REMOTE MEASUREMENT SYSTEM GROUND SHIFT WITH GSM

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ABSTRACT

Indonesia is a country that a lot of valleys, hills and volcanoes. So every year, Indonesia many natural disasters landslides. A landslide is the movement of slope-forming materials such as rocks, debris material, soil, or a mixture of materials, moving down or off the slopes. This research tries to build an early warning system of landslides using microcontroller ATMEGA8535, using draw wire sensor and telemetry using Siemens mobile phones. At ground shifted over 4 cm then this system will sound sirens and danger will contact the village to evacuate its citizens. The results showed that the system can transmit data via GSM network information to the media in the form of SMS time data (day, month, year, hour, and minute) with soil shear scale of 1 mm. The system can transmit data in the form of SMS information automatically when shifting ground beyond the normal values determined shift to one of the numbers that have been registered as a shipping destination number.

KEYWORDS

Landslides, Siemens mobile phones, AVR, GSM

1. INTRODUCTION

Natural disasters as natural events can occur at any time anywhere and anytime, in addition to causing loss of material and immaterial to people's lives. Landslides are one of the natural disasters that often lead to loss of property and loss of life and damage other infrastructure that brings social and economic impacts. In January 2011 landslide occurred in the border region Gunungkidul (Yogyakarta) with Klaten, precisely in Hamlet Mundon, Tancep Village, District Ngawen, Gunungkidul (DIY). As a result of the incident two home pent soil (Sovereignty of the People, 2011). Landslides caused by heavy rains this area for a long time. In Boyolali district, sub-district Selo in 2011 which has resulted in loss of life 1 person and 1 avalanche collapsed homes (Reuters, 2011). Reality has to be followed up quickly related to the early warning to communities that threatened the victim.

Research on soil erosion have been carried out one Iswanto [2008] with the title "System Monitoring and Landslide Early Warning". Research results indicate that the landslide monitoring tool based on the IBM PC remote works well and has the ease of measurement and monitoring. The system uses a MySQL database for data storage landslides and rainfall. Additionally Adelina Widyanti [2010] with the title "EARLY WARNING SYSTEM FOR landslide". The results of his research, he was able to send data using a ground shift wavecom GSM module. The data is sent in the form of soil data and data landslide early warning Furthermore this research is related to

Amber Tri Utomo [2011]. Ambar conduct research using microcontroller ADC to measure the temperature of eight rooms. Amber has been successfully used ATMEGA8535 ADC using BASCOM language.

2. RESEARCH METHOD

In the design of equipment there are 2 parts of the design, the part that contains the sensor sensing a shift in the soil, as well as measurement data processing section transmits the measurement results remotely (LAN) using GSM networks using SMS services. In the design of which will be a low cost design-oriented design is simple but has a high level of accuracy (order of millimeters) that measures only one parameter only, namely the value of the land relative shear (displacement). The unified alert system block diagram is shown in Figure 1.

