring and detection of waste bins placed in an area or a city. All the information is displayed in the GUI of the software in the event of a waste bin getting full and then being emptied by municipal waste trucks or field workers. So that all the components in this entire system work in an efficient manner to make waste management automation possible so the waste is collected and disposed to the landfill at proper time.

## **2.2. PROBLEM DEFINATION**

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 traditional method used for segregating of waste in India is through rag pickers which are time-consuming and can have adverse effects on the health of the people who are exposed to such wastes. The economic value of the waste generated is not realized unless it is recycled completely. There is a need for a cheap and also an easy-to-use solution for segregation of household waste.

## 2.3. OBJECTIVES

The proposed system would be able to automate the solid waste monitoring process and management of the overall collection process using IOT (Internet of Things). The Proposed system consist of four main subsystems namely Smart Trash System (STS), Local Base Station (LBS), Vehicle System (VS) and Smart Monitoring and Controlling Hut (SMCH). In the proposed system, whenever the waste bin gets filled this is acknowledged by placing the waste bin, which transmits it to the receiver at the desired place in the area or spot. In the proposed system, the received signal indicates the waste bin status at the monitoring and controlling system.

- To separate waste at the houses in the society into dry waste and wet waste using a relay circuit driven by a comparator circuit. This waste is collected at the container. The container has a sonar sensor used to detect the level of the garbage collected into it. When garbage reaches a particular level, an indication to the control unit is sent using RF module. Also, an area besides the roadside garbage containers is implemented. This zonal area uses the concept of load sensor to indicate if any garbage spills out the container.
- The process of making things automatic is being exploited in almost all the major fields of life. Making things automatic reduces burden on the humans. The cost and effort used in manually controlled products is much higher than the automated systems. Considering the fact, that the problem of efficient waste management is one of the major problems of the modern times, there is an utmost need to address this problem. The proper waste management system is must for the hygienic society in general and for world as a whole. Solid waste which is one of the sources and causes of environmental pollution has been defined under Resource Conservation and Recovery Act as any solid, semi-solid liquid or contained gaseous materials discarded from industrial, commercial, mining or agricultural operations and from community activities.
- Solid waste also includes garbage, construction debris, commercial refuse, and sludge from water or waste treatment plants or air pollution, control facilities and other discarded materials.
- In order to protect human health and the environment from the potential hazards of delayed waste disposal and environmental pollution a systematically supervised and controlled handling of these wastes is must.
- The type of wastes which constitute environmental pollution and which this work emphasizes on is domestic refuse consisting of degradable food wastes, leaves, dead animals and non-degradable ones such as plastics, bottles, nylon, medical and hospital wastes, generated in households, hospitals, industries and commercial center.

## CHAPTER 3

### METHODOLOGY

#### **3.1. PROPOSED SYSTEM**

The Smart bin is divided into three compartments. Each Compartment has their own function, the first compartment Consists of an IR sensor and a metal detector and the second Compartment consists of another IR sensor and moisture Sensor for detecting dry and wet waste, the last compartment is subdivided into three bins for collection of the segregated

Waste respectively. The whole system is controlled by Micro controller. Each and every component is interfaced to the microcontroller board.

The necessary code for controlling the sensors and the motors is coded using embedded-C language, in which the inputs and the output ports can be defined easily. In this project we have used IDE compiler to compile the code and upload it to the board using an A-B wire. To provide details of every decision we have used a Liquid Crystal Display device to display the decisions made by the Arduino processor.

#### **3.2. COMPONENTS REQUIRED**

- ARDUINO UNO
- Supporting Frame
- Collecting Bin
- Moving Disc
- Screws And Joints
- Proximity Sensor
- Ir Sensor Arduino
- Moisture Sensor
- Battery
- Buzzer
- Servo Motor
- Stepper Motor with Module
- Jumper Wires

## ➤ Arduino uno



3.2.1 Fig **Arduino uno**

Arduino Uno is based totally microcontroller board. It has 14 input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, 16 MHz ceramic resonator (CSTCE16M0V53-R0), USB connection, energy enter, ICSP header and reset button. microcontroller; simply join it to a laptop with a USB cable or strength it with an AC-DC adapter or battery and you are geared up to head.

Arduino is a popular open-source electronics platform that makes it easy to create interactive projects. It's great for beginners and experts alike because it uses simple hardware and software. You write code in the Arduino IDE (Integrated Development Environment) using a simplified version of C++ and upload it to an Arduino board.

