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IoT based E-toilet with Automatic Flushing and Sanitizing

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ABSTRACT

In our nation, sanitation has always been a major issue. Most significantly, this issue is not just concentrated on the rural areas but is also widespread in urban and semi-urban areas. The people do not show the same level of concern when it comes to keeping the public sanitation systems clean as they show towards the ones at their homes. The right to good health and sanitation is one of the goals to be achieved as per the Millennium Development Goals of the United Nations organization, 2000. However, in India, the scenario of public toilets is still dismal. One of the reasons for this is that people do not bother to clean up after they use the toilet. These places are thus the breeding grounds of bacterial germs like Escherichia coli and many deadly diseases. Till today many e-toiles are installed successfully at different parts of India even at the smallest sector is being covered, but still many people sometimes prefer discomfort to use these toilets because of cleanliness. Looking at such troubles, the decision to construct unmanned toilets which work on a sensor-based technology. The self-sanitizing and water conservation mechanism in the toilet makes it unique. The user will be guided with smart communication which will make them feel user friendly. To conserve water, the toilets are programmed to flush 1.5 litres of water after three minutes of usage and 4.5 litres if the usage is longer. This "smart" toilet also washes the platform by itself after every 10 persons use the toilet and also after some time it sanitizes itself with UV light. The design is robust and cost-effective. As the old saying goes "cleanliness is next to godliness", this is a public welfare project which aims to propagate a cleaner and hygienic society and hence, take our nation to the heights of glory.

Keywords: *Automatic flushing, Coin acceptor, e-Toilet, IoT, Sanitizing.*

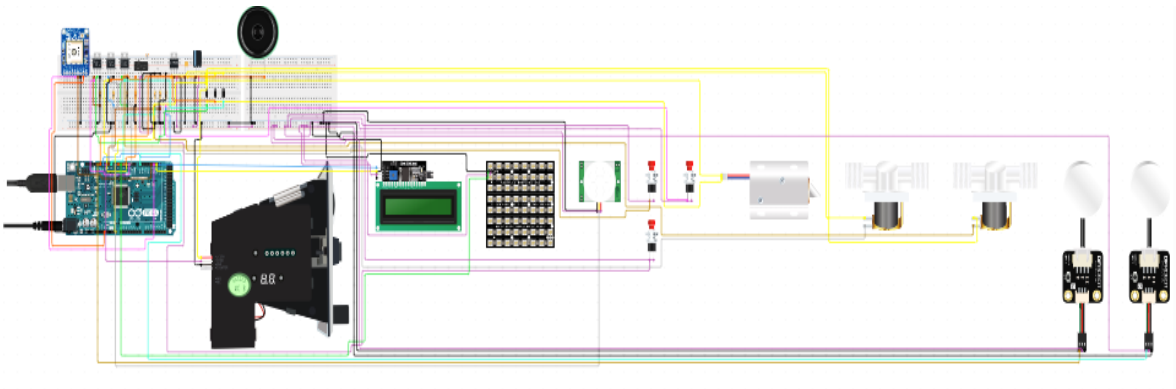
1. INTRODUCTION

The project Development of a smart toilet for automatic sanitizing deals with automatic cleaning of Indian toilets without requiring any human assistance. Most of the public toilets are not clean due to the irresponsible people who are often enforced to flush the toilet after using it. In India, all the state and central governments are allotting numerous funds for constructing public toilets. The central government under "SWACHH BHARAT MISSION" has built a vast number of new toilets to provide the citizens with a healthy and hygienic environment. Therefore, the cleaning of public toilets is equally important as cleaning of household toilets. So, we have developed a hardware that can automatically sense the presence of a human and

guide him with the utilities inside by voice transmission commanded by our smart machine e-toilet. Till today many e-toiles are installed successfully at different parts of India even at the smallest sector is being covered, but still many people sometimes prefer to use these toilets because of cleanliness. They are found to be used in airports, shopping malls, multiplexes, etc. But their use in public toilets is not possible due to the excessive cost and frequent maintenance. In our papers, we have explained that after some usages the platform and floor are flushed and sanitized automatically when the presence of a human is not detected and as it is supported by an IoT platform all the working operations, status of daily usage, funds collected (by in a day, week, month), troubleshooting and fail-safe operations are uploaded to the cloud server and to the website.

