Waste Segregation and Management System for Railways

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Abstract : *In Indian Railways one of the biggest worries is the amount of waste generated each day by train passengers . This waste is spread across the country, polluting land and soil and contaminating the water bodies. As of now, there is no comprehensive system to collect and manage this enormous amount of waste. This paper provides a solution to the above stated problem by collecting the waste generated via a **waste collection robot** and segregating it using **conveyor arrangement** . The waste collection robot is provided in the rail coaches. When a passenger wants to throw the waste he can just press the switch provided nearby him. The waste collection robot will go to that particular bay and will collect the waste and throw in the waste collecting tank provided in each rail coach .This waste is moved on a conveyor belt which is provided in the railway stations and using different capacitive proximity ,inductive proximity and photoelectric sensor waste is segregated, crushed and collected in different bins according to the nature of the waste as metal, paper, glass and plastic. The entire system is controlled and monitored by Programmable Logic Controller(PLC).*
Keywords : *PLC, GSM, Capacitive Proximity sensor, Inductive Proximity sensor, waste collection robot*


I.   INTRODUCTION

The quantity of plastic and paper waste generated daily by the railways is vast. Improper waste disposal creates many ecological and social problems. The dumping of solid wastes is hazardous to human health. It has been estimated that about twenty-five human diseases are associated with solid waste. It also has serious environmental impacts such as Degradation of Land, Pollution of drinking water, Destruction of aquatic life and contamination of ground water. **ENVIRONMENTAL PROTECTION, WASTE COLLECTION BY ROBOT** and **WASTE SEGREGATION** are the main motto of the paper.

II.   BLOCK DIAGRAM
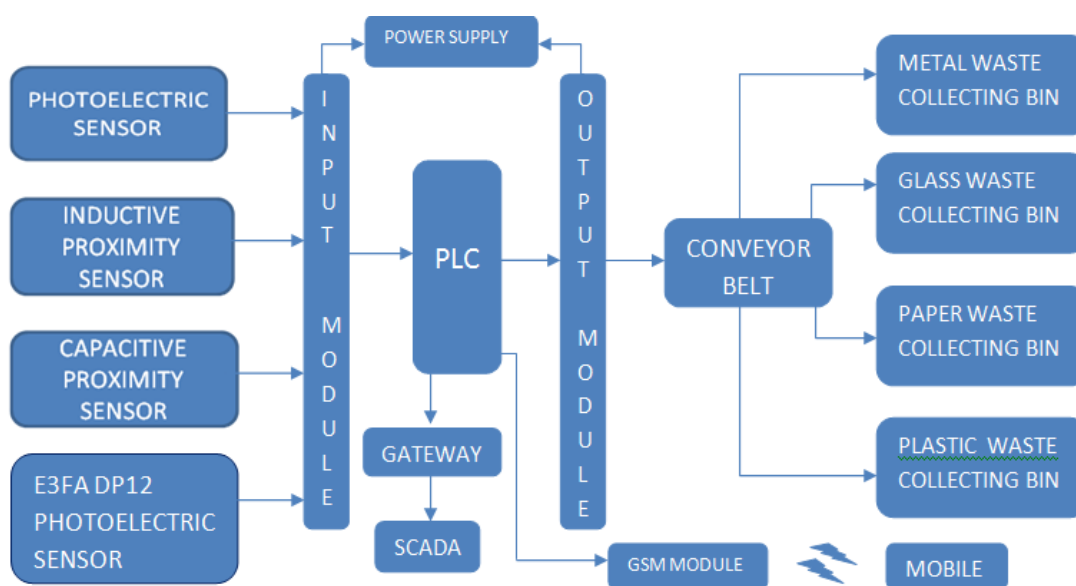
III. BLOCK DIAGRAM DESCRIPTION

The Block diagram stated above consists of the following blocks:
- Input Module
- PLC
- Output Module
- SCADA
- GSM Module

1) Input Module: The input module consists of four sensors which are interfaced with PLC for detecting different kinds of waste such as metal, paper, glass and plastic . The purpose of the sensors used is the input module is as follows:

- **Photoelectric Sensor:**
    This sensor detects all kinds of input which is placed in front of it. It is used to just start the conveyor only when the presence of the waste is detected and the material would be moved further by the conveyor for segregation. If the presence of the material is not detected the conveyor will not be started. It prevents wastage of power which is caused by running the conveyor all the time even without any input .

