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Flood Detection Tool Using Ultrasonic Sensor Based on Telegram and Sound in Krueng Kluet River Flow

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ABSTRACT

Flooding is a problem that until now still requires special handling from various parties, both from the government and the community. Flooding is not a light problem because flooding can disrupt community activities and cause losses, such as the washing away of household equipment, valuables, and electronic goods. Flooding occurs due to rising water levels in rivers due to abnormal rainfall, damaged dams, obstruction of water flow at the site of the dam's destruction in the River Basin Area (DAK), and the construction of facilities and infrastructure. The series of "Flood Detection Devices using Ultrasonic Based on Telegram and Sound consists of three parts, namely the input section, the control section, and the display section. This design was made to simplify the process in the Ultrasonic Flood Detection Device Design using telegrams and sound. The Ultrasonic Flood Detection Device Design Circuit using telegrams and sound consists of three parts, namely the input section, the control section, and the display section. The first Flood Detection Device Test using Ultrasonic Sensors Based on Telegram and Sound has been tried as many as 10 The first experiment The water depth is 1 meter, the distance of the sensor to the water surface is 3 meters, it is said that the status is safe, there is no notification to the telegram and the siren does not sound. Experiment 2: The water depth is 2 meters, the distance of the sensor from the water surface is 2 meters, it is said to be on standby, then the flood detector provides notification to the telegram via the telegram bot, and the siren sounds. Experiment 3: The water depth is 3 meters, the distance of the sensor from the water surface is 1 meter, it is said to be on standby, then the flood detector provides notification to the telegram via the telegram bot, and the siren sounds.

INTRODUCTION

Flooding is one of the most frequent natural disasters in various countries, including Indonesia(Septiana, 2018). This disaster can be caused by climatic factors such as high rainfall, land-use changes, and other natural conditions (Zain et al., 2020). The impact of floods includes not only material losses but can also cause casualties (Septiana, 2018). Therefore, effective mitigation efforts are needed to reduce the risks and impacts of flooding.

One important mitigation effort is a flood early warning system (Callanga et al., 2020). This system allows communities to prepare and take preventive actions before a flood occurs (Septiana, 2018). An effective flood early warning system must be able to provide accurate, timely, and easily understandable information to the public.

The use of technology in flood early warning systems is growing rapidly (Septiana, 2018). One promising technology is the use of ultrasonic sensors to monitor water levels (Jackman, 2021). Ultrasonic sensors have advantages in terms of ease of installation, relatively low cost, and the ability to provide accurate measurements (Kang et al., 2021).

In addition, developments in communication technology also enable the rapid and widespread dissemination of flood early warning information (Natividad & Mendez, 2018). The use of instant messaging applications such as Telegram can be an effective alternative for sending flood early warning notifications to the public (Natividad & Mendez, 2018). Telegram has the advantages of ease of use, the ability to send messages to many people at once, and support for various types of media (text, images, audio). Research has aimed at flood disaster mitigation by building a monitoring and flood disaster early warning information system using an Internet of Things based Arduino microcontroller (Zain et al., 2020); (Métrologie, 2019).

Based on the description above, this study aims to develop a flood detection device that uses an ultrasonic sensor as a water level meter and Telegram and sound as media for conveying early warning information to the public. It is hoped that this tool can contribute to flood disaster mitigation efforts and reduce the risks and impacts caused.

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LITERATURE REVIEW

Flood early warning systems are an essential part of flood disaster mitigation. FEWS aim to provide accurate and timely information to the public, allowing them to prepare and take preventive action before a flood event (Septiana, 2018). Effective FEWS must meet several criteria, including:

- Accuracy: The information provided must be accurate and reliable.
- Timeliness: Information must be provided in a timely manner so that people have enough time to prepare.
- Ease of Understanding: Information must be easily understood by people from all backgrounds.
- Wide Reach: Information must reach all people potentially affected by flooding (Natividad & Mendez, 2018).

