Jurnal E-Komtek
Vol. 6, No. 2 (2022) pp. 184-195
https://jurnal.politeknik-kebumen.ac.id/index.php/E-KOMTEK
p-ISSN : 2580-3719 e-ISSN : 2622-3066

The Water Monitoring System in Flood Alert Level Design Based on Internet of Things (IoT)

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https://doi.org/10.37339/e-komtek.v6i2.959

Published by Politeknik Piksi Ganesha Indonesia

Artikel Info
Submitted:
08-07-2022
Revised:
15-12-2022
Accepted:
16-12-2022
Online first :
31-12-2022

Abstract

This study aimed to produce a flood alert system that can monitor water-levels in watersheds based on the Internet-of-Things (IoT), using the NodeMCU ESP8266 as a microcontroller and connecting internet connections. The main hardware used was a probe sensor as a water-level detector, an LED as a water level indicator, an LCD displaying the water level status, and a nodeMCU ESP8266 as a processor for the probe sensor detection results and sending information on the water-level status to the Telegram on Android. The status consisted of a safe level when the water level was at 1.5 m, an alert status was at 2 m, and a hazard status was at 3 m. When the water surface touched the probe sensor, nodeMCU ESP8266 read and processed the detection results. Then the status information was sent to Telegram and displayed on the LCD.

Keywords: Internet of Things, Aplikasi telegram, NodeMCU ESP8266, Sensor probe

Abstrak

Penelitian ini bertujuan untuk menghasilkan sistem peringatan banjir yang dapat memantau ketinggian air di daerah aliran sungai berbasis Internet-of-Thing (IoT), menggunakan NodeMCU ESP8266 sebagai mikrokontroler dan menghubungkan koneksi internet. Perangkat keras utama yang digunakan adalah sensor probe sebagai pendeteksi ketinggian air, LED sebagai indikator ketinggian air, LCD yang menampilkan status ketinggian air, dan nodeMCU ESP8266 sebagai pemroses hasil deteksi sensor probe dan pengiriman informasi air. status -level ke Telegram di Android. Status tersebut terdiri dari status aman pada ketinggian air 1,5 m, status waspada pada ketinggian 2 m, dan status bahaya pada ketinggian 3 m. Ketika permukaan air menyentuh sensor probe, nodeMCU ESP8266 membaca hasil deteksi dan diproses. Kemudian informasi status dikirim ke Telegram dan ditampilkan di LCD.

***Kata-kata kunci**: Internet of Things, Aplikasi telegram, NodeMCU ESP8266, Penyelidikan sensor*

1. Introduction

Flood incidents are disasters that cannot be taken lightly. Prolonged rainfall can cause watersheds to overflow and endanger residents living around watersheds. The losses caused by floods are significant, namely material damage and even causing casualties **[1].** The failure occurred because residents had difficulty predicting early the arrival of floods, so when the river overflowed, residents no longer had time to make early anticipation **[2].** Therefore, it is necessary to design a flood alert system to monitor the river flow's water level and alert residents to rising water levels online **[3].** Several studies have been conducted previously on the design of flood detection systems.

Previous research using Arduino and sensors in ultrasonics and monitoring is accessed from SMS media. Still, there is a weakness, namely a weak GSM signal that makes incoming message information hampered **[4].**

Research using ultrasonic sensors and flood warning media via SMS and buzzer. In theory, ultrasonic sensors are perfect to use, but the readings will be chaotic if the water detected is corrugated and exposed to the surface of other solid objects **[5].**

Utilizing increasingly advanced technology, design and build a water level system using the Internet of Things (IoT) base so that monitoring the water level of river flows can be accessed online and in real-time. The water level status consists of safe when the height is 1.5m, standby when the water level is 2m, and danger when the water level is 3m. The components used are a probe sensor that detects water levels and NodeMCU ESP8266, which functions as a processor. Furthermore, it sends water level status information to the Telegram application, which contains a bot for automatic communication. LEDs as water level indicators, and LCDs water level status. The goal is to produce a system that can monitor water levels and warn residents online so that residents can anticipate flooding early.

