EARLY FLOOD DETECTION DESIGN USING NODEMCU INTEGRATED WITH IOT BASED MD0127 SENSOR WITH TELEGRAM NOTIFICATION

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ABSTRACT

The rapid advancement of technology has led to the widespread use of technology in daily activities. One application is the Internet of Things (IoT) which can be implemented to monitor rainfall as an early warning for natural disasters, such as floods. This early flood detection device utilizes a NodeMCU ESP8266, an MD0127 rainfall intensity sensor, an ultrasonic sensor for measuring water level, Arduino IDE, Blynk, and Telegram. The research employed the 4D development method, comprising definition, design, development, and dissemination. The device was tested using a product validation questionnaire, design testing, and Quality of Service (QoS) analysis. Based on the research and testing results, the developed early flood detection system effectively monitors water conditions and provides timely notifications when flood risks are detected. It is expected that this system can be a useful tool in mitigating flood risks by providing accurate and real-time information to users.

Keywords: Sensor MD0127, NodeMCU ESP8266, Sensor Ultrasonik. IoT, Blynk

INTRODUCTION

"Internet of Things (IoT) is a concept or scenario where an object has the ability to send data over a network without requiring human-to-human or human-to-computer interaction. [1] IoT can be used as a control tool in a person's presence detection tool that can handle cases of loss people or acts of crime against a person or group that functions in terms of monitoring, security and crime enforcement, one of which is a case of robbery. The standard definition of the term Internet of Things (IoT), namely describing the real world into cyberspace using the methods used is wireless or automatic control without knowing distance. (Reza Fahlevi et al., 2020) Technological developments nowadays are very rapid and make everyone use technology in carrying out daily activities, especially in the fields of technology and information. Utilizing the IoT concept can help humans in applying technology in managing disasters effectively and efficiently. One application is Internet of Things (IoT) technology which can be applied to monitor rainfall as an early warning of natural disasters, including floods. Flooding is a natural phenomenon that we cannot avoid. In Indonesia, floods often occur due to several internal and external factors. The impact of this flood is very detrimental to the community both materially and socially. One of the causes of flooding is the result of fluctuations in rainfall which continue to increase every year. Climate characteristics, especially rainfall, can be analyzed accurately based on climate data from meteorological stations. The following is information regarding the intensity of rainfall that occurs in Indonesia, which is shown in the image below. Seen from the picture above, rainfall units are always expressed in millimeters (mm) (Desmonda et al., 2018). According to the Central Bureau of Statistics, Indonesia has a high amount of rainfall, seen from the amount of rainfall in the country recorded at 2,898 millimeters (mm) per year. The author tries to create a design for implementing IoT technology with the equipment "Early Banjar Detection Design Using an Integrated Nodemcu with an IoT-Based MD0127 Sensor with Telegram Notifications" so that this tool can produce an early warning that the area has been flooded by water at a certain height and can minimize the frequency of disturbances floods, so by connecting to Telegram users can monitor remotely to save time and energy and get quicker treatment.

1. ESP 8266

Figure 1. ESP 8266

NodeMCU ESP8266 is a microcontroller module that can connect to a Wi-Fi network for IoT project development. This module is equipped with an 80 MHz microcontroller andhas flash memory and RAM to store programsand data. The NodeMCU ESP8266 also has several GPIO pins that can be used to connect the module to other devices such as sensors, motors or lights.

2. Ultrasonic Sensor

Figure 2. Ultrasonic Sensor

Ultrasonic sensor is a working sensor based on principle reflection wave sound and use For detect existence a object certain in front ofit , frequency works in the above area wave voice from 40 KHz up to 400KHz. The ultrasonic sensor consists of two units, namelythe transmitter unit 9 and the receiver unit. The structure of the transmitter and receiver unit is very simple, a piezoelectric crystal isconnected to a mechanical armature and is only connected to a vibrating diaphragm.

