Heltec Wifi LoRa 32 V2 Flood Stream Area Early Detection Technology

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Abstract

The goal of this research is to develop a LoRa (Long Range) technology-based early flood detection tool. The instrument designed features to track and identify possible flooding at Indonesian Teknokrat University, Bandar Lampung, and Kalibalau. The Heltec Wifi LoRa 32 V2 microcontroller was connected to an ultrasonic sensor installed to monitor the water level of the Kalibalau River as part of this study technique. River conditions can be categorized into four statuses using this tool: Danger (water level > 143 cm), Alert 1 (water level 64-119 cm), Alert 2 (water level 120-142 cm), and Safe (water level 14-63 cm). The output, which takes the form of a buzzer, will be on constantly in the Danger status; it will be on for one minute in the Alert 1 status; it will be on twice for one minute in the Alert 2 status; and it will not be on in the Safe position. Based on the test findings, it can be concluded that the LoRa sending and receiving devices perform as intended and have communication capabilities up to 400 meters away. This tool is useful for keeping an eye on the Kalibalau River's health and for alerting users in the event that a possible flood hazard is identified. By developing flood monitoring technologies, this research helps improve public safety and awareness in flood-prone areas.

1. Introduction

Situated on the equator, Indonesia experiences two distinct seasons: the rainy season and the dry season. In Indonesia, the rainy season runs from March to October(Rahayu et al., 2018), and the dry season typically lasts from April to September. Strong rains might result in flooding(Wijayanti et al., 2022).

Natural disasters like floods frequently happen during the rainy season(Lili Somantri, 2008). Human conduct that involves the reckless disposal of trash is one of the factors contributing to flooding(Wijayanti et al., 2021). Trash has the ability to obstruct water channels, which leads to flooding. In addition to the effects of waste disposal, a variety of other factors can lead to flooding, such as the topography of the region, the capacity of the water catchment. Area, the duration and intensity of rain, and the capacity of the canal network (drainage)(Astuti & Sudarsono, 2018).

In general, floods have both direct and indirect effects(Rosyidie, 2013). One of the immediate effects of flooding is on buildings, specifically on the physical damage and loss of building function. This can be considered a financial (or economic) loss because, in addition to the costs of repairs, there is also a loss of opportunity to engage in other activities(Fahlevi, 2019). The emergence of several diseases is an indirect effect of floods on the environment(Faiqoh et al., 2017).

The root cause of flooding issues, which typically arise in densely populated urban areas, is poor management of river watersheds. This issue, which was once quite significant, has now grown considerably more intricate. District- to village-level regional government representatives, the corporate sector, non-governmental organizations, and the community have come to the realization that a flood prevention program is necessary and that the issue of flooding needs to be addressed from its root causes. then given top priority for execution after receiving resolute support from all parties involved(Rahardjo, 2018).

Bandar Lampung is one of the Indonesian provinces that commonly suffers from flooding disasters(Islam, 2019). In Kalibalau Teknokrat Bandar Lampung, there was a flood disaster(Pratama, 2020). The Kalibalau river overflowed as a result of the intense rain that has been falling on Bandar Lampung since Thursday night, June 11, 2020(Afandi, 2020). Additionally, locals reported that Kalibalau frequently experiences floods during the rainy season(Ariadi, 2022).

1.1 Literature Review

A lot of research has been done to offer answers. The design of the Heltec Wifi LoRa 32 V2 Flood Detection System is one example of research that has been done. This system detects water levels and uses the ESP8266 Node MCU as a microcontroller to read the water level sensor and send messages via the Blink application, which functions to gather preliminary data about flood events(Muzakky et al., 2018). Using an ultrasonic sensor and an Arduino UNO R3, the water level detection prototype can transmit data on safe and harmful water levels as well as the most recent alerts to smartphones through the Things Speak app(Hanggara, 2020) (Hanggara Fuad Dwi, 2020). In addition, a Real-Time Flood Early Detection Monitoring Information System is present. Pit level tanky apparatus, which comprises a float and a water level measurement sensor, is used in this study(Muhajirin, 2014). Regarding studies on real-time flood early warning tools that employ ultrasonic sensors and LORA 32U4, these devices may communicate up to 25 meters apart and display sensor values on an LCD(Prabowo, 2021). In addition, there is research that measures water flow using the Water Flow Sensor G 1/2 and uses the LoRa GPS HAT for Raspberry PI DRAGINO to acquire real-time data(Saragih et al., 2020). A prototype water level detection tool is being developed by a study using an Arduino Uno microcontroller and two sensors: a DHT sensor to detect rain and an ultrasonic sensor to assess water level. Things on the Internet(Kurniadi & Riyandini, 2022) In addition to monitoring amounts or physical phenomena where the sensors are placed using the Arduino Uno microcontroller, this research makes use of the Sensor Node as a processing, storage, and communication tool(Jahir et al., 2022). The flood early warning system in this study uses one transmitter and one receiver, both of which are constructed utilizing the LORA telecommunications paradigm(Haidi et al., 2023). This flood warning system makes use of an ESP8266 nodemcu as the microcontroller and an ultrasonic sensor for sound wave detection. Data on river water levels will eventually be represented numerically using this system(Supriadi et al., 2021).

