Wireless Sensor Networks for Landslide Warning

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Abstract— In this paper, we are going to study about Landslide warning system, as the occurrence of landslides is a big loss for human life as well as property. We cannot stop the natural causes but we can be alert before they occur. So to alert people from landslides, we use this idea. In this design we have used five sensors of a Strain gauge is used to measure the strain on an object when force is applied to the board, the resistance of the gauge changes in accordance with the strain produced in the board. Soil moisture sensor generally used to detect the moisture content of the soil and compare the soil humidity with set threshold value. The tilt sensor is a component that detects the tilting of an object. Rain fall sensor is a type of water sensor might just be a good equalizer. Vibration sensor is used originally as vibration switch because of it is sensitive to environment vibration, and generally used to detect the ambient vibration strength. All sensors output is then given to Microcontroller ARM LPC2148 after desired processing the result are send to LCD display, GSM module and Buzzer for further communication, alert as well as analysis. The message from transmitter is send through transmitter GSM device and received by receiver side GSM, the information is given through SMS by GSM connected at receiver end. We have LCD receiver to observe the readings directly at receiver station without using SMS. Used APR9600 voice module which gives voice message alerting nearby places in danger. Thus this paper is very important as we use it in our real time purpose for saving lives and property. This design combines of GSM wireless communication technology and Wireless Sensor Network.

Key words: Sensors, GSM, LCD, Audio System, Buzzer

I. INTRODUCTION

In mandate to reduce and prevent the damage of landslides, landslide monitoring is extremely significant to the future and forecast of the landslide hazard and prevention [1][2]. Landslide monitoring is an main topic connected at the hillsides. Landslides are geological phenomenon cause important loss of life and loss of properties in compensation every year in many countries. Some landslides move slowly and cause damage gradually, whereas others move so faster that those can destroy property and lives suddenly and unexpectedly [5]. As landslide move down slope, the ground surface cracks, tilts, and drops [5]. The causes of landslides in India are mostly due to excessive rainfall and earthquake [6]. Landslides affect nearby 15% of land area of Indian continent and reaching around 0.49 million km. India has a sensational record of catastrophes due to landslide[2][5]. Therefore technology has to be developed to capture proper signals with minimum monitoring delay [3][5]. Wireless sensors are one of the technologies that can rapidly respond to rapid changes of data and send the captured data to the receiver section in [3].

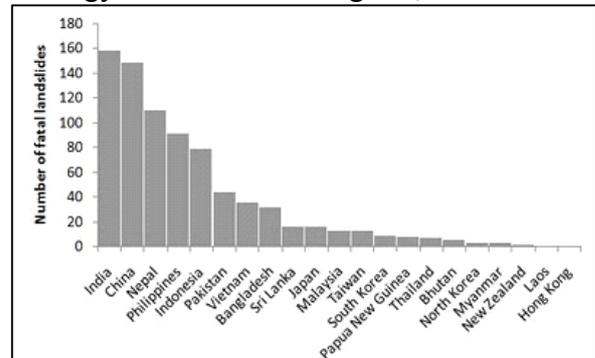Following Chart Shows Landslide Detection:

Fig.1. Number of Fatal Landslide

Wireless sensor network (WSN) technology has the efficient of faster in processing, capturing and transmit data in real time with high resolution [7][8][5]. However it has its disadvantage of low battery power and low storage availability compared to other existing technologies [3]. It has the advantage of deploying sensors in adverse environments with a low maintenance [5]. This fulfills a very important need for real time monitoring, particularly in hazardous or remote scenarios [5][7].

II. PROPOSED DESIGN FOR LANDSLIDE DETECTION SYSTEM

Fig.1 shows the system overview. The working of this system is explained with following steps
1) Every Acceleration sensor has GSM Transmitter.
2) When landslides happens sensor sense that and move data to ARM controller [5].
3) ARM controller receives data from sensors and transmits to GSM Transmitter [5].
4) Coordinator has GSM Transmitter. + GSM Rx.
5) This information is transmitted by GSM to the Control center.
6) GSM in the Control center receives and transfers this information to rescue team.
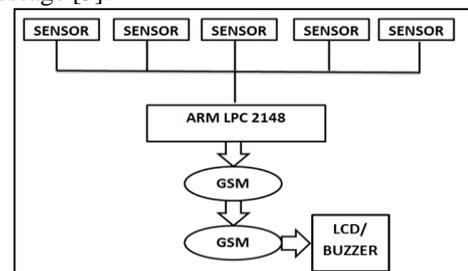7) We can also check the status of sensor by sending message [5].

