

Automatic Deodorization and Toilet Cleaning System

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Abstract: Living in today's time, the bustle of work makes the human commitment to clean up their homes and living areas, especially the toilet area, diminished. To address this issue, an automatic toilet deodorization and cleaning system was developed to ensure that the toilet environment is clean and can work automatically. The developed system consists of several parts such as a watering part for draining water and soap to the floor part of the toilet, a ventilated part to keep the room in the toilet always good, a lighting part to ensure sufficient lighting in the toilet, an input sensor part as a determinant of the presence of the use of the toilet or toilet in use, the display part of the process as an indicator of the toilet user, The control part is Microcontroller (Arduino) to control the entire system and power supply parts to enable the entire system to get enough power supply. When the input sensor receives a user presence signal, the LCD display and LED indicator will provide information and temperature readings related to the toilet. The system will be activated and equipment such as lights and fans will be turned on. Once the user has finished using the toilet, the system will perform the process of watering water and soap into the toilet to ensure that the floor is clean. The LCD display and LED indicator will again display toilet information for the next user. The next toilet user will feel more comfortable with the information provided through the display and indicators and clean toilet floor conditions before entering the toilet.

Keywords: Automatic Deodorization And Toilet Cleaning System, Temperature Sensor, Ultrasonic Sensor, Arduino Maker UNO

1. Introduction

The flush toilet is one that disposes of human waste by flushing it into the pipeline to be treated elsewhere. Flush toilets are designed to be used while sitting or squatting. But for the project this time more focused on squatting. In this project, the user-friendly toilet system benefits not only ordinary users but also those with disabilities. This is because the user-friendly toilet system is built on top of Arduino Uno, which incorporates electronic parts to allow the system to automatically open and shut down, control the water level used, and clean itself [1]. Arduino Uno installed as microcontroller to make easier do debug program. The toilet will also be equipped with LEDs and an LCD to inform the toilet user is occupied or not. As a result, existing technology can be used to create a user-friendly toilet system, making it easier for users as well as maintaining the cleanliness of the toilets especially during the Covid-19 season. An unsanitary toilet will lead to the transmission of viruses and bacteria to the user. Smarter toilet systems may include capabilities such as water conservation and automatic cleaning. It is thought out to develop a superior high-tech toilet system with more research.

The most difficult aspect of creating this automatic deodorization is that it takes a large space to install a second water tank connected to the water pipe around the wall, making the toilet a little cramped for large-bodied users [2]. In addition, the already watered floor will remain wet as there is no ventilation that can dry the floor. The solution is, ventilation fan will be installed in the toilet to allow good ventilation to remove bad odors and also dry the floor. Furthermore, the floor that has been watered with a detergent mixture will become wet and smooth, potentially causing injury. To deal with this problem, a tap water valve should be installed to clean soapy water. Furthermore, determining the capacity necessary for the water pressure to produce water to push all dirt and dust to the edge of the channel or into the channel hole is difficult. In addition, insufficient light in the toilet will block the user's view when using the toilet. This will cause the toilet to be dim and risky to the user. As a solution, two lights will be installed in the toilet where the lamp1 will turn on automatically when the user enters the toilet. Lamp2 is installed to enable the user to change the brightness of the lamp according to the desired comfort and brightness. This alternative is to provide adequate lighting and brightness to consumers when using the toilet.

The purpose of this project is to build a user-friendly toilet cleaning system to ensure the toilet condition always in a clean and hygienic. The system will use Arduino, a popular open-source microcontroller platform, to control the various components and automate the cleaning process with the help of sensor. It will use a water pump to dispense cleaning solution or water over the toilet and floor, and will include a drying function to help prevent streaks and residue. The system will be programmed using Arduino to perform different cleaning routines or to use different cleaning solutions depending on the needs and preferences of the user. Next objective of this project is to develop a system that utilizes an ultrasonic sensor to detect the presence of users in order to allow cleaning equipment to be in ready mode [3]. By using an ultrasonic sensor to detect the presence of users, the cleaning equipment can be put into a ready mode when the area is unoccupied, ensuring that the cleaning process is safe and efficient. Using this technology, the cleaning equipment can be programmed to turn on only when the area is empty, maximizing the efficiency of the cleaning process while minimizing the risk of accidents or disruptions [4]. Lastly is to develop a system that can display information related to the condition of the toilet that will be used to users. By implementing a system that displays information about the condition of the toilet, users can make informed decisions about which toilet to use, potentially reducing wait times and increasing overall satisfaction with the facilities [5]. The LCD displays can be placed outside of each toilet stall and can show real-time information such as whether the toilet is occupied or available, as well as its cleanliness level.

