

## DESIGN AND CONSTRUCTION OF A NATURAL DISASTER DETECTION EQUIPMENT USING THE WATER LEVEL SWITCH SENSOR AND SENSOR SW-420

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
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### ABSTRACT

Disasters such as earthquakes, tsunamis, floods and others always cause losses in the form of material, psychological can also cause casualties. To avoid the occurrence of greater losses, an early disaster warning and information system is needed to provide opportunities for self-rescue so that losses can be minimized. The basic concept of the Internet of Things (IoT) "wherever, whenever and however" and connected to the internet is very suitable when applied to detect and early warning of natural disasters. This tool will monitor the water level using a water level float sensor and detect vibrations with the SW-420 vibration sensor module. when the water exceeds the height of the water level sensor, the data will be processed by the Arduino programmed using the Arduino IDE then the data is sent to the NodeMCU 8266-12E to send data notifications to the user. The reading results can be seen on the Telegram smartphone application.

**Keyword :** Detection System, Early Warning, Natural Disaster, Internet of Things (IoT)

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## 1. INTRODUCTION

Nowadays, natural disasters such as floods, earthquakes and tsunamis are very prone to occur. The causes of natural disasters can occur anytime and anywhere. The occurrence of natural disasters can be caused by many factors, natural factors or human factors themselves. All the causes of these natural disasters can not be predicted in time and place. A place that should be safe from an earthquake can happen. Rapid technological developments encourage many parties to develop their own hardware technologies, many enthusiasts choose microcontrollers to be further developed to help facilitate human work.

In order to reduce material losses and loss of life caused by this natural disaster, an organization was formed to monitor and provide early warning in case of a natural disaster. However, in its operation, it turned out that this organization was hit by a relatively long delivery time and one of the factors for the delay was the way it was delivered via electronic media such as television or radio which was not appropriate when a natural disaster was taking place, sometimes the information provided late after a natural disaster occurs then a warning that in a certain area a natural disaster has occurred is then broadcast through the media.

## 2. RESEARCH METHOD

In designing a system, it is first planned by making a block diagram. Block diagram is a statement of sequential relationships of one or more components that have a unity where each component block affects other components. Block diagrams have a special meaning by providing information in them. For each block connected by a line that shows the direction of work of each block concerned. In the block diagram of the system there are several blocks, namely the input block (input), the control block (process) and the output block (output). The block diagram as a whole is shown in Figure 1

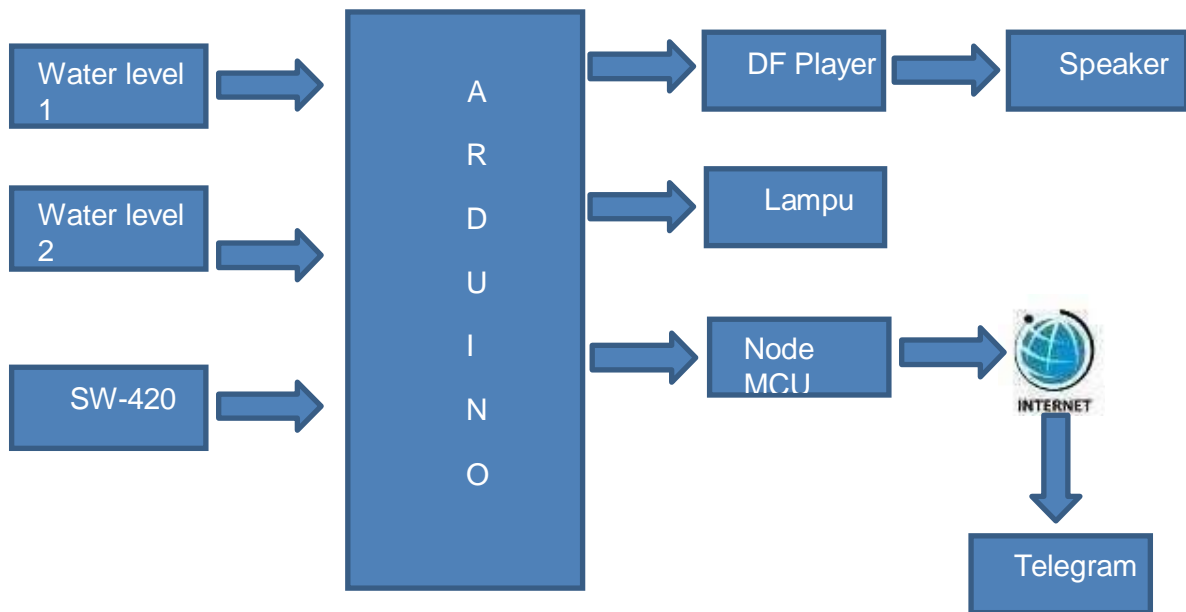


Figure 1 Overall Block Diagram

### Functions of Each Block Diagram

1. NodeMCU ESP8266-12E  
Get a supply voltage of 5V from the Adapter which is in charge of controlling the circuit and sending data to the computer.
2. Water Level Float Sensor Module as a water level detector.
3. SW-420 Vibration Sensor Module as a vibration detector
4. Arduino IDE Software as a microcontroller application programmer.
5. DF Player as an MP3 Player
6. Speaker
7. LED 3V as Indicator Light
8. Arduino as a microcontroller in the system which is the control center of all ongoing system work processes
9. Using the Telegram app Serves to display readings on the sensor