2. Research Methods

This study used an observational methodology and was conducted on August 12, 2023, on a Saturday at the University of Technology Indonesia campus located near Kalibalau. Sungai Kalibalau has never experienced a Hujan Muslim's banjir. According to research that was completed for Peelitian Yang Terkait, there is internet network congestion. Thus, based on this research, the authors propose to use LoRa Heltec Wifi LoRa 32 V2 as the LoRa technology for the Dini Banjir Daerah in the Southern Region. This device functions to maintain the air quality from dust mites by using LoRa Heltec Wifi LoRa 32 V2 as a cleaning solution in the Kalibalau Technology. This method uses a buzzer to signal when the sun's rays are starting to fade or become bright, an ultrasonic sensor to measure the sun's ray intensity, and LoRa as a microcontroller to monitor the sun's rays.

In this study, solar panels, buzzers, ultrasonic sensors, Heltec WiFi LoRa 32 V3, and other tools were employed by the researchers. Additionally, Fritzing programs and the Arduino IDE are the materials employed.

Fig. 1 Heltec Wifi Lora 32 V2

This device's microcontroller, the Heltec Wifi LoRa 32 V2, allows for remote communication without the need for an internet connection. An OLED is already there in this tool to show the values or data obtained from the sensors that we employ. Since LoRa can function without an internet connection, researchers developed this tool to utilize LoRa to obtain data about river water levels without an internet connection. Fig 1 illustrates how this may happen when it rains a lot.

Fig. 2 Ultrasonic Sensor

River water levels are measured with this ultrasonic sensor, as shown in Fig 2.

Fig. 3 Buzzer

As illustrated in Fig 3, the buzzer serves as an extra tool that sounds when alerts 1, 2, and danger.

Fig. 4 Lithium Charger Module

As shown in Fig 4, the TP-4056 type C Lithium Charger Module is utilized to recharge lithium batteries.

Fig. 5 Lithium Ion Battery

As with the Fig 5, lithium-ion batteries are employed to store energy from solar panels.

Fig. 6 Step Down LM2596

To convert high brackets with low current to low voltage with high current, such in Fig 6, step down LM2596.

Fig. 7 Solar Panel

Similar to the Fig 7, this aerial detector is powered by a solar panel.

Fig. 8 Arduino IDE

Similar to Fig 8, this flood early detection tool was made with the Arduino IDE.

Fig. 9 Fritzing

As in Fig 9, Fritzing served as a location to stack the Flood Early Detection gadget.

