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Research Article

Automated Flood Monitoring and Alarm with Real-Time SMS Notification

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Abstract - *Flooding remains one of the most destructive natural hazards in the Philippines, causing loss of lives, property damage, and economic disruption each year. Many existing flood monitoring systems are costly, limited in coverage, or dependent on manual observation, which may delay warnings. This study aimed to design and develop a functional prototype of an automated flood monitoring and alarm system with real-time SMS notification to provide early warnings to communities at risk. The system hardware comprises an ultrasonic sensor, Arduino Uno microcontroller, GSM SIM A7670E module, LCD display, and buzzer alarm; it is programmed via Arduino IDE to classify water levels into Safe, Warning, and Danger stages, triggering alarms, SMS alerts, and calls as thresholds are met. Testing includes three components: sensor effectiveness to measure accuracy across 5–25cm distances, communication effectiveness to evaluate SMS/call delivery speed, and functionality testing to verify alarm activation using an aquarium to simulate rising water levels, following standard formulas to calculate error rates and transmission delays. Results showed that the ultrasonic sensor achieved an average error percentage of 0.0072%, with an overall accuracy of 99 9928% SMS notifications were generally received within 4 to 6 seconds, while automated calls were successfully connected in an average of 2.4 seconds under stable network conditions. Although occasional network errors occurred, the system consistently responded according to the programmed flood levels. The findings demonstrate that the developed prototype is reliable and effective as an early flood warning system.*

Keywords - *Arduino Uno, Early warning, Flood monitoring system, GSM SIM A7670E module, Prototype, SMS notification, Ultrasonic sensor, Water level detection.*

I. INTRODUCTION

Persistent societal challenges demand urgent solutions, especially when the very survival of communities is at risk. Every year, the Philippines suffers extensive devastation from natural disasters, leading to significant loss of life, widespread property damage, and economic losses amounting to billions (Lagmay et al., 2017). Situated in a disaster-prone zone characterized by frequent tropical cyclones, tsunamis, earthquakes, and volcanic eruptions, the country continues to face these hazards. With rapid population growth and development in vulnerable areas, damage to infrastructure and human casualties are expected to persist or even increase without immediate and effective government interventions (Lagmay et al., 2017).

Although major storms in the Philippines are highly destructive, smaller-scale flooding caused by rising sea levels is also prevalent. Research shows that the cumulative effects of these smaller floods may be more detrimental, disproportionately impacting the poorest communities. Disaster assistance is typically prioritized for severe events, leaving those frequently affected by less severe floods largely unsupported and forced to manage on their own (Williams et al., 2020).

According to Christopher (2022), flooding is not a new hazard in the Philippines; historical records confirm its continuous occurrence. Early warning systems play a crucial role by sending timely flood warnings to vulnerable communities, thereby helping protect lives and assets through advance preparation. However, traditional flood monitoring systems have several drawbacks that lessen their effectiveness. These methods often involve manual data collection, are prone to errors and delays, lack real-time monitoring capabilities, and rely excessively on historical data, which may not reflect current climate realities.

Their installation and maintenance are costly, creating barriers in resource-limited settings. Additionally, traditional systems frequently lack automated alerts, have limited reach in remote areas, and do not integrate modern technologies like IoT or real-time analytics, all of which negatively impact their accuracy and responsiveness. Overcoming these limitations is essential to improve preparedness and emergency response (Kamal et al., 2025).

Global efforts have increasingly focused on developing cost-effective and reliable flood monitoring techniques to address these issues (Arshad et al., 2019). Various technologies have been designed for measuring flood and water levels, yet conventional physical gauge stations remain expensive and cover limited areas (Hashemi-Beni et al., 2024). To overcome these challenges, sensor-based flood detection systems coupled with wireless communication, IoT integration, and automated alerts have been proposed and developed (Tolentino et al., 2022).

A promising innovation utilizes flood water level sensors integrated with Arduino microcontrollers a versatile, accessible, open-source platform. This combination enables the development of customizable, flood monitoring systems suitable for rivers, lakes, reservoirs, and urban drainage, empowering communities to enhance localized flood resilience strategies (Magnaye et al., 2024). The use of SMS-based warning systems is rooted in the global ubiquity of mobile phones. With the world population under 7.2 billion and active mobile devices exceeding this number, SMS remains the most widely adopted communication method, facilitating rapid and universal dissemination of alerts (Azid et al., 2015).

This research aims to develop an early flood alert system utilizing SMS notifications to monitor water levels and provide timely warnings to communities. Such a system helps at-risk families prepare and evacuate to safer locations, safeguarding lives and valuable possessions. Its flexibility and scalability make it suitable for deployment in diverse environments from urban centers to remote rural areas. Ultimately, the autonomous flood detection system represents a significant advancement in boosting community safety and resilience in the face of unpredictable natural disasters (Athirah et al., 2019). The proposed system integrates water level sensors with real-time SMS notifications, aiming to enhance continuous flood risk management. Its timely warnings via commonly used mobile networks can improve public safety and emergency responsiveness.

II. MATERIALS AND METHODS

A. Preparation of Materials

The main hardware components used in this project are an Ultrasonic Sensor, GSM module SIM A7670E , Liquid Crystal Display (LCD), buzzer alarm, and Arduino Uno (microcontroller). The usage and descriptions of each of the components are described below:

i. Ultrasonic sensor is one of the essential components that measure the flood water level. This sensor can measure distance to an object. The sound wave used in a ultrasonic sensor calculates the distances.
ii. GSM module SIM A7670E enables real-time SMS notifications and alarm calls. This LTE Cat 1 module supports quad-band GSM/GPRS/EDGE and integrates with Arduino via UART for reliable wireless communication in remote flood-prone areas.
iii. Liquid Crystal Display (LCD) can display the readings through the LCD screen. For this project, the 16 x 2 LCD is used to display the status and the flood water level.
iv. Buzzer alarm is also an essential component for this project for alarming the surrounding when it reaches “Dangerous” and “Warning” flood water level.
v. Arduino IDE is used to code the functions of the project. It is a software that programs the microcontroller. It contains a text editor, message area, text console, toolbar, and series of menus. IDE stands for Integrated Development Environment.

