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DEPARTMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY

DIPLOMA IN INFORMATION TECHNOLOGY
(DIGITAL TECHNOLOGY)

DFT50114: INTEGRATED PROJECT

(HydroGuard) IOT Based Flood Detector

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1.0 ABSTRACT

The (HydroGuard) Flood Detector System is a prototype-based project aimed at addressing the lack of awareness and preparedness in flood-prone regions. Its objective is to enhance safety by providing early notifications and advance warnings about rising water levels, thereby reducing the probability of accidents and flood damage. The methodology we used is the prototype method. The system incorporates a reliable monitoring solution to efficiently manage flood threats, accompanied by a sound alert system utilizing a buzzer, ensuring timely and effective user awareness in the event of a detected flood. Users also will be notified from the Telegram app notification that connects to the Flood Detector. Our client, Ms. Halimaton Zariah Binti Parman who is a villager in Parit Baru, Sabak Bernam. The area where she lives is often flooded when it rains heavily. So, with HydroGuard it can help solve her problem.

2.0 PROJECT PLAN

2.1 PROBLEM STATEMENT

1. Unaware of the increase in the water's level

- People who live in flood-prone locations might not be aware that the water level would rise.

2. Those who will be affected by a flood will be unprepared

- Those who will experience the flood cannot fully prepare.

3. Safety issues

- Flooding can result in life-threatening situations such as electric shock, drowning, etc.
- The probability of an accident will occur because of insufficient preparation in advance.

2.2 OBJECTIVE

1. To notify users about the water level.
2. To reduce flood damage by providing advance warning.
3. To alert the user through sound when a flood is detected by using a buzzer.

2.3 SCOPE

User's Scope

Visual

- Users can see a warning message on their phone about each water level.

Audio

- Users can get a notification from the sound produced by the alarm when the water has reached the set level.

Action

- Users can ignore notifications that come out of their smartphones.

System Scope

Audio

- The system will sound a notification that the water level has reached a dangerous level.

Visual

- The system can measure and show the height of water level.

2.4 LITERATURE REVIEW

1. “Flood Monitoring and Warning System” by Muhammad Ramizu Ab Halim (2015):

This research paper proposes a flood monitoring and detection system based on wireless sensor networks. The study focuses on using sensor nodes to collect data on water levels and rainfall intensity for flood detection. It discusses the implementation of algorithms and communication protocols to enable real-time monitoring and early warning systems.

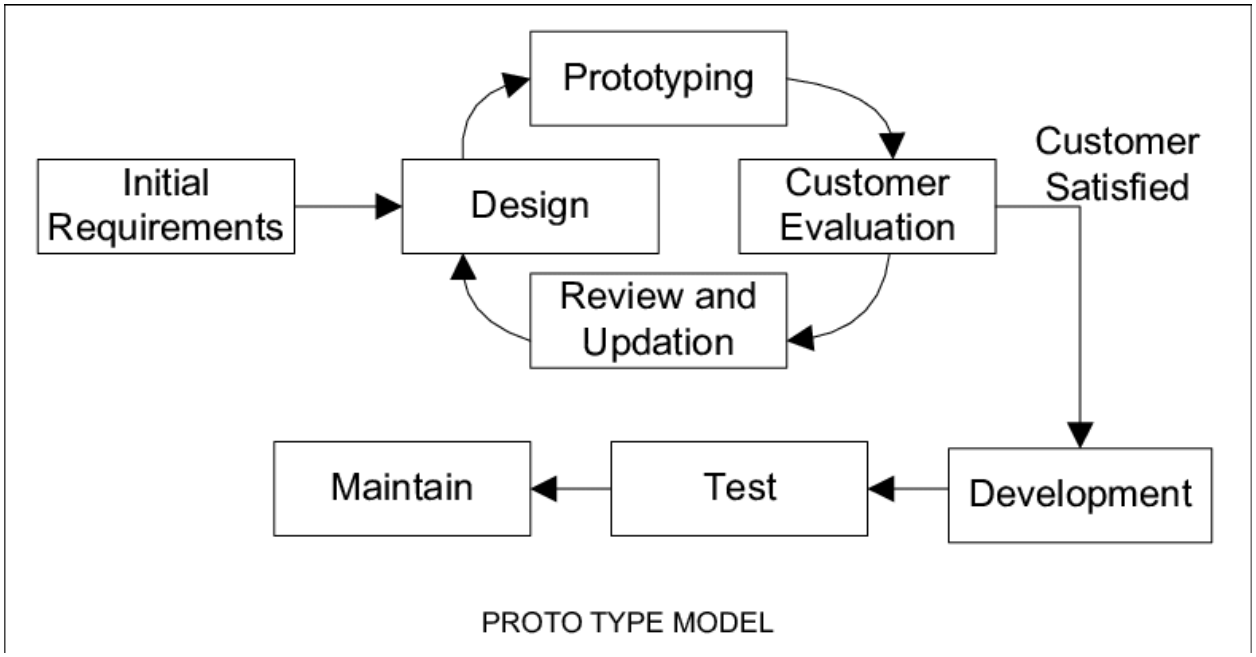
2. "Internet of Things-Based Flood Detection System Using Image Processing Techniques" by R. Sivaraman and N. Santhi (2020):