2. Materials and Methods

This section fully describes the resources and method used in this project. The data will include all aspects of the work procedure for each stage, such as a block diagram, the hardware and software used, and an overview of the system flowchart.

2.1 Flowchart

Throughout the project and development of the automatic cleaning, the project flowchart as shown in figure 1 is used to represent the overall workflow of the development process.

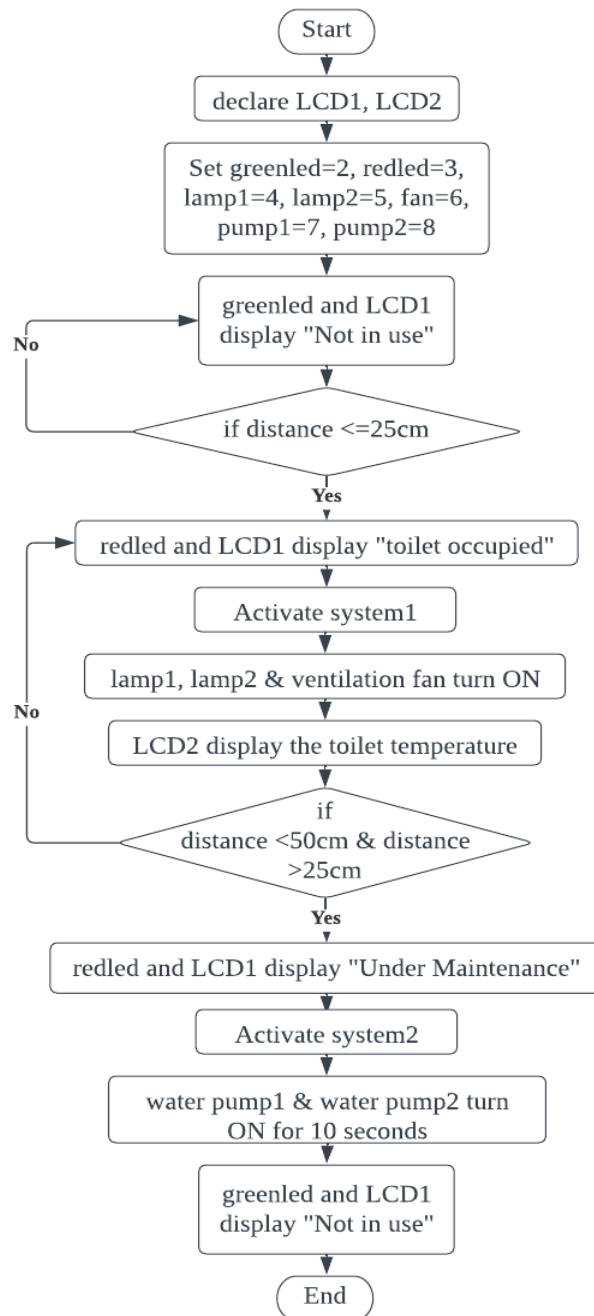


Figure1: Project Flowchart

2.1.1 Flowchart Explanation

Firstly, the LCD1 and LCD2 are declare in programming by using Arduino IDE as the output. Then the components are connected to Arduino Maker UNO by the correct port. The green led is connected to the port 2, red led to port 3, lamp1 to port4, lamp2 to port5, fan to port6, pump1 to port7 and pump2 to port 8.

Then the system will start by green led and LCD1 is displayed “Not in Use” when there is no presence of user. The ultrasonic sensor will detect any obstacle in range less than 50cm, if there is any obstacle, the LED will turn to Red and LCD1 outside the toilet is turn ON to inform the user that “Toilet is occupied”. But if there is no any obstacle within 50cm, the LED will remain Green. The microcontroller will activate the system 1 that will cause Lamp1 and Lamp2 to turn ON. Lamp2 is connected with dimmer as an option for the user if the lighting in toilet is dimmed. The user can adjust the brightness of Lamp2 as appropriate. The ventilation fan is turn ON to ensure good ventilation in the toilet.