- **Inductive Proximity Sensor:**
    Inductive type Proximity sensors are used for detecting metallic waste. Metallic waste such as juice can be segregated from the waste , crushed and then stored in metal waste collecting bin by using this sensor. Metallic waste is crushed to reduce the space occupied by the juice can in the collecting bin.
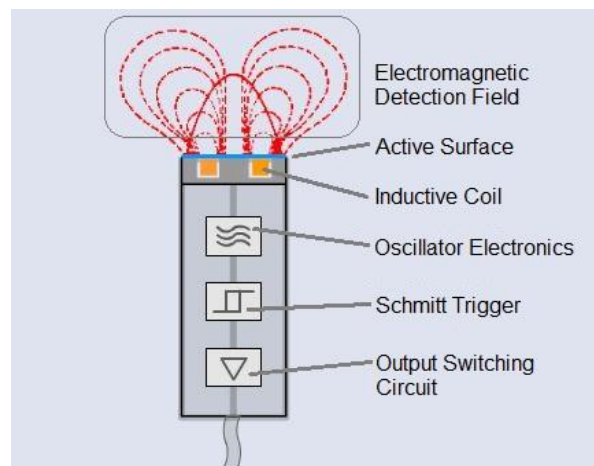
The operating principle is based on a coil and oscillator that creates an electromagnetic field in the close surroundings of the sensing surface. The presence of a metallic object in the operating area causes a dampening of the oscillation amplitude. The rise or fall of such oscillation is identified by a threshold circuit that changes the output of the sensor. The operating distance of the sensor depends on the metallic object shape and size.

- **Capacitive Proximity Sensor:**
    Capacitive Proximity sensor is used for detecting both metallic and non metallic objects such as metal can, glass , paper, wood etc. In this paper it detects glass and paper and they are segregated and collected in collecting bins. Unlike inductive sensors which use induced magnetic fields to sense objects, capacitive proximity generate an electrostatic field and reacts to changes in capacitance caused when a target enters the electrostatic field. When the object is at a preset distance from the sensitive side of the sensor, an electronic circuit inside the sensor begins to oscillate. The rise or the fall of such oscillation is identified by a threshold circuit
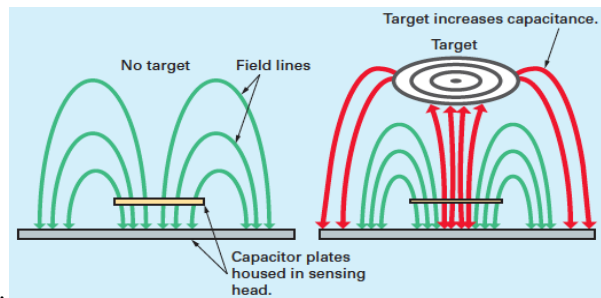
- **E3FA DP-12 Photoelectric Sensor:**

This is a type of Photoelectric Sensor with Built-in Amplifier for Detecting Clear, Plastic Bottles. Reliable Detection of Transparent Objects, Including Thin-walled Clear, Plastic Bottles from 500-ml bottles to 2-l bottles.

2)PLC: To implement the proposed segregation process , PLC is used . PLC stands for Programmable Logic Controller which receives information from connected sensors or input devices, processes the data, and triggers outputs based on pre-programmed parameters. A supervisory control and data acquisition (SCADA) server or gateway allows to remotely monitor and control the main apparatus and machines used in waste collection and management process.

3)OUTPUT MODULE: The output module consists of various waste collecting bins such as metal, paper, plastic and glass which are attached to the conveyor. In this the metal and plastic waste are alone crushed after segregation to reduce the volume occupied by them in the bin.

4)SCADA: A supervisory control and data acquisition (SCADA) server or gateway allows to remotely monitor and control the main apparatus and machines used in waste collection and management process. Supervisory control and data acquisition (SCADA) is a system of software and hardware elements that performs the following activities :

- Controls segregation processes locally or at remote locations

- Monitor, gather, and process real-time data

- Directly interact with input devices such as inductive proximity sensor, capacitive proximity sensor, photoelectric sensor and output devices such as waste collecting bins.

SCADA systems are crucial since they help to maintain efficiency, process data for smarter decisions, and communicate system issues to help mitigate downtime.

5)GSM MODULE: When the waste collecting tank system provided in the rail coaches are full a LED light provided in the tank starts blinking and a message is sent to the nearby railway junction station master using this GSM Module. When the message is received, the collecting system is cleaned by the waste collectors. This avoids wastage of time by cleaning the non filled collecting system.

