

AUTONOMOUS TRASH CLEANING BOT IN RAILWAY LINES

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Abstract: Railways network in India is the largest transportation facility, daily millions of people use them because of their less expensive operation. Besides its advantages, there are a few disadvantages such as the disposal of litter on track. Litter disposal has emerged as a challenging task for the railway department, especially for the sanitary workers of the railway department. In many areas, track cleaning is done manually with zero or less precautionary measures. The process of litter management, from the process of collection to dumping, has become one of the toughest and most time-consuming tasks for sanitary or cleaning workers. The concept of an autonomous trash cleaning bot is a level up from standard garbage collection methods. This cost-effective device replaces manual litter collection. In this project, the proposed concept of an automated railway lane cleansing machine contains an autonomous bot with four major components Trash management unit, a control unit, a motor unit, and a power supply. The trash collecting unit is made up of three sub- units collection storage and disposal in which the collection sub-unit is equipped with two rotating brushes which intake the trash and send it to the storage sub-unit and the storage sub-unit also acts as a disposal unit that can be lifted using a spur gear and stopped at a certain point using stop switch and the trash can be disposed of using another standard trash collection vehicle outside the track. This bot makes the trash collection process even simpler because of its small size, easy operation methods, and can easily be lifted on and off the track using a manual stacker.

Keywords: Autonomous Trash Cleaning Bot, Standard Garbage Collection Methods, Manual Stacker.

1. INTRODUCTION

Railway is the biggest and most widely used modes of transportation by many persons for their easy day-to-day traveling. It covers most parts of our country. It is considered as one of the profit money-making systems in our country. When it comes to cleaning tracks, the railway department has lost its terms and conditions to follow the rules. It has turned into a place of litter disposal in tracks. Litters are thrown by people on the tracks and unclean compartments and sealed meals from the stores are some examples of the poor cleaning and sanitizing unit in railways. Poor cleaning unit in railways is the reason for creating many health problems. Problems are created by small micro-organisms that are developed from litter disposal on the track. Since the disposal of litter on the track, it becomes a social cause since every people are affected by it, who are waiting in the stations for the train arrival. Since it is a human issue, it needs to be cleaned by the social workers. Manual litter cleaning came to act that they should clean the litter in tracks to avoid health problems. But they are facing many health problems while picking that litter from the tracks. So to avoid that manual litter cleaning and health problem issues we are designing an autonomous bot that does the work of members who are working on the track. In the initiative of cleaning litters in tracks, our autonomous bot will do the collection of litter by moving on the track and filling it in a storage unit. It will be running on a four-wheel bot. When the storage unit is filled it will be dispatched to the bin placed outside by the person. This has been built to reduce manual litter cleaning and collection of litter efficiently without the spread of diseases.

2. EXPERIMENTAL METHODS OR METHODOLOGY

The methodology used is divided into the steps on how the bot works on the railway tracks.

It uses Arduino-UNO microcontroller which is connected to a 12v battery and a 5 relay is connected to the other end of the arduino. It control the on and off operation of the dc motor used in the bot. The bot is divided into three sections. The three sections are as follows:

- Feeder Section
- Storage Section
- Discharge Section

When the bot is placed in a track and when the power supply is activated the controller makes the feeder unit motor to start its work. The feeder unit collects the plastic litters thrown on the track and send it to the storage unit. The storage unit collects the trash and store it on the storage bag with a basic capacity of about 6kg. A person will be monitoring the bot by standing outside the track. When the storage unit is filled the trash will be discharged in the container placed

outside the track using a conveyor belt placed in the container. With the help of monitoring person the trash will be discharged. Again the bot will be placed in the track and starts its work. The location of the train is identified using the gps location of the train, when the train approaches the monitoring person will take the bot outside the track using a manual hand stacker.

