FACULTY OF ENGINEERING

ELECTRONIC (COMPUTER) ENGINEERING
UH6523002/HK20

KS32603 Design Project III
Semester II-2021/2022

Contactless Washroom Instant Feedback System (IFS)
Group I

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EXECUTIVE SUMMARY

An instant feedback system (IFS) is a system that is developed to acquire feedback from users and can be found anywhere in public places, including schools, libraries, and public washrooms. These inputs from users will be used to improve on the issue that is addressed in the feedback system and enhance the wellbeing of the community.

Public washrooms can be quite overwhelming in a negative perspective. A faulty and dirty toilet is very unpleasant to the eye and will cause users to feel uncomfortable to use. Normally, the cleaners will only clean washrooms according to their shift schedule. This results in an inconsistency of cleanliness in the washroom, from it being clean after the cleaning process to the washroom being foul due to irresponsible users right away during the absence of cleaner. The objectives of this project are:

1. To improve the cleanliness of public washrooms
2. To provide the users with a system that can input feedbacks for faulty and foul toilet
3. To brush up the cleaners working ethics and morale
4. To encourage more users to give feedbacks after using public washrooms

Our group proposes an interactive and contactless feedback system that can be operated to acquire the public's evaluation regarding the cleanliness of the washroom. The system consists of a mountable device that we constructed and a mobile application that is used to enter the feedback. Equipped with a friendly user interface, this makes it easier for users to input their opinion regarding the public toilet. Upon submitting feedback, the user will be rewarded with coupons that can benefit the user. After feedback has been acquired by the system, a cleaner will be alerted and the cleaning process will be done immediately. The cleaner, too, will receive a reward if they perform well. This solution will achieve all the objectives stated above and improve the well-being of public toilets.

The video demonstration of the prototype can be found at the following link.

Video Demonstration YouTube Link	https://youtu.be/RFv_ogYEl-s

CHAPTER 1

Task 1: Exploration

1.1 Literature Review

In the initial process, reviews on current articles of existing innovations in the market and the terms “contactless” and “feedback system” were made. Contactless simply means interaction without any contact with a device while a feedback system is a medium that acquires input, be it a criticism or praise, from a user regarding a system. There are a few common contactless methods that can be found in the market which apply to a feedback system. These include scanning a QR Code, receiving a survey via SMS, using a website feedback system, pop-up forms on websites, feedback questions via email, and through social media (Falin, 2022). Good amount of research has been done to review articles regarding existing inventions to solve our problem and achieve objectives. Three major articles found almost similar are read thoroughly and compared. The results are tabulated in Table 1.1.1. The articles that are found are as below:

- Intelligent Public Toilet Monitoring System Using IoT (Deshmukh et al., 2020) consists of a few sensors that are connected to a NodeMCU and has a feedback system that uses a switch keypad. This review mainly focuses on detecting what is lacking in that toilet.
- Smart Toilet Feedback System (Shahane et al., 2020) suggested an automated flush system that deals with dirty toilets, applying a contactless concept in cleaning toilets and a feedback system afterwards. This feedback system can be accessed by scanning the QR code provided in the restroom.
- Smart Public Toilet Health Check System (Shinganwade et al., 2019) is powered by Raspberry Pi instead of NodeMCU like the other two systems. Janitors will be notified via SMS and users will need to download their android application which is specifically designed for giving feedback to the system.

Table 1.1.1: Comparison Table Between Three Similar Projects

Author(s) & Year	**Publication Title**	**Disadvantage**
Deshmukh et al., (2020)	Intelligent Public Toilet Monitoring System Using IoT	Uses a switch keypad for the users to input feedback into the system
Shahane et al., (2020)	Smart Toilet Feedback System	Feedback system only shows different degrees of rating responses but no

		further options
Shinganwade et al., (2019)	Smart Public Toilet Health Check System	The feedback system requires users to download the application beforehand which is only for the feedback system

1.2 Empathize and Define

After doing research on the Literature Review stage, this Empathize stage will give the group more clarity and deep understanding regarding this matter. A few rounds of observations were made to the washrooms that are available in the Faculty of Engineering to detect what problems that can be found. It is observed that some toilets have broken flushes, wet floors, faulty taps and more problems. The round trips to most toilets in the faculty was unpleasant due to the foul-smelling environment as well. These problems are found more commonly on floors that are full with students, especially the toilet on the ground floor of the faculty.

To help themselves with the problems faced in the toilets, some students bring their own tissues and prepare hand soap in the toilet. Because of the broken flushes in the cubicles, the foul-smelling environment is unavoidable. However, items such as hand soap, functioning flushes, and tap water at the sink are all necessities in a washroom.

Therefore, it is inevitable that users will have bad reviews regarding these toilets if all of the public toilets are similar. Surely, users of washrooms that are not in a perfect condition will leave them feeling uneasy and uncomfortable after using it. On the other hand, unclean washrooms are also home to dangerous diseases and have a higher risk of spreading to the user. Hence, a platform for users to report their concern is indeed a need for all toilets.

During the two stages previously, our group has identified and seen problems that public washrooms have. Among all of the issues, we identified some problems that most toilets have and thus it becomes the core problems to be addressed. Listed below are the main issues for most washrooms:

- Lack of water in the toilet
- Flush problem in toilet cubicles
- Foul-smelling environment
- No hand soap available

1.3 Possible Design Constraints

On the other hand, despite having bizarre and very attentive ideas to resolve the problem stated in the Problem Statement section, there are constraints that are possible to appear both before and during developing the innovation. The possible design constraints are tabulated in Table 1.3.1.

Table 1.3.1: Table of Possible Design Constraints and Solution

Possible Design Constraint	**Solution**
Some users may find the contactless instant feedback system difficult to use.	Design an easy to understand and to use interface.
Some cleaners may not be equipped with a device capable of receiving notifications from the instant feedback system.	Develop an application that is compatible with all types of devices.
Budget-constraint to develop both a fully functioning and an appealing hardware.	Try to find the cheapest but high-quality components to cut budget and use recycled items for the casing of the hardware
The rewarding system may cost money if we give out rewards using our own budget	Try to collaborate with the canteen or the stationary shop so that the rewards can be in the form of coupons that can be redeemed at these shops

CHAPTER 2

Task 2: Design Idea

2.1 Brainstorming

In the brainstorming session, each member is assigned to produce a flowchart and block diagram for both system hardware and application software according to their own ideas. After that, we finalized our flowchart and block diagram by combining all of the ideas and modifying them to meet the project requirement. The result is shown as in 2.2 and 2.3. In addition, we have also discussed the specific details about how the system functions, as we are trying to get a glimpse of the system's concept. Next, We have agreed to reward the user and janitor by points. After reaching certain reward points, users and employees can redeem rewards, such as book coupons and food coupons. For application software, we decided to make an application with 3 different roles; user, cleaner and management.

