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# Advanced Hygienic Cleaning System for Railway (AHCSR)

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**Abstract:** The dehumanizing practice of manual scavenging persists in various parts of our country. Their caste-designated occupation reinforces the social stigma of untouchability that perpetuates widespread discrimination. The proposed system will eradicate the need for the so called employment in the form of slavery by making the process automatic. This project aims to develop a hygienic and clean method to collect (rather than discharging it to the tracks) and use human waste from railway toilets to generate electricity and further use it to power the railway station.

**Keywords:** AHCSR, Manual Scavenging, Discharge valve, Railway, Sleeper, Monostable multivibrator, Biogas plant

## I. INTRODUCTION

Manual scavenging refers to the practice of manually cleaning, carrying, disposing or handling human excreta in any manner. Manual scavenging is an indelible part of Indian Railway network. It is not possible to prevent passengers from using train toilets while the train is stopped at a railway station, thus causing human excreta to be discharged onto the railway track causing hygiene and health issues for the passengers. This waste has to be moved from the track for proper management and disposal. This is done by the manual scavengers. In this modern era of technology and development it is pivotal to find a solution to prevent this outrageous task of cleaning human excreta. In this paper a technique is described to make the process of human waste collection possible without human interference and also generate electricity with the human waste collected [2].

India is the world's second most populous nation. The country has marked tremendous development since gaining independence nearly seven decades ago. There are still some issues inside which are indicators of a developing nation. The distance between being 'a still developing' and 'a fully developed' country lies in resolving the problems that are faced by majority of the citizens. Public transport systems are the biggest mode of transportation in any country. The India railway system is the most popular and cheapest mode of long distance transportation. The more people travel in it, the more unclean it becomes. Hence maintaining hygiene is the most difficult task for the department of railways.

Toilet waste disposal and management has always been a challenge for the railways. The current method in high end trains is to dispose the toilet waste when train speed hits 45kmph or above and collect the waste if the speed is lower than that whereas in low end trains human excreta is directly discharged to train track irrespective of the speed. Irrespective of the motion or halt of the train human waste is simply plummeted on to the track. Manual scavengers are employed to remove these wastes from the vicinity of the railway station. This work questions the integrity of the workers.

## II. PROPOSED AUTOMATION IDEA

The proposed model of AHCSR can be implemented in all types of trains that are in commission in India. This can be implemented by adopting few changes to the current architecture of rail network from train bogie to sleeper structure of the railway track at the station. The changes to be implemented are listed below

### A. Changes Required on Bogie

In order to implement the idea a temporary storage tank needs to be attached under the bogie in such a position that the tank is able to collect the toilet waste from the train conveniently. This storage tank has an electrically operated discharge valve to pass out the wastes collected in the tank when a suitable voltage is applied across the valve. This valve can be an enlarged version of water inlet valve used in washing machines which supply water to the impeller and these valves give water only when a power supply is applied across it.

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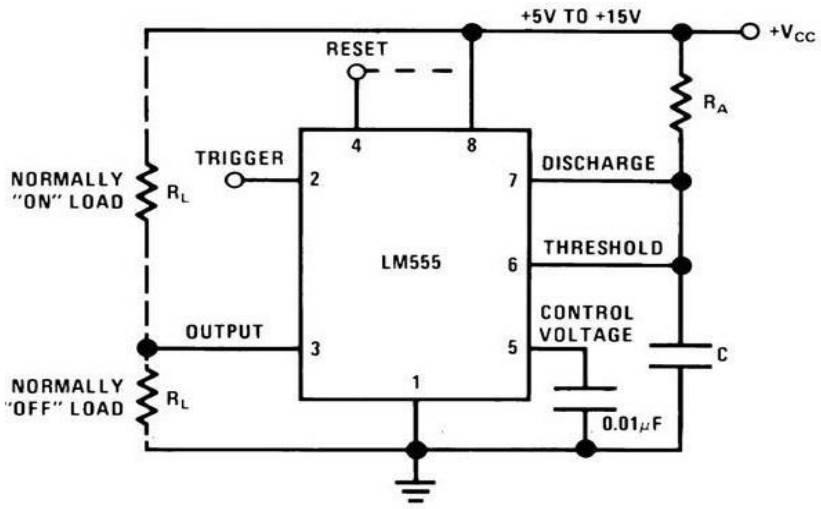
B. Changes Required on Railway Track