The notification inside the toilet which is LCD2 will display the toilet temperature. If the temperature sensor detects the temperature is within 26° to 28°, the LCD2 inside the toilet will displayed “The temperature is normal” and “The temperature is abnormal” if the temperature is out of range. When the temperature is abnormal, the system proceeds with ultrasonic detecting the obstacle. Then the ultrasonic sensor will detect the user has done using the toilet, the microcontroller will activate the system2. In this system, the led is still red but the LCD1 is display “Under Maintenance” to inform the user the toilet is in cleaning process. the water pump1 and water pump2 will drain soap to tank1 and tank 2. The other hardware such as lamp1, lamp2 and ventilation is still turn ON but the water pump1 and water pump2 will turn ON for 10 seconds only. Lastly, the LED and LCD1 will return to Green and display “Not in Use” after the cleaning process is done

2.2 System Block Diagram

A block diagram is used to depict the operation or screen navigation of the entire system of automatic deodorization and toilet cleaning. Figure 2 depicts a simple block diagram of the microcontroller, input sensor, output indicator, and output.

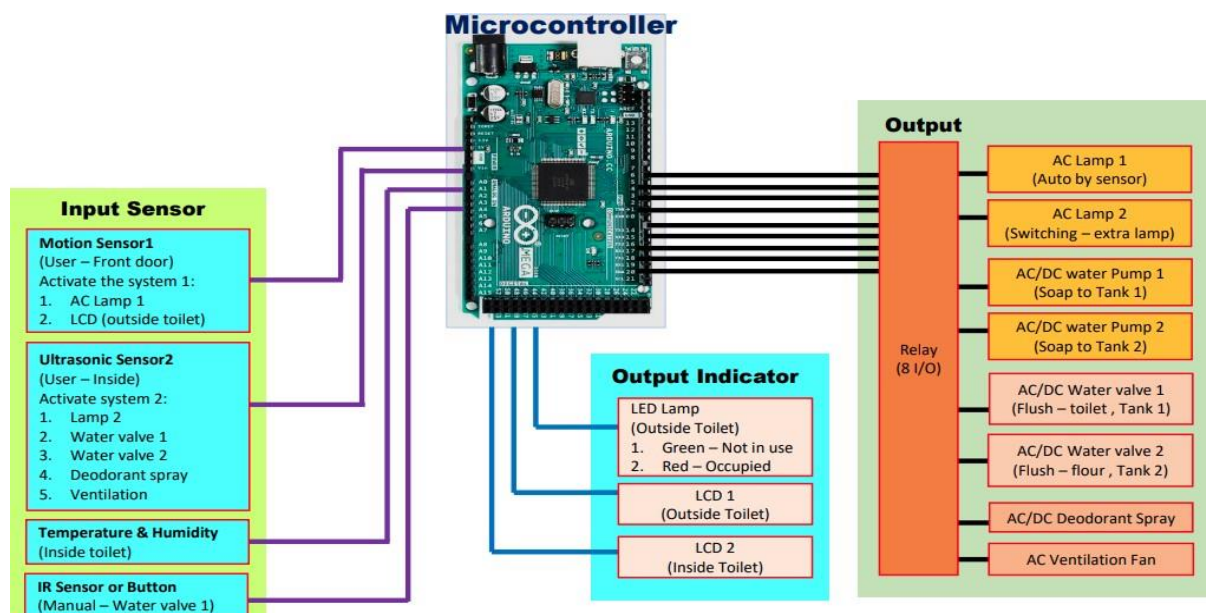


Figure 2: Simple system block diagram

2.2.1 Block Diagram Explanation

The detail system block diagram is shown in the figure 3.5 above. The Arduino Uno was chosen as the microcontroller for this system because it can control the activity of the toilet system [6]. The

microcontroller, Relay, and motor driver are all powered by the same power supply [7]. The buttons are connected to the microcontroller in order to send the digital input for the part of digital input. The buttons are linked to the microcontroller and are used to manually flush the water. As a result, the sensor is also connected to the microcontroller as an auto detect and send the signal in wave form to the microcontroller. Furthermore, the LCD and LEDs are connected to the microcontroller as the output to show the condition of the toilet and whether or not it is occupied. The microcontroller is connected to two LEDs: LED 1 (green) indicates that the toilet is empty, and LED 2 (red) indicates that the toilet has been obtained by the user. Finally, when the ultrasonic sensor detects the presence of an obstacle, the relay is connected to the microcontroller and controls the LCD on and off. Besides, the system is also installed with 2 lamps where lamp1 will automatically light up when the user is using the toilet while lamp2 is used as a backup lamp. Users can change the brightness of the lamp2 by adjusting the dimmer according to the desired brightness.