3. DESIGN AND BLOCK DIAGRAM

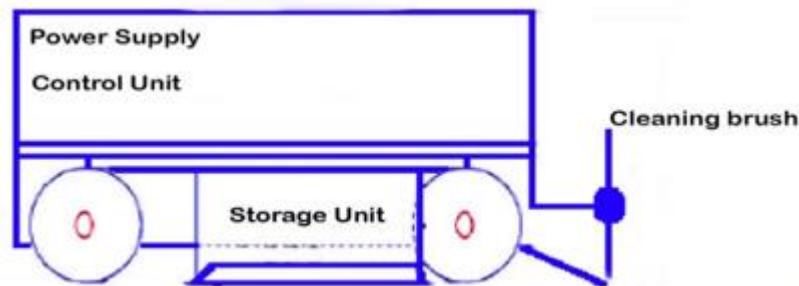


Figure 1: Structure of our proposed bot.

This is the design for the proposed autonomous trash cleaning bot. It consists of 3 units such as feeder unit, storage unit, and litter discharge unit. The litter will be collected using a feeder unit and it will be stored in a storage unit. When the storage unit is full it will be discharged outside using the discharge unit.

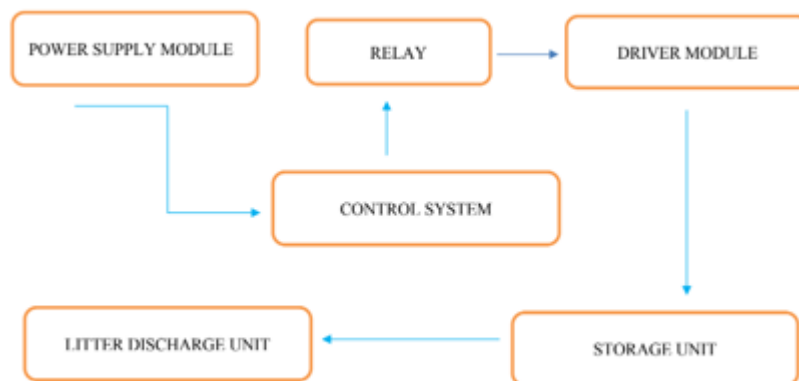


Figure 2: Block Diagram

The 5v battery is used to charge up the Arduino Uno micro-controller. The controller is the main part of the bot. It contains the Arduino code that the bot needs to operate. The Arduino microcontroller is connected to a relay. It controls the movement of the motor. There are three motors present in the bot. It is used to control the movement of the bot in a forward, reverse direction. When the motor starts rotating the brush in the bot is starts collecting the litter and the little will be stored in a storage unit. The storage unit with the help of another motor displaces the litter outside the track with the help of a conveyor belt to the bin.

4. NOVELTY OF THE PROJECT

Employing Autonomous trash cleaning bot to clean railway lines enhances waste management in railway department, by automating the process we can achieve rapid and enhanced result than we get in manual methods. Size of the bot is smaller(3.50 m*5 m) compared with it's counter ones, since the bot is portable no need of stopping train service on the particular track cleaning process was going-on we can easily relieve the bot from the track in the arrival time of the train us a stacker or ramp mechanism.

5. METHODOLOGY

The basic methodology or working of the bot is that the bot can be placed on the track using a manual stacker. While the bot is moving on the track it intakes the trash into the storage unit via a rotating cleaning unit attached to the front of the bot and discharges trash which is previously collected and stored in the storage unit when filled will be dumped into

another vehicle outside the track in which a conveyor belt system is equipped which will be doing the rest of the work by carrying the litter to the dumping yard to do further processing. If the cleaning work is done the bot can be relieved from the track using a manual stacker. A person will be monitoring the bot while the process is going on. If the train approaches the person relieves the robot from the track using the manual hand stacker.

6. FEASIBILITY OF THE PROJECT

The Total Cost of the prototype is around 15000 and for the product around 70,000. The bot is made on the size of the normal railway track and which is of light weight. Railway Tracks which implements this product will reduce working of scavengers in railway track and helps in fast collection of litters. It helps in reducing the spread of disease during the collection of litters. Easy ways of collection and discharging in the tracks.

