E-SWACHH PUBLIC TOILET MONITORING SYSTEM

Sushant A. Parab[1], Kashyap K. Meher[2], Trupti A. Patil[3], Vomeshwari T. Badhe[4], Ranjana R. Gite[5]

[1-4]B.E. Students, [5]Assistant Professor

[1-5]Department of Electronics & Telecommunication Engineering, Vidyalankar Institute of Technology, Mumbai, Maharashtra, India

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Abstract – *Nowadays with the increase in population, toilet sanitization has become a major problem in our country. The main problems faced by people are clogging, bad odour, unhygienic toilet seats, unavailability of water, etc. Such improper hygienic conditions contribute to the spread of many diseases that can cause widespread illness and death. The main aim of this project is to create a concept of a hygienic toilet in the society by means of technology thereby providing toilet seat sanitization.*

Key Words: GSM, seat cleaning, solenoid, auto-flush, MQ-135

1.INTRODUCTION

In our country due to unhygienic toilets people suffer from various diseases like typhoid, cholera, hepatitis, etc. This happens because of improper use of given facilities, negligence by maintaining staff, unavailability of resources, etc. Also, the maintenance staff has to be there for maintaining the toilets whole day. This is a pity job to stay in the toilets for whole day even when not paid adequately nor provided safety equipment.

To overcome all these problems, we came with a project names 'E-Swachh Public Toilet Monitoring System'. The model comprises of ultrasonic sensors, gas sensor, GSM, DC motors, LCD, all controlled by Arduino controller. There is a toilet seat cleaning mechanism providing hygienic toilet seats. The toilets conditions are continuously monitored by sensors. If bad odour detected, a SMS will be sent to the control room. The water level in the tank will be continuously monitored and if empty, filled automatically by water pumps controlled by Arduino. The main objective of this project is to provide a hygienic toilet and also to eliminate the duty of a worker to continuously present in the washrooms.

2. LITURATURE SURVEY

Mrs. K. Elavarasi, Mrs. V. Suganthi, Mrs. J. Jayachitra have proposed "Developing Smart Toilets Using IOT" paper for the development of safe and hygienic toilet and also ensure the responsibilities of sweepers. The system prevents many contagious diseases that spread due to improper sanitation of the toilets.[1]

The paper shows ways of maintaining hygiene of a toilet using microcontroller, LCD, buzzer, GSM and different sensors like gas sensor, ultrasonic sensor, infrared sensor and RFID reader. The system consists of 4 phases. In first phase, it checks if there is any dirt present in the toilet basin and if present, it increases an alarm. In second phase, the smell is monitored by Figaro sensor. If sensed value extends the threshold, alert SMS is sent via GSM so that the toilet can be cleaned. The third phase monitors the sweeper's activity by using RFID tags. In the final stage, if the sewage level reaches the threshold, alert is sent to the control room that the septic tank is full.

Vinod, M.S, Baby, Bency has proposed a paper named "Research on self-sustained E-toilet for household/urbansemi urban, public/community sanitation".[2] India's first electronic public toilet 'e-toilet' was developed. The proposed paper provides better sanitation, cleanliness and ease of maintenance by using different Engineering technologies.

The proposed model is working on 2 thing, optimum usage and minimum wastage of water resources. The system mainly highlighting 2 processes i.e. sterilization and sucking mechanism. The sterilization mechanism comprises of automatic toilet seat cleaning mechanism that goes beyond the normal flushing system. The seat cover will be automatically opened or closed whenever required by using pedal or switch mechanism. Then the unit will be recombined with the sterilization technology. Power flushing/water sucking mechanism is made to minimize the water consumption used in flushing. The design comprises of an efficient high torque motor system which is capable of sucking the waste in the closet with high pressure. This will reduce the half of the water wastage.

3. PROPOSED SYSTEM

The proposed system consists of various elements as follows:

    i.   Door mechanism
    ii.   Sensors
    iii. Controller
    iv.   iv. Seat cleaning mechanism and Auto-flushing v. Water level detection

vi. GSM

The person has to press the button to enter the toilet. As the person enters, the LCD will display that the toilet is not vacant. The ultrasonic sensor on the opposite wall of the door will detect the person and then the controller will trigger the motors to lift the toilet seat cover upwards. Also, at the same time light and exhaust fan will be turned ON. After use as the person walks out, seat cover will be pulled down and then the seat will be cleaned and auto flushing is done. Light and fan will be turned OFF. On other hand, level of the water tank is monitored continuously. If the water level falls below the lower threshold, relay will switch the water pumps and the tank will be filled. As the water level reaches the higher threshold, the pump will be turned off. The odour will the monitored continuously, as the sensed value extends the threshold then SMS will be sent to the maintenance staff via GSM.

