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Design and Fabrication of Hygiene Sink With Internet of Things Enable Automation System

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***Abstract*— Due to the recent coronavirus spreading around the world, it moves through the air, and you may get it when you touch your eyes and mouth using our hands that have the virus, so that is why hygiene is now more important than ever. This virus has taken the lives of more than a few hundred thousand people in the world. COVID-19 phenomenon has made people take care of their hygiene. So, this project is to develop a smart sink that has an automatic faucet that is user-friendly. This project uses sensors that will detect the user's hand, and then the mechanism will run and dispense water, hand soap, and hand sanitizer. After that, a water level sensor built in for the hand sanitizer and liquid soap will detect the water sensor. If it is lower or the same as 10ml, it will trigger the system to notify the user to refill the hand sanitizer or liquid soap. This project will keep users' hands clean as it reduces touch and lowers the chance of getting the virus.**

***Index Terms*— Automation system, Blynks, Covid-19, Hygiene Sink, Internet of Things.**

I. INTRODUCTION

Nowadays, the world is full of diseases and viruses. The world is not as clean as it used to be. The world is constantly evolving, and so are viruses. This can be proven by seeing and feeling what is happening nowadays, the Covid-19[1]. This virus can kill people, and it has made about a hundred thousand people be a victim to it still has no antidote, so the only way is to do everything you can to prevent it [2]. So that is why hygiene is very important. Washing your hands properly is one of the most important things you can do to help prevent and control the spread of many illnesses. Asymptomatic patients are particularly contagious, according to recent studies, because people avoid contact with others who have obvious symptoms, but asymptomatic people are difficult to identify [3, 4].

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Good hand hygiene will reduce the risk of flu, food poisoning, and healthcare associated infections being passed from person to person. So, washing your hands is one of the most important and effective ways to prevent from getting and spreading viruses[5].

Hand sanitizers were created to clean hands without the use of soap or water. These are made up of alcohol-based gels used to kill germs on the skin [6]. Alcohol kills bacteria and a variety of viruses quickly and effectively. Sanitizer is inexpensive and readily available for hand cleansing. They are convenient, portable, simple to use, and take less time [7]. Next is one of some importance of the project, namely the provision of automatic means for controlling the flow of fluids such as water, with the consequent saving of energy [8], by providing water at sinks and similar devices only when needed or being used. In addition to the potential to save millions of gallons of water a day, the energy savings provided in the reduction of the amount of water required to be heated to desired temperatures is manifest, as is the savings in oil, gas, and electrical energy utilized to heat the water [9].

Because of this, we came up with an idea to do a project to build a sink specifically for this problem. A sensor that will detect your hand and the water will come out from the tap. A sensor is also built in for the soap. This is because it is not hygienic using a bar soap or the pump bottle. This is because it will be touched too many times and it will make it not clean. As it is automatic, water will also not be wasted.

A. Related works

This project's main idea is not a new one. Many other projects have some features of this project. However, this project has a few differences from the others. Firstly, this project will notify the user when the soap and sanitizer level is low. Other projects do not have this feature. For example, other projects like the Automatic Hand Sanitizer Dispenser [10] by Ashish Choudhary also have only the system to dispense hand sanitizer automatically. This project and the others project are quite the same for the system because they use the same principle and objective. The materials used in this project like the Arduino, the motor, and others are quite the same as others' previous projects. For example, an ultrasonic sensor is used to detect a user's hand, and then it will dispense whether it is soap, water, or sanitizer.

Then, motor pumps and servo are used in this project to allow specific substances to dispense. Arduino is used for

programming and the iot, a blynk app used to notify the user about the soap and sanitizer. Last but not least, this project is different from others because it technically combines most of the previous studies into one project, and it is also different because it will send notifications to the user to notify that the level of soap and sanitizer is low.

Next, other projects like the Automatic faucet-sink control system [9] by Frank S. Piersimoni also have the same purpose as our project. The project uses a photosensor, while our project uses an ultrasonic sensor. This is the difference between our project and other projects. Although the purpose is the same, which is to detect a user's hands, it uses two different sensors. A proximity sensor consists of all types of sensor functions. Proximity sensors are used to detect the presence of objects and send data into electric signals. The proximity sensor does not require any interaction between the object for sensing a presence. Meanwhile, an ultrasonic sensor is a device used to measure the distance between objects and sensors. This sensor transmits the ultrasonic waves that are reflected to the ultrasonic sensor from the object. An ultrasonic sensor is reliable and used in any condition in home and outdoor.

