

A Sensor-Based of Detection Tools To Mitigate People Live in Areas Prone to Landslide

Satryo Budi Utomo , ST.,MT, 1 Januar Fery Irawan , ST.,M.Eng. 2
1Lecturer of Electrical Departement, Faculty of Engineering , Jember University
E-mail: satryo.budiutomo@yahoo.com,
2Lecturer of Civil Departement, Faculty of Engineering , Jember University
E-mail: januar_ir@yahoo.com

Abstract— Landslide that occurred in the district of Panti, Jember is still leaving concerns the people in the region are affected by the loss of lives and huge material losses. To anticipate the same loss in the future, it is necessary to increase the capacity of community through the establishment of early warning systems in areas prone to landslides locations. The long term goal of this research is to provide emergency response preparedness landslides, so that in the event of micro ground motion at the site of the landslide-prone, the public can readily evacuate to a safe place. By increasing the capacity of the technical aspects, the expected loss and damage caused by landslides can be minimized. The specific objectives are to produce a tool to improve early warning systems through disaster preparedness landslides. The research activity is to make a sensor-based of detection tools of landslides. The working principle of the tool is to know the movement of soil micro-automatically. This tool uses an Arduino to control the working of the entire system, and laser Photodiode sensor used for detecting a shift in the soil due to landslides. From the test results, the voltage available at the time the distance between the laser sensor and the sensor is 50 cm high from the seventh sensor voltage of 0.4 volts whereas when the distance between the laser and the sensor 600 cm is the seventh largest of the voltage sensor at 0:13 volts. This tool can work well in the detection sensor to ground movement.

Keywords— camera, arduino, photodiode, landslide, sensor, early, warning.

INTRODUCTION

Landslide problem has come out in the last decade, not only in Indonesia but also in other parts of the world. One reason is the degradation of land resources and land use patterns less attention to the preservation of nature. Another factor is climate change and some of extreme rainfall events that exceeded the carrying capacity of the land. The existence of a system of land resource development planning and monitoring practices plantation cultivation could anticipate and mitigate the negative impact of a landslide.

The impact of landslides in the area of coffee plantations could lead to another catastrophe derivatives of which are catastrophic flood downstream areas. In addition, the landslide will bring social conflicts between farmer with the community in surrounding area of plantation. On the other hand, farmers restrict land use in coffee plantations because landslides can narrow the utilization of land in the mountainous region. The development of land resources in the mountain range (land resources) requires the conception, design, planning, construction and operation of the means for controlling landslides and land use so that the land can be managed and governed in order to meet the objectives of comprehensive and integrated. Avalanche Control is the application of techniques of land resources so as not to cause excessive damage to agricultural resources and the environment. Land conservation are examples of land use (utilitization of land) for useful purposes.

Practice plantation cultivation in the hilly region has a strategic position in the development of agriculture, because about 45% of Indonesia in the form of hills and mountains with a very diverse topography. Various types of horticultural crops including coffee cultivated in the hilly region. In addition to providing benefits to millions of farmers, hilly land also play a role in maintaining environmental functions watershed (DAS) and a buffer area at the bottom. The use of early warning systems today is considered the best because it can send information to the community in the area prone to landslide. In each recording maps, information aspects of landslides and land use change can be presented in digital form. Thus this method can be used as a mitigation planning and monitoring of landslide earlier.

STUDY OF LITERATURE

SINMAP method generates that Panti village is prone to landslides. Results of analysis of dividing each - each index value stability of any region (per pixel DEM) according to the classification of class 6 stability index and then classified into three classes as the stability index

in the table in Figure 1. Coffee plantations located in Mount Gunung Pasang in Hyang Mountains Argopuro located Kemiri Village is a part of Panti District with a percentage of 91% prone to landslide. Coffee Plantation in that area expands of 576 thousand hectares with a production of 878 thousand tons based on data production in 2006.