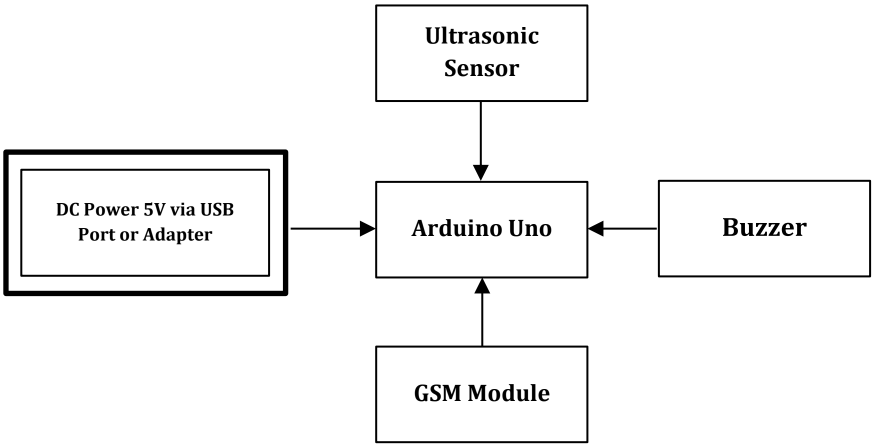

Figure 1. Block Diagram of the Proposed Flood Monitoring System

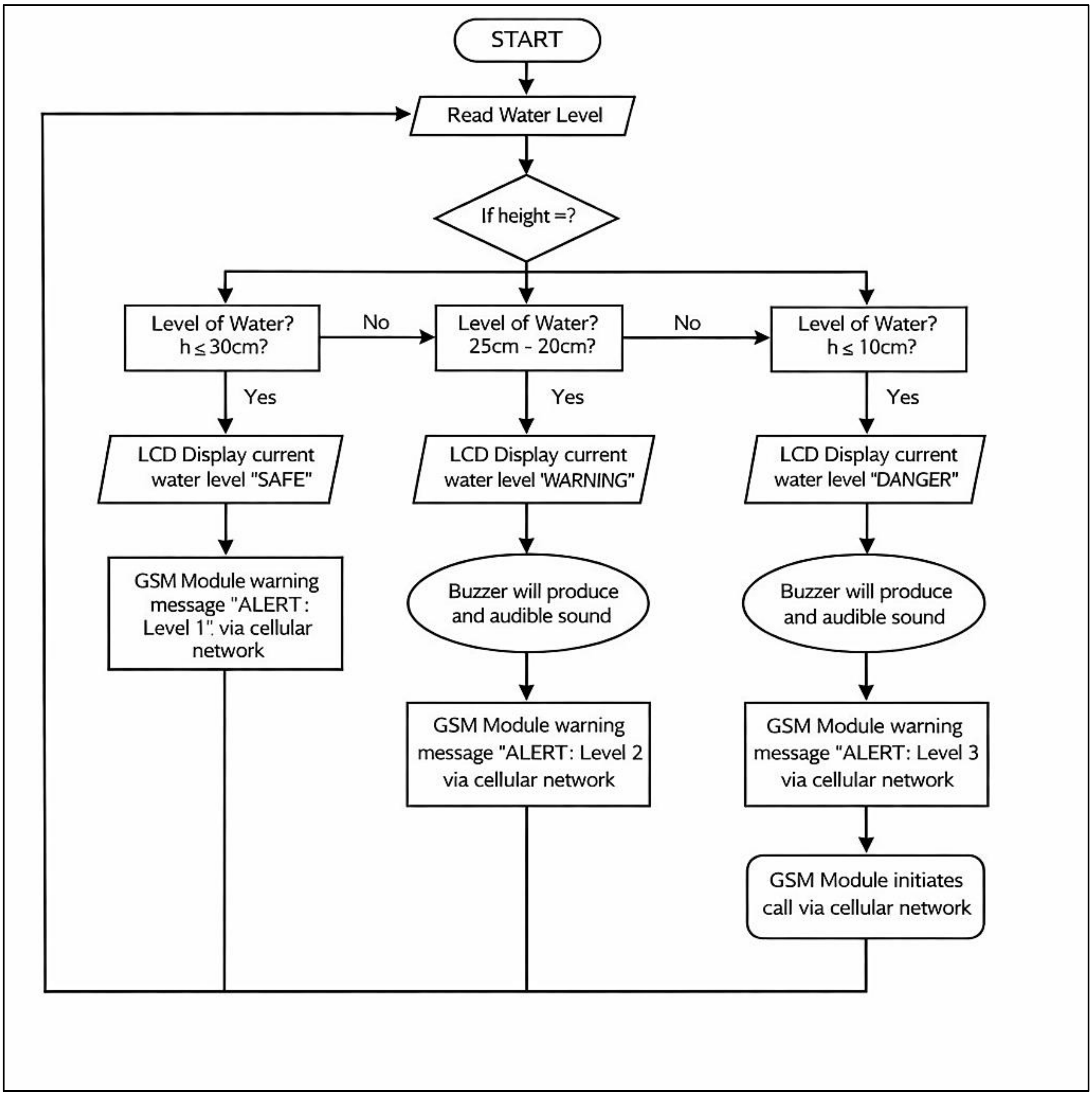

Figure 2. System Flowchart

B. Prototype Development (Tolentino et al., 2022)

The automated flood monitoring system operates as follows: The solar panel is installed to continuously supply power to the system. Water level sensors are positioned at designated flood monitoring points. The microcontroller constantly reads signals from these sensors. When the water level exceeds a predefined threshold, indicating an overflow risk, it activates the buzzer alarm and sends a real-time SMS notification to designated users via the GSM module. The system continuously monitors and logs sensor data to track performance, while a rechargeable battery ensures continuous operation.

