



# ADVANCED HOSPITAL WASTE DISPOSAL SYSTEM

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**Abstract:** Hospital waste and containers including disposed of push, needles, glucose, drip bottles, plastic papers, and bandages are separated by hand, which has detrimental long-term health impacts .Hepatitis, cholera, HIV, and typhoid are among the diseases that are brought on by hospitals' poor waste management .But incorrect disposal of medical waste poses the biggest risk. To avoid detrimental effects on human health and the environment, waste from these categories needs to be handled and disposed of differently. An automated trash segregation system is what is being suggested. This system has the ability to distinguish garbage by waste recognition and identify waste on its own. The image is captured and transferred to a microprocessor that processes and recognizes the type of waste to complete the segregation process. Following the separation procedure, discarded into the dustbin .In addition to making the neighborhood safer and healthier, this medical waste segregation shields the workers from potentially dangerous items.

**Index Terms – Ultrasonic sensor, ESP 32, Servomotor, Waste segregation.**

## I. INTRODUCTION

In order to preserve public health and safety and lessen environmental effect, hospital waste management is crucial. Hospitals generate a wide range of garbage, including biological, hazardous, and general waste, all of which require specific handling and disposal procedures. Bandages, used needles, and tissue samples are a few examples of biomedical waste that must be disposed of safely and in accordance with strict regulations due to the high danger of infection. Hazardous waste, which includes chemicals, pharmaceuticals, and radioactive materials, must be managed properly to prevent contamination and damage to the environment. Hospitals need to have adequate waste segregation in order to facilitate safe disposal and recycling practices .Color-coded bins and signs make it easier for users to identify and separate different waste types at the site of generation. They also help to minimize cross-contamination and guarantee regulatory compliance. Strong waste management standards, individual training, and frequent monitoring are necessary to maintain compliance, minimize risks, and maximize resource utilization. In addition to following the law, hospitals are implementing more ecologically friendly waste management practices. Initiatives such as recycling programs, garbage energy recovery, and the use of eco-friendly products promote environmental stewardship

and improve the health of the planet. Hospitals need to have an effective waste management plan with stringent regulations and suitable segregation in place to safeguard public health and the environment. The smart dustbin is a cutting-edge garbage disposal system. This cutting-edge bin provides effective garbage management by incorporating electronic components. In order to prevent overflow, sensors recognize when a person is in front of them and automatically close the lid. Moreover, it makes use of speech recognition technology to alert users to materials disposed of in the trash can, allowing for more efficient waste collection routes.

## **II.LITERATURE SURVEY**

### **2.1 SMART WASTE DISPOSAL SYSTEM**

It is an open source integrated development environment's suggested methodology. A microcontroller called an Arduino UNO board is used to enable communication between linked devices. An ultrasonic sensor mounted at the front of the dustbin senses the presence of a user when they are no closer than 30 cm from it. The microcontroller receives this signal and uses it to instruct the servo motor to rotate 180 degrees, opening the dustbin.

### **2.2 APPLICATION OF MICROCONTROLLER : BIOMEDICAL WASTE MANAGEMENT SYSTEM WITH SENSORS**

This is the suggested paper that has a conveyer belt motor that activates when waste gets onto the belt. Prior to reaching the waste container, the proximity sensor detects the waste. The input image is captured in five steps: preprocessing, median filtering, contrast enhancement, and segmentation. An infrared sensor, a gas sensor, a water sensor, and an ultrasonic sensor track the garbage's condition in the waste bin.

### **2.3 SMART DUSTBIN SYSTEM WITH INTERNET OF THINGS (IOT) NOTIFICATION**

The smart garbage management system suggests employing Internet of Things (IOT) equipped dustbins for effective waste collection and tracking. For sensing and data collection, they make use of PIR and ultrasonic sensors. To dispose of waste, the dustbin lid is opened by a servo motor. In order to ensure data sent online via an IOT platform for waste management organizations to monitor, the microcontroller checks the accuracy of the sensor data. They employ LED indications to change the mechanism. The trash management organization uses IOT to continuously monitor bin status.