### Block Diagram Explanation

The 220V AC voltage flows to the 12V/1A Adapter. Then the voltage from the 12V/1A Adapter will be lowered by the LM2596 voltage reducer to 5 V, then this power will be channeled to the Arduino Uno so that it is active / ON.

When the Water Level switch sensor detects the water level past the specified point, the water level switch sensor will provide a voltage of 5V or logic 1 to the Arduino so that Arduino reads it as a command to the MCU Node to give notification via Telegram that a flood or tsunami has occurred.

When the SW-420 Sensor detects a vibration, the SW-420 sensor will provide a voltage of 5V or logic 1 to the Arduino so that Arduino reads it as a command to the MCU Node to provide notification via telegram that an earthquake or tsunami has occurred, when Arduino receives voltage from one of the one Sensor then the Indicator Light will go out, as well as the Df Player when the Arduino receives a voltage from one of the sensors then the Df Player will play the sound recording stored on the SD Card through the Speaker.

### Hardware Design (Hardware)

#### Arduino UNO circuit

Arduino is an open source single-board micro controller, derived from the Wiring platform, designed to facilitate the use of electronics in various fields. The hardware has an Atmel AVR processor and the software has its own programming language.

Arduino uses the ATmega microcontroller family released by Atmel as a base, but there are individuals/companies that make Arduino clones using other microcontrollers and remain compatible with Arduino at the hardware level. For flexibility, programs are loaded via the bootloader although there is an option to bypass the bootloader and use the downloader to program the microcontroller directly through the ISP port.

### Arduino Circuit to Sensor Water Level Switch

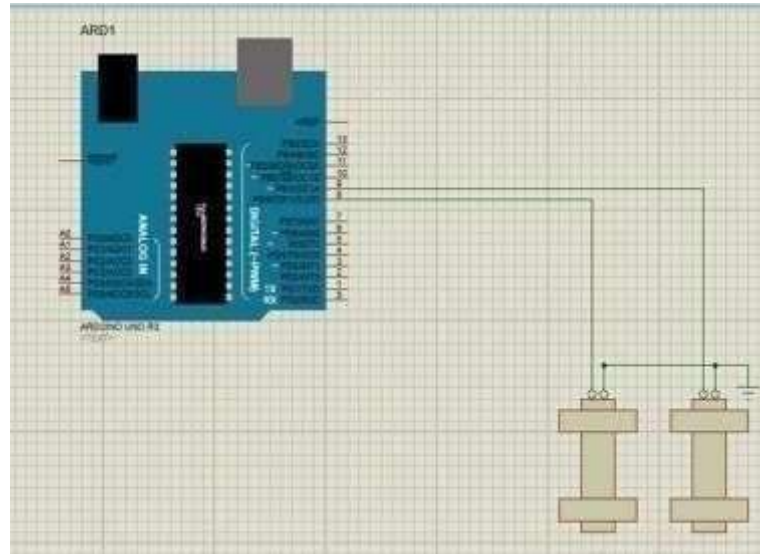


Figure 2 Arduino circuit to the Water Level Switch sensor

This circuit is for reading the water level. There are two water level switch sensors that are used, pin 2 of the sensor is the pin that will send data to the Arduino. Pin 2 of the first sensor is connected to pin 8 of Arduino, and pin 2 of the second sensor is connected to pin 9 of Arduino. Pin 1 of both sensors is connected to GND.

Table 1 Sensor Water Level Switch to Arduino

| No. | Sensor PIN | Connected to |
|-----|------------|--------------|
| 1   | 1          | 8            |
| 2   | 2          | 9            |
| 3   | GND        | GND          |

### Software Design (Software) Telegram Application Programming

Telegram is an application that has many features, one of the features of Telegram is the Telegram bot. Telegram bot can be used to make a command received from various microcontroller boards including nodemcu.

The telegram application has a telegram bot API feature that users can use as a tool to integrate telegram bots with nodemcu (mikroavr.com). Users can download the Telegram application for free on the Play Store.