3. Rain Sensor

Figure 3 Rain Sensor

This sensor works to distinguish several variations in rainwater intensity by using the principle of differences in resistance on the plates. Then transfers the signal in the form of changes in resistance value to a microcontroller. This sensor is made into a grid composed of two copper plates like a comb. When the surface of this sensor is dry the resistance between the two plates is very high, but when water covers the plates, current will flow between the copper plates thereby reducing the resistance (Ulum et al., 2023)

4. Led

Figure 4 LEDs

Light Emitting Diode (LED) is an electronic component that can emit monochromatic light when a forward voltage is applied. LED is a diode output made from semiconductor material. The color of light emitted by an LED depends on the type of semi-conductor material it uses (Firmansah, 2020).

5. Blynk

Figure 5 Blynk

Blynk is an application platform that can downloaded for free for iOS and Android thatworks control Arduino, Raspberry Pi and the like via the Internet. Blynk designed for the Internet of Things with objective can controlthe hardware from distance far , can display sensor data, can store data, visual and perform Lots matter advanced other . There are three main components in the platform, namelyBlynk App, Blynk Server, and Blynk Library(Saputra et al., 2020)

6. Arduino IDE

Lots of Arduino software used namely IDE or Integrated Development Environment . Arduino IDE software is a program used to create program sketches for the Arduino microcontroller board. Arduino IDE has debugging and serial monitoring features which aim to make it easier for users to operate and monitor data from programs run through the Arduino IDE software (Yanti, 2020)

7. Telegram

Telegram is used as a communication medium to send data to users. Telegram was chosen because Telegram is a messaging service application with a focus on speed andsecurity.

Telegram can send messages , photos , videos and other types of files type whatever . Telegram also supports encrypted end-to-endcalls . For create a bot on telegram, first type "newbot " in chat with botfather . Next, the botfather will ask for the bot's name and username. After that, the botfather will provide the bot's ID. Save the ID of the bot that has been created. Bots can be used by using the chat ID that is available **on Node- RED (Wandi et al., 2023)**

8. Quality of service (QOS)

Quality of Service (QoS) is a concept in computer networks that aims to ensureoptimal service quality for users. QoS is defined as the ability of a network to provideservices with the quality desired and expected by users, by prioritizing and managing data flows based on certain requirements. The basic theory of QoS includes several main components, including: (Kurniasih et al., 2021)

A. Throughput

Throughput is Transfer speed (rate) and effectiveness are measured in bps. Throughput is the total number of successful packet arrivals observed at the destinationduring a certain time interval.

Table 1. Throughput

Throughput **Category**	***Throughput*** **(bps)**	**Index**
Very good	100	4
Good	75	3
Currently	50	2
Bad	<25	1

B. Packet Loss

Packet loss is the loss of data packets during data transmission from source to destination (Halim et al., 2019). Packet loss that is too high can cause service quality to decrease, especially in applications that require fast and consistent data transfer.

Table 2. Packet Loss

Category ***Packet Loss***	***Packet Loss***	**Index**
Very good	0%	4
Good	3%	3
Currently	15%	2
Bad	25%	1

C. Delay

Delay is the time required to send data fromsource to destination. Delays that are too long can cause inconvenience for users, especially when used for services that require fast response times, such as video streaming and online gaming.

Table 3. *Delay*

Category ***Delay***	**Large** ***Delay*** **(ms)**	**Index**
Very good	<150 ms	4
Good	150 - 300 ms	3
Currently	300 - 450 ms	2
Bad	>450 ms	1

D. Jitter

Jitter is a variation in delay in data transmission caused by differences in time insending data packets. High jitter can cause disruption to service quality, especially inmultimedia applications such as video and sound.

Table 4. Jitter

Jitter Category	**Jitter (ms)**	**Index**
Very good	0 ms	4
Good	0 – 75 ms	3
Currently	75 - 125 ms	2
Bad	125 - 225 ms	1

METHOD

This research on designing early flood detection tools aims to make it easier for users to remotely monitor regional conditions and also to implement IoT methods. To realize thisdesign requires several components such as ultrasonic sensors, rainfall sensors, LEDs, microcontrollers and Android application software. The method used in this research isthe 4D method which consists of Define, Design, Develop and Disseminate. The following is an explanation of the research flow regarding Flood Detection Tools using the 4D method:

1. Define

At this stage, the author carries out an initial analysis by looking for references from previous research to find gaps which will later be used as a reference in developing research.This initial analysis includes hardware, software requirements, and gathering information about the use of each tool component.