2. Method

a. Hardware and Applications Used

1) NodeMCU ESP8266

NodeMCU has a size of 57 mm x 30 mm which is an Internet of Things (IoT) and open-source platform. ESP8266 has been packaged NodeMCU on a board with several characteristics, such as a microcontroller. Moreover, a path to connect to the internet network and also in USB

to serial communication in the form of a chip. Then the programming process is in the form of a USB data cable **[6].**

2) LCD 16x2

LCD 16x2 stands for Liquid Crystal Display as a hardware component used to display text in writing and numbers. The LCD configuration of the microcontroller is done using pins on the LCD connected to the microcontroller port **[7].**

3) LED

LED stands for Light Emitting Diode, a component or hardware when the forward process is biased. It will emit monochromatic light. Light Emitting Diodes are also from the family of diodes whose materials are semiconductors. LED light beams of various color types are based on the material and type of semiconductor used **[8].**

4) Sensor Probe

The material of the probe sensor is a wire or copper cable that is a conductor so that it can conduct current or voltage to other components. The probe sensor consists of four wires that detect the water level status at each predetermined height point. The voltage-generating probe sensor will connect with other probes when submerged in water because the nature of the water can also be a conductor of current from one probe to another so that it turns on other components.

5) Telegram

Telegram is software in the form of an application that can send and receive messages. Telegram has been tested safe because this application is equipped with end-to-end encryption **[9].** In Telegram, Bots are available, functioning as special accounts designed to receive messages automatically **[10].**

b. Method

The research stage that will be carried out follows the research framework, as shown in **Figure 1**, to facilitate the process of designing and producing a system.

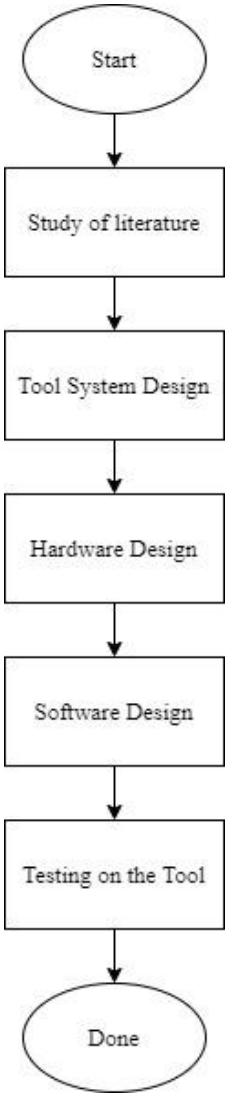

Figure 1. Research Framework

The block diagram of the flood alert water level system design in figure 2 consists of hardware, namely the ESP8266 NodeMCU, probe sensors, LEDs, LCDs, and adapters. The system performance of these devices can be connected based on software commands that have been programmed blocked on the circuit consisting of:

1) Input (Input), as input in the form of a 5-volt consisting probe sensor.
2) Process, namely NodeMCU ESP8266 as a reader of sensor and processor detection results.
3) Output in the form of illuminated LEDs, LCDs, and the Telegram application.

