

Use of Smart Toilet in Trains: An Initiative towards the Cleanliness of the Railways

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ABSTRACT

Toilets of the railways are generally seen to be as dirty one mostly in the passenger general class coaches due to the non-cleanliness or the excessive use of the toilets. These are the major source of the spread of the infection due to their non-cleanliness. So there must be a fixed period of time after which the toilets must be cleaned and toilets should be available only for the passengers having the fare ticket. In this research paper the concept of smart toilets has been proposed in which firstly only the passengers having their ticket will be able to use the toilet, the presence of the person inside the toilet will also be detected to ensure the closing and the opening of the toilet gate. This technique will be helpful in managing the toilets of the railways in a better way and will also help in the maintenance of their cleanliness.

Keywords: Coaches, Infection, Passengers, Railways, Ticket, Toilets.

I. INTRODUCTION

Toilets are used in the railways from a long time. With the change in time the design of the toilets and their method of disposing the waste material keep on changing with the time due to the infection and unhygienic nature of the waste. The first and most widely method of using the toilets was the hopper system toilets. Hopper toilets: In these toilets the waste excreta and the urine was directly flushed and the waste keep on depositing on the track lanes or rail beds which cause the infection due to its presence in the open environment as the train passes over the track because the moving train spreads the germs of the excreta. Even the platform gets infected due their presence on the tracks. Secondly sometimes passengers do not bother to flush the waste due to their directly passage to the railway bed. These toilets are similar to the old fashioned sea toilets due to the release of the excreta into the open environment. These type of toilets are the most widely used toilets all over the world. In UK these were used till 2019. One advantage is that the air passage through the hole make the adour less as the train moves over the track.

Chemical holding tanks: In these toilets the tanks for the collection of the waste need to be emptied regularly at the terminal stations, but if the train is to be used again and again in short span of time the tank may not be emptied and that may clog the hole of the toilet which can be more harmful from the infection point of view and the toilet cannot be used until and unless emptied for the usage. Vacuum toilet: in this toilet the wastage is sucked into the waste tank and everything is flushed but the water. The waste material sucked using the pump may chock and burst the pump. This type of toilets is used in the new carriages and in the airliners.

Composting toilets: In these toilets the composting toilets tank stores the waste material of the toilet and with the help of the bacterial action the waste material is broken down into small parts and the only the processed waste after the sterilization is released onto the railway beds. These types of toilets are only emptied in half a year and are used in the trains of the Switzerland and Netherlands. An infrared (IR) sensor is an electronic system which measures and detect the infrared radiations in its outer environment. These radiations were discovered by the astronomer Herschel in 1800 when he was measuring the temperature of each color which was dispersed by the prism. So while measuring the temperature of the color beyond the red color he noticed the highest temperature [1]. As IR is not visible to the human eye and the wavelength of the IR is longer than the visible light on the same electromagnetic spectrum. Any object emitting out the heat always emits infrared radiations. IR sensors are mainly of two types: Active and Passive

Active sensors do both the tasks of emitting and the detection of the infrared radiations. Active IR sensors possesses two parts part one for the emitting of the light that is light emitting diode (LED) and the second one is a receiver. When an object comes near the sensor, the infrared light will emit out from the LED, reflected and then detected by the detector. Theses sensors also acts as the proximity sensors and are commonly referred to as the obstacle detection systems. Passive infrared sensors only detect the radiations and do not emit from the LED. It comprises of: A sensor which is pyroelectric sensor, an infrared filter which blocks all the extra wavelengths means other than required one, a Fresnel lens which works for the collection of the light from a number of angles into a single point, a covering unit or housing unit for the avoidance of the environmental degraders like the moisture. Passive infrared sensors or PIR sensors are generally used for motion detection such as in home security systems. Whenever a moving object generating the IR enters the sensing range of the detector, the plus minus between the levels of the IR for the two pyroelectric elements is measured, which is sensed by the sensor leading to the passage of the signal to an embedded computer thus raising the alarm.

The Arduino UNO is the best board to start with the electronics and coding/programming. The UNO is the very much in demand and documented board of the whole Arduino family [2]. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 are analog inputs, a 16 MHz ceramic resonator

(CSTCE16M0V53-R0), one USB connection, one power jack, one ICSP header and one reset button. It also contains everything required to support the microcontroller; by simply connecting it with a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in the Italian and was chosen to mark the release of Arduino Software –IDE b 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino [3]. The Uno board is the first one in the series of USB Arduino boards and the reference model for the Arduino platform, for an extensive list of the current, past and the outdated boards.