IV.   Flow Chart

a)Waste collection at subsequent rail coaches using waste collection robot

```
                          ┌─────────────┐
                          │    START    │
                          └─────────────┘
                                 │
          ┌──────────────────────────────────────────────┐
          │  WHEN PASSENGER WANTS TO THROW THE WASTE HE   │
          │          PRESS THE SWITCH NEAR HIM           │
          └──────────────────────────────────────────────┘
                                 │
          ┌──────────────────────────────────────────────┐
          │  A WASTE COLLECTING ROBOT COMES TO THAT BAY   │
          │          AND COLLECTS THE WASTE              │
          └──────────────────────────────────────────────┘
                                 │
          ┌──────────────────────────────────────────────┐
   ┌─────▶│  ROBOT THROWS THE WASTE INTO WASTE COLLECTING │
   │      │  TANK                                        │
   │      └──────────────────────────────────────────────┘
   │                             │
   │              NO         ◇ COLLECTING ◇
   └─────────────────────────◇ TANK FULL? ◇
                             ◇           ◇
                                 │ YES
                          ┌─────────────┐
                          │ LED LIGHT ON│
                          └─────────────┘
                                 │
          ┌──────────────────────────────────────────────┐
          │  MESSAGE IS SENT TO STATION MASTER BY GSM AND │
          │          TANK IS CLEANED                     │
          └──────────────────────────────────────────────┘
                                 │
                          ┌─────────────┐
                          │    STOP     │
                          └─────────────┘