The board then reads inputs (like light from a sensor) and controls outputs (like turning on an LED). You can build a variety of projects, from simple LED blinks to complex robots. Have you got any specific project in mind for your Arduino?

## **Communication**

Arduino Uno has many tools for speaking with a laptop, every other Arduino board or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication placed on pins zero (RX) and 1 (TX).

The ATmega16U2 on the motherboard takes the USB communication interface and looks as a digital port for computer software program. The 16U2 firmware makes use of general USB COM drivers and does not require outside drivers. however, on home windows a. inf record is required. The Arduino software (IDE) includes a controller that lets in smooth sending and receiving of records to and from the board. The RX and TX LEDs at the board will flash whilst sending information to the laptop through the USB-serial chip and USB connection (however now not for communication among pins 0 and 1).

The serial software library allows conversation thru any of the Uno's digital pins. The board has two 5V pins, 3V3 pins and seven ground pins (0V).

## ➤ Supporting Frame



3.2.2 Fig. supporting frame

**Objective:** To provide a stable and secure structure to house and integrate various components involved in automated waste management systems.

A frame is often a structural system that supports other components of a physical construction and/or pipe frame that limits the construction's extent. Here the Frame allows us to mount all other components on it.

## Structure:

- **Modularity:** Design the frame to be modular, allowing for easy installation and replacement of components like sensors, motors, and control units.
- **Accessibility:** Ensure that all components are easily accessible for maintenance and troubleshooting.
- **Stability:** Provide a robust structure to prevent vibrations and movement that could interfere with sensor readings and motor operations.

## ➤ Collecting Bin



3.2.3 Fig. Collecting bins.

**Objective:** To provide designated containers for the collection and segregation of different types of waste, ensuring efficient and effective waste management.

The collecting bins are used to collect the segregated waste in the respective bins.

## Features of Collecting Bins

### 1. Material:

- Made from durable and weather-resistant materials like high-density polyethylene (HDPE) or stainless steel to withstand outdoor conditions.

### 2. Size and Capacity:

- Available in various sizes to accommodate different volumes of waste, from small household bins to large industrial containers.

### 3. Labelling and Color-Coding:

- Clear labels and color-coding help users identify the correct bin for each type of waste, promoting proper segregation.

## ➤ Moving Disc



3.2.4 Fig: moving disc

Moving Disc is the component whose primary task is to collect trash in the respective bin with the help of the servo motor. All the trash collecting bins will be placed on it.

## ➤ Screws and Joints



Shaft adaptor



3x20mm bolt

3.2.5 Fig: joints screws

Joints are connections between two or more parts of a structure, providing stability and allowing for movement or flexibility where needed.

## ➤ Supporting Frame Construction:

- Use screws and butt joints for the basic frame structure, ensuring a solid and stable foundation.
- Incorporate lap joints and additional screws for areas requiring extra strength and support.
- Use mortise and tenon joints in high-stress areas to ensure durability and longevity.
- Integrate hinged joints for movable parts, such as automated lids and access panels.

## ➤ Proximity sensor



3.2.6 Fig: 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 are 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.

### Working of Inductive Proximity Sensor:

Inductive proximity sensors come across magnetic area loss because of eddy present day-day created thru the outside magnet of electrical tool. An AC magnetic area is created through the sensing coil to experience the impedance trade because of the eddy cutting-edge produced on the metal object.

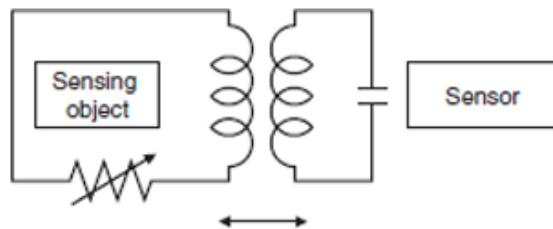
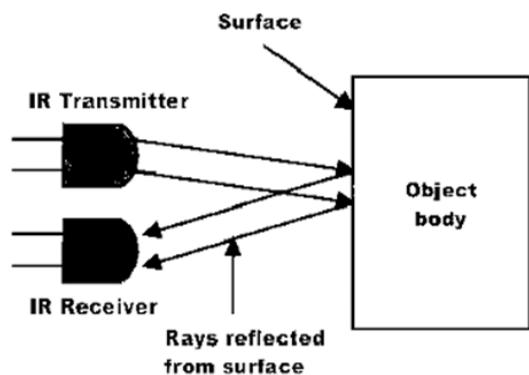


