The Application Performance of Landslide Detection Devices based on AT89S51 Arduino Microcontroller using Extensometer Sensor, Humidity and Vibration of Solar Energy Supply

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Keywords: Early Detection, Landslide, Disaster Mitigation, Solar Powered.

Abstract: The purpose of this research is to study the performance of early landslide detection devices based on arduino microcontroller AT89S51. This is related to the frequent landslide hazards caused by high rainfall, improper soil characteristics and soil tillage. Therefore it is necessary to preventive action is the existence of a tool that is able to monitor or detect any cracks and soil instability that has the potential to landslides. This research is carried out with a research and development approach. At the beginning of the study, the data needs analysis of soil shifting parameters. The design of landslide detection devices is constructed based on research that precedes and developed as needed in the field. Landslide early detection devices utilize extensometer sensors (detection of ground shift), humidity sensors and vibration sensors and AT89S51 arduino microcontrollers in the supply of electrical energy from the sun and equipped with GSM communication networks, and sirens as a warning sign of landslides. The result of the design of landslide detection device can work well with some limitations that is the maximum transmission signal coverage range of only up to 800 meters and soil moisture sensor has a percentage error value of 2.89%. The test results indicate that the warning sign through the buzzer will sound after 2.0 seconds from signal reception in the RX section, while the SMS gateway via mobile will appear after 2.5 seconds from signal reception in RX. Solar cell as a power supply in the transmission (TX) has a great benefit considering the location of TX is in the field, which is difficult PLN electricity but very much got sunlight during the day. The result of converting solar light energy into electrical energy will be stored on the akmulator / battery so as to provide energy requirements on the device at night.solar powered for disaster mitigation.

1 INTRODUCTION

In landslide areas, risk mitigation must often face problemsrelated to economical resources, environmental impact and logisticissues. This is particularly true for structural counter-measures, whichaim at mitigating the risk by reducing the probability of failure (bolts,anchors, piles etc.), by preventing the landslide from reaching theelements at risk (barriers, ditches, retaining walls etc.) or by reinforcingexisting buildings. On the other hand, early warning systems (EWSs) are an alternative cost-effective means to reduce the risk with a low environmental and economical impact. In some cases, for instance when a landslide is so large that it cannot possibly be stabilized, theycan even be the only solution. Indeed an efficient EWS should comprise the following activities. (DiBiagio and Kjekstad, 2007): (a) monitoring, including data acquisition, transmission and maintenance of the instruments; (b) analysis and forecasting, which can be done by using thresholds, expert judgment, forecasting methods and so on; (c) warning, i.e. the dissemination of understandable messages alerting for the impending threat; (d) response, concerning if people are able to understand and how they react to the warning. Therefore the need for landslide detection equipment that has the ability from the side of monitoring, forecasting, warning and response in detecting the movement of the soil to obtain information as early as possible. This paper examines the application performance of landslide detection devices based on AT89S51 arduino microcontroller using extensometer sensor, humidity and vibration of solar energy supply.

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2 METHOD

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This research is designed using a "research and development" approach that is a program that begins a research needs analysis, then developed a development program and test its effectiveness (Sugiyono, 2006).

For the design of this landslide early detection device in the first year through several stages as follows:

1. Device design of solar cell landslide detection equipment with extensometer, arduino soil vibration sensor and soil moisture sensor.
2. Design of landslide detection based on microcontroller AT89S51
3. Connection of telemetry radio landslide detection device with GSM communication network (SMS gateway), and buzer.

3 RESULT AND DISCUSSION

3.1 Result

After doing the research, the following results are obtained:

First, measurement of the output voltage of the solar cell module. The result is shown in Table 1.

Table 1: Test result of solar cell voltage.

Time	Voltage (VDC)
06.00 – 09.00	16.00
09.00 – 12.00	21.00
12.00 – 15.00	23.00
15.00 – 17.00	15.00
17.00 – 19.00	4.00

Second, measurement distance of data delivery of landslide detector. The result is shown in Table 2.

Table 2: Result of Distance of data delivery.

Distance of Data Delivery (Meter)	Sent	Not sent
1	1	0
10	1	0
20	1	0
30	1	0
40	1	0
50	1	0
60	1	0
70	1	0
80	1	0
100	1	0
200	1	0
300	1	0
400	1	0
500	1	0
600	1	0
700	1	0
800	1	0
900	0	1
1000	0	1

Third, measurement time taken of buzzer and SMS gateway. The result is shown in Table 3.

