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EQUIPMENT OF EARTHQUAKE DETECTION AND WARNING WITH VIBRATION SENSOR

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Abstract: The purposes of writing this paper are to determine: (1) the working principle of vibration sensors can detect impending earthquakes, (2) the sensitivity or the sensitivity of the tool when used in detecting the vibration of an earthquake, (3) demonstration tool Earthquake Detection and Warning with vibration sensor has good meets criteria for use students learn. The method of this research is an a demonstration tool in learning. The basic principle of work and warning earthquake detector with a vibration sensor this is when an earthquake occurs or when the dynamo (earthquake simulator) is started, the resulting vibrations cause movement of the pendulum. This pendulum movement is what will trigger the sound of the bell. When the pendulum movement causes the pendulum in contact with the copper wire ring, then the electricity will flow toward the bell. When electricity flows into the bell will arise in the membrane vibration in the bell. A vibrating membrane will produce resonance which then led to a wave. This wave is what produces the sound on the buzzer. Pendulum vibration frequency is closely related to the magnitude of the voltage / potential difference given input on the dynamo that causes the rotor to rotate. Increasing the voltage will increase the rotational speed of the rotor on a large dynamo. The faster the rotor rotation, the vibration of the pendulum will be even greater. This resulted in the pendulum will be faster and more frequent touching circle copper wire which is connected electricity and bell. Thus the buzzer will sound increasingly rapid and dynamic. The results of the experiment are the greater the number of loops and the greater the voltage will cause a greater rotational speed of the rotor is generated, so that the greater the pendulum vibrations and buzzer / alarm to sound more dynamic. Detector and earthquake warning with vibration sensor has a sensitivity to the number of loops starting from 2 pieces with a 3V input voltage and is capable of detecting an earthquake of ≥3,6 SR. Based on the results of the assessment of a demonstration tool detection and warning of earthquakes with vibration sensor was found that the maximum value that is filled by a validator is 39. It can be concluded that the demonstration tool detection and warning of earthquakes with vibration sensor is included in good criteria for the use of students in learning.

Keywords: detection and warning of the earthquake, vibration sensor

1. INTRODUCTION

In historiography, Indonesia is the region of the earthquake and tsunami subscription. Tectonically, the Indonesian archipelago lies at the confluence of three tectonic plates world that Eurasian plate, the Indo-Australian plate and the Pacific. According Kertapati (2004: 23) Indo-Australia plate moves relative to North direction relative to the Eurasian Plate (7.0 cm / yr), the Pacific Plate and the Philippine Plate in the East moved west both rested on the bottom plate periphery of Southeast Asia (10 cm / yr), as part of the Eurasian Plate.

According to Sri (2009: 25), the movement of large plates in the form penumpuan and bumped raises some subduction zones and fracture surfaces. Besides this movement will free up some of the energy that had accumulated for so long suddenly, where the process of releasing the cause tremor with diverse values. Thus the consequences of the order that makes the Indonesian archipelago into areas prone to earthquakes, and even prone to tsunamis.

Many lives and property lost when the big earthquake. The earthquake and tsunami from Aceh, Nias, Yogyakarta and parts of Java had a lot of casualties. One example of earthquake magnitude is large enough earthquake that shook the region of Yogyakarta and Central Java in May 2006. At that time DIY earthquake rocked for 57 seconds with a force of 5.9 on the Richter scale. According Haifani (2008: 285) the

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impact of the quake resulted in 5,743 people died and 38 423 people were injured.

Earthquakes cannot be predicted time of occurrence. This is due to the earthquake can occur suddenly in an earthquake zone. To minimize the impact of the earthquake required the existence of an early warning system (early warning system) that serves as an emergency alarm or warning at any time if there was an earthquake. Currently the only earthquake detector owned by certain agencies, so the earthquake information cannot be directly up to the community and caused people to be confused if an earthquake happens or not. Muhammad (2012: 96) adds that the current monitoring system of earthquakes conducted by the Bureau of Meteorology, Climatology and Geophysics (BMKG) only recording earthquakes that are being or have been happening so it is difficult to suppress the casualties and damage caused by lack standby ready to face earthquakes. Therefore, needed a tool that could provide warnings of impending earthquakes which can be installed in any place, especially in houses so that people can take steps to deal with such disasters and to suppress and minimize casualties.