7. PROPOSED ALGORITHM

- The Project contains three main units waste management unit which is of two sub-units cleaning; storage cum disposal, control unit, and power supply.
- The Power supply is given through a 1.3 amps battery, the Arduino gets activated and starts running the programs that we have coded and stored in it already.
- There are five relays connected throughout the circuit and it acts as a switch for the control of specific operations at a specific time by the motors such as front and back movement of the bot, storage and cleaning unit movement.
- First the Arduino send signal to the relay R1 which is connected with the cleaning sub-unit and turns it on and the motor M1 connected with the cleaning unit the brushes in front of the bot start rotating and starts to collect the litter and pushing the trash into the storage unit and the bots movement is enabled by the signal send by the Arduino to the motor.
- M2 via relays R21 and R22 in which relay R21 is responsible for the forward movement and relay R22 is responsible for the reverse movement of the bot when filled Arduino sends a signal to the vertical movement motor M3 via the relays R31 and R32 in which R31 is responsible for lifting up the storage sub-unit and the litter collected in the storage sub-unit.
- This will later be dumped into another vehicle outside the track in which a conveyor belt system is equipped and will be stopped at a certain point using limit switch L1 and R32 is responsible for the storage sub-unit to revert back to its original position.
- Again the movement of the motor will be stopped when the storage sub-unit limit reaches by the Limit switch L2. The process continues to repeat until the particular railway track is cleaned.
- After completing all the processes it can be taken out of the track in the same way it is put on the track previously manually by a monitoring person using a manual hand stacker.

8. RESULTS AND DISCUSSION

The proposed project's circuit connections are configured, compiled to get the appropriate result as expected and ensured the forwarded movement of the cleaning unit motor, forward and reverse the autonomous state of the bot. In addition to that, vertical forward and backward movement of the storage unit is deployed.

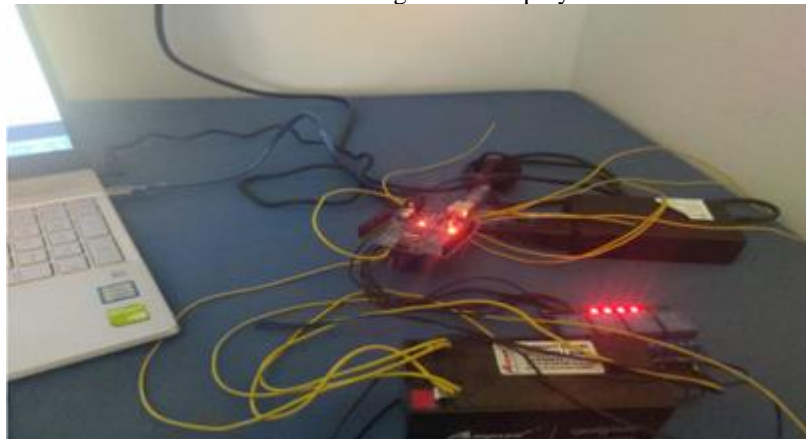


Figure 3: Experimental setup of arduino based bot in the working condition.



Figure 4: Definitive model of the proposed Bot.

9. CONCLUSION

A fully automated collection and disposal of garbage present in the railway tracks using the bot is developed and experimented in this project. It is carried out with various components such as Arduino, DC motor, Relay, Limit Switch, Battery. The results are extracted with the use of Arduino IDE. The advantage of this proposed project helps to reduce the manual litter cleaning in railway tracks. In this way, the disease spread caused during the collection of litter manually is getting reduced.

The advantageous factors are as follows:

- i) It is only limited to carrying some amount of garbage at a particular time.
- ii) It will automatically dispose of the litter once the container is full.

The Constraints are:

- i) If the control unit is damaged then the whole device will get damaged.
- ii) Need one person to monitor the bot throughout the process.

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