2.3 Materials

2.3.1 Arduino Maker UNO

The board' microcontroller can grasp what it must treat giving it a group of directions in programming form. Programming language that's put in in Arduino want Arduino computer code (IDE) for the Arduino to method and wiring supported the programming language [8]. during this project, port A1 & A3 are connected with temperature device and inaudible sensor severally because the input for microcontroller. A4 &A5 can connected to the digital display to display in line with the established committal to writing. whereas port a pair of & three will hook up with junction rectifier inexperienced and LED red as output. Port 4, 5, 6, 7, 8, 9, and ten is connected to Lamp1, Lamp2, Fan, Pump1, Pump2, Valve1 and Valve2 as the bathroom main system. The coding that has been set in Arduino IDE will be transfer into Arduino Maker UNO.

2.3.2 Ultrasonic Sensor (HC-SR04)

Ultrasonic sensors use sound waves to detect the distance to an object. They emit a high-frequency sound and measure the time it takes for the sound to bounce back. This time is used to calculate the distance to the object [9]. If the distance is less than a certain threshold, it can trigger an event such as turning on a green or red LED. For example, When the ultrasonic sensor detects any obstacle in range less than 25 cm, the redled will turn ON and LCD1 display "Toilet is occupied". This will cause the system to activate system 1. In system 1, the lamp1, lamp2, and ventilation fan will turn ON to provide extra lighting to the user and allow good airflow in the toilet to remove bad odor. If the sensor detect obstacle within 25 cm to 50 cm, the system will activate system 2 that will cause water pump 1 and water pump 2 to turn ON. The water pump 1 function is to flush the user's waste while water pump 2 will spray and clean the toilet floor.

3. Results and Discussion

The performance of the Automatic Deodorization and Toilet Cleaning System was examined and deliberated upon by comparing experimental data. For ease of viewing, the results are summarized in a number of tables, graphs, and charts. By comparing the results, the performance of the Automated Floor Cleaning Robot is investigated and discussed. The results are presented in various types of charts to make it easier for the readers to understand. The efficiency of the water pump was tested to test the strength of the suction, and the temperature sensor was tested to detect the room temperature [10]. There will be three experiments to test: toilet condition notification, water pump strength testing, and lithium-ion battery durability.

3.1 Toilet Condition Notification

3.1.1 When there is no user



Figure 3: The LCD1 display “NOT IN USE”

3.1.2 When the user is using the toilet



Figure 4: The LCD1 display “TOILET OCCUPIED”



Figure 5: The LCD2 display the toilet temperature



Figure 6: Ventilation fan, lamp1 & lamp2 turn ON



Figure 7: Lamp2 brightness is adjusted using dimmer & lamp2 turn ON

3.1.3 After the user used the toilet



Figure 8: The LCD1 display “UNDER MAINTENANC”



Figure 9: The pump1 & pump2 turn ON

3.2 Explanation of Toilet Condition Notification

The system will start with greenled turn ON and LCD1 outside the toilet displayed “Not in Use” respectively when the system does not detect the presence of user. When the ultrasonic sensor detects any obstacle in range less than 50cm, the redled will turn ON and LCD1 display “Toilet is occupied” as shown in Figure 4.4. But if there is no any obstacle within 50cm, the LED will remain Green. In Figure 4.5, the microcontroller activates the system 1 that will cause Lamp1, Lamp2 and ventilation fan to turn ON. This hardware is to provide extra lighting to user and allow good air flow in the toilet to eliminate the bad odor. The Lamp2 is connected with a dimmer as an option for the user to adjust the brightness of the light. The user can adjust the brightness of Lamp2 as appropriate. Inside the toilet is installed with LCD2 which will inform the user about toilet temperature. The temperature that used for this project is LM35 that connected with microcontroller inside the box. When the ultrasonic sensor detects the user has done using the toilet, the microcontroller will activate the system2. In this system, the LCD1 will inform the user that the toilet is under cleaning process. After the user left the toilet for 5 seconds, the water pump1 and water pump2 will flush and clean the floor. Both water pump is mixed with detergents to remove dirt and kill germs. The process will run for 20 seconds to ensure that such toilets are properly cleaned. Lastly, after the cleaning process has done, the LED and LCD1 will return to Green and display “Not in Use”.

