

Landslide Warning System Using ZigBee And MEMS

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Abstract- We are going to study about landslide Warning System using ZigBee & MEMS sensor. Because of the landslides is a big loss for human life & property. Landslide is natural causes so we cannot avoid this problem. We have to develop a system which can be warning the human before landslide occur. So for warning people from landslides we can use this system to save life & property. In this design we have used two sensors of MEMS sensor & soil moisture sensor. MEMS sensors give the readings of slope angle if there is any change or movement in landslide & we also have soil moisture sensor it collects the water content value in soil. All nodes of sensors are connected to the AVR ATMEGA16 for collection of data. All the readings are converted in suitable format which was given to ZigBee for transmission. As we obtain the information at the receiver side by another ZigBee module & according to received value we can warn the people. This paper is very important as we use it in our real time purpose for saving lives & property.

Keywords- Microcontrollers, ZigBee Module, MEMS, Soil moisture, LCD Module, buzzer.

I. INTRODUCTION

In order to reduce & prevent the damage of life because of landslides, for that reason landslide detection is important to the prediction & approximation of the landslide hazard & prevention. Landslides are geological phenomena that cause loss of life & properties in damages every year in many countries. Therefore technology has been to be developed to capture important signal with minimum delay. Wireless sensors are one of the technologies that can quickly respond to rapid changes of the data & send the sensed data to the receiver section in areas.

A sensor has the capability of quick capturing, processing & transmission of required data in real-time that is with the minimum delay through ZigBee. However, it has limitations such as low amounts of battery power & also low memory availability compared to many existing technologies. It has the advantage of installing sensors in hostile environments with a less maintenance required. This fulfills an important need for any real time observing, especially in hazardous scenarios. It is combination of a multiple of sensors & rapid installation, which can be directly on the landslide, or in the immediate surroundings, to provide continuous data on

the landslide activity. They cause considerable damage to railways, pipelines, waterways & highways.

II. DESIGN OF LANDSLIDE WARNING SYSTEM

In this paper we have the modules of ZigBee & two sensors. The sensors used are MEMS sensors & Soil moisture sensors. Soil moisture sensors will convert water depth into equivalent electrical signal. This design adopts high precision angle sensor ADXL330 produced by VTI to detect the mountain angle. MEMS sensors will convert land displacement into electrical signal. ADXL330 is two axis angle sensors. Its measuring range is +90degrees, +5v power supply, & the output voltage is proportional to the landslide displacement, its output range is 0.5-4.5v, the capability of resistant strong impact & have low power consumption. ADXL330 is an accelerometer.

MEMS consists of a silicon micro sensor & signal processing chip, through measuring the l& position in the direction of measurement, then convert to angles. If the landslides along the direction of arrow on the chips have acceleration, the output value increase. ZigBee is connected to processor using serial communication for communication purpose. The message from transmitter is send through transmitter ZigBee device. At the received side message received by the receiver side ZigBee module. We have LCD at receiver side to observe the readings directly at receiver station. This is the overall function of all the components in this system.

III. BLOCK DIAGRAM AND WORKING OF TRANSMITTER AND RECEIVER

A) Sensors used

Here we have used two sensors for detecting occurrence of landslide. They are

- 1) MEMS (Accelerometer).
- 2) Soil moisture sensor.

1) MEMS Sensor

MEMS is Micro Electro Mechanical Systems. This sensor senses if there is any change in the angle of sensor it

sends the data of changed angle to receiver side. MEMS is the combination of mechanical elements, actuators, sensors, & electronics on a common silicon substrate through micro fabrication technology. It is placed on the land (or on the big stone which easily not change their position) if any movement occurs then sensor senses it & sends information so that we can be worn at that area.

2) Soil moisture sensors

The Soil Moisture Sensor is used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture, botany, & biology.

Use the Soil Moisture Sensor to:

- Measure the loss of moisture over time due to evaporation & plant uptake.
- Evaluate optimum soil moisture contents for various species of plants.
- Monitor soil moisture content to control irrigation in greenhouses.
- Enhance your Bottle Biology experiments.

B) ZIGBEE Module

ZigBee is the main hardware module used in this system for communication purpose. We have two ZigBee modules one at transmitter side, another at receiver side. By using this ZigBee, we can communicate with data of high speed & minimum delay can be sent through ZigBee. We can use this ZigBee modules anywhere even in forests, hill stations etc. In this we have peer to peer (P2P) communication. One ZigBee can communicate with any other ZigBee present in the surrounding area. The transmitter ZigBee transmits the data obtained from transmitter side processor it transmits without having any delay. Then receiver side ZigBee receives the signal & automatically receives data transmitted from transmitter. In this we don't have data loss so it is safe & useful by using ZigBee modules. In this ZigBee there is no need of human intervention to send or receive data it's automatically sends & receives data.

