



# Developing smart railway toilets

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## ABSTRACT

*In the fast-growing world, the advances are surely growing, at the same time the cleanliness is a major concern in our country. The abstract of this paper is to deliver clean and hygiene Railway Platform. All the Railway Platform should be clean and hygiene. In our country, our government has introduced a scheme called "Swachh Bharat" (Clean India). Keeping the Railway Platform uncontaminated is one of the objectives of the Clean India scheme. This paper can be helpful to encourage a clean India project. In the future, it can show the major part in clean India scheme. In an Existing system, they are focused on identifying the dirt on the platform and cleaning them. In our proposed system, we have determined on keeping Railway Toilet Automatic. Therefore, our development is to switch the waste storage to a tank when the train is standing at the platform. This paper is based on Automation and concepts of switching tank using different sensors like the PIR sensor and Relay [1].*

**Keywords**— PIR sensor, Relay, RF transmitter and receiver

## 1. INTRODUCTION

In our country, people do use the Toilet at Railway Platform. This leads to several diseases, such as Malaria, Cholera, Streptococcus Hepatitis, Flu, Typhoid, etc. Hence we introduce the concepts called "Smart Railway toilet". It is introduced to use and maintain the toilets in a clean and hygienic way. The project is based on Automation concepts using sensors like PIR sensor, Relay, RF transmitter, and Receiver. Using these materials we are trying to provide the clean Platform [2].

### 1.1 Scope of the project

Here this paper talks about how to provide a clean Platform. This paper can bring the idea of using smart railway toilet. This paper can take the responsibilities of a clean Indian railway platform. Finally, this concept is a way towards the "Clean and disease free India".

## 2. LITERATURE REVIEW

The system uses Radiofrequency as an underlying communication protocol. The protocol is used in knowing the position of trains. There are two mechanisms involved here. They are,

- (a) Automatic Tank Switching
- (b) Dumping off waste

The PIR detects if there is a human in the toilet. If the user keeps staying in front of the sensor continuously, it is considered that a user is currently using the toilet then the doors didn't lock. On the other hand, if it does not find that the toilet is in use then locks the door as the train reaches the platform. Thus the condition of the platform can be easily maintained using this concept and the storage tank dump the waste as the train leaves the platform so no waste is there in the tank Such an attempt was also made by A. D. Kadge has proposed "Disposal System for Indian Train Toilet", Indian railways have 114,500 km of total track over a route of 65000 km and 7500 stations. While travelling by train people expect healthy and hygienic surrounding. Feel bad due to the poor condition of the platform and the allied foul smell [2].

This also creates a bad impression on foreign tourist. Sanitation problem caused due to a system in which train dispose of human waste on to the platform. In this disposal mechanism, the ultrasonic sensor and position sensor is used. After the proper detection of the place is done, the solenoid valve on. Then the sewage disposal is done.

Another such attempt was made in 2015 by Pandya Chintan, YadavJatin, Kareliya Sanket. They have proposed "Automatic bio-toilet for railway coaches", Bio toilet tank is a human waste disposal mechanism in the area with no infrastructure facilities. In that project, there are two doors [3].

This scheme is impracticable. In this paper, we are presenting a "smart railway toilet" performing automation which switches the tank system while the toilet is simple to use. The main aim of the system is to make clean the Indian railway platforms.

Here we have used PIR sensor for detecting the presence of a human in the toilet. Electromagnets are used for closing the door automatically. There is the presence of a Solenoid valve for switching the waste in the tank when the train is at the platform. The RF transmitter and receiver are there to detect the position of the train that whether the train is standing at the platform or not.

### 3. EXISTING SYSTEM

In an existing system, we are more focused on organizing sewages from the railway system. They are concentrated on reducing water wastage on platform cleaning, by the Workers. But no one is concentrating that what is the cause of platform being in poor condition. The root of the problem is the use of train toilets on the platforms.

If the focus will be made on stopping anyhow the use of the toilet at the platform then this problem will be automatically solved without any problem. Thus this paper helps in dealing with such kind of problem (using the toilet at the platform).

