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Railway Waste Management

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Abstract: ***A smart waste management system is of great necessity looking at the current increase in waste produced every year. This is a very unorganized sector where no such precautions are taken for proper waste disposal. Railways face difficulty in managing the waste produced inside the coaches. In order to help the government and protect nature from corrosive non-biodegradable waste this waste management system was designed. In this project Arduino UNO was the main processor used along with sensors like inductive proximity sensor and soil moisture sensor. The main principle of the project was based on the information processed by the sensors and effective segregation of the waste individual bins to store the waste produced. A main support is placed which helps in holding the complete structure together.***

Keywords: Waste Segregator for Railways, Arduino UNO, Moisture Sensor, Stepper Motor, Inductive Sensor

I. INTRODUCTION

LOOKING at the current statistical data, about 299 grams of waste is produced by each passenger travelling for each mile travelled. This is the main reason for a proper waste management system for railways. The recent addition of adding tanks for human waste disposal in railways has changed a lot. Since then, there has been a need of such management of other wastes too. Old-fashioned dustbins did not serve the purpose of proper disposal. A lot of human scavenging was performed for segregation of the waste and for further processing for recycling and dumping of the waste generated. The main purpose of this project is to serve the railway as a waste management system along with a large-scale application of reducing human scavenging which is hazardous to humans.

II. METHODOLOGY

A. Materials and Components

Plastic bins are used after fabricating according to the required measurements.

A wooden rod is used to support the entire system and to hold the main dustbin which holds the waste at the beginning. The initial bin has all the sensors including inductive proximity sensor and soil moisture sensor. Metal plates are used as lids for allowing the waste to fall freely in the bins placed below where the waste is separately stored until disposed.

B. Connections

1) The brain of a waste management system made up of numerous parts is the Arduino Uno board as shown in Fig. 1.
2) For operating the waste compartment door, the system contains a Servo motor (flap) connected to pin 5 on the Arduino.
3) For measuring the distance to find waste in the bin, the ultrasonic sensor module is linked to pins 7 (trigPin) and pin 6 (echoPin).
4) The Moisture Sensor is plugged into analogue input A0 to gauge the waste's moisture content.
5) To find metallic waste, the inductive sensor is attached to digital pin 4.
6) For the purpose of producing aural notifications when specific waste kinds are recognized, the Piezo Buzzer is attached to pin 12.

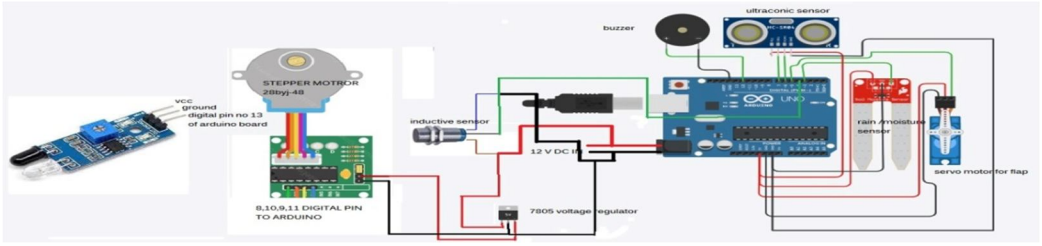


Fig. 1 Circuit diagram

7) In order to manage the stepper motor in charge of waste segregation, the system also includes an AccelStepper motor driver library.
8) The four stepper motor control pins (8, 10, 9, and 11) are connected to the corresponding Arduino Uno pins. The connections are made in accordance with the pin configurations described in the code.
9) Overall, these connections provide the Arduino Uno the ability to keep track of the waste bin's contents, determine the type of garbage, and independently manage waste segregation and disposal depending on the predetermined conditions and actions set in the code.

C. Algorithm

Below is the Algorithm for the code used:

1) Include necessary libraries

- The code includes the libraries "Servo.h" for controlling the servo motor and "AccelStepper.h" for controlling the stepper motor.

2) Define pin connections and variables

- Define pin connections for Moisture, Ultrasonic, Inductive Proximity sensors, Buzzer, Servo and Stepper Motors.
- Initialize variables for storing sensor readings and controlling the system.

3) Setup function

- Initialize serial communication for debugging purposes.
- Set pin modes for the sensors, actuators, and motors.
- Configure the AccelStepper library for the stepper motor, setting its maximum speed, acceleration, and initial position.
- Move the stepper motor to a specific position (i-2) and set its current position to 0.

4) Loop function:

- Rotate the servo motor to an angle (120 degrees) for closing the flap.
- Measure the distance using the ultrasonic sensor (HC-SR04) to detect an object's presence in front of the waste bin.
- Read the moisture level from the moisture sensor (analog input).
- Read the inductive sensor (metallic waste detector) to identify metallic waste.
- Map the moisture sensor's analog reading to a range of 0-100 for better readability and comparison.

5) Waste Segregation Logic:

- If metallic waste is detected (inductive sensor HIGH), perform the following actions:
  - Sound the buzzer twice.
  - Move the stepper motor to a position (75 steps) to open the flap.
  - Delay for 2 seconds to allow time for the waste to fall.
  - Close the flap.
  - Move the stepper motor back to the initial position (0 steps)

- If the moisture level is greater than 90 (indicating wet waste), perform the following actions:
  - Sound the buzzer thrice.
  - Open the flap to allow the wet waste to fall.
  - Delay for 1.5 seconds.
  - Close the flap partially (at an angle of 120 degrees).

