

# Flood Detector Monitoring System Using Raspberry Pi

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## Abstract

Flooding is a serious issue for cities, leading to infrastructure damage, loss of property and threats to human safety. The project focuses on developing an advanced flood detection system that uses sensor technology and smart grids to provide real-time data on water levels and rainfall. Recent floods have caused significant displacement and damage, highlighting the need for better early warning systems. The main goal of this project is to create a flood monitoring system using Raspberry Pi that can detect water levels and rainfall in real time and send notifications via Telegram. The system includes a water level sensor that triggers alerts via LED lights and uses WiFi to send notifications. The system is designed with sensors to detect rain, microcontrollers to process data, and communication tools to send alerts. Our results show that the system can effectively warn both authorities and residents through sound alarms and mobile notifications. This flood monitoring solution offers a reliable and efficient way to add early flood warning and response, LCD indicators and Telegram notifications to provide a comprehensive flood monitoring solution. Trial results show that the system effectively provides clear visual and audible warnings, helping to reduce the risks associated with rising water levels.

## 1. Introduction

Flooding is a critical issue for urban areas, causing major infrastructure damage, property loss, and a serious risk to human safety [1]. Recent severe flooding events have highlighted the urgent need for more effective flood detection and early warning systems. Flooding in early 2023, for example, resulted in tens of thousands of displacements, extensive infrastructure damage, and deaths, especially among vulnerable populations [2]. These events highlight deficiencies in existing early warning systems and indicate the need for advanced flood monitoring solutions. Smart grid and sensor technologies offer promising solutions by continuously monitoring water levels and rainfall. Integrating this technology with data processing and real-time communication tools makes it possible to create a more responsive and effective flood detection system. This project aims to capitalize on these advances by developing a flood monitoring system using Raspberry Pi, which can deliver real-time notifications and visual warnings to authorities and residents, thus improving preparedness and response to flood events.

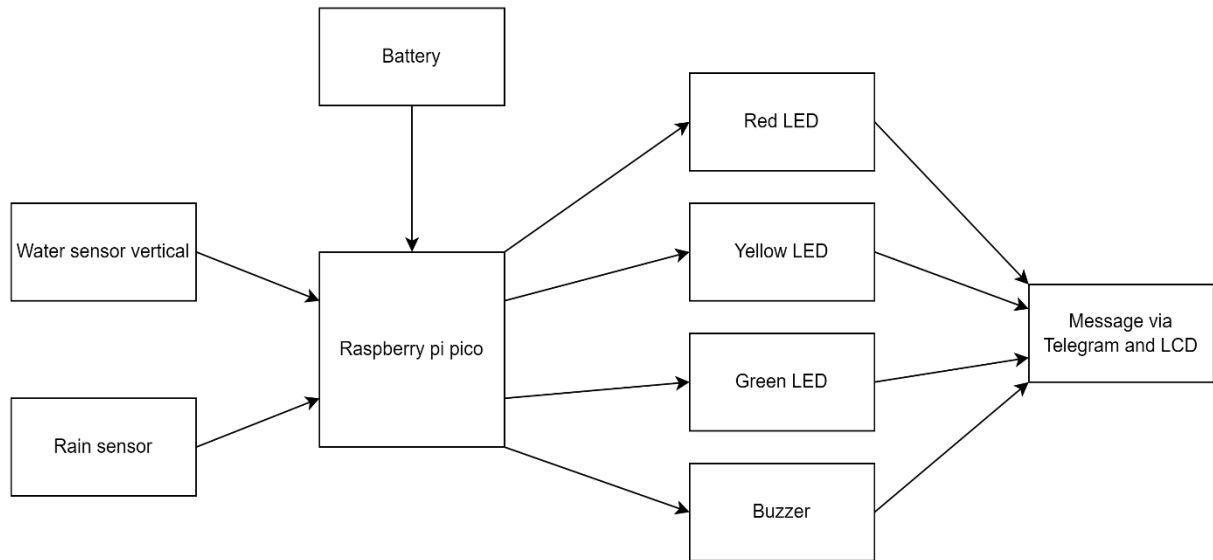
Table 1 highlights the various sensors and microcontrollers used in different flood detection systems. The level of IoT integration varies, with some projects using web servers, GSM modules, or specific applications like Blynk and Twilio. Key features include cost-effective sensors, real-time notifications, and comprehensive monitoring solutions, demonstrating significant advancements in flood detection technology. Each project aims to improve flood preparedness and response, minimizing the risks associated with rising water levels.

