MODELLING OF AUTOMATIC RAILWAY TRACK CLEANING ROBOT

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Introduction:

Indian Railways is one of the world's largest railway networks. The railways cover the entire length and breadth of the country. It has a total track length of 1,15,000 km and 7235 stations along the way. Indian Railways is also the country's largest employer. It has emerged as one of the nation's fastest-growing and most profitable organizations. However, sadly enough, it has been years since the railroads achieved complete sanitation. Open defecation through railways, unclean toilets, choked basins, and littered bogeys and tracks are the causes of the present poor sanitary condition of India's railways. The permanent toilets in train coaches are small compartments with holes through which human waste is disposed of openly on tracks.

Dumping the human excreta containing various harmful and deadly disease-causing microorganisms into the open tracks and there by contaminating country-wide rivers, streams, etc.

Background:

Here we refer to P. Vamsi Krishna and Dr. S. Prakash [1]. Indian Railways may be the country's largest mobile source of environmental pollution. Indian Railways is perhaps becoming the biggest mobile source of environmental pollution in the country. And of course, this kind of round-the-clockdisposal of vast quantity of human waste in open environments to keep the trains clean is not at all healthy and advisable. The garbage from pantry cars and tray loads of hot meals on station and in train are also thrown off through the doors and windows of bogeys onto the tracks polluting the stations and places all along the train's way.

The existing cleaningprocess of the tracks and the railway platforms is manual, which is tedious and far from the desired level of sanitation or cleanliness. Manual scavenging deals with maintenance of hygienic conditions through services such as collection and disposal of solid and liquid waste using basic tools like thin boards and buckets or baskets lined with sacking and carried on the head. By virtue of the job, many of the workers develop serious health problems in course of time. The health hazards include exposure to harmful gases such as methane and hydrogen sulphide, cardiovascular degeneration, musculoskeletal disorders, infections, respiratory system failure, etc

Objectives:

Implementation of existing machine in both major and minor station is not possible because it requires more installation, maintenance cost and skilled/trained person. So that we replace these problem by our automated robotic machine in that main goal of our project is to replace human labour with excellent precision machines and also the time required for the process is same for both manual and machine processes, if we use a machine instead of a person, that person can do another job during that time. Additionally, the employee's efforts will be reduced.

- The main objective of the project is to design an automated robot for cleaning the railway track.
- The purpose of this project is to design and implement an autonomous robot for cleaning the rail road tracks with intelligent control.
- To reach our machine at both major and minor railway stations in our country.
- To overcome the disadvantages of current existing system/machine.

Methodology:

The figure 1 represents that the general block diagram of the proposed railway track cleaning system. The railway track cleaning robot has four systems for the cleaning process. The wheels on the robot are powered by a dc motor. The robot uses sensors that are linked to railway tracks for train sensing. By referring to Jesin James, Jesse Wilson, JovnaJetto, Alna Thomas, and Dhahabiya V. K. [3], the initial movement of the robot includes getting alignment over the tracks when there is no train and moving forward. These movements are done by a preprogrammed algorithm in the microcontroller. The remaining movements are done with the help of application installed in smart phone.

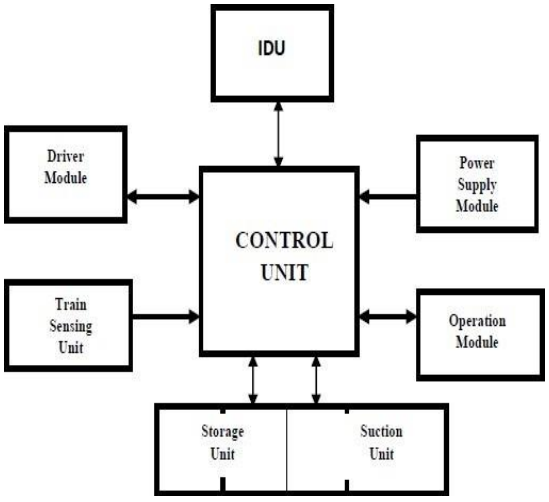


Figure 1: General Block Diagram of the Proposed System.

The following are the main systems in the track cleaning robot:

1. Movement controlling through wireless connection and sequence of operation
2. Cleaning systems, caution alarms to the operator.
3. Power supply, charging and sensing to default problems.

The figure 2 shows that design of robot includes separate controlling and driving element for the purpose of cleaning with complete control in forward direction. The railway cleaning robot proposed consists of a sweeping mechanism, retractable wheels, chlorination unit, and a scissor lift mechanism. The robot which runs on the track via its retractable wheels collects wastes lying within the track using a roller brush while the chlorination unit pours disinfectant onto the swept path.