The sleeper in the railway tracks at the stations needs to be modified in such a way that it can accommodate the provision of collecting the waste which was gathered in the collection tank. A suitably sized hole for a pipe needs to be provided to collect the waste. It is notable that hole is not provided in all the sleepers of the track at station, but only at those critical positions where this collection tanks will be located when train comes to halt. This location is fixed irrespective of the trains because the size of the bogie is identical in India. Also every railway station in India has a numbered coach position so all trains comes to stop at the same spot.

## III. PRINCIPLE

The problem being so complex and socially relevant, the solution should be simple and powerful as it has to replace the existing system of waste management. This project uses the working principle of a monostable multivibrator, relay and RF transmitter-receiver. The desired outputs are achieved by manipulating the output wave form of an monostable multivibrator[1].

A. Working of Monostable Multivibrator




Fig(1). Monostable multivibrator

Monostable multivibrator (fig(1)) or one-shot multivibrator has one stable state and one quasi-stable state. It switches to stable state on application of pulse and returns back to its quasi-stable state after a specific interval of time. This duration depends upon the passive elements used in the monostable circuit.

B. Equations

The time period of the monostable multivibrator can be designed according to need of the designer. It depends on the values of the capacitor and resistor. The formulae for time period (equation 1) for a monostable multi vibrator using 555 timer is given by

$$\text{Time Period 'T'} = 1.1*R*C \qquad \text{----------(1)}$$

C. RF Module

The RF module (fig.(2)), as the name suggests, operates at Radio Frequency. The corresponding frequency range differs between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of the carrier wave. This kind of modulation is identified as Amplitude Shift Keying (ASK). Transmission through RF is superior to IR (infrared) attributable to several reasons. Firstly, signals through RF can travel through larger distances making it appropriate for long-range applications. Also, IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is additionally strong and reliable than IR transmission. RF communication uses a selected frequency, unlike IR signals which are affected by other IR emitting sources.

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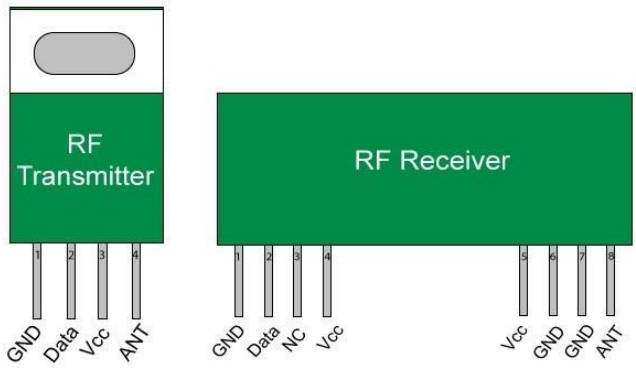
This RF module comprises of an RF Transmitter and RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 megahertz. An RF transmitter receives serial information and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps. The transmitted information is received by an RF receiver operating at the constant frequency as that of the transmitter.

The RF module is usually used alongside a pair of encoder/decoder. The encoder is employed for encoding parallel information for transmission feed whereas the reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.



