

# Prosiding AASEC ACCELEROMETER

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## Accelerometer Sensor Applications Early Warning System Train Accidents due to Landslide at Laboratory Scale

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**Abstract.** Railway is a means of transportation that is favoured by the people. Accidents often occur in provinces Jawa West, Central Java, East Java and Banten. The cause of the accident because of the location of heavy rain and soil in the landslide. The purpose of this study was to design an early warning accelerometer sensor on the railway line and test validation early warning accelerometer sensor on the railway. Methods real-time create an early warning system for landslides that is easy to use and effective in detecting landslide, using sensors and microcontrollers accelerometer arduino. It can be concluded that the early warning system (early warning system) works digitally, real-time, and effective response to the reading of less than 1 second, the average error of the accelerometer sensor reading is 0 to 3.84%.

### 13 Introduction

Indonesia is a country that many valleys, hills and volcanoes. So every year, Indonesia has many natural disasters landslides. Landslides are forming material movements rocky slope, material destruction, soil, or the mixture of materials, move down or out the slopes, where landslides often take casualties [1]. With the above considerations it would need for tools that can detect landslides. By using the early warning system is expected symptoms naturally arising in connection with natural disasters such as landslides can be detected as early as possible. Thus the possibility of casualties due to landslides can be avoided.

Similarly, landslides occurred on the railway is very dangerous. Genesis is found date year to year because the train is a means of transportation that is favored by the people. [2], [4] Landslides are common in Indonesia. Landslides often occur in the rainy season. Landslides are common in mountainous and hilly areas. Longor soil research is often done by researchers of geology, geography, and civilians [1].



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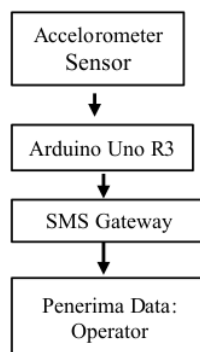
Early warning system for this is still limited, only the sirens, and officials called for the evacuation and long landslides. This system can only read 1 cm landslides. The previous study [2], [3], [5], [6], [7], [8], [9] discusses the tilt sensor can detect objects accelerometer. Objective, accelerometer sensor design early detection of landslides on train, both detect the slope landslides railway line.

## 2. Research methodology

### 2.1. Design of Sensor Accelerometer

Application design in a landslide early warning system there are several stages: first, Designing accelerometer sensor on the early warning system crash due to a landslide on the railway. Second, testing the slope of the cliff sensor accelerometer railway crossings.

Design and testing of sensor outline contained in the block diagram in Figure 1 below.

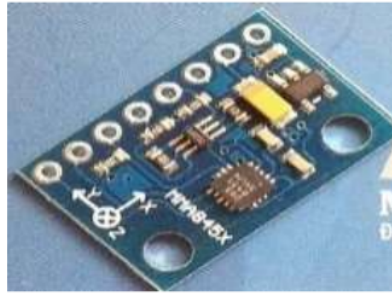


**Figure 1.** Block diagram of accelerometer sensor EWS caused by landslide

Figure 1 is a block diagram workflow accelerometer sensor Early warning system by landslides. Arduino microcontroller connected to an accelerometer sensor as a tool to measure the tilt angle. Data processing such as elevation, slope angle made by the microcontroller as per the order desired by the user, after which the data will be sent in the form of SMS to the driver via a GSM modem in case of landslides, and SMS notification indicator as an indicator of the occurrence of landslides.

### 2.2. Equipment and Materials

In this study used tools and materials as follows: the first Accelerometer Sensor 2.2 MMA845X. It is IC sensor accelerometer MEMS (Micro Electro-Mechanical System) capacitive 3-axis (triaxial / 3-axis MEMS capacitive accelerometer) power saving with a resolution of 14 bits which has a sensitivity range that can be set user between  $\pm 2g$ ,  $\pm 4g$ , up to  $\pm 8g$ .