Shihari [11] comes up with a quick concept for an automatic hand sanitizer. While detecting the IR Sensor, the motor pumps the sanitizer liquid or solution to the human. The IR Sensor is a photodiode that detects the presence of a human hand and controls the motor pump from the liquid. To control the sanitizer's liquid flow, the motor is connected to an RC timer delay setup, and the pipe is connected to a reducer. It has three modes of operation. The system's control LEDs, specifically the White LED, are used to inform the user that the setup is operational and that the battery is being used. The user can see that the battery is charging by looking at the red LED. The user can see that the battery is fully charged by looking at the green LED. From the battery supply, it has an On/Off switch that controls the entire setup. The consumer will find the setup to be convenient to use, and he or she will also save money and energy.

Puput et al. [12] want to create an automatic hand sanitizer that will automatically dispense soap and water. In addition, if the liquid in the automated hand sanitizer runs out, the owner will receive a notification on their smartphone. With a distance of up to 50mm, the infrared (IR) will detect the presence of heat and motion of the object. To activate the pump, it sends data to the Arduino Nano. If the ultrasonic sensor detects a distance of 35 cm between the sensor and the water, data will be sent to the node MCU connected to the Blink server. The Internet of Things can send data to output devices such as smartphones or PCs (IoT). According to the hand sanitizer testing results, the system can run smoothly with a minimal data detection error.

B. Related Issue

A public building is considered vital to be protected from the spread of infection through poor hand hygiene [13]. In this sense, an automated system is required to encouraging people to mitigate the spread of infection in such an environment [13, 14]. Moreover, especially because of this pandemic of COVID-19 19, people have to take their hygiene more seriously, and one way to do it is by trying to prevent from touching surfaces because you do not know whether it is clean or not. An automatic hand sanitizer allows the discharge of the sanitizing liquid without pressing any nozzle. The automatic hand sanitizer design focuses on the mechanism of pressing the nozzle of the hand sanitizer that involves conversion from a rotation movement into a translation movement [15, 16].

Next, when talking about proper water management, we humans underestimate some of the following facts: one of them is that running the tap while brushing your teeth can waste 4 gallons of water. Then, leaky faucets that drip at the rate of one drop per second can waste up to 2,700 gallons of water each year. Next, showering and bathing are the largest indoor uses (27%) of water domestically. It is also a fact that about 95% of the water entering our homes goes down the drain [17]. So, besides the problem of keeping your hygiene, this is also a problem on how to stop wasting a large amount of water.

II. RESEARCH METHODOLOGY

A. Related works

Fig. 1 shows a block diagram of the main component of the circuit of automatic sinks such as Arduino Uno, two ultrasonic sensors, two relays, two water pumps, and four Light-Emitting Diode (LED). They are two input component that used in the AC-19 Hygiene Sink circuit. The inputs are ultrasonic sensor that located at the automatic sink and hand sanitizer dispenser. Each ultrasonic sensor has a trigger pin and echo pin connected to pins 3, 4, 5, and 6 of Arduino Uno. The function of an ultrasonic sensor is to calculate the distance between the sensor and the user's hand at the automatic sink. Next, the relay module connected at pin 8 and 9 in the Arduino and connected with the pump and battery. For LED D1 and D2, it is connected to pin 10 and 11, and when the pump is operating LED D1 switch ON and LED D2 switch OFF to indicate the activity of the pump in each storage.

Fig. 2 shows the block diagram of the hand sanitizer monitor by using Node MCU ESP 8266 for the microcontroller, water level sensor as input, LCD 16x2, and Blynk application as the output. S pin of the water level sensor connected to pin A0 of the Node MCU ESP 8266 and SCL and SDA of the LCD 16x2 connected to pin D3 and D4. Water level sensor is used for sensing the level of hand sanitizer in the storage, and Blynk application is used to monitor the level of the hand sanitizer over Wi-Fi and LCD 16x2 to display the percentage of hand sanitizer.

B. Block Diagram

Fig. 3 shows the system architecture for the faucet, which starts with ultrasonic sensors that detect users' hands and then sends a signal to the Arduino. The Arduino then sent a signal to start the water pump and finally came out from the faucet.

