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Earthquake monitoring system based on Wemos D1 Mini with notification via WhatsApp

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Earthquake monitoring system based on Wemos D1 Mini with notification via WhatsApp

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Abstract. This prototype is a development from previous research with notification via WhatsApp on earthquake vibration detectors. This prototype consists of a power supply circuit as a voltage source and a voltage converter from AC to DC voltage, the Wemos D1 Mini microcontroller as the control center for all the components contained in the prototype, the SW-420 vibration sensor functions to convert the vibration source into a digital signal. Wemos D1 Mini is already equipped with wifi in it so that it can connect to the internet. If the sensor detects vibration, it will be sent directly to the microcontroller in the form of a digital signal and then send a WhatsApp notification to an Android smartphone in the form of a message. Earthquake monitoring system based on Wemos D1 Mini with notification via WhatsApp and using the SW-420 vibration sensor can detect small vibrations to large scale vibrations and immediately sound an alarm horn. With the Wemos D1 module which is directly connected to the internet, this tool can send notifications via WhatsApp with the help of the platform from Twilio. This prototype is also equipped with an LED as an indicator. Hopefully this tool can help the community a lot, especially in earthquake-prone areas.

keywords: Wemos D1 Mini; SW-420 Vibration sensor; Twilio; Horn; LED

1. Introduction

Earthquakes are disasters that often occur in Indonesia[1]. Earthquakes in Malang are classified as frequent occurrences with the order of 133 at the National level. Earthquakes can occur anytime, anywhere, and cannot be predicted. The impact caused by earthquakes can be minimized through earthquake disaster education. Earthquakes have been recognized by the wider community as a high-risk natural disaster and after the existence of this tool, efforts are made to reduce the risk of accidents due to earthquakes. Indonesia is one of the countries in Southeast Asia that frequently experiences earthquakes. Indonesia is prone to earthquakes because it is located on three plates, namely the Eurasian Plate, the Pacific Plate, and the Indo-Australian Plate[2]. The purpose of this tool is to monitor the occurrence of earthquakes when the initial vibration is still small so that it can warn residents or the public so that there is no panic and can prepare themselves to save themselves, relatives, or family and can also save valuables so that no material loss occurs. 3]. The design of the tool is an earthquake monitoring system based on Wemos D1 Mini with whatsapp notifications. The results of the tool show an effective simulation method in detecting earthquake vibrations [4]. With this tool, it is expected to reduce the risk of accidents due to earthquakes and minimize the impact of disasters as well as improve preparedness efforts and strategies in dealing with earthquake disasters [5]. The advantage of this tool over existing tools is that it is connected to the internet and can send notifications via whatsapp, which is the most widely used communication application today[6]. And this tool is equipped with a horn or siren that can sound loudly and an LED indicator as a warning for users and people who hear the siren alarm. Based on previously existing technological innovations, it is necessary to update the notification [7]. With the "Wemos D1 Mini Earthquake Monitoring System With Whatsapp Notifications" this can send notifications via whatsapp by directly connecting via the internet. Sending notifications via whatsapp uses the twilio platform which can be accessed in the browser and pythonanywhere as a python language web that is read by twilio. On this twilio platform we will create ID and Auth tokens which will later be used in the Wemos D1 Mini coding so that they can be synchronized with each other[8].

2. Method

Earthquake Monitoring System Flowchart:

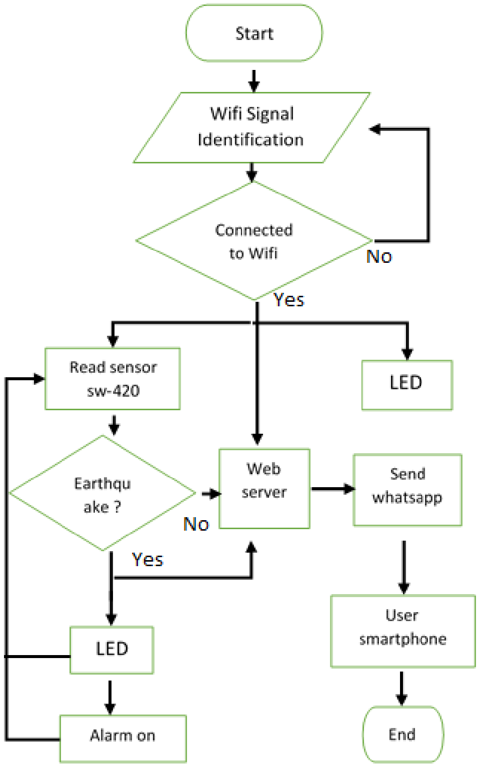

Figure 1. Earthquake monitoring system flowchart

The design of the Wemos D1 Mini Earthquake Monitoring System tool with Whatsapp Notifications is based on the internet of things that is compatible with Arduino. In this system, the microcontroller uses the Wemos D1 Mini to function as a data processing center and communicates data to the web server and then sends notifications to smartphones. The following is an image of the design and wiring for the design of the Wemos D1 Mini Earthquake Monitoring System Tool with Whatsapp Notifications:

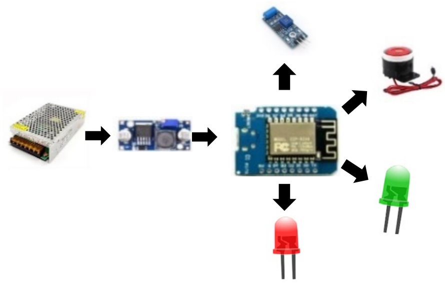

Figure 2. Design tool design

From the picture above, it can be seen that the components used are power supply, LED, LM-2596 stepdown module, Wemos D1 Mini, horn and DC 5v alarm.

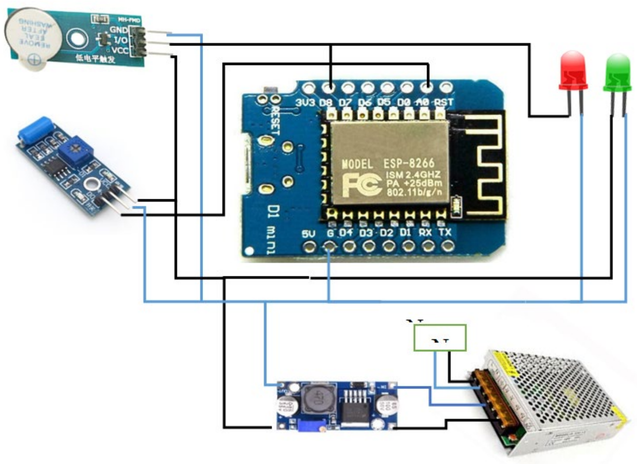

Figure 3. Wiring tool

The following is a table for mapping the component legs and voltage sources:

Table 1. Mapping the stresses of each component

No	Component	Voltage Source
1	Power Supply 12 Volt	PLN 220 Volt
2	Converter Step Down	Power Supply 12 Volt
3	Regulator 5 Volt	Power Suplly 12 Volt
4	Wemos D1	Regulator 5 Volt
5	red and Green LEDs	Pin wemos D1
6	Siren alarm	Pin wemos D1
7	Sensor SW-420	Pin Wemos D1

Table 2. I/O pin placement on the microcontroller

No	I/O Components	Pin I/O	Pin Wemos D1 Mini	Information
1	Siren alarm	Vcc	Vcc	Pin D8 which is the pin out of Wemos D1 is the pin that is connected to all I/O pins of the alarm, and the red led.
		Ground	Ground	
		Data	D8	
2	Sensor SW-420	Vcc	Vcc	
		Ground	Ground	
		Port I/O	A0	
3	Green LED	Ground	Ground	
		Vcc	Vcc	
4	Red LED	Ground	GND	
		Vcc	D8	
5	LM 2596	Output +	Vcc	
		Output -	GND	
		Input +	220 VAC	
		Input -	220 VAC	

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3. Results and Discussion

3.1 Power Supply Test

The power supply test is carried out with the intention of knowing the output voltage of this power supply is in accordance with the desired or not, namely the range of 12 Volt DC. By connecting with a voltage of 220 vac at the input and measuring the output voltage with an avometer. The following is a table of measurement results:

Table 3. Power supply voltage measurement results

Digital Avometer		**Analog Avometer**	
In	**Out**	**In**	**Out**
223 Vac	10.8 Vdc	225 Vac	11 Vdc
Note: VOLTAGE OK (APPROPRIATE)		Note: VOLTAGE OK (APPROPRIATE)	

3.2 LM-2596 . Stepdown Module Testing

Testing the LM-2596 module is intended to determine whether the output voltage value is in accordance with the desired or not, namely the range of 3-5 Volt DC. By connecting to the output voltage of the power supply, which is 12 vdc at the input of the module and measuring the output voltage with an avometer.