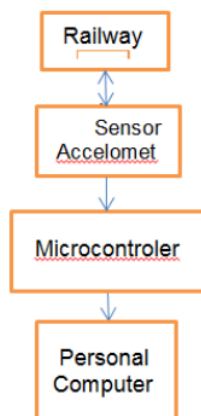
**Figure 2.** Accelerometer sensor

Accelerometer module (of speed / acceleration) MMA845X have LDO voltage regulator / Low-dropout voltage regulator in an integrated 3.3 Volt so that these modules can be turned on by the power supply between 3.6 V to 6 Volt DC. To communicate with the sensor module, the microcontroller/system (Arduino, Raspberry-Pi, etc.) Can be connected via I2C interface capable of operating up to speed 2.25. There frees microcontroller interrupt function of time wasted to collect data (continuous polling data), an interrupt can be set to generate an interrupt trigger signal (wake up interrupt signal) of one or a combination of events (event-driven interrupt) that enables these sensors to monitor the condition while in power saving mode, thus this module is very suitable for use in portable electronic devices are powered by batteries. The second, Microcontroller Arduino Uno R3 Arduino Uno R3 is a microcontroller board based ATmega328. The Arduino Uno Have 14 input pin of digital output, 6 pin input can be used as PWM outputs and 6 analog input pin, 16 MHz crystal oscillator, a USB connection, a power jack, ICSP header, and a reset button. To use the Arduino simply connect the USB cable from the computer to the arduino, but it can also use the adapter and battery. For arduino programming language using the C language and open source. specifications Arduino Uno R3: Microcontroller Atmega 328, operation with 5V power, input voltage (recommended) 7-12V, Input Voltage (limits) 6-20V Digital I/O Pins 14 (6 provide PWM output) Analog Input Pin 6, DC Current per I / O Pin 40mA, When 3.3V Pin 50 mA DC, Flash Memory 32 KB (ATmega328) that is used by bootloader 0.5 KB, 2 KB SRAM (Atmega 328), 1KB EEPROM (ATmega328) and 16 MHz Clock Speed.



**Figure 3.** Microcontroller Arduino Uno R3

2 Arduino Uno R3 can be powered via the USB connection or with an external power supply (automatic). External (not USB) power can come either from the AC-to-DC adapter or battery. The adapter can be 3 connected by plugging a jack plug positive center measure 2.1 mm connector POWER. The head end of the battery can be inserted into the GND and Vinpin header from 4 power connector. The range of power requirements suggested for the board Uno is 7 to 12 volts, if given a 14 power of less than 7 volts possibility of pin 5V Uno can operate but unstable then if given more power than 12V, the voltage regulator could overheat and damage the board arduino uno. Testing sensor using a microcontroller Figure 7 above is an early warning system hardware separately from the PC and has been through the wiring phase, the next step is downloading the program and is ready for use and the assembly to the tube or container songsor as artificial avalanche simulation. The component parts of the hardware: the accelerometer sensor, arduino uno R3 and serial to USB converter cable DB9 male pin. After assembling at the stage of programming hardware then proceed stage (coding) in which the desired structure is in accordance with the flowchart contained in the report by using PC and software or application arduino generation 1.6.5 to complete the library of any hardware components used in early warning system caused by landslide.



**Figure 4.** Accelometer sensor testing program with the PC hardware

In Figure 4, a PC with hardware testing program in which a microcontroller connected to a PC singa serial cable DB9 male to USB type. The reading of the tilt angle can be displayed on the monitor using the serial arduino generation software 1.6.5. Hardware resources early warning system is derived from the voltage PC, different after the program uploaded to the hardware will use its own power supply. This programming running on a PC with an operating system windows 7 ultimate version.

### 3. Results and Discussion

Accelerometer Sensor Testing Tests using the tilt angle sensor accelerometer sensor as a value to be compared with the reading ruler arc as a comparison, using three parameters measured by the angle of the cliff and the third parameter landslide mass of the object in order to get results more accurate data errors. The measure 10 it as follows:

- 30 degrees (mass 1 = 10Kg, mass 2 = 20Kg, mass 3 = 30Kg)
- 45 degrees (mass 1 = 10Kg, mass 2 = 20Kg, mass 3 = 30Kg)
- 60 degree (mass 1 = 10Kg, mass 2 = 20Kg, mass 3 = 30Kg)

**Table 1.** Data accelerometer sensor error

No	The tilt angle cliff	Massa object landslides	The final result of	The final value of the actual	Error
1	30°	10Kg	13°	12,5°	3.84%
2	30°	20Kg	15°	14,25°	5%
3	30°	30Kg	26°	25,25°	2.88%
4	45°	10Kg	15°	14,25°	5%
5	45°	20Kg	20°	19,5°	2.50%
6	45°	30Kg	25°	24,75°	1%
7	60°	10Kg	22°	21,75°	1.13%
8	60°	20Kg	28°	27,5°	1.78%
9	60°	30Kg	37°	36,25°	2.02%

On testing the accelerometer sensor, generating value up and down, then the value is used to determine the error is the highest value. Can be seen in Table 1 the difference between the final results accelerometer sensor readings with actual end value or the value of a ruler arc. The resulting error values are not too big, it is still below the tolerance in general with the percentage of error values must not be more than 5%. It can be concluded the reading of the angle of the accelerometer sensor, stable and effectiveness is still good.