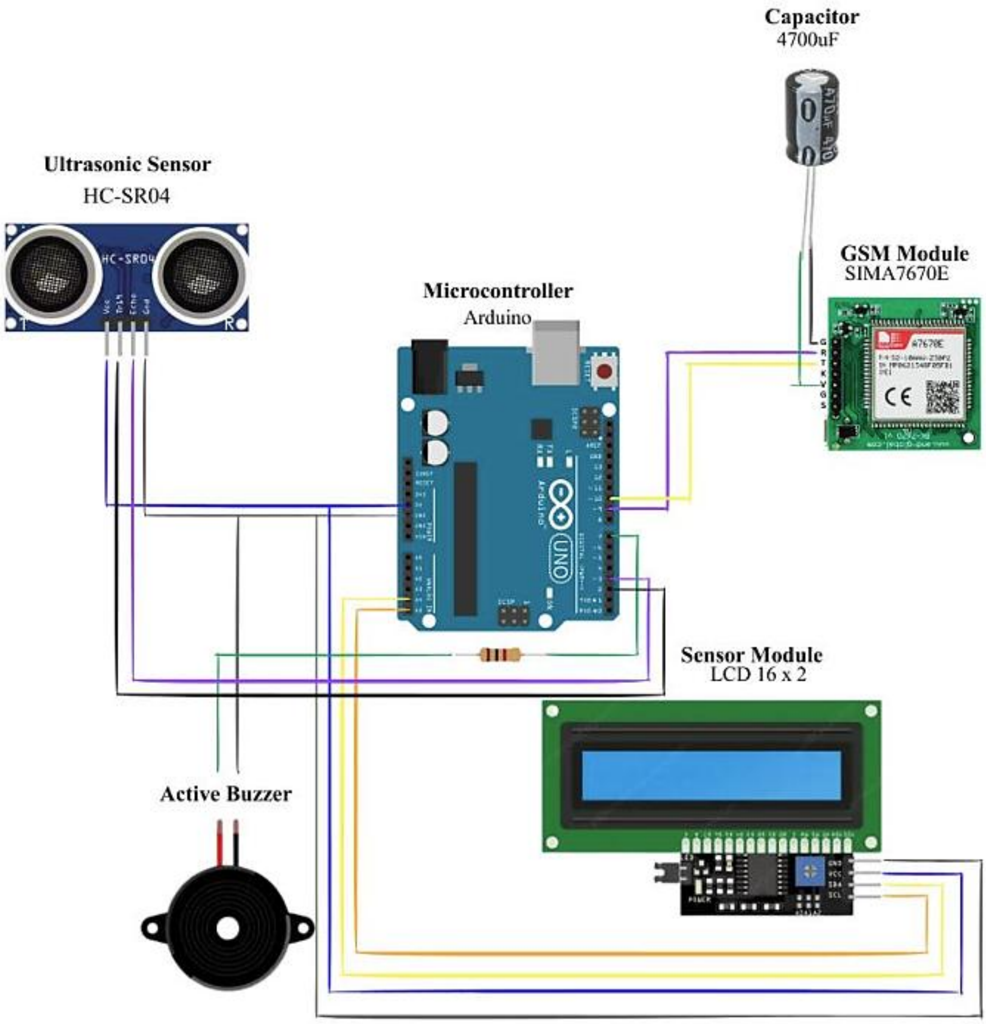

Figure 3. Diagram of the Proposed Flood Monitoring System

Figure 4. Complete Prototype

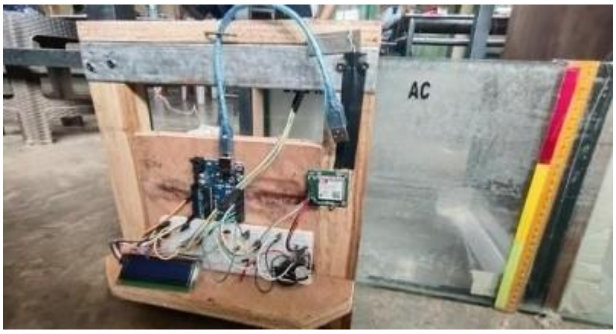

Figure 5. Prototype Setup

Figure 6. Final Project Design (Bottom View)

