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An Automation in Indian Railways for Lavatory and Coach Electricity Management

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ABSTRACT
The idea behind this study is to provide a solution on some problems faced in Indian Railways. Points taken in concern while working on this study are Cleanliness & power generation. Those it has been mentioned everywhere to do not use lavatories while train is at station, still it is observed that such notice is merely followed. Using some techniques like piezoelectric sensors for power generation and RFID for lavatory door locking automation, we can solve the problem faced.

1. Introduction

Indian Railways serve lacs of people each day. The task of managing such a huge network is quite tedious but handled well by the organization. This study is to help in solving some issues related to railway management and power concern in bogies. Railways are main part of Indian travel 'culture', but many times, it generates lot of garbage. A general passenger train consists minimum eight to maximum 24 bogies attached to engine. Each passenger bogie consists approx. four lavatories. However, it has been mentioned on each lavatory, not to use it while train is standing on station, many do not follow it. This is prime reason behind dirtiness at station. Result of it, while waiting on platform we feel uneasy due to human waste on rail lines and platform, which generate foul smell. Another problem identified that, many times, passengers face electricity problem while travelling in train (i.e. mobile/laptop charging). Hence, the idea behind this is to develop the system that will keep railway tracks at station, free from human waste. Second solution is to generate electricity by using railway bogie's current assembly, which will help passengers to charge their electrical appliances and will prove useful to railways.

2. Literature Survey

Xavier Gibert, Vishal M Patel, Rama Chellappa[1] mentioned in their paper titled as "Deep Multi-Task Learning for Railway Track Inspection" some points regarding railway track inspection and multi-task learning. Their paper talks about detection performance can be improved by combining multiple detectors within a multi-task learning framework, which provide better accuracy in detection of defects on railway ties on fasteners.

"Methodology for Design and Fabrication of Human Waste Disposal System for Indian Railway", a paper published by Dhanajay G Dange, Dattaprakash G Vernekar, Sagar D Kurhade, and Prashant D Agwane [2] in IJSTE gives the methodology for design and fabrication of human waste disposal system for Indian railways. It recommends number of design models for human waste disposal system. This also includes testing of a prototype.

Dr. Manoj Hedaoo, Dr. Suchita Hirde , Ms. Arshi Khan [3] in their paper entitled as, "Sanitation in Indian Railway Premises: A Great Cause of Concern" (International Journal of Advanced Engineering Technology of 2011) talks about sanitation in railways has become a need of time due to which Indian Railway's new concepts like modular toilets need to be introduced. Sanitation in Railways though a mammoth task can be achieved only by mutual both. Until and unless passengers share equal responsibility with the railway administration, the goal of achieving complete sanitation in railways looks hard.

3. System Design

3.1 Automatic Lavatory Door Lock

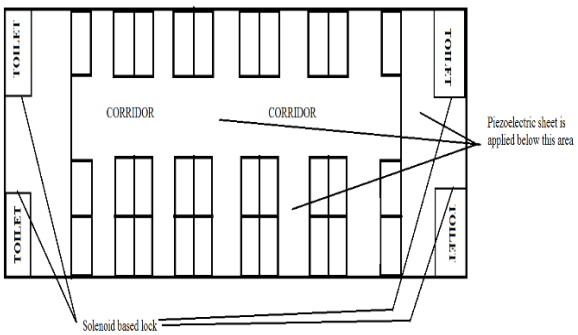

Fig. 1. Layout of piezoelectric sheet and lock in railway coach.

As shown in figure 1, the bogie has 4 lavatories 2 each on either side. The solution we provide includes an automatic door lock for lavatories. This lock will operate on the signaling of arrival and departure of station along with timer arrangement (timer is in case train stay at station more than its decided time duration).

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In station detection mechanism for locking the lavatory doors RFID tag, reader and solenoid valve are used. As soon as station arrives, just before 100 to 200 meters RFID reader will read tag 1, which will lead a signal to solenoid valve arrangement.

Fig. 2. Solenoid Valve for door lock.

