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# IoT-based real-time flood warning system prototype and integrated WhatsApp message

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## Article Info

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**Abstract**
Indonesia is a tropical country that has two seasons, namely summer and rainy season. The weather in Indonesia is currently erratic, it is influenced by changes in extreme weather in the world. These extreme weather changes cause the public to be aware of disasters that can occur at any time. This change in weather triggers a prolonged rainy season or vice versa. During the legal season in Indonesia, many areas are affected by floods. Throughout 2021 BNPB recorded 1,298 flood disasters. When a flood disaster occurs, protection of houses is rarely carried out, this is due to the absence of early warning to the public, so that the occurrence of floods cannot be anticipated. Therefore, it is necessary to have an early warning system for flooding so that people can anticipate the situation. This flood warning system will work automatically periodically to find out the water level in the environment around the house. In this prototype the flood level monitoring system utilizes a water level sensor based on the nodemcu 8266 micro controller and a WhatsApp message as a notification to homeowners when the water level is at certain levels can anticipate flooding.

**Keywords:** Nodemcu 8266, flood, warning system, WhatsApp gateway, IoT

## 1. Introduction
Indonesia has high rainfall. In one year, the rainy season can last for four months. Development in urban areas is increasing, resulting in reduced water absorption areas [1]. Flood disasters are caused by static natural conditions, such as geography, topography and river flow geometry [2]. Or in other situations, flooding can occur due to dynamic natural events such as heavy rains, reduced water catchment areas, tidal water from the sea and siltation due to sedimentation [3]. The occurrence of flooding is triggered by high rainfall in a relatively long time. Indonesian areas often experience flooding when the rainy season arrives. When the flood conditions are high, it can even drown people's houses, this situation is very disruptive to activities. BNPB data shows, throughout 2021 there were 1,298 flood disasters recorded. When a flood occurs, protection of houses is rarely done. Moreover, there is no preparation in the face of flooding, in this case the community can experience losses such as goods being submerged in water, difficulty in accessing daily needs [4]. To prevent the magnitude of the impact of the problem from the occurrence of flooding, a prototype tool is designed that can monitor the water level to provide an indication of the occurrence of flooding in an area. This tool can read the water level using the water level sensor which will then send a WhatsApp message to the homeowner. With this tool, it is hoped that in the future the original form of the prototype of this tool can be made so that it can be used in the wider community, especially in areas that have the potential for flooding in every rainy season. In this study, researchers used a nodemcu esp 8266 microcontroller and a HW -038 water sensor. The HW-038 water sensor will read the water level, the data obtained from the sensor is then read by the nodemcu esp 8266, if the water level data exceeds the predetermined limit this tool will send a notification to the homeowner, so that the homeowner can anticipate flooding.

## 2. Methods
The development of this flood warning system utilizes IoT technology, where a series of tools used to detect water levels are connected to the internet [5] via a wifi network using the nodemcu esp8266 micro controller module which already has a wifi module [6].