II. LITERATURE REVIEW

Dhananjay G. Dange et al. in their research paper proposed for the designing and fabricating the wastage disposal collected in the Indian railways toilets [4]. The storage tank is in the form of an inner tank and the main tank the inner tank of the waste disposal system consists of a stirrer to stir the waste and the inner storage tank waste is collected in the main tank and is liquid in form due to the stirring action. Pratistha Ranjitkar in his research proposed for an innovative toilet which can measure the flow rate of the urine and measure the glucose level of the urine for its test for the kidney stones and the diabetes [5]. These tests although can be conducted in the laboratory in a better way but this research will be useful for the rural areas where test labs are not available so commonly while for the urban areas this test lab can also be useful for those people who want to monitor their health on the daily purpose. Shervin Hashemi, Mooyoung Han, Tschungil Kim and Yeonsik Kim in their research paper proposed for a smart toilet for the smart and green city structure in which they proposed for the separation of the urine and the feces in the toilet system into two separate tanks [6]. The urine will be collected in one tank and the feces can be collected in another tank and can be used for providing valuable nutrients to the soil as the manure. The design of the toilet should be light in weight and handy to use for the sanitization in the emergency situations. Manvita Asnodkar et. al. in their research paper proposed for the smart toilet based on the futuristic technologies for the smart cities. In their research they proposed for a toilet in which the test of the waste will be conducted automatically and the test reports will be sent to the doctor for the check-up so that proper guidance for the health can be taken. Further use of solar based lamp has been proposed than the use of electricity and thus reducing the pollution. Shwetank Shekhar Singh, Rajwant Pandey, Pawan Kumar Agrawal, Vartika Dubey in their research paper proposed an automatic toilet cleaning system for the railway toilets and railway platforms. This research is towards making the toilets automatic and switching the waste storage to a tank when the train waits on the platform. For this automatic operation the use of PIR and the relay sensors has been made. The present research paper is an enhancement of this research in which the entry of the toilet is made through the use of the fare ticket.

III. METHODOLOGY

The person going to use the toilet will have to use his ticket to use the toilet during his/ her journey. If his/her ticket is valid means his/her journey has not yet finished, he/she can use the toilet. Ticket is like an access card for the toilet. It works on bar code scanning technique of the ticket. This will verify the ticket details. Then the person after entering the toilet closes the door using the latch provided on the gate of the toilet which shows the engaged status for the toilet to the outsider so that others can become aware of the engaged toilet and can wait. Opening of the door of the toilet also ensures the water level for the flushing and for the hand wash. Otherwise it will inform the cleanliness department for the same. Now as the person uses the sheet this will also be sensed by the sheet weight sensor for the usage and the release of the weight will give an indication for the flushing of the sheet. After flushing the indicator will not show any indication. After washing the hands, the person will open the latch and thus the engaged status will go off and PIR sensor will also ensure the presence and closing of the door. This data will be sent to the cleanliness department. Now if the number of the persons used the toilet reached the specified level the indication for the cleaning of the toilet sheet will be shown on the display of the toilet and also the cleanliness department will be sent the message for the cleaning of the toilet. This will help in the better management of the toilets and also ensures their cleanliness. In the last if the wastage storage tank of the toilet gets filled then the infrared sensor in the wastage storage tank will give an indication for the same and the tank can be emptied on reaching a platform. All the functioning of the sensors and the alarm, indication system will be controlled with the help of a microcontroller. The microcontroller can be Arduino uno. Figure 1 illustrates the flow diagram for the procedure for the usage of the toilet of the railways.

