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Monitoring River Water Levels to Complete Flood using Ultrasonic Sensors

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ABSTRACT
Most rivers in flood-prone areas often use manual methods to find out how much water is in the river by looking directly at the water surface, therefore sluice guards must be alert every time to avoid overflowing water in the river. The sluice gate is controlled by the officer in charge of keeping the water in the river stable, not less or not exceeding the specified limit. With this background, the tool is designed to monitor the water level in the river connected to the river using ultrasonic sensors which are processed using a microcontroller and a wifi network as a means of internet connection and monitoring media for the blynk platform interface. Which will continue to provide information and warnings to the operator if the water level reaches the normal limit through a warning on the blynk platform and will turn on the buzzer as a warning to the operator or user, so that with a tool designed in this study the water level can be known automatically. This tool can be made as an early warning of potential flood hazards in river areas. In other words, there will be effectiveness in the application of appropriate technology.

Keywords: *Ultrasonic, Buzzer, Led, Wemos D1 Mini*

INTRODUCTION
East Java is a province that can be said to be frequently hit by floods. Every year there are always floods in several districts in East Java. Flood is an event when water inundates an area that is usually not flooded within a certain distance. Floods usually occur because of continuous rainfall and result in overflow of river water. Because, the amount of water that exceeds the capacity of the water passenger media from the rainfall earlier (Sugianto *et al.*,2020).

Besides being caused by natural factors, namely high rainfall, floods also occur due to human activities. For example, reduced water catchment areas due to land use change, deforestation that increases erosion and shallows rivers, and irresponsible actors littering in rivers (Maulayya *et al.*, 2019).

Flood disasters are very local in nature, one area can be flooded and other areas are safe. Therefore, official flood information is usually from responsible regional institutions such as BPBD.

One of them happened in Darurejo village, Plandaan district, Jombang regency. In 2019 there was a flood disaster that submerged some of the residents' houses. So far, the apparatus and the people of Darurejo village are still using the manual method to find out the water level in the village. They control the water level by looking at the water meter that has been made previously. And they do not know when there is a sudden high water. Flood disaster is one of the focuses of attention, because it still causes a lot of losses and casualties. Floods can occur due to overflowing of water, therefore a tool is needed to detect the water level (Hariono & Widya, 2019).

Based on the problems above, a river water level monitoring tool is made. Making this tool aims to determine the real long distance water level and provide information about flood warnings. So this tool was made so that it could help the apparatus and the village community to find out the water level and provide information when the water level exceeds the predetermined one.

METHOD
The research method used in making this water level monitoring is the waterfall method. It is called a waterfall because the stages that are passed must wait for the completion of the previous stage and run sequentially, for example the design stage must wait for the completion of the previous stage, namely the requirements stage. The waterfall method provides a sequential or sequential software lifeflow

approach starting from analysis, design, coding, testing, and support stages. Here is a picture of the waterfall method:

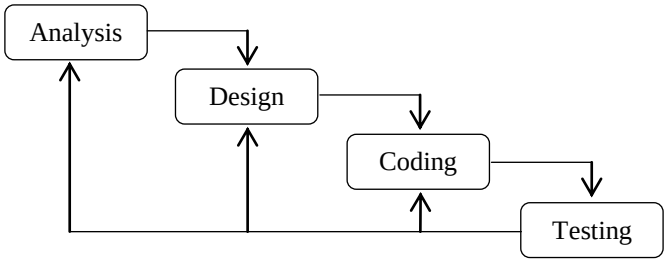

Figure 1 Waterfall Method

- Software requirements analysis
  The process of gathering requirements is carried out intensively to specify hardware requirements so that it can be understood what kind of hardware users need for this flood monitoring.
- Design
  Hardware design is a multi-step process that focuses on the design of a software program including data structures, software architecture, interface representations, and coding procedures. This stage translates software requirements from the requirements analysis stage to the design representation so that it can be implemented into a program at a later stage.