### **2.4 AUTOMATIC HEALTH CARE WASTE SEGREGATION AND DISPOSAL SYSTEM**

The proposed system's hardware component receives from the sensing and classifier unit, which separates the medical waste and places it in the appropriate bin. The five phases of input image capture, pre-processing, median filtering, contrast enhancement, and segmentation are used to implement the sensor unit and classifier unit. In the proposed work, the grey level co-occurrence matrix is established to get statistical texture features of picture segregation, and MATLAB is used to execute the biological wastes segregation based on color codes.

### **2.5 BIOMEDICAL WASTE AND IT'S MANAGEMENT**

This study uses the presentation of an incineration process to treat biomedical waste at a high temperature in order to eradicate infectious organisms. Heat exchangers or a steam jacket around the vessels heat the liquid waste that has been gathered in vessels. The temperature and length of treatment are determined by the types of pathogens present in the waste.

### **2.6 SMART DUSTBIN USING ARDUINO**

The HC-SR04's ultrasonic sensor mode is used to detect waste, and it can detect objects up to 1 to 12 feet (2 cm to 400 cm) away. An Arduino microcontroller case study is also provided, which can be used as an open source platform for coding purposes. This trash is detected by an

ultrasonic sensor, and when the waste comes into touch with it, the server motor turns in an angled manner. Moreover, where an Arduino receives the waste signal from an ultrasonic sensor and generates an output.

## 2.7 SMART GARBAGE ALERT SYSTEM USING THE MACHINE LEARNING

Preparing the Dataset for Image Classification makes this suggestion. Train the neural network, build a model of the Tensor Flow, and then deploy it. Once that is done, an ultrasonic sensor is used to interface it with hardware. The values from the sensors are read and shown on the LCD. Relays are used to open dustbins containing degradable and non-degradable materials based on image processing. The buzzer will sound when the trashcan is full. Additionally, the levels are shown on the LCD.

## 2.8 SMART WASTE BIN MONITORING USING IOT FOR SUSTAINABLE BIOMEDICAL WASTE MANAGEMENT

This proposed method supports the Sensor's data which is sent and processed in the cloud. The smart bins send notifications to the central waste management cloud upon reaching capacity, alerting waste collectors to ensure appropriate collection and segregation. These sensors are linked to hospital routers via a wireless Internet connection, which sends data to a central monitoring center.

## 2.9 A SURVEY OF SMART DUSTBIN SYSTEMS USING IOT AND DEEP LEARNING

When waste is carried close to the smart bin's infrared sensor, it detects it, sends it online, and reaches a server that can hold a database to determine whether the waste is present and provides the information to a data collecting visualization. It presents an Arduino platform that is utilized as an open source platform.

## 2.10 SMART TRASH BIN BASED ON THE INTERNET OF THINGS AND MACHINE LEARNING

It shows that the waste is detected by an ultrasonic sensor, and a servo motor is used to open the lid. The Arduino nano receives the signal, and the Node MCU notifies the user's phone.

## III. COMPONENTS USED

1. Arduino UNO
2. Ultrasonic sensor (HC-SR04)
3. Servo motor
4. ESP 32 camera module
5. USB cable
6. Jumper wire
7. Bread board
8. Dustbin

## IV. HARDWARE SPECIFICATION:-

**4.1. Arduino UNO:-** Arduino UNO is a microcontroller board based on the ATmega328P. 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 a AC-to-DC adapter or battery to get started.



**4.2.Ultrasonic Sensor :-**The configuration pin of HC-SR04 is VCC (1), TRIG (2), ECHO (3), and GND (4). The supply voltage of VCC is 5V and you attach TRIG and ECHO pin to any Digital I/O in the Arduino Board to power it.