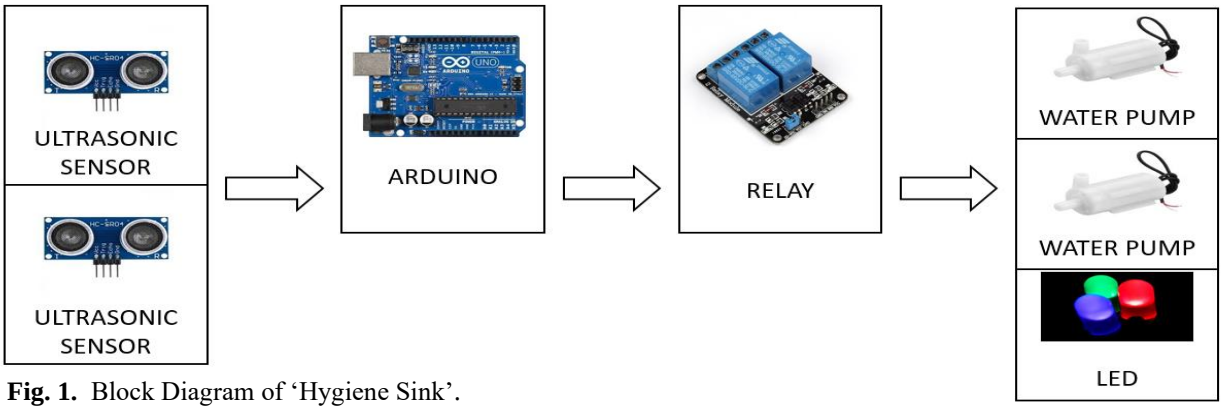


Fig. 1. Block Diagram of 'Hygiene Sink'.

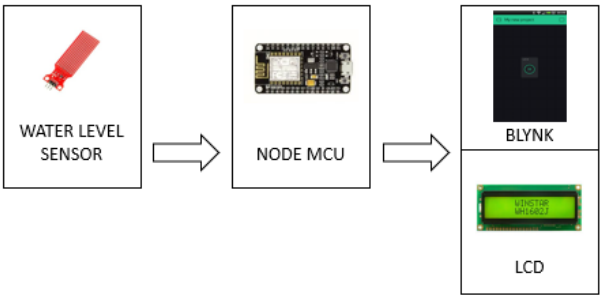


Fig. 2. Block Diagram of (Sanitizer storage).

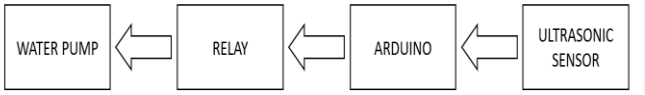


Fig. 3. System Architecture for the faucet.

Fig. 4 shows the system architecture for the water level, which starts with water level sensors detecting that the water level is low. After that, it sends signals to Arduino, which then a notification will be received to the phone via the Blynk application.

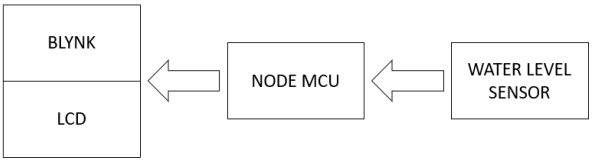


Fig. 4. System architecture for the water level.

C. Flow charts

Fig. 5 Shows the system operation starts with the ultrasonic sensor built into the case of the sink and hand sanitizer dispenser. The sensor will detect the user's hand, and then the mechanism will run and dispense whether wate rand or sanitizer. For the water dispenser, when the distance between hand and sensor is around 4 cm to 9 cm, it will dispense the

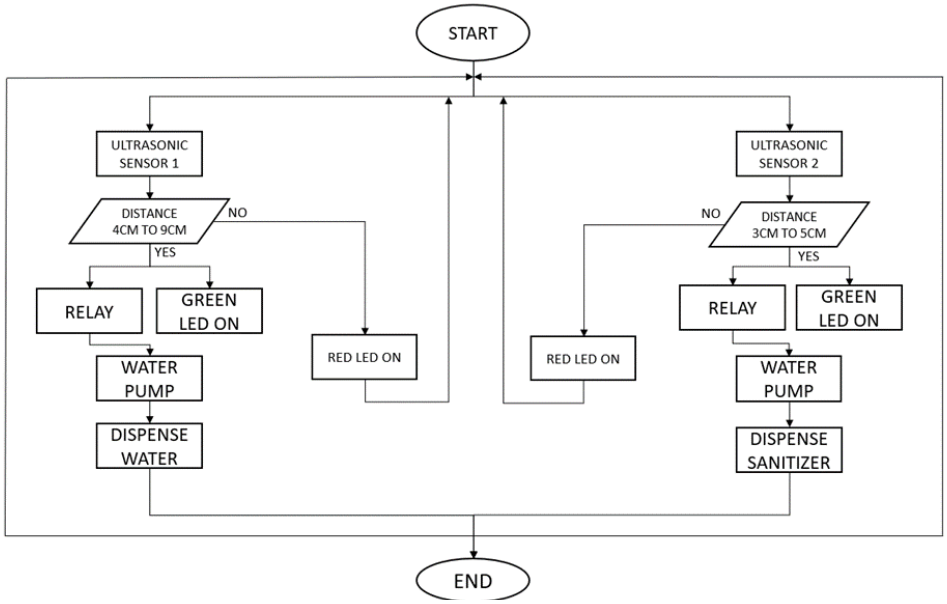


Fig. 5. Flowchart for water dispenser and hand sanitizer dispenser.

