PEAT

Smart Sewer System Using ESP32 and Send Notifications Through Telegram Bot

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Abstract: Flash flood, commonly known as Flooding that occurs within 6 hours, and frequently within 3 hours cause by heavy or significant rainfall, the intensity of the rainfall, the location and distribution of the rainfall, land use and terrain, vegetation and soil types, and, finally, as a cause of a clogged sewer. In Malaysia, Flash flood frequently happen because of the bad sewer system and clogged sewer that happen by people throwing waste in it. The project's primary purpose is to develop a system that can solve clogged sewer by the mechanism that want been built and send message through telegram bot about the water level in that time and send alert message that water level has been reach highest level and can send message through telegram bot about the waste bin had been full. The microcontroller ESP32 is used for Smart Sewer System. The use of water level sensor is to detect the water level in the sewer, and the use of ultrasonic sensor is to check the level of waste in the waste bin. The ESP32 was used to send alert messages through telegram bot to send warning messages to person in charge about the water level and the waste bin had been full. The system in this project can be improved by making full use of the Internet of Things (IoT) technology facility. In addition, this paper includes a detailed description of the mechanism and system, how it was tested and its performance is presented. There are also the challenges faced in the development of such mechanism and system.The test result of the project show the project can detect the water level and the level of the waste in the waste bin and send alert message through the telegram bot.

Keywords: Flash flood, Telegram Bot, Water Level Sensor, Ultrasonic Sensor, Clogged Sewer, Alert Message,Microcontroller,IoT

1. Introduction

The Smart Sewer System is an automatic garbage picker in the sewer that will make less human participation to clear the sewer from rubbish that create clogged to the sewer and can send information about the scrap level that had been collected from the sewer and water level from the sewer. An automated mechanism that is more advance in technology that will replace traditional manual tools. The automated machine is predicted to help the government or the city council to solve the clog sewer problem that happen recently that cause flash flood in the residential area. The sensor that can monitor the water level in the sewer with the help by the Water Level sensor. This will introduce to the automated mechanism that will be improved to solve the problem about the clogged sewer by create invention that will make it easier to monitor and operate by its own, the automated mechanism will be saving the city council time and money to solve the problem. The important criteria in the smart sewer system is should can detect the water level in the sewer and automatically solve it by itself. To add the system complexity, a system that will send information through telegram about the level of the scrap that has been collected from the sewer. The problem about the clogged sewer had been increased recently and cause flash flood to some area especially to the residential area and town with the bad drain system. This problem is the main purpose for this smart sewer system that can run by itself. This technology will have potential to use in the world that will be most of the work will be solve automatically in several years.

The weather disaster such as rainstorm that was not stop for several days had cause flash flood to certain area because of the clogged sewer had happen in our country recently. The government or the city council has to solve the problem about the clogged sewer in "Seremban" [1], "Kuala Lumpur" [2]," Petaling Jaya" [3] and certain area from port Klang [4] that make a lot of loss to property and asset and cause a ton of money to service the drainage system and to solve the problem about the clog sewer [5]. It could be difficult for the city council to fix the problem manually about the clog sewer when the flash flood had occurred because the water level had risen up to dangerous level until car cannot go through it. That would obviously take a lot of time, energy and money to solve the clog sewer. For time, it would take some time for the water level to diminish to safe level and for energy that would take a lot of work to solve it and money. The main problem to produce the smart sewer system is the position to place Water Level sensor must be precisely to determine the water level accurately and the position of the ultrasonic sensor had to be precise to ensure the level of scrap that had been collected form the sewer. The motor that had to use must have the power to take out the scrap from the sewer because the scarp in the sewer will be heavy because of the water. The mechanism for lifting up the scrap in the sewer that cause the clog sewer had to be solid and strong and not easy to collapsed because of the water pressure when rainstorm is occur. Finally, yet importantly, the iot system that will send telegram message to the person in charge for the city council must have work properly to pick up the scrap that had been collected.

The purpose of this project is to monitor the water level in the sewer to avoid flash flood caused by the stuck scrap and solves by its. Besides, to design and develop the prototype mechanism that can trap and take out the scrap from the sewer. Next, to send notification using telegram to alert about the scrap had been full and the water level has been reaching the highest level. Thus, to fulfill the stated objectives, the scopes of this project is This project is specified for several sewer and not suitable for the other places such as river and it will be fully automated. Next, Water Level Sensor will be used to indicate the water level of the sewer to determine the motor to start running and collect the scrap that had been trapped. The iot module and ultrasonic sensor will be used to determine the level of scrap that had been piled up to keep the bin from exceeding the limit.