2.2 Detail Block Diagram

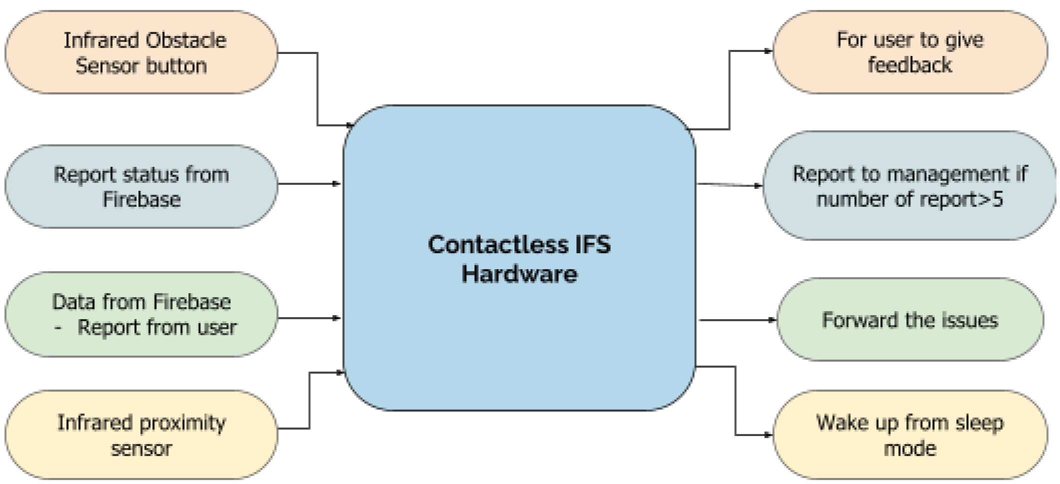


Figure 2.2.1: Instant Feedback System Block Diagram

The figure shown above is our Contactless Instant Feedback System block diagram that describes the function processes among the input variables and the output variables. Infrared obstacle sensor buttons act as a contactless navigation button. There are a total of 3 contactless navigation buttons, which are 'Start', 'Yes', and 'No', these infrared sensor buttons are directly connected to the Raspberry Pi 4b. Users can give feedback through the system by hovering their hand in a range between 1 cm to 5cm from the infrared sensor. Then, the feedback data by users will be stored in the contactless IFS's Firebase. After reaching the same feedback for more than 5 times, the detailed data from firebase will be forwarded to the management firebase, alerting them to take action. Next, an infrared proximity sensor is used for power saving. For example, when the user is in the range of 1 meter from the infrared proximity sensor, the contactless IFS will automatically wake up from sleep mode.

2.3 Detail Flowchart

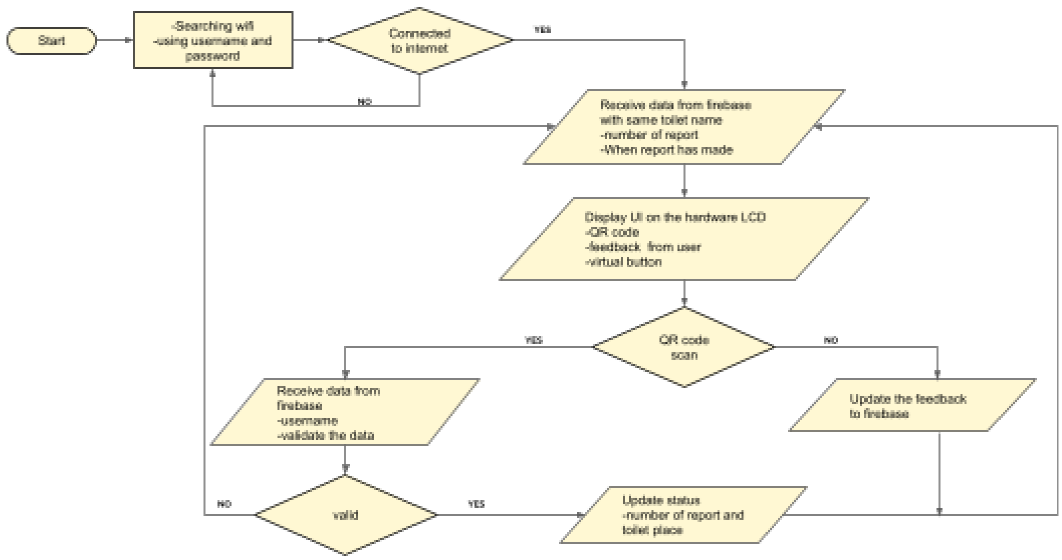


Figure 2.3.1: Detail Flowchart of the IFS Hardware

Figure above showed the flowchart for the contactless IFS. After turning on the system power supply, the system will connect to the nearby Wi-Fi. When there's an absence of Wi-Fi, the system will continue to search for another internet source. After connecting to the internet, the system will receive data from firebase then display the user interface on the screen. After the user gives feedback to the system, a QR code will be displayed. If the user is a student, scan the QR code, the system will receive the student data from the firebase. If the student data is valid then it will update the changes to the firebase. If the user is not a student, then they do not have to scan the QR code, the feedback will still be updated to firebase.

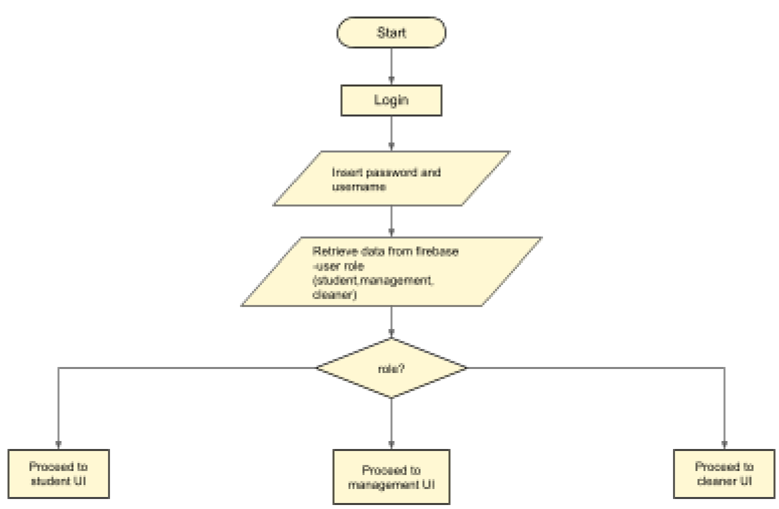


Figure 2.3.2: Detail Flowchart of the IFS Software Application (Login Interface)

The figure above showed a login interface for software applications. On the login page, the user will have to input their username and password that has been set during registration. The application then will receive the user role data from firebase. If the user is a student, the application will proceed to the student interface in the next page, the same thing for cleaner and management. If the user has not registered, they will need to choose the sign up option, and the data they inserted will be stored in firebase.

