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Design a Flood Detection Device Using Virtuino-based HC-SR04 Sensor

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ABSTRACT:
The flood detection tool uses the HC-SR04 sensor made specifically to detect the water level in the river. This tool is a series of simple tools that utilize the esp32 microcontroller and media monitoring in real time via a smartphone. The flood detection tool using the HC-SR04 sensor consists of a tool frame made of iron, the HC-SR04 sensor and a panel box. The main power source for this tool is a 12 V 5 Ah battery that comes from a 50wp solar panel. This tool is equipped with various electronic components including an LCD, HC-SR04 sensor, relay and stepdown module. The designed tool will be placed on the riverbank, the HC-SR04 sensor acts as a real time measure of water level. When the sensor has detected a predetermined water level, the sensor will send data to the microcontroller. The microcontroller will process the data and send it to the virtuino application which will display it virtually on the smartphone. Along with this, the data will also be displayed on the LCD.

KEYWORDS: Flood Detection, Virtuino, HC-SR04, Sensor, Microcontroller.

1. INTRODUCTION

Floods are disasters that often occur in the territory of Indonesia. Disasters caused by hydrometeorological factors always increase every year. Although sometimes not causing many casualties, this disaster still damages infrastructure and disrupts the economic stability of the community significantly [1] Flooding is the overflow of river water due to water exceeding the river's holding capacity so that it overflows and inundates the plain or lower area around it. Floods, in fact, are a phenomenon of "ordinary" natural events that often occur and are faced by almost all countries in the world, including Indonesia. Because according to its nature, water will flow and look for lower places [2].

The factors causing drought and flooding as a whole are caused by rain, tree felling and blockage of water flow. Based on the rules of science on hydrology and watershed balance (DAS), floods and droughts are twin brothers whose emergence comes after the factors that cause drought exactly as the factors that cause floods. Both behave linearly-dependently, meaning that all factors that cause drought will roll around driving flooding. The more severe the drought, the more devastating the flood will follow and the opposite is true [3] Floods cannot be prevented, but can be controlled and reduced the impact of losses [4].

It can be said that smartphones and the internet sustained all human activities during this period. To overcome this problem, an early warning tool for flood disasters in rivers is needed equipped with water level conditions and monitoring via smartphones. The purpose of this study is to Design a Prototype Water Level Monitoring System as an Early Flood Detector Using Virtuino-Based HC-SR04 Ultrasonic Sensors, so that the community, especially officers,

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can monitor, monitor and get warnings of river or dam water level conditions online and in real time.

This research was conducted with a waterfall development method that began with a tool to monitor river water levels through the Telegram bot application with the black box testing method. This tool uses ESP32 as a microcontroller to coordinate system operation, HC-SR04 ultrasonic sensor as water level monitor, camera as live streaming video monitoring on rivers, and Telegram bot android application contains a menu of monitoring commands that have been downloaded and installed on the smartphone.

The results of this study, this tool can provide information in the form of water levels applied in the river. Users can request information about the condition of the river water level. The tool provides information via live streaming video that can be accessed over a local network, and automatically when river water exceeds the danger threshold.

2. RESEARCH METHODS

2.1. Block Diagram

Flood Detection Design Using HC-SR04 Sensor This virtuino-based has hardware that supports its operation. Here is Fig. 1 of the block diagram:

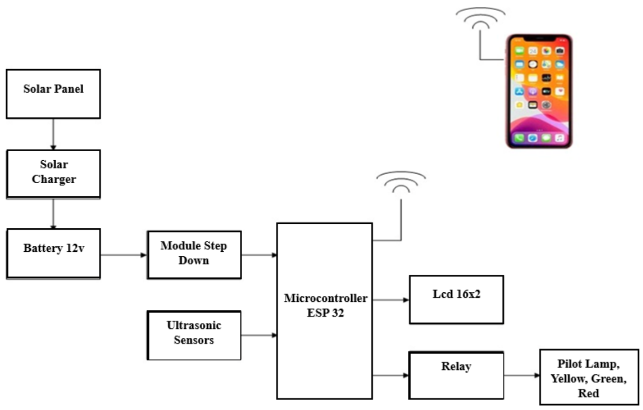

Fig. 1. Block Diagram

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2.2. Research Stages

At this stage the author makes an overall flow chart that can make it easier to analyze and implement a design system that will be carried out. The following is the path of research:

a. Begin

To start a design, it is necessary to conduct a literature study related to what will be discussed so that it can be used as a guide or reference of the problems to be raised in the prototype of a flood detection device using a virtuino-based HC-SR04 sensor.

b. Hardware Design

At this stage, the author made a hardware design for flood detection using a virtuino-based HC-SR04 sensor.

c. Testing and data retrieval

At this stage the author conducted design testing with photovoltalk and took data on the voltage of solar panels, batteries and ultra sonic sensor testing.

d. Data processing

The data obtained is processed and analyzed to determine the parameters on a 50 wp solar panel, 5 Ah battery and ultra sonic sensor.

e. Conclusion drawing

Draw conclusions from the test results from the effect of temperature on solar panels, batteries and sensors

2.3. Tool Suite Design Scheme

Program design includes the stages of making programs using C ++ language through the Arduino ide application, designing electronic circuits and program loading processes.