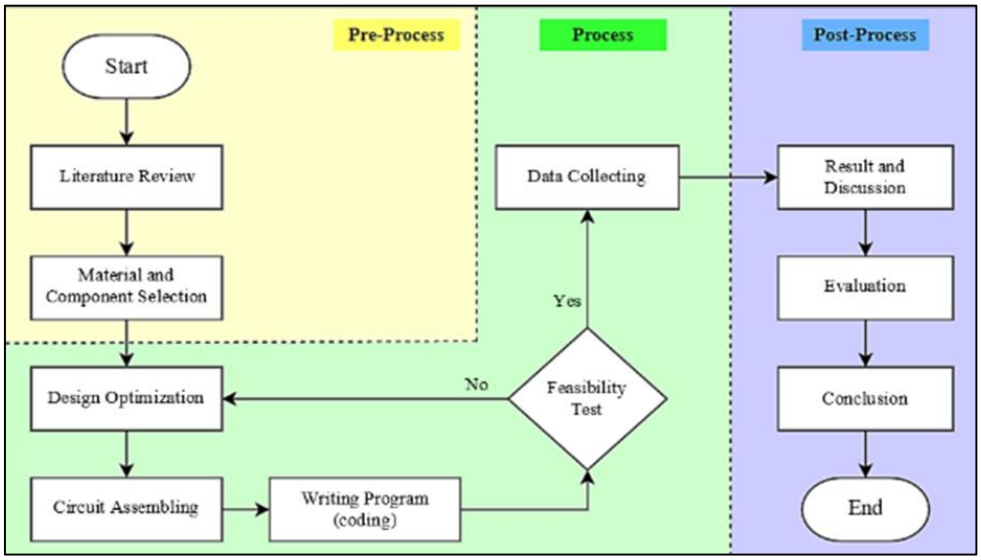


**Fig 1:** Research Workflow

The research methods used in this research are literature study, quantitative data analysis, and experimental observation using tools/tools as prototypes [7]. Quantitative data is obtained through testing tools and web servers in real time. Water level data collection is done by immersing the water sensor in a glass filled with water. The water level is calibrated according to the data that can be provided by the water sensor, namely 0 – 520 so that water level grouping is carried out to trigger information that will be given to homeowners. The design of the tool that has passed the testing phase is then analyzed and data collection is carried out. From these data the author can get an analysis to make conclusions about the prototype.

The main difference from the research conducted with previous research is the use of the WhatsApp messaging application as information sent to the homeowner, this message is sent from a web server that receives a request from nodemcu esp 8266 which gets data from the water sensor. This system consists of a web server, nodemcu esp 8266, water sensors and whatspp gateway which can then be output in the form of flood information sent via WhatsApp messages. Homeowners will get real-time information in the event of a flood disaster and the water level has passed the specified limit. The following is an explanation of some of the tools used in the system:

### a. Nodemcu ESP8266

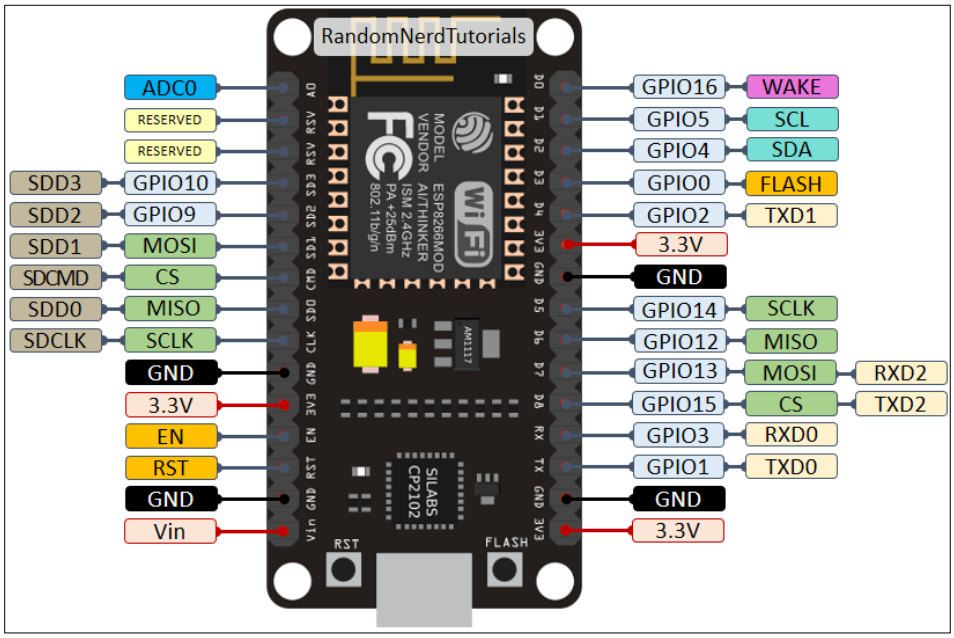


**Fig 2:** Node MCU ESP8266

The NodeMCU esp8266 microcontroller functions as the main component [8] which receives data information from the sensor and then sends it to the web server using the http request library. The microcontroller is also integrated with the ESP8266 chip, which is a chip that is able to communicate over a wifi network. The ESP8266 chip is used for microcontroller communication with the web server [9].