Ultrasonic Sensors for Water Level Measurement

Ultrasonic sensors have been widely used in various water level measurement applications, including in FEWS (Jackman, 2021). These sensors have several advantages, including:

- Non-Contact: Measurements are made without direct contact with water, reducing the risk of sensor damage due to corrosion or contamination.
- Relatively Low Cost: Ultrasonic sensors are relatively affordable compared to other water level sensors.
- Ease of Installation: Ultrasonic sensors are relatively easy to install and integrate with other systems.
- Good Accuracy: Ultrasonic sensors are capable of providing water level measurements with good accuracy (Kang et al., 2021); (Anggraini et al., 2024).

Several studies have tested and implemented ultrasonic sensors to monitor river water levels (Wijaya & Siagian, 2024). and detect potential flooding (Septiana, 2018); (Novelan, 2022).

Telegram Communication in Early Warning Systems

Telegram is an instant messaging application that is increasingly popular and has great potential for use in FEWS (Natividad & Mendez, 2018). Some of the advantages of Telegram include:

- Ease of Use: Telegram is easy to use for people of all ages and backgrounds.
- Group and Channel Capabilities: Telegram allows the creation of groups and channels with a large number of members, so information can be disseminated widely.
- Media Support: Telegram supports sending various types of media, such as text, images, audio, and video, so information can be conveyed more effectively.
- Automated Bots: Telegram has a bot feature that allows automation of message sending and interaction with users.

Integration of Ultrasonic Sensors and Telegram

The integration of ultrasonic sensors and Telegram in a flood detection system can provide an effective and efficient solution for providing early warnings to the public. Ultrasonic sensors are used to monitor water levels in real-time, while Telegram is used to send early warning notifications to affected communities (Norhaslinawati et al., 2020); (Zain et al., 2020). This system can provide accurate, timely, and easily understandable information, so that people can prepare and take preventive actions before a flood occurs ((Natividad & Mendez, 2018); (Septiana, 2018).

METHOD

Hardware and Software

Hardware

The hardware used in designing a Flood Detection Tool using Telegram and Sound Based includes:

Table 1. Hardware

No.	Component name	Component functions
1.	NodeMCU	As a controller of components in the design of a flood detection tool using Telegram and voice-based.
2.	Ultrasonic Sensor	Functions as a flood detection tool and provides information on water levels.
3.	Jumper Cables	Functions as a connector between one component and another.
4.	Siren	Functions as a sound-based warning notification.
5.	Breadboards	As a connecting component between NodeMCU and Ultrasonic via a jumper cable.

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Software

The software used in designing the Flood Detection Tool using Telegram and Voice-Based is as follows:

1. Frizing 0.9.0b.32.pc
   Used to simulate the Flood Detection Tool circuit using Telegram and Voice-Based.
2. Arduino 1.8.5 Windows
   Used to upload the program to the nodeMCU for the Flood Detection Tool using Telegram and Voice-Based.

System Design

This design is made to simplify the process of designing Ultrasonic-based Flood Detection Devices using telegrams and sound. The Ultrasonic-based Flood Detection Device Design Circuit using telegrams and sound consists of three parts, namely the input section, the control section, and the display section as shown in Figure 1 below.

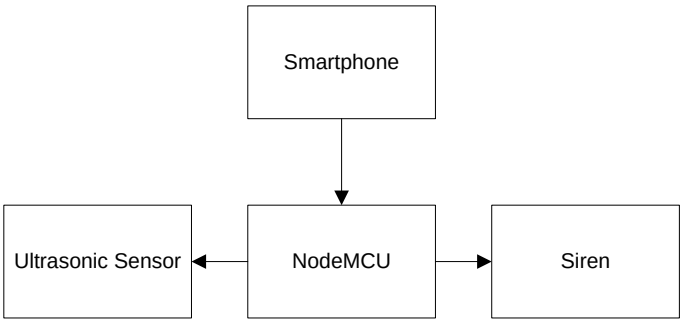

Figure 1. System Design Diagram

From Figure 1, it can be seen that there are four parts of the circuit, namely:

a. Ultrasonic Sensor
   Ultrasonics is a set of tools used to measure water depth.
b. NodeMCU
   NodeMCU is an open-source IOT platform consisting of hardware in the form of the ESP8266 System On Chip, which uses the scripting programming language.
c. Siren
   A siren is an electronic component that functions to convert electrical vibrations into sound vibrations.