In the past decade more, Landslide Detection Tool has been developed through a mechanical approach. Mechanical approach developed by several researchers in the field of landslides [1, 2, 3, 4, 5].The system used to detect ground motion using electrical extensometer, inclinometer and FBG strainmeter.

On the other hand, man can not be separated from the device-based digital electronics. The development of landslide monitoring has been integrated with the sophistication of the computer. Sensor landslide supported by the technology of single chip microcontroller system interfaces make computers become easier with internal facilities are getting better, including ADC, UART, timer / counter and others [6].

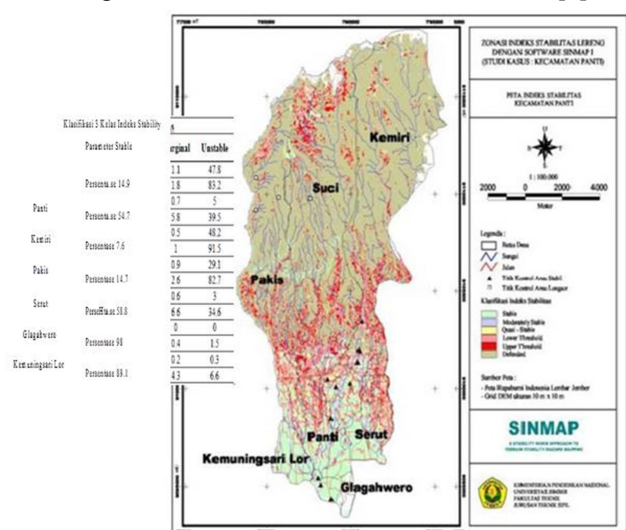


Figure 1. Index Map and Table of Land Stability Classification

Data acquisition system developed rapidly in line with advances in digital technology and computers. Existing data acquisition systems generally use a serial port connector, parallel or else to interface with the computer. While the laptop is now very difficult to find the connectors mentioned above and the average laptop new output provides only a USB connector. Besides speed of USB is very high, can reach 12 Mbps which is certainly far lebihcepat compared with a serial port (DB9) and Parallel ports that exist today. Seeing so many

uses data acquisition and with limited means of communication to a computer, the authors designed a data acquisition system based on microcontroller and a light sensor so that it can communicate with a computer via USB serial communication.

a. Identification of Landslide

Landslides are rock displacement, destruction of materials, forming tanahmaterial slope downward or exit slope [4]. Movement of soil is a geological event that occurs due to the movement of soil or rock mass making up the slope toward the foot of the slopes, as a result of the disruption of stability soil or rock slope composing is shown in Figure 3.

Identification of landslides according to geotechnical engineer requires analysis of slope and its relation to the geomorphology, geology, hydrogeology, climate and vegetation [7]. From the analysis should be taken as follows:

1. Classify the type of landslide will happen
2. Measure the physical properties of each landslide will happen
3. Measure the events that trigger landslides such as physical characteristics and mechanisms material landslides
4. Identify the glide distance and speed of movement
5. Identification of possible processes glide fast

The method used to identify the disaster include geomorphological mapping, collecting information chronology in topography, Geotechnology and climate, so that a disaster can be measured accurately. When disaster measure of glide very important to be able to estimate the distance of glide and speed. This factor determines the slide area and the ability to take rescue action. Distance depends on the characteristics glide slope, elevation, slope, material properties, the mechanism of debris and the type of movement (figure 3) and grooves slopes.

b. Landslide Detection Tool

The use of a detector as a tool to present information at any time make more effective disaster mitigation in disaster management. The landslide detector consists of tools Mechanics Avalanche Detection and Data Acquisition System.

Mechanical Parts landslide detector is used to measure the relative movement by comparing the difference in the distance between the two points with a reading accuracy of about 1 mm. The tool is installed at the location of cracks (crack) on the primary or secondary landslide crown to monitor surface deformation in the area. This tool can be set to trigger the siren sound after the relative movement reaches a certain distance. At one point anglemeter will be installed to monitor the slope due to ground movement. The main system is equipped with a tool box panel to prevent theft and protect the appliance from rain water, as shown in Figure 4 [8].