In the era of globalization, advances in science and technology are quite rapid. It is characterized by electronic devices used by the public is able to facilitate the work. According Brathwaithe cited by Fitri (2013: 2) states that in the study of physics, electronics and instrumentation has the potential to contribute to the development of science and technology is appropriate for the product results from the work of students who are useful to society, both in the industrial, scientific and field a common one with making tool to detect the existence of an earthquake.

Based on the above be the main driver for designing an earthquake warning and detection equipment using vibration sensors. By applying the concept of physics as its base, the tool is able to provide great benefits in the community. The working of the vibration sensor is a combination of mechanical and electronic circuit design. The design of the system that will be done is a design-oriented low cost simple design. Vibration sensor is a simple sensor that consists of a pendulum made of metal and slabs of a circle that serves as a catcher vibrations resulting from the earthquake and flow of electric current. Based on the descriptions exposed above, will be designed detectors and warning of earthquakes by using a vibration sensor.

2 LITERATURE REVIEW

2.1 Framework of thinking

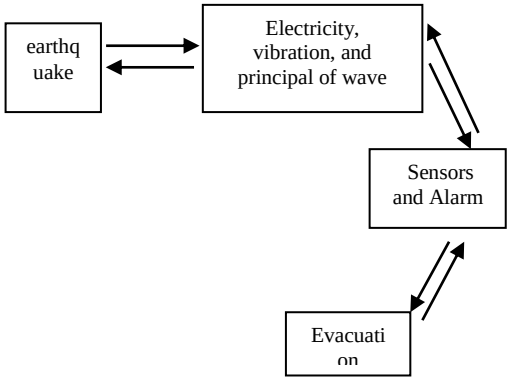

Figure 1. Framework of thinking

2.2 Earthquake

The earthquake is a natural event that occurred vibrations at the surface (skin) of the earth caused by the release of energy suddenly from the epicenter (endogenous force). Based on the cause of earthquakes are classified into:

1. Tectonism
2. Volcanism

Seisme Bayong (2013) states, according to the occurrence, earthquakes are classified into the following.

1. Preliminary Earthquake
2. The Main Quake
3. Aftershocks.

2. 3 The Principle of vibration and waves

Vibration is experienced alternating movement of an object towards a point of equilibrium. When the vibrations propagate, then it generates a wave. The influence of vibrations and waves affect the functioning of the detectors and the warning of this quake. When the earth shook, and the vibrations propagate in the Earth's plates, thus generating seismic waves, the resulting energy propagation propagate to all parts of the earth. The effect caused by the presence of such seismic waves,

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move or breakage tectonic plates, which we are familiar with the term earthquake.

From the state of the Earth vibrating plate, the pendulum on an earthquake warning detectors and will move and vibrate. Pendulum vibration causes the pendulum touches the circle electrical copper wire connected, and the bell. So the sound of the bell sign earthquakes have been/is going. Inside the bell, there is also the concept of wave, in which electricity flows on the bell produces vibrations on the membrane inside the bell, which causes resonance at around membrane. Resonance around the membrane generates longitudinal waves. The result buzzer sounded loud to us.

2.4 The principle of the center of mass

In the detector and warning of this quake is used pendulum aka (conical pendulum) as a determinant sensor is connected and electricity to the entry of the bell. This is because the cone shape has a sharp tip. When the taper placed below, and then tie the cone at its upper end, the cone tends to remain in position (fixed straight edges). This happens because of the emphasis on the cone body is ¼ of the height of the cone. High cone located on the y-axis, so that conical object will remain strong if tied to a cable (upper bound).

2.5 Vibration sensor

According to Sharon (1982), quoted by Irnanda (2013: 4), the sensor is a device that serves to detect gejal symptoms or signals originating from a change in energy. Physical sensors detect a magnitude based on the laws of physics. Bayong (2013: 19) said sample Physics sensors include light sensors, audio sensor, pressure sensors, motion sensors, temperature sensors and vibration sensor / vibration. Vibration sensor is a simple sensor that consists of a pendulum and a slab of a circle. Pendulum made of metal which can flow of electric current, functions as a catcher vibrations resulting from earthquakes. When an earthquake of a given magnitude occurs, the pendulum will vibrate and then touches the circular plate.

