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Development of an IoT-Based System for River Siren Control and Height Detection Utilizing LoRa and Solar Cell Technology

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Abstract: We need a tool that can measure river water levels automatically based on IoT so that water level data can be received in real time. This tool uses an Arduino microcontroller which functions to convert analog data into digital by measuring water level using an ultrasonic sensor so that the data can be converted into digital water level data and displayed via the internet and a buzzer or siren as a danger warning when the water level rises high as well as water level data. can be monitored as a whole. Apart from that, this tool is equipped with LoRa communication. This LoRa can send signals as far as 15 km without obstructions, so even if there is no internet, this tool can still work and can be used in areas without electricity because it uses solar cells as a power supply. If the water reaches the maximum limit, the siren will sound and stop again when the water in the river is at normal level.

Keywords: Internet of Thing (IoT), Real Time, Ultrasonic Sensor, Bazzer or Siren, Lora, Solar Cell, Power Supply

1. Introduction

Rivers are a natural resource that is very important for human life (Hamidi, Furqon, & Rahayudi, 2017). Rivers not only function as a source of water for human needs, but also as a place for various species of fish and other aquatic animals. However, in recent years, the problem of water levels in rivers has become increasingly worrying. Rising water levels can threaten the safety of local residents, as well as damage the river ecosystem itself. Therefore, efforts need to be made to deal with water level problems in rivers.

Please note that Indonesia is a country that has very high rainfall. During the rainy season, almost all regions in Indonesia receive high intensity rain, so you need to be wary of flooding (Baskoro, Nafik, Widodo, & Rahmadian, 2021). Monitoring the water level in rivers is an important job, therefore if there is negligence in monitoring the consequences are very detrimental because it concerns the safety of residents in the area. Likewise the delivery of information regarding water levels. So when the rainfall is high, residents who live around the river do not have enough time to fix the items that need to be secured. The consequences are very detrimental because it concerns the safety of local residents if water overflows (Levidow et al., 2014).

Therefore, we need a tool that can measure river water levels automatically based on IoT so that water level data can be received in real time. This tool uses an Arduino microcontroller which functions to convert analog data into digital by measuring water level using an ultrasonic sensor so that the data can be converted into digital water level data and displayed via the internet and a buzzer as a danger warning when the water level rises high and the water level data can also be monitored. overall.

Apart from that, this tool is equipped with LoRa communication, this LoRa can send signals as far as 15 km without obstacles so even if there are none

[1] This internet device can still work and can be used in areas without electricity because it uses solar cells as a power supply. If the water reaches the maximum level, the siren will sound to notify residents of danger.

3. Methods

3.1. Research methods

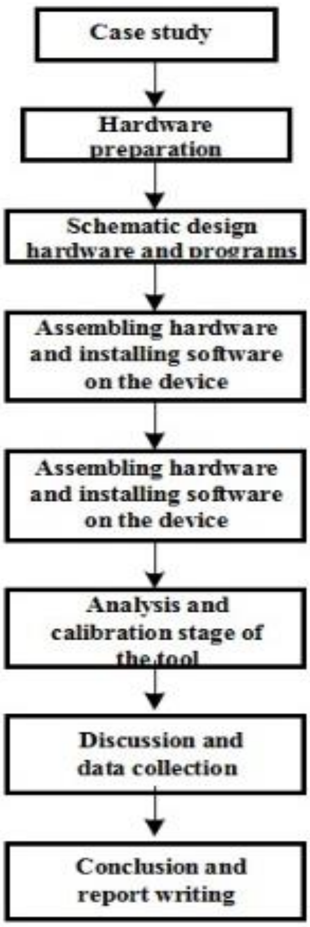

Figure 1. *Research Stages*

At this stage, a discussion of the observational data and data analysis is carried out. Explains the results displayed in monitoring via LCD and Android. The conclusion of this research is to answer the preliminary objectives above, all of which will be written in accordance with a predetermined format.

3.2 Research Location

This research was carried out in Medan, North Sumatra, namely Jalan Badur No.2C, Hamdan sub-district, Medan Maimun sub-district on the edge of the Deli River.

3.3 Measurement and Observation Parameters

The changes observed/measured are the water height that reaches the predetermined minimum and maximum limits that appear in the system.

3.4 Research Model

This research model uses an experimental research model, namely by carrying out system design activities while simultaneously measuring water levels.