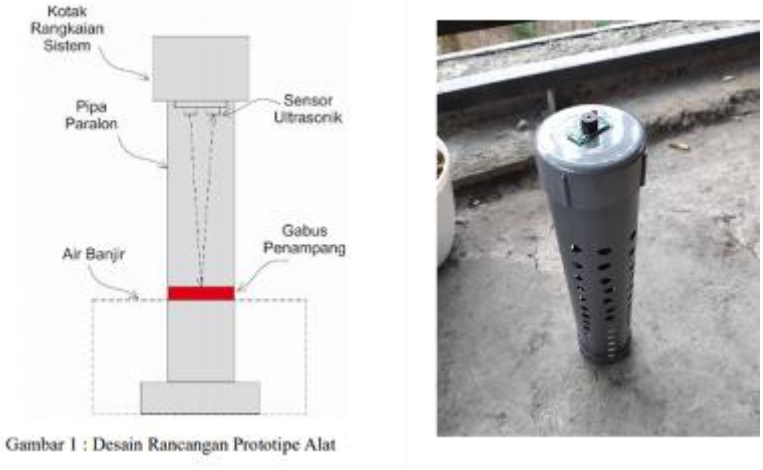

Figure 2 Flood tackling tools

- Program code generation
  The design must be translated into a software program. The result of this stage is a computer program in accordance with the design that has been made at the design stage. This stage is the determination of the command and output of an Arduino. At this stage the developers write the code that will be used in the project. This code is Arduino source.

```
ultrasonik_blynk_1
#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#define echoPin     D2 //Echo Pin
#define trigPin     D1 //Trigger Pin
#define ledNotif    D3 //LED Pin
#define buzzer      D5 //Buzzer Pin
#define ledNyala    D8

char auth[] = "Ka-9h7_9PyFW9v2LxEAGfDW-gqaDLec1";

char ssid[] = "vivo 1918";
char pass[] = "ardy1234";
//char ssid[] = "JOGRES KOPI";
//char pass[] = "kobarkan";

int maximumRange = 200; //kebutuhan akan maksimal range
int minimumRange = 00; //kebutuhan akan minimal range
long duration, distance; //waktu untuk kalkulasi jarak

void setup()
{
```

Figure 3 Programming code

Testing
Testing focuses on the software logically and functionally and ensures that all parts have been tested to minimize errors and the output must match. The selection of the test method is carried out using data that is often used for data processing, ranging from operational data, input and output data.

RESULT AND DISCUSSION

Result

The results of the assembly of the tool are placed on a pipa for the sensor is in the upper pipa which will read the water level that enters the pipa. And if the water level is below 20 cm, the Arduino will process the data and will turn on the buzzer and lights and will give a warning to the user in the blynk application. The results of assembling the tool can be seen in the image below.

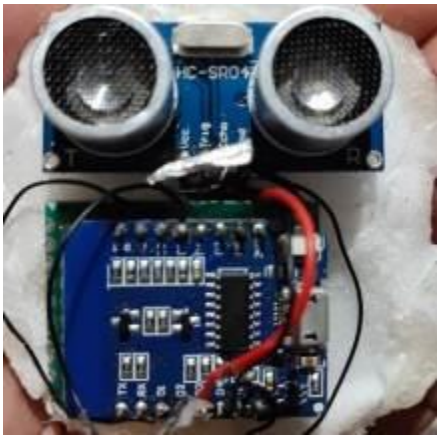

Figure 4 Assembly tool

- Wemos D1 Mini
  Wemos D1 which functions to process the output data on the HC-SR04 proximity sensor. Ultrasonic sensor (HC-SR04) which consists of 2 ultrasonic transducers, namely transmitter (sender) and receiver (receiver) with a measurement capability of 300 cm. The display used is a 0.91 Inch-I2C Interface OLED display which functions as a display of distance figures generated from the HC-SR04 ultrasonic sensor.
  The Wemos Microcontroller is a development microcontroller based on the ESP 8266 microcontroller module which has the ability to provide Wifi connectivity facilities easily and the memory used is

very large, namely 4 MB. The Wemos Microcontroller has 2 chipsets that are used as the working brain of the platform, namely the ESP8266 chipset and the CH340 chipset.(Hanif et al., 2018).
The design of the location of the ultrasonic sensor on the tube for measuring the water level placed on the water surface. The material used consists of a cylindrical tube, styrofoam for the water level to be measured and an ultrasonic sensor. The WEMOS D1 microcontroller processes the ECHO pin data on the HC-SR04 ultrasonic sensor which functions to detect the reflected ultrasonic signal (ECHO) whether it has been received or not. When the ultrasonic wave signal has not been received, the ECHO pin is logical (1) HIGH, while when the ultrasonic wave signal is received, the ECHO pin is logical (0) LOW. The trigger pin functions as a trigger for transmitting ultrasonic waves. With high or low logic, the HC-SR04 sensor will emit ultrasonic waves(Rianto & Kristiyono, 2020). Wemos D1 mini images can be seen in the image below.

Figure 5 Wemos D1 Mini

- Ultrasonic Sensors
  This sensor functions as a sender, receiver, and controller of ultrasonic waves. This tool can be used to measure the distance of objects from 2cm - 4m with an accuracy of 3mm. This tool has 4 pins, pins Vcc, Gnd, Trigger, and Echo. Pin Vcc for positive power and Gnd for ground. The Trigger pin is for triggering the output signal from the sensor and the Echo pin is for capturing the reflected signal from objects. How to use this tool: when we apply a positive voltage to the Trigger pin for 10uS, the sensor will send 8 steps of ultrasonic signal with a frequency of 40kHz. Next, the signal will be received on the Echo pin. To measure the distance of objects that reflect the signal, the difference in time when sending and receiving signals is used to determine the distance of the object (Suhaeb et al., 2019). An example of an ultrasonic image is shown in the image below.

