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## SWACHH SMART TOILET

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### ABSTRACT:

In India, almost 60% of its population prefer open defecation over hygiene hence public toilets play a vital role. Although in recent times public toilets built by government help in reducing open defecation but the maintenance of these toilets in hygienic manner is still an issue. Due to the foul smell and improper maintenance the usage of these toilets are less preferred. Open defecation leads to multiple diseases and health problems such as diarrhea. Hence, the issue of open defecation and the hygiene and maintenance of public toilets needs a solution. Government of India has also introduced “Swachh Bharat” (Clean India). Providing uncontaminated toilets is the main objective of “Swachh Bharat” scheme. This paper could be fruitful in order to encourage the clean Bharat scheme. In this paper, we address the above mentioned issues and propose the implementation of public toilets using modern technologies to deliver clean and hygiene toilets, thereby reducing diseases and health problems and improving efficient usage of water and electricity resources.

**Keywords:** Smart Toilets, Arduino, Sensors, Sanitation, open defecation, IOT, Cleanliness

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### INTRODUCTION:

Sanitation plays a vital role in our country’s development and needs to be taken seriously as it may affect future growth. Even after implementing various techniques India has failed for providing and maintaining proper sanitation. One major challenge faced by India is Open defecation. Open defecation is the exercise of removal of human waste (stools and urine) in public without accessing the toilets [11]. The important problem with open defecation is, the E.Coli present in the human stool may enter the digestive tract of the human that may lead to diarrhea [11]. According to the recent survey by the World Health Organization (WHO), 58% of the Indian populations are habituated to open defecation.

According to the latest Census data reveals that the percentage of houses that have access to television and telephones in rural India exceeds the percentage of those that have access to basic toilet facilities [13]. In countries like India, any health problem has to be dealt with seriousness as this may affect the future growth of the country. In the survey made by the United Nations, Millennium Development Goals Report 2014, 66% of the Indian population in rural areas prefers open defecation [13]. To help make India open defecation free, the defence ministry has taken steps to make each and every state open defecation free. In 2014, when the Swachh Bharat Abhiyan was planned and launched, the call to get rid of open defecation gained quite an approval from the nation. India, which had sanitation coverage of mere 41.92 per cent in 2014, has increased its coverage to 63.94 per cent, and this improvement is being viewed as a major success of the Swachh Bharat Abhiyan campaign. India’s sanitation coverage has increased to 63.96 per cent from 41.92 per cent in 2014 [13]. Although many states claim them as Open defecation free, really that is not a fact.

In order to be Open defecation free it needs to concentrate on the development, maintenance and hygiene of the public toilets. These public toilets are utilized not only by the visitors from various places but also used by people who don’t have access to washrooms at home. In this regard, hygiene of the public toilets is very important as the usage of these toilets can be improved only if it is maintained properly. In addition to this, there are times the toilets cannot be used due to water

shortage or no water present in tanks. Often the foul smell present in the toilet as the garbage bins have not been emptied after appropriate time intervals.

In literature, various methods and technologies are proposed for maintaining the hygiene and sanitation of these public toilets in an efficient manner. In this paper, we address all of the above issues and provide various techniques that can be used for maintaining sanitation and to increase the usage of the public toilets.

#### **LITERATURE REVIEW:**

V. Sudha et. al.[1] summarizes the techniques used for maintaining the public toilets and technologies used for facilitating the physically challenged peoples. It concludes that one of the best and possible methods to avoid open defecation is first to provide the infrastructure facilities where ever necessary. It discusses the various technologies used for reducing the water used for flushing the toilet. It also sheds light on the different systems such as the light weight glass system with audio aid that was introduced for the visually impaired people as well as the system that with the help of smart toilet's equipment measured the parameters that were needed to identify any health issues of the user.

D. Katariya et. al.[2] proposed a system to maintain hygienic levels of Railway toilets through automation with the help of IoT. The proposed system automatically cleans the squat pan toilet with the help of a robotic arm. The robotic arm has a brush attached to its end effector which is used for the cleaning purpose. In this system there is minimum usage of water and electricity. Auto door locking system is also provided during the working of this system to avoid human interference. A database is maintained which gives all the notifications to authorities of the cleaning department of railway on a web page and an android application by using Wi-Fi.

