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Risk Assessment and Management Techniques to Avoid Landslide Hazard

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ABSTRACT

The study of landslide occurrence at hillside areas in India, Landslides have frequently occurred on natural slopes during periods of intense rainfall. Landslides have become one of the most significant natural hazards. Thus, it is necessary to protect people from landslides and to minimize the damage of houses, roads and other facilities. To accomplish this goal, many landslide prediction methods have been developed around the world. In this study, a prototype of landslide detection is introduced. This system is based on the wireless sensor network (WSN) that is composed of sensor nodes, gateway, and server system. This combines GSM technology and wireless technology. Sensor nodes comprising sensing and communication part are implemented to detect ground movement. To verify the feasibility of this landslide prediction system, a series of experimental studies was performed at a small-scale earth slope equipped with an artificial rainfall dropping device. It is found that sensing nodes planted at slope can detect the ground motion when the slope starts to move and to detect it. By WSN system to inform the danger to rescue support and automatically barriers on the road are closed the entry and noising the alarm loudly. As we obtain the information at the receiver side by LCD display at receiver station or by SMS we can alert the people and save lives and property. It is expected that the prototype of landslide detection can provide early warnings when landslides occurs.

KEYWORDS: GSM Module, Landslide detection, Wireless Sensor Network, Risk Assessment.

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I. INTRODUCTION

Landslides usually occurs at steep slope, improper cutting of slopes for the construction of roads and other structures, so there is need to prevent landslide by use of proper prevention method according to location and condition of that areas. By use of proper prevention methods. Landslides can be prevented, which will result in no human damage, environmental damage objectives for this project are to prevent the landslide by causing hazardous effect on human life and natural sources applying preventive method To find out natural and man-made factors this causes landslide.

Landslides are geological phenomena causing significant loss of life and loss of properties in damages each year in many countries. 11,000 deaths in the last 12 years, India tops the globe in landslide deaths. According to the Geological Survey of India (GSI), in the year 2018, above 20 landslides were reported in India. Therefore, technology has to be developed to capture relevant signals with minimum monitoring delay. A landslide is a downward or outward movement of soil, rock or vegetation, under the influence of gravity Necessary to protect people from landslides and to minimize the damage of houses, roads and other facilities to accomplish this goal, many landslide methods have been developed around the world. Wireless sensors are one of the technologies that can quickly respond to rapid changes of data and send the sensed data to the receiver section in areas where cabling is not available. Wireless sensor network (WSN) technology has the capability of quick capturing, processing, and transmission of required data in real-time with high resolution. Following are the types of landslides,

- Debris flow
- Earth flow
- Debris slide

- Rock avalanche
- Shallow landslide
- Deep-seated landslide.

1.1 Landslide Prevention and Control

The control works actually carried out in landslide areas are as follows:

1. To save lives;
2. To preserve public structures and buildings;
3. To prevent the disruption of road traffic.
4. The detailed landslide survey, relating to the characteristics and locations of landslide movements and rupture zones etc.
5. Landslide prevention and control works are implemented to stop or slow down landslide movement or avoid landslide in order to prevent any further damage by landslide movement.

Landslides have frequently occurred on natural slopes during period of intense rainfall. With rapidly increasing population on or near steep terrain, landslide has become one of the most significant natural hazards. Thus, it is necessary to protect people from landslides and to minimize the damage of house, roads and other facilities. To accomplish this goal, many landslide prediction methods have been daveloped around the world. In this study, a prototype of landslide detection is introduced. This system is based on the wireless sensor network (WSN).

WSN plays significant and vital role in detection, prediction and management of debris. Different sensors like accelerometer sensors to sense the vibration and management of changes in speed. Moisture sensor to valuate volumetric water content, ultrasonic sensor, video camera, pendulums etc.

Wireless sensor networks (WSN) is one of the major technology that can be used for real-time monitoring of these events.WSN has the capability of large scale deployment, low maintenance, scalability, adaptability for different scenarios. WSN has its own limitation such as low memory, power, bandwidth etc., but its capability to be deployed in hostile environment made it one of the best suited technologies for real-time monitoring.