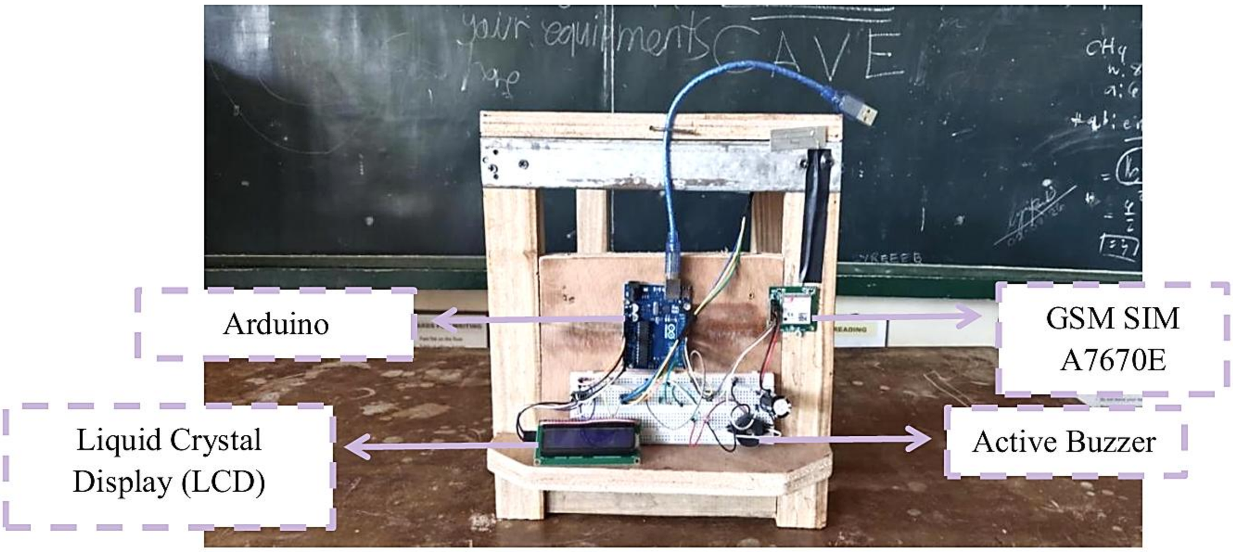

Figure 7. Final Project Design (Front View)

Arduino Code for the Prototype

```
#include <Wire.h>
#include <SoftwareSerial.h>
#include <LiquidCrystal_I2C.h>
/* ================= HARDWARE PINS ================= */
#define ECHO_PIN 5
#define BUZZER_PIN 7
#define GSM_RX 10
#define GSM_TX 9
/* ================= FLOOD LEVELS ================= */
const float SAFE = 25.0;
const float LEVEL1 = 20.0;
const float LEVEL2 = 15.0;
const float LEVEL3 = 10.0;
/* ================= MODULE SETUP ================= */
LiquidCrystal_I2C lcd(0x27, 16, 2);
```

```
SoftwareSerial gsmSerial(GSM_TX, GSM_RX);
String PhoneNum = "+XXXXXXXXXX";
/* ================= SYSTEM VARIABLES ================= */
int currentLevel = 0;
int lastLevel = -1;
unsigned long lastBeep = 0;
bool gsmReady = false;
bool level1Done = false;
bool level2Done = false;
bool level3Done = false;
/* ================= SETUP ================= */
void setup() {
 Serial.begin(9600);
 gsmSerial.begin(115200); // Higher baud rate for faster communication
 pinMode(TRIG_PIN, OUTPUT);
 pinMode(ECHO_PIN, INPUT);
 pinMode(BUZZER_PIN, OUTPUT);
 lcd.init();
 lcd.backlight();

 lcd.print("FLOOD MONITOR");
 delay(2000);
 lcd.clear();
 initGSM();
}
/* ================= LOOP ================= */
void loop() {
 float distance = getUltrasonicDistance();
 if (distance > 0 && distance < 400) {
  updateFloodLevel(distance);
  updateDisplay(distance);
  handleAlarms();
 } else {
  lcdError("ULTRASONIC ERR");
 }
 delay(50); // Reduced delay for continuous readings
}
/* ================= GSM INIT ================= */
void initGSM() {
// Initialize GSM module with AT commands
 sendATCommand("AT", "OK", 2000);
 sendATCommand("AT+CMGF=1", "OK", 2000); // SMS text mode
// sendATCommand("AT+CNMI=1,2,0,0,0", "OK", 2000); //configure new message indications
 gsmReady = true;
}
/* ================= SENSOR ================= */
float getUltrasonicDistance() {
 digitalWrite(TRIG_PIN, LOW);
 delayMicroseconds(2);
 digitalWrite(TRIG_PIN, HIGH);
 delayMicroseconds(10);
```

```
  digitalWrite(TRIG_PIN, LOW);
  long duration = pulseIn(ECHO_PIN, HIGH, 40000);
  if (duration == 0) return -1;
  return duration * 0.0343 / 2;
}
/* ================= FLOOD LOGIC ================= */
void updateFloodLevel(float dist) {
  lastLevel = currentLevel;
  if (dist > SAFE) currentLevel = 0;
  else if (dist > LEVEL1) currentLevel = 1;
  else if (dist > LEVEL2) currentLevel = 2;
  else currentLevel = 3;
}
/* ================= DISPLAY ================= */
void updateDisplay(float dist) {
  lcd.setCursor(0, 0);

  if (currentLevel == 0) lcd.print("SAFE");
  else if (currentLevel == 1) lcd.print("CAUTION L1 ");
  else if (currentLevel == 2) lcd.print("WARNING L2 ");
  else lcd.print("DANGER L3 ");

  lcd.setCursor(0, 1);
  lcd.print("W:");
  lcd.print(dist, 1);
  lcd.print("cm ");
  lcd.print(gsmReady ? "NET" : "LOC");
}
void lcdError(String msg) {
  lcd.clear();
  lcd.print("ERROR:");
  lcd.print(msg);
}

/* ================= ALARMS & SMS ================= */
void handleAlarms() {
// Level 1 Alarm
  int freq[] = {0, 1000, 1500, 2000};
  if (currentLevel == 1 && !level1Done) {
    tone(BUZZER_PIN, freq[currentLevel], 300);
    sendSMS("ALERT: Level 1 - Prepare to evacuate.");
    level1Done = true;
  }
// Level 2 Alarm
  else if (currentLevel == 2 && !level2Done) {
    tone(BUZZER_PIN, freq[currentLevel], 300);
    sendSMS("ALERT: Level 2 - Water rising!");
    level2Done = true;
  }
// Level 3 Alarm
  else if (currentLevel == 3 && !level3Done) {
```

```
    tone(BUZZER_PIN, freq[currentLevel], 300);
    sendSMS("ALERT: LEVEL 3 - EVACUATE NOW!");
    sendCall();
    level3Done = true;
  }
// If water level is safe, reset all flags
  else if (currentLevel == 0) {
    noTone(BUZZER_PIN);
    level1Done = false;
    level2Done = false;
    level3Done = false;
  }
}

/* ================= SMS ================= */
void sendSMS(String message) {
  sendATCommand("AT+CMGS=\"" + PhoneNum + "\"", "OK", 2000);
  gsmSerial.println(message); // Send the message content
  delay(500);
  gsmSerial.write(26); // // ASCII code for CTRL+Z to send the SMS
  Serial.println("SMS Sent: " + message);
}

/* ================= CALL ================= */
void sendCall() {
  sendATCommand("ATD" + PhoneNum + ";", "OK", 2000);
  Serial.println("Call outgoing...");
  delay(30000); // ring 30 sec
  sendATCommand("ATH", "OK", 5000); //sendATCommand("AT+CHUP", "OK", 5000); // Hang up call
  Serial.println("Call ended.");
}

/* ================= AT COMMAND ================= */
void sendATCommand(String command, const char* expectedResponse, unsigned long timeout) {

  Serial.print(">");
  Serial.println(command);
  gsmSerial.println(command);
  long int time = millis();
  while ((time + timeout) > millis()) {
    while (gsmSerial.available()) {
      String response = gsmSerial.readStringUntil('\n');
      Serial.println(response);
      if (response.indexOf(expectedResponse) != -1) {
        Serial.println(command + " : SUCCESS");
        return;
      }
    }
  }
  Serial.println(command + ": FAILED");
}
```