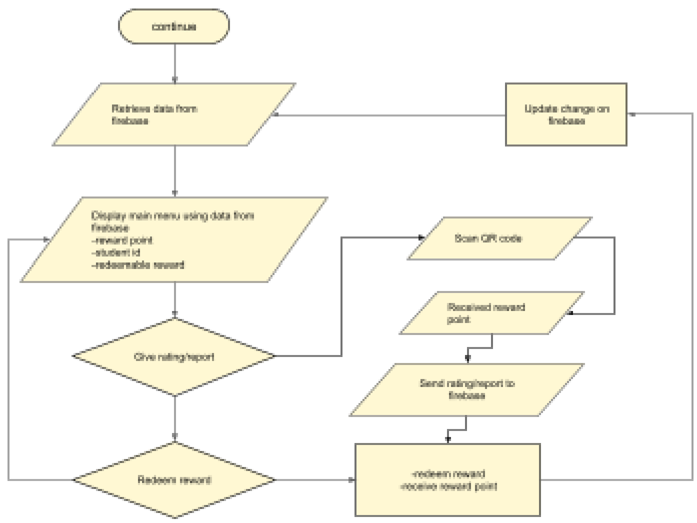


Figure 2.3.3: Detail Flowchart of the Student/User UI

In the student UI showed above, the application will retrieve data from firebase and display the user information, gift point, and reward collection. Students can receive reward points by scanning the QR code or inserting the unique number from the system hardware. Then they will receive the reward point and the feedback data, and updated points will be stored in the firebase. Next, they can redeem rewards if a certain point is reached. The data will be updated in firebase.

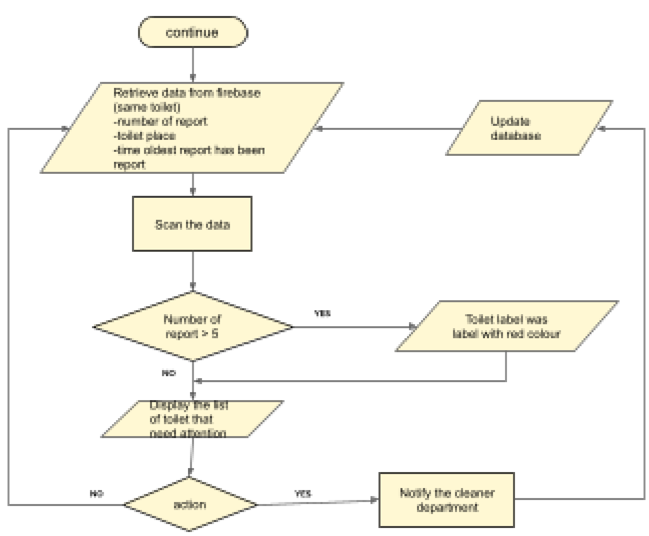


Figure 2.3.4: Detail Flowchart of the Management UI

For the management UI, the application will scan the data that is retrieved from firebase. If the number of bad feedback is more than 5 times, the toilet will be labeled as red. If the reported feedback is less than 5, it will display the list of toilets that need attention. Management will notify the cleaner department . The data will be updated in the database.

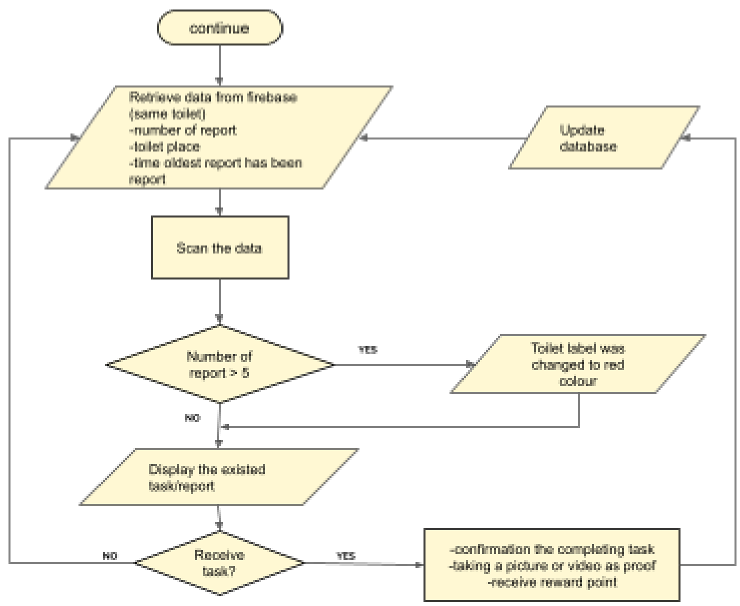


Figure 2.3.5: Detail Flowchart of the Cleaner UI

Figure shown above is a detailed flowchart for the cleaner UI. The application will retrieve the data from firebase, such as janitor information, task available, and redeemed collection. If the toilet label turns to red, meaning that the report has been made more than 5 times. If not, it will display the other task available. If the cleaner received and completed a task, they have the reward point. Then the firebase will be updated.

2.4 List of Components

Raspberry pi 4b was chosen as it is compatible with the 7 inch raspberry pi LCD display. Raspberry pi 4b has more RAM and faster processor than other raspberry pi models, it makes the system flow smoothly. A 7 inch raspberry pi LCD display is used because the screen size is bigger and information on screen can be clearly seen by the user. This type of LCD also has a HDMI port where it can be directly connected to the raspberry pi 4b by using Micro-HDMI to standard HDMI. Then, a 32GB SD card is chosen as it is a key part of the raspberry pi, it provides greater initial storage for the operating system and files, than a 8GB SD card. A E18-dD80NK infrared proximity sensor is used to wake the system from sleep mode when it senses human presence, thus this system reduces power consumption. This sensor has less interference by sunlight because of the modulated infrared light, it can continue to transmit infrared light. MH infrared obstacle sensor was chosen to act as contactless button for our system. It works fine with 3.3 to 5V, and have effective distance range up to 80cm, the dimension of the sensor is also suitable for our system as it is small and easy to assemble. Next, a 5V DC brushless fan is used as it is durable, reliable, and highly energy efficient. The fan function is to prevent overheating while still minimizing electromagnetic interference that could negatively affect the raspberry pi. Table 2.4.1 shows the overall budget of the components for our system.

Table 2.4.1: List of Components With Price

No.	Components	Quantity	Price per item (RM)	Total price of item (RM)
1	Raspberry Pi 4 Model B	1	184	184
2	Official RPI 15W PSU USB C	1	35	35
3	RPI Micro-HDMI to standard HDMI	1	30	30
4	E18-dD80NK IR proximity sensor	1	10.90	10.90
5	Breadboard half BB-801	1	2.90	2.90
6	MH IR Obstacle Sensor Module	5	2.40	2.40
7	Dupont jumper wire 20cm FTM	1	2.90	2.90
8	DC brushless fan 5V	1	8	8
9	RPI aluminum heat sink	1	3	3
10	SD card for RPI 32GB	1	40	40
11	Corrugated Cardboard	1	3.80	3.80
Total Price				322.90

2.5 Project Timeline and Milestones

Table 2.5.1 displays the initial Gantt Chart that was made before the progress of developing this project. The timeline shows a graphical period of expected progress. Meanwhile, Table 2.5.2 displays the actual Gantt Chart of the project. The timeline depicts a graphical representation of the project according to real development progress.

