A REVIEW ON AUTOMATED HYGIENE FOR PUBLIC TOILET SYSTEM USING IOT

[1]K Sai Kowshik,[2]P Laxmikanth,[3]Mohammed Hassan,[4]P Sai Siddartha,[5]Ambika Naik Y
Department Of Electronics & Instrumentation Engineering,
Dayananda Sagar College of Engineering, Bengaluru, India

Abstract –While improvements are undoubtedly made in the modern world, our country's cleanliness is declining . The abstract of this project is to deliver clean and hygiene toilets. All The public restrooms ought to be hygienic and tidy. One of the goals of the Clean India initiative is to maintain clean restrooms. The clean India project may benefit from the support of this project. It may play a significant role in the clean India initiative in the future. They are primarily concerned with recognising the dirt in the toilets under the current system. In our suggested strategy, we focused on maintaining spotless restrooms while keeping an eye on the sweeper's work activities. It can avoid a variety of syndromes. It might raise people's awareness of proper lavatory management. We are therefore developing to utilise sanitary and secure restrooms. The MQ-135 sensor, PIR sensor, Ultrasonic sensor, and Turbidity sensor are only a few of the various sensors used in this project, which is built on IOT and image-processing techniques. Making use of these sensors we can create smart toilets.The emergence of the Internet of Things (IoT) has revolutionized various aspects of our daily lives, including the integration of smart technology into everyday objects. This abstract presents the concept of an IoT-enabled smart toilet, designed to enhance efficiency and hygiene while providing a seamless user experience. By integrating sensors, connectivity, and intelligent data analysis, the smart toilet brings forth a range of innovative features.

The IoT-enabled smart toilet has sensors built in to keep track of a number of factors, including occupancy, water use, air quality, and seat temperature. These sensors allow for real-time monitoring and data collecting, which improves user comfort and resource management.

Keywords - MQ- 135 sensor, PIR sensor, ultrasonic sensor, turbidity sensor, IOT

1. INTRODUCTION

Based on the data provided by UNICEF, India has the highest rate of exposure to human waste. An estimated 625 Million people lack access to restrooms. Serious public health issues are consequently getting worse.Only 50% of people in India use toilets. There are more than 5.1 lakh working toilets and public restrooms in Indian cities, in addition to more than 59 lakh renovated toilets, according to Swacch Bharat Mission Urban, a division of the Department of Housing and Urban Development. Despite the fact that more rural Indians had access to toilets in 2018 than they had four years prior, 44% of those toilets are still located outside in public spaces. It is significant to remember that 43% to 58% of rural people over the age of two relieve themselves in the open, and 44% is a popular measure.Despite the fact that our country has plenty of public toilets, there is no other way to check and maintain their cleanliness. There is no procedure in place to ensure that the workers allocated to these restrooms are clean.

Toilets should be inspected in person to keep track of their state, which is harmful to employees. As a result of these causes, the level of public toilets has dropped dramatically, endangering the health of the general public. In this research, we propose to use an IoT system to collect data on many aspects of toilets to solve the problem of toilet monitoring and maintenance, including air quality, access to water, and water, water closure, and vacant toilets. Using a well-defined web interface, this software may provide centralized data visualization. People in our nation lack sufficient information of how to use restrooms. Numerous illnesses, including malaria, hepatitis, the flu, cholera, streptococcus, typhoid, etc. are caused by this. Consequently, we introduce the "Smart Toilet" IOT concept. It is mandated that bathrooms be used and kept in a clean, hygienic manner. The project is based on IOT concepts and makes use of many sensors, including MQ-135, PIR, Ultrasonic, Turbidity, and Database. We are attempting to offer the public with clean restrooms and raise awareness with these items.All public restrooms ought to be

hygienic and tidy.

How we interact with common objects has been revolutionised by the Internet of Things (IoT), which has paved the door for creative developments in many fields. The use of IoT technology in lavatory facilities, notably in the form of smart toilets, is one such topic that is currently being explored. An IoT-enabled smart toilet comes with a number of functions targeted at improving user efficiency, convenience, and hygiene.

Toilets have typically been thought of as simple sanitary appliances with few features. With IoT integration, these commonplace fixtures can instead be upgraded to intelligent systems that collect information, deliver timely insights, and facilitate frictionless interactions. Smart toilets have the potential to revolutionise sanitation procedures and enhance the entire user experience by integrating sensors, networking, and data analytics.

