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Smart Gas and Water Detector Monitoring System using Android Mobile Application

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Abstract: This project introduced Smart Gas and Water Detector Monitoring System using Android Mobile Application which can detect gas leakage and overflow of water. In this project, the mobile Graphical User Interface (GUI) was developed on the mobile interface app to monitor the gas and water level that was completed with the alert message and notification system. This mobile app monitoring system was integrated with the sensing devices such as MQ5 and an ultrasonic sensor to detect LPG gas and water level, respectively. Results show that the integration system between the sensing device and the mobile app that developed in this project was able to display a gas monitoring graph with its concentration value if the MQ5 detector senses gas. The mobile app will also send notification to the user if the system detects high gas concentration. The GUI mobile app for water monitoring system was able to show the water level from sensor either in low (37 cm to 41 cm), middle (33 cm to 36 cm) and high (25 to 32cm) condition with LEDs illumination either in green (low), blue (middle) and red (high) as well as the meter gauge and LCD display if ultrasonic sensor detected the water. Thus, this monitoring system allows the user to monitor remotely, avoid leakage of the gas, save more water, and avoid flooding.

Keywords: MQ5, LPG, GUI, ESP8266 NodeMCU

1. Introduction

As we are striving to IR 4.0, more industry factories are being built to accommodate the technology such as manufacturing company. This manufacturing company consist of chemical, mechanical, and electrical environment. Thus, safety precaution procedure are important to be implemented those that deal with chemical hazard either liquid or gas elements. Other than that, the usage of water during manufacturing or experiment is important where water is used for cleaning purpose. The chemical hazard issue can happen when it dealt with chemical elements in one place where it can make the surrounding expose to chemical whenever flammable or chemical gases are used; it is possible for gas to leakage into the laboratory space. In some cases, water leakage can occur when there is no-one available in the laboratory. This problem will be serious if no notice is given and brings to the laboratory.

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Hence, a system that can monitor gas and water level need to be created. A remote access technology known as 'Smart Gas and Water Detector Monitoring System using Android Mobile Application has been created to detect and monitor gas and water level. This system can be monitor by smartphone application and send warning notification if gas and water level is high.

The smart detector system using IoT technology such as sensor, application and wifi module are widely used to ease the user to detect gas and water level in laboratory remotely thus reduce the workload of the lab assistance to check manually. Gas detector technology such as Non-dispersive infrared. Metal oxide semiconductor based on portable Deep-UV absorption spectrophotometry have been developed by some researcher, however the implementation cost is high as it required a lot other equipment such as infrared light machine. MQ5 sensor is used in the system due to its low cost and easy to implement as it involve only two component hardware. This sensor also capable to detect gas such as hydrogen (H_2), carbon monoxide (CO) and liquefied petroleum gas (LPG) [1] – [5].

The water detector technology such as dot matrix electrode and optical fiber detector have been created to detect water level [6]. This technology is very costly and involve big parameter as this method is widely used for big water storage. G. Zhang stated that, dot matrix electrodes and optical fiber detector suitable to detect large amount of water as the detector are connected directly to water pump which makes the cost of the project high and hard to implement [6]. Ultrasonic sensor is used in the system due to its low cost and easy to implement as its involved two component only. This sensor can detect water level by measuring distance from sensor to water surface [7].

In smart gas and water detector monitoring system, the gas and water level detected by the sensor reading was display in an application namely *Blynk*. There are two option to build an application for smartphone which is *Blynk* and *ThingSpeak*. In this system, *Blynk* is used to create mobile application as it easy to create interface and user friendly. This application is developed to monitor the gas and water level remotely anytime. For gas level application interface, monitoring chart or graph is display with alert notification system. The warning notification will be sent if gas detector sense high concentration value which in this project 150 part per million (ppm). For water level monitoring system, the light indicator with a real-time distance measurement has been generated. The alert notification for the water system can easily be noticed with the aid of LEDs illumination either in green (low), blue (middle) and red (high) as well as the meter gauge and LCD display which represents the water level.[8], [9]

2. Methodology

The smart gas and water detector monitoring system divided by two parts which is gas detector part and water detector part. Both system was developed by using C++ language in Arduino IDE since it is open-source software and able to work efficiently with the system. In hardware part, ESP8266 NodeMCU act as microcontroller of this smart detector system where integrate between hardware and software or server. Power supply using USB is connected to NodeMCU in order to operate the system. The *Blynk* software will store and display data from gas and water detector via application in smartphone.