Figure 6 Ultrasonic Sensors

- Blynk Application
  Blynk is a new platform that allows users to quickly build interfaces to control and monitor hardware projects from iOS and Android devices. The use of Blynk is basically to save time and cost in coding for making android applications supporting IoT, Blynk is a free application for enthusiasts and application developers to use. , although some are also available for commercial use.
  After downloading the Blynk app, we can create a project dashboard and arrange buttons, sliders, charts, and other widgets onto the screen. Using the widget, you can turn pins on and off or display data from sensors. Blynk is perfect for interfacing with simple projects like monitoring temperature or turning lights on and off remotely. Blynk is an Internet of Things (IoT) service designed to make remote control and sensor data read from Arduino or Esp8266 devices quickly and easily. Blynk is not just a "cloud IoT", but blynk is an end-to-end solution that saves time and resources when building meaningful applications for connected products and services. One problem that can cause problems for the uninitiated is coding and networking. Blynk aims to remove the need for very long coding, and make it easy to access our devices from anywhere via a smartphone.(Arafat, 2016)

Internet of Things (IoT) basically connects all devices to the internet, IoT is often called today's technology, namely technology that utilizes mini-sized computer devices and can be connected to a local network or internet, the devices used are designed to use small power so that the device only uses a small amount of power. can run simple commands, IoT has been widely applied to smart homes today, the device is managed using only certain tasks such as an embedded system to read data from sensors, IoT can also be used as an intermediary device between sensors and users and can also plays a role in controlling the actuator (Muzakky et al., 2018).

Figure 7 Blynk Application

- Buzzer
  Buzzer serves to convert electrical vibrations into sound vibrations. Basically the working principle of a buzzer is almost the same as a loud speaker, so the buzzer also consists of a coil attached to the diaphragm and then the coil is energized so that it becomes an electromagnet, the coil will be attracted in or out, depending on the direction of the current and the polarity of the magnet, because the coil mounted on the diaphragm, every movement of the coil will move the diaphragm back and forth so that the air vibrates which will produce sound(Nurdianto et al., 2018).

Figure 8 Buzzer

- LED Light
  LED-Based Smart Lamp with Multi Sensor is a lighting device that uses LED (Light Emitting Diode) as a light source and multi sensors as an auto switch and auto illumination. 50,000 hours is also more efficient than incandescent and self-ballasted lamps. In addition, LED lamps are also environmentally friendly because LED lamps do not contain mercury and produce lower CO2 emissions when compared to other conventional lamps.(Ade Ramdan, Dicky Rianto Prajitno, Herlan, 2013).

Figure 9 Led

Discussion

The ultrasonic sensor test results begin with the calibration process on the Arduino sketch. Then it will be managed and will produce a number in the form of cm distance. From the results of calculations made by Wemos, it will display the current water level and will be displayed in Blynk. If the water level is below 20 cm, the Arduino will turn on the buzzer and LED and will give a warning to the user. The results of

measuring the water level were tested 10 times and this trial compared the ruler with the ultrasonic sensor. For more details, see the test results below.

Table 1 Research table

No	Testing Result			Status
	Sensors	Ruler	Blynk	Buzzer
1	30 cm	30cm	30cm	OF
2	28 cm	28 cm	28 cm	OF
3	27 cm	27 cm	27 cm	OF
4	26 cm	26 cm	26 cm	OF
5	25 cm	25 cm	25 cm	OF
6	24 cm	24 cm	24 cm	OF
7	20 cm	20 cm	20 cm	OF
8	19 cm	19 cm	19 cm	ON
9	18 cm	18 cm	18 cm	ON
10	16 cm	16 cm	16 cm	ON

Figure 10. Testing of flood detectors

It can be seen from the test results above that in 3 tests with a ruler, sensor and blynk the same data was produced and there were no differences in the 3 tests. And on the status buzzer lights up smoothly according to the commands given by wemos D1.

CONCLUSION

Based on the results of research and testing that have been carried out, it can be concluded that a high and stable internet connection is needed so that nodemcu can connect to the server. From 10 times the research that has been done there is no error in the test. All tools that have been assembled run normally and without errors.

This tool is able to provide early warning when the river water level has exceeded the maximum limit specified. This tool can also send warnings in the form of messages to device gadgets and village communities using the blynk application.

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