The adoption of IoT technology in toilets creates new opportunities for enhancing the effectiveness, practicality, and hygiene of lavatory facilities. Smart toilets can optimise resource management, improve the user experience, and contribute to larger sustainability and health initiatives by utilising real-time monitoring, networking, and intelligent analysis.

2. LITERATURE SURVEY

IoT (Internet of Things) refers to a network of physical objects, devices, vehicles, buildings, and other items embedded with electronics, sensors, and software that can connect and exchange data with each other. IoT has enabled us to connect even our toilets to the internet. In this literature survey, we will explore the existing research on developing an IoT toilet using Arduino, MQ-2, IR sensor, and ultrasonic sensor.

"Smart Toilet System with IoT Application" by R. Khajornrungruang et al. (2019)
This research proposes a smart toilet system that utilizes IoT technology to monitor and control various toilet functions such as flushing, water flow, and seat temperature. The system uses an Arduino board and several sensors, including MQ-2 and ultrasonic sensors, to detect and monitor toilet usage. The system also has an IoT application that allows users to remotely control the toilet's functions.
"Design of an Intelligent Toilet System Based on the Internet of Things" by L. Liu et al. (2020)
This paper presents an intelligent toilet system that uses an Arduino board and various sensors such as an ultrasonic sensor, IR sensor, and temperature sensor to monitor and control the toilet's functions. The system also includes a mobile application that enables users to monitor and control the toilet's functions remotely.
"IoT Based Smart Toilet System" by P. B. Kakade et al. (2018)
This research proposes a smart toilet system that uses an Arduino board and various sensors, including an ultrasonic sensor, to detect and monitor toilet usage. The system also has an IoT application that enables users to remotely control the toilet's functions. The system's primary goal is to conserve water and reduce the toilet's environmental impact.
"IoT Based Smart Toilet System" by P. B. Kakade et al. (2018)
This research proposes a smart toilet system that uses an Arduino board and various sensors, including an ultrasonic sensor, to detect and monitor toilet usage. The system also has an IoT application that enables users to remotely control the toilet's functions. The system's primary goal is to conserve water and reduce the toilet's environmental impact.
"Smart Toilet Monitoring System using IoT" by S. Das et al. (2018)
This research proposes a smart toilet monitoring system that uses an Arduino board and various sensors such as an ultrasonic sensor and IR sensor to detect and monitor toilet usage. The system also has an IoT application that allows users to remotely monitor the toilet's usage and receive alerts when the toilet needs maintenance

3.METHODOLOGY

- In the first phase The passive infrared sensor does not radiate energy to space. It receives the infrared radiation from the human body to make an alarm. Any object with temperature is constantly radiating infrared rays to the outside world. The surface temperature of the human body is between 36° C - 27 ° C and most of its radiant energy concentrated in the wavelength range of 8 um-12 um.
- If someone present, it glow red led.
- If not then, it glow green led.
- Within the toilet, the MQ-135 sensor detects smells. This MQ-135 sensor measures the amount of ammonia gas present in the toilet's air. The ammonia inside the toilet produces a nasty odour. It has a strong odour that can be detected at concentrations more than 5 parts per million (parts per million).The ventilation fans are automatically switched on when the ammonia concentration in the toilet surpasses the predetermined threshold of 5 ppm; however, if the concentration falls below 5 ppm, no action is performed.
- if there is smell in the room or threshold value of the MQ-135 sensor is reached then the ventilation fan is turned on
- For water level detection we have used ultrasonic sensor to measure the level of the water in the tank. In our hardware we have used small container to store the water so based on the distance, the ultrasonic sensor can detect the water. If the water level decreased then the sensor will turn ON the water pump.
- The turbidity sensor measures scatted light at 90° which is according to ISO 7027 / DIN EN 27027 to beused for turbidity values below 40 NTU.The NIR light source and receiver are positioned in a 90° angle to each other. The light transmitted from the source is directed in equal strength to the reference detector and into the medium. Light is scattered from the particles and the portion which is scattered at a 90° angle is received by the detector. The meter now compares the light from the reference detector and scattered light receiver and calculates the turbidity value.
- In the final phase, if the turbidity sensor sense undissolved particles in toilet sink it will trigger the flush automatically.