The block diagram of smart gas and water detector monitoring system using android mobile application is shown in Figure 1. The system started with MQ5 sensor detects the gas and an ultrasonic sensor detects the water, it will send the collected data and store it to the *Blynk* database. Thus, this data can be visualised using the *Blynk* application that represents in GUI gas and water level, respectively on the smartphone. In case of gas level, it has been setup with the interface showing the real-time with maximum concentration gas level was 150 ppm and the graph chart. A warning notification will be sent to the user if the gas level exceeds the maximum value. For the water level, the LCD screen, along with the meter gauge and three LED lights appear in the GUI mobile app. The three lights serve as an indicator to represent the position of water, either it in high, medium or low level [10], [11].

2.1 Wiring connection of the gas and water detector system.

Figure 2 shows a circuit diagram of the smart gas monitoring system that was designed using Fritzing software. The depicted image shows the circuit connection between ESP8266 NodeMCU and

MQ5 sensor. MQ5 Vcc pin connected to ESP8266 3V pin, ground (G) pin of ESP8266 NodeMCU connected to ground (GND) pin of MQ5, and lastly, the A0 pin of ESP8266 NodeMCU connected to A0 pin MQ5.

The circuit diagram of the smart water monitoring system was shown in Figure 3, where ESP8266 NodeMCU and Ultrasonic sensor connected. The ESP8266 NodeMCU pins connected to the ultrasonic sensor pins, respectively such as Vin connect to Vcc, the ground (G) to ground (GND) pin, the D4 to Trig pin, and D5 to Echo pin.

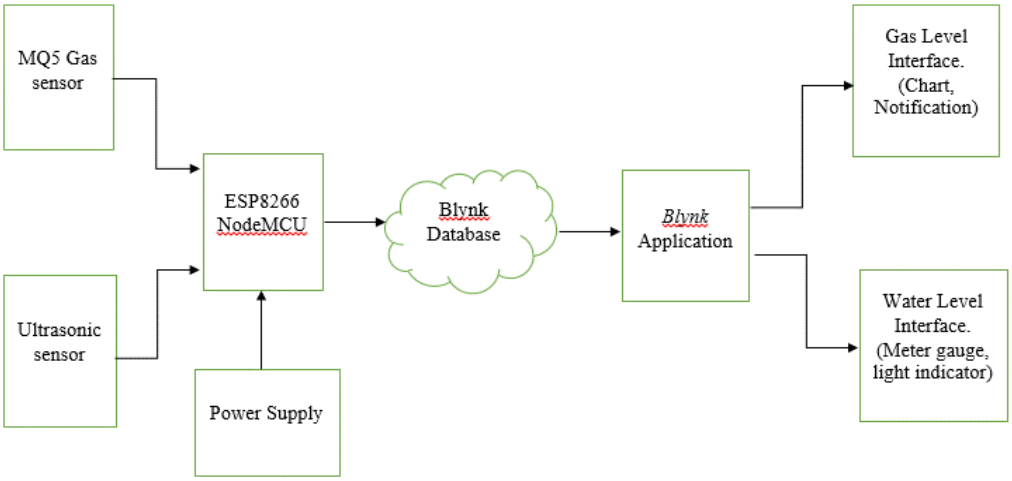


Figure 1: Block diagram of the monitoring system using android mobile application.