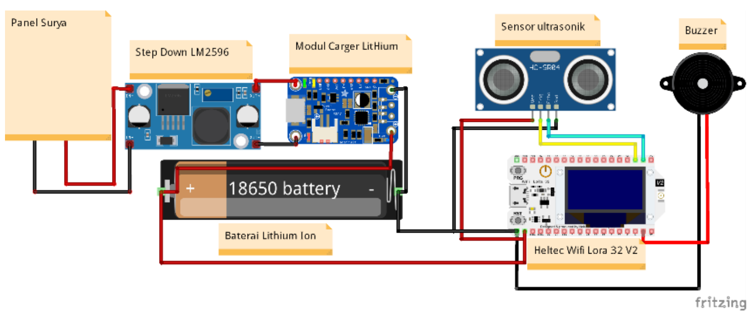

Fig. 10 Tool Network

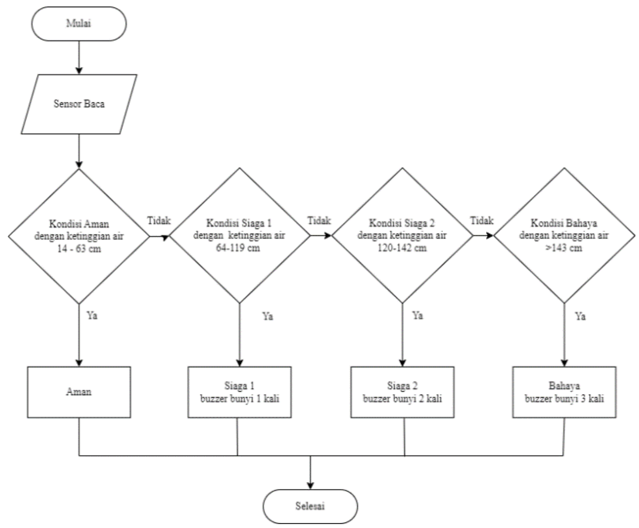

Fig. 11 Flowchart Early Badge Detection

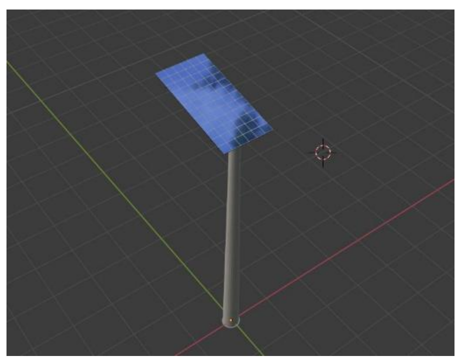

Fig. 12 Top View Tool Design

Fig. 13 Tool Designs Look Down

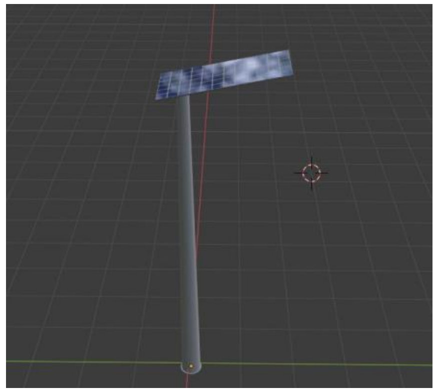

Fig. 14 The tool design looks side-by-side

3. Result and Discussion

The results and interpretation cover a variety of tests conducted on various instruments. The test seeks to demonstrate that the gadget is constructed in compliance with the guidelines. Test results were used to get the data needed for analysis. The apparatus uses an ultrasonic sensor to determine the water's elevation. Both the LoRa sender and receiver's OLEDs show the sensor readings. This illustration shows the flood detecting equipment located on Fig 15.

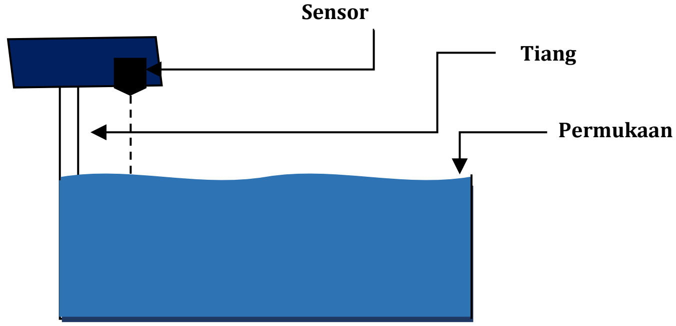

Fig. 15 Planning a Flood Early Detection Alarm(Supriadi et al., 2021)

3.1 Sensor Test Results

The study's ultrasonic sensor test results show four states: safe, where the water is between 1 and 60 cm in height; alert 1, between 61 and 90 cm in height; alarm 2, between 91 and 130 cm in height; and danger, above 130 cm. This setting is modified to account for the unique circumstances of the test site, specifically by measuring the height of the river to the point at which the device is positioned. From there, we derive the sensor's height distance value, which is 54 cm for the safe station, 72 cm for alert station 1, 123 cm for alert station 2, and 131 cm for danger status, can be seen in Table 1.

Table 1. Sensor Testing

Water Height	Value of the altitude range on the Sensor	Status
1 - 60 cm	54 cm	Safe
61 - 90 cm	72 cm	Watch out 1
91 – 130 cm	123 cm	Watch out 2

>130 cm	131 cm	Danger

3.2 Overall Tool Testing

This flood early detection device's overall test has a 5-second delay for each reading of the water altitude. At 44 cm, which is the state of safe water, the buzzer does not light. At 82 cm, which is the state of alert 1, the buzzer rings once with a 1-minute delay. At 120 cm, which is the next state, the alarm 2 is called, the buzzer rings twice with a 1-minute delay. At 134 cm, which is the state of danger, the buzzer rings continuously with a 5-second delay. These results are shown in Table 2.

Table 2. Overall Tool Testing

Water Height	**Sensor Height Distance**	**Delay**	**Buzzer Sounds**	**Status**
1 - 60 cm	44 cm	0	No	Safe
61 - 90 cm	82 cm	1 Minutes	Sound	Watch out 1
91 – 130 cm	120 cm	1 Minutes	Sound	Watch out 2
>130 cm	134 cm	5 Seconds	Sound	Danger

4. Conclusions

The LoRa Heltec Wifi LoRa 32 V2 was created to make it easier for students and lecturers to know the elevation conditions of the river at the Technokratic University of Indonesia. This device serves as a reminder/alarm that sounds when the river water is already high, this device has 4 status namely Safe, Siwa 1 Siwa 2 and Danger. This device is made using Heltec Wifi LoRa 32 V2 microcontroller because this device does not need to use an internet connection to access it. The overall test of this flood early detection device has a delay of 5 seconds each reading of the water altitude, on the safe water status at a height of 44 cm and the buzzer is not on, the alert status 1 at an altitude of 82 cm where the buzcer is ringing once in a one-minute delay, then on the next status is the alarm 2 at a 120-cm height then the Buzzer is ringed 2 times in a 1 minute delay and the last is the Danger status at an elevation of 134 cm then the buzger is Ringing with a five-second delay. The LoRa sender and the LoRa receiver work well based on the schedules that have been made. LoRa sender and LoRa receiver can communicate up to 400 meters.

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