4.CIRCUIT DIAGRAM

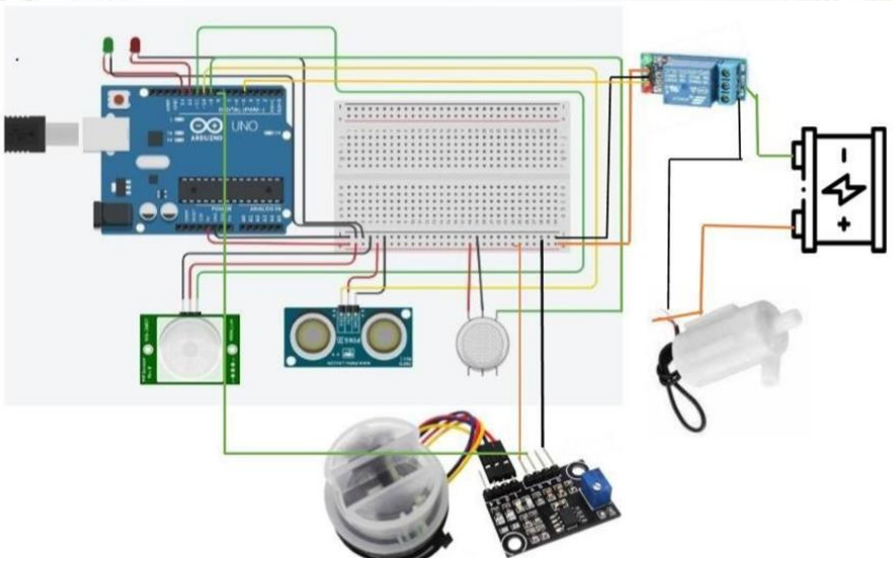

Fig.1 Simulation diagram on tinkercad

5.BLOCK DIAGRAM

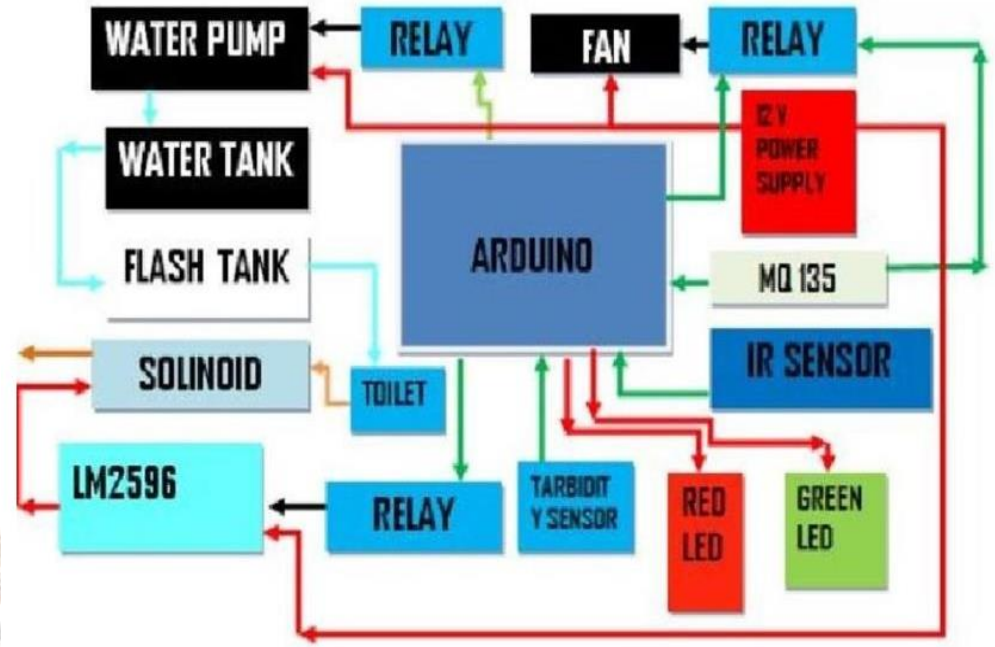

Fig.2 Block diagram of hardware implementation

6.DESCRIPTION OF EACH HARDWARE INSTRUMENT

6.1 AURDINO UNO:

A well-known microcontroller board from the Arduino family of open-source hardware platforms is the Arduino Uno. It is frequently used for a variety of electronic projects and prototyping by professionals, students, and enthusiasts.