- If the distance measured by the ultrasonic sensor is less than 6 cm (indicating dry waste), perform the following actions:
  - Sound the buzzer once.
  - Move the stepper motor to a position (-75 steps) to open the flap.
  - Delay for 1.5 seconds to allow time for the waste to fall.

- Close the flap.
- Move the stepper motor back to the initial position (0 steps).

- If none of the above conditions are met, it indicates no waste:
- Print "No Waste" to the serial monitor.
- Move the stepper motor to the initial position (0 steps).

6) Delay

- Introduce a delay of 1 second before restarting the loop to avoid rapid iterations.

III. RESULTS AND DISCUSSIONS

With the final prototype and its application now, the waste can be stored and separated using this project. Metal scraps can be stored individually to avoid it going into the soil. Plastic waste can be stored for recycling purposes, waste containing moisture can be stored to process and dispose of them accordingly. This helps in reducing the human power used to do this task in real life and provides a smooth interaction for the workers to increase the efficiency of the job and to speed up the processing of the waste generated.

IV. FUTURE SCOPE

More features like proper lids for the main bin can be added. Automatic tying of the garbage bags can be implemented to remove more of human work. Motion sensors can be added to the lid so that it opens when a hand is placed over it to put waste.

V. CONCLUSION

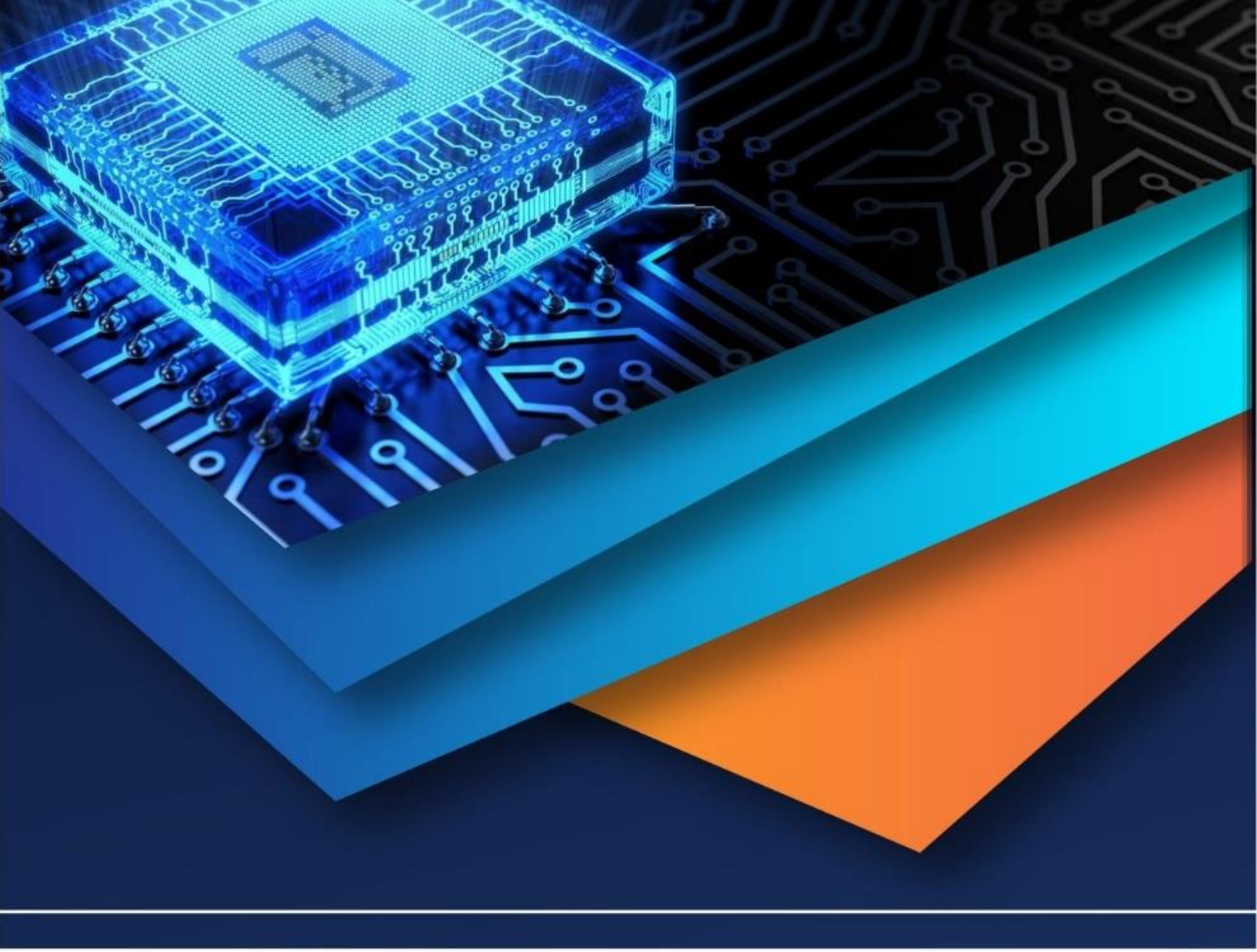
Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

VI. ACKNOWLEDGMENT

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