**Table 2.** Data Testing Sensors Accelerometer.

No.	The tilt angle cliff	Massa object landslides	Accelerometer sensor angle changes			Ruler arc	Object speed landslides
			Early	Supreme	End		
1	30°	10Kg	0°	177°	13°	12,5°	3,73s
2	30°	10Kg	0°	178°	12°	11,75°	3,75s
3	30°	10Kg	0°	177°	13°	12,5°	3,74s
4	30°	20Kg	0°	183°	15°	14,25°	3,52s
5	30°	20Kg	0°	185°	14°	13,5°	3,56s
6	30°	20Kg	0°	181°	14°	13,5°	3,51s
7	30°	30Kg	0°	197°	24°	23,25°	3,23s
8	30°	30Kg	0°	198°	26°	25,25°	3,27s
9	30°	30Kg	0°	196°	23°	22,75°	3,22s
10	45°	10Kg	0°	187°	14°	13,5°	2,66s
11	45°	10Kg	0°	185°	14°	13,5°	2,69s
12	45°	10Kg	0°	183°	15°	14,25°	2,67s
13	45°	20Kg	0°	190°	20°	19,5°	2,35s
14	45°	20Kg	0°	194°	18°	17,5°	2,36s
15	45°	20Kg	0°	193°	19°	18,75°	2,39s
16	45°	30Kg	0°	203°	23°	22,75°	2,18s
17	45°	30Kg	0°	206°	24°	23,25°	2,16s
18	45°	30Kg	0°	204°	25°	24,75°	2,15s
19	60°	10Kg	0°	193°	22°	21,75°	1,53s
20	60°	10Kg	0°	194°	22°	21,75°	1,55s
21	60°	10Kg	0°	192°	21°	20,25°	1,57s
22	60°	20Kg	0°	201°	26°	24,75°	1,21s
23	60°	20Kg	0°	205°	28°	27,5°	1,24s
24	60°	20Kg	0°	203°	27°	26,25°	1,23s
25	60°	30Kg	0°	213°	37°	36,25°	1,08s
26	60°	30Kg	0°	216°	36°	35,5°	1,06s
27	60°	30Kg	0°	211°	35°	34,5°	1,05s



In Table 2 shows that changing the object's speed landslides influenced by the increased mass of the object landslides and increased steepness of the cliff. The greater the mass of the object landslide, the faster the object avalanche fell. So even also with increasingly steep cliff slope angle, the faster the object avalanche fell.

#### 4. Conclusion

Based on the design and testing of the accelerometer sensor arduino microcontroller early warning system against accidents due to landslides we can conclude: first, the test results the average percentage error (error) on the accelerometer sensor readings ranged from 1 to 3.84%, the second greater the mass of the object landslides, the faster the object avalanche fell. So even also with increasingly steep cliff slope angle, the faster the object avalanche fell.

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#### References

- [1] Yulianto, Thomas (2010) Analysis of the causes of railway accidents and preventive efforts that can be done, Research Reports, UAJY
- [2] Ismail A, 2014, Metering Systems and train speed using accelerometer sensor MMA7361 as a means of information for passengers, Faculty of Engineering University Research Journal Brawijawa, Malang
- [3] Alimuddin, Anggoro Surya Pramoedya, Eko Hadi Santoso, 2014, Design Build in Flood Early Warning Ssystem, Proceedings of the Nation Seminar on Microwave Antennas and Propagation (SMAP), the Department of Electrical Engineering University of Mercubuana Jakarta.
- [4] Ahmad danil Effendi (2008) Identification of Genesis landslide And Key Factors Determining Cause In District Babakan Madang, Bogor regency., Department of Forest Management. Bogor Agricultural Institute
- [5] Nunik Hariyanti, Nurwiyanti Kusumaningrum, 2008, Apikasi accelorometer 3 AXIS for measuring the angle of inclination (TILT) engineering model of the satellite on the Water Bearing, Journal Vol.10 # 2 October 2008 Tesla, in Electrical Engineering Suryadharma University, Jakarta.
- [6] Floreal Yuwono, wahyudi, Andri Akhiuyanto 2010, Development of Personal Computer-Based Accelerometer to determine the characteristics of Sprint Using Wireless Technology, Professional Journal, Vol 8 no May 1, 2010, ISSN 1693-3745
- [7] Rio Riantana, Hanief Beta, Weskita Cahya and Darsono, 2015, the Android app as registrar earthquake vibration online, Journal of Physics and Applications, Volume 11 Number October 3, 2015, the Faculty of Mathematics, University of March, Surakarta.
- [8] Huang Libin, Yang Gao in 2015, Research on Surface Mounting technology of Silicon Micromechanical Resonant Accelerometer, Indonesia Journal of Elecrical Compterr Engineering and Science (IAES) Vol 11, 5 May 2015
- [9] Didik R, Santoso, Sukirr Maryanto, Ahmad Nahir, 2013, Application of Single Mems Accelerometer to measure 3-axis and 2-axis Vibrations Tilt-Angle Simultaneously, Vol 13, No 2 June 2015 Telkomnika, ISSN 1639-6930, A accredited by the Higher Education, Decree 58 / DIKTI / Kep / 2013, DOI: 10.12928 / TELKOMNIKA v.1312.1490.



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