

Review Paper on Automatic Railway Track Cleaning Machine

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Abstract—India is traveling towards the dream “clean and green”. This paper aims to present a prototype model for a cost efficient track cleaning machine which would prove to be a wonderful alternative to the current system in place if implemented. The proposed prototype is designed to overcome disadvantages of the available machine. The existing cleaning process on the tracks at Indian railway platform is manual, which is tedious particularly, when the frequency of the trains is very high. In this, the high pressure water jet is used to spray the water through nozzle on the track and the suction pump is used to suck the garbage which is below the track. Sanitation at the railway platforms is the first, major requirement of developing railway system.

Keywords: Water jet, nozzles

1. INTRODUCTION

The executive authority for the administration of the railways vests with the central government and the same has been delegated to the railway board as per the Indian Railway Act. The maintenance of railway track can be carried out either manually or by use of mechanical appliances or by a combination of both i.e. machines and labour. In India, conventional maintenance is carried out by means of manual labour and hand tools. To maintain a good quality on the working surface of the track, it needs regular cleaning and maintenance.

Our main focus lies on simplifying the process of cleaning as much as possible, since tracks are to be cleaned frequently. This prototype is designed to remove waste (plastic covers, paper cups, polythene covers etc.) and store it in a separate cabin which would enable removal of all the wastes at once. Gallons of water are utilizing for cleaning the stations. The Indian Government is spending 500 crores for cleaning tracks in Railway stations. The track is so long that it will take many manual cleaning. The low efficiency cannot meet the requirement of daily tests. As a result, we need a higher degree of automatic cleaner-and maintaining equipment for track. Cleaning floor is highly repetitive and monotonous task and which has been efficiently solved. Basic objective is to remove the garbage from the surface below the track by using automatic cleaning machine. The machine will exert high

pressure water over the garbage to drain it out through the trench. Another objective is to reduce the cost of the cleaning garbage at perfect and efficient level and safety to manual operators due to high frequency of trains. The main objective of this innovative work is to reduce the cleaning process in stations and to decrease the budget included for maintenance in railways and also to give a good eco-friendly environment in stations. The cleaning and maintaining parts is very important of the vehicle that could make the cleaning and maintaining for the track possible.

2. LITERATURE REVIEW

K.S. Nagla, MoinUddin, R. Jha, Akshay Mathur states the kinematics, dynamics and trajectory planning of robot for cleaning the surface below the railway tracks at a platform. In the first part of the paper, properties of the service robot are stated and some similarities and differences between the service robots and industrial robots are explained. In this paper, a system is proposed which is suitable trajectory planning and scheduling algorithm for efficient cleaning and to minimize the wastage of water also.[1]

Hiroshi Murase, Masato Ukai, Nozomi Nagamine, Ryuta Nakasone proposed a method for detecting obstacles by comparing input and reference train frontal view camera images. In the field of obstacle detection, most methods employ a machine learning approach, so they can only detect pre-trained classes, such as pedestrian, bicycle, etc. This means that obstacles of unknown classes cannot be detected. To overcome this problem, a system is proposed of background subtraction method that can be applied to moving cameras. First, the proposed method computes frame-by-frame correspondences between the current and the reference (database) image sequences. Then, obstacles are detected by applying image subtraction to corresponding frames. [2]

Wen-Yuan Chen 1, Shih-Sung Cheng1, Ching-Te Wang 2, Chin-Fu Tsai 1and Chiou-Kou Tung proposed a method that have double round positioning, three-point positioning, cross-ratio positioning, bilinear interpolation, cubic interpolation, memory path flow-chart, vector-path tracing, and many other

algorithms. Infrared and ultrasonic waves required for the hardware are used as distance detection, and combined with a smart obstacle-avoidance algorithm to correctly avoid all the obstacles. The overall design goal is to achieve under stable, reliable states accurate control and flexible movement. In this paper, aim is to achieve high efficiency of automatic mobile obstacle-avoidance capability by using image processing techniques.[3]

Dr. A. Selwin Mich Priyadharson proposed a work uses Trimble GPS (Global Positioning System) studio and B&R Automation studio PLC (Programmable Logic Controller) with HMI (Human Machine Interface). GPS is used to find exact location of the train (whether train is in station or not) and after acquiring data GPS will send digital signal to automated PLC - HMI to open/close the electrical actuator, solenoid valve for controlling the lavatory outlet. When solenoid valve is closed minimum water level is maintained in the storage tank by level switch for cleanliness in the storage tank. Moreover in lavatory motion detector is placed so that if anyone used toilet and left without flush, sensor will detect and send signal to PLC and it will automatically flush out with certain amount of water.[4]

Yuxin Huang, Tongyu Wang, Lin Lin, Huiying Gao, Yanwen Zheng, Ying Xu drafts the design for special cleaning-and-maintaining vehicles, which unifies the cleaning and maintaining. It is based on the layout and movement mode of the structural characteristics of tracks to design the cleaning equipment. Meanwhile, a series of steps such as cleaning, wiping and oil covering is conducted by central control board to save the manual operations. According to the layout and movement mode of the structural characteristics of tracks to design the cleaning equipment. By the central control console for a series of cleaning, drying and other steps and oil control it greatly reduce the manual operation. [5]

Xavier Gibert, Vishal M. Patel, and Rama Chellappa proposes a new method for fastener detection by 1) carefully aligning the training data, 2) reducing intra-class variation, and 3) bootstrapping difficult samples to improve the classification margin. Using the histogram of oriented gradients features and a combination of linear SVM classifiers, the system described in this paper can inspect ties for missing or defective rail fastener problems with a probability of detection of 98% and a false alarm rate of 1.23% on a new dataset of 85 miles of concrete tie images collected in the US Northeast Corridor (NEC) between 2012 and 2013. [6]

3. DESCRIPTION

The Indian railways run about 11000 trains everyday serving 7000 railway stations and carry about 4018 million passengers and about 405 million tons of goods transfer in a year. The Indian railway system today is the very large railway system under unitary management. Cleaning of the surface below the railway track, at entire platform is done manually. Sanitation at the railway platforms is the first, major requirement of

developing railway system. The operation of cleaning garbage from railway track on the platform of Indian railways has been studied, and it has been found that its manual removal is tedious, especially when the frequency of the train is very high. The manual work is not only costly and time consuming but also unsafe to the humans who work on the site. A machine can be installed within the permissible area between the two railway tracks parallel to each other. The installation of the machine will not disturb the regular and irregular movements of mobile and stationary objects at railway stations.