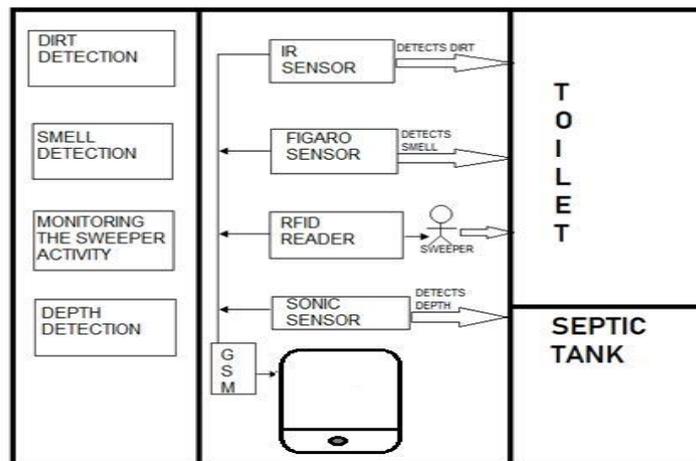
#### 3.1 Disadvantages

- (a) They are not focused on providing clean and hygienic platforms.
- (b) The cleaning of the platform could not be done all the time.

### 4. WORKING PRINCIPLE

In the first phase, RF transmitter and receivers are used. The transmitters are placed at the platform and the receivers are at the fitted in the train. As the train reaches the platform it receives the RF signal. At the same time, the PIR sensor is used to discover if any person is in the toilet. If any person is there in the toilet then the door does not lock. The mechanism of the toilet in use changes and the waste is stored to a tank. The mechanism is done with the help of water relays that works on 24volts. In case two if no person is there in the toilet then it locks the door of the toilet till the train is at the platform. In the second phase, as the train starts to move away from the platform the RF signal that was received by the train start to become weaker and weaker. A point comes when no signal is received by the RF receiver which means the train has passed the platform this point, all the door gets unlocked. PIR sensors get deactivated. The other 24-volt relay gets activated and the mechanism is switched such that the waste is dumped off from the tank. RF receivers are still activated so it can easily detect whether the train has reached the platform or not. [8]

#### 4.1 Architecture of the proposed system



**Fig. 1: Architecture of the proposed system**

#### 4.2 SOFTWARE REQUIREMENTS

Embedded C

#### 4.3 Description of architecture hardware requirements

- Microcontroller
- Power supply
- LCD display
- Buzzer
- PIR sensor
- Solenoid valve
- Water Relay

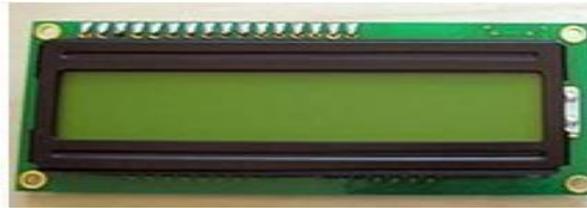
**4.3.1 Microcontroller:** A microcontroller is a small computer on a single combined circuit holding a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general-purpose applications. PIC 16F877 is one of the most advanced microcontrollers from Microchip. This controller is commonly used for experimental and modern applications because of its low price, a wide range of requests, high quality, and ease of obtainability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The PIC 16F877 features all the mechanisms which present microcontrollers usually have. [9]

PIC microcontrollers follow Harvard architecture for internal data transfer. In Harvard architecture, there are two separate memories for program and data. These two memories are accessed through different buses for data communication between memories and CPU core. This architecture improves the speed of system over Von Neumann architecture in which program and data are fetched from the same memory using the same bus. PIC18 series controllers are based on the 16-bit instruction set.



**Fig. 2: Microcontroller**

**4.3.2 LCD:** LCD stands for Liquid Crystal Display. By using the LCD, all the outputs are displayed. LCD doesn't know about the content (data or commands) supplied to its data bus. It is the user who has to specify whether the content at its data pins is data or commands. For this, if a command is inputted then a certain arrangement of 0s and 1s has to be applied to the Control lines so as to specify it is a command on the other hand if a data is inputted at the data lines then another combination of 0s and 1s has to be applied to the control lines to require it is Data.[6]



**Fig. 3: LCD Display**

**4.3.3 Buzzer:** The buzzer is also called as Beeper. It is a sound signalling mechanical device. Piezo sounders contain a piezoelectric vibration plate (also known as a piezo element) within a molded case. The sound is emitted when a voltage is applied and the piezo element inside the case vibrates.