2. PROBLEM STATEMENT

Lack of toilets has resulted in defecation in open places, which has created a major sanitary problem. With increased awareness among the people, the government and a number of organizations should come up with public urinals and toilets in various areas. Most of the public E-toilets remain perpetually dirty because the users don't flush water after using the toilet. It is also because regular cleaning isn't done properly by the cleaner. When the public toilets remain perpetually dirty then the system cleans the toilets automatically with the help of various sensors and Arduino controllers. Hence, new and innovative solutions are required for the betterment of these public toilets.



3. CIRCUIT DIAGRAM OF PROPOSED SYSTEM

Fig.1. Circuit connection of proposed system

3.1 CONTROLLER

We use this Arduino Mega as a microcontroller board which is based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

3.2 COMMUNICATION DEVICES

We use this GSM module which is a mobile communication modem; it stands for global system for mobile communication (GSM). A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot and using this we can get all data to our cloud server and also get the location.

3.3 INPUT DEVICES

3.3.1 Push-button:

A push-button is a simple switch mechanism to control some aspect of a machine or a process. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed and is used for manual flush and door unlock from inside.

3.3.2 Latching switch:

A latching switch is a switch that maintains its state after being activated. A push-to-make, push-to-break switch would therefore be a latching switch – each time you actuate it, whichever state the switch is left in will persist until the switch is actuated again.

3.3.3 Passive infrared sensor:

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view.PIR sensors detect general movement, but do not give information on who or what moved. The term passive refers to the fact that PIR devices do not radiate energy for detection purposes. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects and is used for user detection in toilets.

3.3.4 Ambient light sensor:

An ambient light sensor is a photodetector that is used to sense the amount of ambient light present. There are three common types of ambient light sensor: phototransistors, photodiodes, and photonic integrated circuits, which integrate a photodetector and an amplifier in one device and is used for sensing the surrounding area light and accessing LED tube light ON/OFF.

3.3.5 Currency detector:

A currency detector or currency validator is a device that determines whether notes or coins are genuine or counterfeit. The process involves examining the coins and/or notes that have been inserted into the

machine, and conducts various tests to determine if the currency is counterfeit. Because the parameters are different for each coin or note, these currency acceptors must be correctly programmed for each item to be accepted.

3.4 OUTPUT DEVICES

3.4.1 Solenoid valve:

A solenoid valve is an electromechanically operated valve. Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid and the type and characteristics of fluid they control.

3.4.2 Non-contact Level sensor:

Level sensors detect the level of liquids and other fluids and fluidized solids, including slurries, granular materials, and powders that exhibit an upper free surface. Substances that flow become essentially horizontal in their containers (or other physical boundaries) because of gravity whereas most bulk solids pile at an angle of repose to a peak. The level measurements are continuous values. Continuous level sensors measure level within a specified range.

3.4.3 Stereo Speaker:

Stereophonic sound or, more commonly, stereo, is a method of sound reproduction that creates an illusion of multi-directional audible perspective. This is usually achieved by using two or more independent audio channels through a configuration of two or more loudspeakers in such a way as to create the impression of sound heard from various directions, as in natural hearing.

3.4.4 Liquid-crystal display:

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical devices that use the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, instead of using a backlight or reflector to produce images in colour or monochrome. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements.

3.4.5 Dot-matrix display:

The display consists of a dot matrix of lights or mechanical indicators arranged in a rectangular configuration (other shapes are also possible, although not common) such that by switching on or off selected lights, text or graphics can be displayed. A dot matrix controller converts instructions from a processor into signals that turn on or off indicator elements in the matrix so that the required display is produced.

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3.4.6 Electromagnetic lock:

An electromagnetic lock, magnetic lock, or maglock is a locking device that consists of an electromagnet and an armature plate. There are two main types of electric locking devices. Typically, the electromagnet portion of the lock is attached to the door frame and a mating armature plate is attached to the door. The two components are in contact when the door is closed. When the electromagnet is energized, a current passing through the electromagnet creates a magnetic flux that causes the armature plate to attract the electromagnet, creating locking action. Because the mating area of the electromagnet and armature is relatively large, the force created by the magnetic flux is strong enough to keep the door locked even under stress.