The modules which were used for detecting the small vibration generated before the avalanche comes. The sensor node senses those vibrations by geographic sensor and we have used 3-axis sensor to detect the vibrations. The data from sensing node is gathered at the master node, master node upload that data to server via GSM.

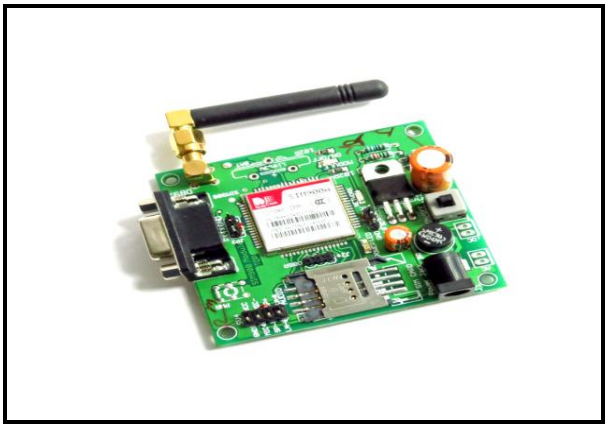
II. THEORETICAL CONTENT

2.1 Microcontroller

MICROCONTROLLER PIC18F4520:

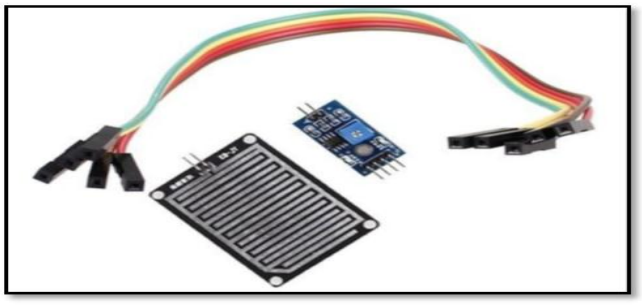
It is an 8-bit enhanced flash PIC microcontroller that comes with NanoWatt technology and is based on RISC architecture. Many electronic applications house this controller and cover wide areas ranging from home appliances, industrial automation, security system and end-user products. This microcontroller has made a renowned place in the market and becomes a major concern for university students for designing their projects, setting them free from the use of a plethora of components for a specific purpose, as this controller comes with inbuilt peripheral with the ability to perform multiple functions on a single chip. It functions like a normal computer does and needs to be connected with external input output devices (mouse, keyboard (display). PIC18F4520 is a PIC microcontroller, introduced Microchip, and mainly used in automation and embedded systems. This board uses various types of microprocessors and microcontrollers. .Boards also have feature of loading programs from personal computers through Universal Serial Bus (USB) .The microcontrollers are regularly customized utilizing a feature from the programming dialects C and C++. We can address hardware properly using code.

2.2 GSM Modem



The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor but we use only SMS alert. The communication of GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot.

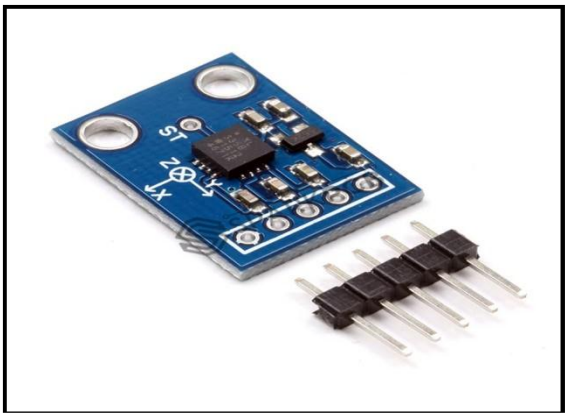
2.3 Moisture sensor



The moisture sensor measures the volumetric water content present in the soil. The moisture sensor used for soil

measures the volumetric water content indirectly by using some other properties of the soil, such as the electric resistance, dielectric constant or the interactions with neutrons as a proxy for the moisture content. The Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. The sensor creates a voltage which is directly proportional to the dielectric permittivity. Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential The rain sensor module is used for detecting the presence of rainfall, acting as a switch when raindrop touches its board and detect rainfall or moisture and warns to the particular authority by system installed.