water at the sink through a silicon tube. Moreover, a green LED will switch ON when the pump is operating. For a hand sanitizer dispenser, the distance between the hand and the sensor must be around 3 cm to 5 cm. So, the relay will turn ON, and the sanitizer pump starts operating. The green LED will switch ON when the pump is operating. Fig. 6 shows that a water level sensor built in for the hand sanitizer will detect the level of hand sanitizer in the storage. If the level of hand sanitizer is below than optimum level, it will send a notification to the user's phone to refill the hand sanitizer and display the percentage of hand sanitizer at the LCD

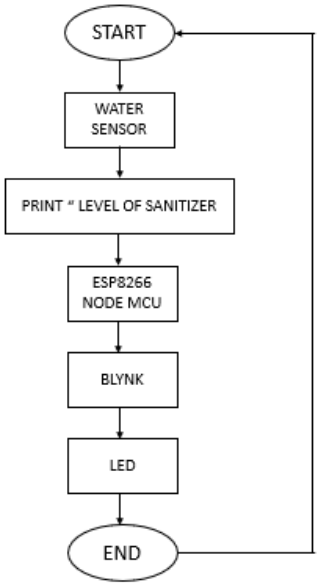


Fig. 6 Flowchart for hand sanitizer level monitor.

D. Hybrid Topology

Fig. 7 shows the topology of the AC-19 smart sink. It started when the sensor detected the user's hand. Then the sensor will send a signal to the server. Then the server will decide to send a signal to the microcontroller. The microcontroller then will start the water pump, and water will flow out.

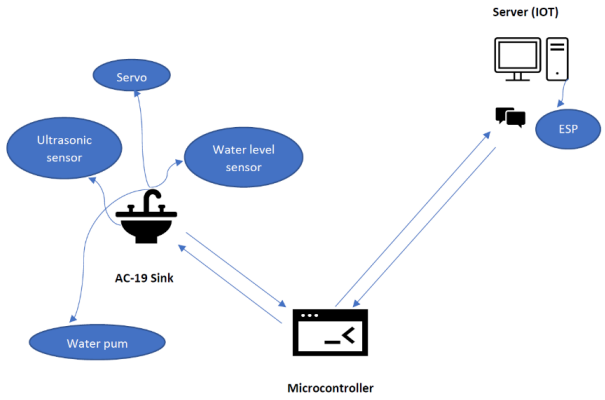


Fig. 7. Hybrid topology for AC-19 smart sink.

E. Schematic Diagram

Fig. 8 shows the schematic diagram of the automatic sink by using Arduino Uno V3 for the microcontroller and ultrasonic sensor for the input to sense the user's hand. In this project, two ultrasonic sensors were selected for the input of the automatic sink. One is for the water at the sink, and another one is for the hand sanitizer. Each sensor connects with a water pump to dispense the water and hand sanitizer from the sink. The Ultrasonic sensor module's "trigger" and "echo" pins are directly connected to pin 3 and 4 for trigger and pin 5 and 6 for the echo.