Fig. 2. Tool Suite Design.

2.4. System Flowchart

The following is a flow chart in the design of flood detection equipment using a virtuino-based HC-SR04 sensor.

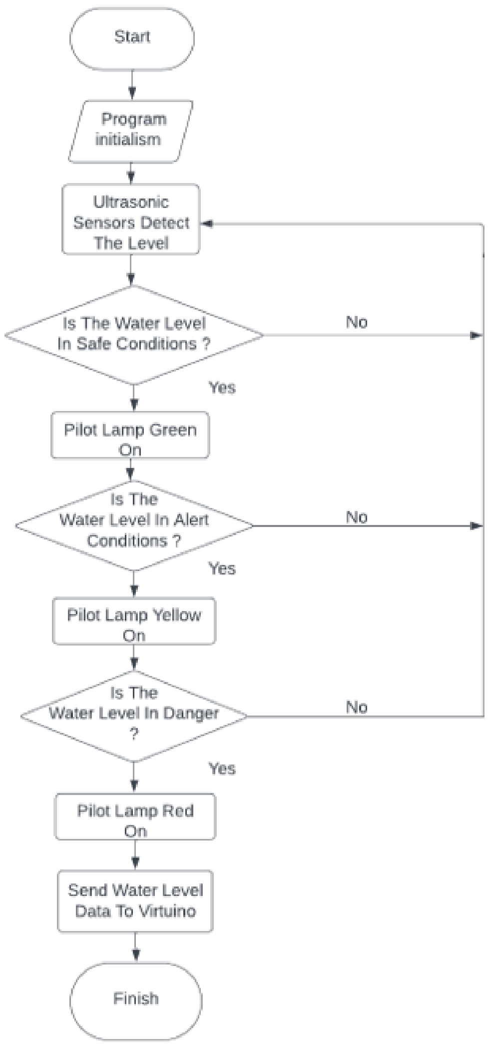

Fig. 3. System Flowchart.

3. RESULTS AND DISCUSSION

3.1. Design Results of Flood Detection Equipment

Flood detection tools using virtuino-based HC-SR04 sensors are made specifically to detect water levels. This tool is a simple tool that utilizes the esp32 microcontroller and real-time monitoring media via a smartphone. This virtuino-based flood detection tool using HC-SR04 sensors consists of a tool frame that is generally made of iron, HC-SR04 sensors, solar panels and box controllers. The main power source on the appliance comes from solar panels with a capacity of 50wp and is stored on a 12V 5ah battery. The results of the design of flood detection equipment using a virtuino-based HC-SR04 sensor can be seen in Fig. 4

Fig. 4. Real Design of flood detection tool using HC-SR04 sensor based on Virtuino.

The controller box is used as a container for a series of electronic components. The panel box used measures 35cm x 25cm. The panel box can be seen in Fig. 5.

Fig. 5. Control Tool Box Panel

Table 1. Working voltage of flood detection device components using virtuino-based HC-SR04 sensor.

Electronic Devices	Input Voltage
Solar Panel	50 WP
Stepdown module	12.30
Relay	5.07 V DC
LCD	5.10 V DC
Battery	12 V 5 Ah
Sensor HC-SR04	5.01 V

Based on Table 1, it is known that each electronic device is given according to the voltage on each electronic device given according to the voltage on the *sheet* tool of each electronic device

3.2. Overall Analysis

In making this tool, the microcontroller is the parent of the control system built, the microcontroller runs the tool or module in accordance with the program that has been given. The test carried out is an input processed by a microcontroller, resulting in an output that can operate other components according to their respective wishes and functions. The microcontroller is given a command (input) when the sensor used as a detector works as a process input, input data will be received by the microcontroller through data output from the sensor module used.

3.3. Solar Cell Voltage Testing

Table 2. Solar Cell Testing.