Power Supply: DC 5V

Working Current: 15mA

Working

Frequency: 40Hz

Ranging Distance : 2cm – 400cm/4m

Resolution : 0.3 cm

Measuring Angle: 15 degree

Trigger Input Pulse width: 10uS

Dimension: 45mm x 20mm x 15mm



**4.3.Servo Motor:-**

Operating Voltage is +5V typically

Torque: 2.5kg/cm

Operating speed is 0.1s/60°

Gear Type: Plastic

Rotation : 0°-180°

Weight of motor : 9gm

Package includes gear horns and screws



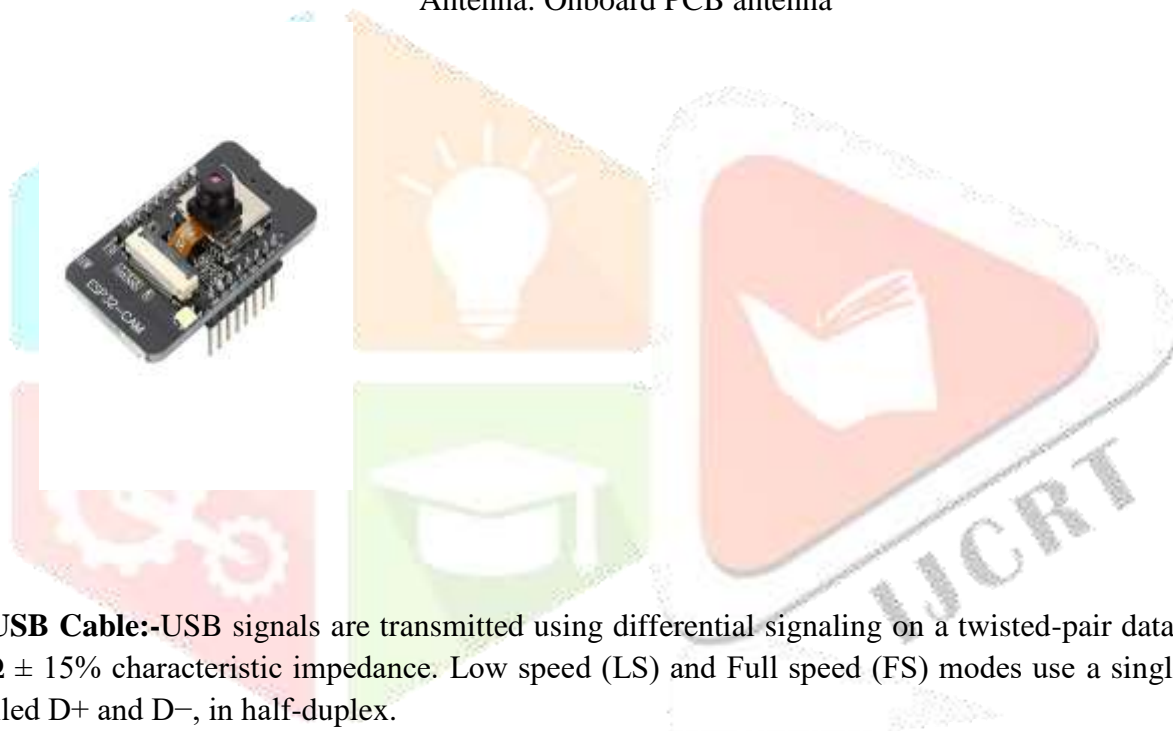
**4.4.ESP 32Camera Module:-**

Power supply :5V

Built in Flash : 32Mbit

Wi-fi protocol : IEEE 802.11b/g/n/e/I

Antenna: Onboard PCB antenna



**4.5.USB Cable:-**USB signals are transmitted using differential signaling on a twisted-pair data cable with  $90 \Omega \pm 15\%$  characteristic impedance. Low speed (LS) and Full speed (FS) modes use a single data pair, labelled D+ and D-, in half-duplex.



**4.6.Jumper wires:-**By attaching a jumper wire on the circuit, it can be short-circuited and short-cut (jump) to the electric circuit. By placing the jumper wire on the circuit, it becomes possible to control the electricity, stop the operation of the circuit, and operate a circuit that does not operate with ordinary wiring.

**4.7.Bread Board:-**A breadboard is commonly rated for five volts at one amp or fifteen volts at one-third of an amp, both of which have a power dissipation of five watts. Due to the temporary nature of the contacts, most breadboard has a current limit of one amp or less.

## V.SOFTWARE DESCRIPTION

**ArduCAM Library:** The ArduCAM library provides support for various camera modules including the OV7670. It simplifies the process of capturing images and interfacing with the Arduino.

**ESP 32 Library for Arduino:** Another library specifically tailored for the OV7670. This library is designed to work without additional RAM, suitable for Arduino Uno.

**Servo Library:-**The Servo library is included with the Arduino IDE and is one of the most widely used libraries for controlling servo motors. It supports up to 12 motors on most Arduino boards and up to 48 on the Arduino Mega.