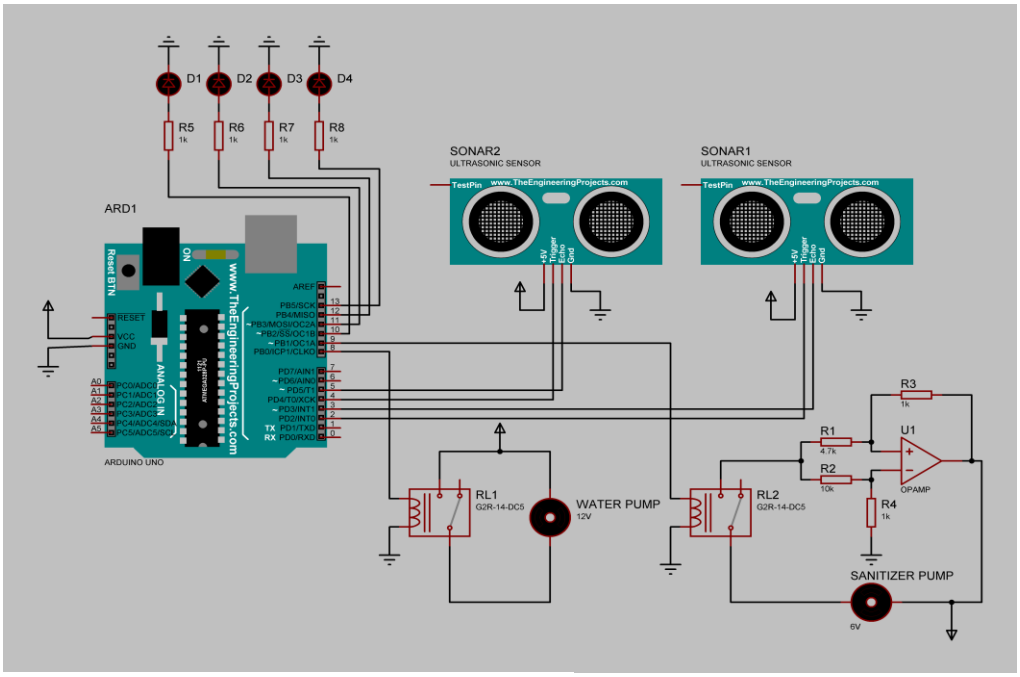


Fig. 8. Schematic diagram for the automatic sink

Two relay modules are connected to pin 8 and 9 to switch on or switch off the water pump. The Light-Emitting Diode (LED) use to indicate the operation of the water pump. When the water pump is operating, a green LED will be ON, and a red LED when the pump is not operating. Fig. 9 shows the schematic diagram of hand sanitizer level monitor with IOT circuit using Node MCU ESP 8266 for the microcontroller and water level sensor for the input to sense the sanitizer level in the storage. The water level sensor connects to pin A0, and the data of the level hold in 0. The percentage of the level of hand sanitizer display on the LCD and the user get the notification from the Blynk application about the level of hand sanitizer in the storage.

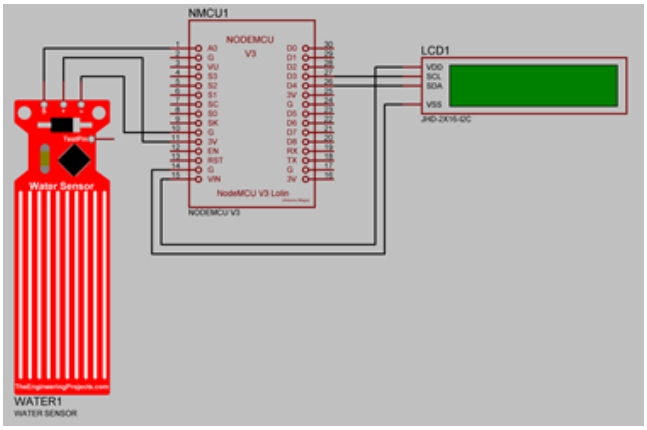


Fig. 9. Schematic diagram hand sanitizer level monitor.

III. Results and Discussion

The circuit of AC-19 Hygiene Sink was designed using Proteus Design Suite 8.5 software**.** The purpose of designing the circuit is to ensure the simulation can run properly by adding coding into the Arduino Uno. If there are some errors in the simulation, we need to troubleshoot, such as checking the connection and check the coding part line by line to ensure there are no errors. In this project, AC-19 Hygiene Sink uses two different circuit types: automatic sink and hand sanitizer level monitor. The trial was divided into two phases: an ultrasonic sensor to sense the hand and a water level sensor to monitor the level of hand sanitizer in the storage. Both systems were controlled by software using microcontroller Arduino Uno Rev3 and Node MCU ESP 8266. In the end, the overall system will be tested out in simulation for the AC-19 Hygiene Sink.

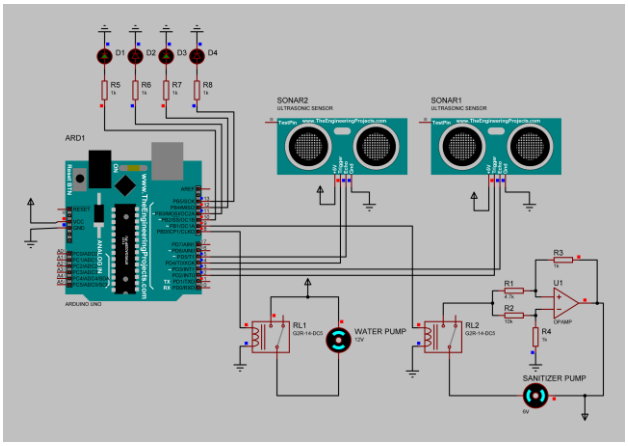


Fig. 10. The simulation result for AC-19 Hygiene Sink.

Fig. 10 shows the output result of the automatic sink when the distance between ultrasonic sensor 1 and hand is 4 cm to 9 cm and 3 cm to 5 cm for the hand sanitizer dispenser. The relay will switch ON when the distance between ultrasonic sensor 1 follows the condition, and the pump will dispense the water through the silicon tube. The relay will switch ON when ultrasonic sensor 2 follows the coding distance, and the pump will dispense the hand sanitizer. When the water pump and sanitizer pump are operating, the green LED will turn ON and turn OFF the red LED. Table I show the relationship between distance and water pump for sensors 1 and 2.

TABLE I. Units for Magnetic Properties Relationship between Distance and Water Pump for Sensors 1 and 2.