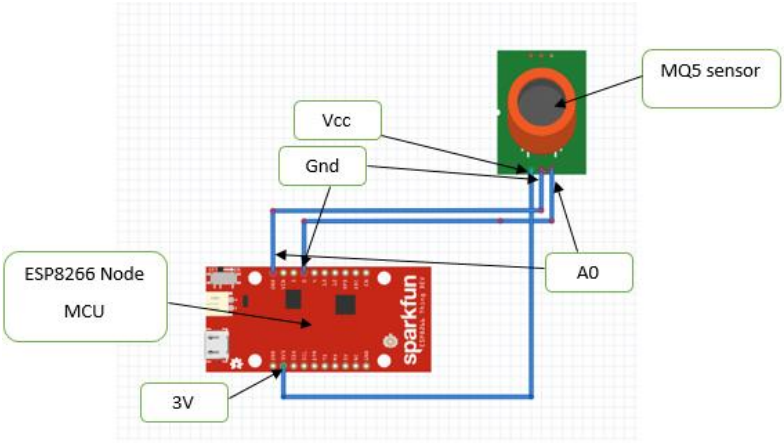


Figure 2: Circuit diagram of smart gas monitoring system

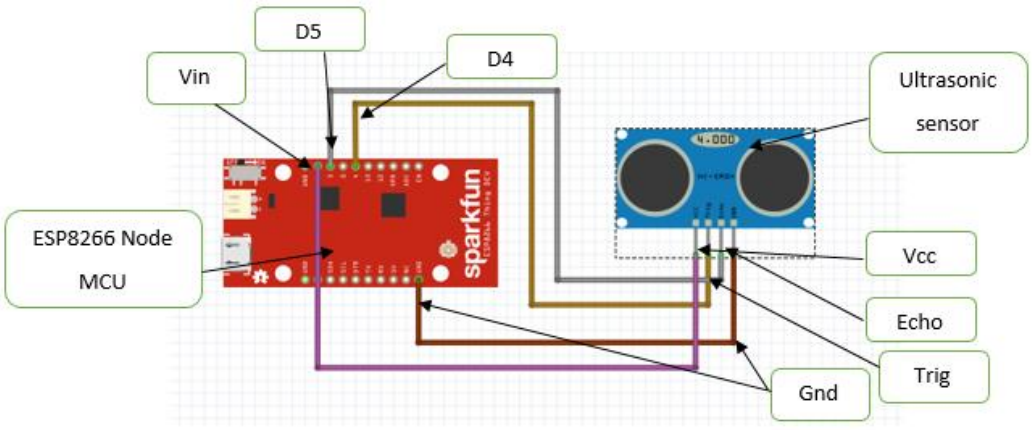


Figure 3: Circuit diagram of smart water monitoring system

2.2 Smart Gas Detector Flowchart

The smart gas detector monitoring system flowchart is shown in Figure 4. The system starts when they have gas present and read by MQ5. If gas is not detected, the MQ5 sensor will not detect any gas level. If gas is detected, the user needs to open or start the *blynk* application to read the gas level. NodeMCU, which is a microcontroller connected to the application, will send data from the sensor to *blynk*. If gas is at a low level, which is below 150 ppm, no warning notification is sent to the smartphone, and the gas level is shown in the LCD screen with a monitoring chart. If the gas level exceeds 150 ppm, a warning notification will be sent to the smartphone to indicate that the gas level is high. If the user wants to end the system, close the application, else the system will read back the MQ5 sensor. After that, turn off the application when the reading is completed.