K. Osathanukul et. al. [3] proposed a smart automatic urinal flushing system. It is designed and implemented to provide the entire usage information to a caretaker. It is developed using an ESP8266 chip connected with an ultrasonic sensor. Once the sensor detects an object, it controls a solenoid to flush water. This sensor and solenoid activation data is sent from ESP chip to a Raspberry Pi board via MQTT protocol. Once the data has been received, it is saved into a database inside the Raspberry Pi. This system has validated its functionality by testing under different scenarios.

K.Elavarasi et. al. [4] proposed a system which concentrated on keeping clean toilets and monitoring the sweepers working activities. This system is to use safe and hygienic toilets. It is based on IOT and image-processing concepts using different sensors like smell sensor, IR sensor,sonic sensor, RFID reader. The RFID reader (Radio Frequency Identification) is used to observe the sweepers activities (absence and presence in the toilet cleaning).

N.Muntashar et. al. [5] proposed an idea of a smart mech automatic flush system. This device helps to control the amount of clean water running in urinals in the toilets while ensuring that the urinals are always flushed after it has been used. It also prevents the chances of any infection from pushing the flushing button. And if there is a no water the system will send message to the caretaker and with the help of a message the caretaker can refill the water to the storage tank from time to time.It is implemented using Arduino Uno, water level sensor, ultrasonic sensor and odor sensor, relay, submersible water pump and GSM module.

S Mohamed Ashiq et al. [6] have designed and fabricated the semi autonomous flushing system.Their main objectives were to clean the train toilet basin automatically with more pressure than head pressure of the normal toilet flushing and with less quantity of water, reducing water wastage, making efficient cleaning of toilet basin since water should be consumed efficiently in trains.the proposed system uses the force exerted on the door that is used for opening and closing

the door to compress the water in a cylinder arrangement so that high pressure has been created, it opens a valve and water is pushed forcefully with high pressure into the basin.

R Kanesaraj Ramasamy et al. [7] have presented an architecture of Smart Toilet (ST) which does not focus only on a bowl or the wash basin but entire toilet cleaning frequency. They have proposed an architecture which is able to optimize the resources usage. They have even developed a mobile application that the manager will be able to view the status of the toilet and instruct the janitors to clean the toilet along with ability to view the average toilet usage on a monthly basis.

Priti Falke et al. [8] have proposed a system for cleaning the washroom. The proposed system makes use of a Node MCU and a variety of other sensors to provide different functionalities such as the use of PIR sensor to detect the motion of person when they enter in the washroom and switch the lights ON/OFF. The system detects the odour level present in the washroom with the help of ammonia sensor. The system is capable of tracking how frequently restroom are used with the help of SMS alert.

Mithya V et al. [9] have proposed a smart toilet using a turbidity sensor. The turbidity sensor detects water quality by measuring the level of turbidity in the water. It is able to detect suspended particles in water. An IR sensor is used to discover the dirt present in the toilet. If the dirt present, it gives the beep sound alerting the user to flush. They have used a gas sensor to detect the unwanted gases present in the toilet.

Madhurima Santra et al. [10] have proposed a Smart Wireless water level Monitoring & Pump controlling System. This project is designed to build to master a water level in a tank, and controlling the water pump by without human interfacing. They have used Arduino R3 as a microcontroller. Also, an ultrasonic sensor is used to detect the level of water in the water tank.