**Servo Control:-** Provides basic methods to control the angle of a servo motor

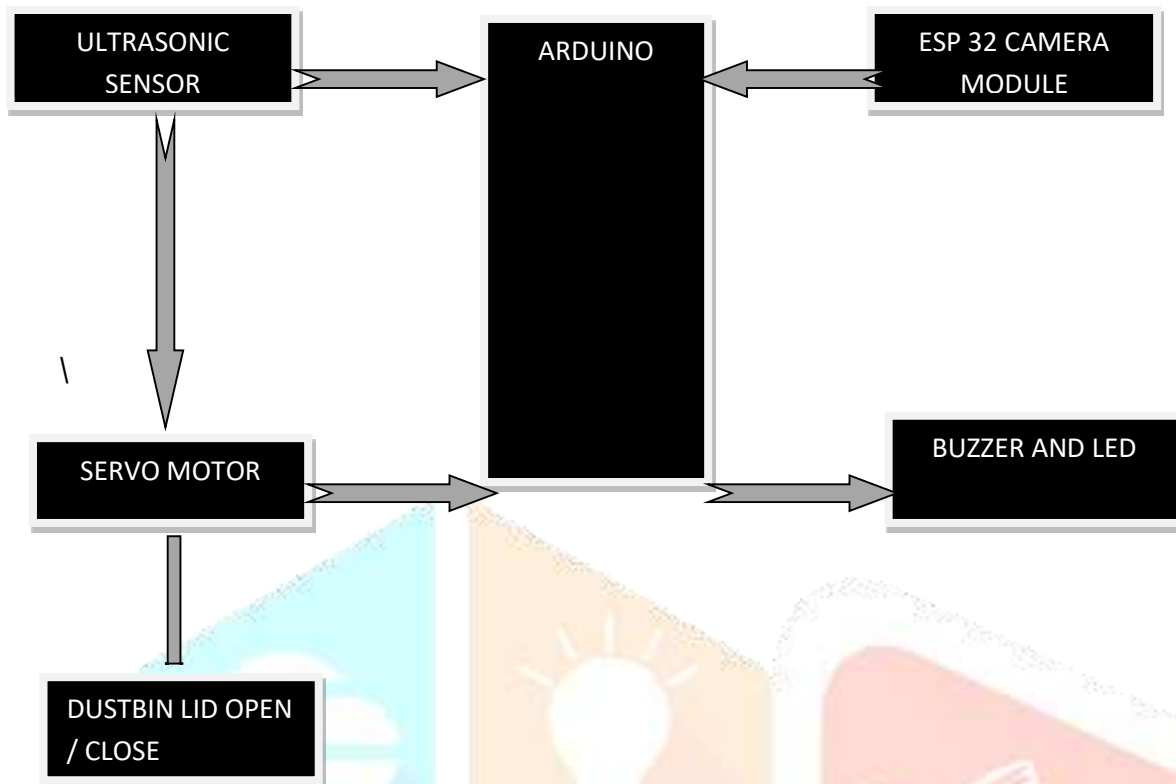
**NewPing Library for ultrasonic sensor :-** The NewPing library is specifically designed to facilitate the use of ultrasonic sensors, such as the HC-SR04, with Arduino. It simplifies the process of measuring distances by handling the sensor's timing and data processing, allowing for more straightforward and accurate distance measurements.

**Arduino IDE :-** This is an integrated development environment that facilitates the communication between components via an algorithm. In this project, the software is used to design the circuit diagram for automatic dustbin system.

## VI.PROPOSED METHOD

This paper focuses on presenting our suggested approach, which aims to intelligently separate hospital trash. The two sensors utilized here are an ESP 32 camera module and an ultrasound sensor, which are used to detect the presence of a person in front of the trash can and take a picture of the waste that has to be tossed inside. When an individual approaches the designated distance, an ultrasonic sensor detects their presence and relays this information to the Arduino, which then triggers the servo motor to open the lid. To take the pictures, an ESP 32 camera module is employed. The photos are taken with the ESP 32 camera module. When the trashcan lid is opened, a camera module mounted there detects the kind of waste and sends data to an Arduino board. When the dustbin is matched to the bin, the Arduino recognizes the image and proceeds with no further action. If not, it emits a buzzer sound or blinks an LED. By the way, one technique is used to accomplish both operations. The primary method of this smart bin's autonomous garbage sorting while it places itself is the sensing approach. This form of trashcan prevents the transmission of life-threatening infections by allowing machines to handle them rather than people.