Ultrasonic Sensor	Distance between hand and sensor (cm)	Pump	Red LED	Green LED
1 (Water)	1 cm to 3 cm	OFF	ON	OFF
	4 cm to 9 cm	ON	OFF	ON
	10 cm to 90 cm	OFF	ON	OFF
2 (Hand Sanitizer)	1 cm to 2 cm	OFF	ON	OFF
	3 cm to 5 cm	ON	OFF	ON
	6 cm to 90 cm	OFF	ON	OFF

Fig. 11 (a) shows the hardware of the AC-19 Hygiene Sink for the automatic sink. This hardware is made from ½ inch PVC pipe and several pipe connectors such as 4-ways tee, 3-ways elbow, tee, elbow, and end cap. The microcontroller used in the automatic sink is Arduino Uno, and the component used in this hardware are two ultrasonic sensors and two relay modules. The output of this sink is the water and sanitizer dispense, and the red and green LED turns ON and OFF during the process.

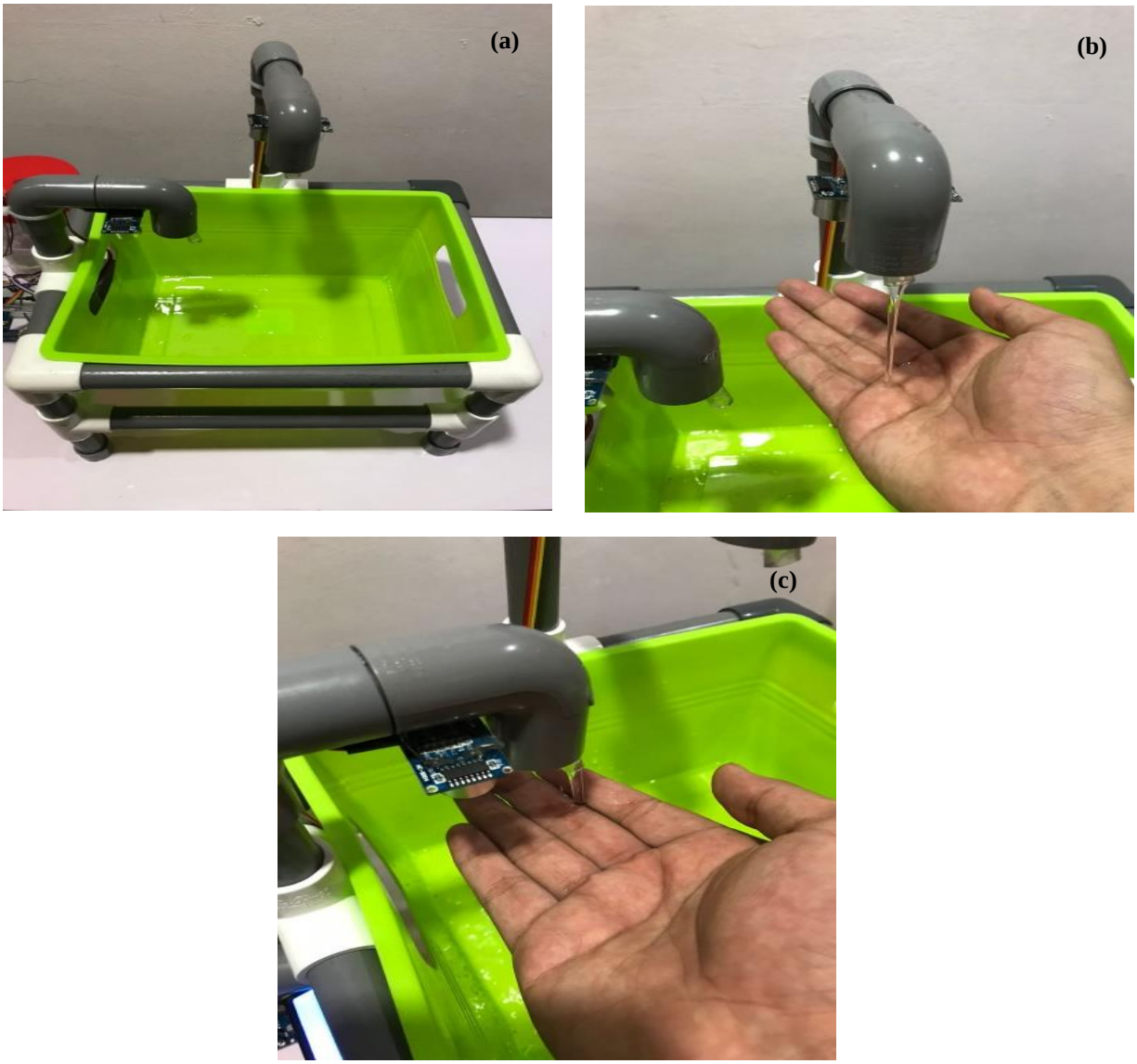


Fig. 11. (a)Hardware for AC-19 Hygiene Sink (b) Water dispense from the pipe when the distance is between 4 cm to 9 cm. and (c) Hand sanitizer dispense when the distance is between 3 cm to 5 cm