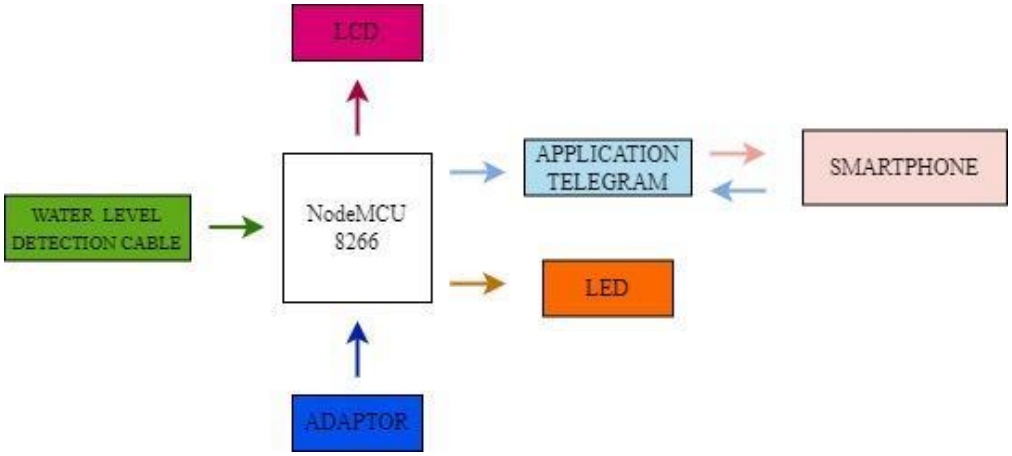

Figure 2. Block Diagram of Flood Alert System Design

Hardware design uses a probe sensor as a water level detector. The probe sensor consists of four copper wires, namely a voltage supply probe to other probes, and probe 1 detects a water level of 1.5 m w safe status. Then probe 2 detects a water level of 2 m with a standby status, and probe 3 detects a water level of 3 m with a hazard status. When the water surface touches the probe sensor, the ESP8266 NodeMCU will read the detection results and process, which then outputs it in the form of an LED as a lit indicator, a display of water status information on the LCD, and messages that enter the Telegram application on Android.

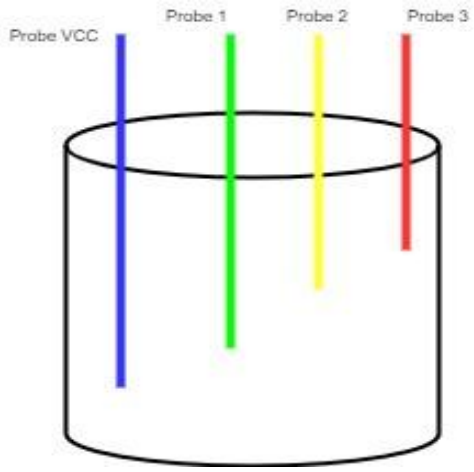

Figure 3. Sensor Probe

After doing the hardware design stage and the software design stage. The software design system aims to monitor water levels and river status alerts in real-time from the Telegram application media so that the monitoring process does not need to go to the place where the river flows directly but from android only. The application on Telegram that the Telegram Bot has created can also send a "status" message to NodeMCU ESP8266 which aims to find out whether the water level tool in the river flow is in good condition or vice versa. If the tool is in good

condition, the NodeMCU ESP8266 will reply to the message containing information about the status of the water level in the river flow.