Table 2.5.1: Planned Project Timeline Gantt Chart

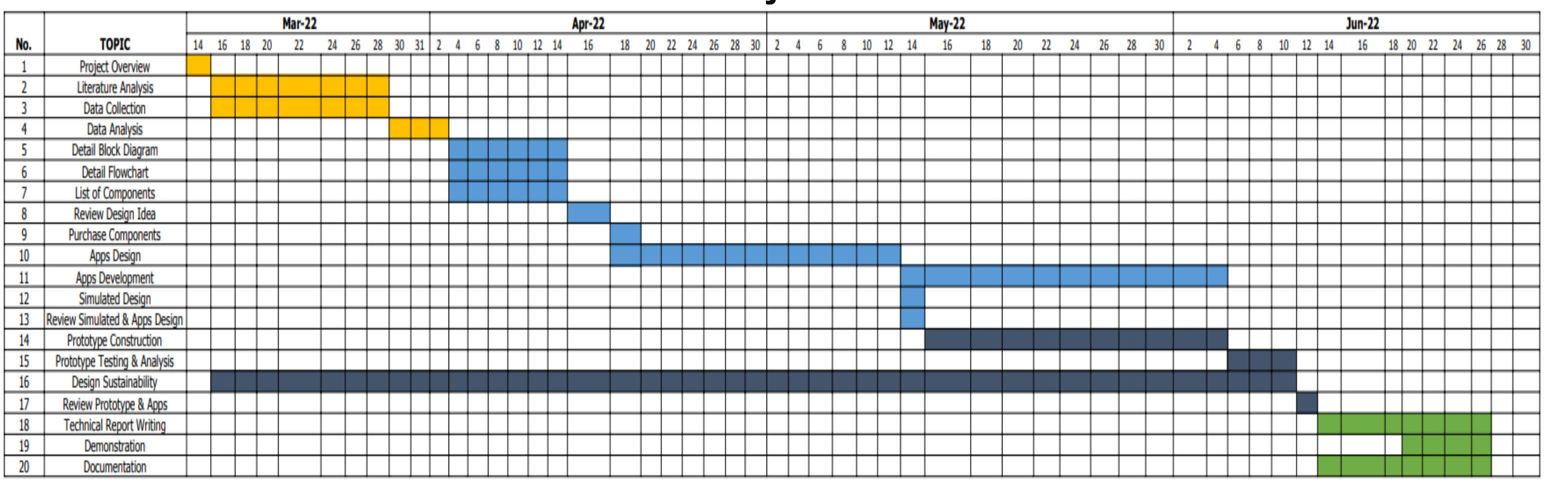
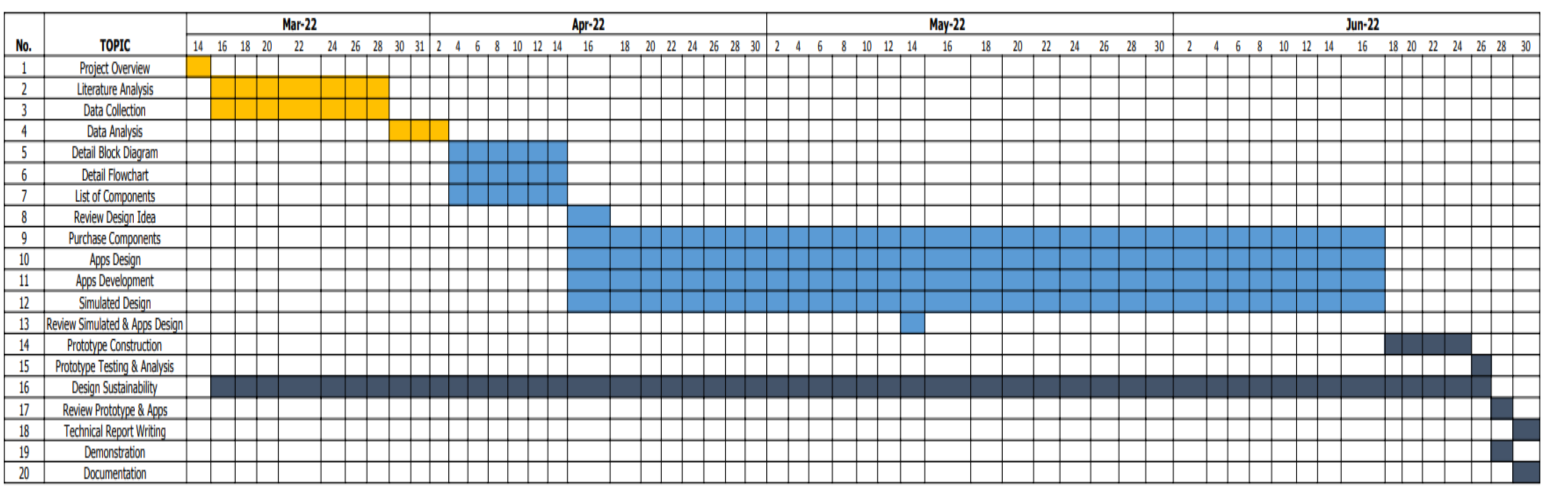


Table 2.5.2: Actual Project Timeline Gantt Chart



	Milestone 1 (Project Exploration)
	Milestone 2 (Design Idea)
	Milestone 3 (Prototype & Testing Completion)

Each topic has their own role in order to achieve the project requirement. Here is a brief description of each topic:

Table 2.5.3: Description of Each Milestone Activity

#	TOPIC	DESCRIPTION
1.	Project Overview	A thorough explanation of the project's objectives, measures taken to achieve them and results anticipated.
2.	Literature Analysis	An argument about the piece of writing that conveys the author's unique viewpoint, interpretation, assessment, or critical appraisal.
3.	Data Collection	The method of obtaining and analyzing data on relevant variables in a predetermined, methodical way that makes it possible to respond to specific research questions, test hypotheses, and assess results.
4.	Data Analysis	The method of systematically using logical and/or statistical techniques to summarize, summarize, and analyze data.
5.	Detail Block Diagram	Detailed blocks that represent one or more objects, entities, or concepts are connected by lines to demonstrate their relationships in a system represented visually.
6.	Detail Flowchart	A diagram showing the various steps of a process in their proper order of the project process.
7.	List of Components	The control system schematic includes a list of the controllers and related devices.
8.	Review Design Idea	Presentation Task 2
9.	Purchase Components	Purchasing the control system schematic includes a list of the controllers and related devices.
10.	App Design	Combination of UI and UX design to build out a usable piece of software.
11.	App Development	The process of making apps that work on both Android and iOS mobile platforms.
12.	Simulated Design	Aids manufacturers in confirming and validating a product's ability to be manufactured, as well as its intended function.
13.	Review Simulated & App Design	Presentation Task 3

14.	Prototype Construction	Construct the functionality and the physical experience of a product.
15.	Prototype Testing & Analysis	To identify problems and potential areas for improvement, the prototypes are tested on actual users.
16.	Design Sustainability	A holistic approach to activity design that places an emphasis on the success of people and the environment
17.	Review Prototype & Apps	Presentation Task 4 & 5
18.	Technical Writing Report	A formal report created to provide technical knowledge in a format that is understandable and accessible.
19.	Demonstration	Design Project Competition
20.	Documentation	A formal report created to provide technical knowledge in a format that is understandable and accessible. anything that can be communicated and is used to describe, explain, or instruct on certain characteristics of a thing, a system, or a process, like its components, assembly, installation, maintenance, and use.

The planned and actual are different because of some circumstances that cannot be avoided such as late postage arrival since we bought online, develop, tested and troubleshoot at the same time also some dates were extended for a better result in our project.