2.6 Motor DC

Motor current (DC) is a device that receives energy in the form of electric transmission and channel the energy in the form of mechanical energy / effort in the form of round (Serway, 2010: 571).

In the DC motor that applies persamaan2 magnetic field, torque and rotational speed. Magnetic field

$$B = \frac{\mu_o NI}{2\pi r_1}$$

Torsion

$$\tau_{maks} = IAB$$

Results maximum torque is valid only when the magnetic field is parallel to loop. Clockwise rotation if the direction of current is reversed, the direction will be reversed his style and tendencies rotation will be counter-clockwise.

Playback speed

The linear velocity v of an element associated with the angle speed (ω) through v = rω. Therefore

$$\omega_n = \frac{V_n}{B_n lr}$$

2.7 Demonstration Tool as Media for Learning

Robert Heinich in Musfiqon (2012: 26) in his book, "Instructional Media and Technologies for Learning" defines, media is the channel that connects information between the source and recipient information. In this sense the media is defined as communication facilities, which can clarify the meaning between the communicator and the communicant. The National Education Association (National Education Association / NEA) have a different understanding. Media are forms of communication, both printed and audio-visual and equipment (Arief S. Sadiman, 2009: 7).

According McKnown in Musfiqon (2012: 34), there are four functions of a medium of learning, namely:

1. Changing the focus of formal education, ie education that emphasizes on academic instructional into education that emphasizes life needs of learners
2. Generating motivation of learners
3. Provide clarity (clarification)
4. Provide stimulation (stimulation)

According to Gagne in Daryanto (2010: 16-17) media are classified into seven groups, which **objects to be demonstrated**, oral communication, print media, still images, moving images, sound film and machine

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learning. The seventh group learning media is associated with its ability to fulfill the function according to a hierarchy of study developed, namely the stimulus thrower learn, towing interest in learning, examples of learned behaviors, giving external conditions, leading the way of thinking, put over science, assessing achievements and giving feedback

3 RESEARCH METHOD

The method of making a tool used in the study is a demonstration tool in learning.The method of making these tools for sensitivity or sensitivity to know when the tool is used in detecting the vibration of the earthquake seen from the potential difference. Demonstration method to demonstrate the concept of Vibrations and Waves and concepts Center Mass or point of weight, that is when the earth shakes or when the earthquake simulator (dynamo) is turned on, vibrations propagate in the Earth's plates will cause the pendulum to move and vibrate and cause the pendulum touches the circle copper wire connected electricity, and bell. So the sound of the bell sign earthquakes has been / is going.

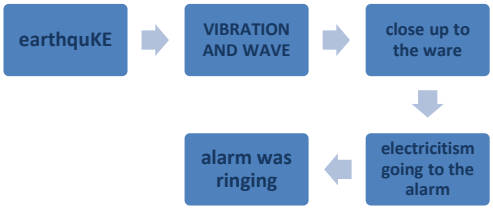
Research carried out starting with the preparation stage, which includes literature review and prepare the tools and materials needed to make the detector and earthquake warning with vibration sensors. The next stage is the making of a series of detectors and earthquake warning with vibration sensors. At this stage it will be testing tools as well as data retrieval. Then in the last stage of this research is the analysis of data**.** This demonstration tool perhaps to have good criteria for students.

4 DATA ANALYSIS

Based on the research that has been implemented then obtained the following results:

Figure 2. Tools of Earthquake Detection and Warning

Work Principal



Qualitative Data

Based on the chart, we concluded the greater the voltage or electrical voltage which issued the greater the rotational speed is generated. The power supply voltage has an important role in detection equipment and earthquake warning with vibration sensors this by increasing the voltage will cause greater rotational speed, this has resulted in increasingly large pendulum vibrations and buzzer / alarm will sound more dynamic from the observational data it can be concluded that based on the number of loop voltage variation detector 2 pieces and earthquake warning with vibration sensor has a sensitivity with a starting voltage of 3 V to the number of loops 2 pieces. In his research Irnanda (2013) states that the input voltage of 5 V is able to detect an earthquake of magnitude 6. Thus the tool is able to detect an earthquake is $\frac{3}{5} \times 6SR = 3{,}6SR$.