2. Materials and Methods

This section provides a thorough overview of the methods and materials used in this project. The information will include all aspects related to component used, which show are block diagram, software and hardware used, and the overview of the system flowchart.

2.1 Materials

The materials used in this project have been divided into three parts: microcontrollers, sensors and components as well as output components.

A. Microcontroller

- NodeMCU ESP32: This microcontroller is used for Smart Sewer System because this microcontroller already has an assembled Wi-Fi-module on the board. This wi-fi module will make it easier to link this microcontroller directly to a Wi-Fi network and connect to telegram bot.

B. Sensors and Components

- Water Level Sensor: This sensor is used in this project to detect the water level. This sensor is an analog-type, so it requires calibration to get the right distance and the operating voltage for this sensor is 5VDC.
- Ultrasonic Sensor: This sensor is used in this project to measure the level of waste that had been scoop in the waste bin. This sensor is an analog-type, so it requires calibration to get the right distance. The operating voltage for this sensor is 5V.
- Relay Module: The 1 channel module relay is used to turn on the motor by changing the state from normally open to normally closed after being triggered.
- AC to DC Converter: This power supply unit is used in this project to convert 240VAC to the 12 VDC value required by the motor to move.

C. Output Components

- 12V 1Nm 775 DC Motor: This motor is DC motor and requires 12VDC to function.
- Telegram bot: It is used to send alert message through telegram bot about the waste bin been full and the water level had reached the highest level
- LED: It is used as an indicator when the system has detected a water level