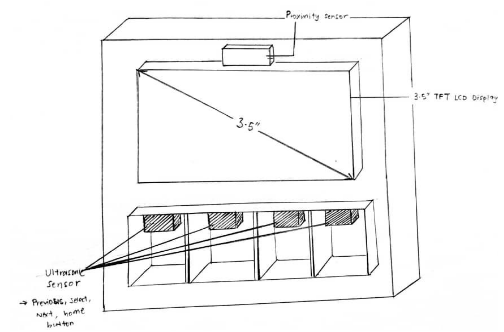
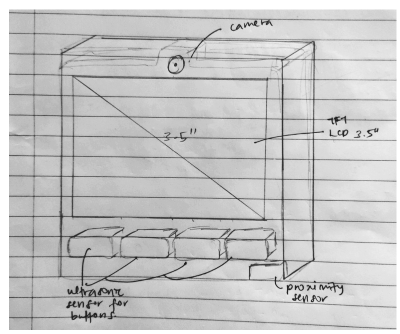
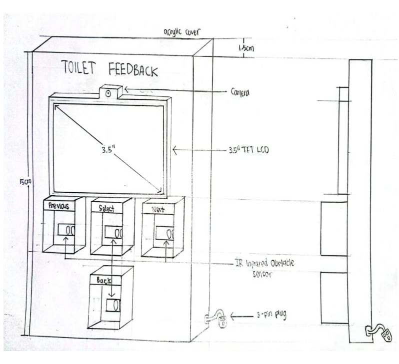
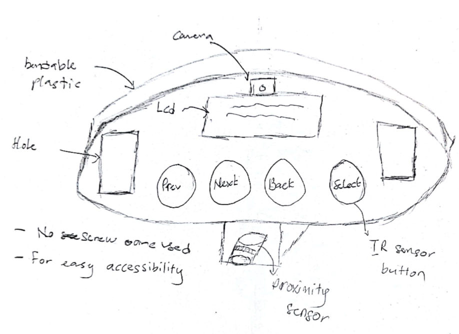
CHAPTER 3

Task 3: Conceptual Design

<u>3.1 Paper Design (Sketch/AutoCad/3D Model)</u>

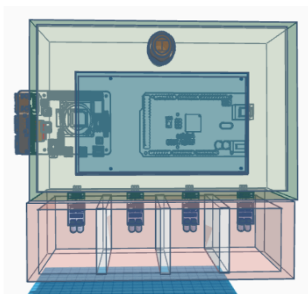
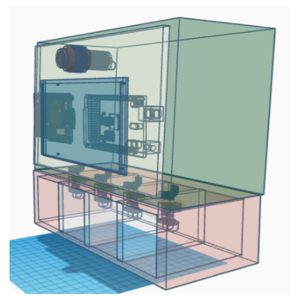
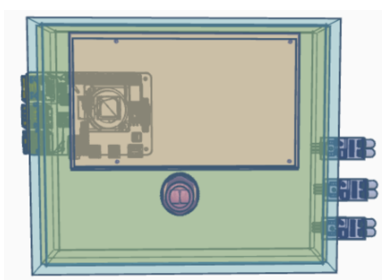
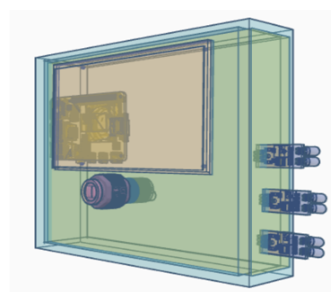
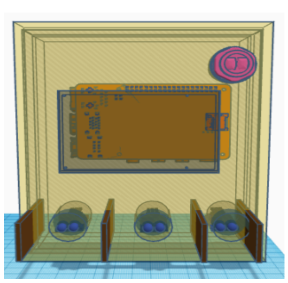
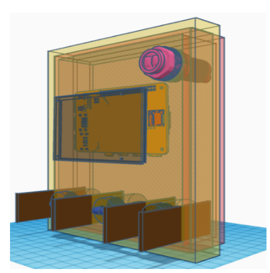
Initial sketch designs as shown in Table 3.1.1 were designed by members of the team as the initial idea of how our prototype would be. Each of the sketches includes all the components that our member has agreed to use. In the beginning, we were planning on using a 3.5 inch Raspberry Pi LCD display, which was affordable for our team. Then, we agreed on using 4 infrared obstacle sensors as the touchless navigation button, infrared proximity sensor and a mini camera module to activate the system from sleep mode. For the casing, our idea was to use acrylic material as it is easy to fabricate, bonds well with adhesives and solvents, and easy to thermoform. Next, for the initial idea of the system's interior, we used a raspberry pi 4b and Arduino Mega for the sensors. After that, we agreed to use Sketch 1 as our reference to improve our prototype design using Tinkercad.

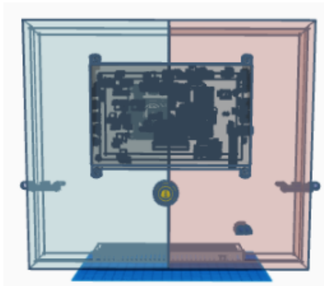
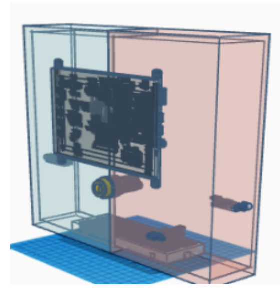
Table 3.1.1: Table of Prototype Initial Sketch Designs

 Sketch 1	 Sketch 2
 Sketch 3	 Sketch 4

Meanwhile, in Table 3.1.2, we have modified the design based on sketch 1 and provided the interior details by using Tinkercad. A few modifications have been done to the initial plan design based on the components used. For the LCD, we changed from a 3.5 inch raspberry pi LCD display to a 7 inch raspberry pi LCD display, so that the information can be clearly seen by the user. We have also modified the interior system. Other than that, we lessen the number of infrared obstacle sensors to only 3 sensors. Next, rather than connecting the sensors to the arduino mega, we decided to connect the sensors directly to the raspberry pi 4b as it is more reliable. For the casing, we decided to use a packaging box, which is more cost-effective. In Table 3.1.3, a concept selection is done to select a design to be developed.

Table 3.1.2: Table of Prototype Initial Sketch Designs

 Front view for Design 1	 Side view for Design 1
 Front view for Design 2	 Side view for Design 2
 Front view for Design 3	 Side view for Design 3

 Front view for Design 4	 Side view for Design 4

Based on Table 3.1.3, design 4 obtained the highest overall score of 4.70, making it the final design sketch to be developed. The reason is that it is the most constructible, the casing size is appropriate, cost-efficient as it is not using Arduino mega, is safe to use, and has higher durability.