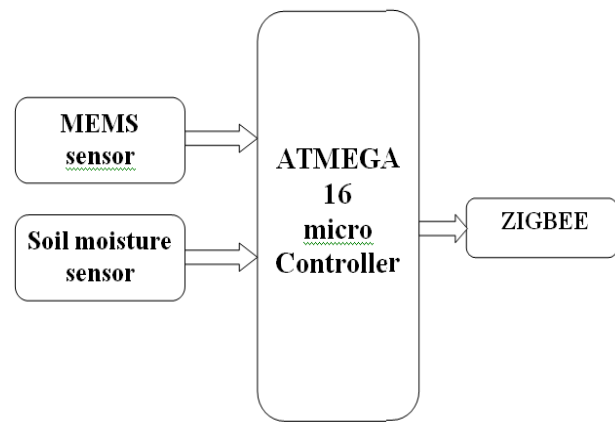


Fig 4.1 Block Diagram of Transmitter Section

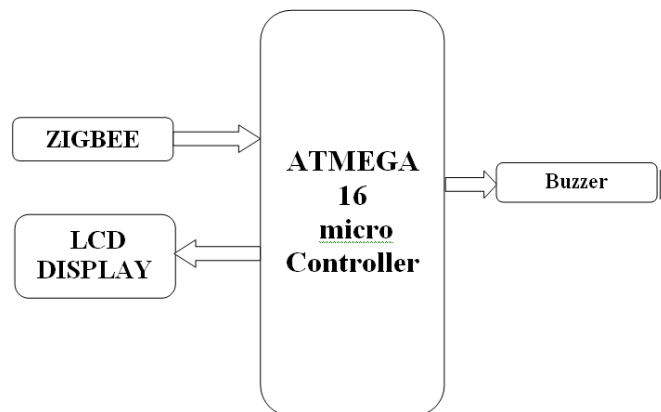


Fig 4.2 Block Diagram of Receiver Section

C) MICROCONTROLLER

Here we used ATMEGA16 micro controller. The ATMEGA16 micro-controller is low-power CMOS 8-bit micro-controller based on AVR enhancement RISC architecture. By executing powerful instruction in single clock cycle. The ATMEGA16 achieve throughput 1MIPS/MHz allowing the system designed to optimize power consumption versus processing speed.

In this paper, controller collects the data from sensors & continuously sends information to the receiver through the ZigBee. Receiver section analyses the data & display the status of l&.

For e.g. If landslides occur then it will display "vibration in the land". Also one buzzer is also placed to indicate the landslide occurrence.

C) LCD display

LCD screen is an electronic display module. A 16 X 2 LCD display is very basic module & It's very commonly used in various circuits for display.

A 16 X 2 LCD means it display 16 character per line & there are 2 lines. In this LCD each character is displayed in 5 X 7 pixel matrix. The data register stores the data to be displayed on the LCD when they receive data from the micro controller. The data is the ASCII value of the character to be display on the LCD. Here ZigBee received data from transmitter send the data to micro-controller. Micro-controller send the necessary data to the LCD data line to display the values of the sensors.

IV. OBSERVATION TABLE

Table 1.1 Observation Table

MEMS	SOIL MOISTURE	RESULT
X=250 Y=280	30%	Buzzer OFF Normal Condition
X=300 Y=320	25%	Buzzer OFF Normal Condition
X=300 Y=320	40%	Buzzer ON Landslide Detected

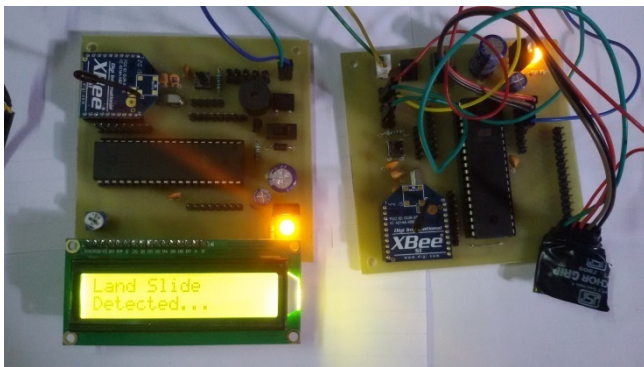


Fig 1.1 Hardware

V. CONCLUSION & FUTURE SCOPE

Landslide detection is one of the challenging research areas available today in the field of geophysical research. This paper describes about an actual field installment of a wireless sensor network for landslide detection. This system will detect the landslide by using sensors. Communication is done through ZigBee. By using the buzzer we can warn the people when landslide occurs. In the future, the modules which are now working on batteries going to work on solar panels also

some other features like GPS, etc. will be added on the module. Field experiments will be conducted to determine the effects of density of the nodes, vegetation, location of sensor node etc., for detecting vibrations before the landslides.

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