This research paper presents an Internet of Things (IoT) based flood detection system that utilizes image processing techniques. The study explores the use of image sensors to capture flood-related images, and the images are processed to detect flood occurrences. It discusses the integration of IoT platforms for real-time data transmission and flood alerts.

3. "Flood Monitoring and Early Warning System Based on IoT and Machine Learning" by M. Ali et al. (2019):

This research paper proposes an IoT-based flood monitoring and early warning system that incorporates machine learning algorithms. The study focuses on collecting data from water level sensors and weather sensors to predict and detect floods. It discusses the use of machine learning models for flood prediction and the integration of IoT platforms for data transmission and alerts.

2.5 METHODOLOGY



PROTO TYPE MODEL

For this project our team will develop it by using a prototype model. We will build the project prototype and test the prototype.After that, we will continue by adjusting the prototype until we get the final result that allows for the development of the entire system or product is acceptable and has been reached by our client and our supervisor.

This project uses ultrasonic sensors and water level sensors to determine the water distance and show the information of water distance on LCD. It uses GSM technology to send the warning and information to users based on SMS (Short Message System). For the warning system, the water level and ultrasonic sensor will be used as a marker and float sensor will send SMS alerts via GSM system beside it will trigger the buzzer with the LED light up for alerting the user and their environment of exposure to the flood when buoy on float sensor hits the switch. GSM also serves as a modem for transmission to the satellite for sending the SMS so that users can receive the notification.

2.6 GANTT CHART

No.	Activity	June		July				August	
		W1	W2	W3	W4	W5	W6	W7	W8
1.	Project Title Research.	✓							
2.	Research and prepare proposals.	✓							
3.	Submission of Proposal.	✓							
4.	Plan requirements and design specifications.		✓						
5.	Buy the project equipment.		✓						
6.	Manage hardware or software configuration.			✓					
7.	Develop problem specification and design.			✓					
8.	1st Project Demonstration			✓					
9.	Improve and correct all errors and deficiencies in the project.			✓	✓	✓			
10.	2nd Project Demonstration					✓			
11.	Improve and correct all errors and deficiencies in the project.						✓	✓	
12.	3rd Project Demonstration							✓	
13.	Improve and correct all errors and deficiencies in the project.							✓	
14.	Final Presentation								✓

COST PLANNING

BIL	ITEM	PRICE PER UNIT (RM)	QUANTITY	PRICE (RM)
1.	ESP8266 NodeMCU	25.00	1	25.00
2.	18mm Cutter	2.40	1	2.40
3.	Cutting mat	10.00	1	10.00
4.	Float sensor	4.90	1 unit	4.90
5.	Water level sensor	5.50	1 unit	5.50
6.	RED LED (5mm)	0.35	5 pieces	1.75
7.	Male to female wire jumper	2.80	1 set	2.80
8.	Male to male wire jumper	2.80	1 set	2.80
9.	Female to female wire jumper	2.80	1 set	2.80
10.	Donut board (9x15)cm	4.90	2	9.80
11.	Transistor NPN bc337	0.80	3	2.40
12.	Resistor 10k ohm	0.10	5	0.50
13.	Resistor 1k ohm	0.10	5	0.50
14.	Resistor 220 ohm	0.10	2 pieces	0.20
15.	60W Solder Kit (AIO)	34.90	1	34.90
16.	0.8MM Solder Lead Metal Wire	8.90	1 roll	8.90
17.	Ultrasonic Sensor	3.30	1	3.30
18.	9V Battery Energizer Max	19.50	1	19.50
19.	9V Battery Connector Strap	2.50	1	2.50
20.	Buzzer	2.60	1	2.60
21.	LCD Display (20x4)mm	19.90	1	19.90
22.	Shipping Cost	5.00	-	5.00