Flowchart Design

The following is a flowchart of the design of how the tool works, as shown in Figure 2 below.

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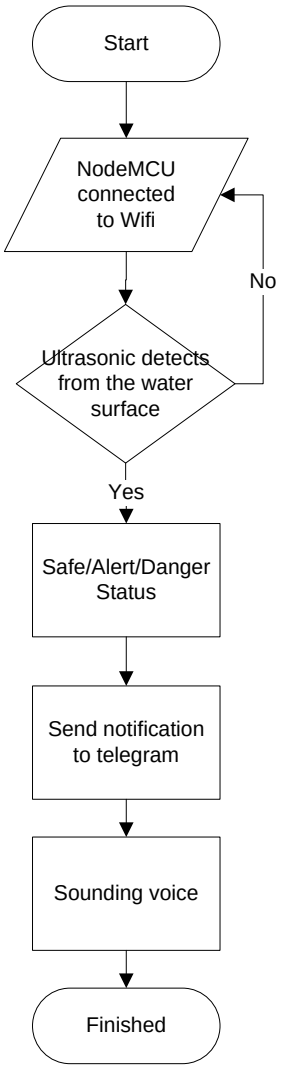

Figure 2. Flowchart Design

From Figure 2 above, it can be seen that when the system starts running, the NodeMCU is connected to WiFi or a network, and the ultrasonic sensor detects the water depth. If the water depth reaches the limit, it will send a telegram notification with a safe and alert danger status and will emit a sound output.

Overall Circuit

The overall circuit of the Flood Detection Tool Using Ultrasonic Sensors Based on Telegram and Sound can be seen in Figure 3.

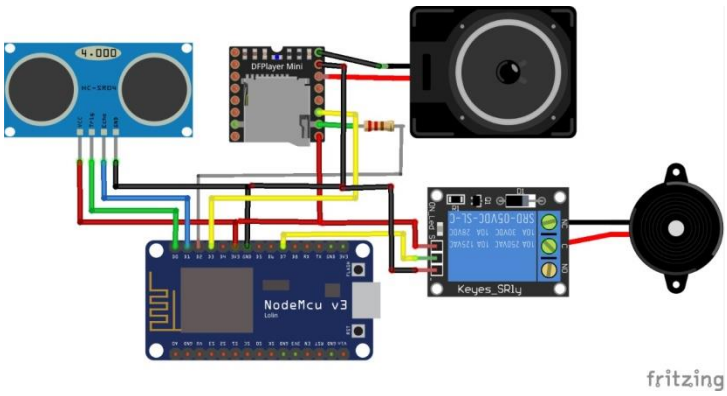

Figure 3. Overall series of tools

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Where all components are interconnected with each other, the Ultrasonic Sensor functions as a detector of water depth in rivers that are potentially flooded, the water depth detected is 1 meter normal, then the distance of the sensor from the water surface is 3 meters, the water depth is 2 meters, then the distance of the sensor surface from the water surface is 2 meters, then the alert status, notification is sent to telegram and the siren sounds, the depth of dangerous water is 3 meters, then the distance of the sensor from the water surface is 1 meter, then the danger status, there will be a notification to telegram and the siren sounds.

RESULT

Krueng Kluet River, where all components are interconnected with each other, Ultrasonic Sensor functions as a detector of water depth in rivers that are potentially flooded, the water depth detected is 1 meter normal then the distance of the sensor from the water surface is 3 meters, the water depth is 2 meters then the distance of the sensor surface from the water surface is 2 meters then the alert status, notification is sent to telegram and the siren sounds, the depth of dangerous water is 3 meters then the distance of the sensor from the water surface is 1 meter then the danger status, then there will be a notification to telegram and the siren sounds.