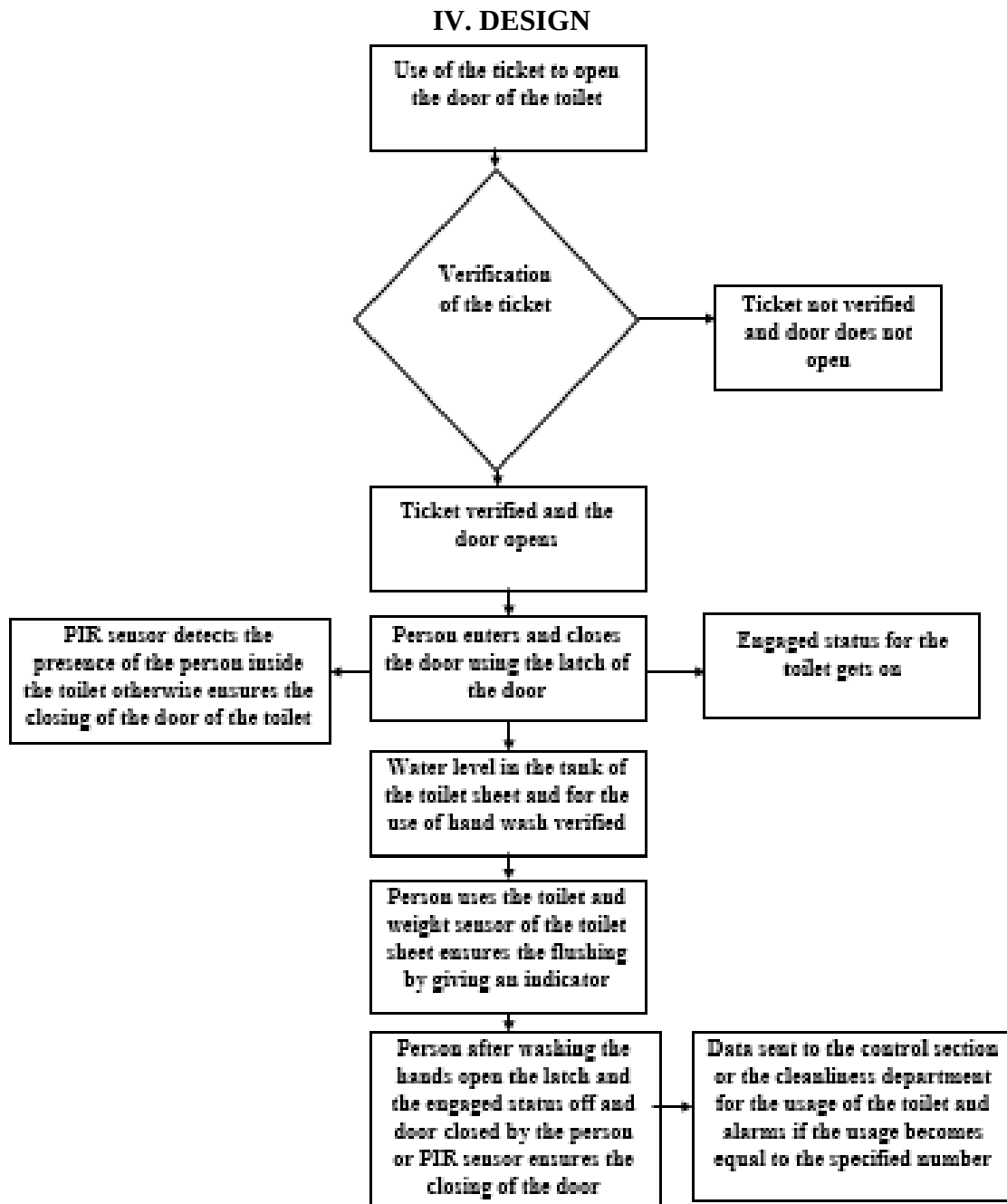


Fig. 1 Flow diagram for the procedure for the usage of the toilet of the railways.

V. RESULTS & DISCUSSION

Usage of the smart toilets will ensure the better management of the toilets and ensure the in-time and proper cleaning of the toilets. Thus it will stop the spread of the diseases spreading due to the unhygienic condition of the toilets of the railways. Some persons do not use the toilet of the railways due to their non-cleanliness so it will their problem also. As the entry to the toilets has

been made through the use of the ticket so only passengers having fare ticket can use the toilet and it can be ensured that for a particular time period no entry can be made again say 1 hour to avoid the misuse of the toilet. Emergency button can be used for the before time usage of the toilet but that usage must also be restricted to a certain number. This data will also be sent to the cleanliness department. The expiry of the ticket won't permit the entry to the toilet and also the PIR sensor ensures the presence and the absence of the person inside the toilet. The door of the toilet remains closed all the times till the usage of the entry ticket. It will ensure that no one can use the toilet travelling without the ticket or the usage of the toilet by any person while the train is waiting on the platform.

VI. CONCLUSION

This concept of smart toilets can be applicable for the trains having limited rush because for the general class of the Indian Railways this concept is difficult to be implemented because of the heavy rush in such compartments and a person has to permanently sit there for the cleanliness. For the other classes like sleeper class onwards this can be implemented successfully. The indication given to the cleanliness departments for the cleanliness and the water level has to be followed in a strict manner. If implemented fully this system will help to maintain the cleanliness and a check on the spread of the diseases thorough the railway toilets. During the period of COVID-19 the concept of smart toilets is must to keep a check on the spread of the disease.

VII. REFERENCES

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