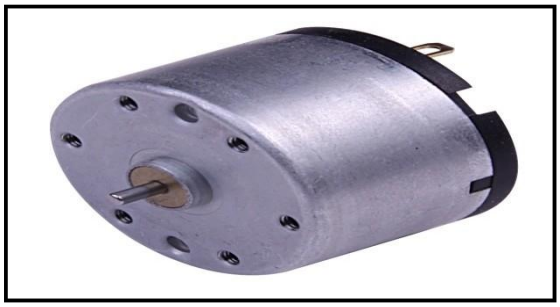
2.4 Vibration sensor



VIBRATION SENSOR ADXL335: Vibration sensors are used to measure displacement, proximity, linear velocity and acceleration. Here in this project we are using vibration sensor which detect the seismic vibration of earth. The

ADXL335 gives complete 3-axis acceleration measurement. An accelerometer is an electromechanical device that will measure acceleration force. It shows acceleration; only due to cause of gravity Accelerometer can be used for tilt- sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration. A vibration sensor also called as an accelerometer. It is a sensor which produces electrical signals which are directly proportional to the seismic vibration of the earth to which the sensor will be attached. These signals produced by the accelerometer are passed on to the instrument that in turn converts this signal in the form of velocity signal

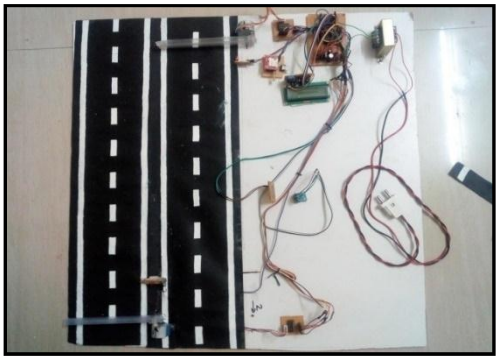
DC Motor Driver



The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor. The L293D IC receives signals from the microprocessor or microcontroller and transmits the relative signal to the motors.

III. DEVELOPMENT 0F MODEL

The system is GSM based landslide detection wireless sensor network (WSN) system. The model is prepared for the pre-warning or alert to the specific authority and people.



WORKING: Landslides usually occurs at steep slope, improper cutting of slopes during periods of intense rainfall. At the time of heavy raining and landslide occur, By WSN system using of vibration and moisture sensor, when any landslide or ground activity is detected or occurred then vibration sensor is detect, if this is liquefaction activity then the moisture sensor detect it. To inform the danger to rescue support and automatically barriers on the road are closed the entry and noising the alarm loudly. As we obtain the information at the receiver side by LCD display at receiver station or by SMS we can alert the people and save lives and property.

EXPERIMENTAL RESULTS

Vibration sensor ADXl335: as the land movement or any activity like vibration can be detect accelerometer tilts more than 30^0 as landslide on road.

The moisture sensor: as the ground wets more than 50% then detect the activity of moisture threshold crossed.

IV. CONCLUSION

A prototype of landslide detection by WSN has been describe landslide monitoring system are becoming more precise and cost effective landslide monitoring system by wireless sensor network will be an alternative to detect and predict slope failure including debris flows in order to develop the technology. Software agents have been embedded into the wireless sensor nodes to continuously collect and analyze ground acceleration data and orientations of the nodes.

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VI. FUTURE SCOPE

Since this study was performed several years ago, the wireless sensor node for landslide detection has now a lot of room to develop. Recently, wireless communication module has been improved and smart sensor to detect movement has been also developed. Emerging technologies such as energy harvesting, IOT (Internet of Things) and artificial intelligence are now being introduced. If this study is performed again at this moment, current technologies can be incorporated to provide more reliable results. Wireless sensor nodes introduced in this study have been applied to not a real landslide but a tested, because there are many problems such as short battery life, lack of lightning damage prevention, and lack of validation for issuing alarm, etc. Wireless sensor node to detect landslide, however, are very promising and the technology is likely to develop rapidly over the coming years. To do this work, geotechnical engineer and ICT engineer should cooperate with each other. It is expected that this work will provide a methodology to develop a wireless sensor node for landslide detection.

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