Table 3: Result of time taken sounds of buzzer and SMS gateway.

Time taken (second)	Sounds of buzzer (sirine)	SMS gate way
0	0	0
0,5	0	0
1,0	0	0
1,5	0	0
2,0	1	0
2,5	1	1
3,0	1	1
3,5	1	1
4,0	1	1

The component of hardware system is devided into three parts. The first, front view Box contains Microcontroller, BCR and Accumulator is appeared in Figure 1. Second, transmiter box landslide detection is appeared in Figure 2. Third, Sensors and Component landsilde detection appeared in Figure 3.

Figure 1: Front view Box contains Microcontroller, BCR and Accumulator.

Figure 2: Transmiter box landslide detection.

Figure 3: Sensors and Component landsilde detection.

3.2 Discussion

In this study telemetry function has been working as expected, if there is a signal from the sensor movement of the soil, vibration and soil moisture. The system can work from battery source / accumulator in charger using solar cell. This series of early warning systems is supplied using a 12V voltage from the accumulator battery. The arduino board here serves to operate extensometer sensors, ground vibration sensors and sensor sensors and telemetry radios. If there is a signal input from the sensor then the Tx part will send the signal to the receiver part so that the siren will sound, so also SMS Gateway will work sending sms warning to handphone. The test results show that the sirine first responds to 2.0 seconds after the receiver receives the signal from the transmitter. For signals to mobile phones the SMS warning takes 2.5 seconds after the signal is received in the receiver / Rx. An early landslide detection device is capable of transmitting signals at a maximum distance of 800 meters between the sender (TX) and the receiver (RX).

4 CONCLUSIONS

Land slide-based terrestrial detection software (land slide) based on solar AT89S51 microcontroller as disaster early information by using extensometer sensor, soil moistur

Information by using extensometer sensor, soil moisture sensor and ground vibration sensor. As for warning of landslide through siren device and SMS gateway.

Design of landslide detection device can work well with some limitations that is the maximum transmission signal coverage range of only up to 800 meters and soil moisture sensor has a value of percentage error of 2.89%. The test results indicate that a warning sign through the siren will sound after 2.0 seconds of signal reception in the RX section, while the SMS gateway via HP will appear after 2.5 seconds from signal reception in RX.

Solar module as a power supply in the transmission (TX) has a great benefit considering the location of TX is in the field, which is difficult PLN electricity but very much got sunlight during the day. The result of converting solar light energy into electrical energy will be stored on the accumulator / battery so as to provide energy requirements on the device at night.

After doing this research it is suggested the following things: In the selection of sensors must be considered accuracy so that when applied to the detection device the resulting error value is not too large; to obtain data that is real time and can be stored (restore) it needs to be equipped with computer database so that can be reviewed historical data; need the existence of solar tracking or sun tracker that is able to follow the movement of the sun to obtain maximum light emission for charging accumulator / battery.