Table 3.1.3: Concept Scoring Table

Concept Scoring									
		Design 1 (Ref)		Design 2		Design 3		Design 4	
Selection Criteria	**Weight**	**Rating**	**Weighted score**	**Rating**	**Weighted score**	**Rating**	**Weighted Score**	**Rating**	**Weighted score**
Manufacturing ease	**15%**	2	0.3	4	0.6	3	0.45	5	0.75
Size	**10%**	5	0.5	5	0.5	5	0.5	5	0.5
Usability	**15%**	5	0.75	5	0.75	5	0.75	5	0.75
Information presentation	**15%**	5	0.75	5	0.75	5	0.75	5	0.75
Cost	**15%**	3	0.45	5	0.75	5	0.75	5	0.75
Safety	**20%**	4	0.8	1	0.2	3	0.6	4	0.8
Durability	**10%**	5	0.5	3	0.3	4	0.4	4	0.4
Total		**4.05**		**3.85**		**4.20**		**4.70**	
Rank		**3**		**4**		**2**		**1**	
Develop		**NO**		**NO**		**NO**		**YES**	

3.2 Simulated Design

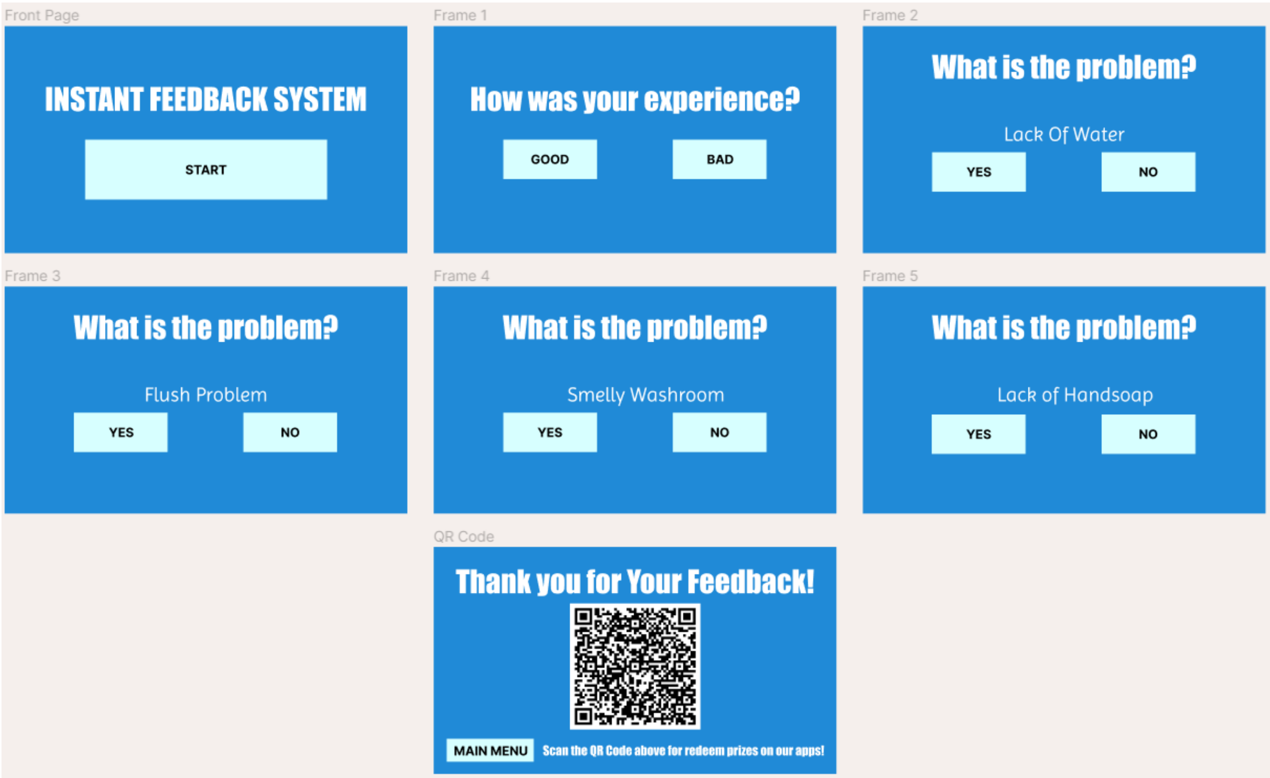


Figure 3.2.1: GUI for Raspberry Pi 4

Figure 3.2.1 displays the Graphical User Interface simulated using the web-based graphical prototyping tool, which is Figma, to acquire the visuals of the displayed system. It starts with the main screen, followed by asking the user regarding their experience using the public washroom, then problems that they faced while using the washroom, and lastly the page where a QR Code is displayed for the users to scan in order for them to acquire the reward for redemption.

CHAPTER 4

Task 4: Embodiment and Detailed Design

4.1 Prototype Construction

Figure 4.1.1 until Figure 4.1.6 displays the construction of the hardware prototype.

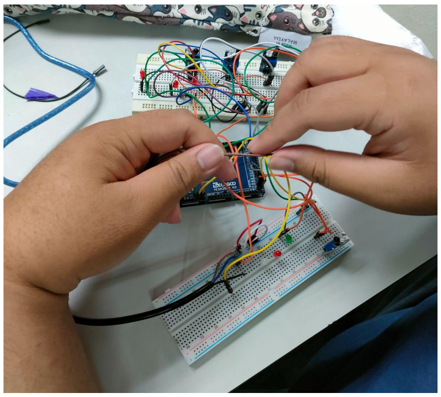


Figure 4.1.1: The Process of Wiring Components

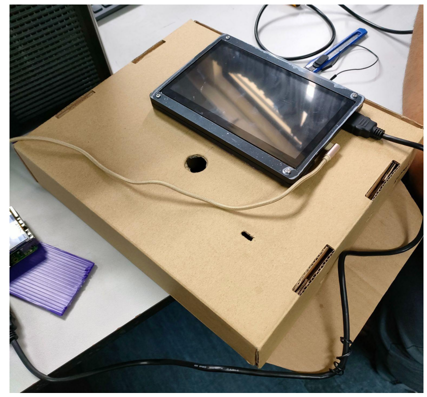


Figure 4.1.2: Assembling The Hardware Together With The Casing

Figure 4.1.3: Making Airflow Hole for The Mini Fan

Figure 4.1.4: Front View of Completed Hardware

Figure 4.1.5: Side View of Completed Hardware

Figure 4.1.6: Completed Hardware

Student UI

A software application was also developed during this project. This helped the user to manage their contribution to report the toilet condition to management and janitor. For the management it helps to give an alert to the janitor if the toilet condition is neglected. While for the janitor, it was helped because the apps can give the early alert, which toilet needs to be cleaned. Not only that, it will give the cleaner a gift point which will motivate janitors to work more efficiently.

Figure 4.1.7: Login and Signup UI for Mobile Application

The SIGNUP UI has the role for the user to choose which is the user need to select before their first login. This will differentiate the next UI generated to the user to use the application.