### b. Water Level Sensor

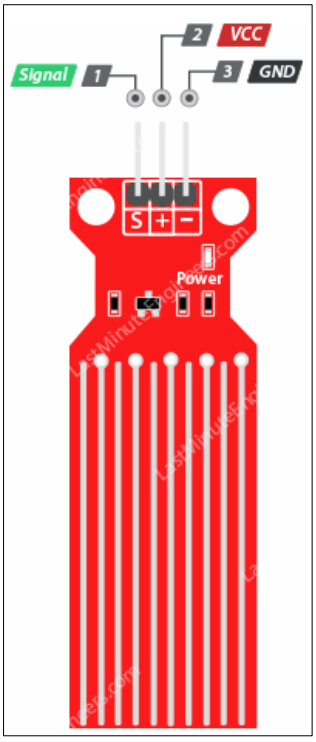


**Fig 3:** Water level Sensor HW-038

Water Level Sensor is a sensor used for water level. This sensor will read the water level according to the depth of the water that immersed the sensor. The water level generated from the sensor is as follows:

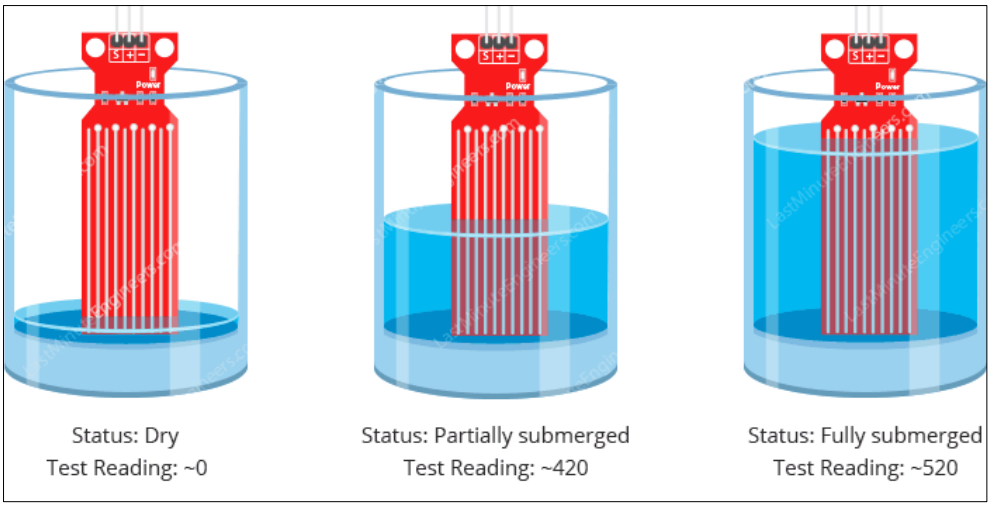


**Fig 4:** Water Level

In the figure above, the value that will be obtained from the water level sensor after calibration is when the sensor is dry it will be 0 and when partially submerged in water the value is ~420 and when fully submerged the value given is ~520 [10]. This value will be a reference when sending flood information messages via WhatsApp to homeowners.

### c. Web server

Web service is application logic that can be accessed and published using internet standards (TCP/IP, HTTP, Web). Webservice can be implemented in the internal environment (Intranet) for the need for integrity between application systems (EAI = Enterprise Application Integration) or in the external environment (Internet) to support business-to-business (e-business) applications [11]. In this study, the web server functions as a liaison between the nodeMCU esp8266 to be able to send information via the WhatsApp gateway which will then be sent to the homeowner's device.