**PROPOSED SYSTEM:**

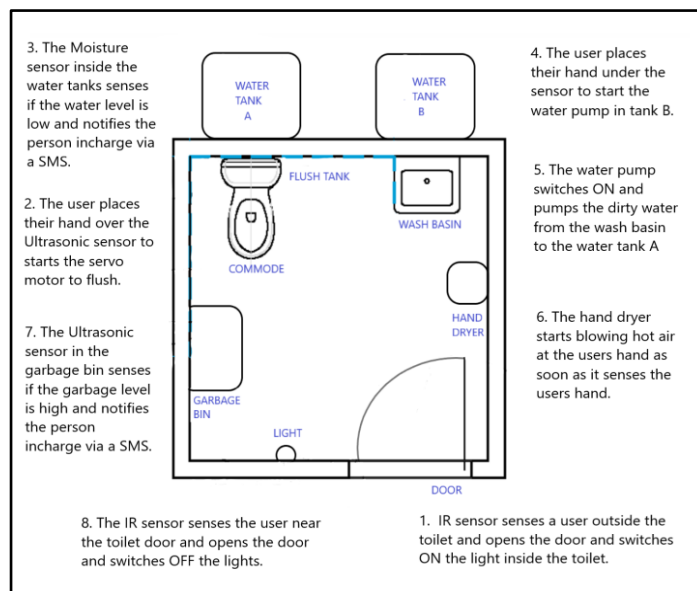


Fig. 1. System Design

The Swachh Smart Toilet consists of the following components:

**Arduino Uno:** It is a microcontroller board based on ATmega328P. It has an Operating voltage of 5 volts, 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, reset button and power jack.

**Global system for mobile (GSM) Communication:** It is a device which modulates and demodulates signals as required to meet the communication requirements. Used to send message to the admin when the water level in the tank drops below a certain threshold value

**Ultrasonic Sensors:** Ultrasonic Distance Sensor provides very short (2cm) to long-range (4m) detection and ranging.

**Moisture Sensor:** Used to measure the water level in the water tank.

**IR Sensor:** Used in the door module to detect the presence of a person.

**Servo motor:** It is an electrical device used which can push or rotate an object with great precision.

**Relay:** A relay is an electrically operated switch.

**Submersible Water Pump:** A submersible pump is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped.

**WORKING:**

The programming of the system is done using Arduino IDE and uploaded in Arduino UNO.

**Door Module**

The door module has the functionality of counting the total number of users along with the usage time per user and the total time of usage.

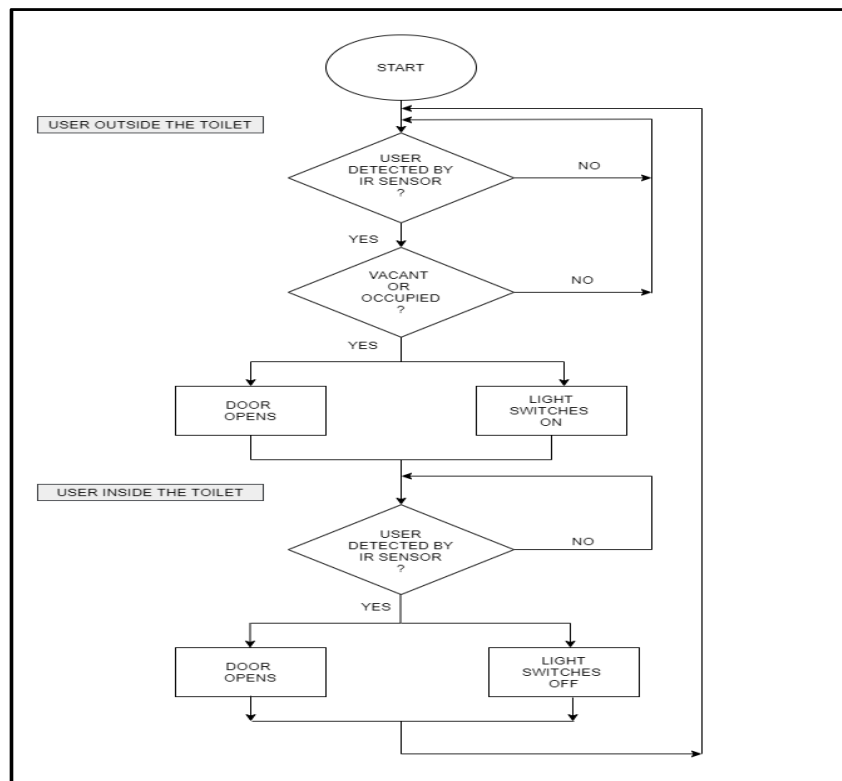


Fig. 2. Door Module

**Door Opening Mechanism:**

In our proposed toilet system, there is an IR sensor outside the washroom which detects the user waiting outside and if the washroom is vacant, it sends a signal to start the servo motor to unlatch the door and also the system will automatically switch ON the light in the washroom. Then the servo motor again latches the door once the user enters the washroom.