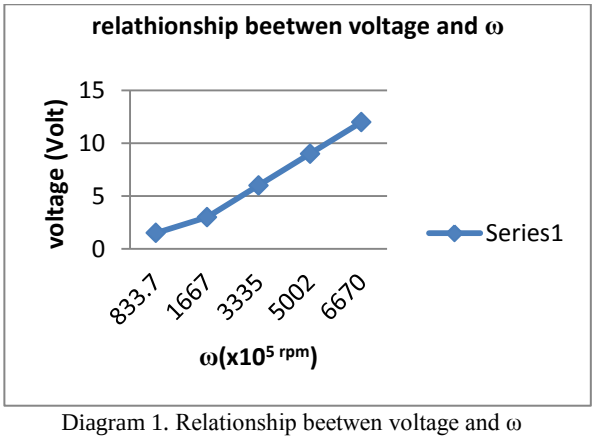


Diagram 1. Relationship beetwen voltage and ω

Demonstration Tool Earthquake Detection and Warning with Vibration Sensor has Good Meets Criteria for Use Students Learn

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Beads of assessment validation and warning earthquake detector with vibration sensor in Annex 2 covers three aspects: the display, the aspect of conformity with the matter physics experimental tools as well as aspects of the success rate of the use of demonstration tools.

Based on the evaluation of the detector and warning earthquake vibration sensor was concluded, among other things:

1. Display Aspects

Detector and earthquake warning with vibration sensor judged from the aspect look good already meet the criteria which includes the selection of the type of materials that are easily obtainable, component layout has been arranged with props as well as visual display of props was simple and uncomplicated.

2. Aspects of Compliance Viewer tool with Matter Physics and Community and Student Needs

Based on the results of the validation, and warning earthquake detector by using a vibration sensor in accordance with the basic principles of the physics of matter that is the subject of Vibrations and Waves, Point Weight, Playback Speed (ω). Goals developed detection and warning of earthquakes with vibration sensors that facilitate the public in general to anticipate the occurrence of an earthquake so as to minimize the impact of the quake. In the other hands, this tool compliance with student needs.

3. Aspects Success Rate Using Viewer Tool

Detector and earthquake warning with vibration sensors have been successfully demonstrated in particular physics concept shows the effect of input voltage variation of the rotational speed (ω) is generated and can detect and alert terjadinyan earthquake through the alarm. The greater the input voltage will cause the rotor further rotates rapidly and irregularly. Thus the pendulum vibration will be greater and the alarm will sound faster and dynamic.

The total amount of the item of validation is 10. The highest score achieved for the overall ideal is (10 x 5 = 50), the ideal minimum score achieved is (10 x 1 = 10), with a mean ideal (Mi) 30 and the standard deviation of the ideal (Sbi) 6,67.

Based on the results of the assessment of a demonstration tool detection and warning of earthquakes with vibration sensor was found that the maximum value that is filled by a validator is 39. It can be concluded that the demonstration tool detection and warning of earthquakes with vibration sensor is included in good criteria for the use of students' learn.

5 CONCLUSIONS

The working principle and warning earthquake detector with a vibration sensor this is when an earthquake occurs or when the dynamo (earthquake simulator) is started, the resulting vibrations cause movement of the pendulum. This pendulum movement is what will trigger the sound of the bell. When the pendulum movement causes the pendulum in contact with the copper wire ring, then the electricity will flow toward the bell. When electricity flows into the bell will arise in the membrane vibration in the bell. A vibrating membrane generates resonance which then led to a wave.

This wave is what produces the sound on the buzzer. Pendulum vibration frequency is closely related to the magnitude of the voltage / potential difference given input on the dynamo that causes the rotor to rotate. Increasing the armature voltage will increase the rotational speed of the rotor on a large dynamo. The faster the rotor spins, the vibration of the pendulum will be even greater. This resulted in the pendulum will be faster and more frequent touching circle copper wire which is connected electricity and bell. Thus the buzzer will sound increasingly rapid and dynamic.

Detector and earthquake warning with vibration sensor has a sensitivity to the number of loops starting from 2 pieces with a voltage of 3V (3,6SR). Based on the results of the assessment of a demonstration tool detection and warning of earthquakes with vibration sensor was found that the demonstration tool detection and warning of earthquakes with vibration sensor is included in good criteria for the use of students in learning.

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