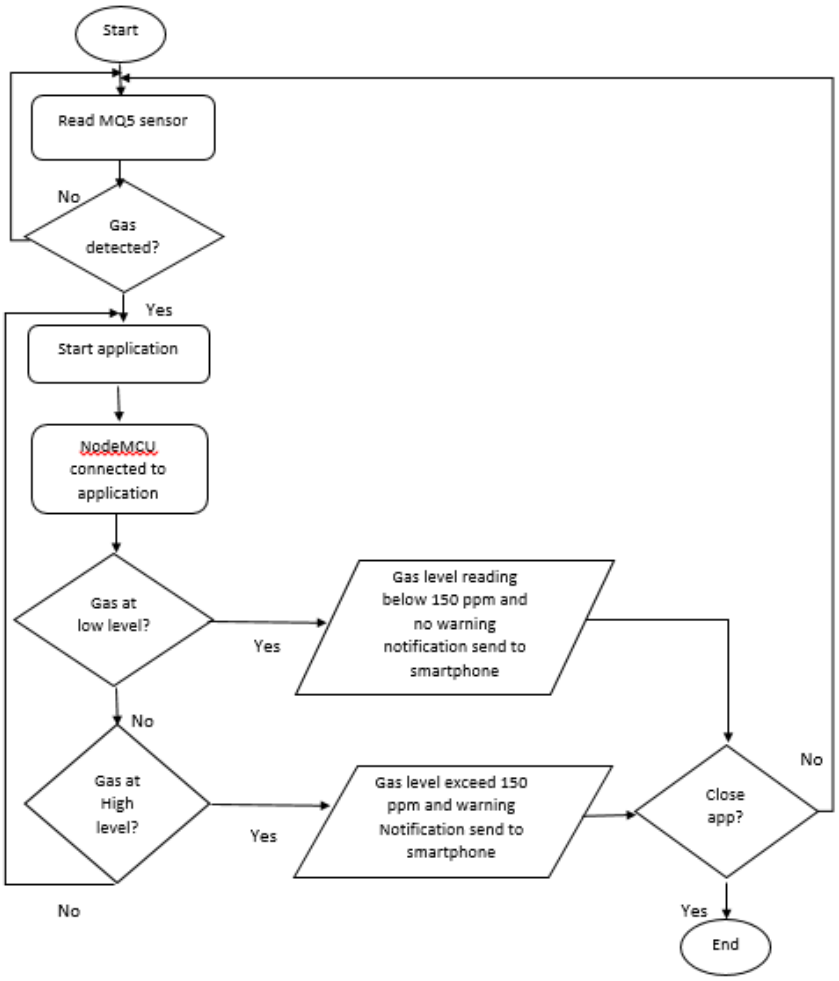


Figure 4: Smart gas detector monitoring system flowchart

2.3 Smart Water Detector Flowchart

The system starts when water is detected in the sink and read by an ultrasonic sensor that located at the tap water. If water is not detected, the ultrasonic sensor will not read, but if water is detected, the user needs to start the application to read the water level. NodeMCU, which is a microcontroller connected to the application, will send data from the sensor to *blynk*. There are three conditions of water level set up in this system which are low, medium and high level. If water is at low level (37-41 cm), green/low indicator light up in the *blynk* application interface; if not, the water is at medium level (33-36 cm). If water is at medium level, a blue/medium indicator light up in the application interface; if not, the water is at high level (25- 32 cm). If water is at high level, a red/high indicator will light up in the application interface; if not, the system is back to the start. After user satisfied with the system, close the application else the system still on and it will read ultrasonic sensor. The monitoring process is shown in Figure 5.

