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Sea Surface Monitoring System as a Support for Mitigation of ROB Using Wemos D1 Microcontroller Based on Internet of Things

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ABSTRACT

Rob is a flood disaster that is generally caused by the flow of strong water that rises to a lower land. In other cases, the occurrence of tides is due to the meeting of tides with the flow of the river so that the overflow of water into the mainland. Therefore, to support the mitigation of tidal disasters, researchers took the initiative to design a water level monitoring tool to provide early warning information about tidal disasters in real time. The design of the tool uses an ultrasonic sensor and a Wemos D1 R1 microcontroller as a prototype of sea water level detection devices, then sensor data will be sent to thingspeak to be monitored in real time so as to produce output in the form of warning notifications via telegram on smartphones and social media information on Twitter and Facebook. The results of testing the system and tools are able to work as expected. When the sensor reads the water level between 26 <35cm it will be alerted to a telegram alert with a delivery time of 17 seconds, and the system will automatically post warning information via Facebook with a duration of 10 seconds and Twitter for 13 seconds. However, if the water level is <25cm, the hazard notification will appear continuously every 16 seconds by telegram. The results of testing the sensor data accuracy there is a difference of an average error value of 3.68cm with an error percentage of 7.7%.

1. Introduction

Flooding in the Greater Jakarta area from 2019 to early 2020 was a major disaster that occurred throughout the history of flooding in Jakarta. This flood is thought to originate from extreme weather and a drainage system that is not working optimally resulting in flooding in Jakarta being increasingly frequent, especially in North and West Jakarta. Rob disaster is a flood caused by the strong flow of water that rises ashore. In general, an event like this when the land of an area is lower than sea level [1]. In other cases, the occurrence of rob due to the meeting of tides and river flow has resulted in the retention of the river flow so that it overflowed, the embankment burst and inundated the land area. All mitigation efforts are carried out by the government starting from building infrastructure such as talud, dykes, drainage system and water pump. Besides that, the role of information technology as supporting rob mitigation is urgently needed as an early warning. Some related research, for example research conducted by Ade Bastian, Development of Prototype Monitoring System for Water Levels for Early Warning uses Arduino uno with LCD viewer, alarm warning in the form of speaker and there is no IOT control that can be accessed by the public [2]. There is also research by Umar Katu with the title Tidal Sea Water Measurement Monitoring System using Arduino Atmega328P with LCD viewer as a warning output and cannot be monitored by many people [3]. In other related research conducted by Arta Mariana Sihite who designed the Sea Water Wave Height Monitoring System on a Web-Based Port using Arduino uno with the Wifi module communication system (ESP8266) with a web-based viewer and LCD but there is no warning system and cannot be monitored by the public [4]. Then there is also a study conducted by Nugroho Agus Sugandi entitled Prototype Early Warning System and Seawater Height Monitoring using Arduino nano and GSM module modems that function as warners via cellular phones but cannot be monitored by many people [5]. Judging from some previous studies,

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This study aims to provide information on sea level data by utilizing the thingspeak platform and early warning using telegram platforms, Twitter and Facebook so that people are aware of the dangers of a sea flood disaster so as to reduce the impact of losses due to flooding.

2. Method

The steps carried out in this study, namely the study of literature, the formulation of problems, design tools, system design, and testing of tools and systems.

2.1. Literature Study and Problem Formulation

The activities carried out in this study began with a literature study and problem formulation and how to solve it. After the study of literature and the formulation of the problem is done, then prepare and design the tool.

2.2. Tool Design

At the design stage the tool uses an HC-SR04 ultrasonic sensor which functions to detect water level distance and sea level activity. The sensor will be connected to the Wemos D1 microcontroller which acts later as a server, the device circuit schema as shown in Figure 1.

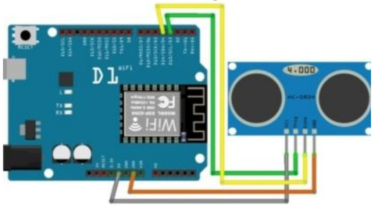

Fig 1. Tool set

Furthermore, sensor data will be sent to the thingspeak platform as a web data logger application and with the help of a widget application on a smartphone so that the height and activity of sea level can be monitored in realtime. In the notification notification system using the IFTTT platform as a trigger if the value of the thingspeak data logger reaches a certain condition, the IFTTT will automatically give a warning in the form of a notification on the smartphone. Block diagram The design of the tool can be seen in Figure 2.