3.3 Water Pump Functionality Testing



Figure 4.10: Mud Water



Figure 4.11: Sandy Lake Water



Figure 4.12: Milo Water



Figure 4.13: Small Trash

Table 1: Result of toilet cleanness

Experiment	No	Rate of succeed	Experiment	No	Rate of succeed
Mud water	1	70%	Milo water	1	80%
	2	80%		2	80%
	3	80%		3	80%
	4	70%		4	80%
	5	80%		5	80%
	6	70%		6	80%
	7	70%		7	80%
	8	80%		8	80%
	9	80%		9	80%
	10	70%		10	80%
Experiment	No	Rate of succeed	Experiment	No	Rate of succeed
Sandy lake water	1	20%	Small trash	1	42%
	2	30%		2	67%
	3	25%		3	35%
	4	33%		4	60%
	5	35%		5	33%
	6	40%		6	53%
	7	25%		7	57%
	8	20%		8	38%
	9	40%		9	68%
	10	33%		10	27%

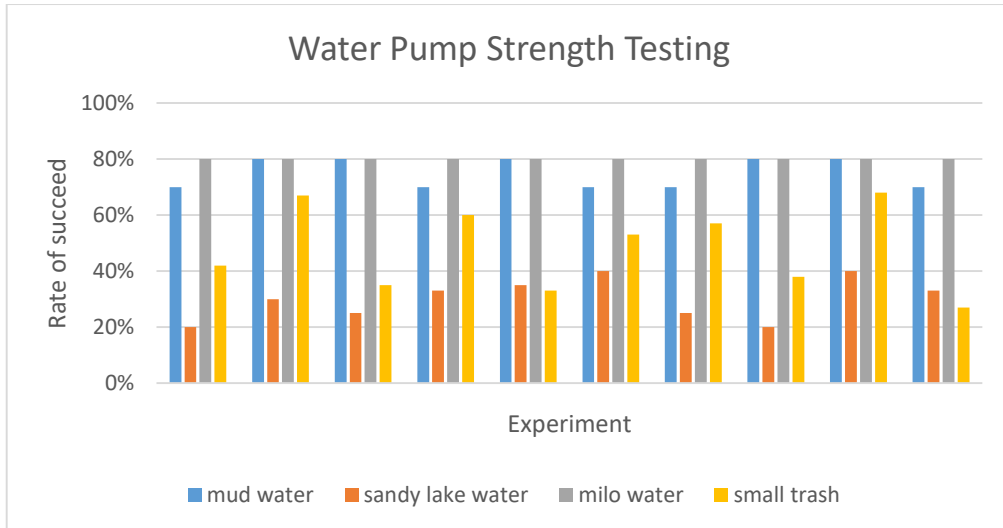


Figure 4.10: Comparison chart for toilet cleanness

3.3.1 Explanation of Water Pump Functionality Testing

The first experiment, which uses mud water, has an overall high success rate, according to the results table. This demonstrates that the Automatic Deodorization and Toilet Cleaning System's 12V water pump is powerful enough to remove the mud water from the toilet. Five out of 10 experiments completed had a success rate of 80%, and the other five also received great marks. This is primarily due to the pipe's opening mouth not being effective and wide enough to cover a substantial area. Otherwise, the mud water can be simply cleaned up by the water pump.

Additionally, the experiment used water from a sandy lake to evaluate the system's performance. As a result of only 60% of the sand being cleaned after 10 experiments, the test was deemed to be highly unsuccessful. The goal of the experiment is to determine whether the system can effectively clean the user-brought sand. In the third experiment, milo water was used in place of urine. The test was successful because 80% of the dirt could be removed. this is due to the pipe built around the wall's ability to thoroughly clean the floor's surface and get rid of any signs of filth.

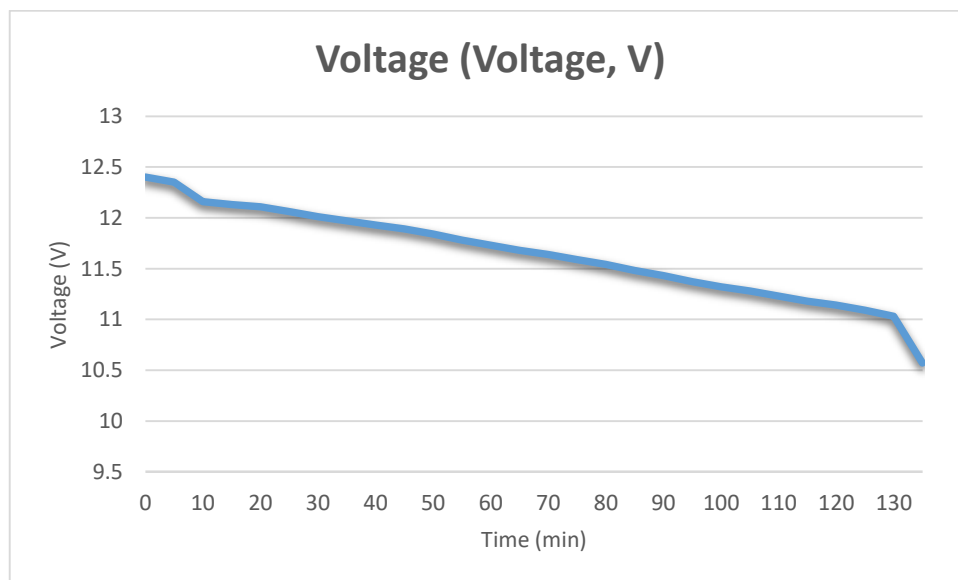
In order to determine whether this system is capable of cleaning small garbage, the experiment is finished by adding small trash, such as pieces of paper and grass. After ten studies, the average success rate is 48%. This is because the water pump's weak power prevented it from getting rid of the waste. Therefore, the experiment involving little rubbish was a failure.