Fig. 2: System block diagram

In this paper we have used modules of GSM, LCD Display, Audio system, Buzzer and five sensors. The sensors used are Strain gauge sensor, soil moisture sensor, tilt meter, rain fall sensor and vibration sensor. A strain gauge is used to measure the strain on an object when force is applied to the board, the resistance of the gauge change in accordance with the strain produced in the board. Soil

moisture sensor normally used to distinguish the moisture content of the soil and compare the soil humidity with set threshold value. The tilt sensor is a component that detects the tilting of an object. Rain fall sensor is a type of water sensor might just be a good equalizer. Vibration sensor is used as vibration switch because of its more sensitivity; it is sensitive to environment vibration, and normally used to detect the ambient vibration strength. All sensors output is then given to Microcontroller ARM LPC 2148 are result are send to LCD display, GSM module and Buzzer for further communication, alert as well as analysis. The message from transmitter is send through transmitter GSM device and received by receiver side GSM, the information is given through SMS by GSM receiver side. We have LCD receiver to observe the readings directly at receiver station without using SMS. Used APR9600 voice module which gives voice message alerting nearby places in danger.

III. METHODOLOGY

The following are the sensors and components used in network for to sense and control the various parameters for landslide detection.

A. Strain Gauge Sensor

A strain gauge is used to measure the strain on an land. It is a very thin, flat coil of conductive wire. It is "catched" onto land the on which the strain is to be applied. In this exacting circuit, the strain gauge is formed by a very thin trace laid out on the printed-circuit board.[5] When strain is applied to the board, the resistance of the gauge changes in the strain applied to bend the board [1].
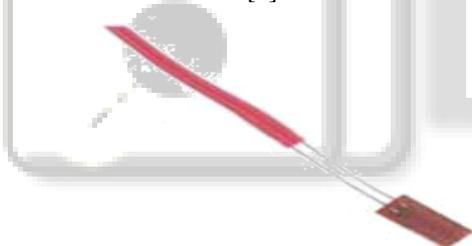

Fig. 3: Strain Gauge sensor

B. Soil Moisture Sensor

Soilmoisture module is moresensitive to the ambient humidity is usually used to identify the moisture content of the soil. Module in the soil humidity little a set threshold value when the D0 port output high, when the when soil humidity break the threshold value is set, the module D0 output low[3]. Small plate's digital outputs D0 can be straight linked with the ARM controller, ARM controller to detect high and low soil moisture [1].
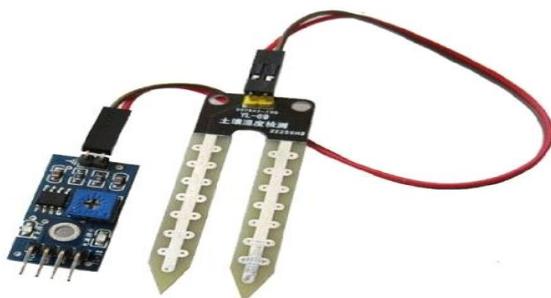

Fig. 4: Soil Moisture Sensor

C. Tilt Meter Sensor

The tilt sensor is a element that can distinguish the tilting of an object. However it is only the equivalent to a push button this is a different physical mechanism. This sensor is the environmental-friendly a mercury-switch. It's contains a metallic ball within that will exchange the two pins of the device from off to on and vice versa if the sensor reaches a certain angle[1].
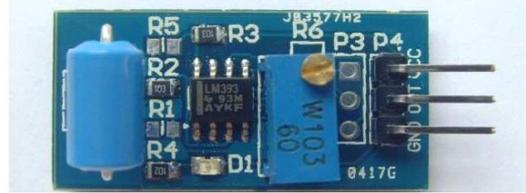

Fig. 5: Tilt Meter Sensor

D. Rain Fall Sensor

A rain fall sensor is rapid and easy start for using and explores the Rain Sensor module occasionally called a "Raindrops Sensor Module"[5]. A kind of water sensor force now is a good equalizer [1].
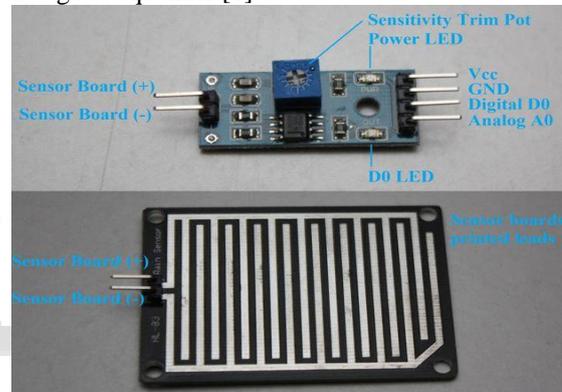

Fig. 6: Rain Fall Sensor

E. Vibration Sensor

Vibration sensor is used as vibration switch because of its high sensitivity; it is sensitive to environment vibration. When module did not arrive at the entrance in shock or vibration force, DO port outputs get high level and when external vibration force exceeds; D0 port gives output gets low level. The output D0 can be directly connected to the ARM controller, for the ARM controller to detect low level of ambient vibration. Small digital output DO can directly gives the relay module, which can be composed of a vibration switch[2].