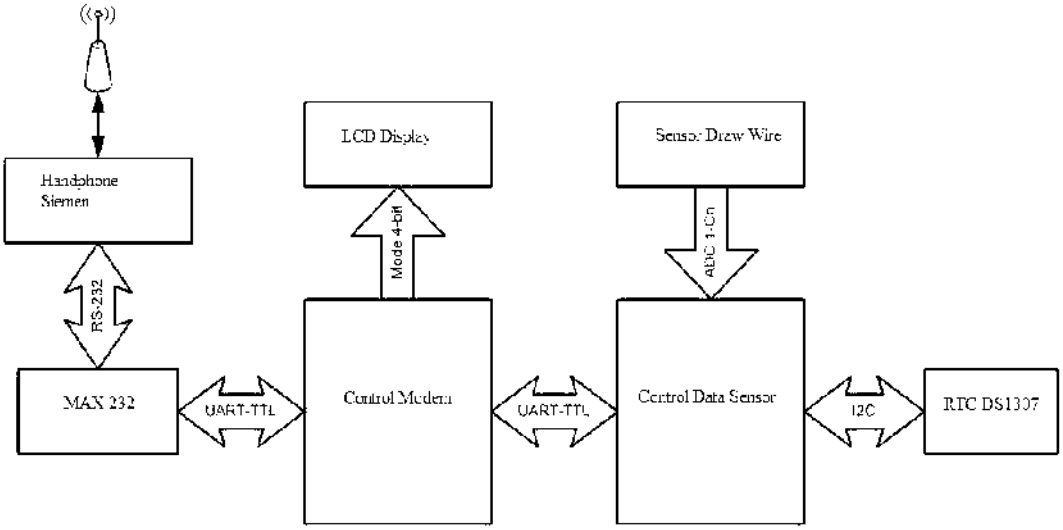

Figure 1. Block Diagram of System

Controlling Data Transmission

In this section serves to regulate any kind of data communication towards a GSM Modem or received from a GSM Modem in order to perform remote communication via the GSM network. In Atmega162 microcontroller will contain a Hand phone GSM Modem interpreter that will translate the data both incoming and outgoing data, this is because the Hand phone GSM Modem uses a unique communications protocol (text mode) so as to read and send data for SMS, GPRS packet data and voice call should follow existing communication protocols.

Controlling Sensor Readings

In this section serves to retrieve and translate analog data from the sensor readings. In addition to the data from the desired analog read something, also controls the communication I2C (inter-integrated circuit) with a digital timing device (RTC). This section can also communicate asynchronous serial (UART) with communication controller modem to transmit data obtained both time data or data value of land slide that occurred. Analog inputs are linear with respect to the value of the land shift is converted using the ADC (analog to digital converter) 10-bit

internally contained in the microcontroller Atmega8535 the reference voltage (Vref) of 5 volts to obtain a resolution ADC for:

$$ADC_{RES} = \frac{V_{REF}}{2^{10} - 1} = \frac{5\,volt}{1024 - 1} = 4.88mV/bit$$

From the above calculation shows that each additional input in steps of 4.88 mV will add the value of the ADC registers 1-bit microcontroller with the LSB, and the value obtained by linear accumulation of the value of the land according to the shifting calibrations done before. Calibration results showed that for every 1mm shift occurred analog voltage output of 11.42 mV calibrator so that its value as follows:

$$Kal = \frac{V_{OUT\,KAI}}{ADC_{RES}} = \frac{11{,}42mV\ per\ mm}{4.88mV\ per\ bit} = 2{,}34bit/mm$$

So with a share value of the ADC conversion result registers microcontroller with calibration values will be obtained land value shift that occurs in mm scale.

Communication interface

Siemens mobile phones modem using RS-232 communication protocol with a logic HIGH level is-15V and +15 V logic LOW is so it can not directly communicate with TTL devices. For that require intermediaries can bridge these differences using IC MAX232, so the microcontroller with serial TTL logic can communicate two-way full duplex with a GSM modem. With the charge pumping method (charging pump) is obtained RS-232 logic level of the supply voltage is not symmetrical (single supply) of 5 volts, thereby facilitating the conduct interface. In Figure 2 is a schematic circuit RS-232 adapter.