After the user downloads the Telegram application, the next step is to log in to Telegram to be able to create a Telegram bot and enjoy the features in Telegram. After successfully logging into telegram, the next step is to create a telegram bot through the bot creator account that has been provided by telegram, namely @BotFather to get the API code that will be used to integrate the telegram bot with nodemcu which the user will use as a flood detection alarm. telegram bot can be seen in the following picture

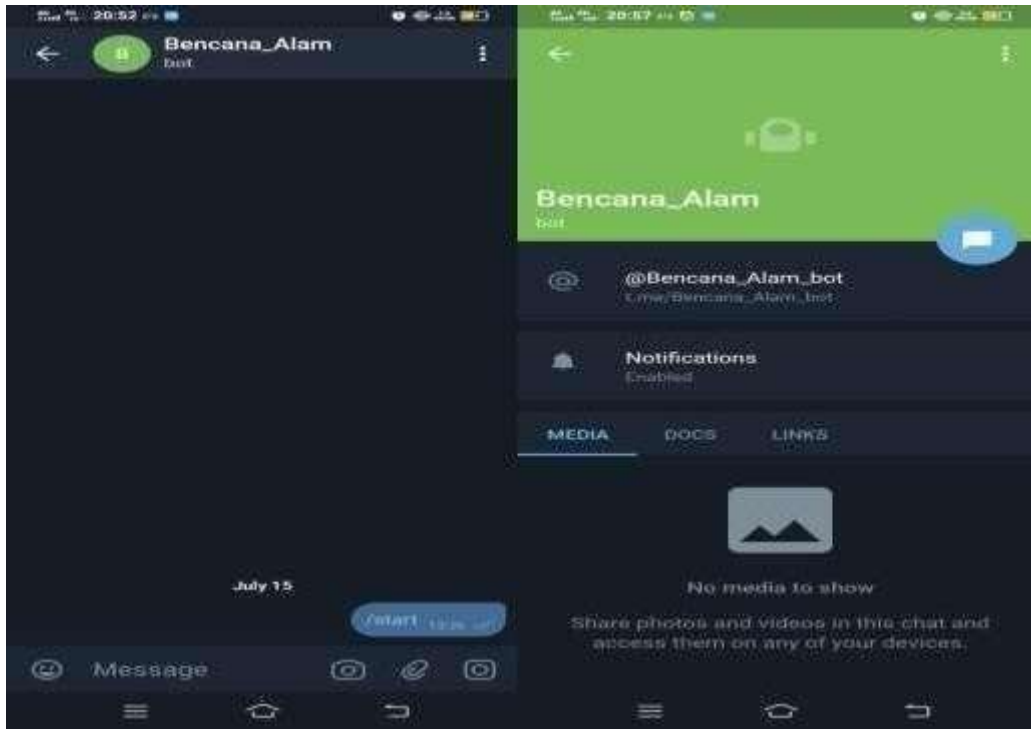


Figure 3 Bot Telegram

### 3.

## 4. RESULTS AND DISCUSSION

### Overall Testing Tool

The test results on the Design of a Natural Disaster Detection Tool Using a Water Level Switch Sensor and a SW-420 Sensor were carried out for the overall sensor monitoring process. The test consists of several stages and the analysis has been carried out.

### Functional Test Results

The results of the test are carried out to determine whether the designed system has worked well or not as expected. Tests are carried out on each main block on the system independently.

### Test Results on the Water Level Switch Sensor

The test is carried out by filling water in the cross section so that when the water reaches the height limit determined by the level sensor, the data will be processed by the Arduino programmed using the Arduino IDE, then the data is sent to the NodeMCU 8266-12E to send data notifications to the user. The reading results can be seen on the Telegram smartphone application.

The Water Level Switch sensor is an NC switch so when the water level switch sensor does not detect water then the sensor will logic 1 and when the sensor detects water the sensor will logic 0

Table 2 Test Results on the Water Level Switch Sensor

| No. | Water        | Output  | Indicator Light | Water Level |
|-----|--------------|---------|-----------------|-------------|
| 1.  | Detected     | Logic 0 | Off             | >2,5 cm     |
| 2.  | Not Detected | Logic 1 | On              | <2,5 cm     |