6.2 ULTRASONIC SENSOR:

An ultrasonic sensor is a tool that uses sound waves to find objects that are nearby or present. It produces high-frequency sound waves and clocks how long it takes them to return to the source after striking an object. The sensor can determine the distance between itself and the item based on this time delay.

6.3 MQ-135 SENSOR:

The MQ-135 sensor is a gas sensor that is frequently used to identify environmental pollutants and air quality. It is especially sensitive to toxic chemicals like smoke, benzene, nitrogen oxides, ammonia, carbon dioxide, and other volatile organic compounds (VOCs).

6.4 TURBIDITY SENSOR:

A turbidity sensor, commonly referred to as a turbidimeter or turbidity metre, measures the turbidity or cloudiness of a liquid. It is frequently used in industrial applications where the presence of suspended particles or solids in a liquid needs to be quantified, environmental monitoring, and water quality monitoring.

6.5 IR SENSOR:

A device that detects and monitors infrared radiation in its environment is an IR (infrared) sensor, commonly referred to as an infrared detector or IR receiver. A type of electromagnetic radiation having longer wavelengths than visible light is infrared radiation. In many different applications, including proximity sensing, object detection, motion detection, and remote control systems, IR sensors are frequently employed.

7.SOFTWARE REQUIREMENTS:

7.1 AURDINO IDE:

The firm, initiative, and user community known as Arduino creates and produces single-board microcontrollers and microcontroller kits for the construction of digital devices. The software is licenced under the GNU Lesser General Public Licence (LGPL) or the GNU General Public Licence (GPL), whilst its ten hardware devices are licenced under a CC BY-SA licence. anyone can produce Arduino boards and distribute software. Commercial Arduino boards are offered on the official website or from accredited distributors. Different types of microprocessors and controllers are used in Arduino board designs. The boards have sets available of input/output (I/O) pins, both digital and analogue, that can connect to a variety of expansion boards (or "shields"). or breadboards and other circuits (for prototyping).

The boards feature serial communications interfaces,including Universal Serial Bus (USB) on some models, which are also used for loading programs. In addition to being utilised for programme loading, boards provide serial communications interfaces, including on some models, Universal Serial Bus (USB). The C and C++ programming languages, as well as a standard API known as the Arduino Programming Language, which was modelled after the Processing language and used with a modified version of the Processing IDE, can be used to programme the microcontrollers. The Arduino project offers an integrated development environment (IDE) and a command line tool created in Go in addition to using conventional compiler toolchains.

7.2 EMBEDDED C:

Embedded The C Standards Committee created C as a set of language extensions for the C programming language to solve issues of commonality between C extensions for various embedded systems. Non-standard modifications to the C language are often needed for embedded C programming in order to support improved microprocessor functionality such basic I/O operations, several independent memory banks, and fixed-point arithmetic. A Technical Report created by the C Standards Committee, which was most recently revised in 2008 and revisited in 2013, established a uniform standard that all implementations must follow. It offers a variety of features not found in standard C, such as named address spaces, fixed-point arithmetic, and fundamental I/O hardware addressing. The majority of conventional C's syntax and semantics are used by embedded C, Examples of C programming include the main() function, variable definition, datatype declaration, loops (while, for), functions, arrays and strings, structures and unions, bit operations, and macros.

8.RESULTS:

- A prototype model for public toilet system has been developed .
- Hygeine for public toilet system has been improved.
- It stops the spread of the numerous new infectious diseases brought on by bad bathroom sanitation
- With the use of the Internet of Things, a fast developing technology, our suggested initiative would raise public awareness of good sanitation.
- Everyone will be forced to strictly adhere to cleanliness and adequate sanitation in the restrooms under our suggested method.
- Infront of IR sensor if there is any object detected the red LED will glow otherwise the green LED will glow
- If there is any gas detected by the MQ-135 sensor the fan will be turned on and the gases will be thrown out.