Fig: Working of Inductive Proximity Sensor

different methods consist of aluminium detection sensors that hit upon the frequency to-segment level, and all-steel sensors that use coils to hit upon the impedance exchange of the product. There are also impulse response sensors that create eddy contemporary in pulses and stumble on the time variation of eddy modern with voltage induced in the coil. The change-like coupling is changed by way of impedance trade because of eddy contemporary loss. The alternate in impedance may be considered because the change in resistance positioned in series with the source

➤ **infrared (IR) sensor**



3.2.7 Fig: (IR) senser

➤ **Working of IR Sensor:**

Active infrared sensors work in conjunction with radar technology, simultaneously emitting and receiving infrared radiation. These electrons hit nearby objects and return to the receiving device.

With this technology, the sensor detects not only the movement of the environment, but additionally how near the object is to the device. This is in particular useful in robotics to govern proximity. Infrared radiation paperwork the lower quit of the electromagnetic spectrum and consequently is invisible to the human eye.

The infrared part of the electromagnetic spectrum is among seen waves and microwaves. Infrared wavelengths range from zero.75 to one thousand and are divided into 3 zones. Infrared radiation is function of all materials with a temperature above zero (zero Kelvin or -273 ranges Celsius).

Those items are thermal and emit infrared waves. Infrared sensors commonly use infrared lasers and lids with infrared wavelengths. For thermal electricity to attain the infrared scale, it ought to use a transmission medium. The published medium is air, vacuum or Fiber optic.

Optical lenses made from a combination of metals and materials such as quartz, calcium fluoride, polyethylene, germanium, aluminium and silicon are used as electronic components. The light or spotlight is then detected by an infrared detector. Infrared detectors require a preamplifier to amplify the signal.

## ➤ Moisture Sensor



3.2.8 Fig. Moisture sensor(or) rain drop senser

**Objective:** To optimize the handling and processing of wet materials in waste management systems, ensuring proper treatment and reducing environmental impact.

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.