2. Design (Designing)

At this stage, the author designs the components between the hardware and software that will be used. The components used include the ESP8266 microcontroller, rain sensor, ultrasonic sensor, LED, Telegramand the Blynk application. Tool design can use block diagrams or flowcharts to make it easierto make tools.

3. Develop (Development)

At this stage, the author develops tools, namely by assembling the hardware and programming the software that will be used. In this stage the author needs to carry out

initial trials and evaluations to ensure the toolcan work well.

4. Disseminate

At this stage, the author applies the tool andcarries out testing with several predeterminedindicators. This stage aims to provide information about the level of quality andusability of the tool to users.

Flowchart of How the Tool Works

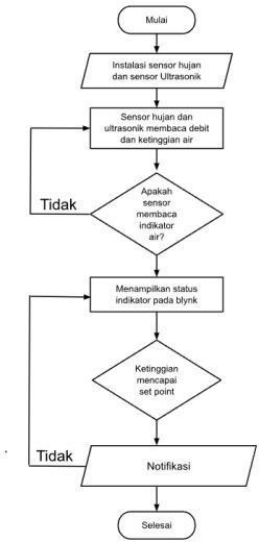

Figure 6 Flowchart of How the Tool Works

Ways of working the equipment shown infigure 6 is started from installation of rain

sensors and ultrasonic sensors if both sensors were successfully installed then the rain sensor can reading water discharge andultrasonic sensors read water level , if both sensors have succeed read the data then will displays indicator status on the application bylnk that with use internet connection if both sensors yet Can displays indicator status so both sensors will read return discharge and water level . Then the data that has beenreceived when it reaches the set pointindicator will alarm and will display a notification on Telegram.

Testing Techniques

After the tool is created, in this research the author sees whether the tool that has been assembled runs according to the commands ofthe program. In this test, the author looks atthe data obtained from the test results of eachcomponent of the preparation and testing of the tool as a whole. The data from the test results are based on material that is in accordance with the aim of this research, namely monitoring the intensity of dischargeand water level. as a remote flood warning based on IoT which can be monitored via telegram.

1. Design Test

Design trials are used to test the Flood Detection Tool to work as desired by theauthor and ensure that the tool's performanceconditions are normal. If a failure occurs in thetest, a revision will be made to the design used. In testing design there are also trials delivery message via telegram.

2. QoS

Quality of service is used to test the speedof the internet network used on the equipment whether it provides good network quality or not. In this research QoS is used to measure Throughput, Packet Loss, delay (Latency),and jitter.

Data Analysis Techniques

In this research, the authors collected data from the readings of rain sensors which wereused to measure the intensity of rainwater discharge and ultrasonic sensors to detect water levels. The data analysis techniques used by the author include product validationand also QoS (Quality of Service) testing. In product validation the author refers to the "Air Quality Monitoring" research as a source for determining equipment testing indicators. Product validation takes the form of 4 aspects of assessment regarding tool design, namely Software, Visual Design, Tool Function, and Tool Practicality.

No.	Aspek Penilaian	Skor				
		1	2	3	4	5
	A. Perangkat Lunak					
1.	Maintable (dapat dipelihara dan dikelola dengan mudah)					
2.	Usable (mudah digunakan dalam pengoperasiannya)					
3.	Compatible (media aplikasi dapat diinstal dan dijalankan di berbagai hardware)					
4.	Reusable (script dapat digunakan Kembali dan dikembangkan)					
5.	Software aplikasi dapat terkoneksi dengan internet					
	B. Desain Visual					
6.	Kerapihan tata letak komponen dalam box					
7.	Kerapihan tata letak komponen diluar box					
8.	Penggunaan komponen yang tahan lama dan tidak mudah rusak					
9.	Sabungan lem atau lainnya tidak mudah terlepas					
10.	Bahasa yang ditampilkan pada aplikasi Blynk mudah terbaca					
11.	Bahasa yang ditampilkan pada telegram mudah terbaca					
12.	Penggunaan ukuran text dapat dibaca					
	C. Fungsi Alat					
13.	Keefektifan sensor MD0127 dalam mendeteksi intensitas hujan					
14.	Keefektifan sensor ultrasonik dalam mendeteksi ketinggian air					
15.	Kefektifan LED dalam mengidentifikasi peringatan					
16.	Alat dapat terkoneksi dengan aplikasi Blynk dan telegram melalui jaringan internet					
17.	Memberikan informasi sistem early warning					
	D. Kepraktisan Alat					
18.	Efisiensi alat					
19.	Daya tahan alat					
20.	Penggunaan alat mudah dipahami					
21.	Penggunaan alat mudah dioperasikan					