4. FUNCTIONALITY

- The user has to insert a coin.
- The door opens automatically.
- The sensor-based light system is turned on once the user enters the toilet.
- There is a programme set on these toilets that flushes 1.5 litres of water after three minutes of usage and 4.5 litres if the usage is longer. The basic idea is to conserve water.
- This e-toilet also is programmed to clean the platform on its own after the toilet has been used by 5 or 10 persons.
- There are not only audio commands inside the toilet to guide the user but also an instruction note pasted outside the toilet to make the user understand the functioning of this toilet.

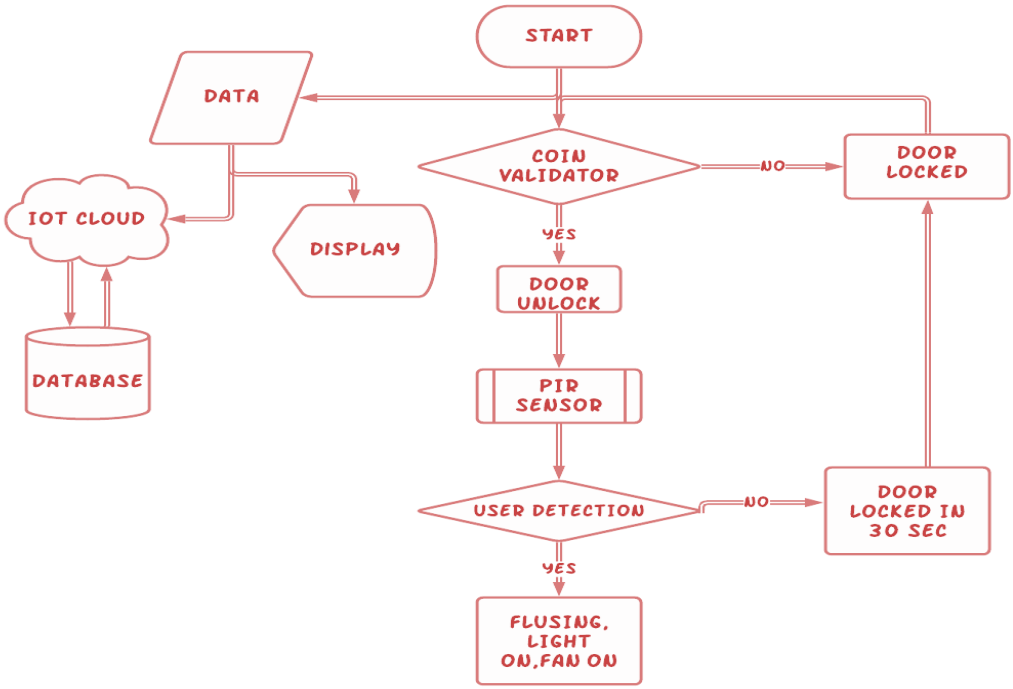

Fig.2.Flowchart explaining how IoT based E-toilet with Automatic Flushing and Sanitizing.

5. RESULTS

The monitoring signal gets from sensory units as shown in above Fig.1 hardware connections. By observing the figure, we can point that the coin validator needs to be calibrated properly with various coin currencies and also setting a perfect delay between each operation which is going to execute. By investigating further, a flowchart presented in the Fig.2 shows the steps and decisions which are followed with a certain delay to complete a loop per single use. As per the changes of outdated hardware in a system, outputs tend to give a more reliable and sustainable performance; with IoT, in the background, the database can be controlled over the cloud which makes it easy to execute, read and write any command.

6. CONCLUSION

In this article, we have clarified the utilization of IoT in public toilet services with the execution of a cloud-based e-Toilet observation framework. The designing of the monitoring-based hardware exhibited first. Implementation of the Wi-Fi and cloud server is presented and then calibrated with the monitoring-based hardware are analysed. In the view of the proposed engineering, an IoT-based e-toilet framework was executed. The assembled information was transmitted to the IoT cloud utilizing Wi-Fi, which blisters high information rates and wide coverage regions. The IoT cloud is in charge of forming the coin collection datasheet, total usage, water usage, level of the water tank, and activity status of the e-toilet information to clients and putting away this important information for assistive examination, which is actually based on HTTP server. It is trusted that long haul and easy to use e-toilet can enormously help alleviate human services issues to specific hygiene.

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