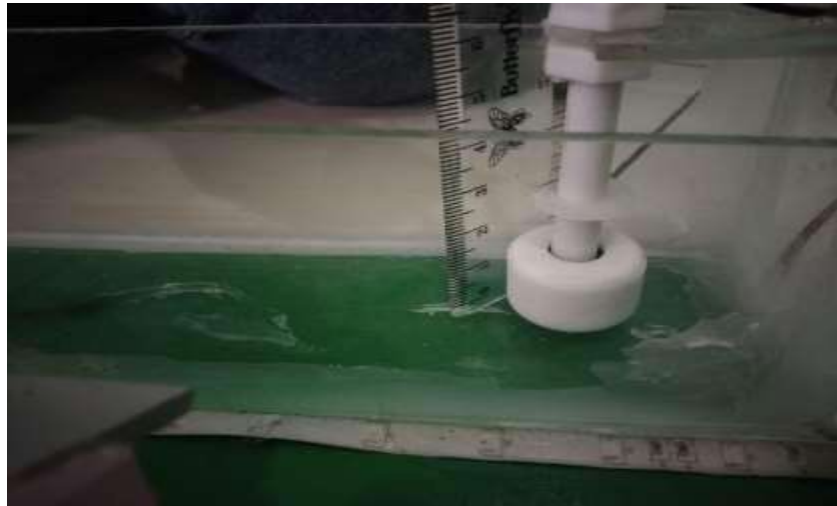


Figure 4 Sensor State When Not Detecting Water



Figure 5 Sensor State When Detecting Water

The test is carried out by connecting the multimeter positive cable to a 5 volt voltage and the negative cable connected to the water level switch sensor output and the test results obtained when the water level does not detect the presence of water then the resulting voltage is 5 volts. When it does not detect water, the resulting voltage is 0 volts. The measurements can be seen in the following picture



Figure 6 When the Water Level Switch Sensor Detects Water

#### SW-420 . Sensor Test Results

The test is carried out by measuring the voltage at the SW-420 output pin, the data will be processed by the Arduino programmed using the Arduino IDE then the data is sent to the NodeMCU 8266-12E to send data notifications to the user. The reading results can be seen on the Telegram smartphone application. The SW-420 sensor is a sensor whose working principle is Active Low when the SW-420 sensor detects vibration, the voltage generated at the output pin is 0 volts (GND) and vice versa when the SW-420 sensor does not detect vibration, the resulting voltage is 5 volts.

Table 3. SW-420 . Sensor Test Results

| No. | Getaran          | Output   | Lampu indikator |
|-----|------------------|----------|-----------------|
| 1   | Terdeteksi       | 0V (GND) | Padam           |
| 2   | Tidak Terdeteksi | 5V       | Menyala         |

The test is carried out by connecting the multimeter positive cable to a voltage of 5 volts and the negative cable connected to the SW420 sensor output and the test results obtained when the SW420 does not detect any vibration then the resulting voltage is 5 volts. When it does not detect a vibration, the resulting voltage is 0 volts. The measurements can be seen in the following picture



Figure 7 When the SW-420 Sensor Detects Vibration



Figure 8 When the SW-420 Sensor Does Not Detect Vibration

**DISCUSSION**

**Trial Discussion and Analysis**

Testing the NodeMCU ESP8266-12E aims to find out the program that has been made can run well. This test is done by entering the program on the Arduino IDE application into the NodeMCU ESP8266-12E. When the SW-420 detects a vibration, the data will be processed by the Arduino IDE programmed by the Arduino IDE then the data is sent to the NodeMCU 8266-12E to send data notifications to the user. Likewise with the Water Level Switch, when the sensor detects that the water level exceeds the specified limit, the data will be processed by the Arduino programmed by the Arduino IDE, then the data is sent to the NodeMCU 8266-12E to send notifications to the user. The reading results can be seen on the Telegram smartphone application.

Table 4 Sensor Test Results and Telegram Commands

| No | Sensor                          | Test result | Description   |
|----|---------------------------------|-------------|---|
| 1. | Sensor Water Level Switch PIN 8 |             | When PIN 8 gets a High value, NodeMCU will send a message to Telegram |

|           |  |   |  |
|-----------|--|---|--|
| <p>2.</p> | <p>Sensor Water Level Switch PIN 9</p> |   | <p>When PIN 9 gets a High value, NodeMCU will send a message to Telegram</p> |
| <p>3.</p> | <p>Sensor SW- 420 PIN 7</p>            |  | <p>When PIN 7 gets a High value, NodeMCU will send a message to Telegram</p> |

The source from PLN has a voltage of 220VAC, the voltage is lowered and rectified to a voltage of 12VDC.



## 5. CONCLUSION

From the tests carried out, the authors get the following conclusions:

1. The MCU Node Microcontroller can work in coordination with all connected devices.
2. The water level sensor can only detect if it is immersed in water, it cannot detect if it is only known to splash a drop of water.
3. Telegram messenger is responsive in the Internet Of Thing (IoT) system. Internet of thing (IoT)-based systems rely heavily on global telecommunications networks (internet). This detection tool cannot work if it is not connected to the internet network and also cannot send telegram messenger messages in real time if the internet connection is slow for fast and slow parameters on the Internet Of Thing (IoT) system.

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