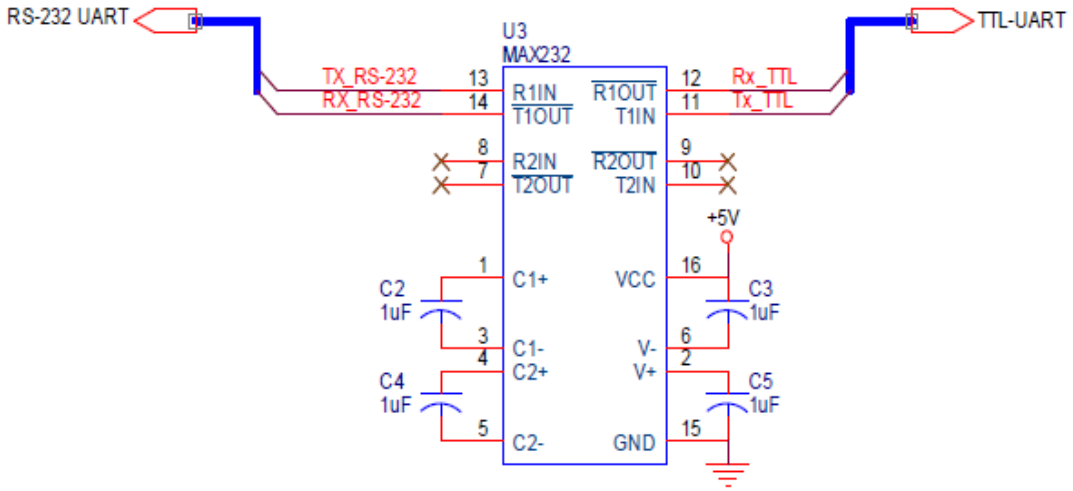

Figure 2. Scheme Logic RS-232 Adapter

Digital Timing IC DS1307

In each time a reading sensor readings must be accompanied reading time when it happens, it is a historical time in the form of data accompanying each reading is done. So that the data

transmitted is not only a shift of land value data, but also in the form of a date-time data month-year-hour-minute-second. Thus, these data can be used by the monitors to be used as input in the computer database as a reference for the data processing subsequent research. Schematic circuit of the RTC of the system can be seen in Figure 3.

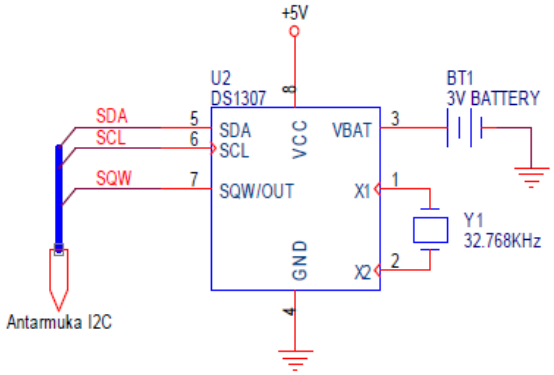

Figure 3. Digital Timing Scheme RTC

In addition to using the main power supply at 5 volts, DS1307 also uses a backup power supply in the form of large Lithium Ion battery with voltage of 3 volts to keep the registers when it corrected according to the time available. So when the main power supply is removed, the backup power supply is used. In communication with the microcontroller using I2C communication involving the 2 pin is pin SDA (Synchronous Data) and SCL (Clock Synchronous) with master and slave configuration.

Readers Shifting Soil Sensor

Sensors are used to read the value of the land slide using draw-wire principles with transducer components such as variable resistors (potentiometers). The working principle is to use an electronic voltage divider rule, so that the sensor output in the form of an analog voltage between 0-5 volts which is linear with respect to the value measured ground shifting.
The use of additional components C1 is used to reduce contact noise that occurs in the resistive layer during the movement on it. This would make the average analog voltage output to the ADC input is fed into the microcontroller.

Viewer Liquid Crystals

The LCD viewer has the number of rows and number of columns by 2 by 16 for a total maximum characters that can be displayed at once as many as 32 characters in ASCII (American Standard Code for International Interchange). In conducting the microcontroller interface does not require any brokerage because it works on TTL level.
There are 8-bit data bus communication, but it is used only 4-bit to save the use of a microcontroller pin. There is a 3-bit control pin is Rs pin, pin and pin E Rw, Rw but the pin is directly connected to ground (logic 0). The fundamental difference in using 4-bit mode compared to using 8-bit mode is saving the amount of usage for the interface pins of the microcontroller into the LCD, while the total propagation time interface 2-fold longer having to transmit data every HIGH NIBLE consuming and certainly more PEROM Flash memory space as needed more source code. Figure 4 below is a schematic LCD series.