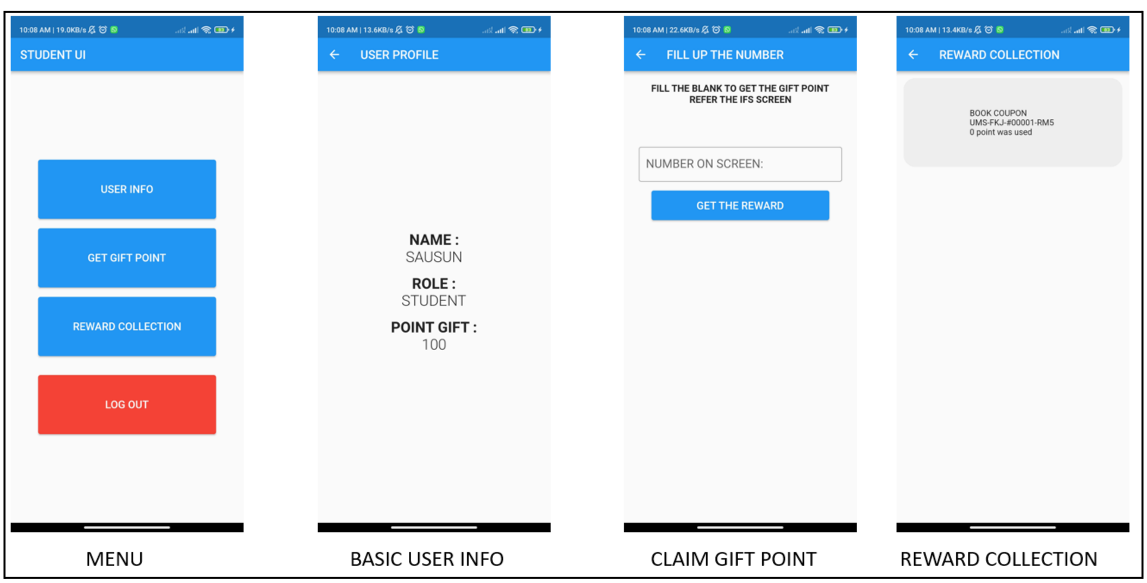


Figure 4.1.8: Student UI

The STUDENT UI has the capacity to work as showing the user info, claiming gift points by inserting the unique number from the IFS hardware and showing reward collection that has already been claimed by the user.

<u>MANAGEMENT UI</u>

Figure 4.1.9: Management UI

The list of toilets will show the status of the toilet and show the person in charge of the toilet. The status will help the janitor to find which toilet needs the most critical care and it allows the management to monitor the toilet condition. If none of the janitors has taken action for the problem toilet, the management will alert the janitor by using the application. The reward system was used to encourage the user to contribute to the system, then it needed a mechanism to adjust the reward value and quantity to ensure fairness to all users.

JANITOR UI

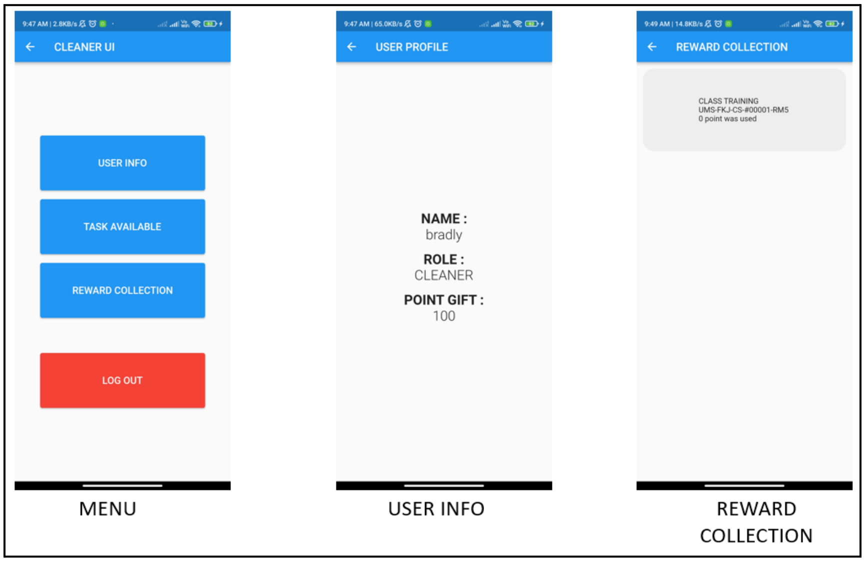


Figure 4.1.10: Janitor UI

Almost similar to the STUDENT UI, the JANITOR UI is a little bit different. The JANITOR UI has a list of toilets that need to be cleaned. This will help the janitor to clean the toilet without doing monitoring to each toilet and deciding which toilet needs to be cleaned.

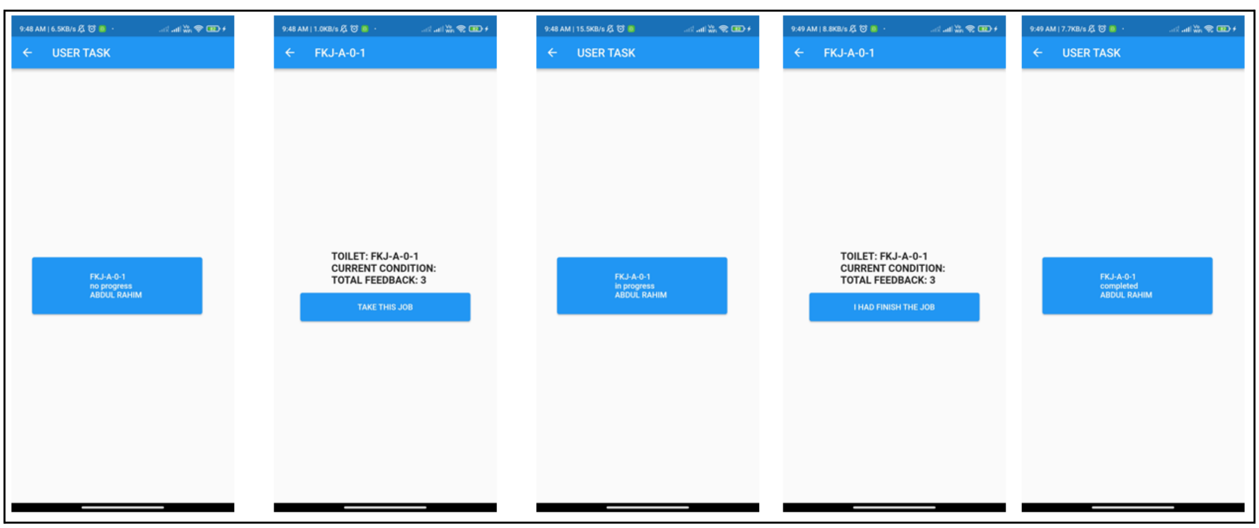


Figure 4.1.11: User Task

The task available option in the menu was used to help the janitor to select the toilet needed to clean and record their process as proof of cleaning. The purpose of this option is to minimize the time consumed by the janitor to find the faulty toilet and focusing on cleaning the toilet,

4.2 Prototype Testing and Analysis

Table 4.2.1: Hardware Testing Analysis

Testing Phase	Results	Problem
1	The LCD displays “No Signal”	The display is not connected properly from the Pi 4 to the LCD using HDMI
2	White screen problem on the LCD	The SD Card was corrupted
3	The GUI keeps looping at the end of the main screen	Hardware coding problem
4	The performance of the hardware is sluggish	Too much power consumption

Table 4.2.2: Software Testing Analysis

Testing Phase	Results	Problem
1	GUI is kinda messy	Using Random Coding on Thonny IDE without adjusting it correctly
2	Certain Button cannot be pressed	The components options is not properly in sync from the design with the coding
3	The data from the GUI is not correctly collect	Problem with the database

4.3 Design Sustainability

1. Using Corrugated Cardboard

   Our group decided to use corrugated cardboard as the material for the casing of the hardware. This is due to the fact that corrugated materials are recognized as natural bio-based and biodegradable substitutes to hydrocarbon products like plastics (Corrugated Paper - Sustainable Packaging Solution, 2021). Besides that, corrugated cardboards are recyclable because they are made up of 70% to 100% recycled materials, which makes them recyclable up to 25 times (“What Makes Corrugated So Sustainable?”, n.d.). On the other hand, the price of this cardboard is reasonable and the condition is hard and sturdy enough to support the whole hardware. This makes it the right material as the casing.