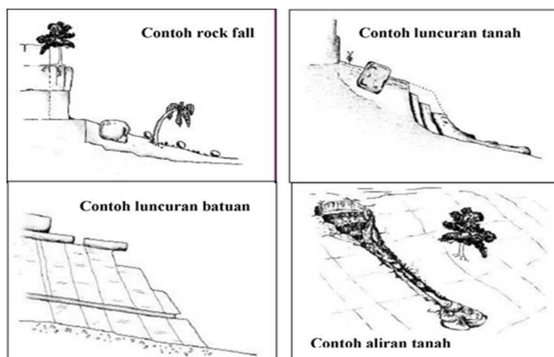


Figure 2. Type of Landslides [7].

How fitting extensometer is as follows: First, determine and select the fracture that will be installed

ektensometer ground and place on a foundation that has been created. Second, pull the wire ektensometer perpendicular transverse fracture that will be monitored and relate to concrete markers that have been made on the opposite side of the fracture, as shown in Figure 1. Third, connect keLogger that has been placed in a special box and then connect to the electric current or power adapter tool solar cell or battery [9].

Photodiode is a semiconductor light sensor that can change the amount of light into electrical quantities. Photodiode is a diode with a p-n connection influenced in his light. The light that can be detected by this Photodiode ranging from infrared light, visible light, ultra violet to X-rays. The working principle, because Photodiode made of semiconductor p-n junction, the light is absorbed by Photodiode will result in a shift of photons that will generate electron-hole pairs on both sides of the connection. When electrons are generated that go into the conduction band, the electrons will flow toward the positive voltage source. whereas the resulting hole flows toward the negative source = voltage so that current will flow in the circuit. The amount of the electron or hole pairs generated depends on the size of the intensity of light absorbed by the photodiode.

Photodiode is used as a component of detecting the presence or absence of light and can be used to form an accurate measuring instrument that detects the light intensity under the 1PW / cm² until the intensity above 10 mW / cm². Photo diode has a low resistance at forward bias conditions, we can utilize this photo diodes in reverse bias condition in which the resistance of photo diodes will fall in line with the intensity of incoming light.

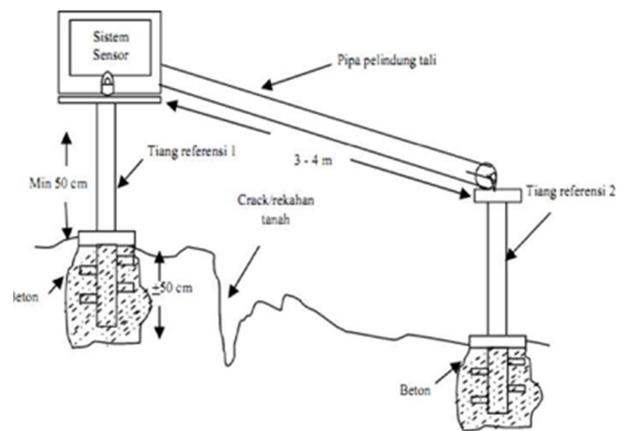


Figure 3. Schem of Detector Instalation

Light sensitive diode is a type of diode that serves mendeteksi light. Unlike the ordinary diodes, electronic components will change into an electric current. The light that can be detected by these light-sensitive diodes ranging from infrared light, visible light, ultra violet with X-rays. Light-sensitive diodes applications ranging from vehicle counters in jalanumum automatically, the light meter on a camera as well as some of the medical equipment field.

A similar Tool to sensitive diode is a photo transistor (phototransistor). Transistorfoto this is basically a bipolar type of transistor that uses the contact (junction) base-collector to receive light.

This component has a better sensitivity compared to diodepeka light. This is because the electrons generated by the photons of light padajunction is injected at the base and reinforced at the collector. However, the response time of the photo transistors will generally be slower than the light-sensitive diodes.