Figure 7 User Assessment Form

RESULTS AND DISCUSSION

Design Design

Design is the stage of designing a product. Tool design can be done starting from determining and selecting the hardware and software components that will be used. This research designs a connection scheme between hardware and software. The hardware components consist of the MD0127sensor (rain sensor), ultrasonic sensor, NodeMCU, and LED. The software sensor component is in the form of the Blynk application on websites and smartphones as well as Telegram.

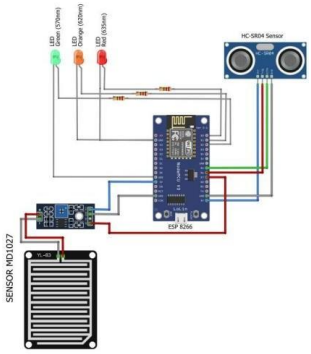

Figure 8 Hardware circuit

Figure 8 is a series of hardware used in making an early flood detection tool. The ultrasonic sensor is placed in the box to detect standing water, while the rain sensor, LED and ultrasonic sensor are placed outside the aquarium.

Tool View

Gambar 4. 23 Tampilan Alat dari atas

Figure FiguFigure 9 Tool Display

Figure 9 is appearance tool from on Where outside the box is there NodeMCU ESP8266and MD0127 sensor for detect rainwater intensity , ultrasonic sensor is in the middle Close the box facing up down For detect waterheight . Figure 4.24 is a side view of the tool to determine the height of the water being heldand will be read by the ultrasonic sensor.

Design Trial

From the tool design that has been made,several things that might happen in the field will be tested, so that the performance resultsfrom the tool design can be seen. As forimplementation the test includes :

NO	PERCOBAAN	PEMBACAAN	LEVEL	LED
1.	Percobaan 1	0-30 %	Hujan ringan	Hijau
2.	Percobaan 2	30-60 %	Hujan sedang	Orange
3.	Percobaan 3	60-100 %	Hujan tinggi	Merah
4.	Percobaan 4	0-5 cm	Very low	Hijau
5.	Percobaan 5	5-10 cm	Low	Hijau
6.	Percobaan 6	10-15 cm	Medium	Orange
7.	Percobaan 7	15-20 cm	High	Orange
8.	Percobaan 8	20-25 cm	Very High	Merah

In the table above, the overall design test wascarried out 8 times with different condition results. In experiments 1-3, it was carried outwith the results of water intensity readings on the MD0127 sensor, experiment 1 with a reading of 0-30%, which is the lowest point in calculating rainfall intensity, the intensity obtained was light rain, the LED that lit up was green with. Experiment 2 with a readingof 30-60% is a calculation of rainfall intensity, the intensity obtained is moderate rain, the LED that lights up is orange. experiment 3 with a reading of 60-100%, which is the lowest point in calculating rainfall intensity, the intensity obtained is high rain, the LED that lights up is red. Experiment 4-8 is an experiment to determine the water level whenit rains. In experiment 4 with moderate rain intensity, the water level reading is 0-5 cm, which will produce a very low flood level, the LED will light up green. In experiment 5 withmoderate rain intensity, the water levelreading is 5-10 cm, which will produce a lowflood level, the LED will light up green. In experiment 6 with moderate rain intensity, the water level reading is 10-15 cm, which will produce a medium flood level, the LED will light up orange. In experiment 7 with moderate rain intensity, the water levelreading was 15-20 cm which would produce ahigh flood level, the LED would light up orange. In experiment 4 with moderate rain intensity, the water level reading was 20-25 cm, which would produce a very high flood level, the LED would light up red.