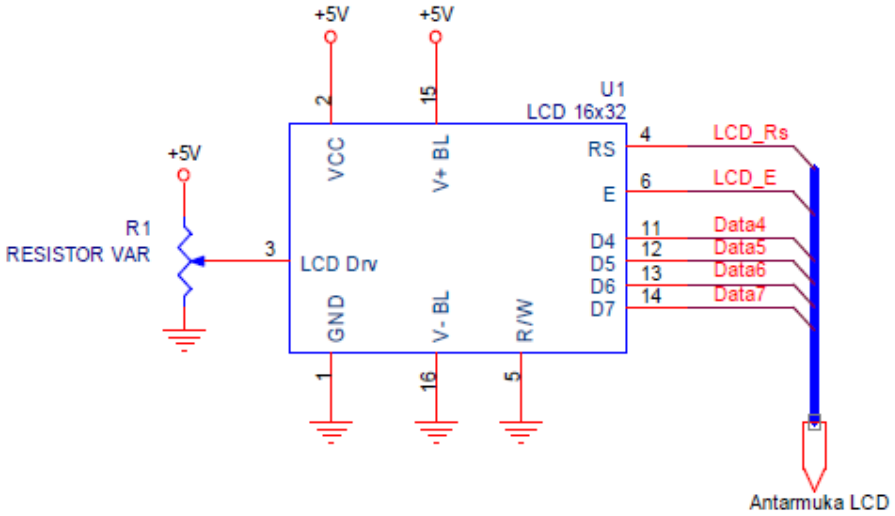

Figure 4. Schematic Viewer Mode 4-bit LCD

3. RESULTS AND ANALYSIS

The hardware that make up the parts of the system consists of several components of both the semiconductor and other passive components. Here is a complete schematic circuit hardware that make up the system shown in Figure 5 below.

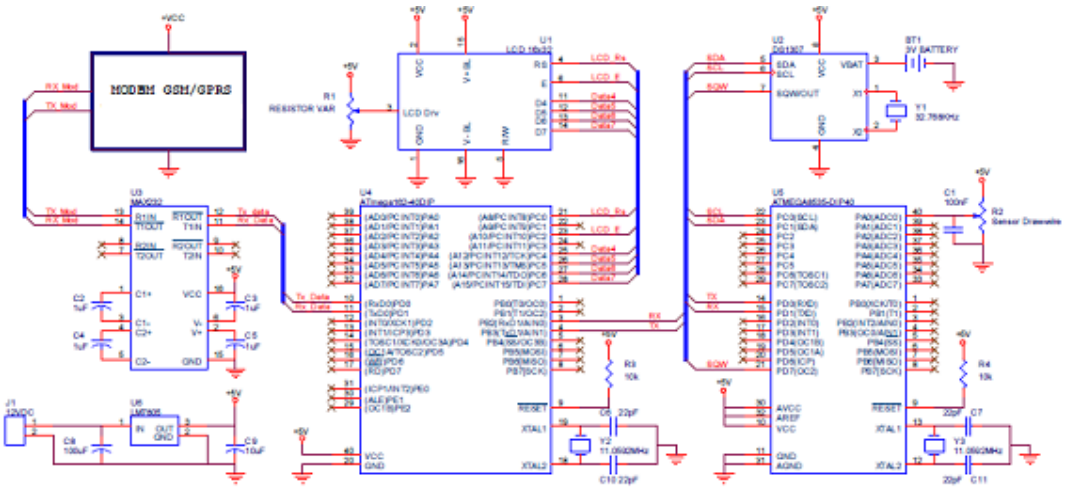

Figure 6. Complete series Hardware Systems

The observations made in the design of this system aims to obtain data that support the performance of the system is formed.

Observations Flow and Voltage

Observations on the electronic system useful to know the electrical characteristics of the system. Observations current and voltage that occurs on systems that are designed to be viewed in Table 1.