2.2 Methods

The Smart Sewer System project makes use of a variety of different components, as seen in the block diagram and other figures found in Figure 1 and the figure 2 below show the circuit diagram of this project and block diagram for the project. The use of NodeMCU ESP32[6] in this project to connect the Smart Sewer System to telegram bot using internet connection., creating Smart Sewer System with the Fritzing software. The microcontroller ESP32, the Water Level Sensor, and the Ultrasonic Sensor [7][8][9] will each get 5Vdc from their respective power supplies by ESP32 that had been supply by 5vdc from the power bank. Through the use of a single channel relay module [10], 12Vdc will be given to the motor. The Water Level Sensor is the kind of sensor that is utilized for the purpose of determining the water level and will divide into three level and when it detects level 1 the greed led will be light up, when it detects level 2 the yellow led will be light up and when it detects level 3 the red led will be light up, while the Ultrasonic sensor is the type of sensor that is utilized for determining the level of scrap that has been gathered. The ESP32 is used as a controller and as the component that will send a message to in the telegram to warn that the scrap had been loaded and will warn when the water level had reached the highest level.
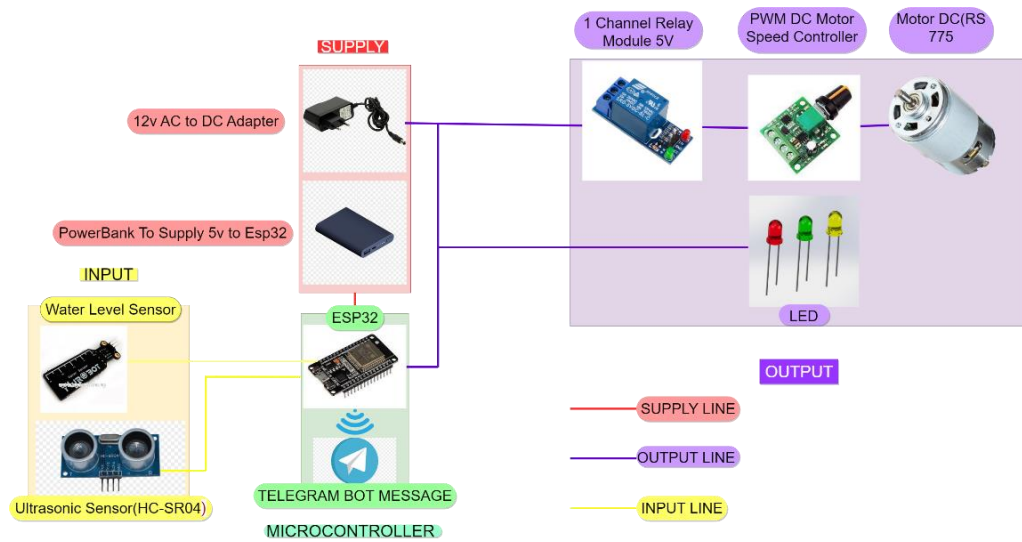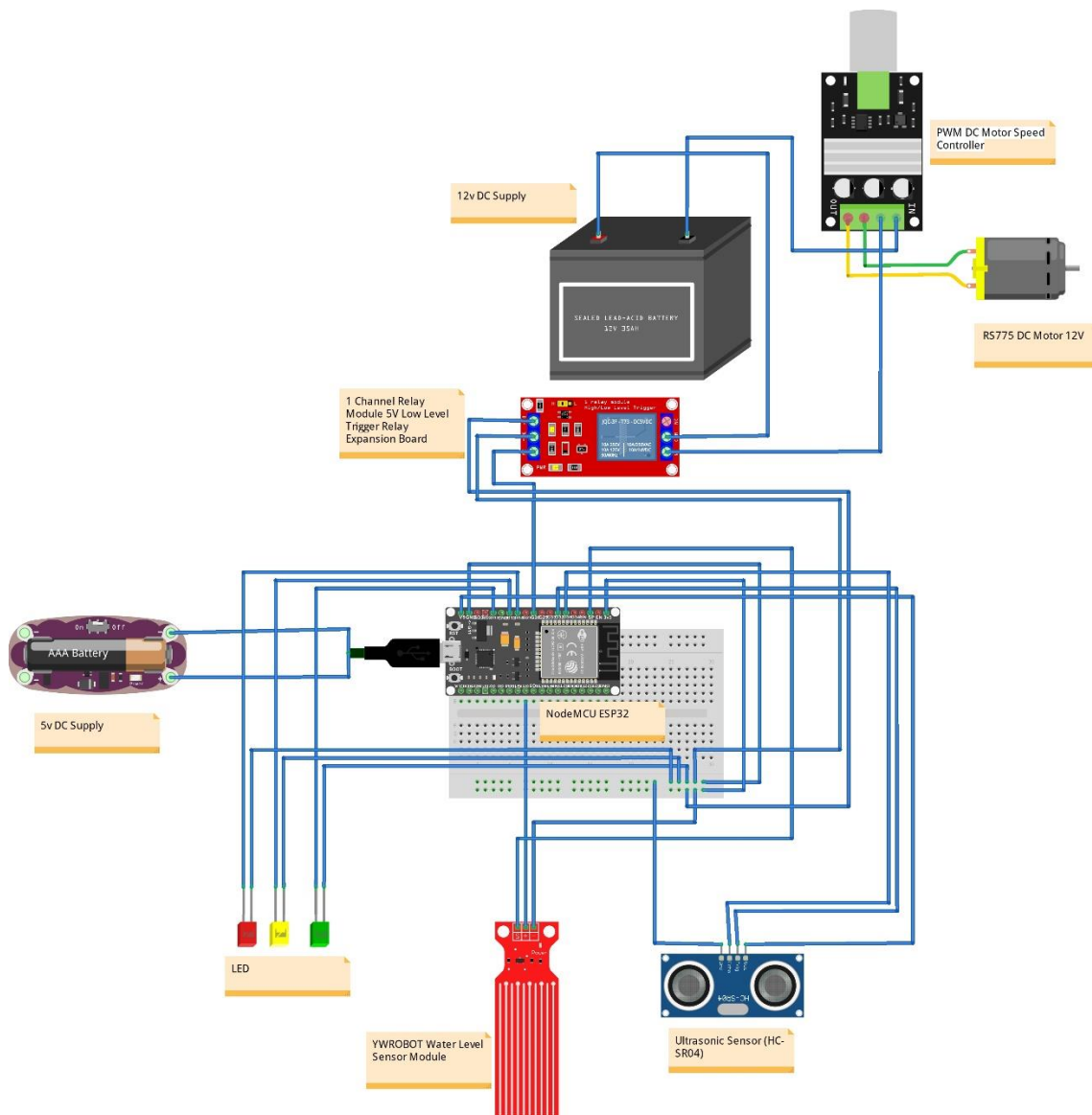
Figure 1: Block diagram of the System