NO	PERCOBAAN	Status	ISI PESAN
1.	Percobaan 1	Hujan Ringan	Hujan Ringan
2.	Percobaan 2	Hujan Sedang	Hujan Sedang
3.	Percobaan 3	Hujan Deras	Hujan Tinggi
4.	Percobaan 4	Tinggi air 0-<5cm	Very Low jarak : 5 cm, potensi banjir 10%
5.	Percobaan 5	Tinggi air 5-<10cm Low	jarak : 10cm, potensi banjir 30 cm
6.	Percobaan 5	Tinggi air 10-<15cm Medium	jarak : 15 cm, potensi banjir 50%
7.	Percobaan 7	Tinggi air 15-<20cm High	jarak : 18cm, potensi banjir, 70%
8.	Percobaan 8	Tinggi air 20-<25cm Very High	

			jarak : 22cm, potensi banjir 90 %		

Uji Coba Quality of Service (Qos)

Quality of Service (QoS) in research This used For measure how much Good deep internet network send package or data. Tested parameters namely Throughput, Packet Loss,Delay, and Jitter. Following table results testing Qos by the author :

NO	PARAMETER	WAKTU	NILAI	INDEKS	KATEGORI
1.	Throughput (bps)	60 detik	1947	4	Sangat Bagus
2.	Packet Loss (%)		0	4	Sangat Bagus
3.	Delay (ms)		3.084	4	Sangat Bagus
4.	Jitter (ms)		3.088	3	Bagus

shows the QoS data carried out by the author, Throughput Parameters got value of 1947 bps, Packet Loss gets value 0%, Delay gets value 3084 ms , and Jitter gets value 0.28 ms. The Throughput, Packet Loss and Delay parameters received an index value of 4 and were categorized as very good. Meanwhile, Jitter gets an index score of 3 and is categorized as good for sending packets overthe internet network.

Conclusion

Based on the conclusions that have beenmade, the information, the system can calculate water levels ranging from 0 cm to 25 cm. The designed water level set point is 15 cm to 25 cm for flood detection and 15 cm and below for safe conditions. 3. The early flood detection tool is designed to work automatically in sending warnings to users via Telegram when the water level reaches a specified threshold. The notification that appears on Telegram is in the form of data obtained from the reading results of the two sensors sent to the NodeMCU ESP8266 which can also be seen in the Blynk application.

following decisions can be made:

1. This system successfully implements IoT technology to monitor early flood conditions in real time. The working principle of this equipment is that the use of the NodeMCU ESP8266 as the main microcontroller allows the integration of the MD017 sensor as arainwater intensity detector connected to an ultrasonic sensor as a water level calculator and data communication via the internet. When the ultrasonic sensor detects incoming water (flood) and the water level has reachedthe specified set point, the ultrasonic sensor will send distance data to the NodeMCU8266.
2. The MD0127 sensor is used to detect rainwater intensity, while the ultrasonic sensoris used to measure water height. The integration of these two sensors with NodeMCU allows water level detection which is an indicator of potential flooding. The MD0127 sensor is able to work by detecting water levels and producing water

3 water level clusters, namely light, medium and heavy. Meanwhile, ultrasonic sensors work based on the principle of sound waves. When the sensor sends a sound wave signal tothe water surface, the wave will be reflected back to the sensor after reaching the water surface and produce a signal again. The signal travel time from sending to receiving is used to calculate the distance between the sensor and the water surface. With this distance

Suggestion

This design still has many shortcomings, therefore the following are several suggestions that can be given to improve the design, including:

1. Given the system's dependence on a stable internet connection, it is recommended to consider using various network redundancy methods such as cellular connections (4G/5G) in addition to Wi-Fi to ensure the systemcontinues to function even if there is a disruption to one of the networks
2. It is recommended that users carry outroutine checks on the MD0127 sensor and ultrasonic sensor so that the sensor provides accurate data in real-time.
3. Integration with notification platforms is recommended to be more diverse, for exampleSMS and email to reach users who may not have access to Telegram. And developing a more sophisticated notification system with additional features such as flood locations and providing more detailed data visualization.

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