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Water Level Monitoring and Flood Early Warning Using Microcontroller With IoT Based Ultrasonic Sensor

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ABSTRACT

In recent years, floods Often result in material, financial and even loss of life. The absence of an early warning system when floods occur makes people less aware of the occurrence of floods. In this study, Researchers designed a flood detection system that works automatically to monitor water levels and send an early flood warnings. This water level monitoring system uses the nodemcu esp8266 with ultrasonic sensors and based on IOT to provide real-time the data to find out the water level created at Certain levels. This system is connected online that displays real-time water level data on the thingspeak platform and is integrated with the telegram application as a flood early warning. The results of the test of this system design have accuracy of ultrasonic sensors on the which produce an average error rate of 0.78% and an average error of 1 cm.

1. Introduction

The floods still continue to occur in Indonesia, especially Jakarta. The floods caused by the overflow of river water to the mainland. Many of the impacts of flooding not only material losses, and even fatalities. Effects of flooding can be reduced if the public can monitor real-time water level and the flood early warning so that people can be aware before the floods came.

In a previous study conducted by Akhiruddin designing water level monitoring system using a microcontroller Arduino Nano and Ultrasonic sensor output Thingspeak platform as an information medium water levels [4]. Then there is also research conducted by Gilang Bramantio Elvan Suryatno designing water level monitoring system using a microcontroller Wemos D1 and Ultrasonic sensor output Telegram platform as an information medium water levels [5]. In the other study, which is still associated performed by research by Riny Sulistyowati, Hari Agus Sujono, and Ahmad Khamdi Musthofa designing the system monitors the water level using a microcontroller 8535 and sensors Ultrasonic with output SMS as an early warning, Warning light as a medium of information with lights, Buzer to output danger,

Thus viewed from a previous study, thingspeak platform as water level monitoring information in realtime and telegram platform as an early warning of flooding is very effective in order to display the information in real time and quickly.

This study aims to provide information in real-time water level data using the platform thingspeak and flood early warning platform using telegram to alert people of the danger of floods so as to reduce the impact of losses due to flooding.

2. Research methods

The design tool is divided into two stages, the design stage and the stage of making a block diagram of a software system. The system uses a microcontroller and output information nodemcu water level that can be viewed in real time on the platform thingspeak and flood early warning

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platform using telegram. Ultrasonic sensor that is connected to the microcontroller nodemcu as water level gauge proximity sensor which is then processed by a microcontroller, then microcontroller sends level data via wifi connected to the internet to thingspeak platform and telegrams. The design of the block diagram is shown in Figure 1.

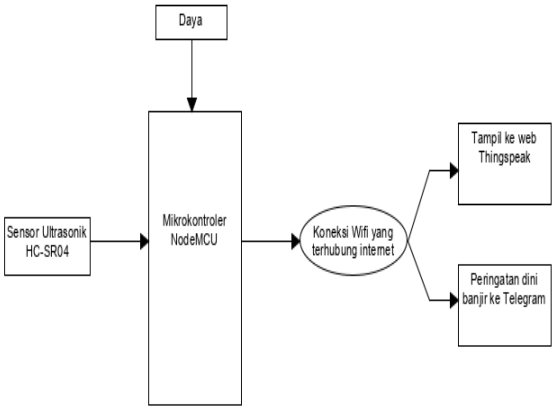

Fig 1, block Diagram

A. Ultrasonic sensors

HC-SR04 ultrasonic sensor has a 4 pin, namely pin Vcc, Gnd, Trigger, and Echo. Vcc pin for positive electricity and Gnd pin as groundingnya [4]. While the Trigger pin D4 is connected to the microcontroller to transmit signals from the sensors and Echo pin D3 is connected to the microcontroller as a catcher signals reflected from the object. This sensor has a range that can detect objects up to 400 cm. Here is a HC-SR04 ultrasonic sensor in Figure 1.

Fig 2, Ultrasonic sensors

B. Microcontroller NodeMCU ESP8266

NodeMCU is a microcontroller used in this study to process commands are planted through the Arduino software. NodeMCU suitable for IOT-based projects because there is wifi ESP8266 embedded in this microcontroller. Here is a sensor NodeMcu in Figure 3.

Fig 3, Microcontroller NodeMCU ESP8266

C. Telegram

Telegram Applications used in this study to send a flood early warning messages. This application is used for the many users and has features that simplify use telegram bot chat bot.

Telegram app is suitable for early warning of flooding because there are bots that can be set in realtime chat and fast. Users can also communicate with the bot telegram to determine the water level by typing the word "check" on the bot telegram.

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D. Thingspeak

ThingSpeak is an open source platform that is used for this study to receive data from the water level and the tool displays information level data in realtime. Thingspeak feature also allows for logging, social network status updates, and location tracking, and others.