Figure 2: Circuit diagram of Smart Sewer System

The flowchart for the Smart Sewer System is seen in figure 3. After turning on the adaptor for 12 volts and connect the power bank to supply the ESP32, The ESP32 will turn on and try to connect to the WIFI that had been set in the coding. After the ESP32 connected to the WIFI, it will show in serial monitor that "WIFI Connected" and it will login to the telegram and if its success to login the telegram it will show in the serial monitor "Telegram Connection OK!". After that, The Water Level Sensor and Ultrasonic sensor will be activated and will do the sequence that had been set in the Coding. For the Water Level Sensor sequence, it will be divided to three conditions that was water level 1, water level 2 and water level 3. When the first conditions were met it will trigger and turning on the green led and when if the second conditions were met it will trigger and turning on the yellow led and will trigger motor that will cause the mechanism to move and scooping out the stuck waste in the sewer. Next for the third conditions, when the condition was met it will trigger and turning on the red led, will trigger motor that will cause the mechanism to move and scooping out the stuck waste in the sewer and send alert notification through the telegram bot that saying "The water level has been reach the highest level". For the Ultrasonic Sensor sequence, there was only one conditions that was set in the coding that was when the Ultrasonic Sensor detect the piled-up waste that had been scoop is less than 4cm from the Ultrasonic sensor it will send notifications to the person in charge that was saying "The waste bin had been full, please unload the waste". The two sequences will be looping infinitely and can be turning off by taken out the supply from the ESP32.
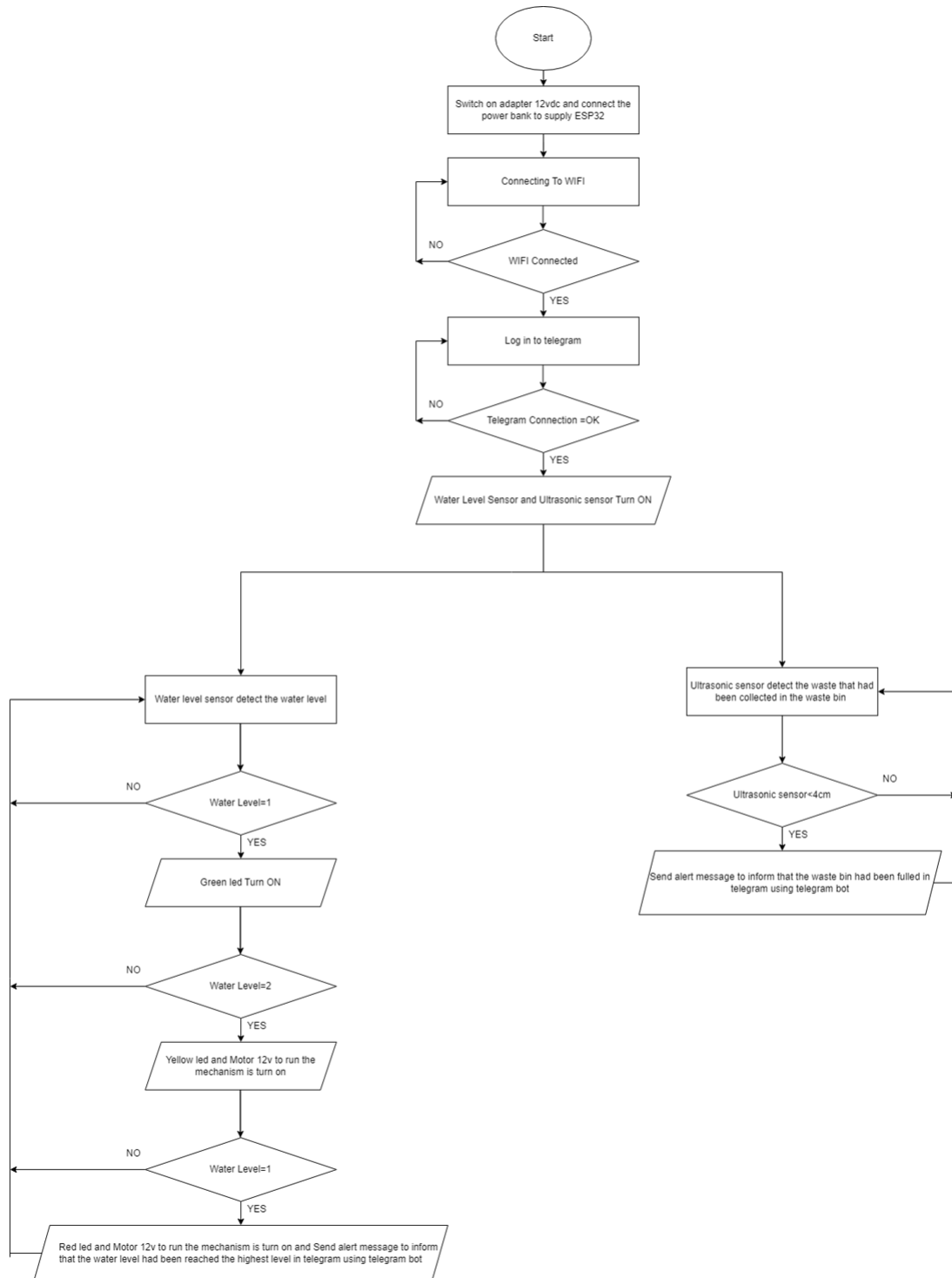
Figure 3: Flowchart of Smart Sewer