Fig. 7: Vibration Sensor

F. Microcontroller

We have used LPC2148 microcontroller, The LPC2148 ARM controller is based on a 32 bit ARM7. CPU with real-time emulation and embedded support and combines the microcontroller with embedded high speed flashes memory

up to 512 kb. A 128-bit wide memory interface and a unique accelerator [3].

To this microcontroller GSM modules are attached. Microcontroller performs the collection of data and transferring data from sensors to GSM and displays the outputs on LCD screen[3].

Fig. 8: ARM (LPC2148)

G. LCD Display

LCD screen is an electronic exhibit module and find a extensive range of applications. a 16x2 LCD display is basic module and is very usually used in different devices and circuits. a 16x2 LCD it can display 16 characters per line and there are 2 lines. Each character is display in 5x7 pixel matrix in this LCD. This LCD has two registers one is command second is data.the command instructions stored command register. a command is an instruction given to LCD to do a predefined task like initializing, clearing its screen, setting the cursor position, scheming display etc. the data register stores the data and displayed on the LCD[5]. The data is the ASCII value of the character to be displayed on the LCD conclusion.
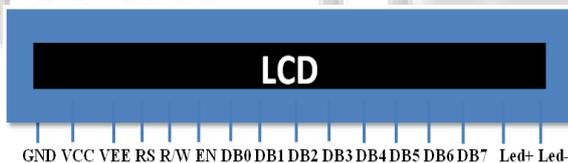

Fig.9. LCD Pin Diagram

H. GSM Module

The SIM900 is a Quad-band GSM solution in a SMT module which can be embedded in the users applications. Feature an industry-standard interface, the SIM900 delivers [5]. GSM850/900/1800/1900MHz it performance for voice, SMS, Data, and Fax in a small and low power consumption.SIM900 is a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your application, especially for slim and compact demand of design[2].

Fig. 10: GSM Module

– SIM900 is designed with a more powerful processor.
– AMR926EJ-S core
– Quad - band GSM module with a size of 24mmx24mmx3mm
– SMT type suit for all users application
– An embedded Powerful TCP/IP protocol
– Based upon mature and field-proven stage from definition to design and production [3].

I. APR9600

APR9600 is low cost high performance sounds record/announce IC incorporate flash analogue storage technique. Recorded sound is stored even after power supply is removed from the module. The announced sound passed high quality with a small noise rank. Sample rate for a 60 recording period is 4.2 kHz that gives a sound record/announce bandwidth of 20Hz to 2.1 kHz [2]. The total signal of sound recording in 32 seconds. Total sound recording time can be changing from 32 seconds to 60 seconds by altering the value of the single resistor. The IC can work in one of two mode serial mode and parallel mode [3]. The APR9600 has a 28 pin DIP package. Supply voltage is between 4.5V to 6.5V. During recording and announcing, current consumption is 25mA. An idle mode, the current drops to 1uA. An 8-16 ohm speaker is to be used with the module; number of user can choose different modes with the mode selection switch. The circuit is measured 80mm*55mm. APR9600 voice circuit which gives voice message carry over areas in danger [2].

J. Buzzer

A piezoelectric element may be driven by an audio signal source, driven with a piezoelectric audio amplifier [5]. Sounds normally used to designate that a button has been press are a click, a ring or a beep.

1) PiezoBuzzer Characteristics:
– Wide operating voltage: 3~250V.
– Lower current consumption: less than 30mA as higher rated frequency.
– Larger footprint.
– Higher sound pressure level.

Fig. 11: Piezoelectric Buzzer

IV. CONCLUSION

Wireless Sensor Networks (WSNs) are up-and-coming technology and a large amount literature available in theoretical, so practical deployments of WSNs are very less if any. Using real practical experience, this overview of operations is one such guide providing the steps and outlining the necessary requirements when designing and deploying a WSN into any given application System is very

helpful to protect human life and avoid accident where landslide happens. Because of landslides many accident happen on highways, hill station and railway track. So with the help of this system we can warn the main center about where the landslides happen. We can also check the status of tunnels and landslides prone area. The knowledge gained from this real experience is helpful in the development of other systems for constant monitoring and detection of conclusive and emergency applications.

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