Figure 4. Photodiode

If the photo diode is not exposed to light, then there is no current flowing to the comparator circuit, if the photo diode is exposed to light, the photodiode will act as a voltage, so that Vcc and photo diodes arranged series and as a result the current flowing to the comparator circuit. Image sensor photodiode shown in Figure 5.

LED is a family of diode made from semiconductors. How it works is similar to the diode which has two poles, namely Positive pole (P) and the negative pole (N). LEDs will only emit light when energized forward voltage (forward bias) from the anode to the cathode to the LED consists of a semiconductor chip in doping thus creating junction P and N. The definition of doping in the semiconductor process is the process of adding impurities (impurity) on a pure semiconductor to produce desired electrical characteristics. When LED flowed forward voltage or bias forward is on the anode (P) to the cathode (K), excess electrons in the N-type material will move to the area with excess Hole (hole) ie areas that are positively charged (P-Type material). When electrons meet with Hole will release photon and the light emitting monochromatic (one color).

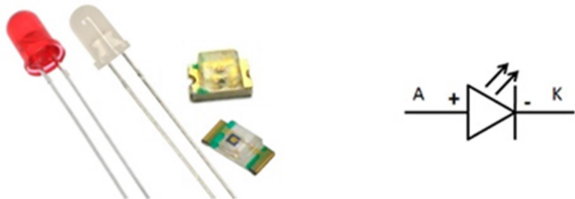


Figure 5. Form and Symbol for LED

LED or Light Emitting Diode which emits light when energized forward voltage can also be classified as transducers that can turn into Energy Electrical or Energy of light. Symbol and Shape LED (Light Emitting Diode) can be seen in Figure 6.

Single-board micro controller that is open-source, derived from the Wiring platform, designed to facilitate the use of electronics in various fields. Atmel AVR processor has hardware and software has its own programming language. Languages spoken in Arduino instead of assembler relatively difficult, but the C language simplified to help libraries (libraries) Arduino. Arduino also simplifies the process of working with microcontrollers and some advantages that should not chip device programmer because it is already boot-loader that will handle uploading of computer programs. USB has been a means of communication, so that laptop users who do not have a serial port / RS232 can be used. Have ready-made modules (Shield) which can be plugged into the arduino board. For example shield GPS, Ethernet, etc.



Figure 6. arduino nano

Arduino Nano there are two options with the Arduino Nano ATmega128 and ATmega328 which has a capacity of Flash memory that is different from the ATmega128

ATmega328 16Kbyte while the 32Kbyte, 512Kbyte EEPROM on the ATmega128 and ATmega328 are 1Kbyte and SRAM in the ATmega128 is 1 Kbyte The ATmega328 is 2Kbyte. Arduino used in the design of this tool is Arduino Nano with ATmega328 with a specification of the better ones. Arduino Nano board consists of 14 pieces of the channel I / O pins of which 6 can be used as PWM outputs and 6 pin to analog. IC configuration for Arduino Nano can be seen in Figure 7.

METHODOLOGY

The research was conducted through several stages, including : hardware design, testing tools in the laboratory, software design and data processing. Lines of inquiry at this stage is shown in Figure 8.

Equipment ground motion detection sensors can work automatically, with the way it works is when laser light is emitted to photodiode sensor was obstructed by objects automatically arduino will instruct the alarm to sound or alarm condition on. If instead the current incoming laser light sensor not obstructed by objects, then the condition alarm off. Thus the device can work automatically as shown in the flowchart illustrated in figure 7.