## ➤ Power supply



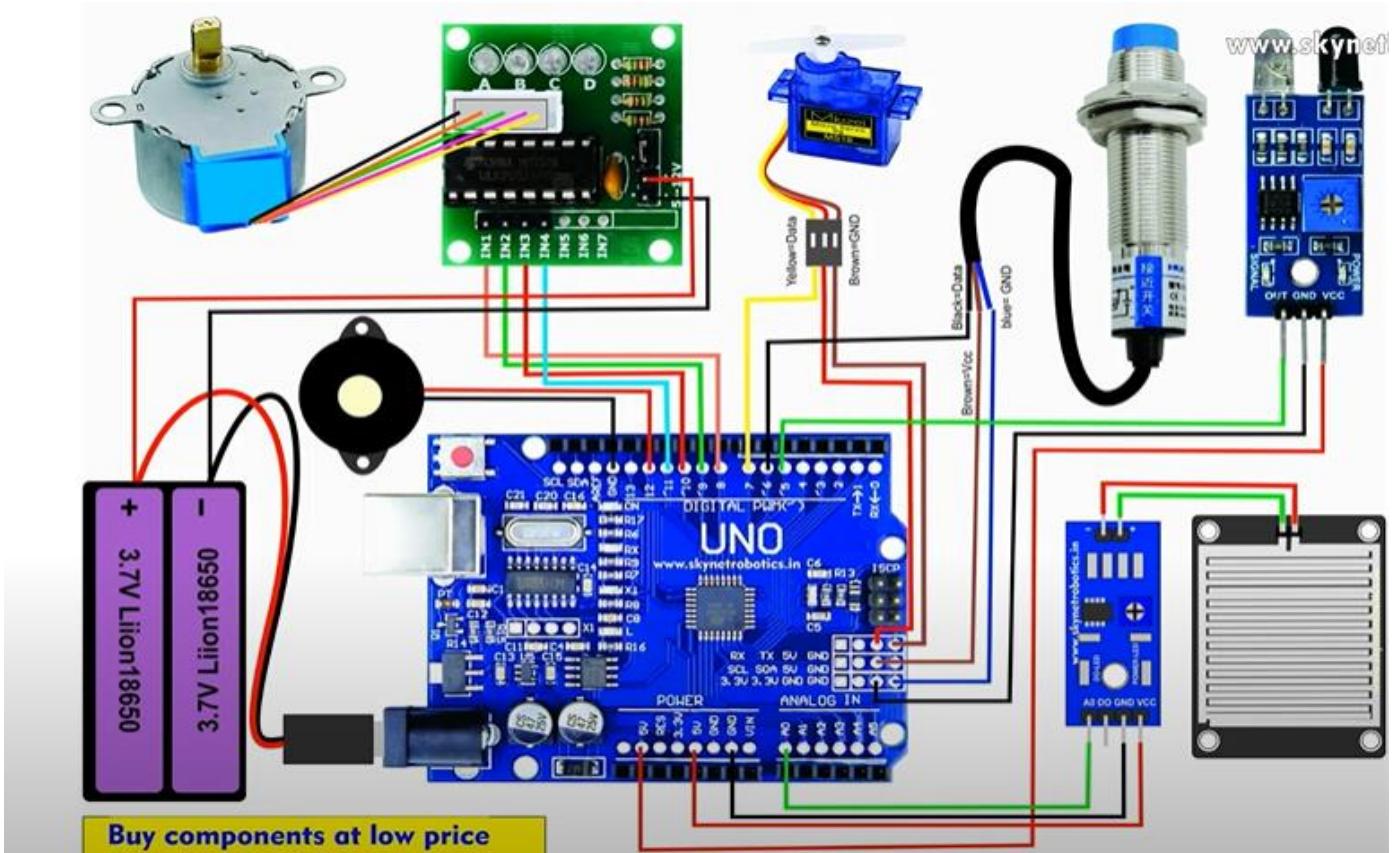
3.2.9 Fig: Power supply

The 18650 lithium-ion batteries are commonly used in various electronic devices due to their high energy density and rechargeability. They typically have a nominal voltage of 3.7V and capacities ranging from 800mAh to 3500mAh

To combine two 18650 lithium-ion batteries, you can either connect them in parallel or series. Connecting in parallel will increase the capacity while keeping the voltage the same. Connecting in series will increase the voltage while keeping the capacity the same. Make sure to use a Battery Management System

(BMS) to protect against overcharging and short circuits, and ensure the batteries are of the same type and charge level to avoid problems.

### ➤ Circuit diagram



3.2.10 Fig: Circuit diagram

### ➤ Buzzer



3.2.11 Fig: Buzzer

A buzzer makes sound when it gets an electric signal. You connect one pin to the Arduino's output pin and the other to the ground. In code, you turn the pin on and off to make the buzzer beep.

This is handy for alarms or notifications in your projects.

Buzzers in waste management provide audible alerts for efficient sorting, collection, and processing, enhancing operational efficiency, safety, and ensuring timely responses to issues.

## ➤ Servo Motor



3.2.12 Fig: Servo Motor

A **servo motor** is a precision motor used for applications that require accurate control of position, speed, and acceleration. It consists of a motor, a feedback sensor, and a control circuit.

## ➤ Key Points:

- **Control Signal:** Operates on a Pulse Width Modulated (PWM) signal that dictates the desired position.
- **Feedback Loop:** Internal sensors provide real-time position feedback, allowing precise adjustments.
- **Applications:** Commonly used in robotics, manufacturing, automation, and electronics for tasks such as controlling robotic joints, conveyor belts, and valves.
- **Advantages:** Offers high precision, versatility, and high torque, making it suitable for a wide range of industrial and hobbyist applications.

## ➤ Benefits in Waste Management

- **Automated Bin Lids:** Open and close bin lids based on sensor inputs, protecting waste from rain.
- **Sorting Mechanisms:** Control sorting gates for accurate waste segregation.
- **Leachate Management:** Operate valves in leachate treatment systems, ensuring efficient waste processing.

SG90 Servo Motor Pinouts	
Terminal Color	Brief Description
Red	VCC Connected to 3.5V to 5V
Brown	Ground
Orange/Yellow	Control Signal or PWM Signal to be applied on this terminal