23.	Tool Box	10.00	1	10.00
24.	Hard paper board	8.00	1	8.00
25.	Gift wrapper	1.50	2	3.00
26.	Labeling sticker	2.40	1 unit	2.40
27.	Black straw 40pcs	2.40	1 unit	2.40
28.	Modeling clay	2.40	2	4.80
29.	Microwavable container	2.40	1 unit	2.40
30.	Workmanship	50.00	-	50.00
31.	Banner	50.00	-	50.00
TOTAL				**RM 300.95**

3.0 REQUIREMENT SPECIFICATION

3.1 FUNCTIONAL REQUIREMENT

a. Ultrasonic Sensor functionality:

i. The ultrasonic sensor should be capable of measuring the distance from the sensor to the surface of the water.

ii. It must be able to detect the water level accurately and provide real-time readings.

b. Float switch and water level sensor functionality:

i. The float switch should be designed to float on the water surface while water level sensor should detect the incoming water.

ii. When the water level rises to a predetermined level, the water level sensor should detect the arrival of water and the float switch should trigger a signal to indicate a high water level.

c. **LED and Buzzer Notification:**

i. When the float switch buoy is triggered due to high water level, an LED should light up, indicating the high water condition.

ii. While buzzer should sound an audible alarm to draw attention.

d. Telegram Integration:

i. The ultrasonic sensor should be integrated with a Telegram bot to send real-time messages to a specified user or group when the water level reaches a predetermined level.

3.2 NON-FUNCTIONAL REQUIREMENT

a. **Responsiveness:** The system should respond quickly to changes in water level and trigger appropriate actions, such as activating the LED, buzzer, and sending Telegram messages, in real-time.

b. **Accuracy:** The water level measurements from the ultrasonic sensor should be highly accurate to ensure precise monitoring of the water level.

c. Security and Privacy: The communication channel used for Telegram notifications should be secured with encryption to protect the integrity and confidentiality of the messages.

d. Reliability: The system should be highly reliable, providing accurate water level measurements and prompt notifications when the float switch or ultrasonic sensor is triggered.

3.3 HARDWARE AND SOFTWARE REQUIREMENT

Table 3.3: Hardware Requirement

Hardware Requirement	Description
ESP8266 Development Board	ESP8266-based development board (e.g., NodeMCU)
Ultrasonic Sensor	HC-SR04 or similar ultrasonic distance sensor
Water Sensor	Water level sensor to detect water presence
Float Switch Sensor	Float switch sensor to detect high water level
LCD I2C Module	I2C interface LCD module for displaying information
Buzzer	Buzzer for audio alerts when water is detected
LED	LED for visual alerts when water is detected
Jumper Wires	Wires for connecting components
USB Cable	Standard USB cable for connecting the board to PC
Power Source	USB power adapter or batteries for standalone use.

Table 3.4: Software Requirement

Software Requirement	Description
Arduino IDE	Integrated Development Environment for programming. To upload code into ESP8266 Board
Telegram	Platform to receive notification message about water level from HydroGuard.

3.4 SYSTEM CONFIGURATION

a. The ESP8266 board continuously reads data from the ultrasonic sensor, water sensor, and float switch sensor to monitor the water level.

b. If water is detected or if the water level rises beyond a specified threshold, the ESP8266 sends an alert message to the configured Telegram chat using the Telegram Bot API.

c. The system also displays the water level on the LCD I2C module for local monitoring.

d. When water is detected, the buzzer is activated to provide an audible alert, and the LED lights up to indicate the water presence.

e. The ESP8266 board regularly checks the sensor data and updates the status information on the LCD and Telegram chat.

f. Users can receive real-time notifications about water levels and any potential issues with the water tank via the Telegram chat.

g. The system can be powered by a USB power adapter or batteries for standalone use.

3.5 SECURITY REQUIREMENT

Authorized User Access:

a. The system shall maintain a list of authorized chat_ids that are allowed to interact with the Telegram bot.

b. The bot shall verify the sender's chat_id before processing any incoming messages.

c. If the sender's chat_id matches an authorized chat_id, the bot shall proceed to handle the message.

d. If the sender's chat_id does not match any authorized chat_id, the bot shall respond with an "Unauthorized User" message and ignore further commands from the sender.

Chat ID Configuration:

a. The system shall provide an interface for the authorized user to input and configure their specific chat_id for the Telegram bot.

b. The configuration interface shall ensure the correct format of the chat_id to avoid input errors.

c. The system shall store the configured chat_id in non-volatile memory to retain the configuration between power cycles.