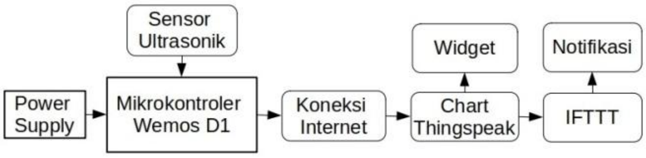

Fig 2. Block Diagram

2.3. System planning

In Figure 3 explains about the workings of the system that is ultrasonic sensor has the duty to detect the distance of the object as a gauge of sea level. Furthermore, sensor data will be stored on the microcontroller and then sent to thingspeak so that it can be monitored. If the water level exceeds the predetermined threshold, the system will send a notification notification via telegram on the smartphone. In addition, everyone can also check the status of the water level through the smartphone widget in realtime as long as the user is connected to the internet. As for the water level used, the alert and danger that will be notified via telegram as an early warning.

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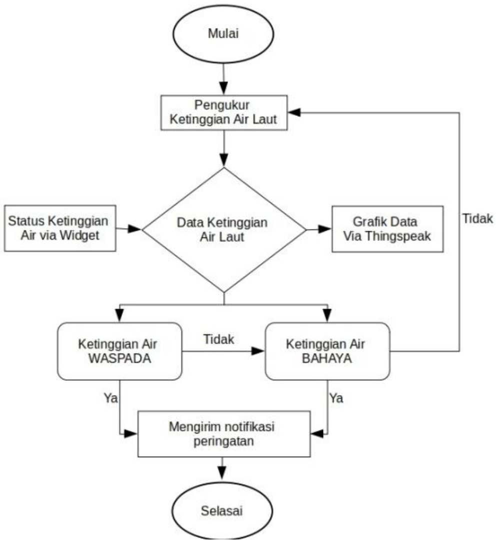

Fig 3. Program Flowchart

On the other hand, the design of the system will automatically post to social media Twitter and Facebook. In Figure 4 is a flow notification system diagram with a combination of Thingspeak and IFTTT that communicate with each other through the internet using the http protocol.

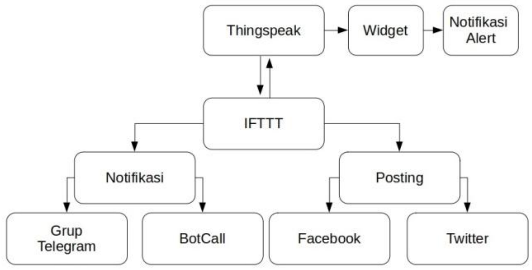

Fig 4. Notification System Flowchart

3. Results and Discussion

3.1. Testing Tools and Systems

Testing of tools and systems aims to determine the performance of the device designed. The test scenario in this study uses a container filled with water by providing a wave effect on water and increasing the volume of water so that it can monitor the performance of the tool in detecting water surface objects. The container used in this scenario has a length of 50cm and a width of 30cm. The functional components used are contained in table 1.

Table 1

Functional component

No	COMPONENT	Function
1	Wemos D1 R1	Controller board to be programmed
2	Ultrasonic HC-SR04	Distance or object detection
3	Thingspeak	Chart platform and data logger
4	IFTTT	Automation of notification system
5	Telegram	Alert notification application
6	Facebook Twitter	Mass warning information
7	Widget	Smartphone chart application

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Fig 4. Prototype tool

Figure 4 is an ultrasonic sensor that detects the surface of water which is directly processed by the microcontroller wemos, then the sensor output in the form of a data logger is sent to the thingspeak server to be processed in the form of charts or graphs. The results of ultrasonic sensor readings in the form of thingspeak charts can be seen in Figure 5

Fig 5. Realtime Chart Thingspeak

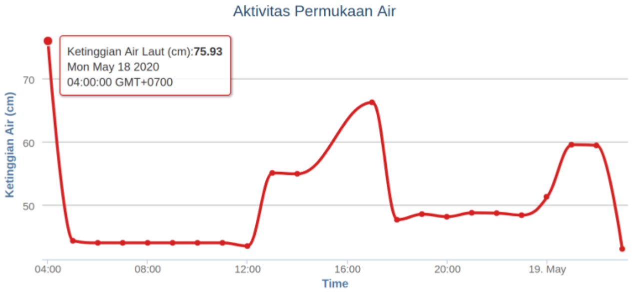

Fig 6. Chart per 1 day

In Figure 6 is the chart data recorded by the sensor for one day with an hourly time span.