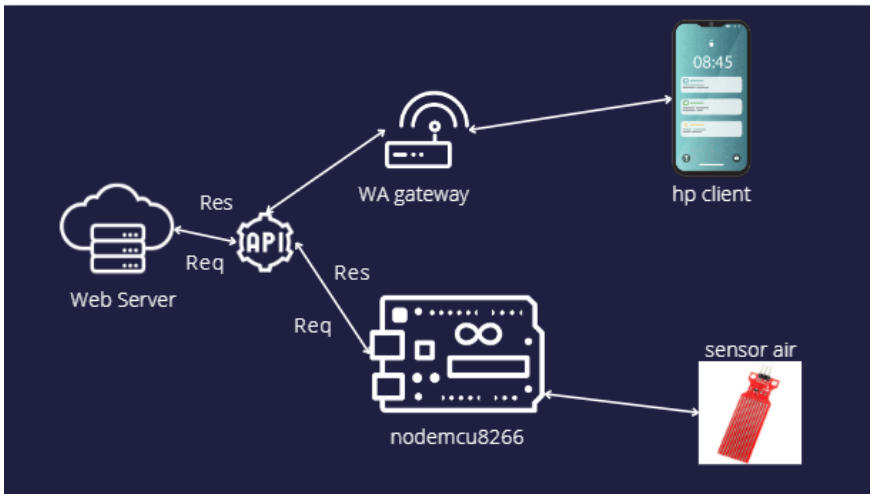


**Fig 5:** How Webserver and IoT work

### d. WhatsApp Gateway

WhatsApp gateway is a third-party application that provides a Rest API for sending messages via WhatsApp that can be integrated with various platforms. In this study, the WhatsApp gateway functions as a sender of flood information to homeowners. This message will be sent when the water level reaches the specified limit. The water level determined is as follows:

**Table 1:** Flood level

| Flood Level | Status | Message |
|---|---|---|
| > 420 < 520 | Hati - Hati | Hati hati terjadi banjir, persiapkan kemungkinan terjadi banjir |
| > 520 | Siaga | Telah terjadi banjir, selamatkan diri dan barang berharga anda |

Table 1 explains the water level limit as a simulation of the occurrence of flooding, at the water level 420 - 520 the status is still careful about the occurrence of flooding then at the water level above 520 indicates that a flood has occurred. If the water level has touched both levels, the tool system will automatically send a notification to the homeowner in the form of a WhatsApp message.

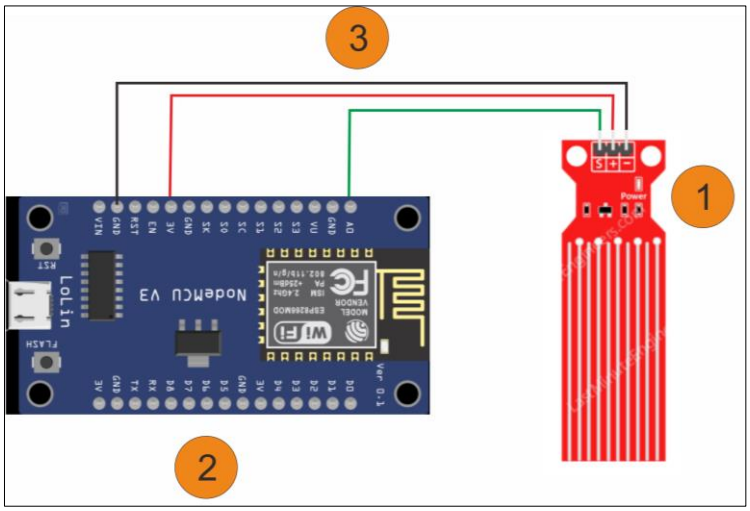


**Fig 6:** Set of tools

As a microcontroller, Nodemcu esp8266 receives input from the sensor and then reads the value received from the sensor to send information regarding the occurrence of flooding if it passes a predetermined limit. The devices used in the above series are as follows:

1. Water Level Sensor HW-038
2. Nodemcu ESP8266
3. Jumper Cable

**Table 2** Correlation between components

| Component | Sensor Data Pin | Nodemcu ESp8266 |
|---|---|---|
| Water Level Sensor HW-038 | Pin – | Pin GND |
| | Pin + | Pin 3V |
| | Pin S | Pin A0 |

Table 2 shows the correlation between the components of the water level sensor and the nodemcu esp8266 where the negative pin (-) of the sensor is connected to ground (gnd), the positive (+) pin is connected to 3v power and pin (S) which is the pin of the sensor is connected to the analog pin (A0).