The solenoid valve can be operated manually from inside for avoiding a case like, train arrived on station while passenger is inside the toilet and he or she want to detrain at that same station. Therefore, in such scenario, one can press power button present inside which will move solenoid valve's shaft temporarily to allow passenger to come out. As soon as passenger shut the door, the lock will regain its state until train leave the station. Lock arrangement is made using RFID tag, RFID reader and relay circuit in accordance.

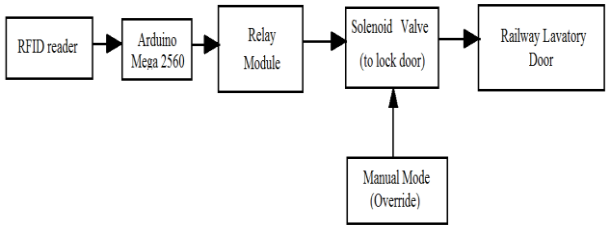

Fig. 3. Block Diagram of Locking Mechanism Inside Train Lavatory.

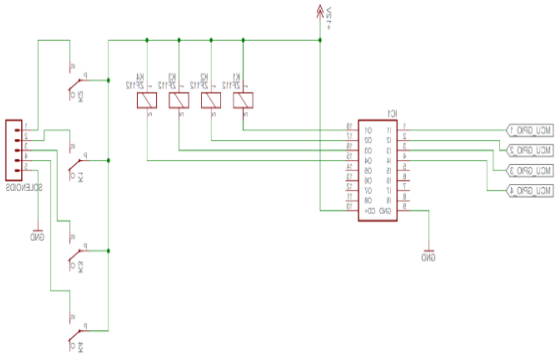

Fig. 4. Schematic Circuit Diagram of Mechanism to Lock Lavatory Door.

3.2 Electricity Generation in Railway Coach

Today's travel culture requirements are quite challengeable. As this world is brought on palm by many electronics devices like mobile, laptops, tablets etc., people became more like used to it.

Fig. 5. Charging point in Indian Railway's coach.

Due to use of such electronic equipment in many applications, they require charging time to time. Charging points are provided in some coaches but most of the times are not working due to no power. Here the second idea of this paper prove useful. Figure 1 shows the corridors present in railway coach. Whereas there is more place for corridors in many coaches. Many passengers keep their luggage below the seats and on corridor floor. In addition, people will tend to roam around in train (like pantry person). These both will generate a considerable amount of force on corridor sheet. Hence, the idea of we are applying which will use this force to generate electricity using piezoelectric sheet.

The piezoelectric sheet is placed below the metal sheet present in corridor of coach. When the pressure is applied on this sheet, it will convert that into electricity, which can be stored in batteries and used for, not only charging, but also for lights and fan like electrical equipment present in railway coach.

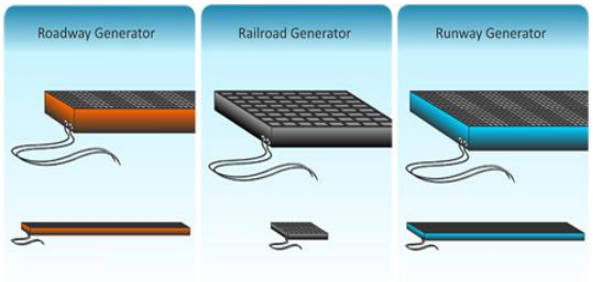

Fig. 6. Application of piezoelectric sheet.

Figure 1 shows the area of corridor, which is useful for applying piezoelectric sheet and the area below the seats where luggage is placed usually, is used for the same. The supply generated from the same is stored in batteries for further use. The key point is, when the generated power is in use, we can keep generating power as pressure will remain continuously on corridor sheet and as a result on piezoelectric sheet. These sheets are placed below corridor's metal sheet.

Calculation. The In actual experiment one crystal yielded 0.9 V at weight of 50 kg In theoretical calculation, Voltage generated can calculated using,

$E = g \times t \times P$

Where,

g=Voltage sensitivity of PZT (10 ×10-Vm)

t = Thickness of one crystal (0.5 mm)

P=Pressure exerted on the PZT crystal

Pressure = Force exerted by human walk /Area of one crystal

Force by human walk is 490.5 N (i.e. 50 × 9.81)

$P=490.5/(\pi \times 2.5 \times 2.5 \times 10\text{-}2 \times 10\text{-}2)$

P=0.249MN/m2

Voltage generated in theoretical calculation is

$E=10 \times 10\text{-}3 \times 0.5 \times 10\text{-}3 \times 0.249 \times 106$

E = 1.245 V.