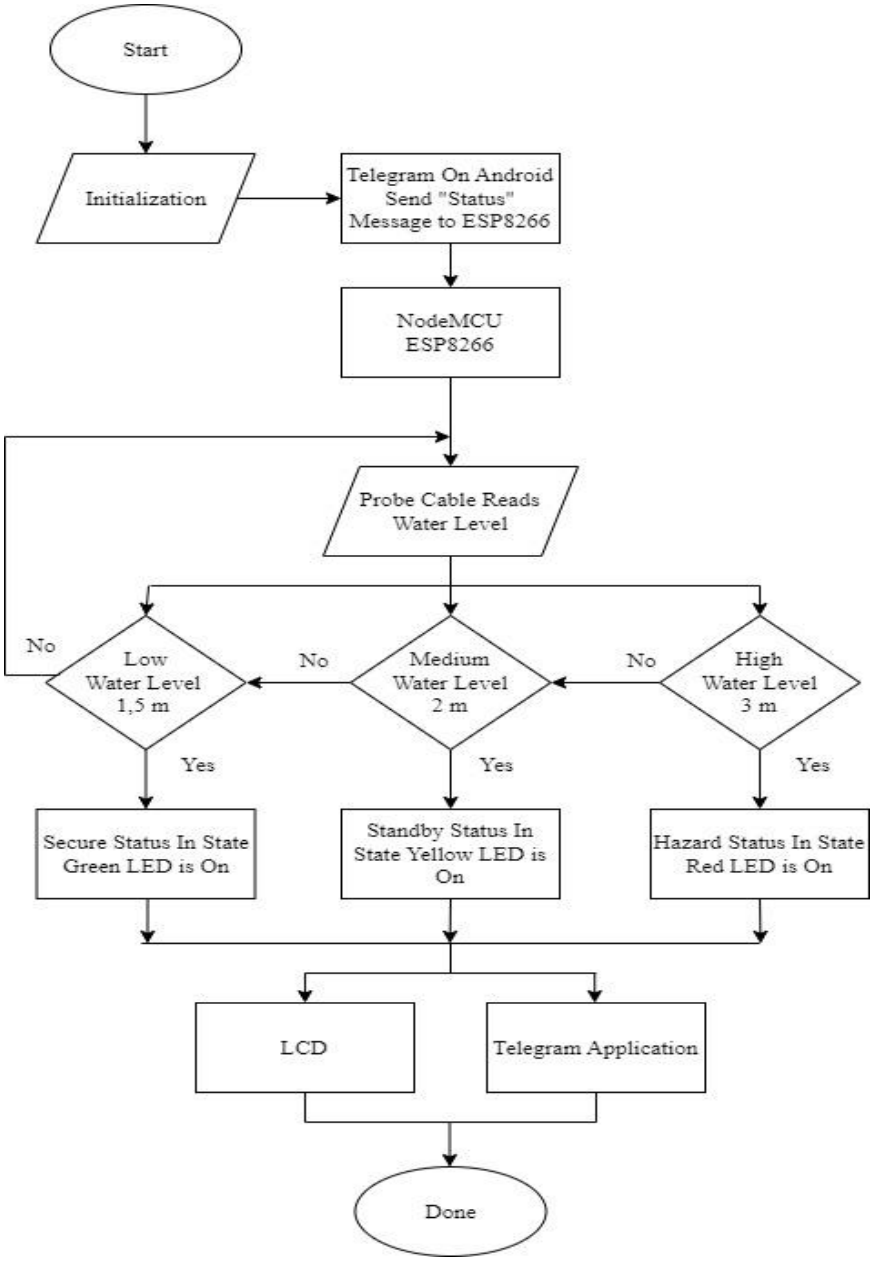

Figure 4. Overall Software design flow flowchart

3. Results and Discussion

a. Presenting Result

The result of hardware is a series of water levels that can detect the water level in the watershed. The ESP8266 NodeMCU microcontroller connected to a probe sensor consisting of four copper wires can read the detection sensor results and transmit the information to the Telegram application. The LED on the circuit will light up as an indicator of the water level status, and the LCD on the circuit will display the status of the water level condition.

Figure 5. Water Level Tool

Figure 5 is a water level circuit hardware from the outer view that has been packaged as a whole and a probe sensor consisting of four detection cables whose length has been adjusted according to the needs of the watershed (DAS). The wiring of the device is seen in **Figure 6.**

Figure 6. Wiring Water Level

b. Software Design Results

The results that have been done from the software design (software) are in the form of the Telegram application on Android, which the Telegram bot has created as a chat room for user communication and NodeMCU ESP8266 automatically. So that when the tool detects the water level, the ESP8266 NodeMCU will immediately send a water level status message to Telegram automatically.

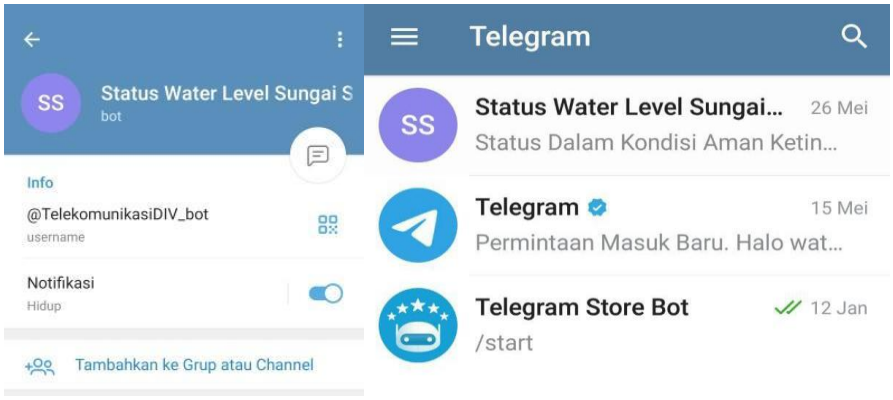

Figure 7. Telegram App Logo and Initial Look

c. Testing

Testing of the design of an Internet of Things-based flood alert water level monitoring system is implemented in real terms in watersheds that often overflow. The test was carried out by gradually inserting the probe sensor, starting from the voltage supply probe to other probes; probe 1 is safe, and probe 2 is on standby. Furthermore, probe 3 is a hazard to see if the NodeMCU ESP8266 can read the probe sensor detection results, send a message to the Telegram application, and display status information on the LCD.