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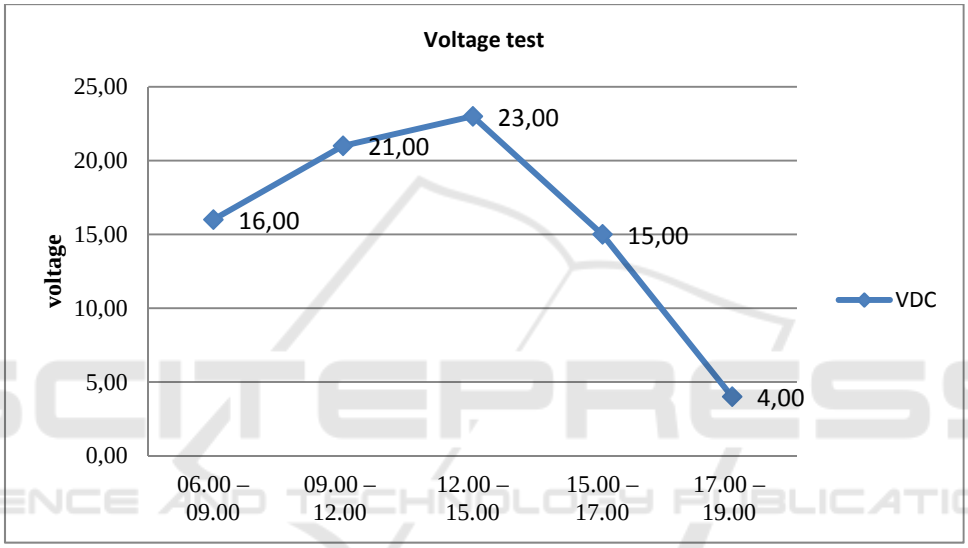
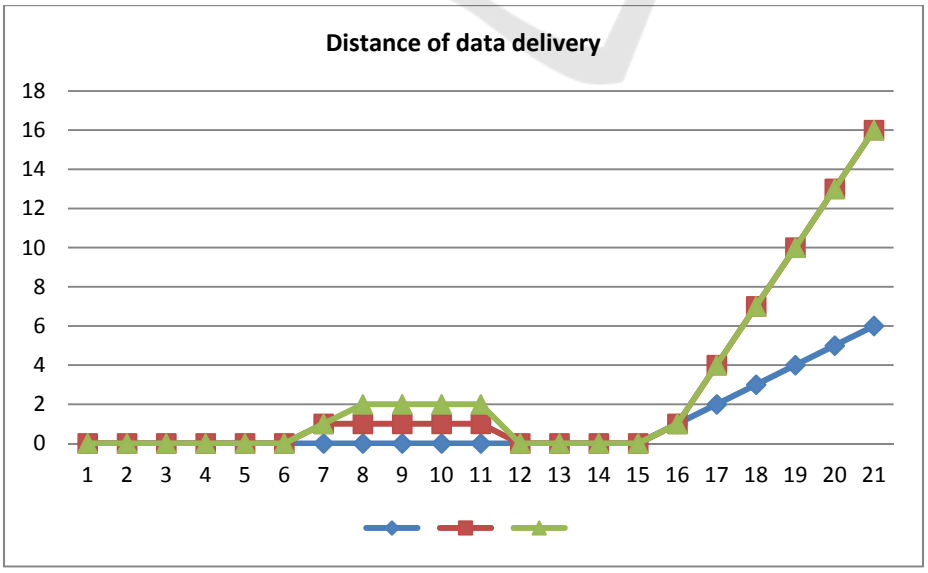
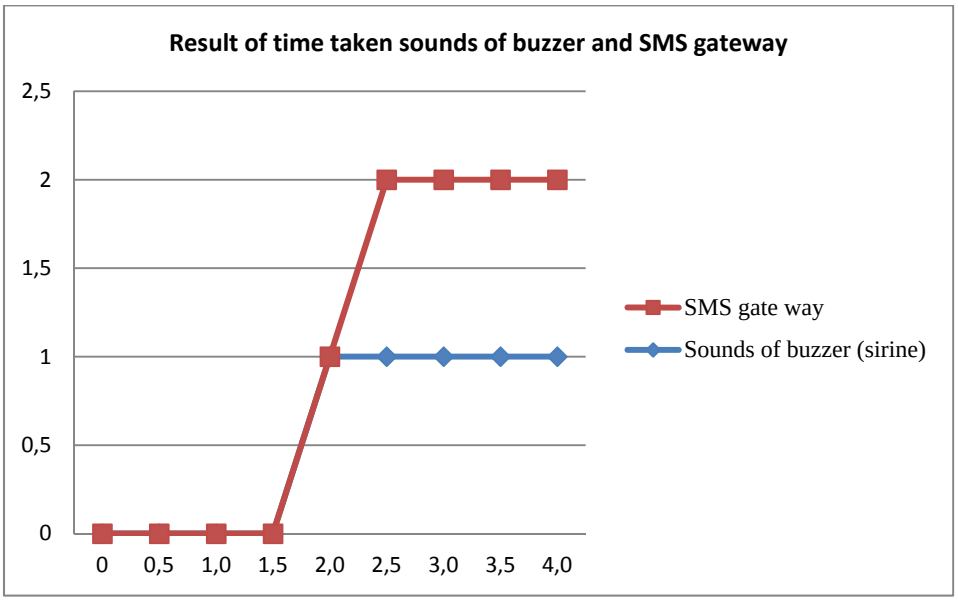
APPENDIX



First, measurement of the output voltage of the solar cell module.



Second, measurement distance of data delivery of landslide detector.



Third, measurement time taken of buzzer nad SMS gateway.

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