The number of machines required at particular platform will depend upon the length of the platform. The construction of Indian railway platform is shown in figure1. High pressure water jets will be used to drain out the garbage through trench. The machine can also be synchronized with the arrival and departure of the train.



Fig. 1: Indian Railway platform

4. OBJECTIVE

1. Basic objective is to remove the garbage from the surface below the track by using automatic cleaning machine.
2. To reduce the cost of the cleaning garbage at efficient level and safety to manual operators due to high frequency of trains.
3. To maintain a good quality of the working surface of the track.

5. RELATED WORKS

Indian railways introduced this cleaning machine (designed and developed by Northern Railway capable of storing 6MT waste) in March 2014. Major disadvantage of this machine is that it requires very high power due to the use of inbuilt vacuum cleaner. Secondly, this machine is built solely for the purpose of removing waste from the tracks; hence, the sides of

the tracks remain unclean. This machine also requires a separate engine in place to be operational. Considerable amount of human power is also inevitable to control the working of this machine. Last but not the least, the design of this system is different from that of the other commonly used compartments by the Indian Railways which makes it quite complicated to manufacture in other parts of the country other than where it is developed.



Fig. 2: The Cleaning Machine Designed By Indian Railways.

6. CONCEPTUAL DIAGRAM

The cleaning and maintaining vehicle for the track mainly consist nozzles, rollers, water tank, reservoir and suction pump, brush, solenoid valve, IR sensor etc.

The nozzle is used to control the direction and characteristics of fluid flow (especially to increase the velocity) as it exits (enters) an enclosed chamber or pipe. The selection of the nozzle depends on the flow rate, spray angle and spray width. The nozzles are 15-30° inclined to the vertical axis. The water is sprayed at a pressure of about 15-30bar.

$$\text{Flow rate (Q)} = CA\sqrt{2gh}$$

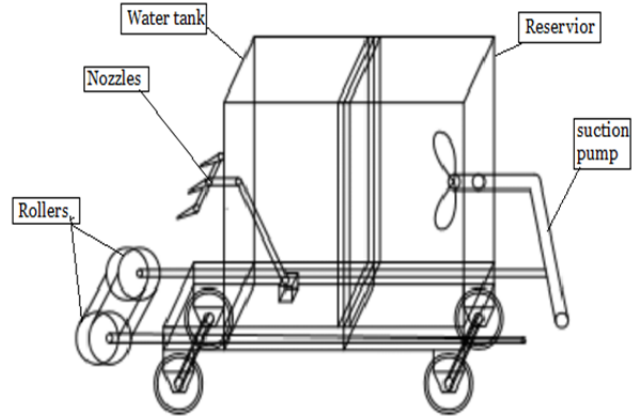
$$Q = \text{flow rate (m}^3/\text{s)}$$

C= flow rate coefficient

A= orifice cross-sectional area (m²)

g= gravity acceleration (9.8 m/s)

h= potential head (m)

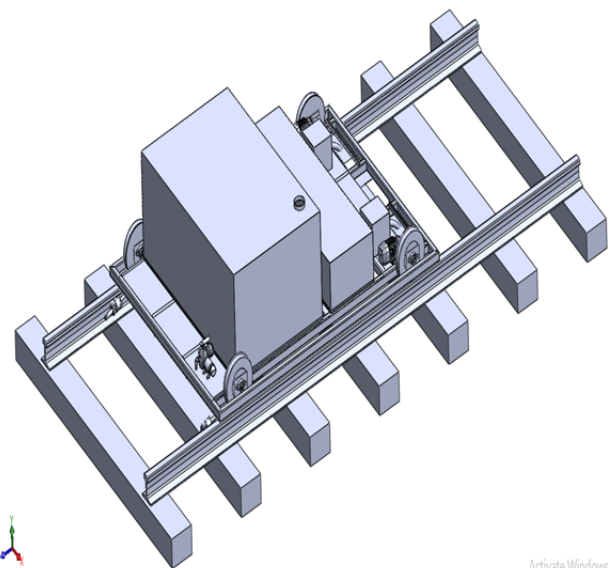


“Fig.3: Schematic Diagram Of Automatic Railway Track Cleaning Machine”

The high pressure water jet is used to spray the water through nozzle on track to drain out the garbage. The water is fed through pump to it. The IR sensor is used for the obstacle detection.

The suction pump is provided to suck the garbage from the track and which is store in the reservoir.

7. CAD MODELLING



“Fig. 4: CAD MODEL of Automatic Railway Track Cleaning Machine”

8. CONCLUSION

This paper presents a design of the cleaning vehicle special for track. The system is designed by considering the drawback of the existing machine. This system also clean the portion which is beside the track by applying high pressure water on the track. This machine is battery charged and electronic control unit is used for the automatic handling of track cleaning machine. The system has following characteristics-

- Machine reach and pressure to clean can vary in wide range.
- Self-organizing behaviours of the system make it robust against external and internal disturbances.

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