4.0 FINAL DESIGN

4.1 LOGICAL DESIGN

Schematic Diagram Circuit

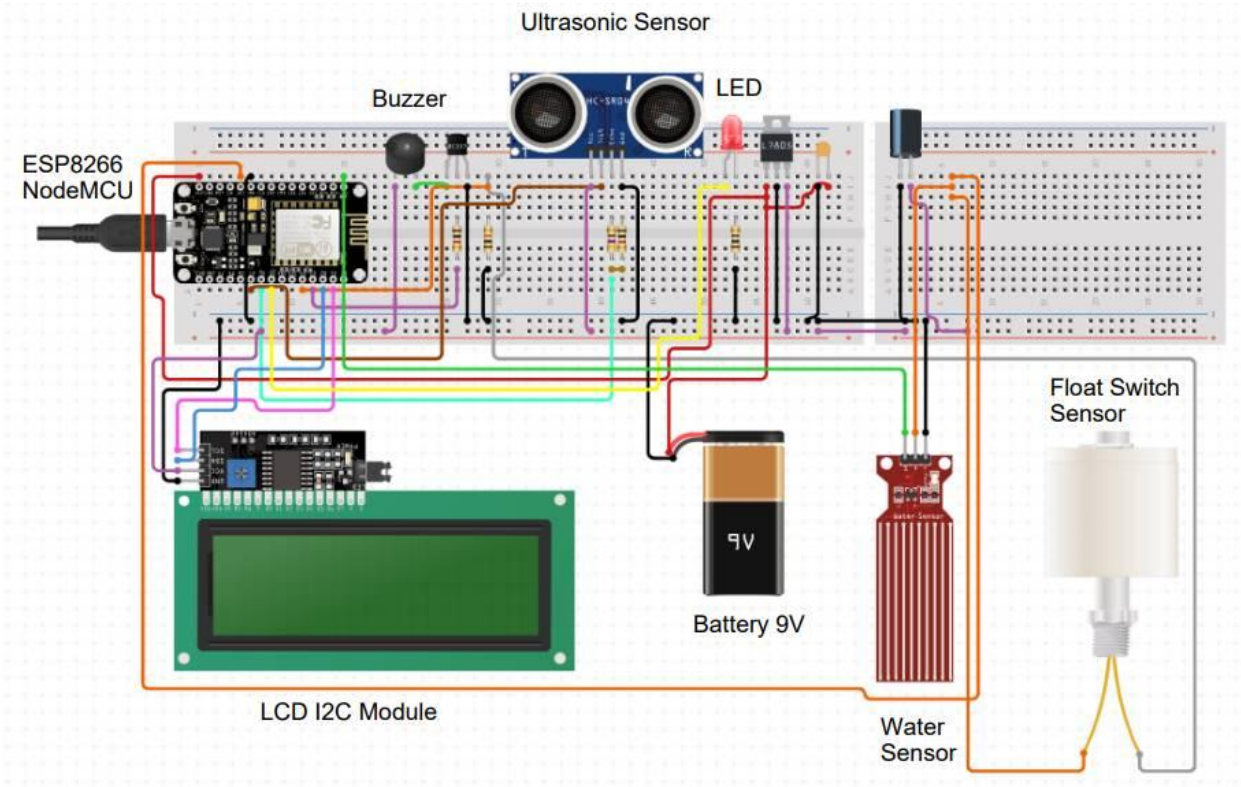


Figure 4.1.1 Circuit diagram

Flow Chart

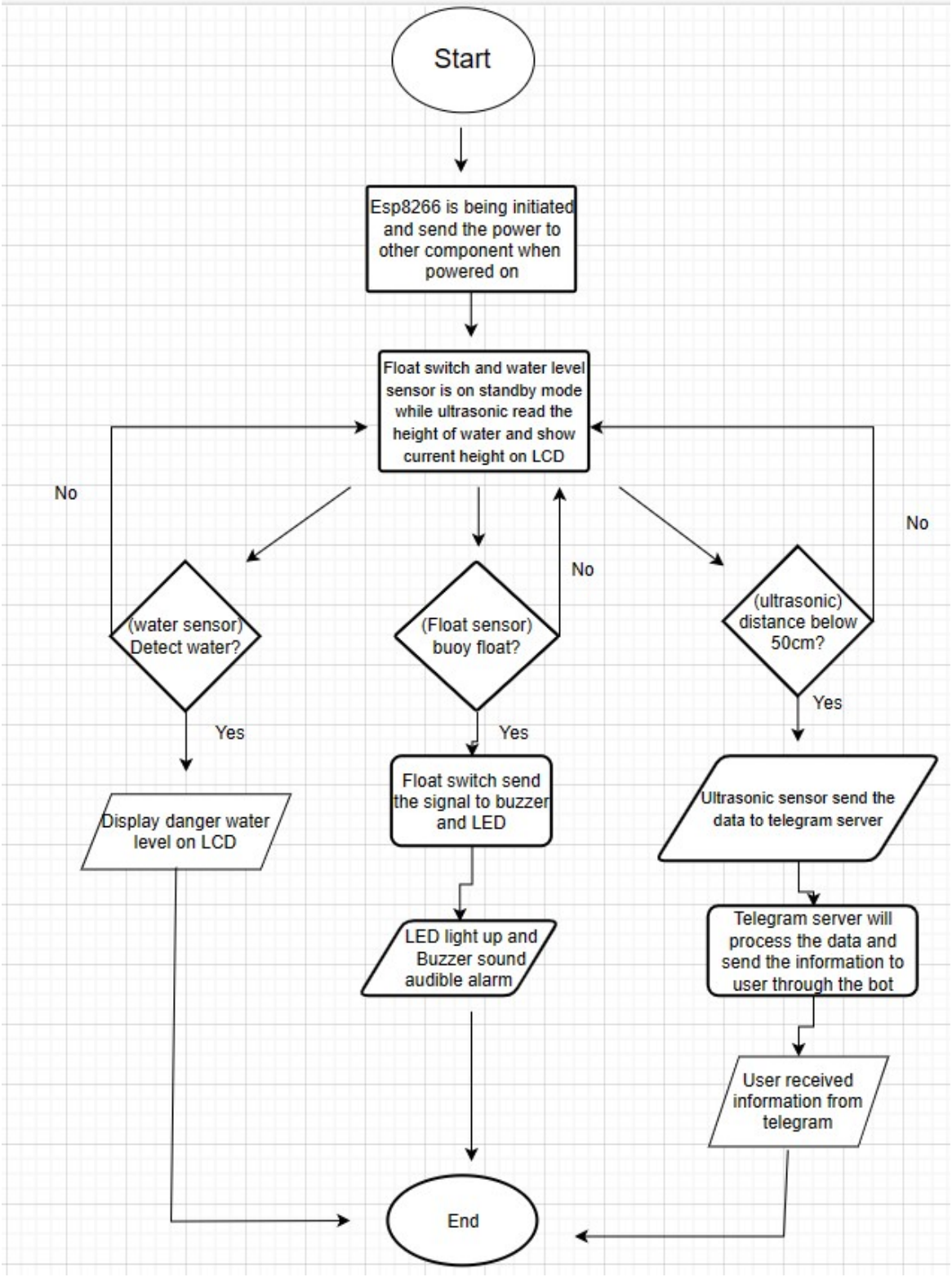