Peukert's law expresses the capacity of a battery in terms of the rate at which it is discharged from former. As its rate increases, the battery capacity may tend to decrease.

$t= H (C/IH)^{k}$

In our work model, we discharged the 12V battery, 7.2 Ah using 40W bulb and the experimental time consumed for the discharge of the battery approximately took 4.5 hours. The theoretical discharge time is calculated using Peukert's law.

t = time consumed by 30W bulb

H =0.36A

C = 7.2 Ah

I= (40 W/ 12 V) =3.33A

K= 1.44 for lead acid battery
From the Peukert's law
$t = 0.36 (7.2/3.33*0.36)^{1.44}$
t = 4.75 Hours

4. Result

A system has been designed by considering figure 3. The lavatory door locking mechanism worked for 4 doors which can be opened manually from inside still locked.

The experiment was conducted for one-hour duration by applying continuous uniformload was applied according to the desired power output. Thereby the following results are verified and they are tabulated.

Table 1. Calculation of Charging Time Using Various Load Conditions.

Sr. No.	Load (in KG)	Charging Time (in Hours)	Voltage Stored (in Volts)	Time Required charging 12 V battery in Hours.
1	60	1	0.56	21
2	80	1	0.8	15

The discharge time is measured for different type of equipment as shown in below

Table 2. Discharge time for various electrical Equipment.

Equipment Used	Charge consumed (in watts)	Time taken by battery to discharge (12 V Lead acid) In hours
Incandescent Bulb	100	1.27
	75	1.92
CFL	20	12.89
	15	19.51
	10	34.98
LED	20	12.89
LED	14	21.55
	12	26.90
	8	48.23

5. Conclusion

The system can lead to energy harvesting by using solar panels on top or side of railway bogie. Added to that, more study on this type of energy generation results in energy harvesting, which will fulfill the mutual requirements of passenger of train and administration.The door locking system is very useful and help the campaign “swachha bharat’ in true ways.

References

[1]. Xavier Gibert, Vishal M Patel, and Rama Chellappa, in their IEEE paper titled as “Deep Multi-Task Learning for Railway Track Inspection” published on 17 Sep 2015

[2]. “Methodology for Design and Fabrication of Human Waste Disposal System for Indian Railway” published by Dhanajay G Dange, Dattaprakash G Vernekar, Sagar D Kurhade, Prashant D Agwane in IJSTE – International Journal of Science Technology & Engineering, Volume 2, Issue 07, January 2016.

[3]. Dr. Manoj Hedaoo, Dr. Suchita Hirde, Ms. Arshi Khan “Sanitation in Indian Railway Premises: A Great Cause of Concern”, International Journal of Advanced Engineering Technology, 2011

[4]. Mohamed Ashiq, K Karthikeyan, S Karthikeyan. “Fabrication of Semi-Automated Pressurized Flushing System in Indian Railway Toilet”, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-3, February 2013

[5]. A Study On Control Discharge Toilet System by G Bhavani Prasad, SSE/NC/LGDS,Indian Railway Conference Association, New Delhi.

[6]. Design Study of Piezoelectric Energy- Harvesting Devices for Generation of Higher Electrical Power Using a Coupled Piezoelectric-Circuit Finite Element Method IEEE Transactions on Ultrasonic’s, Ferroelectrics, and Frequency Control, vol. 57, no. 2, February 2010.

[7]. Estimation of Electric Charge Output for Piezoelectric Energy Harvesting,LA-UR-04-2449, Strain Journal, 40(2), 49-58, 2004;Henry A. Sodano, Daniel J. Inman, Gyuhae Park

[8]. Vibration Based Energy Harvesting Using Piezoelectric Material,M.N. Fakhzan, Asan G.A.Muthalif, Department of Mechatronics Engineering, International Islamic University Malaysia, IIUM,Kuala Lumpur, Malaysia