**Door Closing Mechanism:**

When the user wants to exit the washroom, the system has an IR sensor inside the washroom that senses the user standing near the door and sends a signal to start the servo motor to unlatch the door and also the system will automatically switch OFF the light inside the washroom. Then the servo motor again latches the door once the user exits the washroom.

**Water Management Module:**

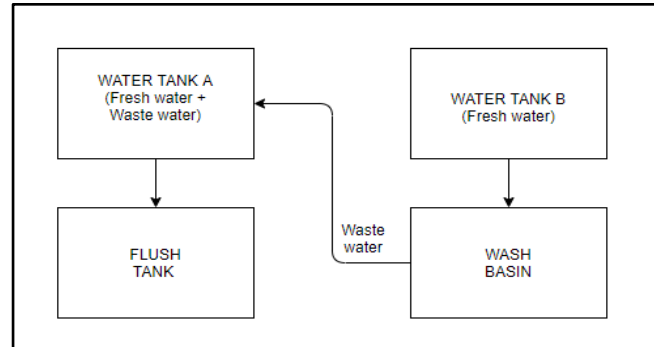


Fig. 3. Water Management Module

**Flushing Mechanism:**

When the user is done using the toilet, he has to just hover over the Ultrasonic sensor to flush. In the flushing mechanism, once the ultrasonic sensor detects the presence of an object, it starts the servo motor which pulls the lever of the flush tank.

**Hands Wash Mechanism:**

In this part, when the user places his hand under the tap, the sensor senses it and starts pumping water from the water tank B using a submersible water pump. The dirty water from the basin is then pumped back to water tank A using another submersible water pump. This water is later reused for flushing.

**Water Level Monitoring Module:**

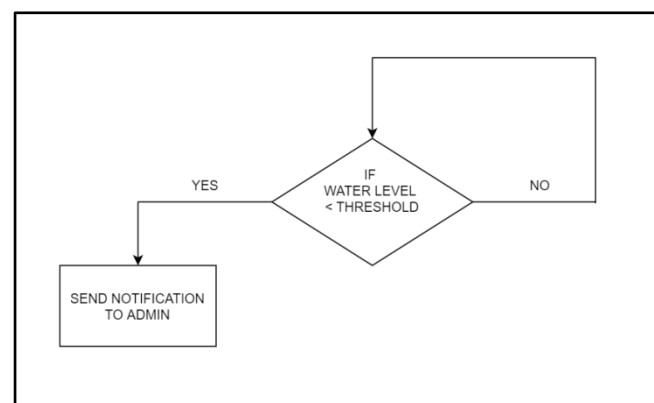


Fig. 4. Water Level Monitoring Module

The entire system has two tanks, water tank A for flushing and Water tank B for hand wash. Both these tanks have moisture sensors immersed in them which are used to monitor the water level inside the tanks. If the water level falls below a set value then it will notify the person- in-charge via a text message sent with the help of a GSM Module.

**Hand Dryer Module:**

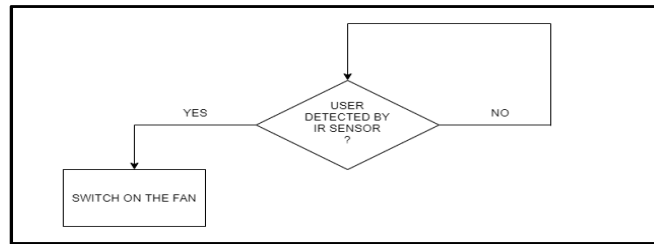


Fig .5. Hand Dryer Module

Here, when the user places his hand under the hand dryer, the IR sensor inside the hand dryer senses it and switches on the 12 V cooling fan that is attached. However, with the use of nichrome wire, the hand dryer is able to blow hot air on the user's hand.