3.5 Research Design

Figure 3.2 is a block diagram of making a river water level detection tool and an automatic river sluice control system using a lora with a solar cell power supply based on the Internet of Things. The ultrasonic sensor detects the river water level continuously, then it is read by the Uno R3 ESP8266 and the data is processed until the data is produced in the form of a LoRa transmitter signal. This signal will be communicated to the LoRa receiver module with a frequency of 433MHz and a maximum distance of 15km (without any obstacles An explanation of the stages or steps taken to carry out research is as follows:

a. Stage 1

Literature review

At this stage, study journals related to river water levels and how to detect them or technology related to river water level detection

b. Stage 2

Preparation of Hardware Components and Programs (Software)

Stages in making hardware, purchasing the required components and prepare module kits, as well as install the Arduino IDE software.

c. Stage 3

Hardware schematic design stage and program code

At this stage, create a schematic circuit of the tool using Proteus software, Livewire and Eagle software to print the PCB, as well as prepare the module kits. Before the design is carried out, a circuit simulation is carried out first to find out whether the circuit is possible or not.

d. Stage 4

Hardware and software integration stage

At this stage, communication or integration is carried out between hardware and software based on the Uno R3 ESP8266. This integration communicates with the LoRa module.

e. Stage 5

Discussion, conclusions and report writing

in the form of objects or objects). The data obtained by the

Lora receiver module is then forwarded and processed by the Uno R3 ESP8266, the data obtained is converted into command signals in the form of a 20x4 LCD output as a display of the river water level, a buzzer and a rotary lamp as an indicator to mark the river water level. The river water level indicator measured based on centimeters will be divided into three markers which are indicated by the ignition of the buzzer and rotary light:

a. Normal river water level indicator (50 cm): green rotary light is on.

b. River water level indicator Caution (100 cm): yellow rotary light is on.

c. Danger river water level indicator (200 cm): Red rotary light and siren are on.

The power supply to power the tool system is divided into 2, namely:

1) Solar cell for power supply to the transmitter panel. Solar cells are used as a power supply because electricity from PLN is affordable to locations close to active mountains, so these solar cells are very effective and as an alternative to overcome this problem. Solar cells can convert energy from sunlight into electrical energy. The solar cell is connected to a battery as energy backup for the transmitter power supply at night.

2) 0 – 12V adapter for power supply on the receiver panel. The adapter functions to convert AC current from PLN into DC current so that it can provide a power supply to the receiver panel. This adapter can convert the output from 0 – 12V depending requirements of the load used.

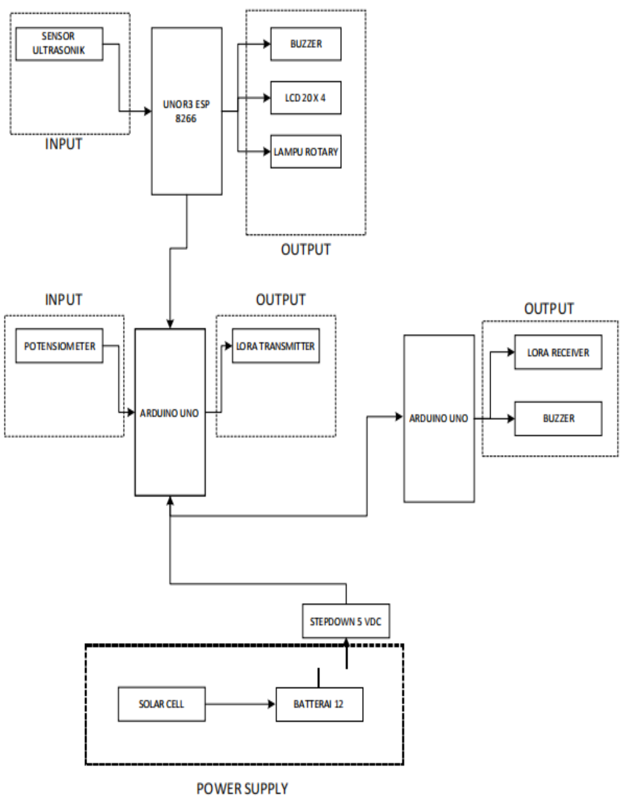

Figure 2. *System block diagram*

The components contained in this system control system include:

1. Input

The input components included are: JNS-SR04T sensor

2. Microcontroller

ESP 8266 Uno R3 is a microcontroller central to controlling input and output on devices.

3. Output

Included in the output is the indicator/output of the self-measurement limit of the ultrasonic sensor in reading the water level.

4. Feedback

This tool functions as an early warning of flood disasters.

From the diagram above, the input is in the form of sensor readings/measurements in measuring river water levels, then the results of the sensor measurements will be processed and issued in the form of output as an indicator. The indicator will turn on according to the river water level which is set via coding via the microcontroller.

3.6 Data Collection and Analysis Techniques

The data collection technique begins by testing the equipment directly until the expected results are obtained. The data collection technique is carried out by taking measurements at each test. Data analysis is carried out by testing the tool to measure the water level in the system. Then the sensor readings will be displayed in real-time via the Blink application.