Table 1. Data Flow and Voltage

No	Voltage (V)	Tegangan (Volt)	Current (Amperes)
1	Pin Input IC 7805	12 V	75 mA
2	Pin Output IC 7805	4,9 V	60 mA
3	Pin VCC IC ATMega162	4.9 V	25 mA
4	Pin VCC IC ATMega8535	4.9 V	25 mA
5	Pin VCC LCD 16x2	4.9 V	30 mA
6	Pin VCC Sensor	4.9 V	0.5 mA

Data from these observations can be seen that at this point there is no source of electricity supply a significant change in the value of the current. It is caused due to the use of electric current which tends to steady and small semiconductor device such as a memory IC, LCD and microcontroller IC. For stable voltage value on the value of 5V ± 10%.

Observation Error Sensor

To ensure the accuracy of the readings of the soil shear sensor calibration is carried out with conventional measuring instruments such as ruler measuring to the nearest 1 mm. The results of the observations can be seen in Table 4.2

Table 4.2. Data Observation Results

No.	Tampilan Alat (mm)	Mistar (mm)	Error
1	0	0	0
2	7	5	2
3	11	10	1
4	17	15	2
5	21	20	1
6	26	25	1
7	31	30	1
8	36	35	1
9	41	40	1
10	46	45	1
11	51	50	1
12	56	55	1
13	61	60	1
14	66	65	1
15	71	70	1
16	76	75	1
17	80	80	0
18	86	85	1
19	91	90	1
20	96	95	1

From the above observations, the data can be obtained as follows:

$$Error\ rata-rata=\frac{\sum error}{n-pengukuran}=\frac{44}{49}=0.898mm$$

Application of Field Observations

In a field test involving GSM modems as media data transmission over long distances. This observation is made by drawing random sensor then carried the soil shear data requests by sending short messages (SMS) to the GSM modem on the sensor reader. Fill in the short message = "Slide" and send to the number on the GSM modem purposes, the following observations detailed in Table 4.3.

Table 4.3. Table Observation Remote Sensor Response

No.	SHIFT Happens	Short Message Contents Answer
	18mm	Monitoring Tool: Date = 01/03/10, Hours = 07:37 Total shear = 18_mm
	35mm	Monitoring Tool: Date =01/03/10, Hours =08:05 Total shear =35_mm
	48mm	Monitoring Tool: Date =01/03/10, Hours =08:45 Total shear =48_mm
	68mm	Monitoring Tool: Date =01/03/10, Hours =09:35 Total shear =68_mm
	148mm	Monitoring Tool: Date =01/03/10, Hours =10:20 Total shear =148_mm
	192mm	Monitoring Tool: Date =01/03/10, Hours =11:42 Total shear =192_mm

In the monitoring system is also equipped with a warning, that if the total shift of soil monitoring results exceed the limits specified, there will be a warning in the form of sending a short message to a number that has been registered as the alarm destination number. To register the number of users as the alarm destination number, by sending a short message to the modem on the sensor number with the message "Reg alarm" would then received a reply message as a confirmation number as the number of users already activated alarm purposes. The warnings are divided into 3 categories, namely ALERT-3 / ALERT-2 / ALERT-1. each of which represents a value of shear limit of> 50 mm /> 100mm /> 150mm. The short message alert details are shown in Table 4.4.

Table 4.4. Information Warning Message on Mobile

No.	Fill Category	Short Message Warning
	STANDBY-3-3	Cautions alert, there has been a shift of 52_mm
	ALERT 2-2-2	Caution alert, there has been a shift of 102_mm
	ALERT-1	Caution alert-1, has been a shift of 151_mm

4. CONCLUSIONS

From the results we concluded that the design of early warning systems for landslide disaster has been built to work properly. The test results showed that:

- The system can transmit information in the form of early warning LED Flash with soil shear values in 2mm scale (0.2 cm).
- The system can automatically transmit information such as LED flash and buzzer sound (mode 1, 2 standby, standby 3) when shifting ground shifting beyond the normal value has been determined.

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