Figure 8. Water Level Tool

The tool is being prepared for the implementation testing process; the circuit is given a voltage of 5 volts so that it can turn on and connect with an internet connection. To find out if the device has been connected to an internet connection can be seen on the LCD displaying "WaterLevel On", as shown in **Figure 9.**

Figure 9. Internet Connection Tool

1) Secure Status

In this safe condition, water increases but still on a small scale. The safe status test is carried out by inserting a probe 1 sensor and a voltage supply probe into the water at the height of 1.5 m.

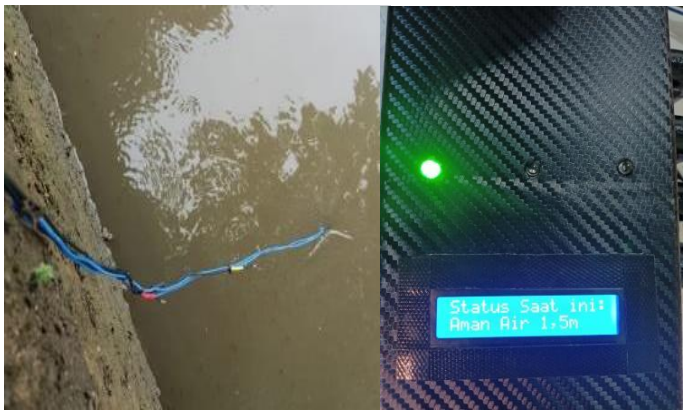

Figure 10. Probe and Circuit sensors

When the probe 1 sensor is safe, and the voltage supply probe has been touched by water; the ESP8266 NodeMCU will read the detection results of the safe probe 1 sensor. Then the output will enter the LCD, which displays a water level of 1.5 m with a Safe status, and a green LED is on. Then the water level status message information will also go to the Telegram app automatically.

Figure 11. Telegram app

2) Standby Status

This alert condition is an increased water change and can be threatening. On standby status, the detected water level is 2m. This process is carried out by inserting the standby probe 2 sensors into the water after probe 1 and the voltage supply probe. It shows that the water increases so that the standby probe 2 is submerged along with the safe probe 1 and the voltage supply probe.

Figure 12. Standby probe 2 sensors and Tools

When the standby probe 2 sensor has been touched by water, the ESP8266 NodeMCU will read the detection results of the standby probe 2 sensors. Then the output will be displayed LCD, namely a water level of 2 m with a Standby status and a yellow LED lit up along with a green LED. Then the standby water level status message information automatically enters the Telegram application.

Figure 13. Telegram app

3) Hazard Status

Hazard Status is due to increased water due to prolonged rains. Hazard status will be detected if the probe 3 hazard sensor touches the water level at 3 m. This process is carried out by inserting a 3-hazard probe sensor into the water and a voltage supply probe, probe 1, and probe 2. It shows that the water is increased to submerge all the probe sensors.

Figure 14. Probe Sensor 3 and Tools

When the probe sensor is 3 hazards, and all probes have been submerged in water; the NodeMCU ESP8266 will read the detection results of the 3 hazard probe sensors. Then the output will be displayed LCD, namely a water level of 3 m with a Hazard status and all LEDs lights up red, yellow, and green. Danger water level status message information is automatically logged into the Telegram app.

Figure 15. Telegram app

Every time the tool detects a status change, the NodeMCU ESP8266 will automatically send the message to the Telegram bot application that has been designed before.

4. Conclusion

Based on the results of the design of an Internet of Things (IoT)-based flood alert water level monitoring system. It can be concluded that this research has succeeded in designing an IoT-based flood alert system that can monitor river water levels remotely online. Software testing successfully makes the tool system work properly. When the circuit is supplied with an input voltage of 5 volts in testing the hardware, the tool will turn on and automatically connect to the internet network. The NodeMCU ESP8266 microcontroller successfully processed the probe

sensor detection results. The LED successfully calculates according to the level, and the LCD can display water level status text and messages that enter Telegram. The LCD delay is 1-2 seconds, and the delay in sending messages to the Telegram application is 3-4 seconds. Messages sent to the Telegram application only go to one account and can be expanded again to log in to more accounts.

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