C. Testing and Evaluation

There are three tests have been conducted for this project. The following are the tests that were performed:

a. Sensor effectiveness
b. Communication effectiveness
c. Functionality testing

a. Sensor Effectiveness

There are three stages of flood water level that have been configured. The stages are Safe, Warning, and Danger levels. These stages are configured for the efficiency of the developed project.

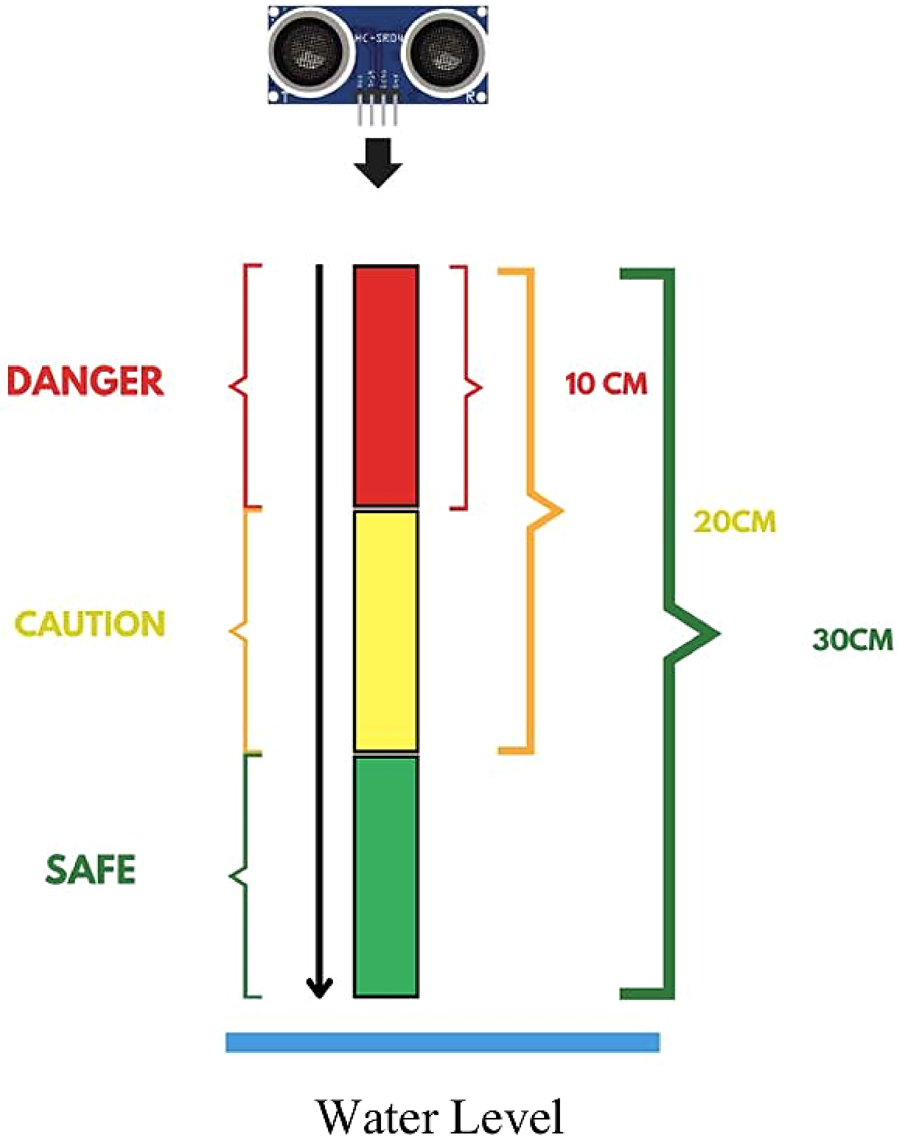

Figure 8. Distance Relative to Sensor

b. Communication Effectiveness

Test SMS notification reliability by checking message delivery time, repeatability, and network signal strength under various conditions.

c. Functionality Test

Perform multiple water testing to verify the timely activation of alarm and SMS alerts.