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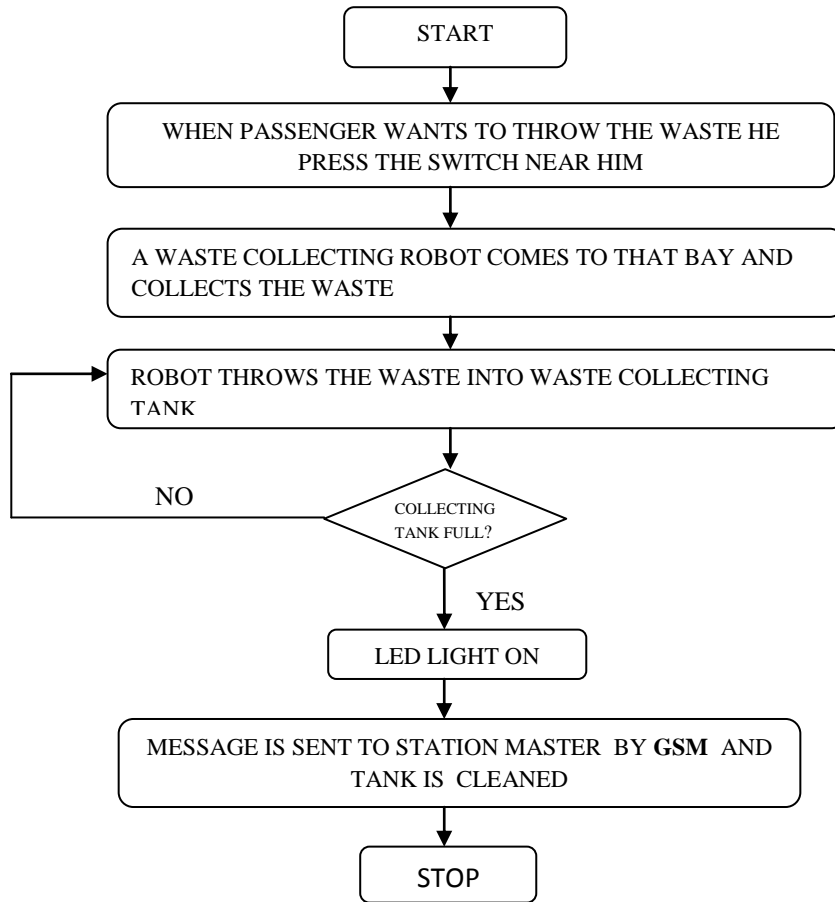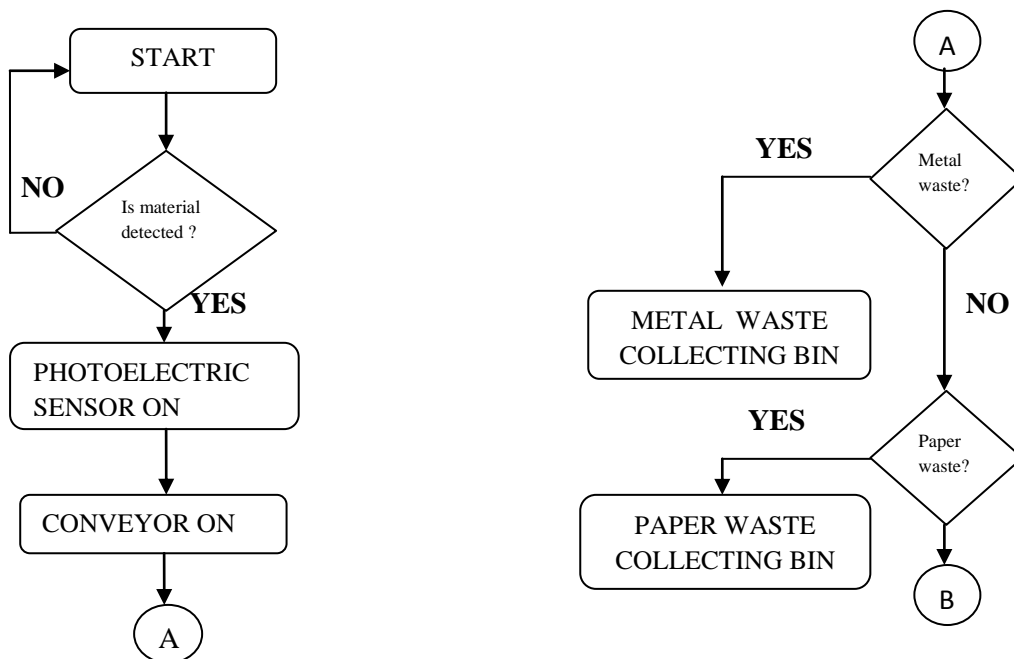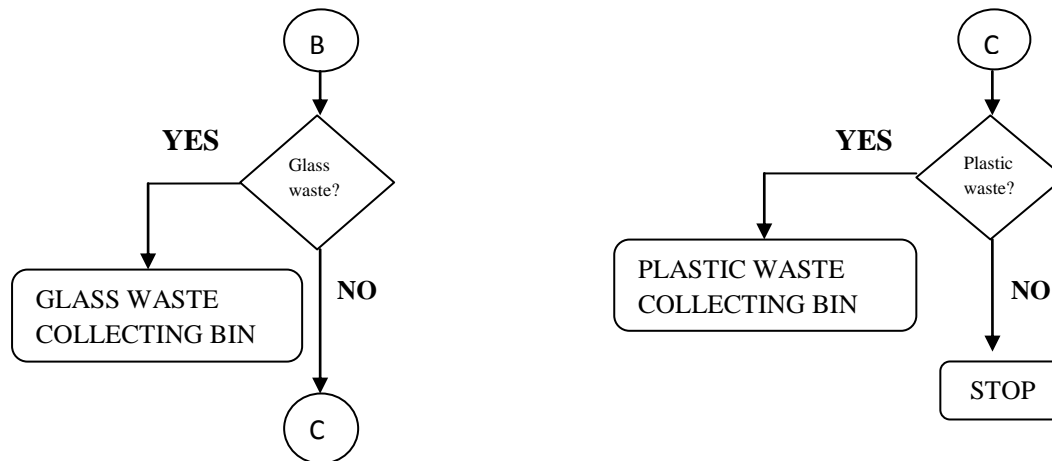
b) Waste Segregation by Conveyor at subsequent railway stations

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        ┌─────────────┐                                    ( A )
   ┌───▶│    START    │                                      │
   │    └─────────────┘                          YES      ◇ Metal ◇
   │           │                           ┌─────────────◇ waste? ◇
   │      ◇ Is material ◇                  │              ◇       ◇
NO └──────◇ detected ?  ◇                  ▼                  │ NO
          ◇            ◇          ┌─────────────────┐         ▼
                │ YES            │  METAL WASTE     │    ◇ Paper ◇
     ┌──────────────────┐        │ COLLECTING BIN   │    ◇ waste? ◇
     │  PHOTOELECTRIC    │        └─────────────────┘    ◇        ◇
     │  SENSOR ON        │              YES    ┌──────────────┤
     └──────────────────┘               ┌──────▼───────┐      │
                │                        │ PAPER WASTE  │      ▼
     ┌──────────────────┐                │ COLLECTING   │    ( B )
     │  CONVEYOR ON      │                │ BIN          │
     └──────────────────┘                └──────────────┘
                │
              ( A )
```

V. CONCLUSION

This paper presents an efficient and cost effective way for collecting the waste using a waste collecting robot and segregating the waste as metal, paper, glass and plastic. It helps in reducing the environmental pollution caused due to the improper disposal of waste and protect the humans and other living beings from getting affected . This system can also be implemented in municipal corporations for segregating the waste by reducing the increasing hazards of waste accumulation.

ACKNOWLEDGEMENT

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