Table 4. LM-2596 . voltage measurement results

Digital Avometer		**Analog Avometer**	
In	Out	In	Out
10.8 Vdc	3.58 Vdc	11 Vdc	4 Vdc
Note: Voltage Ok (Appropriate)		Note: Voltage Ok (Appropriate)	

3.3 SW-420 . Sensor Testing

Sensor testing intends to determine the results of the voltage sent to the microcontroller when an earthquake occurs and the suitability of the system performance that has been designed. The testing steps are as follows:

a. Connect wemos D1 with laptop.
b. Upload the program sketch according to the design.
c. Connect the sensor with pin A0 on wemos D1
d. Provide a voltage source on the wemos D1 . microcontroller
e. Take stress measurements when an earthquake occurs
f. Record the measurement results in the table

The earthquake parameter used is MMI (modified mercalli intensity) which uses visual assessment, international earthquake parameters. GIS (earthquake intensity scale) which already has PGA (Peak Ground Acceleration) units and already includes MMI in it made by BMKG[9].

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Table 5. MMI scale standards from the official BMKG website[10]

No	Skala SIG BMKG	Color	Simple Description	Detailed Description	Skala MMI	PGA (gal)
1	I	White	NOT FEEL (Not Felt)	Not felt or felt only by a few people but recorded by the device.	I-II	< 2.9
2	II	Green	FEEL (Felt)	Felt by crowds but did no damage. Hanging light objects swayed.	III-V	2.9-88
3	III	Yellow	Slight Damage	Non-structural parts of the building suffered minor damage, such as hair cracks on the walls, tiles sliding down and some falling.	VI	89-167
4	IV	Orange	MODERATE DAMAGE	Many cracks occur in the walls of simple buildings,sebagian collapsed, broken glass. Some of the plaster of the walls came off.	VII-VIII	168-564
5	V	Red	HEAVY DAMAGE (Heavy Damage)	Most of the permanent building walls collapsed. The structure of the building was heavily damaged. Curved railroad tracks.	IX-XII	> 564

This measurement was carried out 5 times from the 1 MMI scale to the 5 MMI scale according to the MMI scale table from the BMKG official website.

Table 6. Results of experimental data and voltage values

No	Testing	Nilai Analog	Voltage	Skala MMI
1	1	200	1.57 Vdc	I-II
2	2	200	1.57 Vdc	I-II
3	3	38	0.20 Vdc	I
4	4	124	1.22 Vdc	I-II
5	5	1024	3.55 Vdc	IV-V

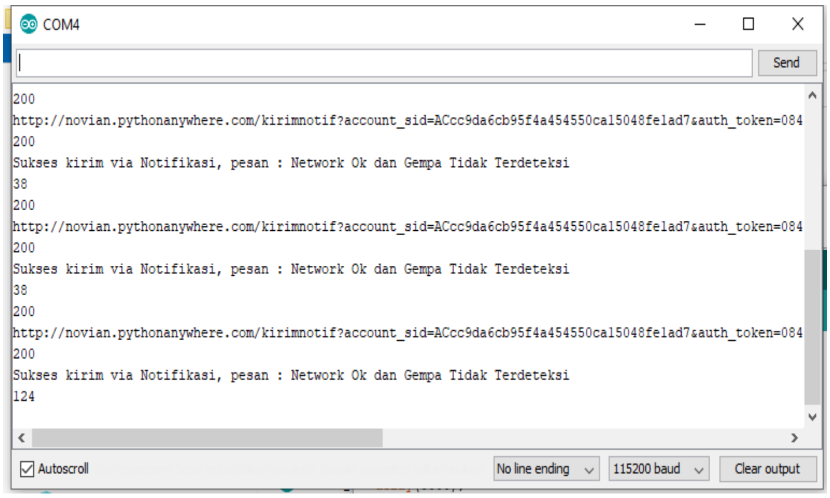

Figure 4. Arduino serial monitor reading results from the SW-420 . sensor analog output

3.4 Wemos D1 Mini Monitoring System and Microcontroller Testing

This test aims to determine the ability of the wifi connection and the Wemos D1 Mini microcontroller interface with twilio to a smartphone. This test uses three different smartphones and three different provider cards. The test results can be seen in the table below:

Table 7. Experimental results of hotspot connection with different smartphon

No.	Type Smartphone	Provider	Range (m)	Trial to - 1	2	3	4	5	Experiment place
1	Vivo 1802 Memori Internal 32 GB	3 Indonesia (Three)	2	1	1	1	1	1	Sawahan Village, Kec. Mojosari Mojokerto City
2	Realme 5 Memeri Internal 64 Gb	Telkomsel	2	1	1	1	1	1	
3	Oppo A83 Memori Internal 32GB	Indosat	2	1	1	1	1	1	

a. Condition 1 states that wifi communication is successfully connected between wemos D1 and android

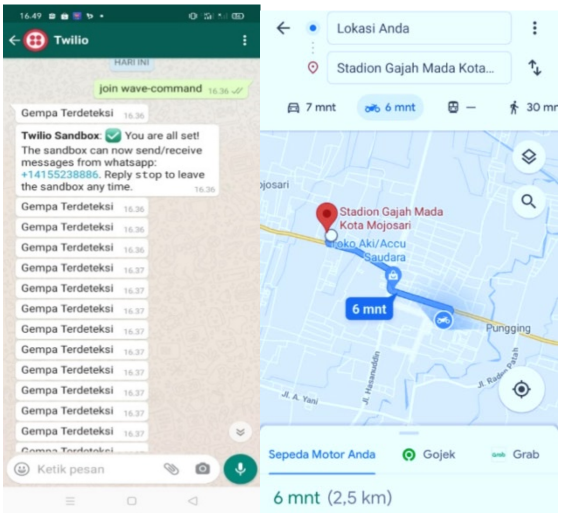

Figure 5. Notification test with a distance of 2.5 Km

This test was carried out using a Realme 5 smartphone with the position of the tool at the user's house at the address Sawahan village, Mojosari Mojokerto city and the location of the smartphone is at the Gajah Mada Mojosari stadium with the total distance between the device controller and the smartphone is 2.5 Km. in this test the tool can send notifications well to the smartphone.

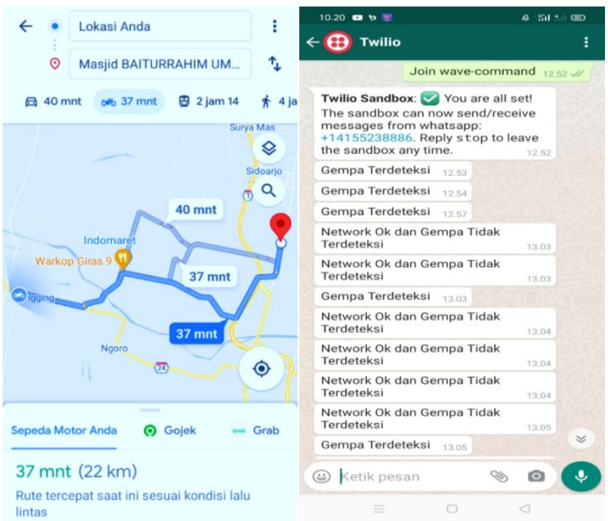

Figure 6. Notification testing with a distance of 22 KM

This test was carried out using a Realme 5 smartphone with the smartphone positioned on Campus 2 of Muhammadiyah University of Sidoarjo with the tool located at the address of Sawahan village,. Mojosari Mojokerto city with the total distance between the tool controller and the tool is 22 Km. in this test the tool can send notifications well to the smartphone.

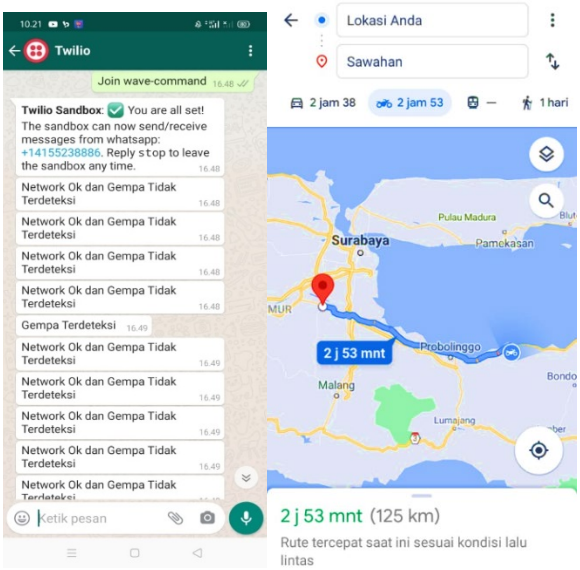

Figure 7. Notification Test with 125 Km. Distance Km

This test was carried out using a Realme 5 smartphone with the position of the tool in Sawahan Village, Mojosari Mojokerto city and the position of the smartphone is in Pandean Village, Paiton Probolinggo city with the total distance between the tool controller and the tool is 125 Km. in this test the tool can send notifications well to the smartphone.