Figure 4.1.2 Flowchart show how it operate

4.2 PHYSICAL DESIGN

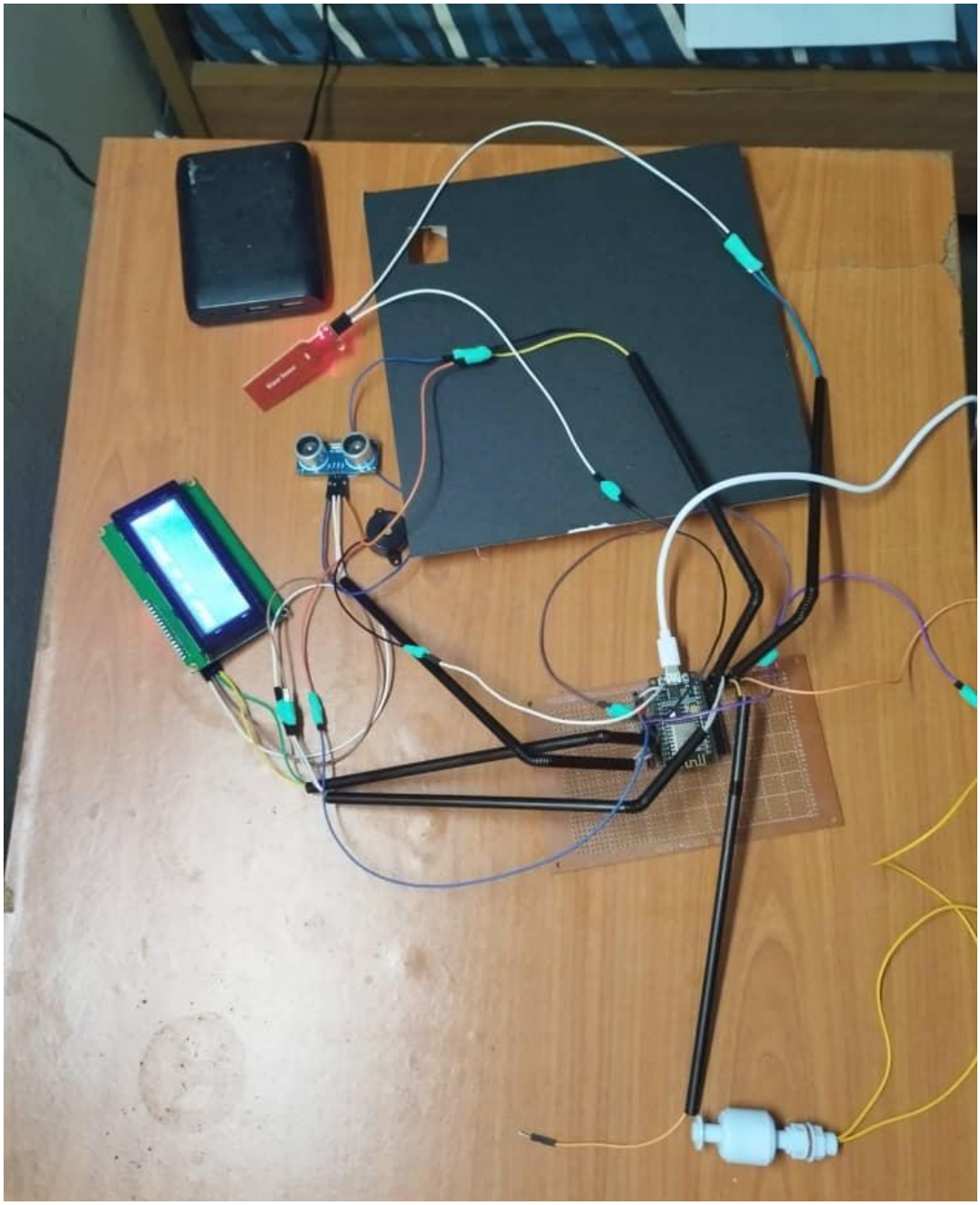


Figure 4.2.1 Physical circuit

Figure 4.2.2 side view of the project

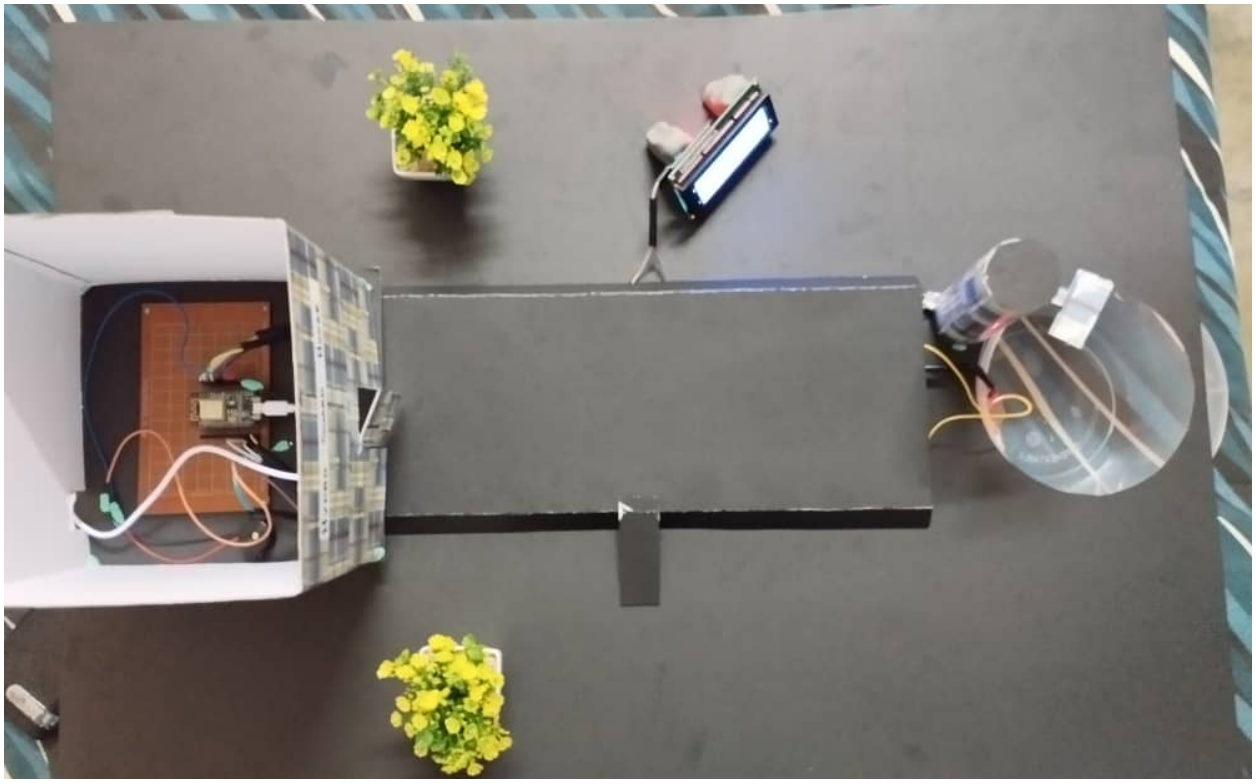


Figure 4.2.3 Upper view of the project

4.3 EXPERIMENTAL CONCEPT

Objective: To improve safety, reduce the probability of accidents through timely notification and early warning of rising water levels.