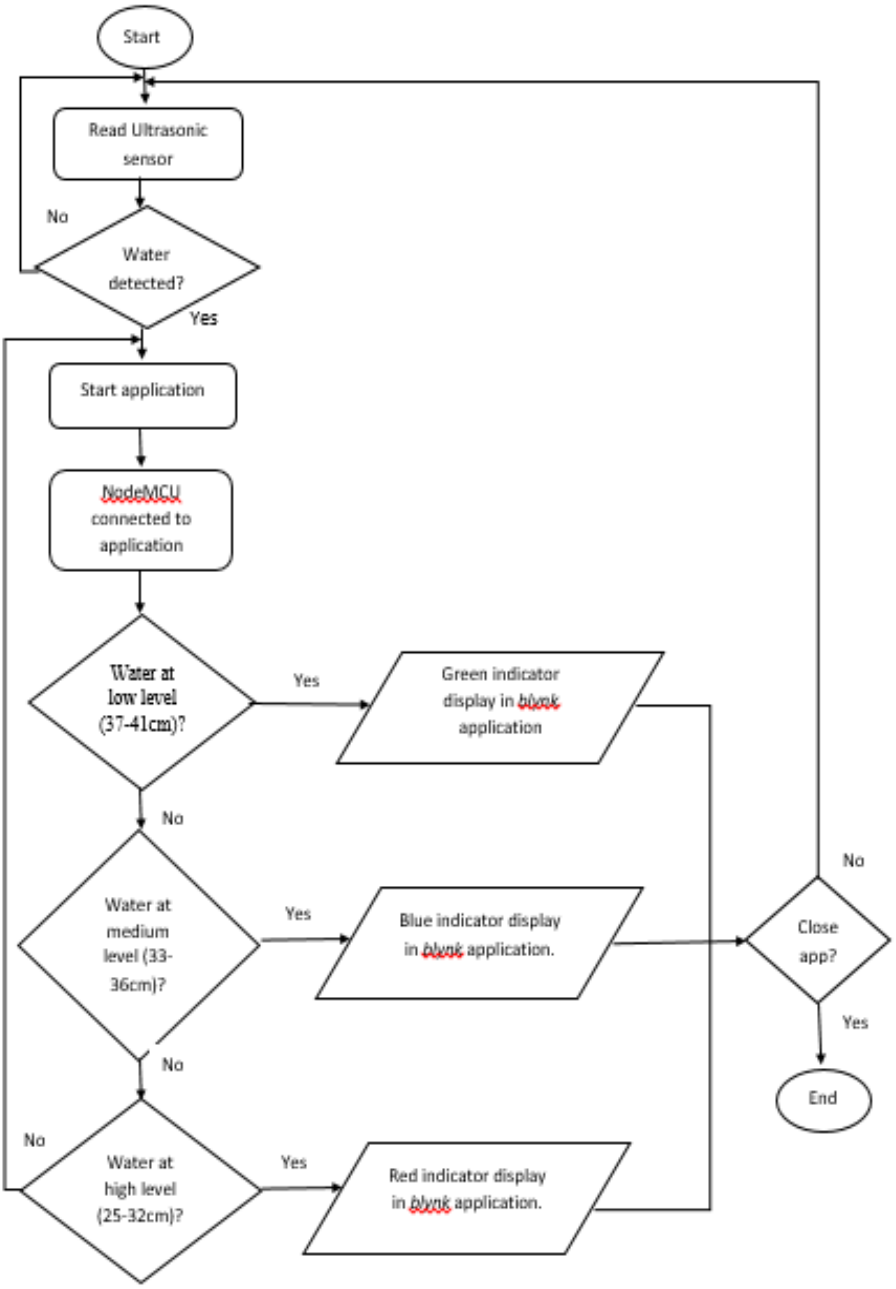


Figure 5: Smart water detector monitoring system

3. Results and Discussion

The *Blynk* interface of smart gas and water detector monitoring system has been developed for the user or lab assistance to monitor gas and water level in laboratory. To monitor the gas and water level, user only need to open and start the application in the smartphone. There have two interface generated which is gas level interface and water level interface. This application integrates with *Blynk* database and hardware to record the gas and water level. Figure 6 shows interface of *Blynk* application for gas and water level detector.