2. Have An Idle Mode On Raspberry Pi

   A proximity sensor was included in our proposed solution, which was to act as a sensor to sense the presence of humans near the feedback system. If the sensor does not detect anyone near the programmed range, the feedback system will stay in idle mode. This mode can save the use of energy and reduce electricity consumption. Once the sensor detects the presence of humans, it will then be switched back on and displays the GUI of the contactless feedback system.

CHAPTER 5

Task 5: Prototype Refinement

LCD Display Issues

The LCD display is difficult to work on to ensure it turns on at first, due to the different ports and connection cables that were needed to configure and exchange connections. However, after changing and adding lines of codes and double-checking both the power supply cables and HDMI cable, the display successfully turned on and lights up.

After figuring out how to turn on the display, the next problem appeared which was the white screen issue on the display. This is due to our corrupted SD card. Our group managed to obtain another 32GB SD Card the next few days after figuring out the root of the white screen issue. Then, the OS was then installed in the new SD Card before continuing to work with the hardware coding.

Hardware Coding and Circuit Design

Once the coding of the hardware was completed, the hardware system was then tested and another problem was detected. The GUI at the end of the system keeps looping back to the previous pages of the system. The coding was then checked thoroughly and edited a few times to fix the problem. After a few times of improving and editing the code in the Pi, the problem was fixed and it stopped looping inaccurately.

However, once it stopped looping, we noticed that the system has become sluggish and gets quite laggy. Our team decided to remove one of our components, which was the Arduino Mega, and connected the sensors directly to the Raspberry Pi instead. Before this, the communication between the IR sensors and the Pi was connected with the Arduino Mega in the middle because we were using 6 IR sensors. The Arduino Mega has enough ports to connect up to 6 sensors, that was why our group initially applied this approach. However, we are using quite a lot of jumper wires, and hence, slows down the system. We then reduced the IR sensors to only 3 sensors and reprogrammed the system in Pi. It became less sluggish and more reliable.

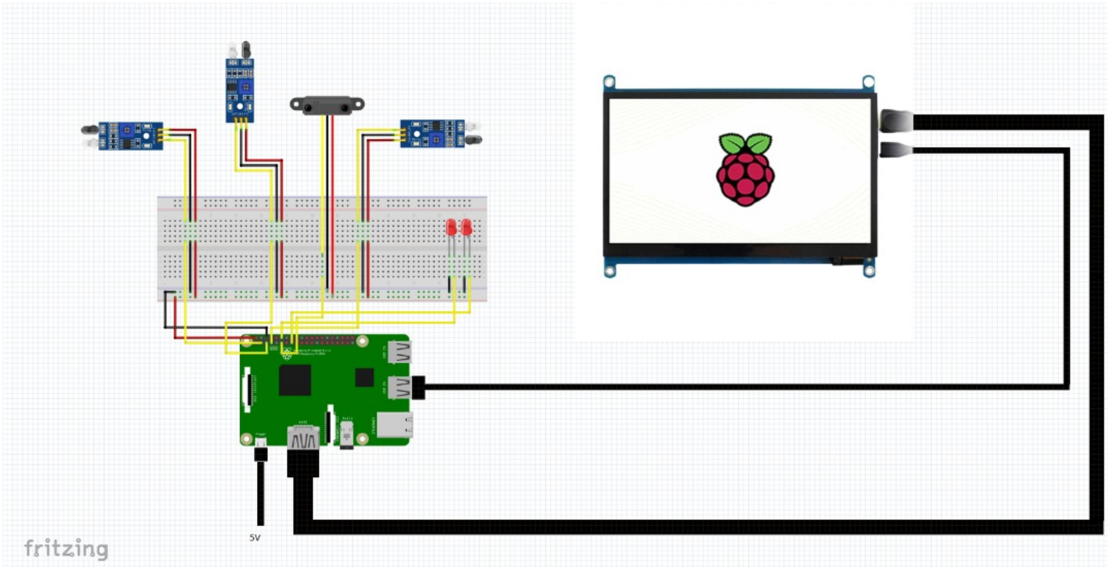


Figure 5.1.1: Improved Circuit Connection

Our system's circuit is shown here. To build the circuit, we used Fritzing software. The circuit consists of a Raspberry Pi 4 B, two LEDs, three infrared sensors, a proximity sensor that can be adjusted, and a 7-inch LCD display.

CONCLUSION

All in all, unpleasant trips to the public washrooms due to the bad condition of the washroom has become a universal experience for most people. Due to this issue that most people face, we propose a contactless washroom instant feedback system with the purpose to provide the users with a system that can input feedbacks for faulty and foul toilet, improve the cleanliness of public washrooms, brush up the cleaners working ethics and morale and lastly, encourage more users to give feedbacks after using public washrooms. The implementation of this system in public washrooms will indeed help with achieving the objectives for the problem statement. Giving feedback in all kinds of situations is essential and should always be applied with full carefulness. It is hoped that more people will take part in giving feedback with this system and other types of feedback in order to improve the quality of living.

REFERENCES

Corrugated Paper - Sustainable Packaging Solution. Flow Packaging. (2021). Retrieved from https://www.flowpac.com.my/corrugatedpaper-sustainable

Deshmukh, P., Mohite, A., Bhoir, H., Patil, R., & Bhonde, A. (2020). Intelligent Public Toilet Monitoring System using IOT. *2020 IEEE Bangalore Humanitarian Technology Conference (B-HTC)*. https://doi.org/10.1109/b-htc50970.2020.9297839

Falin, V. (2022). *5 Ways to Obtain Contactless Customer Feedback*. Beaconstac RSS. Retrieved from https://blog.beaconstac.com/2020/11/contactless-customer-feedback/

Shahane, S., Patil, M., Mahajan, A., & Gholap, B. (2020). Smart Toilet Feedback System. *International Research Journal of Engineering and Technology (IRJET), 07*(04). Retrieved from https://www.irjet.net/archives/V7/i4/IRJET-V7I41148.pdf

Shinganwade, A., Saxena, S., Suryavanshi, S., Kamat, A., & Soygaonkar, P. (2019). Smart public toilet health check system. *2019 IEEE Pune Section International Conference (PuneCon).* https://doi.org/10.1109/punecon46936.2019.9105698

What Makes Corrugated So Sustainable? (n.d.). *6 Reasons Why Corrugated Is The Most Sustainable Packaging*. BPKC. Retrieved from https://bpkc.com/6-reasons-why-corrugated-material-is-the-most-sustainable-packaging

APPENDIX

Google Drive Folder URL	https://drive.google.com/drive/folders/15wuMxA6cuJ73fL2Bq5mtdb72RtIib7dX?usp=sharing
Source Code for Apps Development	https://github.com/wonnur/ifs-i.git