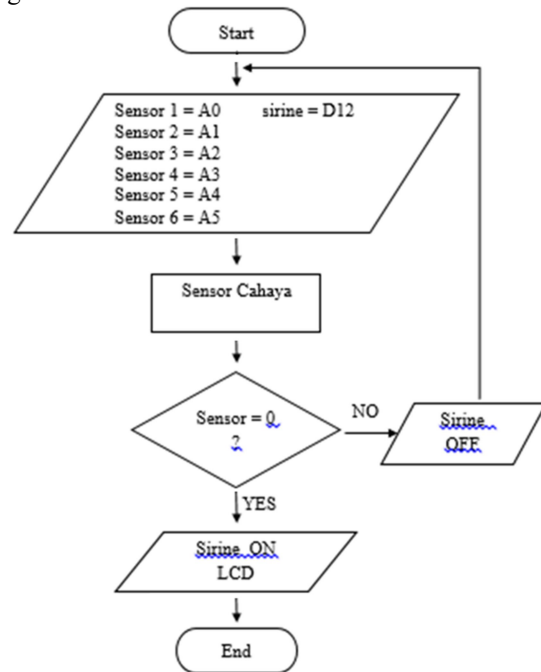


Figure 7. Flowchart through sensor

RESULTS AND DISCUSSION

The test series was conducted to determine the performance of the circuit itself, whether it is in accordance with what has been previously simulated or there are not appropriate. It is expected that the circuit can work well and can work optimally in the system.

The test results are shown in Table 1. The test voltage is done so that the voltage in accordance with what is required by each load so as not to damage the load used and the tool can work optimally. For load testing begins on checking power supply, sensors, laser and alarm.

Table 1. Voltage Test

No.	Tegangan			Arduino dan Lcd
	Sirine On	Sirine Off	Sensor Photodiode	
1.	14.9 volt	0 volt	5.02 Volt	5.02 Volt

Voltage of power supply is 14.9 volt and after through regulator become 5.02 volt, voltage of photodiode sensor is 5.02 volt, arduino dan lcd are 5.02 volt, and for alarm is as much as 14.9 volt.