Figure 4. Overall Flood Detector Circuit

Telegram App View

Figure 5. Telegram Application Display

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Where telegram functions as a notification sent from NodeMCU when Ultrasonic detects water, which is about detecting the distance from the sensor to the water surface.

Testing Procedure

After the system is finished, it is necessary to test the Flood Detection Tool Using Ultrasonic Sensors Based on Telegram and Sound. Where this Ultrasonic Sensor is used as a detector of water depth to provide notifications to telegrams and sounds, here the author made it by taking 10 data points in sequence.

Table 2. Test Results

Testing	Water level	Status			Report	
		Safe	Alert	Danger	Telegram	Voice
1	1 Meter	✓				
2	2 Meter		✓		✓	✓
3	2 Meter		✓		✓	✓
4	3 Meter			✓	×	✓
5	1 Meter	✓			✓	
6	2 Meter		✓		✓	✓
7	1 Meter	✓			✓	
8	3 Meter			✓	✓	✓
9	1 Meter	✓			✓	
10	3 Meter			✓	✓	✓

Based on the results of testing flood detection devices using telegram-based ultrasonic sensors and sound that have been tested 10 times, the experiment was conducted in the Krueng Kluet river, in this test 9 times it was successful and 1 time it was an error, the experiment failed to send notifications to telegram because of the network, the notification will be sent back if the network has improved. The 9th experiment was successful, which was detected to a depth of 1 meter, with a sensor distance from the water surface of 3 meters. It is said to be safe, but there is no notification because the telegram and siren do not sound.

The water depth is 2 meters, then the sensor distance from the water surface of 2 meters is said to be alert, then the flood detector provides notification to Telegram via the Telegram bot, and the siren sounds. The water depth is 3 meters, the sensor distance from the water surface of 1 meter is said to be alert, then the flood detector provides notification to telegram via the telegram bot and the siren sounds, from all tests can be seen in table 2.

DISCUSSION

Of the 30 people/communities who have been interviewed, 10 people said that a water depth of 1 meter means the status is safe, a water depth of 1.5 meters is called alert because their houses are close to the river, and a water depth of 2 meters is called dangerous because it has flowed into residential areas, 15 people said a water height of 1 meter is called alert status, a water depth of 2 meters is considered alert status because if the water depth is 2 meters and the rain has not stopped, it will cause the depth to increase if the water depth is 3 meters, then it has flowed into residential areas, then the status is dangerous.

Four people said that the water depth of 1.5 meters is safe, the water depth of 2.5 is called alert because it is far from the river flow, if the water depth is 4 meters then it is said to be dangerous because the water has started to flow into the community settlement and there is 1 person who said that if there is wind from the south then there will be a flood even though there is no heavy rain if the wind is strong from the south then there will be a big flood and the water depth usually reaches 4/5 meters and in the community settlement it has reached 2 meters of water depth.

The BPBD Service said that the water is said to be safe, where the water that flows does not overflow into the community settlement. No matter how deep the water is, if it does not flow into the community settlement, then the status is considered safe. What is said to be alert is water that flows beyond the dam limit on the edge of the river; what is said to be dangerous is water that has flowed into the community settlement, which has harmed the community, damaged household equipment, and swept away household equipment.

CONCLUSION

Based on the testing of flood detection devices using telegram-based ultrasonic sensors and sound that have been tested 10 times, the experiment was carried out in the Geulumbuk river, in this test 10 times 9 times were successful and 1 time error, the experiment failed to send notifications to telegram because of the network, the notification will be sent back if the network has improved. The experiment that was successful 9 times, which was detected to a depth of 1 meter, with a sensor distance from the water surface of 3 meters, it is said to be safe, there is no notification because the telegram and siren do not sound, the water depth is 2 meters, the sensor distance from the water surface is 2 meters is

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said to be alert, then the flood detection device provides notification to telegram via the telegram bot and the siren sounds.

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