## 3. Results and Discussion

**Fig 7:** Assemble smart home prototype tools and flood warning systems

The circuit in figure 7 shows a finished set of tools, where a water level sensor is connected to a prototype circuit of a smart home, where this sensor acts to provide information to homeowners in order to prepare for and anticipate flooding.

From the results of testing sensors and sending WhatsApp messages that have been carried out, the following data is obtained.

**Table 3** Circuit test results with WhatsApp message sending

| Flood Level | Message Status |
|---|---|
| 429 | Hati - Hati |
| 474 | Hati - Hati |
| 484 | Hati - Hati |
| 473 | Hati - Hati |
| 475 | Hati – Hati |
| 473 | Hati – Hati |
| 475 | Hati – Hati |
| 468 | Hati – Hati |
| 483 | Hati – Hati |
| 466 | Hati – Hati |
| 476 | Hati – Hati |
| 457 | Hati – Hati |
| 473 | Hati – Hati |

Table 3 is the result of tests carried out on a series of tools and WhatsApp notifications, where in this test, the sensor data only reached the highest number of 483 when the water sensor was immersed in water, so the alert message in table 1 was not obtained because the water level was less than 520. Therefore, it is necessary to re-calibrate the tool so that it gets an accurate limit value.

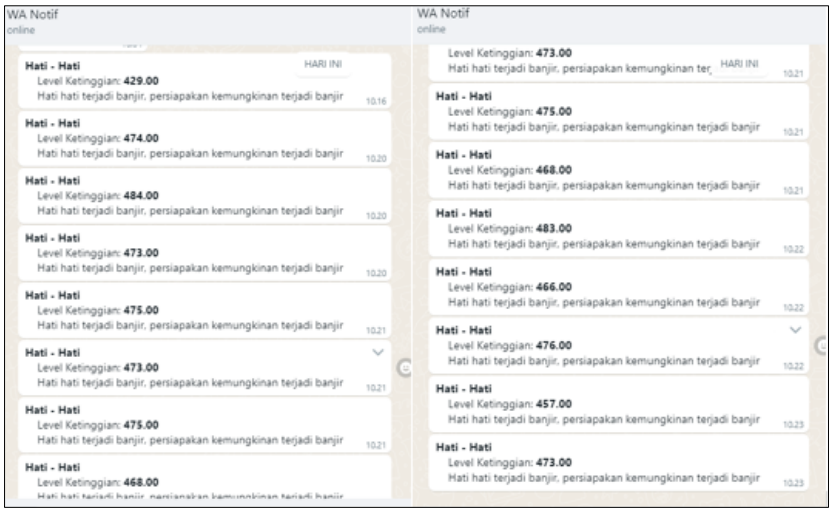


**Fig 8:** Messages received from WhatsApp gateway

Figure 8 is a notification message received from the WhatsApp gateway by the home owner when the sensors in the system circuit detect the water level reaches a predetermined limit. This can be a reference for homeowners to save themselves or valuables.

## 4. Conclusion

Research on a flood warning system using an IoT-based Nodemcu esp8266 and integrated WhatsApp messages implemented on a prototype has been successfully carried out. The sensor data obtained from the water level sensor is successfully read by the microcontroller which is then sent to the web server as an action to send information to the homeowner if the water level limit reaches the specified data or exceeds the specified limit. In the tests that have been carried out, the WhatsApp message was successfully sent to the destination WhatsApp number with the highest sensor data obtained at number 483 as shown in table 3. However, the height limit > 520 failed to be obtained after the sensor was completely submerged, this may occur due to poor sensor sensitivity. maximum so that for future research it is necessary to re-calibrate the accuracy of the numbers that can be read by the sensor.

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