Figure 3. *River*

Rivers are places and containers as well as water drainage networks starting from springs to estuaries, bordered on the right and left and along the flow by border lines


Figure 4. *Uno R3 ESP 8266*

Arduino This is a custom version of the classic ARDUINO UNO R3. Has full integration between the Atmel ATmega328P microcontroller and ESP8266 WiFi IC with 32 MB flash memory, and the CH340G USB-TTL converter on one board, where all modules can work together or stand alone.

Figure 5. *Blynk IoT*

JSN-SR04T is a waterproof ultrasonic distance measurement sensor module with a non-contact range/distance of 25 cm to 450 cm. This sensor is very similar to the ultrasonic sensor found on car bumpers.

Figure 6. *Sensors Ultrasonic JSN-SR04T*

IoT is a concept that aims to expand the benefits of continuously connected internet connectivity (Muzawi, Department of Information Management et al., 2018).

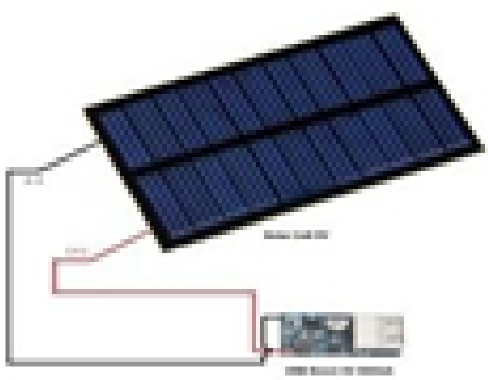

Figure 7. *Solar Cell*

Sunlight can also be used to produce electrical energy, for example solar cells or what can be called solar panels.

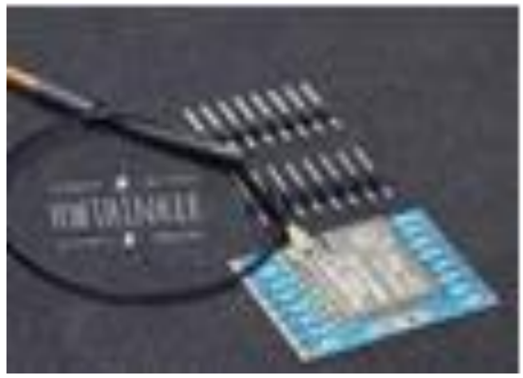

Figure 8. *SX1278 LoRa Module*

LoRa is a device that can transmit serial data using PSK (Phase Shift Keying) or FSK (Frequency Shift Keying) modulation (Saputra et al., 2018).

Figure 9. *Siren*

A siren is a tool for making noise which is usually used as a warning signal for danger. The sound in this siren only has one tone or sound (Juvinka Rhisa Devi & Nyoman Bogi Aditya Karna, 2022)

Figure 10. *Siren Control*

This tool functions as an early warning of flood disasters. From the diagram above, the input is in the form of sensor readings/measurements in measuring the river water level, then the results of the sensor measurements will be processed and issued in the form of output as an indicator. The indicator will turn on according to the river water level which is set via microcontroller coding.

The invention will be explained in full with reference to the accompanying drawings. Referring to Figures 2.1 to 2.4, which show a complete picture of the river, the network architecture of LoRa and Solar Cell Technology. Development of an IoT-Based System for River System Control and Height Detection Utilizing, which consists of 4 main blocks, namely (1) JSN-SR04T Ultrasonic Sensor, (2) ESP 8266, (3) cloud server (Blynk) and (4) web program on the user side. The Ultrasonic Sensor will detect the height of the river water. The detection results will be sent to the ESP 8266 then processed and produced in the form of output, namely a buzzer and indicator light for the air height which is read from the ultrasonic sensor. The measurement results will then be sent to the cloud server via the internet network. Users can access data from river water level measurements on the user's smartphone and PC via the internet network. Referring to Figure 2.5, the Solar Cell is useful as a power supply so that the device can still work which supplies this device even if there is no electricity from the PLN.

In Figure 2.6, this device is also equipped with a LoRa SX1278 module, if there is internet interference during dangerous conditions, a signal will be sent from the LoRa Transmitter. From the description above it is clear that the results of the invention function to convert analog data into digital by measuring the water level using an ultrasonic sensor so that the data can be converted into digital water level data and displayed via the internet and a buzzer as a danger warning if the water level rises high and the water level rises. level data can be monitored as a whole. Apart from that, this tool is equipped with LoRa communication. This LoRa can send signals as far as 15 km without obstacles, so even if there is no internet, this tool can still work and be used in areas where there is no electricity because it uses solar cells as its power source. If the water reaches its maximum level, a siren will sound to alert residents of the danger.