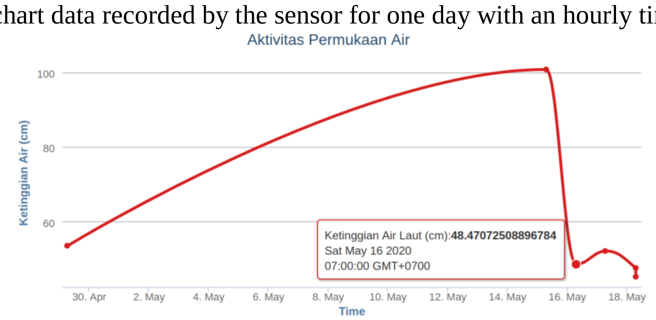

Fig 7. Chart Per Weekly

Figure 7 is the result of recording sensor readings on a weekly basis with a time span per day.

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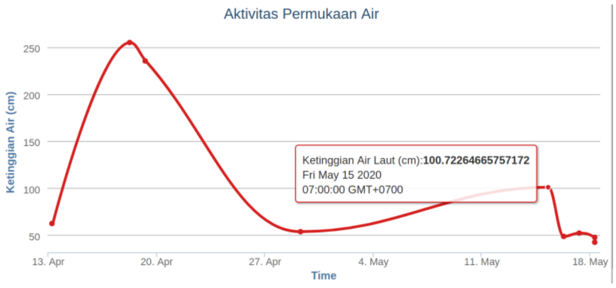

Fig 8. Chart per 1 Month

In Figure 8 a history of sensor readings recorded for one month in the span of every day.

On the thingspeak data chart here, everyone can see and monitor surface water activity in the form of more interactive data charts. To access it, the user must download the Thingspeak Monitor Widget application on the smartphone after that inputting the Channel ID in the application as shown in Figure 9 and Figure 10.

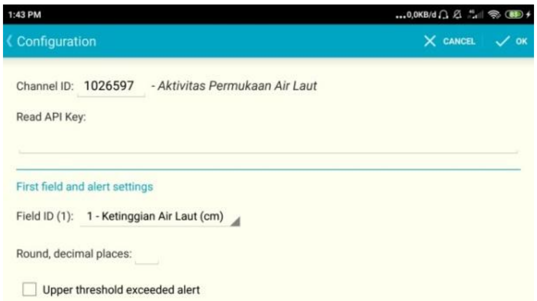

Fig 9. Input Channel ID

Fig 10. Monitoring Widget

The monitoring widget in Figure 10 is an android application for monitoring water levels with the latest data updates every 15 seconds. This really helps the user to get the latest height data without having to access charts on thingspeak.

3.2. Testing the IFTTT Notification System

IFTTT stands for If This Then That, is a platform that combines several internet services into one so that manual work can be automated. The IFTTT automation system functions to provide alert notifications and post to social media. Some of the IFTTT automation services used in this study are Telegram, BotCall, Twitter and Facebook. In table 2 is a guide to the water level that will be notified on the user's smartphone.

Table 2

Water level notification

No	Notification	Distance (cm)
1	Alert Telegram	26 <35
2	Danger Telegram	<25
3	Danger BotCall	<12
4	Facebook posts	<35
5	Twitter post	<35

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Fig 11. Telegram Notification

In Figure 11 there are two warning notifications via telegram, namely alert and danger. Twice alert notification will appear when the water level is between 26cm to 35cm. Meanwhile, if the water level is below 25cm a hazard warning will appear continuously.

Fig 12. BotCall Notifications

BotCall Notification is a telephone call system using the telegram bot service with voice call output. This system works if the water level has reached a height of <12cm then it will automatically get a telephone call notification with the voice output "Evacuate Immediately".

