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PROTOTYPE OF FLOOD EARLY WARNING SYSTEM AS A DISASTER PREPAREDNESS AND RESPONSE EFFORT

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Abstract

This prototype will be designed in a simple way but can provide information to the surrounding community about the water level with signals in the form of lights and alarm sounds, easy to use and can be installed in areas that are very prone to flooding. This prototype is equipped with ultrasonic multi sensors, namely ambient temperature and humidity sensors by HDT11, and HC-SR04 sensor for water level sensors, flood alert sensors. In addition, this prototype also has an OLED screen so that water level information can be directly seen on the screen. The ultrasonic sensor emits sound waves and waits for the return wave travel time, calculating the water height in cm. The reading of the temperature and humidity values by the DHT11 sensor, writing the height of the puddle on the OLED screen, checking the condition if the water exceeds a certain height, the buzzer (alarm) sounds and the warning LED light will light up.

Keywords: Prototype, Early Warning System, flood

INTRODUCTION

The city of Pontianak is located in a lowland with an average altitude ranging from 0.1 meters to 1.50 meters above sea water level (SWL). Pontianak City is a tropical area with temperatures ranging from 22.4 0C - 36.4 0C, with high humidity and rainfall, namely rainfall >3000 mm/year. The biophysical condition of the area is topography with a relatively flat slope, the soil type consists of alluvial and peat. This is what causes the city of Pontianak to frequently flood or inundate. The right solution and serious efforts in dealing with the flood problem will certainly increase the sense of security in the community both in the flooded area. The solutions that have been taken so far are more focused on post-flood control techniques, so they are not effective for prevention efforts. One of the efforts to facilitate flood monitoring in an area is to provide information on flood-prone areas and equip it with flood early warning tools.

Although a map of the flood hazard level is available, so far the City of Pontianak does not yet have a tool that can provide warnings to the public or related parties, so it is planned to find a solution to overcome it, namely by designing and creating tools that are useful as an early warning system. The main problem that will be studied in depth in this research is how to design and make a tool that functions as an early flood warning that is in accordance with local wisdom of the local area and can be installed later in locations very prone to flooding.

Based on these problems, the purpose of this research is to design and manufacture an early warning system that is in accordance with flood conditions in Pontianak City or in accordance with local wisdom of the local area. This research is useful as a flood disaster mitigation effort in Pontianak City, so it is hoped that it can provide information quickly and emergency response to the community and related parties, so as to minimize losses due to flooding.

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MATERIALS AND METHOD

Retrieval and collection of primary data and secondary data is the initial stage of this research. The primary data includes data on the existing physical condition of the local area where floods frequently occur. Furthermore, the collection of material requirements used as a tool design. Hardware: a prototype of this flood hazard early warning system, it requires some hardware (hardware) both microcontroller and other electronic components such as breadboard, ESP8266 d1 mini board, PAM840 Stereo Power Amplifier, MP3 player Module Mp3-TF-16P, Board Hub08-v2+ mp3, Led HPL Red, speakers. The HCSR-04 sensor is used to measure the water level and also as a reference for indicators of the flood hazard early warning system.

In order for the flood hazard early warning tool to function, it is necessary to pay attention to the hardware and software, because the microcontroller will not work as expected without program instructions that are entered into the microcontroller so that this microcontroller can carry out its function, namely controlling or regulating the running of the entire system of the device. Early warning of flood hazard. Software: The software used to process ESP8266 microcontroller data uses the Arduino IDE. Hardware Design: The design and manufacture of a flood Early Warning system tool is made in the form of a functional block diagram.

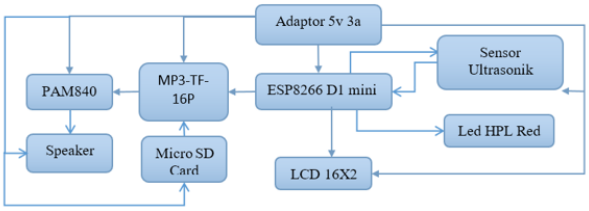

Figure 1: Functional Block Diagram of a Flood Early Warning System Prototype

1. Adapter 5v 3a, functions as a converter of alternating electric current (AC) to direct electric current (DC), the adapter is also a resource for all system components. It is the adapter that supplies 7-9 Volts of electrical power for the Arduino Microcontroller.
2. Esp8266 D1 mini is an electronic board with a minimum system that already has an ESP8266 microcontroller. This microcontroller functions as a controller and data processing.
3. PAM840 is a stereo power amplifier that functions as a sound amplifier to the speakers.
4. The Speaker Functions to Eject the Sound produced by the Mp3 Player Module. The speaker is used as a marker when the water level has reached the maximum limit. LCD is used as to display information in the form of water level in real time.
5. MP3-TF-16P is an Mp3 Player Module that functions to play songs / sounds in mp3 format.
6. Micro SD Card is a memory card that functions to store song / sound data in mp3 format.
7. LCD 16x2 Is a Liquid Crystal Display which functions to display the results of measurement data / information that is processed by the microcontroller.