Fig. 11 (b) and Fig. 11 (c) show the water tap and the hand sanitizer dispenser work as well, the distance between the hand and the sensor follow the condition in the coding, which are between 4 cm to 9 cm, and the relay will turn ON the water pump. Moreover, 3 cm to 5 cm for the hand sanitizer dispenser to pump the hand sanitizer through the silicon tube. Table II shows the LED turn ON when the pump is operating to dispense water and hand sanitizer. Table III and Table IV show the relationship between the distance and the condition of the water pump. The result obtained shows that the AC-19 Hygiene Sink can operate properly and follow the condition. When the pump is operating, the green LED will turn ON and turn red when the pump does not operate.

TABLE II . LED WHEN THE PUMP TURNS ON.

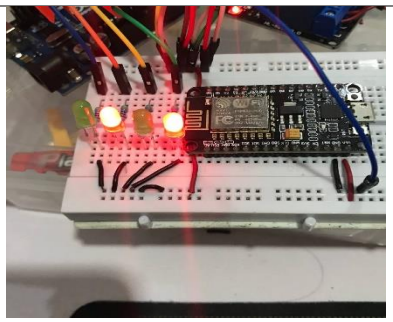
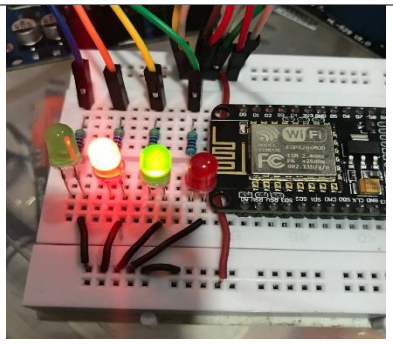
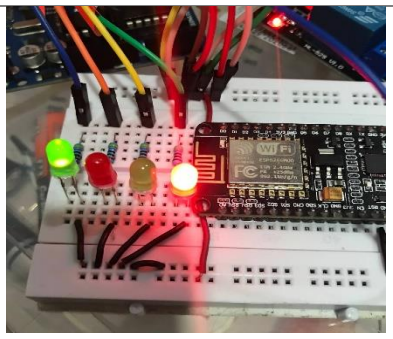
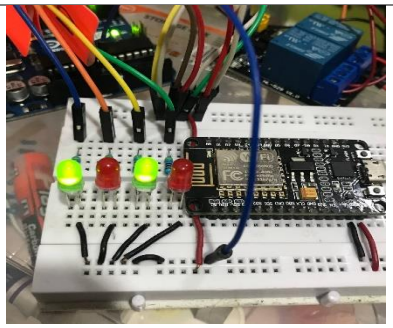
Pump	Condition	LED		Output
		Green	**Red**	
1 (Water)	OFF	OFF	ON	
2 (Hand Sanitizer)	OFF	OFF	ON	
1 (Water)	ON	OFF	ON	
2 (Hand Sanitizer)	OFF	OFF	ON	
1 (Water)	OFF	OFF	ON	
2 (Hand Sanitizer)	ON	ON	OFF	
1 (Water)	ON	ON	OFF	
2 (Hand Sanitizer)	ON	ON	OFF	

TABLE III . RELATIONSHIP BETWEEN DISTANCE AND WATER PUMP FOR SENSOR 1

Distance between hand and sensor (cm)	Water pump	Red LED	Green LED
1	OFF	ON	OFF
2	OFF	ON	OFF
3	OFF	ON	OFF
4	ON	OFF	ON
5	ON	OFF	ON
6	ON	OFF	ON
7	ON	OFF	ON
8	ON	OFF	ON
9	ON	OFF	ON
10	OFF	ON	OFF

TABLE IV . RELATIONSHIP BETWEEN DISTANCE AND SANITIZER PUMP FOR SENSOR 2.

Distance between hand and sensor (cm)	Sanitizer pump	Red LED	Green LED
1	OFF	ON	OFF
2	OFF	ON	OFF
3	ON	OFF	ON
4	ON	OFF	ON
5	ON	OFF	ON
6	OFF	ON	OFF
7	OFF	ON	OFF
8	OFF	ON	OFF
9	OFF	ON	OFF
10	OFF	ON	OFF

Fig. 12 and Fig. 13 show the water level sensor in the hand sanitizer storage and Node MCU ESP 8266 connected to the Blynk application over a WIFI network. The water level sensor connects to pin A0 in Node MCU and will detect the level of hand sanitizer liquid in the storage. Fig. 13 shows the blynks application notification that notifies the user of the sanitizer level of amount. Table V shows the output of the hand sanitizer monitor in the Blynk application and LCD 16x2. Table VI shows the value of the hand sanitizer that detects by the water level sensor will give the output to LCD and notify the user by using the Blynk application. The output of this circuit is a notification on the Blynk application and displays the percentage of hand sanitizer at the LCD 16x2, as shown in Fig. 14.