3. Results and Discussion

This section focuses on the analysis and discussion of collected results and findings that were obtained from several experiments conducted with reference to the aims of the project.

3.1   Project Layout

Figure 4 portrays the Smart Sewer System that has been built for this project that was designed to be controlled using NodeMCU ESP32. The Smart Sewer System was built using iron to ensure durability, toughness and stability as a Smart Sewer System should have.

Figure 4: 3D view of the Smart Sewer System

3.2   Accuracy of Ultrasonic Sensor

        This experiment was carried out to observe the test that has been conducted to test the accuracy of ultrasonic sensor for actual distance and the serial monitor print 2 cm,3 cm,4 cm,,5 cm and 6 cm shown in Table 1. This test had been conducted by differentiate the distance between the object by using a ruler. A box was used as a distance barrier and it had been placed on the ruler. The reading value of the ultrasonic sensor will be shown in the serial monitor in Arduino IDE.

Table 1: Distance between ultrasonic sensor and object for actual distance and serial monitor print

	Distance between ultrasonic and object (CM)				
Actual distance	2	3	4	5	6
Serial monitor print	2	3	4	5	6

        The Figure 5 show the graph of the actual distance that had been measured using a ruler and the data that had been display in the serial monitor. The blue line representing actual distance that had been measured by the ruler and the orange line representing the data in the serial monitor. As a result of this graph, the orange line almost stacked on all of the blue line and it means that was the reading that get

from the ultrasonic sensor with the actual distance that had been measured by the ruler was highly accurate reading.
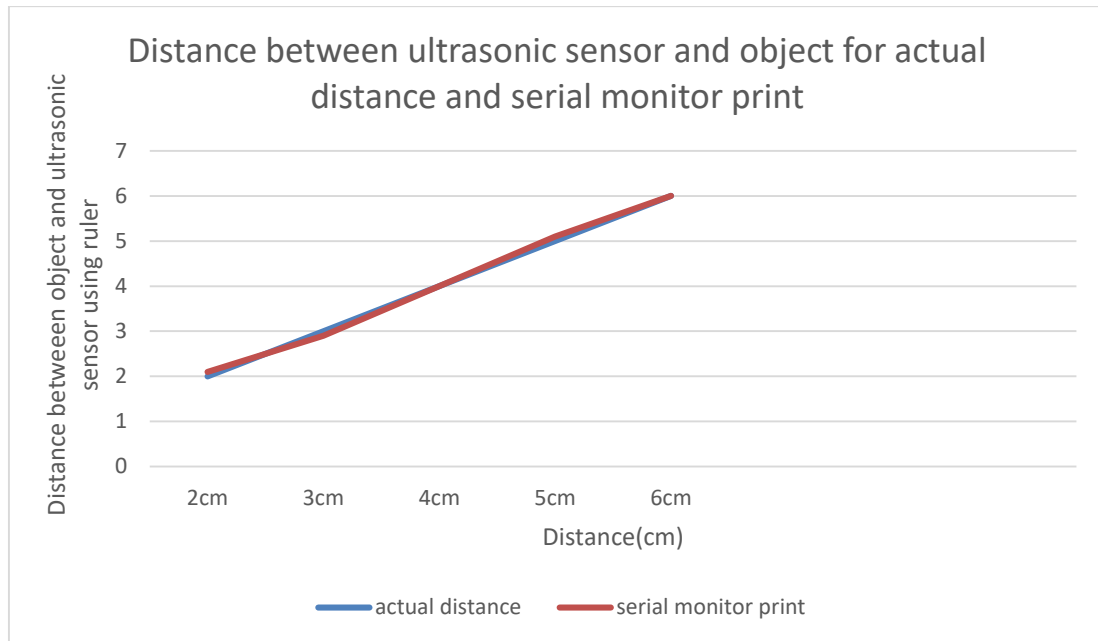