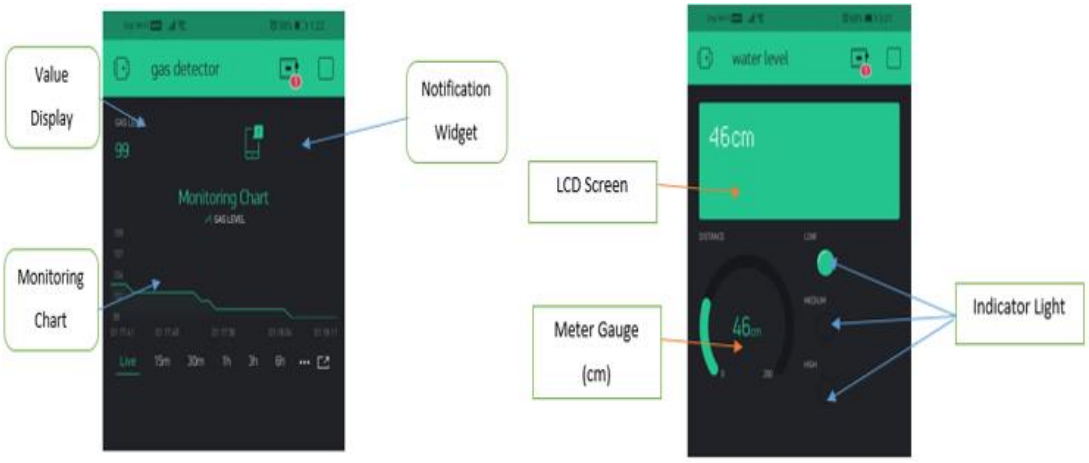


Figure 6: *Blynk* Interface for gas and water level detector

3.1 Smart Gas Detector System

In this project the prototype system has been tested at home with two different places, which are in the bedroom and the kitchen. This comparison will determine which place has a high concentration of gas in the air. Gas level reading and graph chart are shown on the *Blynk* application. In this project, the system has been tested in the house instead of laboratory FKEE due to the pandemic Covid-19 cases. Figure 7 shows the reading of the gas level in the bedroom and in the kitchen. Only one MQ5 sensor was used with size of bedroom 7.1 m^2 and 4.32 m^2 for the kitchen. The reading of the gas level in the bedroom shown in Figure 7(a) is having 84 ppm while in the kitchen shown in Figure 7(b) is 128 ppm higher than in bedroom because near to the gas tank.

Warning notification shows up if the gas level exceeds 150 ppm, that means a high level of gas presence. The *Blynk* application will send a warning notification to a smartphone to remind that the user about gas level is high. Figure 8 shows a warning notification sent via *Blynk* notification.