TABLE V . THE OUTPUT OF HAND SANITIZER MONITOR.

Sensor Value		Blynk	LCD
Minimum	Maximum		
0	100	Empty	Percentage: 0%
101	190	Low	Percentage: 25%
191	260	Medium	Percentage: 50%
261	280	Medium	Percentage: 75%
281	320	High	Percentage: 100%

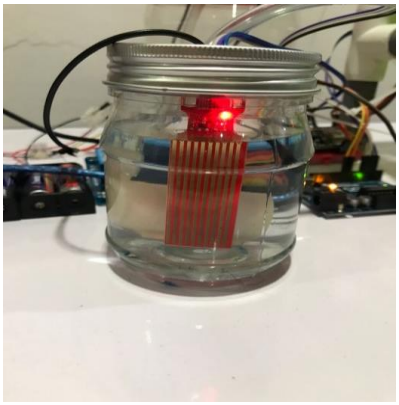


Fig. 12. Water level sensor in hand sanitizer storage.

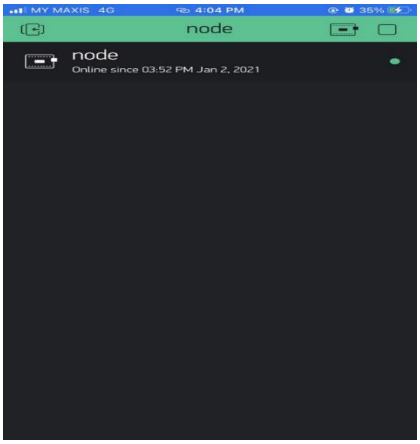
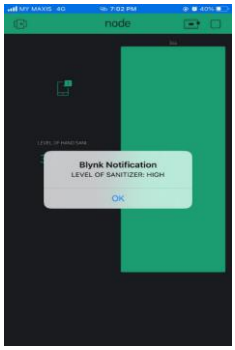
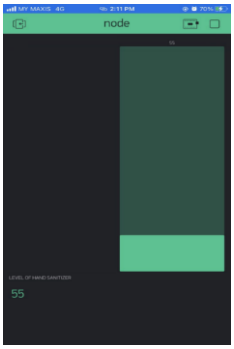
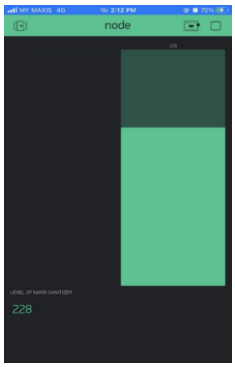
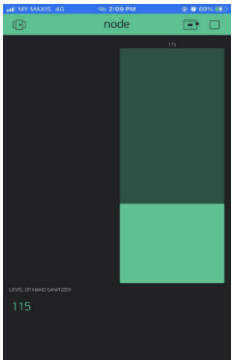


Fig. 13. Water level sensor in hand sanitizer storage shown in Blynk application.

Fig. 14. LCD display the percentage of sanitizer.

TABLE VI . NOTIFICATION IN BLYNK APPLICATION, (B) LEVEL OF HAND SANITIZER AT DIFFERENT VOLUME.

Level of hand sanitizer	Blynk
Notification in Blynk application	
Level of hand sanitizer at 55	
Level of hand sanitizer at 228	
Level of hand sanitizer at 115	

IV. CONCLUSION

This project manages to create a hygienic environment for the user by implementing a hygienic system by using ultrasonic sensors and water pumps which allow the user to wash their hands contactless. Next, we also use a water level sensor to measure the soap level in the soap case, which can also be monitored using the Blynk app. This will ease the user to refill the soap case when they get a notification from their phone telling them that the soap is running low. Finally, the project will also manage the problem faced by the world, which is the waste of water. This project helps to reduce the use of water and help the environment. There will be no more problem of forgetting to turn off the tap as it automatically turns off when it does not detect anything.For recommendation, some features are needed to be installed are the LCD and Blynk applications. This feature is unique from other automatic sink. This is essential because by having this feature, users can know if the amount of soap and sanitizer is low or not. Therefore, users will always have soap to use because it can be refilled even before it runs out. We were a little more inexpensive on our project but also it took us a bunch of time. DIY can save you money and feel satisfying to do fot the skilled and timely. However, industry products are convenient and technically produced in scale with price competitiveness. Benefits with DIY and Industry Products The exact choice will depend on personal price-points and time the individual is willing to spend versus they level of satisfaction it provides them.

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