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8. HC-SR04 Ultrasonic Sensor Is a sensor that can be used to measure distances. This sensor will be used to measure the water level
9. Led HPL Red is a Light Emitting Diode (LED) which can emit monochromatic light rays when a voltage is applied. This LED will be used as an alarm light for flood hazard status with the water level in standby status.

Based on the block diagram above, there are main system parts consisting of the ESP8266 Microcontroller, HC-SR04 Ultrasonic sensor, 16x2 LCD, Mp3-TF-16P and HPL red LED. D1 mini is the minimum system circuit board of the ESP8266 microcontroller. The use of this circuit board is used to make it easier for us to embed program code in the machine. When writing program code, the Arduino IDE is used.

Water level measurement uses the HC-SR04 Ultrasonic sensor, where this sensor can measure distances by utilizing ultrasonic waves. The results of these measurements will be displayed using a 16x2 LCD module. This LCD module is connected to the microcontroller using the I2C display module. Using the I2C display module can be useful to save on pin usage because it only uses 2 communication pins, namely SDA and SCL.

This early warning system uses the mp3 module to sound a hazard alarm. The mp3 module used is the MP3-TF-16P module. This module requires a micro SD card as memory for storing alarm sounds to be loaded. The MP3-TF-16P module does not yet have a power amplifier, so it is necessary to add the PAM840 module as a stereo power amplifier module. Later this PAM840 module will be connected to a 3.5inch speaker. For the alarm light as a sign of danger, we will use 2 red HPL LED modules. To turn on this led module requires a current amplifier circuit. One of the circuits used is the BD139 transistor circuit as a switch.

Software Design: Calibration value and volume settings can be made by changing them via a smartphone. The smartphone will later be connected to the device via a WiFi connection. After connecting to the device, the web application can be opened by accessing the device's IP address (192.168.4.1) using a web browser.

Writing program code: Writing microcontroller programming and web page applications using the Arduino IDE (Integrated Development Environment) application. In making web applications, we use the ESP8266 Web Config library created by John Lassen. Writing programming is divided into two parts, the first is programming for hardware (hardware) and the second is programming page settings (software).

The next step is to combine or assemble all the components so that they become a complete circuit that functions as a prototype for the Flood Hazard Early Warning System (EWS). Then a prototyping evaluation is carried out, which is a test of early warning tools for flood hazards which includes hardware testing which includes sensor tests, displays, alarm or siren tests (speakers) and overall circuit tests. Testing the sensor works or not, by programming the microcontroller so that the HCSR-04 sensor provides water level information in real time (updated regularly) on the display. The value returned by the sensor changes according to the

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condition of the water level in the field, if the water decreases then the value decreases and vice versa.

Alarm testing is done by measuring the water level with a sensor, then one condition is taken if the water level reaches the maximum limit then the alarm speaker will turn on, if the water level is less than the maximum limit then the speaker is silent.

The final step is testing the readiness of the tool to be used in field conditions or real conditions so that the recommendations for the flood hazard early warning system (EWS) that have been tested are ready to be used.

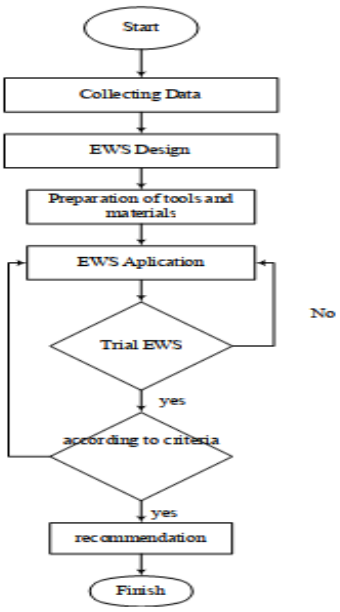

Figure 2: Research Method Flowchart

RESULT AND DISCUSSION

This prototype is equipped with ultrasonic multi sensors, namely ambient temperature and humidity sensors by HDT11, HC-SR04 sensor for water level sensors, flood alert sensors. In addition, this prototype also has an OLED screen so that water level information can be directly seen on the screen. The ultrasonic sensor emits sound waves and waits for the return wave travel time, calculating the water height in cm. The reading of the temperature and humidity values by the DHT11 sensor, writing the height of the puddle on the OLED screen, checking the condition if the water exceeds a certain height, the buzzer (alarm) sounds and the warning LED light will light up. The WIFI module posts the state of the device to the web.

A flood early warning prototype which is a tool for detecting flood inundation heights is very necessary in areas very prone to flood hazards. This is because this tool will provide information on the height of the inundation so that monitoring and rescue actions against valuables or livestock can be carried out before the water reaches a height at the alert limit. The

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existence of a prototype will facilitate the development of the tool so that it can be used in real field conditions, as a disaster emergency preparedness and response effort in a very flood-prone area, especially in Pontianak City.

CONCLUSION

This research can be used as a basic model for making a real early warning system (EWS) and made using the Internet of Things (IoT), so that it can be installed in all places that are very prone to flooding and can be monitored via gadgets.

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