Hardware Setup:

a. Connect the ultrasonic sensor, water sensor, float switch, buzzer, LED, and LCD I2C module to the ESP8266 NodeMCU development board as per the circuit diagram.
b. Ensure proper power supply for the ESP8266 and all connected components.

Software Configuration:

a. Install the necessary libraries (NewPing, LiquidCrystal_I2C, ESP8266WiFi, UniversalTelegramBot, and ArduinoJson) in the Arduino IDE.
b. Create a new Arduino sketch and include the required libraries.
c. Define the Wi-Fi credentials and Telegram bot token and chat_id in the sketch.
d. Set up the ultrasonic sensor, water sensor, and float switch sensor in the code for reading sensor data.
e. Implement the logic to send Telegram notifications for specific water level conditions.
f. Write code to control the buzzer and LED based on sensor readings.
g. Initialize and configure the LCD I2C module to display relevant information.

Deploy and test:

a. Upload the code to the ESP8266 NodeMCU board.
b. Place the sensors in a water tank or container to simulate water level changes.
c. Power on the system and connect the ESP8266 to the Wi-Fi network.
d. Verify that the ESP8266 can successfully communicate with the Telegram Bot API and send messages to the authorized user's Telegram chat.
e. Observe the LCD display, buzzer, and LED to ensure they respond appropriately to changes in water levels and sensor readings.

Testing Scenarios:

a. Verify that the ultrasonic sensor accurately measures the distance to the water surface and calculates the water level correctly.
b. Test the water sensor and float switch sensor to ensure they can detect the presence of water and high water levels respectively.
c. Check if the buzzer and LED produce the expected alerts and visual indications based on water level conditions.
d. Send manual commands to the Telegram bot to trigger specific actions and verify the system's response.
e. Test the system's ability to send timely Telegram notifications to the authorized user for different water level thresholds.

Monitoring and Troubleshooting:

a. Continuously monitor the system's behavior to ensure it operates reliably and accurately.
b. Debug and troubleshoot any issues that may arise during testing.
c. Analyze system logs and error messages to identify and resolve potential problems.

User Interaction:

a. The authorized user can interact with the Telegram bot through the Telegram app on their smartphone or computer.
b. They can request water level information or manually trigger certain actions remotely via the bot commands.

Security Review:

a. Perform a security review to ensure that only authorized users can access the bot and system functionalities.
b. Confirm that the system has appropriate measures to handle "Unauthorized Users" and protect sensitive data.

Final Evaluation:

a. Evaluate the experiment's success in achieving the objective of creating an IoT Flood Detector with Telegram integration.
b. Assess the system's reliability, accuracy, and ease of use for real-world applications.

Conclusion:

a. Summarize the results of the experiment, including the system's performance, strengths, and potential areas for improvement.
b. Determine the experiment's success in providing an effective HydroGuard Flood Detector solution with Telegram integration.

5.0 TEST DESCRIPTION AND RESULT

5.1 UNIT TESTING PLAN

Table 5.1: Unit Testing Plan

UNIT TESTING PLAN (UTP)						
No	**Test Case Name**	**Test Procedure**	**Precondition**	**Expected Result**	**Tester**	**Result (Pass/Failure)**
1.	Test ultrasonic sensor reading	Set in coding for ultrasonic to read distance in cm. (e.g., 50cm)	Ultrasonic sensor connected to board(esp8266)	Distance value (e.g., 50)	Putra Aiman	Pass
2.	Test water sensor reading	Set in coding for serial monitor print “1” if water sensor presence water.	Water sensor connected to board	Water detected (True)	Muhd Danish	Pass
3.	Test float switch sensor	Set in coding for serial monitor print “1” if float switch sensor is floating.	Float switch sensor connected to board	Water level high (True)	Imza Syifa	Pass
4.	Test buzzer and LED	Set in coding for enter “1” in serial monitor to activate buzzer and LED	Buzzer and LED connected to board	Buzzer activated, LED on	Aniq Shaqif	Pass