III. RESULTS AND DISCUSSION

A. Sensor Effectiveness

Table 1 was evaluated using the formulas (1), (2), (3) by Daminon and Yacoob (2024) in solving for the average reading and error percentage of the ultrasonic sensor.

$$Error\ Percentage, \% = \frac{1\ st\ Sensor\ reading - Actual\ resading\ of\ sensor}{Actual\ reading\ of\ sensor} * 100 \quad (1)$$

$$Error = 1st\ sensor\ reading - Actual\ reading\ of\ distance \quad (2)$$

$$Average\ of\ error\ percentage, \% = \frac{Total\ Error\ Percentage}{Amount\ Testing} \quad (3)$$

Table 1. Distance and Calculation of Ultrasonic Sensor

Actual Reading of Distance	Sensor Reading	Error (cm)	Error Percentage (%)	Average of Error Percentage of Distance Measurement (%)	Accuracy of the Sensor (%)
5 cm	5 cm	0	0	**0.0072%**	**99.9928%**
10 cm	9.9 cm	-0.1	-0.01		
15 cm	15.5 cm	0.5	0.03		
20 cm	20 cm	0	0		
25 cm	25.4 cm	0.4	0.016		

The sensor effectiveness, a cornerstone of any flood monitoring system, was rigorously evaluated to ensure the accuracy of water level detection. Utilizing formulas (1), (2), and (3) by Daminon and Yacoob (2024), the ultrasonic sensor's performance was quantified across distance measurements ranging from 5cm to 25cm. The results from Table 1 indicated a remarkably high accuracy rate of 99.9928%, with an overall average error percentage of a mere 0.0072%.

While minor deviations were noted at specific measurement points of 10 cm, 15 cm, and 25 cm, these errors were statistically insignificant, confirming the sensor's precision. This high level of accuracy is critical for a flood monitoring system, as even small inaccuracies in water level measurement can have significant implications for early warning, potentially leading to delayed responses or unnecessary alerts. The consistently low error percentage demonstrates that the ultrasonic sensor is highly reliable for detecting water levels within the tested range, forming a robust foundation for the system's overall effectiveness.

B. Communication Effectiveness (GSM Module)

The GSM module is vital for disseminating flood alerts via SMS and calls, especially in areas with limited internet connectivity. The effectiveness of this module was assessed by measuring the time it took for messages and calls to be delivered after an alert was triggered. Each water level was measured through 5 trials. The formula used is derived from the study of Yumang et. al (2017).

$$Difference = Time\ Received - Time\ Sent \quad (1)$$

$$Average\ (s) = \frac{Trial\ Difference}{Amount\ Testing} \quad (2)$$

Table 2. Level 1 GSM Module Effectiveness

Trial	Time Sent	Time Received	Difference (seconds)	Average
1	2:21:29 pm	2:21:25 pm	4	**4 seconds**
2	2:23:30 pm	2:23:34 pm	4	
3	2:24:17 pm	2:24:21 pm	4	
4	2:25 pm	No network	0	
5	2:27:04 pm	2:27:12 pm	8	

Table 3. Level 2 GSM Module Effectiveness

Trial	Time Sent (seconds)	Time Received (seconds)	Difference (seconds)	Average
1	2:29:13 pm	2:29:20 pm	7	**6 seconds**
2	2:32:13 pm	2:32:26 pm	13	
3	2:34:48 pm	2:34:53 pm	5	
4	2:38:55 pm	No network	0	
5	2:41:25 pm	2:41:30 pm	5	

Table 4. Level 3 GSM Module Effectiveness (Message)

Trial	Time Sent (seconds)	Time Received (seconds)	Difference (seconds)	Average
1	2:52:49 pm	2:52:54 pm	5	**4.4 seconds**
2	2:55:10 pm	2:55:15 pm	5	
3	2:56:32 pm	2:56:36 pm	4	
4	2:59:08 pm	2:59:14 pm	4	
5	3:00:10 pm	3:00:14 pm	4	

Table 5. Level 3 GSM Module Effectiveness (Call)

Trial	Call Outgoing	Call Received	Difference (seconds)	Average
1	2:52:50 pm	2:52:54 pm	4	**2.4 seconds**
2	2:55:12 pm	No network	0	
3	2:56:34 pm	No network	0	
4	2:59:09 pm	2:59:13 pm	4	
5	3:00:11 pm	3:00:15 pm	4	

The communication effectiveness of the GSM module was assessed by measuring the speed and reliability of SMS and call alerts, which are vital for disseminating flood warnings, especially in areas with potentially limited internet connectivity. For Level 1 "SAFE" conditions, as detailed in Table 2, the average SMS delivery time was 4 seconds, with most trials experiencing this delay. However, one notable instance (Trial 4) resulted in a "network error," highlighting a potential vulnerability to mobile network availability. This underscores that while the system is generally swift, external factors beyond its direct control can impact message delivery.

Moving to Level 2 "WARNING" conditions, Table 3 shows a slight increase in the average SMS delivery time to 6 seconds. Variability in delivery times was more pronounced, ranging from 5 to 13 seconds. Consistent with the Level 1 findings, another "network error" was recorded in a trial (similar to Trial 4 in Table 2), further emphasizing the ongoing dependence on network stability. Despite this variability, a 6-second average is still considered very rapid for an early warning system, affording communities valuable time to prepare for rising waters.