Fig 3.2.12 Servo Motor Pin Description

## ➤ Stepper motor with module



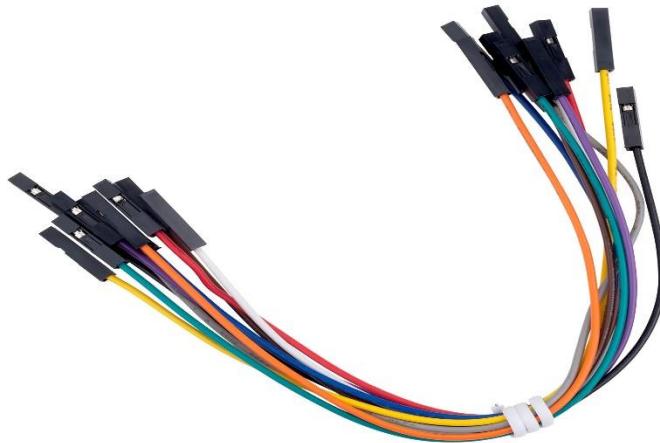
3.2.13 Fig: Stepper motor with module (ULN2003)

you commonly use a driver module like the ULN2003. This module takes low-power signals from a microcontroller, like an Arduino, and converts them to the higher currents needed to drive the motor.

You connect the motor to the ULN2003 module via a set of wires, and then connect the module to the Arduino using digital pins. By sending signals from the Arduino to the driver module, you can control the motor's rotation, speed, and direction.

- **Function:** The ULN3003 is a Darlington transistor array designed to drive inductive loads such as relays, solenoids, and stepper motors.
- **Stepper Motor Control:** It amplifies the control signals from a microcontroller (like an Arduino) to drive the stepper motor.
- **Pin Configuration:** The module typically has input pins (IN1, IN2, IN3, IN4) to receive control signals from the microcontroller and output pins to connect to the stepper motor.
- **LED Indicators:** It often includes LEDs to indicate the status of each input pin, providing visual feedback on the motor's stepping state.
- **Power Supply:** The module can operate with a power supply ranging from 5V to 12V, making it suitable for various applications

## ➤ Jumper wires



3.2.14Fig: Jumper wires

Jumper wires are used to make temporary connections between different parts of a circuit without soldering. They are particularly useful for prototyping on breadboards, connecting microcontrollers to various sensors and modules, and troubleshooting circuits. They allow you to easily modify and test circuits quickly, making them essential for both hobbyist projects and educational purposes

## 3.3WORKING

1. Drop the waste INTO the pipe.
2. Ir sensor will sense THE waste AND it will rest ON the bottom plate
3. Now the sensor ON the plate will sense THE waste AS IN 3 categories metallic dry or wet.
4. Now the algorithm is so made that if the waste is metallic then the mechanism will bring the metal collecting bin below the pipe and the servo will let the waste fall into the bin.
5. Similarly, the process will be repeated for wet test.
6. If the sensor does not activate then the
7. Waste will be detected as dry waste.
8. If wet detected it will drop to wet compartment
9. If metal then its separate compartment

### 3.4 CODE EMBEDDED IN ARDINO UNO

```
#include <CheapStepper.h>
#include <Servo.h>
Servo servo1;
#define ir 5
#define prox1 6
#define buzzer 12
int potPin = A0; //input pin
int soil=0;
int fsoil;
CheapStepper stepper (8,9,10,11);
void setup ()
{Serial.begin(9600);
pinMode(prox1, INPUT_PULLUP);
pinMode(ir, INPUT);
pinMode(buzzer, OUTPUT);
servo1.attach(7);
stepper.setRpm(17);
servo1.write(180);
delay (1000);
servo1.write(70);
delay (1000);
}
void loop ()
{
fsoil=0;
int L =digitalRead(prox1);
Serial.print(L);
if(L==0)
{
tone (buzzer, 1000, 1000);
stepper.moveDegreesCW (240);
```

```

delay(1000);
servo1.write(180);
delay(1000);
servo1.write(70);
delay(1000);
stepper.moveToDegrees(240);
delay(1000);
}

if(digitalRead(ir)==0)
{
    tone(buzzer, 1000, 500);
    delay(1000);
    int soil=0;
    for(int i=0;i<3;i++)
    {
        soil = analogRead(potPin) ;
        soil = constrain(soil, 485, 1023);
        fsoil = (map(soil, 485, 1023, 100, 0))+fsoil;
        delay(75);
    }
    fsoil=fsoil/3;
    Serial.print(fsoil);
    Serial.print("%");Serial.print("\n");

if(fsoil>20)
{
    stepper.moveToDegrees(120);
    delay(1000);
    servo1.write(180);
}

```

```
delay(1000);
servo1.write(70);
delay(1000);
stepper.moveDegreesCCW (120);
delay(1000);
}

else {
tone(buzzer, 1000, 500);
delay(1000);
servo1.write(180);
delay(1000);
servo1.write(70);
delay(1000);}

}
```

## **CHAPTER 4**

### **RESULTS AND DISCUSSION**

“Segregator and monitoring system” sorts wastes into three different categories, namely metal, plastic and the wet (organic) waste. Wet waste refers to organic waste such as vegetable peels, left-over food etc. Separating our waste is essential as the amount of waste being generated today causes immense problem. Here, we have tested the household wastes which are generated in every home today and we have come up with the following result. When exposed to our automatic waste segregator and monitoring system. The proposed system would be able to monitor the solid waste collection process and management of the overall collection process.