From the results of the data listed above, it can be seen that the components of the tool are functioning and the tool is working as desired. The discussion regarding the results of this final project tool is regarding the performance of the tool. As previously explained, the performance of this tool is divided into direct tool performance.

Sensor Ultrasonic JSN-SR04T: JSN-SR04T is a module for measuring ultrasonic water vapor jet lengths ranging from 25 cm to 450 cm. This sensor is very similar to the ultrasonic sensor found on mobile phones. This sensor operates between a nominal 4,5 V to a 5,5 V DC supply. However, this ultrasonic sensor typically operates at 5,0 VDC and requires a minimum of 30 mA of power.

1. Discussion of Tool Performance Directly from Blynk

The NodeMCU ESP8266 reads the results of water sensing sinyal signal detection continuously via a vibration sensor. The data obtained is converted into command signals in the form of a 20x4 LCD output as an ewater sensing sinyal signal display, buzzer and pilot lamp as an ewater sensing sinyal indicator. The display of the sensor readings will then also appear on the Blynk application from your cellphone/PC in real time.

The following are the stages of tool performance:

a. Switching on the Instrument
When the tool is turned on, it will take a few seconds to boot up and establish a connection to the WiFi network that has been made available for it. Once connected, this will enable the remote communication system and prime the sensor to detect vibrations. The vibration sensor readings are displayed on a Blynk display in the remote system.
b. Power on and communication from blynk and NodeMCU ESP8266
The way to communicate is that WiFi is connected by entering the password into the ESP8266 nodeMCU program, once successful, Blynk will connect. The NodeMCU ESP8266 has a flash button which functions to change the WiFi connection if pressed for 10 seconds. Once pressed, the NodeMCU ESP8266 will request WiFi access again from the Blynk application.
c. Normal Condition
When the ewater sensing sinyal strength conditions range between 0 pulses to 300 pulses, the LCD & Blynk will display the magnitude of the ewater sensing sinyal vibrations followed by the status "Ewater sensing sinyal = 0 (NORMAL)", there is also a green pilot light which will be active as an indicator that the ewater sensing sinyal conditions are deep. good condition
d. Condition of Caution
When the strength of an ewater sensing sinyal ranges from 300 pulses to 2000 pulses, the Blynk LCD will display the magnitude of the ewater sensing sinyal vibration followed by the status "Ewater sensing sinyal = 379 (BE CAREFUL)", there is also a yellow pilot lamp which will be active as an indicator that there is an ewater sensing sinyal. in careful condition
e. Dangerous Conditions
When the condition of the ewater sensing sinyal strength is more than 2000 pulses, the LCD and blynk will display a dangerous ewater sensing sinyal situation followed by the status "Ewater sensing sinyal = 14572 pulses (DANGER)" in the second row, the green pilot light which was previously active will turn off and be replaced by the pilot light The red light is an indicator that the ewater sensing sinyal situation is dangerous.

2. Discussion of Tool Performance Directly from Lora

This tool uses 2 Arduinos as controllers for 2 Lora communications. The Lora signal transmitter module is controlled by manually turning the potentiometer when the sensor reads a danger or when the buzzer is on, the signal will be communicated to the receiver module (signal receiving module) using a 433MHz frequency with a maximum distance of 15 Km (without any obstacles in the form of objects). After direct testing, LoRa communication can only work at a maximum distance of 30 m, this is due to the large number of buildings, power cables, network cables and trees that can hinder the LoRa signal.

4. Conclusion

This tool functions to convert analog data into digital by measuring water level using an ultrasonic sensor so that the data can be converted into digital water level data and displayed via the internet and a buzzer as a danger warning when the water level rises high and the water level data can be monitored as a whole. Apart from that, this tool is equipped with LoRa communication. This LoRa can send signals as far as 15 km without obstructions, so even if there is no internet, this tool can still work and can be used in areas without electricity because it uses solar cells as a power supply. If the water reaches the maximum level, the siren will sound to notify residents of danger.

Based on the results of the analysis, design and implementation that have been carried out, as well as based on the existing problem formulation, several conclusions can be drawn including the following:

a. The early water sensor signal detection tool consists of 2 panels, namely the transmitter panel (signal sender) and the receiver panel which acts as a signal receiver or signal catcher from the LoRa transmitter.

b. This tool uses a WiFi module to monitor remote communications in real time as long as there is an internet network and this tool can still work without the internet because it uses LoRa. The maximum network communication distance is 15 km without obstacles.

c. The waterproof ultrasonic distance measuring sensor SN-SR04T has a non-contact range of 25 to 450 cm. The ultrasonic sensor found on automobile bumpers is remarkably similar to this sensor. The nominal supply voltage range for this sensor is 4.5 V to 5.5 V DC. However, the maximum current needed for these ultrasonic sensors is 30 mA, and they normally operate at 5.0 VDC.

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