**Garbage Monitoring Module:**

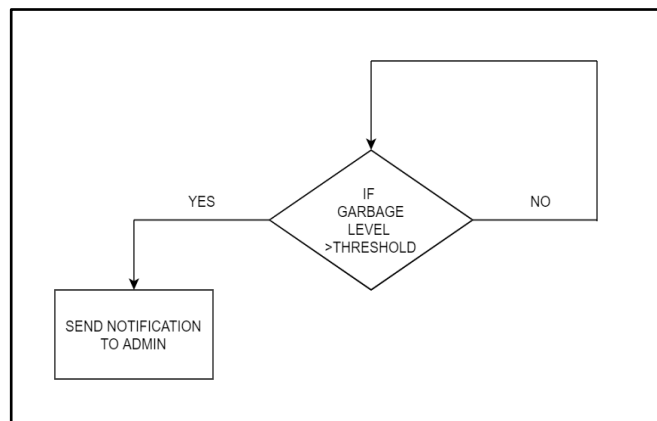


Fig. 6. Garbage Monitoring Module

In this part, the lid of the garbage can has an ultrasonic sensor attached to it. This sensor senses the depth upto which the garbage can is full. If the garbage can gets filled higher than the set depth then the system will notify the person-in-charge via a text message with the help of a GSM Module.

**RESULT ANALYSIS:**

In the below figure, the total number of people using the toilet is counted along with the usage time per user and the total time of usage.

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    COM12 (Arduino/Genuino Uno)

    Entering the toilet
    Exiting the toilet
    Number of people using the toilet:1
    16:04:48.106 -> User 1 usage time in seconds: 25
    16:04:48.139 -> Total Usage Time in seconds: 25
    Entering the toilet
    Exiting the toilet
    Number of people using the toilet:2
    16:05:54.270 -> User 2 usage time in seconds: 57
    16:05:54.304 -> Total Usage Time in seconds: 82
    Entering the toilet
    
```

Fig. 7. Serial monitor indicating the total number of users and the total time of usage



As shown in Fig.7, a message indicating a low water level in the water tank is sent to the person-in-charge via a GSM module.

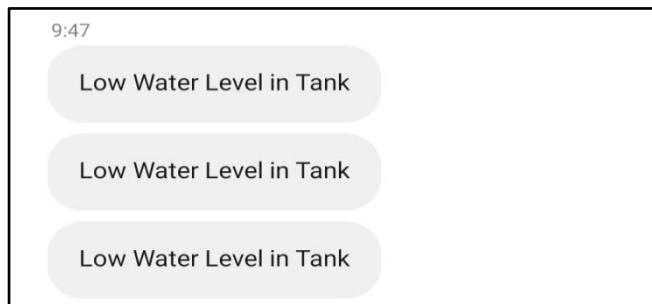


Fig. 8. Low water level notification is sent via a SMS

As shown in the below figure, a message is sent to the person-in-charge when the garbage bin is full.



Fig. 9. Notification is sent when the garbage bin is full

### CONCLUSION;

Hence, the system provides for a Swachh, Hygienic Smart Toilet. Our proposed project helps to avoid health issues created by open defecation and will create awareness among the people about proper sanitation. It makes use of IOT, which is a rapidly growing technology. Our system maintains hygiene along with conservation of electricity and water. Thus by using technologies in a smarter way, we can maintain cleanliness which is next to godliness.

### FUTURE ENHANCEMENT:

The proposed model further would have advancements in terms of design and functionality. Therefore for the future work an odor sensor for smell detection along with an automatic deodorizer can be a part of the system. Specifications for the gases to be detected can be made more precise. As well as Real time data analysis and grey water treatment can be included in the system.

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