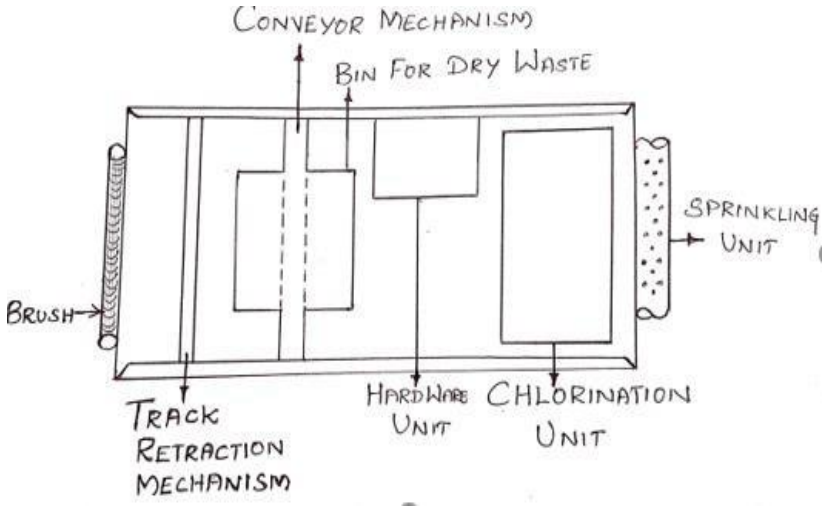


Figure 2: Overview of robot design

In the proposed concept the ladder type Chassis is preferred as it is easy to construct. The ladder body and chassis are discrete, which also make it easier to repair in the event of any chassis damage during off-roading. Theladder chassis handles the entire suspension load and, at the same time it supports the body and mechanical components rested over it. Carbon steel or aluminum alloys to achieve a more light-weight construction.

Required Materials: Arduino UNO, Node MCU, Dual H-bridge controller, 2 relays, Ultrasonic and Water level sensor circuits, DC Motors, DC Water pump, Roller brush, Water tank, LED, Connecting wires, Wheels, Metal Chassis and Battery.

What is the innovation in the project?

In our project we improvement that controlling efficiency of track cleaning robot through Arduino Uno as a controlling unit to perform a particular tasks as per the algorithm with the help of Arduino code, Hardware controlling devices and WiFi connection between Node MCU and Smart phone. The application installed in the mobile controls the robot movements and working particular tasks.

Results:

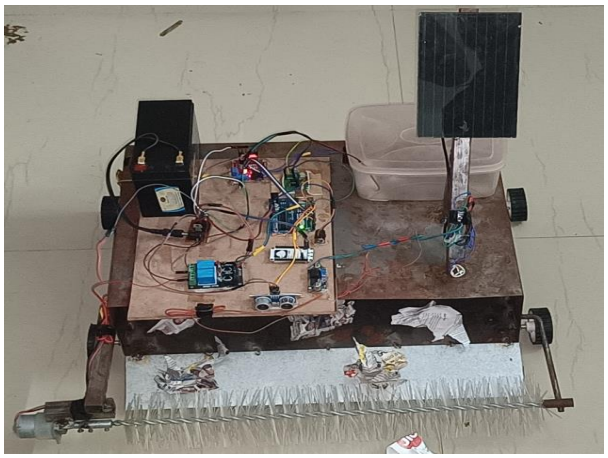
The machine has been tested withwastes. The Robot was made to run on a 15 meter distance, it took 10 minutes to complete the whole process. The robot was placed on level surface to track. Whenthe robot starts its movement, it gets aligned parallel to track according to algorithm and moves forward. The experimental results of each unit were calculated.

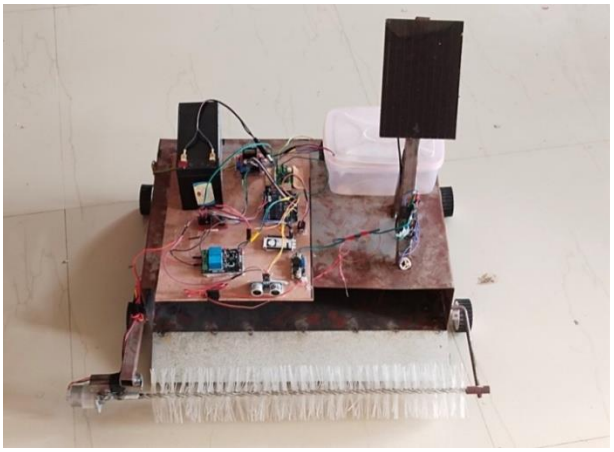
Feeder Unit: The feeder unit takes in almost all kinds of paper wastes, plastic and other kinds of wastes. The weights of wastes found commonly on track are at most 15grams. The feeder unit can collect up to 1 kilogram of waste materials in a single run.