For the critical Level 3 "DANGER" conditions, Table 4, focusing solely on the SMS feature, reported an average SMS delivery time of 4.4 seconds. Notably, no errors were recorded across the trials for SMS delivery at this level, suggesting that the network was stable during these specific tests and successfully dispatched the urgent flood warnings to the users' devices. Table 5 further elaborates on the Level 3 "DANGER" conditions, specifically for automated call initiation. The average reception time for successfully connected calls was 2.4 seconds. However, two trials (Trial 2 and Trial 3) resulted in "no network" errors, indicating a failure to establish the call connection. For these failed attempts, the "Difference (seconds)" was recorded as 0, reflecting the unsuccessful reception. These results collectively demonstrate that while the GSM module is capable of rapid alert dissemination, its overall reliability remains contingent on the stability and availability of the cellular network infrastructure.

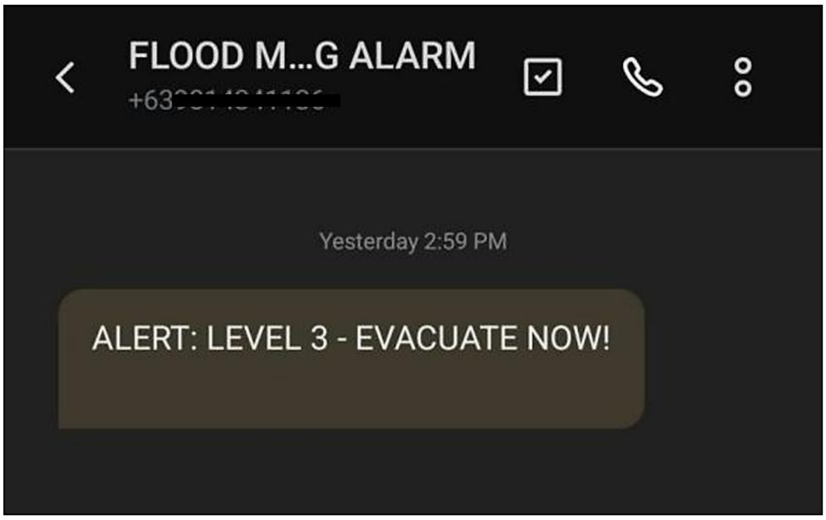

Figure 9. Warning SMS Received by the User

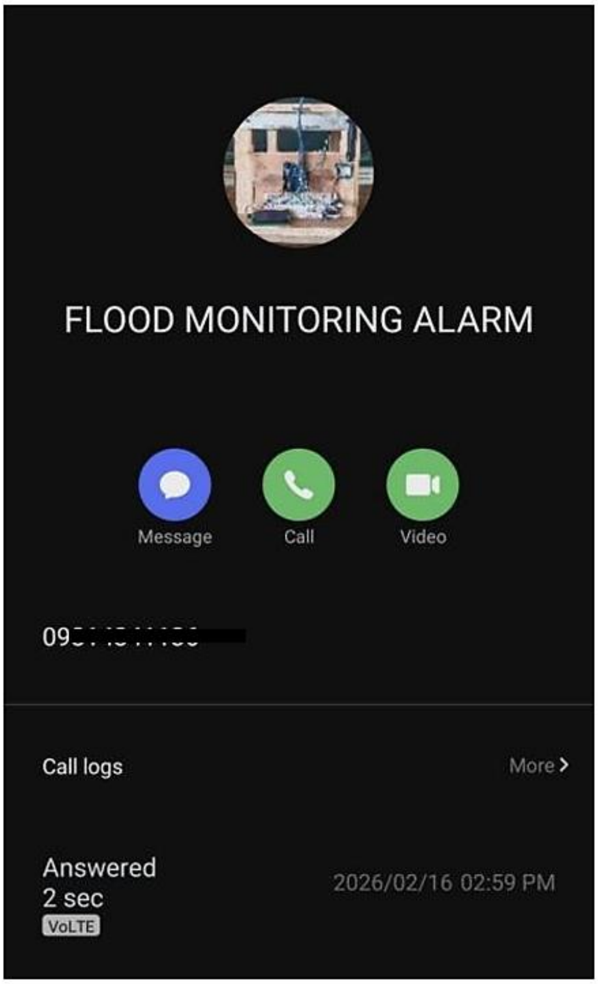

Figure 10. Alarm call from Flood Monitoring Alarm

The following figures 9 and 10, shows the successful execution of the GSM Module during Level 3 "DANGER" condition.

C. Functionality Test

Table 6. Functionality Test

Flow Water Level (cm)		Expected Outcomes				Results
		LCD Display (Status)	Buzzer	GSM Receive/Send SMS	GSM Call	
Case 1	> 30 cm	SAFE	OFF	User	–	Success
Case 2	20–25 cm	WARNING	ON	User	–	Success
Case 3	0–10 cm	DANGER	ON	User	User	Success

The functionality test provided a comprehensive qualitative and quantitative assessment of the system's integrated performance across all defined water level scenarios. Table 5, which summarizes these results, confirms that the system performed successfully in all three critical cases: ">30 cm" for SAFE, "20-25 cm" for WARNING, and "0-10 cm" for DANGER. In a "SAFE" state (water level >30 cm), the system correctly displayed "SAFE" on the LCD along with the current water level. Crucially, the buzzer remained OFF, and an "Alert Level 1: Prepare to evacuate" SMS was successfully sent to the user's device, indicating baseline monitoring and awareness. When the water level escalated to the "WARNING" range (20-25 cm), the system promptly responded. The LCD transitioned to display "WARNING" alongside the current water level, the buzzer activated, providing an audible alert, and an SMS notification stating "Alert Level 2: Water rising!" was successfully transmitted to the user. As per the system's design, automated calls were not triggered at this intermediate warning level.