**Table 1** Comparison table for each previous work

Name article	Sensor	Microcontroller	IoT
1) Domestic Flood Safety Alarm System (D'FESAS) [3]	<ul style="list-style-type: none"> <li>Probe sensor</li> </ul>	<ul style="list-style-type: none"> <li>IC400B</li> </ul>	-
2) The Smart Flood Detector using ultrasonic sensor using IoT [4]	<ul style="list-style-type: none"> <li>Ultrasonic sensor</li> </ul>	<ul style="list-style-type: none"> <li>Wifi module</li> <li>Arduino</li> </ul>	Blink
3) Sistem Pemantauan Banjir Secara Jarak Jauh [5]	<ul style="list-style-type: none"> <li>Water level sensor</li> <li>Water flow sensor</li> </ul>	<ul style="list-style-type: none"> <li>Arduino Atmega Nano</li> <li>Module GSM</li> </ul>	-
4) Domestic Flood Detector [6]	<ul style="list-style-type: none"> <li>Float switch</li> </ul>	<ul style="list-style-type: none"> <li>Arduino</li> <li>Module GSM</li> </ul>	-
5) Real-time flood monitoring system using Raspberry Pi [7].	<ul style="list-style-type: none"> <li>Rain drop</li> <li>Water level sensor</li> <li>Water flow sensor</li> </ul>	<ul style="list-style-type: none"> <li>Raspberry pi</li> </ul>	Twilio
6) Flood Detection And Alert System Based On IoT [8]	<ul style="list-style-type: none"> <li>Water level sensor</li> <li>Rain sensor</li> <li>DHT 11 Sensor</li> <li>Pi Camera module</li> </ul>	<ul style="list-style-type: none"> <li>Raspberry pi</li> </ul>	Web server