It would provide in time solid waste collection. The technologies which are used in the proposed system are good enough to ensure the practical and perfect for solid waste collection process monitoring and management for green environment.

#### 4.1. Result Table

**Table 1:** Result of Metallic Waste Separation.

Sl. No.	Type of Metal Waste	Discarded or Not
1	Safety pin	Yes
2	Paper clip	Yes
3	Battery	Yes
4	Nail	Yes

**Table 2:** Result of Organic Waste Separation.

Sl. No.	Types of Organic Waste	Discarded or Not
1	Kitchen waste	Yes
2	Leftover food	Yes
3	Vegetable peel/Fruit peel	Yes
4	Rotten fruits and Vegetables	Yes

**Table 3:** Result of Dry Waste Separation.

Sl. No.	Type of Dry Waste	Discarded or Not
1	Paper	Yes
2	Small bottles	Yes
3	Heavy cartons	No
4	Milk cover	Yes
5	Dry leaves	Yes
6	Clothes	Yes
7	Tetra pack	No

## **CHAPTER 5**

### **CONCLUSION AND SCOPE OF FUTURE WORK**

- Inlet selection can be incorporated with a crusher mechanism to reduce size of incoming waste.
- Provisions can be made for on spot decomposition of wet waste
- Solar panel can be used for power supply.
- This type of product can be used in housing societies, offices, etc. Since it is cost effective, it can be implemented on a large scale as well with some modifications.
- Using a robotic arm along with a conveyor belt will make the process of segregation easier.
- Self-learning Systems: Develop self-learning models that can improve sorting efficiency over time based on feedback and data analysis.
- Also, more sensors can be used to segregate bio-degradable and non-bio-degradable waste, plastics, recyclable waste, e-waste, and medical waste. Conclusion
- Public Awareness and Participation: Develop apps or platforms to educate and engage the public in proper waste segregation practices.
- Smart Bins: Design IoT-enabled waste bins that can communicate fill levels and types of waste to a central system for efficient collection.
- Networked Systems: Create a network of devices and sensors that can work together for a streamlined waste management process.
- As the name suggests, it segregates the waste into three major classes: Dry waste, Wet waste, Metallic waste.
- The proposed system would be able to monitor the solid waste collection process and management of the overall collection process. Our project provides one of the most efficient ways to keep our environment clean and green.

Our project provides one of the most efficient ways to keep our environment clean and green

# CHAPTER 6

## APPLICATION

### 6.1 Application

- **Household Waste Management:** Installing automated segregation systems in homes can help residents efficiently separate waste at the source. This enhances recycling efforts and reduces the burden on centralized waste management facilities
- **Industrial Waste Management:** Industries produce diverse types of waste, including metal scraps, dry waste (paper, plastics), metal waste (metal cans) and wet waste (food waste). Automated systems can streamline the sorting process, improving recycling rates, and reducing the environmental impact of industrial activities.
- **Public Spaces:** Automated waste bins in parks, streets, and other public areas help maintain cleanliness. These bins use sensors to detect the type of waste and direct it to the appropriate compartment, promoting proper waste segregation even in busy environments.
- **Recycling Facilities:** At recycling plants, automated segregation systems enhance the efficiency of sorting recyclable materials. By reducing contamination, these systems ensure that more materials are recovered and reused, contributing to a circular economy.
- **Smart Cities:** As part of smart city initiatives, integrating automated waste segregation into urban infrastructure can improve overall waste management. These systems can be monitored and managed remotely, making cities cleaner and more sustainable.
- **Environmental Conservation:** Proper waste segregation and recycling reduce the amount of waste sent to landfills, conserve natural resources, and minimize pollution. Automated systems make this process more efficient and consistent, contributing significantly to environmental sustainability.

## CHAPTER 7

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