3.4 Lithium-Ion Battery Durability

The Automatic Deodorization and Toilet Cleaning System is powered by a Lithium-ion Polymer battery, and this experiment is being carried out to test the battery's energy density and self-discharge properties [11]. In this experiment, the battery voltage is measured and compared to the standard state of discharge of a 12V battery.

Table 2: The battery capacity test of hardware with time

Time (Minutes, min)	Voltage (Voltage, V)	Time (Minutes, min)	Voltage (Voltage, V)
0	12.40	70	11.64
5	12.35	75	11.59
10	12.16	80	11.54
15	12.13	85	11.48
20	12.11	90	11.43
25	12.06	95	11.37
30	12.01	100	11.32
35	11.97	105	11.28
40	11.93	110	11.23
45	11.89	115	11.18
50	11.84	120	11.14
55	11.78	125	11.09
60	11.73	130	11.03
65	11.68	135	10.57

**Figure 4.11: Lithium-ion Polymer Battery Level**

3.4.1 Lithium-ion Polymer Battery Level Explanation

According to the results of the experiment, the lithium-ion polymer battery can power the Automated Cleaning Robot for an average of 2 hours and 20 minutes, given that the standard state of charge for a 12V battery is 12.40 at 100% and 11.50V at 0%. According to data collected from experiments, the time for the battery level to finish is around 2 hours and 20 minutes. As a result, the Lithium-ion polymer battery is the ideal battery because it can power the cleaning robot, which has numerous components [12].

4. Conclusion

An Automatic Deodorization and Toilet Cleaning System is a user-friendly toilet system was a project that had to be completed in parts. A progress report on the chosen topic will be written before beginning the actual report. The project's objectives, scopes, and a brief design may aid in understanding the overall concept. Background research and comparative studies related to the issue were discovered, analyzed, and critically evaluated by the organization.

Following that, the project completion procedure will be clearly stated and explained. The results of the software simulation were analyzed and discussed, as were the overall project design plan, circuit diagram, flow chart, materials used, and programming. This chapter will collect, analyze, and explain the hardware installation results and data.

The project's objectives and scope were met after numerous tests using hardware and software simulation. According to the findings, the toilet system's flushing and sanitizing systems, as well as the notification system, all work as expected. The flushing system, as well as the notification system, were thoroughly tested in test 1.

The project friendly user toilet system can be considered a success. As a result, the toilet system's design cannot withstand prolonged use. The toilet system model was created and modified based on the toilet system used in real life. The lower the power of the water pump, the weaker the water flow. Furthermore, a lack of power supply is one of the issues that prevents it from being used frequently. Some improvements can be made in the future to improve the toilet system's perfection. The use of an alternating current power supply can be considered to provide additional voltage to stronger the input of hardware such as water pump and ventilation fan [13].

4.1 Recommendations

Several recommendations are made throughout the development process of an automatic toilet cleaning system to be implemented in the development process and the output product.

The first suggestion is for automatic rim wash systems. After each use, a nozzle sprays the inside of the toilet bowl with a disinfectant solution [14]. This removes any remaining waste and keeps the toilet bowl clean and sanitary. Because the toilet bowl is automatically cleaned after each use, automatic rim wash systems can reduce the need for manual cleaning.

The second suggestion is automatic seat cleaning systems. After each use, these systems use a disinfectant solution to clean and sanitise the toilet seat [15]. This reduces the possibility of cross-contamination and improves hygiene. Automatic seat cleaning systems can also improve the overall user experience by ensuring that the toilet seat is fresh and clean after each use.

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