**Fig. 4: Buzzer**

**4.3.4 PIR Sensor:** The PIR sensor is used to detect if any human is there in the toilet. It measures the Infrared (IR) light radiating from the object. When a warm body like human passes by it first intercepts one half of the PIR sensor which causes the positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. [12] These change pulses are what is detected. For many basic projects or products that need to detect when a person has left or entered the area or has approached, PIR sensors are great. They are low power and low cost, pretty rugged, have a wide lens range and are easy to interface with. Digital pulse high (3V) when triggered (motion detected) digital low when idle (no motion detected). Pulse lengths are determined by resistors and capacitors on the PCB and differ from sensor to sensor.



**Fig. 5: PIR**

**4.3.5 Solenoid Valve:** The solenoid consists of several turns of the enamelled wire wound around the ferromagnetic material like steel or iron.[10] The coil forms the shape of the hollow cylinder. Externally this coil is covered with the steel covering and inside the hollow part, there is a plunger or the piston.



**Fig. 6: Solenoid valve**

**4.3.6 Electromagnetic door locker:** Magnetic door locks use an electromagnetic force to stop doors from opening, so they are ideal for security.



**Fig. 7: Door Locker**

Magnet locks, such as the Deed lock magnets locks are made up of an electromagnet and an armature plate. The plate is attached to the door, and the magnetic to the door frame An electromagnetic lock creates a magnetic field when energized or powered up, causing an electromagnet and armature plate to become attracted to each other strongly enough to keep a door from opening. As they require power to remain locked, this allows them to be fail-safe, making electromagnetic door locks safe for use as emergency exits. If the power was to go out in a fire via a fire relay or call button, the door would unlock, allowing people to exit the building. [9]

**4.3.7 RF Transmitter and Receiver:** The RF module, as the name suggests, operates at Radio Frequency.

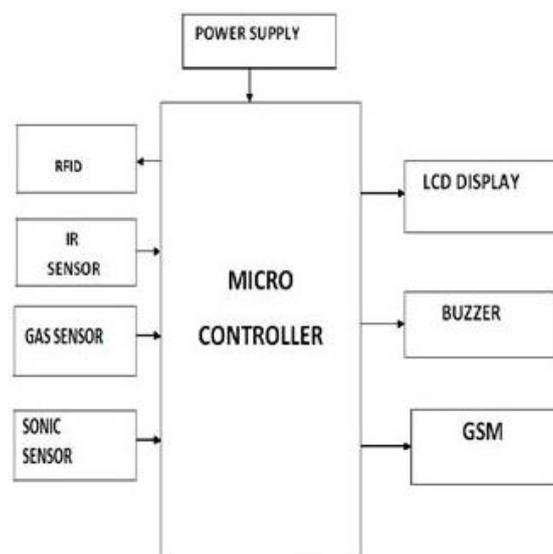


**Fig. 8: Door Locker**

The corresponding frequency range varies 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 known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long-range applications. Also, while IR mostly operates in a line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency, unlike IR signals which are affected by other IR emitting sources.

This RF module comprises an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.

## 5. BLOCK DIAGRAM



**Fig. 9: Block diagram of the proposed system**

### 5.1 Advantages

- It can help in making the platform clean.
- It can prevent many contagious diseases like malaria, typhoid, cholera, streptococcus, asthma, etc..
- It can promote the "Swachh Bharat" scheme

## 6. CONCLUSION

Our proposed project will create awareness among the people about the proper sanitation. It makes use of the Internet of things, which is a rapidly growing technology. Our proposed system will make everyone to strictly follow the cleanliness and proper sanitation in the toilets. It prevents the many new contagious diseases that spread due to improper sanitation of the toilets. Thus by using technologies in the smarter way, we can maintain the cleanliness which is next to the godliness. Keep Clean, Be Safe.[15]

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