## VII. BLOCK DIAGRAM



## VIII. METHODOLOGY

### 8.1 MOUNTING THE ULTRASONIC SENSOR

Attach the ultrasonic sensor to the top edge of the dustbin so it can detect approaching fast.

### 8.2 INSTALLING THE SERVO MOTOR

Secure the servo motor to the lid of the dustbin , ensuring it can move the lid without obstruction.

### 8.3 WIRING COMPONENTS

Connect the ultrasonic sensor , servo motor ,and ESP 32 module to the arduino or directly to the ESP 32 if it is main controller. Then ensure the proper power supply and grounding for all components.

### 8.4 PROGRAMMING THE ARDUINO

Initializing the pins for the ultrasonic sensor and the servo motor, write a function to measure the distance using ultrasonic sensor. Writing a function to control the servo motor to open and close the lid based on the distance measured .Implementing the loop to continuously check the distance and trigger the servo motor when an object is detected within a specified range.

### 8.5 UPLOADING THE CODE

Using the arduino IDE to upload the code to the Arduino board. By monitoring the serial output to verify that the sensor readings and motor actions are correct.

## 8.6 IMPLEMENTING DATA TRANSMISSION

Writing the code on ESP 32 to receive data from the arduino . Verifying the ESP 32 connections with the Wi-Fi and with arduino. Ensured that the data is sent and received properly, and displayed on the monitoring platform.

## 8.7 ASSEMBLING THE SMART DUSTBIN

Carefully integrating all components into the dustbin,ensuring all connections are properly housed.

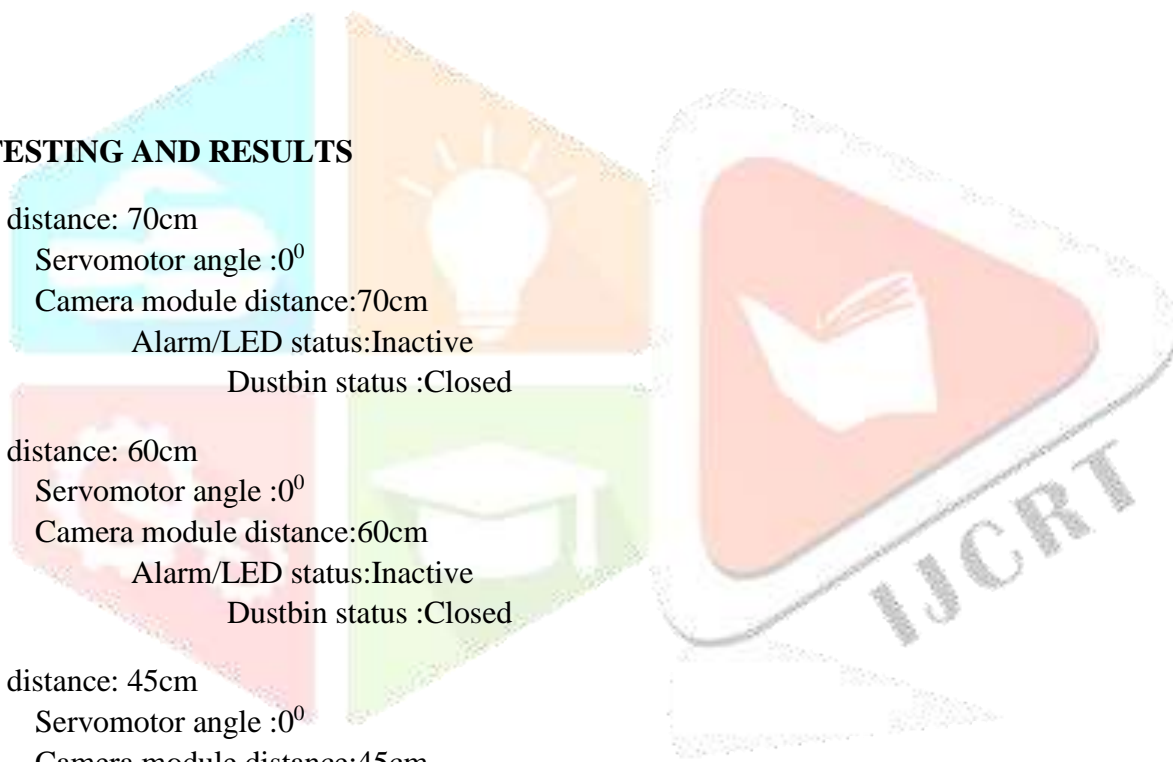
## 8.8 FINAL TESTING

Perform a final round of testing to ensure all the features are working properly. Test the system under different conditions to ensure reliability.