9.CONCLUSION:

- With the use of the Internet of Things, a fast developing technology, our suggested initiative would raise public awareness of good sanitation.
- Everyone will be forced to strictly adhere to cleanliness and adequate sanitation in the restrooms under our suggested method.
- Smart toilets using IoT represent a significant advancement in bathroom technology, offering a range of features and benefits.
- These innovative fixtures enhance hygiene, optimize resource usage, and provide personalized user experiences.
- With the increasing adoption of IoT technology, smart toilets are becoming a popular choice in modern homes, offices, and public facilities, transforming the way we interact with and experience our bathrooms

10.REFERENCES:

[1] Scheduling and Predictive Maintenance for Smart Toilet by AMAR LOKMAN, R. KANESARAJ RAMASAMY, (Senior Member, IEEE), AND CHOO-YEE TING. Lokman, A., Ramasamy, R.K. and Ting, C.Y., 2023. Scheduling and Predictive Maintenance for Smart Toilet. *IEEE Access*.

[2]WORK AUTHENTICATION AND MONITORING SYSTEM WITH BLOCKCHAIN AND INTERNET OF THINGS (IOT) by POOJA TRIPATHI, AMAN PRADHAN, SHRUTI KHANDELWAL, AKANKSHA SINGH and ANUSHKA SINGH. TRIPATHI, P., PRADHAN, A., KHANDELWAL, S., SINGH, A. and SINGH, A., 2022. WORK AUTHENTICATION AND MONITORING SYSTEM WITH BLOCKCHAIN AND INTERNET OF THINGS (IOT).

[3] IoT Based Cubicle Occupancy Indicator for Public Toilets by Adrian B. Alfonso, Rainier C. Atizado, Angela Mae V. Encinas, Deanne Marie Nivera, Leanne Kirsten G. Samala, Dr. Eric Blancaflor. Alfonso, A.B., Atizado, R.C., Encinas, A.M.V., Nivera, D.M., Samala, L.K.G. and Blancaflor, E., IoT Based Cubicle Occupancy Indicator for Public Toilets.

[4] Smart Toilet DHARMESH KATARIYA, 2PRATIK PARIK, 3AKSHAY PINCHA, 4GAURI LODHA, 5ANITA BORSE. Katariya, D., Parik, P., Pincha, A., Lodha, G. and Borse, A., 2018. Smart Toilet. International Journal of Electrical, Electronics and Data Communication, 6, pp.71-74.

[5] Futuristic Technologies for Smart Toilets in Smart Cities by Manvita Asnodkar1, Dr. Prasanjeet Patil, Dr. Nilesh Bahadure, Uma Pujari. Asnodkar, M., Patil, P., Bahadure, N. and Pujari, U., 2020. Futuristic Technologies for Smart Toilets in Smart Cities. *International Journal of Engineering Research and*, *9*.

[6] Developing Smart Toilets Using IOT by Mrs.K.Elavarasi, Jayachitra. Elavarasi, M.K., Suganthi, M.V. and Jayachitra, M.J., 2018. Developing smart toilets using IoT. International Journal of Pure and Applied Mathematics, 119(14), pp.611-8.

[7] Smart Toilet Monitoring System Using IOT by Vimalesh Dhamale , Shekhar Singh , Shubham Zadane , Manish Bhelande. Vimalesh Dhamale, Shekhar Singh, Shubham Zadane, Manish Bhelande, "Smart Toilet Monitoring System using IOT," International Journal of Computer Trends and Technology, vol. 68, no. 3, pp. 67-69, 2020.

[8] IoT based Smart Washroom by Ms. Nayana B. Chide1, Mr. Nilesh P. Bobade. Chide, M.N.B. and Bobade, N.P., 2020. IoT based Smart Washroom. International Research Journal of Engineering and Technology (IRJET), *7*(01).

[9] Kim, J., Kim, Y., Kim, H., & Han, D. (2017). IoT-based Smart Toilet for Urine Analysis. In 2017 IEEE 17th International Conference on Bioinformatics and Bioengineering (BIBE) (pp. 71-74). IEEE.

[10] Chong, Y. T., & Wong, W. C. (2016). IoT-enabled Smart Toilet System for Healthcare Monitoring. In 2016 IEEE Region 10 Symposium (TENSYMP) (pp. 369-374). IEEE

[11] Jeon, J., Yoon, K., & Yang, S. H. (2020). Design and Implementation of a Smart Toilet System Based on IoT. Electronics, 9(10), 1662.

[12] Huang, M., Yang, Y., & Sun, L. (2020). A Smart Toilet Design Based on Internet of Things. In Proceedings of the 2020 10th International Conference on Electronics Information and Emergency Communication (ICEIEC) (pp. 383-386). IEEE.