No	Hour	BMKG Data (Weather)	Solar Cell Voltage (Volts)
1	09:00	Overcast	19.73 V
2	10:00	Overcast	19.76 V
3	11:00	Overcast	19.83 V
4	12:00	Overcast	20.03 V
5	13:00	Overcast	21.13 V
6	14:00	Overcast	21.04 V
7	15:00	Overcast	20.81 V
8	16:00	Overcast	18.95 V

In solar cell testing of flood detection equipment using Esp32 as a microcontroller. Solar cell test results can be seen in table 2. The test results above are carried out per one hour, starting from 09:00 WIB in the morning to 16:00 WIB in the afternoon. Testing at hours (09:00 WIB sunny weather), (10:00 WIB sunny weather), (13:00 WIB sunny weather), (16:00 WIB cloudy weather), then the voltage values are (19.73 V), (19.76 V), (19.83 V), (20.03 V), (21.13 V), (21.04 V), (20.81),(18.95 V). Changes in the position or tilt of the solar cell when testing will affect the absorption of light. This is because the voltage value will change when there is a change in the intensity of sunlight. Thus, to get the optimal voltage, the determination of the solar cell is placed in an open area so that the solar cell is directly exposed to exposure to sunlight.

3.4. Ultrasonic Sensor Testing HC-SR04

Ultrasonic sensor testing aims to determine the minimum and maximum distances that can be measured by the HC-SR04 ultrasonic sensor. Tests on ultrasonic HC-SR04 were carried out by measuring the distance of the water level.

Table 3. Water Level Measurement Results and HC-SR04 Sensor.

No	Water Level	Actual Height	Distance Error
1	1 cm	1.2 cm	0.2 cm
2	5 cm	5.5 cm	0.5 cm
3	10 cm	11 cm	1 cm
4	15 cm	16.5 cm	1.5 cm
5	20 cm	20.2 cm	0.2 cm
6	25 cm	25.8 cm	0.8 cm
7	30 cm	31.1 cm	1.1 cm
8	35 cm	36.4 cm	1.4 cm
9	40 cm	42.3 cm	2.3 cm
10	45 cm	46.5 cm	3.5 cm
11	50 cm	52.3 cm	2.3 cm

Based on Table 4. The minimum distance measured 1 cm with the HC-SR04 sensor has an error, it can be concluded based on the results of sensor testing that the sensor can read close to the object can read the distance with the sensor, the greater there is an error in the HC-SR04 sensor.

3.5. Battery Charging Testing

Table 4. Battery Voltage.

No	Time (Minutes)	Voltage (Volts)
1	2	12,70
2	4	12,77
3	6	12,84
4	8	12,92
5	10	13
6	12	13,08
7	14	13,16
8	16	13,25
9	18	13,38
10	20	13,55

From the load results above, it can be seen that the test is carried out every 2 minutes so that data is obtained, namely at 2 minutes produces a voltage of 12.70 volts, the battery is charged by 10%, at 10 minutes produces a voltage of 13 volts, the battery is 50% drained, and within 20 minutes, the battery produces 13.35 volts with the battery charged 100%. Based on the test results of battery charging under normal conditions.

3.6. Water Level Testing with Software

Table 5. Water Level Testing and Virtuino App Notifications.

No	Water Level	Virtuino App Data (Status)
1	1 cm	1.4 cm
2	5 cm	5.5 cm
3	10 cm	10.6 cm
4	15 cm	15.6 cm
5	20 cm	20.2 cm
6	25 cm	25.8 cm
7	30 cm	30.1 cm
8	35 cm	35.4 cm
9	40 cm	41.3 cm
10	45 cm	46.2 cm
11	50 cm	50.3 cm

Table 5 shows that notifications in the virtuino application display different values because the HC-SR04 sensor has an error. The farther the object is from the sensor, the greater the error value sent to the virtuino application.

Table 6. Data Testing on the Thing Speak App.

No	Water Level	Things Speak App Data (Status)
1	1 cm	1.4 cm
2	5 cm	5.5 cm
3	10 cm	10.6 cm
4	15 cm	15.6 cm
5	20 cm	20.2 cm
6	25 cm	25.8 cm
7	30 cm	30.1 cm
8	35 cm	35.4 cm
9	40 cm	41.3 cm
10	45 cm	46.2 cm
11	50 cm	50.3 cm

Table 6 shows the results of testing data on the ThingSpeak application showing the same results as on the virtuino application. This is because the data received by the virtuino application is obtained from database submissions by the ThingSpeak application.

4. CONCLUSION

From this study, the author can draw several conclusions, including:

1. The results of experiments that have been carried out prove that the flood detection system is able to run well.
2. The flood detection system is able to work at any time according to the water level detected by the HC-SR04 sensor and can transmit data and can monitor previous water level data with ThingSpeak.
3. Solar panels used as a source are able to charge well, only take 20 minutes and are also able to charge the 12 V 5 Ah battery properly. This is because the greater the capacity value on the panel, the faster the charging time on the battery.

Data Availability. Data underlying the results presented in this paper are available from the corresponding author upon reasonable request.

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Ethics. The authors declare that the present research work has fulfilled all relevant ethical guidelines required by COPE.

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