By following the detailed descriptive methodology , the smart dustbin will be successfully created. This smart dustbin not only opens the lid automatically when someone approaches but also has the potential for wireless status monitoring.

## IX.TESTING AND RESULTS

1. User distance: 70cm  
 Servomotor angle :0<sup>0</sup>  
 Camera module distance:70cm  
 Alarm/LED status:Inactive  
 Dustbin status :Closed
2. User distance: 60cm  
 Servomotor angle :0<sup>0</sup>  
 Camera module distance:60cm  
 Alarm/LED status:Inactive  
 Dustbin status :Closed
3. User distance: 45cm  
 Servomotor angle :0<sup>0</sup>  
 Camera module distance:45cm  
 Alarm/LED status:Inactive  
 Dustbin status :Closed
4. User distance: 30cm  
 Servomotor angle :180<sup>0</sup>  
 Camera module distance:30cm  
 Alarm/LED status:Inactive  
 Dustbin status :Open



5. User distance: 18cm  
     Servomotor angle :180<sup>0</sup>  
     Camera module distance:18cm  
     Alarm/LED status:Inactive  
     Dustbin status :Open
  
6. User distance: 12cm  
     Servomotor angle :180<sup>0</sup>  
     Camera module distance:12cm  
  
     Alarm/LED status:Inactive  
  
     Dustbin status :Open



## X.RESULTS AND DISCUSSION

User distances of 70 cm, 60 cm, and 45 cm were examined based on the aforementioned testing. In order to take pictures and categorize the different kinds of waste, the ESP 32 camera module is also installed inside. The servo motor shaft stays in its original position, which is a closed trashcan, when the user is outside the ultrasonic sensor's range of information to the microcontroller. In these circumstances, the LED and alarm were also inactive. On the other hand, the ultrasonic sensor recognizes a user and transmits a signal to the microcontroller when the person remains 30 cm away from the dustbin. 180<sup>0</sup> is moved by the servo motor's shaft, opening the dustbin's lid. Until the user leaves the designated area. The trashcan stays open until the user leaves the designated range. The ESP 32 camera module and user distances of 18 and 12 cm produced the same outcomes. In the conducted tests, it takes the ultrasonic sensor one second to correctly process a user's presence before moving on to the next activity. This was done to make sure that a foreign object wouldn't trick the front sensor into thinking the user was there. When a person leaves the range, there is also a 1-second lag before the dustbin's lid shuts.

## XI.CONCLUSION

Maintaining a clean environment and limiting the spread of diseases are made possible by effective waste management. An appropriate management of garbage is guaranteed by a smart waste disposal system, which offers a new paradigm suitable to smart cities. A smart trash can was designed for this project. To detect user distance and garbage levels within the bin, this dustbin employs ultrasonic sensors. The bin can be opened and closed using a servo motor. The mechanism is built to keep people from accessing the dustbin while it is full by staying closed and sounding an alert to them. Thus, this technology lessens environmental pollution and enhances personal hygiene. As trash production increases daily, the manual process of waste management monitoring is currently carried out, which poses difficulties and takes a considerable amount of time. Manual trash management exposes workers to infectious diseases such as viruses and bacteria. While digital waste management is not a novel idea, its potential to track the entire waste management process and offer precise waste situation insights has not yet been completely realized. For example, while information regarding the production and application of a facial mask box is easily accessible, it is essential to comprehend the disposal procedure and the appropriate way to dispose of masks. Regulation adherence can be guaranteed by digitizing waste management monitoring protocols. In summary, the Advanced hospital

waste disposal system maintains cleanliness in the surrounding area and increases the efficiency of garbage collection.

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