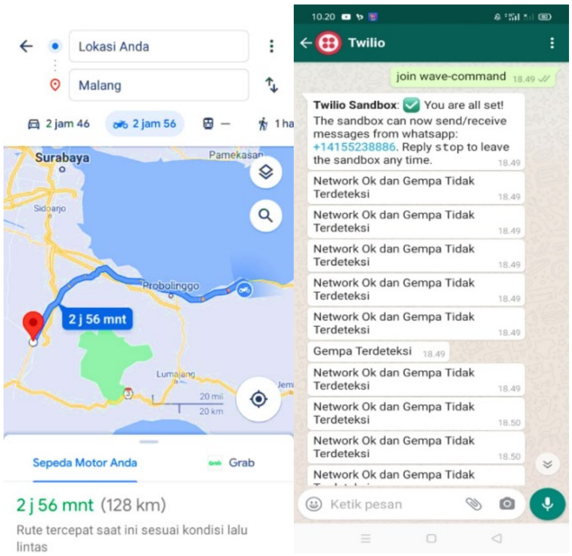

Figure 8. Testing Notifications with a distance of 128 Km

This test was carried out using a Realme 5 smartphone with the position of the tool in Pandean Village, Paiton Probolinggo city and smartphones are located in Malang City with the total distance between the device controller and the device is 128 Km. in this test the tool can send notifications well to the smartphone.

3.5 Led Test

LED testing is done to find out whether the LED used is lit or not. The working voltage of the LED used is about 3-5 vdc. There are 2 LEDs used, namely the red LED and the green LED. This test is done by connecting the out voltage (+) from LM-2596 on the positive leg of the LED and the out voltage (-) to the negative leg of the LED.

3.6 Horn Test or Alarm Sirine

LED testing is carried out to determine whether the horn used is lit or not. The working voltage of the horn used is 4-5 vdc. This test is carried out by connecting the out voltage (+) from the LM-2596 on the positive horn leg and the out voltage (-) to the horn negative leg.

3.7 Testing Entire Tool

This test is carried out to find out whether the tool as a whole is running well or not. Test tools include Power bank and Earthquake monitoring system tools that have been designed with the effectiveness of easy and practical use (can be seen in Figures 4.1 and 4.2). Test method: The test was carried out on the road in the factory area of PT. LNK in Pesanggrahan Village, Kec. Mojosari Kab. Mojokerto, where the monitoring system equipment is placed on the side of the road or on the sidewalk which is passed by container trucks of different weights at a distance of 50cm, 100cm, and 200cm from the roadside. By referring to the MMI scale table, you can see the test results in the table below.

Table 8. The overall test results of the tool

No	Truck Type	Distance(cm)	Jarak(cm)	Skala MMI
1	Container Truck	50	Detected	III
2	Tronton Truck	50	Detected	III
3	Forklift	50	Not detected	I-II
4	Container Truck	100	Not detected	I-II
5	Tronton Truck	100	Not detected	I-II
6	Forklift	100	Not detected	I-II
7	Container Truck	200	Not detected	I-II
8	Tronton Truck	200	Not detected	I-II
9	Forklift	200	Not detected	I-II

From the table above, it can be seen that the results show that the earthquake detected by the sensor readings is a truck that produces vibrations on the MMI scale III and is not detected because the vibrations generated based on the MMI earthquake scale are classified as mild or from the I-II scale. The above test also shows that the distance between the source points of the vibration/earthquake has an effect on the tool. Based on several tests that have been carried out, it can be concluded that in the manufacture of this tool overall it runs well.

4. Conclusion

Based on the results of testing and data analysis carried out, conclusions were obtained from the Wemos D1 Mini-Based Earthquake Monitoring Tool with Whatsapp Notifications as follows: Wemos D1 transfers the data received by the SW-420 sensor via the tethering hotspot of the WiFi network. The data will be sent to the pythonanywhere web server and then forwarded to the web twilio which will then be processed. The data that has been processed via twilio will be sent to the whatsapp number listed in the arduino sketch program. The tool can monitor real-time network connections and state status as long as we are connected to the twilio API.

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