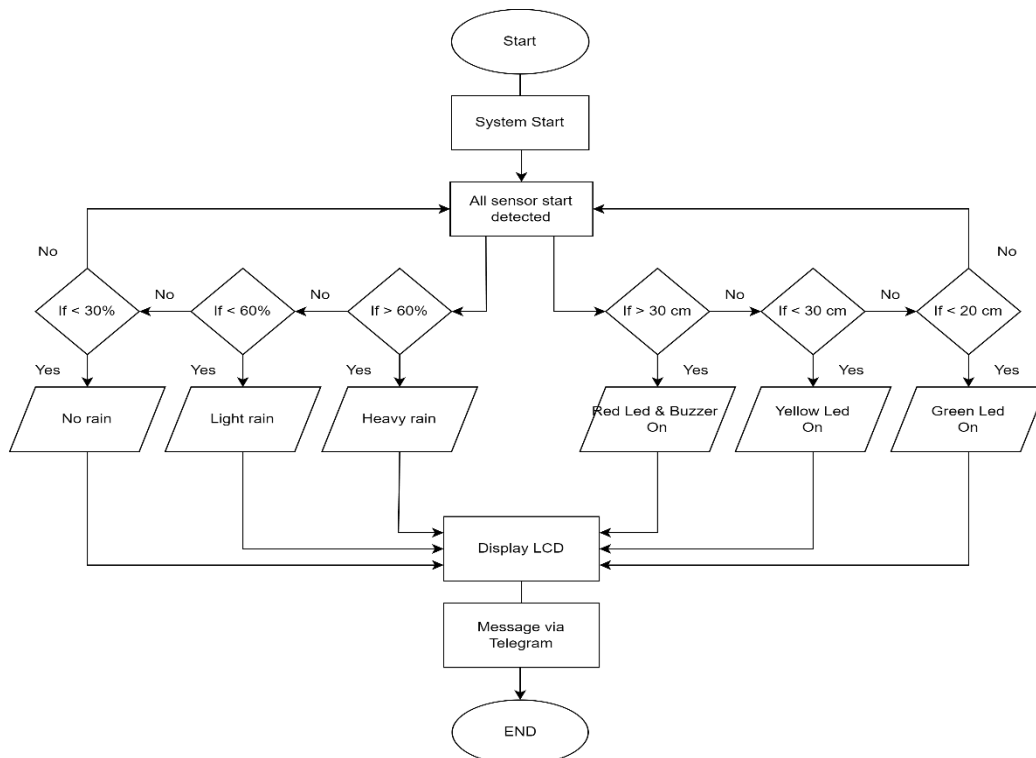
## 2. Methodology

Figure 1 shows the block diagram of this project's flood detection system, which has 4 inputs, namely vertical water level sensors 1, 2, and 3, as well as a rain sensor. As the name suggests, it uses Raspberry pi as a microcontroller that takes power from the battery. End once, as an indicator, it uses LCD and sends notifications to Telegram.



**Figure 1** Block diagram of Flood detector monitoring system using Raspberry Pi

Figure 2 shows the flowchart of this system, where it has 2 flow of system first water level sensor, which is have 3 conditions. First, if sensor one is detected, then a green LED will be on, and it will display 'Safe Water Level'. Second, if sensor two detected then yellow Led will on and it will display 'First warning'. Lastly, if sensor three detected then red Led and buzzer will on and it will display 'Critical Warning'. For the second flow is Rain sensor which is also have 3 conditions. First, if sensor detected below 30% rain then it will display 'No rain'. Second, if sensor detected above 30% then it will display 'Light Rain'. Lastly, if sensor detected above 60% it will display 'Heavy rain'. All the information that collected from sensor will display at LCD and Message via Telegram.



**Figure 2** Flowchart of Flood detector monitoring system using Raspberry Pi

Figure 3 is a preliminary test for this project, Wokwi software was used for make this preliminary test. Initial tests for a prototype flood detector, it used rain sensors, water level sensors, red, yellow and green LEDs, buzzers, LCD and using a Raspberry Pi as a microcontroller with Wokwi simulation software, aim to evaluate the effectiveness of these components in detecting and warning of possible flood events,

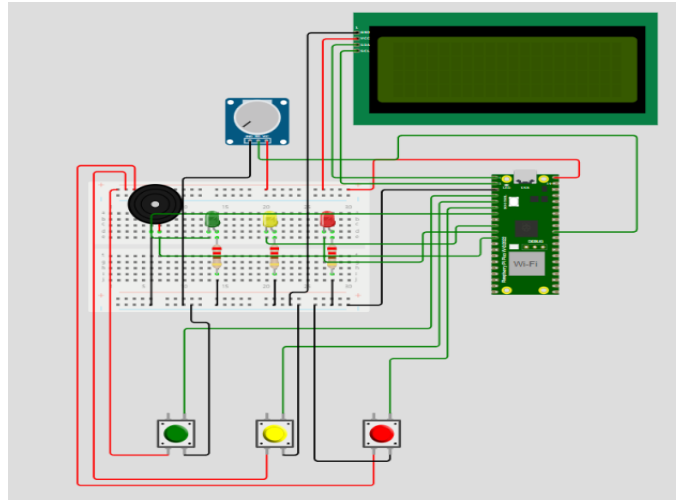


Figure 3 Preliminary test using Wokwi

### 3. Result and Discussion

Figure 4 shows the indicator for the LCD(a) and the message from the telegram(b) for the completed system. The indicator part of the flood detection system includes an LCD(a) and a Telegram messaging (b), both indicating are providing real-time alerts about flood status and rain conditions. The LCD displays real-time data on water levels and flood status, placed in a visible location for easy monitoring. Telegram messaging sends real-time flood alerts to users' smartphones, easier people that far away from system and home.



