Design of Earthquake Early Warning System Based on Internet of Thing

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Abstract. Earthquake Early Warning is needed to reduce casualties and material losses. In this research, a system of earthquake disaster early detection system with vibration sensor and fuzzy algorithm is designed that is run on a microcontroller. In this study, the results of vibration measurements are obtained which are posed by earthquake vibrations and simulated in real time. This tool still needs to be developed and further calibrated to get perfect results.

1. Introduction
Indonesia is a country with a high level of earthquake risk because it is located on a layer of the earth that is prone to earthquakes. The Indonesian archipelago is located in the vicinity of a volcano which is still widely active as a trigger for earthquakes [1].

With these conditions, Indonesia must have technology in early detection of earthquake natural disasters. This technology has earthquake sensors installed in earthquake prone areas in Indonesia. Current tools and technology are still expensive, so researchers have made a breakthrough to design a tool with a sensor that is simpler and cheaper but has good reliability.

This research was conducted to find solutions in overcoming the above problems. With this technology, sensors can detect natural signs as early signs of an earthquake. With an early warning system or disaster mitigation, it can be faster because it is connected to the internet [2].

1.1. Formulation of the problem
The formulation of the problem in this research are as follows:

• Application of earthquake disaster mitigation sensors use a microcontroller based internet of things.
Designing technological innovation as an effort to improve the nation's competitiveness in the field of information and communication technology for disaster mitigation.

1.2. Interest Study
The purpose of this study include:

- Implementation of vibration sensors to detect earthquakes that internet of things based on the sensor data more quickly processed and sent to the control room server or authorities. So that disaster management becomes faster.
- Designing a prototype technology in the form of hardware (hardware) and software (software) to detect earthquakes.

2. literature Review
2.1. Microcontroller
The microcontroller used in this study is the ATMega 328 produced by the Atmel company which specifically produces microcontroller ICs with low power consumption and memory using flash memory technology. This ATMega 328 microcontroller is specifically used with the Arduino Uno board so that it is easy to program in C language [3][4].

![Figure 1. Physical Form Arduino Uno](image)
The following is the pin arrangement of the ATMega 328 IC:

![Arduino Pin Mapping](www.arduino.cc)

![Figure 2. Pin ATMega 328](image)

### 2.2. Vibration sensor

The vibration sensor is a device which serves to detect the vibration and to be converted into an electrical signal. This sensor is also called casing measurement. The sensors used are seismic sensors transducers, the sensor is used to measure speed and acceleration. To measure the speed using velocity probe and probe, while for measuring acceleration using the acceleration sensor probe [5].

Principle of velocity probes work according to the laws of physics that if a conductor / coil surrounded by a magnetic field and then conductors move to a magnetic field or magnetic fields move to the conductor it will cause an induced voltage in a conductor. When the transducer is placed on the machine that vibrates, then even this will be vibrating transducer, so that the coil is in it will move relative to the magnetic field so that it will produce an electric voltage to the coil wire ends. By processing the electrical signal and transducer, the vibration can be measured [5].

![Figure 3. Vibration Sensor](image)
2.3. The Internet of Thing

Internet of thing is something that is connected to the internet [6], where all electronic objects can communicate and exchange data with one another either using a server or without a server. In this study, the internet of thing functions as a control center that receives data from the vibration sensor which is processed by a microcontroller that is connected to the internet network to the server. The server then processes the data and presents in the form of an earthquake alarm or early warning to internet users who have access to the server.

![Figure 4. The Internet of Thing](image)

3. Result and Discussion

The following is a block diagram of an earthquake detector. This tool has a microcontroller to process data received from the earthquake sensor. The output of this tool is an alarm as an earthquake early warning system connected to the IoT which has a database server. The data from the server is then sent to the user’s smartphone that has access to the IoT server.

![Figure 5. Block Diagram of Earthquake Early Warning](image)
Table 1 below is the test results of the vibration sensor when the conditions get a simulated vibration from an earthquake and when it does not get a vibration. The output voltage from this sensor is processed by the microcontroller.

**Table 1. Testing Vibration Sensor**

| Vibration | Logic | Voltage (V) |
|-----------|-------|-------------|
| Weak      | 0     | 1.5         |
| Strong    | 1     | 2.5         |

Vibration Sensor Testing Program

```c
void loop ()
{
  // variable digital data readout of data is output from the
  sensor data = digitalRead (pinSensor);

  // if the data is a logic HIGH or 1
  if (data == 1)
  {
    // buzzer lit.
    digitalWrite (pinBuzzer, LOW);  
    digitalWrite (pinBuzzer, LOW);
  }

  // if not
  else
  {
  
    // buzzer dead
    digitalWrite (pinBuzzer, HIGH);
    digitalWrite (pinBuzzer, HIGH);
  }   
}
```

4. Conclusion

Earthquake detector serves to detect the earthquake. The main components of this tool is a vibration sensor that detects vibration in case of an earthquake. This initial vibration as a signal early warning system to provide alarms and notifications via the Internet. This can be done because the system is based on internet of things.

References

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