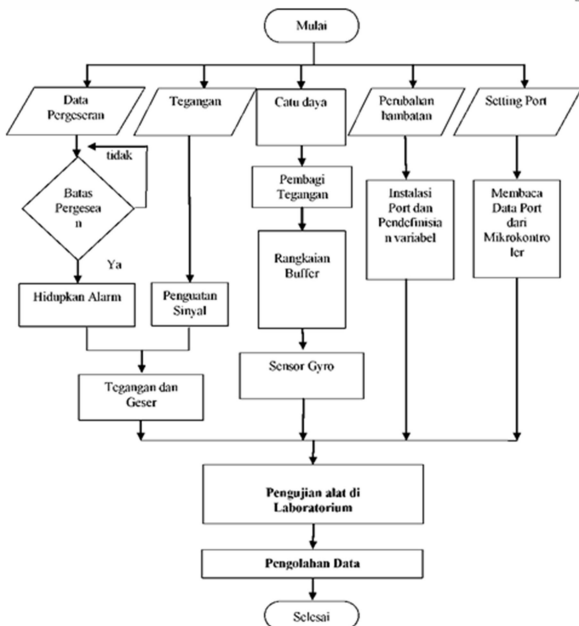


Figure 8. Flowchart of Research

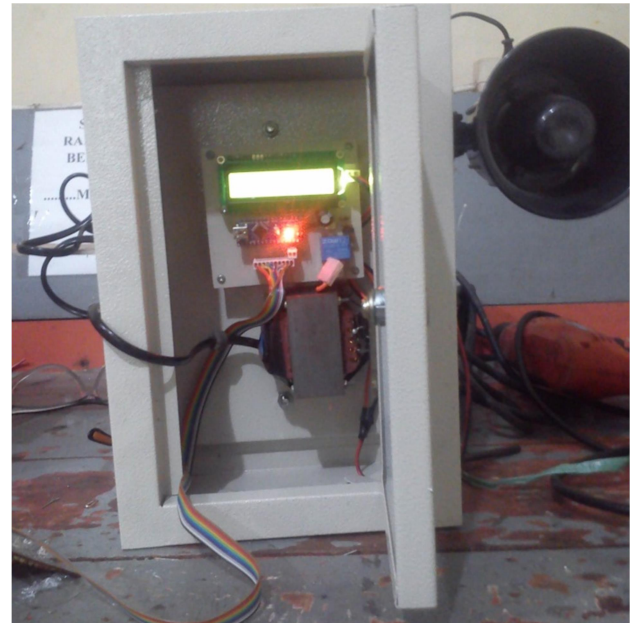


Figure 9. Design of Landslide Detection

The result of the test has been shown in Table 2. The results from the test has done for the voltage measurement at the start of the distance between the sensor and the laser sensor 50 cm to 600 cm. For the first measurement closest done when the distance between the sensor and the laser as far as 50 cm for the voltage data obtained each of the seventh sensor is a sensor 1 voltage measured 0.3 volts, the sensor 2 voltages measured 0.4 volts, the sensor 3 volts measured 0.3 volts.

Table 2 The Whole Examination

No.	Sensor photodiode	Jarak (cm)					
		50	100	150	200	250	300
1.	1	0.3 Volt	0.3 Volt	0.4 Volt	0.5 Volt	0.6 Volt	0.7 Volt
2.	2	0.4 Volt	0.4 Volt	0.5 Volt	0.6 Volt	0.7 Volt	0.7 Volt
3.	3	0.3 Volt	0.3 Volt	0.4 Volt	0.5 Volt	0.6 Volt	0.7 Volt
4.	4	0.3 Volt	0.4 Volt	0.4 Volt	0.5 Volt	0.6 Volt	0.7 Volt
5.	5	0.2 Volt	0.2 Volt	0.3 Volt	0.4 Volt	0.5 Volt	0.6 Volt
6.	6	0.3 Volt	0.3 Volt	0.4 Volt	0.5 Volt	0.6 Volt	0.6 Volt
7.	7	0.3 Volt	0.3 Volt	0.4 Volt	0.5 Volt	0.6 Volt	0.7 Volt

No.	Sensor photodiode	Jarak (cm)					
		350	400	450	500	550	600
1.	1	0.8 Volt	0.9 Volt	0.11 Volt	0.11 Volt	0.12 Volt	0.13 Volt
2.	2	0.8 Volt	0.9 Volt	0.11 Volt	0.11 Volt	0.12 Volt	0.13 Volt
3.	3	0.8 Volt	0.9 Volt	0.11 Volt	0.11 Volt	0.11 Volt	0.12 Volt
4.	4	0.8 Volt	0.9 Volt	0.11 Volt	0.11 Volt	0.12 Volt	0.13 Volt
5.	5	0.7 Volt	0.8 Volt	0.9 Volt	0.9 Volt	0.11 Volt	0.11 Volt
6.	6	0.7 Volt	0.7 Volt	0.8 Volt	0.9 Volt	0.11 Volt	0.11 Volt
7.	7	0.8 Volt	0.9 Volt	0.11 Volt	0.11 Volt	0.11 Volt	0.11 Volt

Voltage of Sensor 4, 5, 6, 7 is 0.3, 0.2, 0.3 and 0.3 volt respectively. For the final test, when the distance between the sensor and the laser 600 cm, the voltage data obtained each of the seventh sensor is 1 voltage measurable 0,13 volt, sensor 2 voltage measurable 0,13 volt, sensor 3 voltage measurable 0,12 volt, sensor 4 voltage measured 0,13 volt, the measured sensor 5 of voltage is 0,11 volts, the voltage measured sensor 6 is 0,11 volt, and the sensor 7 measured voltage 0,11 volt. The design tool is shown in Figure 9.

CONCLUSION

Based on discussion, it can be conclude that:

1. The voltage measured on the sensor when the distance between the laser and the sensor as far as 50 cm, the highest voltage of the seventh sensor at 0.4 volts while the current distance between the laser sensor with 600 cm, the highest voltage measured at 0:13 of the seventh sensor volts.
2. At the time of the test sequence, if the greater the distance between the sensor and the laser then the voltage measured on the larger sensor, and vice versa if jarak between multiple sensors with laser closer then that happens is the voltage measured on the smaller sensor.
3. In the overall test according to the data that has been obtained, it can work well without error.

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