i. Door Mechanism

A push button is placed on the door. When a person presses the button, the solenoid valve will be triggered and the door will be opened.[3] There is another push button on the opposite side of the door through which a person can come out. As a person enters, a message will be displayed on the LCD that the toilet is not vacant. Similarly, as the person moves out, the LCD will display a message that toilet is vacant. 16x4 LCD is used.[4]

ii. Sensors

There are total 3 sensors used in the system in which 2 are ultrasonic sensors and 1 gas sensor. MQ-135, gas sensor is used in air quality monitoring. It is suitable for detecting LPG, CO2, smoke, ammonia, benzene, alcohol, etc. The gas sensor provides fast response, high sensitivity, wide detecting scope and long and stable life. The gas sensor module is having 2 output pins: analog and digital. The analog output of sensor is provided to the digital pin of controller. Detection range for ammonia is 10-300 ppm.[5] Another sensor used is HC-SR04 ultrasonic sensor. It uses sonar to determine distance of an object. It offers excellent non-contact range detection with high accuracy and stable readings. Its operating range is from 2cm to 400cm. The sensor module consists of 4 pins: VCC, GND, Trig, Echo. Trig is an input pin always provides with high pulse. When the sensor detects ultrasonic from receiver, it will set the Echo pin high and delay for a period(width) which proportion to the distance. To obtain the distance, measure the width of Echo pin.[6] In the proposed system ultrasonic sensor is used to determine the presence of a person inside the toilet. And another ultrasonic sensor is used for water level detection.

iii. Controller

In the proposed system, ATMEL ATmega2560[7] and ATmega328[7] are used.

a. Arduino Mega is responsible for most of the working of the system. It performs following tasks:

- In initial stage, controller will send a message to LCD that "Toilet is Vacant".
- The controller will compare the sensed value of gas sensor with the defined value and if the sensed value extends the defined value, controller will activate GSM so that GSM will send message to the maintenance staff.
- Ultrasonic sensor and motors are interfaced with controller. When ultrasonic sensor detects a person, controller will trigger the motors to lift the seat cover upwards and turn on the light and exhaust fan. LCD will display message "toilet is not vacant".
- After use as the person moves out, the toilet seat is pulled downwards and the controller will trigger the water pump with high signal which will clean the toilet seat. The light and fan will be powered off and message will be displayed on LCD "Cleaning in progress".
- As the cleaning process is done, the controller will send message to LCD "Cleaning is done" and few seconds later message will be displayed "Toilet is vacant".

b. Arduino Uno is a microcontroller. It is responsible for water level detection of the tank and automatically filling it.

iv. Seat Cleaning Mechanism and Auto-Flush

The seat cleaning mechanism comprises of motors and water pumps. When the person enters the toilet, seat cover is lifted upwards. Two DC motors of 90rpm each are used for lifting the toilet seat cover.[8] Relays are used for switching the motors.[9] There is a small water tank which is filled by the main water tank is used for cleaning the toilet seat. There is a small pipe placed on the inner side of the seat cover. When the seat cover is lifted downwards, water will be sprinkled on the toilet seat which is pumped from the mall water tank. The system also provides a facility of auto-flush after every use. The pump used is a DC submersible water pump operating at 3-6V supply providing 120 liters of water per hour with very low power consumption of 220mA.[10]

v. Water level detection

The water level detection and auto-filling are done by Arduino Uno. The water level of the tank is continuously monitored by using ultrasonic sensor. Two thresholds are

defined i.e. lower threshold and higher threshold. If the water level reaches lower threshold, signal will be sent to the controller. Then the controller will trigger the water pump to refill the tank. During refilling of tank, if the water level reaches the higher threshold then the pump will be turned off.

vi.   GSM

The Arduino Mega communicates serially with the GSM Sim900A module. It works on t he frequencies of 850MHz, 900MHz, 1800MHz, 1900MHz.[11] The baud rate can be configurable form 9600-115200 through AT commands. In the proposed system, when the detected value of gas sensor exceeds the defined value, SMS about bad our will be sent through GSM to the maintenance staff.
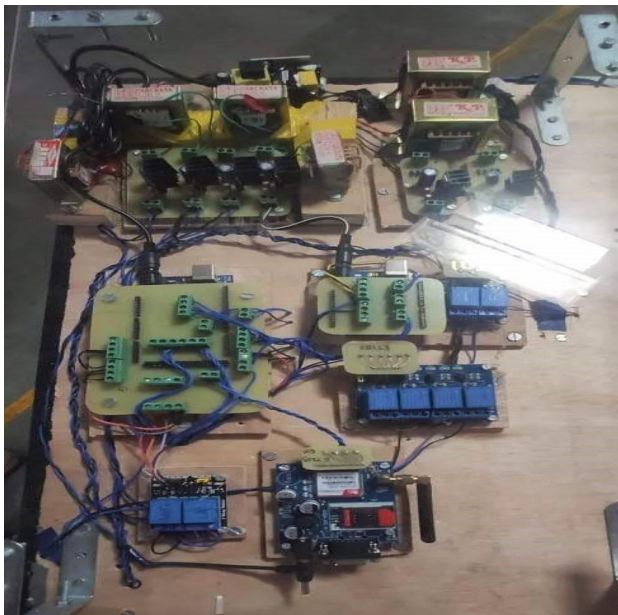
4. RESULTS

Fig 1. Assembled Circuit

Fig 2. Outer view of the model

Fig 3. Inner view of the model

5. CONCLUSION

In our proposed system we found some advantages over existing system, with the help of electronic sensors such as ultrasonic sensor, gas sensor and Arduino controller we have implemented an automatic toilet monitoring system

which provide proper sanitization. It reduces the spreading of contagious diseases due to improper sanitization. Our system also incorporates efficient use of power and reduces wastage of water. The system make smart use of electronics equipment and it is simple to use for any person.

6. Future Scopes

  i.   Solar Panels can be used to power the entire circuitry.
  ii. The toilet can be made mobile along with GPS implementation and an application to detect the location of toilet for person in need.
  iii. RFID tags can be used to monitor the cleaning done by staff of daily basis.
  iv. Choke up monitoring can be implemented using flow sensors and turbidity sensor

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