Figure 5 show graph actual distance vs serial monitor print for distance between the ultrasonic sensor and object

Figure 1, as are all figures, should be referenced in the text. Figures should be placed at the top or bottom of a page wherever possible, as close as possible to the first reference to them in the paper. Please ensure that all the figures are of 300 DPI resolutions as this will facilitate good output. The preferred format of figures is PNG, JPEG, GIF etc. Items in the figure should be aligned to the centre whenever applicable. Figure caption is aligned to the centre. All writings, symbols, and data markers in the figure should be legible and discernible, even in black-and-white. If a figure is copyrighted by a third party, the authors bear the responsibility to obtain licensing or permission to use the figure in the paper. In this case, proper citation is required to be added in the figure caption.

3.3   Sensitivity of the Water Level Sensor

This experiment was carried out to observe the test that has been conducted to test the sensitivity of the water level sensor. This test had been conducted by submerged the water level sensor in the water in three different heights to separate it into three different level. The reading value of the water level sensor will be shown in the serial monitor in Arduino IDE.

Table 2 The height of the water level sensor that had been submerged in the water and the sensitivity of the water level sensor

Heights (cm)	Sensitivity of the water level				
1	1867	1866	1867	1867	1872
2	2034	2039	2035	2033	2046
3	2073	2071	2076	2095	2085

The figure 6 shows the graph of the sensitivity of the water level sensor. The blue line represents the sensitivity of the water level sensor that had been display in the serial monitor. For the x axis it represents the height of the water level sensor that had been submerged in the water and the y axis represent the sensitivity of the water level sensor. As a result of this graph, the sensitivity of the water level sensor is directly proportional with the height of the water level sensor that had been submerged in the water.
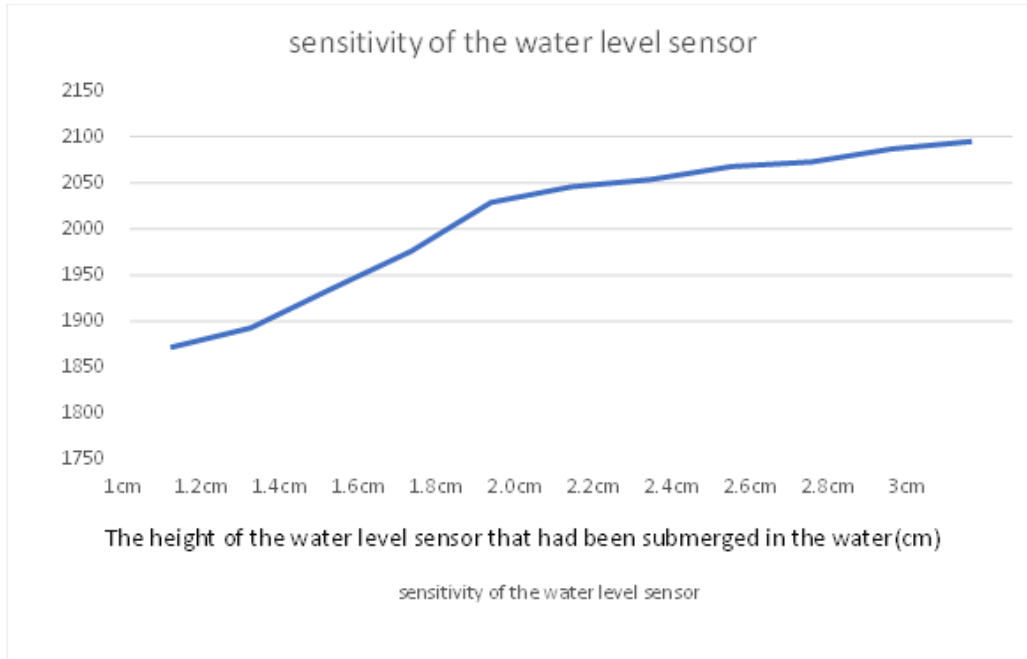