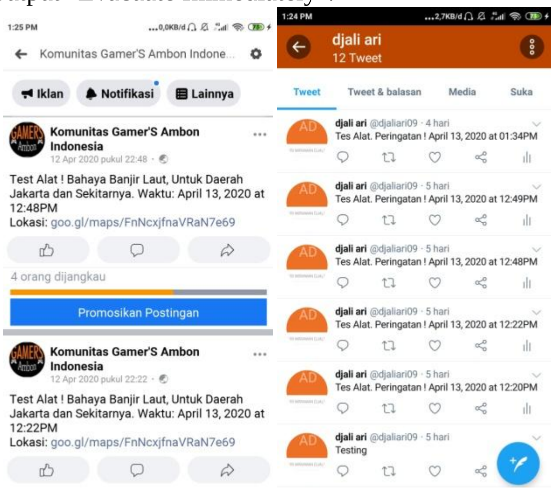

Fig 13. Twitter and Facebook posts

Twitter and Facebook posts in Figure 13 are a means to provide mass warning information through social media.

3.3. Delivery Duration Testing

This test is carried out to validate the microcontroller sensor data with the results received by the IoT platform with a specific time record so that it can know the performance of the device.

Table 3.
Duration of Delivery to the Thingspeak Chart

No	Tool Distance (cm)	Distance Thingspeak (cm)	Delivery Time (s)
1	11.83	11.83	16
2	18.10	18.10	16
3	31.50	31.50	16
4	38.64	38.64	15
5	43.43	43.43	17

Table 3 is the test results when the sensor detects an object with a certain distance with the delivery time from the device to the thingspeak platform requiring a duration of more than 15 seconds by default. Fast or slow delivery duration is very dependent on the speed of the internet connection used.

Table 4
Duration of shipment to Telegram

No.	Notification	Distance (cm)	Delivery Time (s)
1	Alert	32.19	17
2	Danger	22.86	18
3	BotCall	10.84	13

Based on table 4 that the alert system at a distance of 32.19cm requires about 17 seconds of delivery time while the hazard notification system at a distance of 22.86cm takes 16 seconds. In addition, the BotCall notification system at a distance of 10.84cm takes 13 seconds.

Table 5
Duration shipping to Twitter and Facebook

No.	Post	Distance (cm)	Delivery Time (s)
1	Facebook	32.19	10
2	Twitter	32.19	13

Table 5 explains that posting to Facebook takes about 10 seconds to send with sensor detection at a distance of 32.19cm. While on Twitter posts with sensor detection at a distance of 32.19cm requires a delivery time of about 13 seconds.

3.4. Ultrasonic Sensor Testing

This test is carried out to determine the accuracy of the ultrasonic sensor by comparing the ruler instrument as an actual measuring tool. The distance between the sensor and the bar will be compared in order to get the actual data by calculating each percentage of the error value and the error value. The results of testing the accuracy of the tool can be seen in table 6.

Table 6
Tool Accuracy Testing

No.	Distance bar (cm)	Distance Sensor (cm)	Error Difference (cm)	Percentage Error (%)
1	12	11.50	0.5	4.1
2	20	18.90	1.1	5.5
3	25	23.66	1.34	5.3
4	30	28.22	1.78	6.2
5	35	32.98	2.02	5.7
6	40	38.59	1.41	3.5
7	45	42.55	2.45	5.4
8	50	47.84	2.16	4.3
9	55	52.29	2.71	4.9

No.	Distance bar (cm)	Distance Sensor (cm)	Error Difference (cm)	Percentage Error (%)
10	60	57.47	2.53	4.2
11	100	96.26	3.74	3.7
12	150	139.12	10.88	7.2
13	200	184.69	15.31	7.6
Average error value			3.68	7.7

In table 6 a comparison of the actual distance between the ultrasonic sensor and the measuring rod using 13 test samples produces an average error difference of 3.68cm and an error percentage of 7.7%. The effective distance sensor in detecting the water surface is located at a distance of 12cm to 60cm. While at a water surface distance above 100cm the sensor's performance starts to be less effective as in the 150cm crossbar measurement sample which has a large enough difference of 10.88cm. This explains that, the farther the detection distance of the sensor in detecting water surface will affect the effectiveness of sensor performance. In addition there are several factors that affect sensor performance such as environmental conditions and electricity.

4. Conclusion

Based on the results of testing the tools and systems, the researchers drew the conclusion that the sea surface monitoring system using the IOT-based d1 microcontroller was working as expected. The prototype tool is capable of detecting water levels and directly sending data loggers to the thingspeak platform and presented in the form of data charts. Notification system that is designed using the IFTTT service is able to provide an early warning if the water level has reached a predetermined threshold via telegram and social media posts on Twitter and Facebook. The accuracy of the data with the difference in the value of an average error of 3.68cm with a percentage of errors of 7.7%.

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