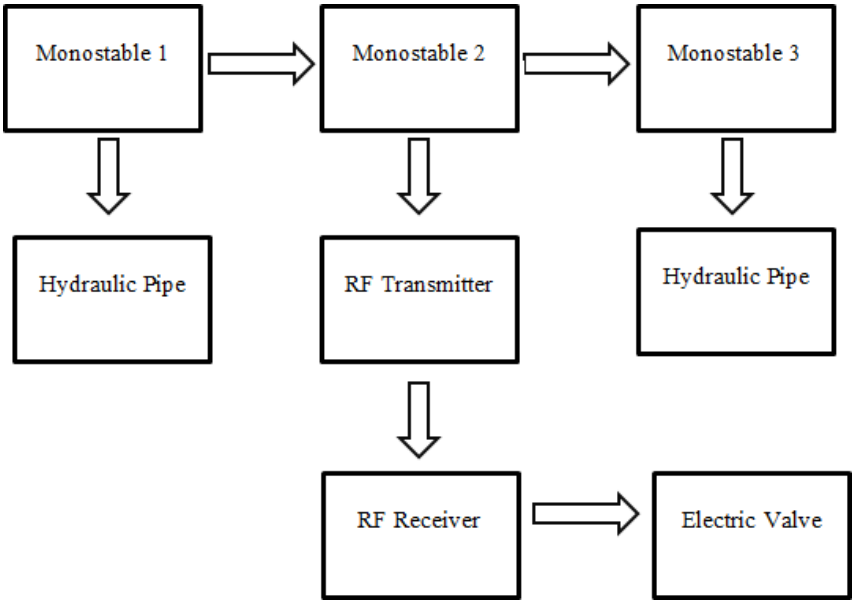

Fig(2). RF Transmitter-Receiver

D. Bio-Gas Plant

Human waste on anaerobic digestion produces a gas mixture popularly known as biogas, predominantly containing methane. This gas is used as fuel in a generator to produce electricity. Thus otherwise a problematic waste is effectively used to generate electricity[3,4].

## IV. WORKING

The process of AHCSR begins when a new incoming train halts at a station, as per normal conditions all coaches comes to halt in a designated position. This makes sure that valves on the collection tank comes above specific sleeper positions. These sleepers have provision for collecting the stored waste from the tank. Once the train stops the station master triggers the Monostable multivibrator (1) by pressing a switch.




Fig(3). Block Diagram of AHCSR

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Once the monostable multivibrator (1) switches from its OFF state to ON state it triggers a hydraulic pipe which is commissioned in between the sleepers on the track using a motor via a driver circuit. On reception of this signal motor drives the pipe and it rises above the ground and attaches it to the output valve of the waste collection tank on the bogie. The monostable multivibrator (2) is in series with the output of multivibrator (1) so that the trigger of multivibrator (2) is using the output of multivibrator (1). It is to be noted that the triggering of the multivibrator (2) happens with a delay equal to time delay of the multivibrator (1).(fig.(3))

Once the output wave of multivibrator (1) ends the multivibrator (2) is triggered and the output of the multivibrator (2) is sent to the train bogie using a RF transmitter and this signal is received in the train using RF receiver. Once this signal is received it triggers the electrically operated valve which is powered 110V DC supply through a relay and the relay is under the control of the received signal. The electrically operated valve stays open as long as the signal is received to the relay from the station via RF. This transfers the waste collected in the storage tank into the biogas plant through the hydraulic pipe that was attached to the tank.

Monostable multivibrator (3) is in series with the multivibrator (2) which is in series with multivibrator (1). Hence the triggering of multivibrator (3) happens only after the output signal of multivibrator (2) of time period $t_2$ duration dies down. Triggering of multivibrator (2) happens only after the output signal of multivibrator (1) of time period $t_1$ duration dies down[1].

On triggering of multivibrator (3) the signal drives he driver circuit triggered by multivibrator (1) in reverse direction so that now the hydraulic pipe detaches it from the collection tank and sinks down to the railway track. The waste collected in the bus pipe is flushed into the bio gas plant using recycled water. The biogas plant consists of a balloon shaped gas collector. The outlet of the gas collector is connected to blower through pipes, blower is also called as sucker, which helps to maintain the outflow, even if gas pressure is low. This is connected to generator or engine which will convert this gas into electricity (table 1). Generator is the same used in small commercial establishments, but here it uses biogas as fuel instead of diesel/kerosene. The waste slurry obtained, is used as manure for crops.

Table I.

| **Table Head** | **Waste to Gas Ratio** | | |
|---|---|---|---|
| | **Waste weight** | **Gas** | **Time** |
| Human Excreta | 17.5 Kg | 1 Kg | 14 days |
| Cow Dung | 22.5 Kg | 1 Kg | 17 days |

The electricity generated from the bio gas system can be used to provide energy for lighting loads at the railway station, this makes the railway station a nanogrid.

## V. CONCLUSION

This manuscript aims to eradicate manual scavenging using existing scientific technology used in a specific manner to maintain hygiene in public places along with generating electricity in all weather conditions irrespective of the time and location.

## VI. ACKNOWLEDGMENT

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