(a)



(b)

Figure 4 (a) Indicator LCD (b) Indicator Telegram interface

Table 2 shows combination for two sensors in this system, A system being described is designed to respond to different levels of rain and water conditions through ten trials. These trials, numbered 1 to 10, simulate scenarios based on the percentage of rain detected and the height in cm water levels. For instance, Trials 1-2 is in state when the water level is below 8 cm, and a minimal response of one spray, indicated only no rain. In trial 3-5 is in state when water level below 16 cm, response of 3 spray, indicated by green LED and light rain. Trial 6-7 is in state water level below 24cm and response of 5 spray, indicated by yellow LED and Heavy rain. Lastly, trial 8-10 where water level above 24cm and response of 5 and above spray, indicated by red LED and buzzer, also heavy rain.

**Table 2** *Combination of Water level sensor and rain sensor*

Trial	Rain Sensor			Water Level Sensor			LED			Buzzer
	No Rain	Light Rain	Heavy Rain	1	2	3	Green	Yellow	Red	
1	✓									
2	✓									
3		✓		✓			✓			
4		✓		✓			✓			
5		✓		✓			✓			
6			✓		✓			✓		
7			✓		✓			✓		
8			✓			✓			✓	✓
9			✓			✓			✓	✓
10			✓			✓			✓	✓

In State Trial = 1-2 (Water < 8 Cm, 1 Spray)  
 3-5 (Water <16 Cm, 3 Spray)  
 6 -7 (Water<24 Cm, 5 Spray)  
 8-10 (Water>24 Cm, 6 Spray)

Table 3 shows the time taken by indicator to produce an output, The table shows how different indicators react to signals from three sensors for ten trials. Trials 1-3 use Sensor 1, Trials 4-6 use Sensor 2, and Trials 7-10 use Sensor 3. Each trial records the different response times of indicators like Telegram and LCD to show safe zone(green), warning 1 (yellow), or critical warning (red with buzzer) levels. For instance, in Trial 4, Telegram took 1 second to display a green light and 4 seconds for a red alert. On average, Telegram takes 4.4 seconds, while LCD takes 2.6 seconds to respond. This setup tests how effectively the system can notify users about different conditions.

**Table 3** Table time for indicator produces an output in second (s)

Trial	Indicator		Safe Level (Green)	Warning	
	Telegram	LCD		Yellow	Red & buzzer
1	5	1	1	-	-
2	5	3	3	-	-
3	4	5	3	-	-
4	4	1	-	4	-
5	5	2	-	1	-
6	4	3	-	3	-
7	5	4	-	-	4
8	4	5	-	-	2
9	4	1	-	-	1
10	4	1	-	-	1
Average	4.4	2.6	2.3	2.6	2

#### 4. Conclusion

The flood detection system utilizing Raspberry Pi with IoT technology offers a reliable method for monitoring flood conditions and providing real-time alerts. Through the integration of various sensors, communication tools, and automation features, the system can keep users informed of water levels, rain status, and environmental changes both locally and remotely via IoT connectivity. However, like any technological solution, the system faces several limitations that affect its overall performance and reliability. One significant limitation is the system's dependence on a steady power source. Any power outage will disrupt its operation, making the system vulnerable during critical weather conditions. Additionally, the physical safety of the product can be a concern, especially if the device is installed in remote or public areas such as rivers, where it might be stolen or damaged. Furthermore, the use of older sensors limits the precision and ease of system installation, and coding complexity can make maintenance more challenging. While the system effectively achieves its objectives of providing real-time weather alerts and protecting property, these limitations suggest areas for improvement, such as enhancing sensor durability and accuracy in diverse environmental conditions. Nonetheless, the project offers a valuable tool for improving weather safety and flood prevention in various settings.

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#### Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

#### Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Ahmad Aqil Haikal; **data collection:** Ahmad Aqil Haikal; **analysis and interpretation of results:** Ahmad Aqil Haikal; **draft manuscript preparation:** Ahmad Aqil Haikal. All authors reviewed the results and approved the final version of the manuscript.

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