Thingspeak display data in realtime useful for displaying information in real-time water level data and information can be shared in order to be seen by everyone.

E. System planning

Prototype-based monitoring water levels this Internet of Things to form a system that can be accessed anywhere as long as there is an internet connection. This system d uses ultrasonic sensors to measure the water level. Level data which will be sent to the server get Thingspeak using wifi modules are connected to the Internet. Level data can be viewed in realtime memalui thingspeak platform. If the elevation data as the state where the water level exceeds the height limit then there is a command for notification mengirimkankan hazard early warning flood level that is sent through the application telegram. As shown in Figure 4.

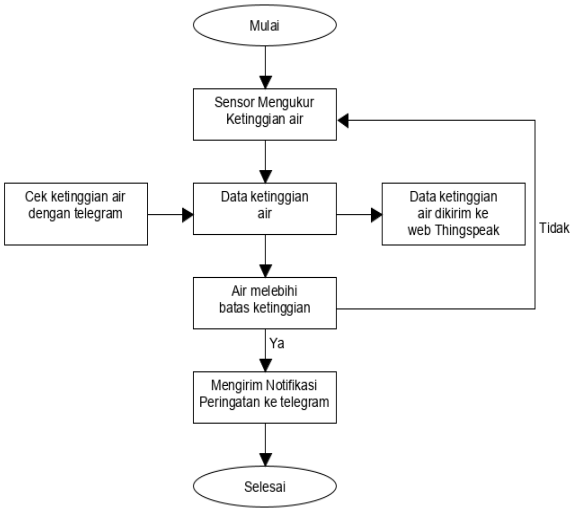

Fig 4, flowchart System

3. Results and Discussion

A. Results of testing tools and systems

In this test some components that are used bai konponen hardware and software, among others:

Table 1.
functional components

No.	Component	Function
1	Arduino Uno	To program the Board
2	NodeMCU	Board that is used to manage data
3	Ultrasonic sensors	detection distance
4	Thingspeak	Platform for displaying real-time data
5	Telegram	Platform for sending notifications

The circuit schematic prototype hardware used to connect components that Utrasonik sensor that reads the data and microcontroller processes the data and follow-up data as in Figure 5. And the physical circuit prototype is the result of a series of schemes that are implemented into a prototype as in Figure 6.

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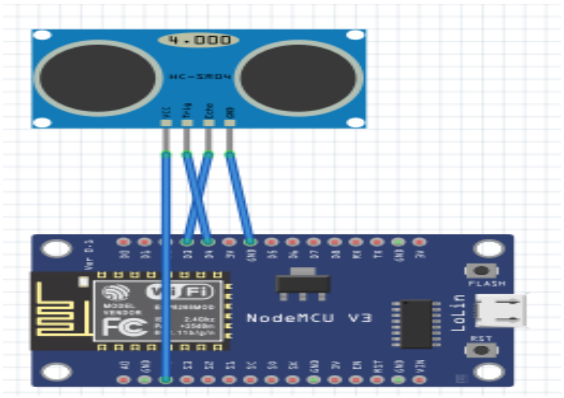

Fig 5, Prototype circuit

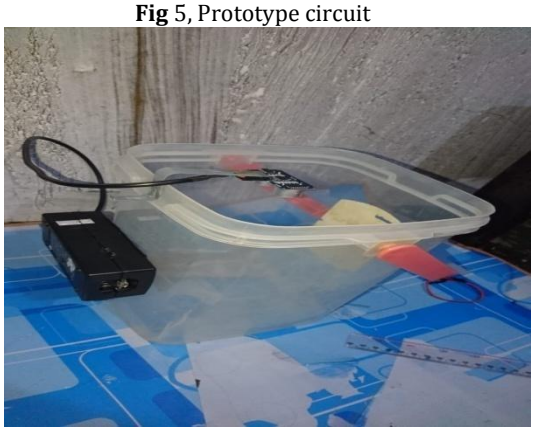

Fig 6, Physical circuit Prototype

Ultrasonic sensor detects the water level, and the results of sensor readings will be processed in the microcontroller. The water level is above the minimum then mokrokontroler will proceed to send a notification via telegram bot application with id that is already registered in the program with the message "standby status" as 1x. If the water level below the maximum limit then mokrokontroler will proceed to send a notification via telegram bot application with the message "alert status" as much as 5x. Guidelines for water levels can be seen in Table 1. At the same time water level data also send data to the web Thingspeak and can be viewed on the web Thingspeak. Level data in Thingspeak updates every 15 second. The water level can be viewed in real time on a PC or handpone. As shown in Figure 7.