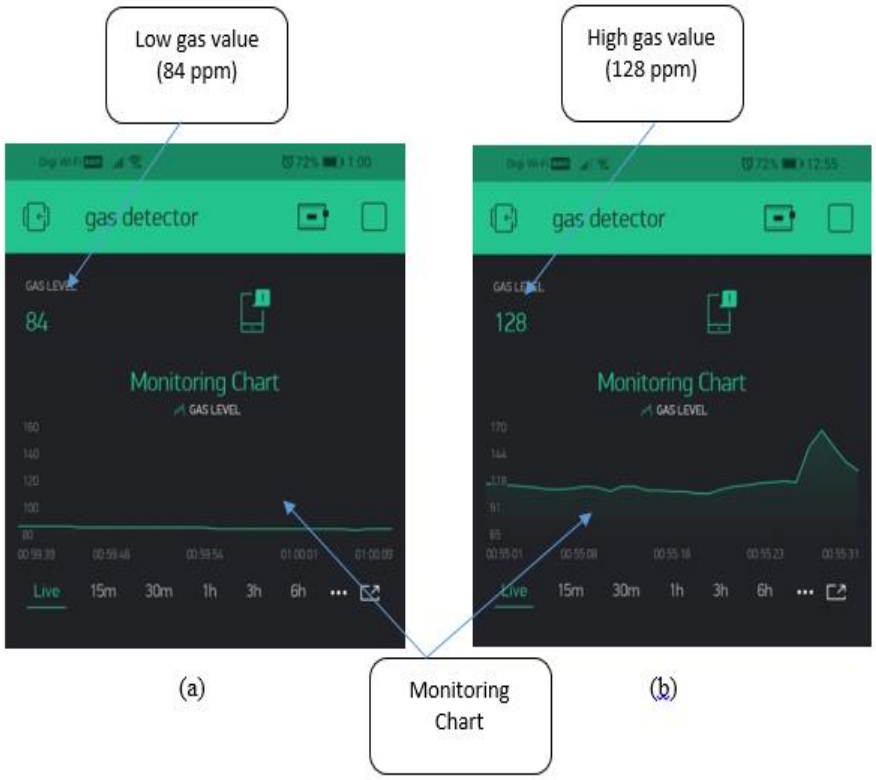


Figure 7: Gas level in (a) bedroom and (b) kitchen

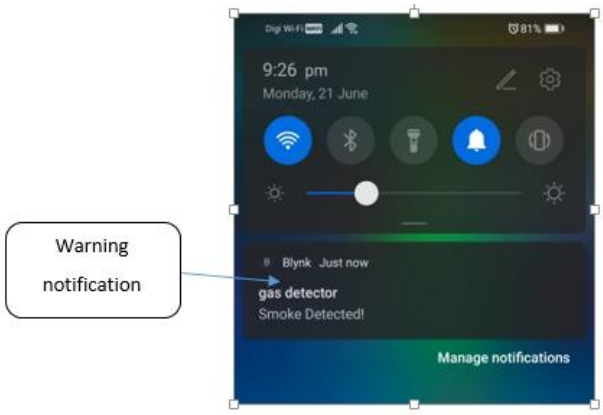


Figure 8: Warning notification on smartphone

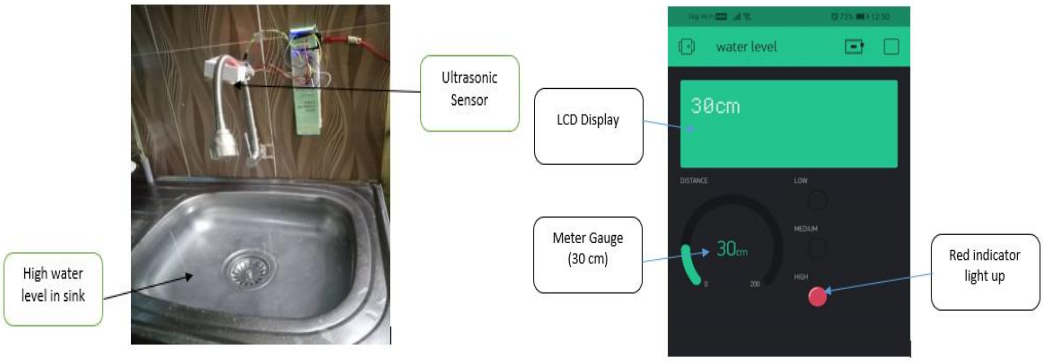
3.2 Smart Water Detector System

This smart water detector monitoring system will be placed under tap water to measure water in the sink. When an ultrasonic sensor at the tap of water detects increasing water level, the sensor will measure the distance between tap water to water surface, and the measurement will be shown in the blynk application. Three indicator that monitor water level in the sink which is "High (25 cm to 32 cm)", "Medium (33 cm to 36 cm)" and "Low (37 cm to 41 cm)" . Figure 9 shows the measurement of the three indicator in the sink. The measurement is measured from the sensor to the water surface.

Figure 9: Measurement of three indicator

The high or red indicator lights up if the water level increases at a high level and almost overflow. The high indicator lights up when the distance between the sensor and the water surface is 25 cm to 32 cm. This range distance means that the user need to be alert that the water in the sink is almost full and need to close the water tab to avoid overflowing of water. This can save water from wastage. Figure 10 (a) shows water in the sink at high level and Figure 10 (b) measurement of high water level on *blynk* application.

After testing all the monitoring system and sensors, the prototype was able to fulfill the expected result without any problem. All the results are successful to detect gas level for MQ5 sensor, water level in three conditions for ultrasonic sensor. For MQ5 sensor, this sensor able to detect and display gas level in real-time in the bedroom and kitchen where the result recorded in the *Blynk* application interface. Besides, the smart gas detector can also send warning notification to smartphone when the gas level reach 150 ppm. For ultrasonic sensor, this sensor able to detect water level in the sink by measuring distance from sensor to water surface. This sensor can help to monitor water level in real-time and recorded the distance in *Blynk* application. The red light indicator light up indicates the smart water detector successful detect the distance at given range.



(a) (b)

Figure 10: (a) Water in sink at high level (b) Measurement of high water level on *Blynk*

4. Conclusion

In conclusion, the smart gas and water detector monitoring system using the android mobile application has successfully developed and functioned. All the objectives in this project have been achieved. The achievement can be observed through the functioning of the circuitry and mobile app for gas and water systems when it is assembled and integrated between hardware and software, respectively. The integration between the sensing element and the IoT application was completed and functioning. The system was able to detect the gas presence and water level through the sensors and display it on the mobile interface application in real-time. It was also equipped with an alert, an instant notification that would be useful to the mobile user to monitor, especially when the gas and water level is high. For example, a warning message will be sent to the user if the gas level exceeds 150 ppm concentration. While, the red LED will illuminate on the mobile interface if there is high water level that ranges from 37 cm to 41 cm that was detected. Hence, this smart system can ease the user or lab assistance to monitor gas and water level in the laboratory as well as can be applied to the household.

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