Figure 6 Sensitivity of the water level sensor that had been submerged in water in different height in cm

3.4   Output regarding to the water level sensor reading that had been divide into three level

The Figure 7 show the output water level 1, water level 2 and water level 3. If the conditions water level 1 were met, the green led will be light up. If the conditions water level 2 were met, the yellow led will be light up and it will trigger the relay and can cause for the conveyer in the mechanism to move and scoop out the waste in the sewer. If the conditions water level 3 were met, the red led will be light up, will trigger the relay and can cause for the conveyer in the mechanism to move and scoop out the waste in the sewer and will send alert message through telegram bot.
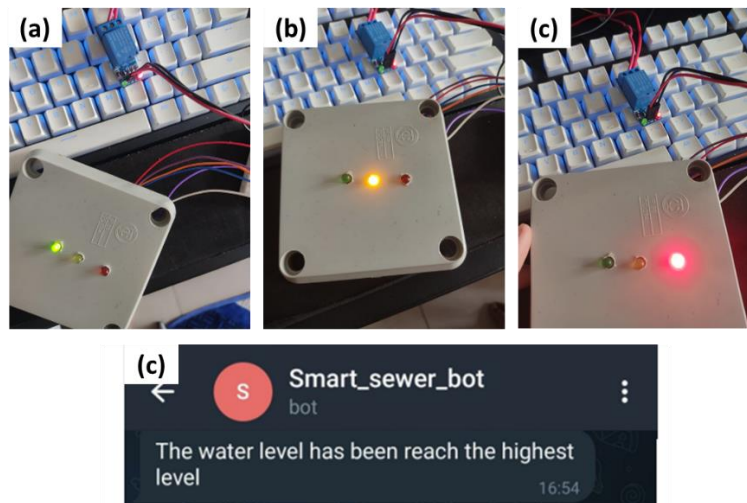

Figure 7: (a) Output Water Level 1; (b) Output Water Level 2;(c) Output Water level 3

3.5 Output regarding to the Ultrasonic Sensor

The Figure 8 show the output Ultrasonic Sensor. If the conditions were met that was when the ultrasonic sensor detect less than 4cm between the senor and the waste in the waste bin, the telegram will send message to person in charge to unload the waste bin.
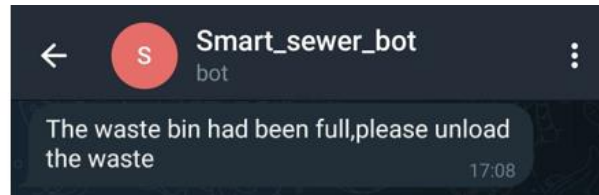

Figure 8 show Output for Ultrasonic Sensor

4. Conclusion

Overall, all of the objective that were initially decides for this project were successfully achieved. Firstly, the develop smart sewer system was capable to monitor the water level through the telegram bot. Besides, the design for the mechanism was successfully develop and can take out and trap scrap from the sewer. Lastly for the last objective, the telegram bot was successfully developed and can send message through telegram bot to notify the person in charge about the scrap had been full in the waste bin and the water level had been reach the highest level.

Even though all the objective of this project has been achieved, there were some imperfections in this project that can be improvises so that the smart sewer system will be able to perform in its full potential and performance. For precedent, the smart sewer system just has only one waste bin so when the waste bin has been full and the person in charge was not unload the waste, the waste will be overflow from the waste bin. Besides that, it was not built to be portable to setup to all type of sewer. Then, the location that want to setup the smart system must have WIFI or internet connection because if the smart sewer system was not connected to the internet, it can not to start or initialize the system. Lastly, the power bank and adapter were used to build this smart sewer system that had use to be supply the motor in the mechanism to move the conveyer and the ESP 32 was not so convenient to use it in long period of time.

Acknowledgement

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