Pressurized Water Unit: Tank was filled with 1 liter of water mixed with chlorine powder. Chlorine powder was sprinkled on tracks along with forward motion. The pressurized water cleaned the sticky debris under the track effectively, and the waste water moved to waste channel situated in the sides of tracks. The water tank was empty in a single run of 3-5 minutes. The sensor got fired and robot senses the alarm. The operator got the indication of water level went low and the operator has to stops the robot for refilling purpose.

Obstacle Sensing Unit: This unit was tested by creating obstacle to ultra sonic sensor network. Then it sent the signal to robot over RF transmitter and the signal was received to control unit. Hence it stops the running robot. Then it waited for next signal to come for continuing its operation. The next signal was sent by operator through smart phone.

Solar charging unit: The solar charging unit is responsible for charging the robot's battery using solar energy. It typically consists of a solar panel that absorbs sunlight and converts it into electrical energy, which is then stored in the battery and the output of the solar charging is 12-18V to charge the supplied 12V battery.





Conclusion:

The Intelligent Track Cleaning Machine provides an efficient cleaning process and promises dirt-free railway tracks in the stations with minimal human interaction. The proposed application of robotics can also be utilized for cleaning during emergency interventions. The Intelligent Track Cleaning Robot is a revolutionary new way to clean around switching points. Intelligent Track Cleaning Robot saves time and eliminates dirt. Our proposed robotic application may serve in scenarios where manual scavenging is unhealthy. The system can be disassembled and operated with external support, making it user-friendly. The machine is an efficient alternative to manual scavenging. Compared with the presently available systems, our robot saves on labour costs and time, as a single machine can do the work of multiple labourers in less time. It is eco-friendly as well.

Scope for future work:

As a future enhancement, the complete system can be implemented using IOT technology that could eliminate the needof the development of a dedicated control channel for the robot, as it could then be controlled over the existing network infrastructure. Also, in view of the current advancements in machine learning, train alarming unit can be redesigned to the detect an approaching train by the robot itself through its integration with vibration, proximity sensors and real time image processing. Additionally, the robot could be attached with a proper railway track crack detection system reducing the human labour and accelerating the inspection process. By improving mechanism of Chassis design and Waste disposal method in future to get more efficient operation of robot. And our model is designed in the ratio 1/3 dimensions of railway track and existing machine dimensions. This proposed mechanism forms a complete system for an autonomous track cleaning robot, ensuring higher overall hygienic levels for railways subject if implemented on a large scale. Moreover, its signaling and retracting mechanism ensures safety from possible train-robot collisions etc.

References:

[1] Vamsi Krishna, Dr. S. Prakash, "Intelligent Railway Track Cleaning Robot with Waste Segregation" International Journal of Advanced Science and Technology Vol. 29, No. 7s, pp. 4895-4899, 2020.

[2] A. Selwin Mich Priyadharson, "HMI-based laboratory flush control in Indian Railway tracks," of Basic and Applied Engineering Research, Volume 4, Issue 1, pp. 24-27, Journal January- March 2017.

[3] Jesin James, Jesse Wilson, JovnaJetto, Alna Thomas, and Dhahabiya V. K, "Intelligent Track Cleaning Robot" , in International Conference on Mechatronics and Automation, 2016.

[4] Neil Rodrigues Francisa, Arun. Ma, and Sudheer A. Pb, "Design, modeling, and fabrication of a railway track cleaning bot." International Conference on Robotics and Smart Fabrication of a railway track cleaning bot." Manufacturing (RoSMa2018).

[5] Balasaheb Kasure, Rohit Sondulkar, Rohit Zagade, Hatim Jalal, Akash Chavan, “A Review on Semi-Automatic Track Cleaning Machine”, IJRESM, ISSN (Online): 2581-5792, Volume-2, Issue-2, February 2019.

[6] Nehal D. Jadhao1 and M.S. Tufail2, "Review Paper on Automatic Railway Track Cleaning Machine”, Journal of Basic and Applied Engineering Research, Volume 4, Issue 1, pp. 24-27, January- March 2017.

[7] http://www.nr.indianrailways.gov.in/view_detail.jsp?lang=0&dcd=3591&id=0,4,268.

[8] "Indian Railways Statistical Publications 2015-16: Year Book English", Ministry of Railway.