5.	Test LCD I2C Module	Set the coding to LCD display “Water is at xxcm!” based on Ultrasonic sensor reading.	Ultrasonic sensor and LCD connected to board.	LCD displaying “Water is at 50cm!”	Hadi	Pass
6.	Test Telegram message sending	Set in coding to send messages to Telegram chat.	Board is connected to the internet.	Messages sent to Telegram chat	Amir Farhan	Pass
7.	Test “Unauthorized User”	Set in coding to send message “Unauthorized User” to unknown Telegram group chat.	Board is connected to the internet.	“Unauthorized user” sent to unauthorized Telegram chat.	Azmeen Syahmi	Pass

5.2 INTEGRATION TESTING PLAN

Table 5.2: Integration Testing Plan

UNIT TESTING PLAN (UTP)						
No	**Test Case Name**	**Test Procedure**	**Precondition**	**Expected Result**	**Tester**	**Result (Pass/Failure)**
1.	Ultrasonic sensor and LCD Display	Connect ultrasonic and LCD displays on board. Then upload a code to board	Ultrasonic sensor and LCD function properly.	The LCD will display “Water is at xxcm!” base on ultrasonic read distance	Ajmal Hazim	Pass
2.	Ultrasonic sensor and Telegram	Connect ultrasonic to board. Then upload a code that has TelegramBot message function to board.	Ultrasonic sensor functions properly and internet connectivity.	Users will get a notification message “Water is at xxcm!” when ultrasonic distance is below 50cm.	Muhd Farouk	Pass

3.	Water sensor and LCD display	Connect the water sensor and LCD display to board.	Water sensor and LCD function properly.	The LCD will display “Dangerous level!” if the water sensor touched with water.	Muhd Badli	Pass
4.	Float switch sensor, buzzer and LED	Connect the float switch sensor, buzzer and LED to board.	Float switch sensor, buzzer and LED function properly.	The buzzer will activate and LED on when the float switch sensor is floating.	Muhd Syazwan	Pass

6.0 MAJOR FINDINGS AND DISCUSSION

6.1 THE ADVANTAGES OF THE PROJECT

a. **Real-Time Notifications:** The LED, buzzer, and Telegram messaging system offer immediate notifications when the water level reaches critical points, enabling timely actions to make early preparation
b. **Redundant Sensing:** Each sensor has their own roles, increasing the reliability of the system. So If one sensor fails, the others can still function and provide crucial information.
c. **Accurate Water Level Measurement:** The ultrasonic sensor provides precise and real-time water level measurements, allowing for accurate monitoring.
d. **Remote Monitoring:** The Telegram messaging feature allows users to receive water level updates remotely, providing convenience and flexibility for receiving alerts.
e. **Energy Efficient:** Each sensor is typically a low-power device, ensuring energy-efficient operation which provides long lasting use, especially when using battery power.

6.2 THE DISADVANTAGES OF THE PROJECT

a. Dependency on Communication Network: The Telegram messaging feature relies on an internet connection, making the system susceptible to communication failures if there is no network coverage.
b. Limited Detection Range: The range of ultrasonic sensors is limited, so the system may not be suitable for monitoring very deep or large bodies of water.
c. Calibration Complexity: Require a good environment for calibrating different sensors which is to ensure accurate readings and coordination between them may require technical expertise.
d. Water Surface Conditions: Ultrasonic sensors rely on sound waves reflected from the water surface. Adverse water surface conditions like ripples, waves, or foam may impact the sensor's ability to provide accurate measurements.
e. Privacy Concerns: If the system relies on cloud-based services for notifications, users may have concerns regarding data privacy and security.

7.0 RECOMMENDATION AND CONCLUSION

The HydroGuard flood detector project utilizes IoT technology and a combination of sensors to create an efficient flood monitoring system. By integrating an ultrasonic sensor, water level sensor, and float sensor, the project ensures accurate and reliable detection of water levels. The system utilizes the ESP8266 NodeMCU to promptly notify users when potential flooding is detected.

The HydroGuard project offers several benefits. The ultrasonic sensor enables contactless measurement, reducing the risk of sensor damage. The water level sensor provides continuous and precise monitoring, while the float sensor adds an extra layer of reliability by triggering alerts at specific water level thresholds. The ESP8266 NodeMCU ensures instant communication with users, allowing them to take timely action to protect their property.

Overall, the HydroGuard flood detector project demonstrates the power of IoT technology in flood monitoring. By combining multiple sensors and ESP8266 NodeMCU communication, the system provides a comprehensive solution for detecting and responding to flood risks. With its simplicity and effectiveness, the HydroGuard project has the potential to enhance flood preparedness and minimize damages in flood-prone areas.

8.0 REFERENCES

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