At the most critical "DANGER" level (0-10 cm), the system demonstrated its full alerting capabilities. The LCD clearly indicated "DANGER" and the current water level. The buzzer activated intensely, and both urgent SMS notifications ("EMERGENCY L3: EVACUATE NOW!") and automated calls were successfully sent or made to the user. This consistent and accurate performance across all tested scenarios strongly validates the prototype's ability to integrate sensor data with multiple alert mechanisms effectively. Despite being tested in a small-scale aquarium setup, serving as a proof of concept, the functionality test confirms that the system can reliably detect different flood stages and disseminate appropriate warnings, thereby fulfilling its primary objective as an automated flood monitoring and alarm system.

IV. CONCLUSION

This study successfully designed, developed, and tested a functional prototype of an automated flood monitoring and alarm system with real-time SMS notification. The system effectively integrates an ultrasonic sensor, Arduino Uno microcontroller, GSM SIM A7670E module, LCD display, and buzzer alarm to monitor water levels and provide timely alerts to users. Based on the results, the ultrasonic sensor demonstrates high accuracy, with an average error percentage of only 0.0072% and an overall accuracy rate of 99.9928%, proving that it is reliable for measuring water levels within the tested range.

The functionality testing confirmed that the system responded correctly to different flood levels (Safe, Warning, and Danger), activating the buzzer and sending SMS notifications accordingly. During the Danger level, both SMS alerts and automated calls were successfully triggered, showing the system's capability to provide urgent warnings. The communication effectiveness tests revealed that SMS notifications were generally delivered within 4 – 6 seconds, indicating fast transmission of alerts. However, occasional network errors occurred, highlighting that the system's reliability partly depends on the mobile network availability. Despite his limitation, the overall performance of the GSM module was satisfactory and effective for real-time flood alert notifications. Therefore, the study concludes that the developed prototype is reliable and practical for early flood warning solutions. While this is currently a proof of concept tested in a small-scale setup, it demonstrates strong potential for further development and real-world application.

Conflicts of Interest

The authors declare that there is no conflict of interest concerning the publication of this paper.

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V. REFERENCES

1. B. Arshad, et al., “Computer Vision and IoT-Based Sensors in Flood Monitoring and Mapping: A Systematic Review,” *Sensors*, vol. 19, no. 22, p. 5012, 2019. Google Scholar | Publisher Link
2. N.A. Athirah, et al., “Solar-Powered Flood Early Warning System with Short Message Service (SMS) Notifications,” *Green and Sustainable Energy Focus Group (GSEnergy)*, vol. 3, no. 18, pp. 1156–1162, 2019. Google Scholar | Publisher Link
3. S. Azid, et al., “SMS Based Flood Monitoring and Early Warning System,” *ARPN Journal of Engineering and Applied Sciences*, pp. 6387–6391, 2015. Google Scholar | Publisher Link
4. F. Christopher, “Review of Related Literature About Floods Management & Socio-Economic Development of People of Kambuga Subcounty,” *International Journal of Academic Management Science Research (IJAMSR)*, vol. 6, no. 7, pp. 160–164, 2022. Google Scholar | Publisher Link
5. E. Daminon, and M. Yaacob, “Solar Powered Water Level Monitoring System for Flood Management in Rural Area Using GSM Module,” *Evolution in Electrical and Electronic Engineering*, vol. 5, no. 2, pp. 98–107, 2024. Google Scholar | Publisher Link
6. L. Hashemi-Beni, M. Puthenparampil, and A. Jamali, “A Low-Cost IoT-Based Deep Learning Method of Water Gauge Measurement for Flood Monitoring,” *Geomatics, Natural Hazards and Risk*, vol. 15, no. 1, p. 2364777, 2024. Google Scholar | Publisher Link
7. N. Kamal, et al., “Development and Implementation of an IoT-Based Early Flood Detection and Monitoring System Utilizing Time Series Forecasting for Real-Time Alerts in Resource-Constrained Environments,” *Malaysian Journal of Science and Advanced Technology*, vol. 5, no. 1, pp. 30–36, 2025. Google Scholar | Publisher Link
8. A.M. Lagmay, et al., “Disseminating Near-Real-Time Hazards Information and Flood Maps in the Philippines Through Web-GIS,” *Journal of Environmental Sciences*, vol. 59, pp. 13–23, 2017. Google Scholar | Publisher Link
9. A. Magnaye, et al., “Automated Flood Water Level Sensor and Alarm System Using Arduino Uno,” *International Journal of Research Studies in Educational Technology*, vol. 8, no. 3, pp. 61–69, 2024. Google Scholar | Publisher Link
10. L.K. Tolentino, et al., “Real Time Flood Detection, Alarm and Monitoring System Using Image Processing and Multiple Linear Regression,” *SSRN Electronic Journal*, 2022. Google Scholar | Publisher Link
11. L. Williams, J. Arguillas, and F. Arguillas, “Major Storms, Rising Tides, and Wet Feet: Adapting to Flood Risk in the Philippines,” *International Journal of Disaster Risk Reduction*, p. 101810, 2020. Google Scholar | Publisher Link
12. A.N. Yumang, et al., “Real-Time Flood Water Level Monitoring System With SMS Notification,” *Institute of Electrical and Electronics Engineers (IEEE)*, pp. 1–3, 2017. Google Scholar | Publisher Link
13. N.M. Zain, et al., “Flood Warning and Monitoring System (FWMS) Using GSM Technology,” *Journal of Computing Research and Innovation*, vol. 5, no. 1, pp. 7–18, 2020. Google Scholar | Publisher Link