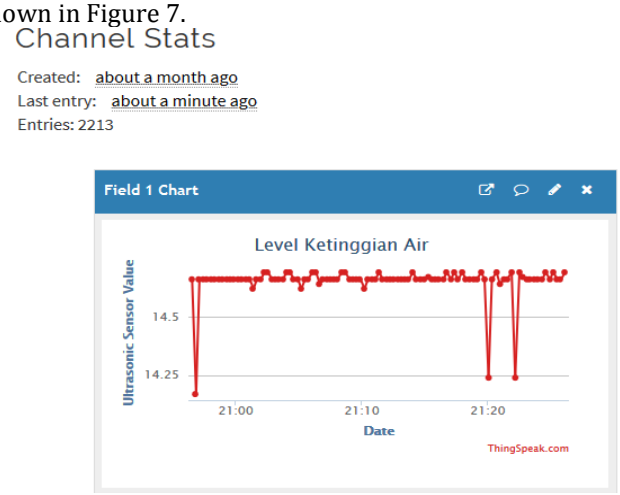

Fig 7, Web View Thingspeak

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Users also Dapa see level data via telegram by typing the word "check" on the bot telegram, nodemcu will process the data and altitude data telegram is sent via bot. As shown in Figure 8.

Fig 8, The Early Warning Alert Telegram

Here are guidelines for water levels in Table 1.

Table 1,
Guidelines Water Level Height

No.	level	Distance	Warning
1	Secure	Distance> 12	-
2	standby	6 <distance> 12	1
3	Look out	Distance <6	5

B. testing Systems

Testing Software on the tool consists of software mikrokomtroler and Thingspeak platform for displaying information and platform level data as an early warning flood Telegram. The microcontroller software program contains a command to set the working tools. Whereas Thingspeak platform and platform validation Telegram load data received by mikrokonroler.

Analysis testing is done by matching performance with the results accepted mikorkontroler Tingspeak platform and the platform it can later be determined Telegram working tool effectively and efficiently. Data on Thingspeak Platform will be updated continuously every 15 second. For more details can be seen in Table 2 for Platform Thingspeak and Table 3 for the platform Telegram.

Table 2,
Data Testing Prototype and Thingspeak

No.	distance Prototype	Distance Platforms IOT (ThingSpeak)	The delivery time (s)
1	24.31	24.31	1
2	23.9	23.9	1
3	23.93	23.93	1

Table 3,
Data testing prototypes and Telegram

No.	distance Prototype	Distance Platforms IOT (Telegran)	The delivery time (s)
1	23	23	5
2	6	6	5
3	10	10	5

Performance testing validation data being sent can be seen in Table 3. Based on the results of Table 3 it can be seen that the tool can work efficiently as it should. With delivery time of 1 second for Thingspeak platform and 5 seconds for the Telegram.

Table 4,
Testing system performance

No.	Distance (cm)	Warning notifications to the	notifications are

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		Telegram	received
1	4	Danger Warning Status	5
2	6	Danger Warning Status	5
3	8	Status Alert	1
4	10	Status Alert	1
5	11	Status Alert	1

Testing the performance of the system can be seen in Table 4. Based on the above it can be seen that the prototype can work properly in accordance with the guidelines for water levels in Table 1.

C. Accuracy Testing Tool

Testing the accuracy of the tool by using a series that has been assembled as in figure 5. The purpose of this test is to determine the prototype instrument capable of providing distance data is actual or not. Tests carried out dengam comparison between the data within the sensor with a ruler instrument that has been measured to see the difference in distance from each other. Results of testing the accuracy can be seen in Table 5.

Table 5,
Testing Accuracy of Data

No.	Distance Measurement Sensor (cm)	Actual Distance Measurement (cm)	Error (cm)	Relative error (%)
1	25.59	26	0.41	1.5
2	50.98	51	0.02	0.03
3	76.31	78	1.69	0.89
4	102.5	104	1.5	1.44
5	128.50	130	1.5	1.15
6	155.5	156	0.5	0.32
7	179.53	182	2.47	1.35
8	207.59	208	0.41	0.19
9	233.5	234	0.5	0.21
Average			1	0.78

For the analysis of data on testing of the accuracy of the data shows the distance that was obtained ultrasonic sensors there are differences with the actual distance. Data results can be seen average error of 1 cm and 0.78%, it can be concluded that the measurement error is very small ultrasonic sensors.

In this test distances above 233 cm always generate measurable value in 1200 cm. With this value can be concluded within 233cm is the limit or beyond the reach of the ultrasonic sensors. There are several factors that affect the performance of the sensor and the environment ultrasonikseperti electricity.

4. Conclusion

Based on the results of the study, researchers gave the conclusion that this tool works well to generate output information level data and flood early warning. Information thingspeak water level using a platform that can be seen by the public in real time early warning and notification platform using a wire in anticipation of the impending flood dangers. Ultrasonic sensors used can work well with the accuracy of data to the error value average error of 1 cm and the relative error was 0.78%.

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