

LANDSLIDE PRE-WARNING SYSTEM BASED ON WIRELESS SENSOR NETWORK USING ZIGBEE – A REVIEW

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ABSTRACT

At any time, any place the planet earth may get hit by any natural hazards, where huge losses occur including human as well as economic. These events cannot be stopped, but using some innovative techniques these losses may be avoided. Among these one of major natural hazard is landslide, which was recently occur in Pune (Malingaon (MH)). Taking these approach into consideration the design and improvement in the techniques must be developed for prevention of landslide hazard. There have been several techniques to determine the landslides risk and land movement. As it is quick and sudden movement, it is necessary to keep continuous eye on environment changes i.e. real time. To make it real time monitoring system for earth environment Wireless Sensor Network (WSN) use is best suited. These paper presents the pre-landslide alert system using WSN's, where data transmission is done by GSM module and zigbee module. In the circuitry, microcontroller is used to read the measurement done by the Wireless sensors. If their occur any changes in set threshold values, then the alerts are made from GSM modem to transmit message wirelessly to server system, also voice output is transmitted from memory module used. Finally the security alarm is also generated using Zigbee.

Keywords: *GSM, GPS, Landslide, Wireless Sensors, Zigbee.*

I. INTRODUCTION

Due to progressive development of urban areas and infrastructure, more and more people settle in the environments such as hilly sides that have become dangerous due to different types of natural hazards. In order to this, there is need to improve basic understanding of landslides, hilly area regions where financial and social risks are more. The occurrence of landslides is a huge loss for human life and economic property and such events are fast. For such rapid events the wireless sensor techniques are best suitable as it can respond quickly to rapid changes of data and send the sensed data wirelessly to the receiver station in areas where cabling is not possible. Several measurement techniques have been proposed to identify slope instability and to estimate the risk of landslide [2], [3]. Deep inclinometer displacement monitoring and GPS table deformation monitoring based on borehole tilt meter are adopted popularly on current Real-time landslide monitoring system. Signal from sensors and detection equipment's are translated into central server by using cable or GPRS communication. Cable has obvious drawbacks such as difficulties on wiring and construction at the danger zone, man-made destroying and devastation from natural disasters. In addition, GPRS communication also has technical limitations. It cannot be used in remote mountainous areas where signal is weak even hard to

be received so that qualified GPRS network is hard to be established. There are projects developed which uses satellite images it consist of combination of digital classification and textual analysis to identify landslide features [2]. Thus using the satellite image includes huge processing which will conclude large calculation and complexity of the system which will make the project harder to analyze. These methods, however are known to be labor-intensive as well as costly. Wireless sensor network (WSN) technology which is utilized in reservoir area where geological hazards occurred easily is effective attempt. Because WSN itself has some better characteristics such as redundancy, wireless, the self-adaptive network and strong anti-destruction capability [1]. WSN can still complete the limited communication even though all communications facilities are damaged totally.

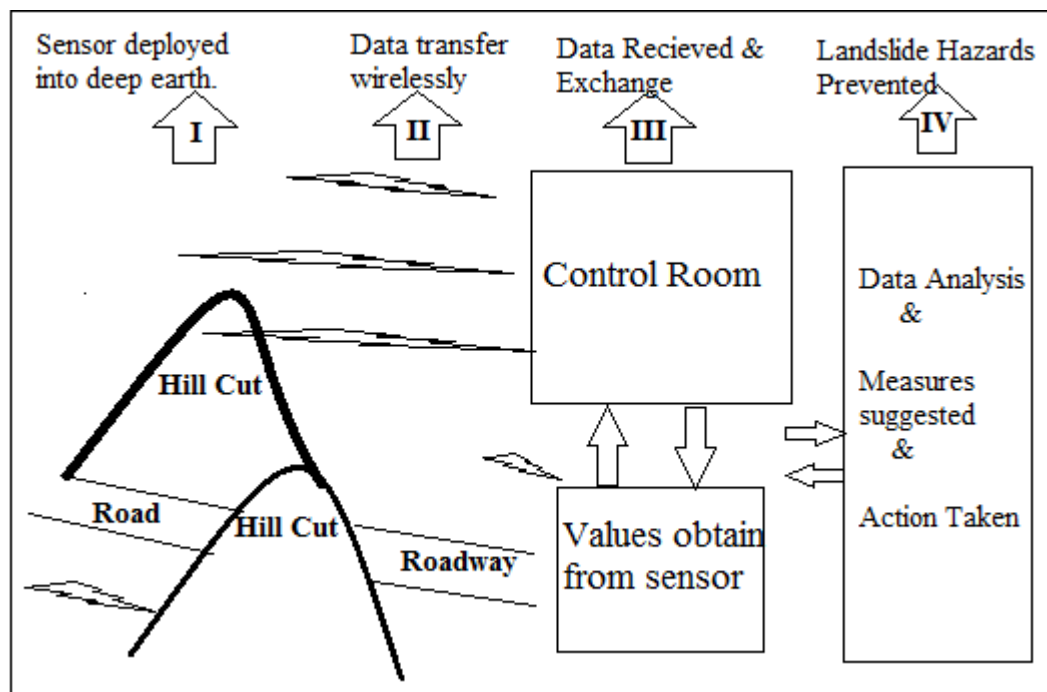


Fig. 1. Architecture for Landslide Prediction

II. RELATED WORK

Landslides may damage to properties like highways, railways, waterways and pipelines. Landslides may also occur with the other natural events like earthquake, volcanic activity, and floods induced by heavy rainfall. As also the mountainous region have their slopes modified for development purpose and deforestation, increases the chances of landslide to occur.

Table 1. Recent Landslide Occurred

DATE	PLACE	CASUALTIES
16 JUNE 2013	KEDHARNATH, UTTARAKHAND,INDIA	5700
31 JULY 2014	MALIN, PUNE DISTRICT (M.S.),INDIA	50
30 OCT 2014	KOLANDA, SRI LANKA	200
20 AUG 2014	HIROSHIMA,SRI LANKA	100

By use of wireless sensor networks the environmental or physical condition are checked automatically and such autonomous instruments or nodes, combine with routers which make a standard WSN system. As such the sensors are buried at different places to obtain values for different places for same region and all these nodes form communicate wirelessly to central entrance where user gathers information, process it, examine it and present the evaluated data. Hence for an extra communication for increasing the length of the network within the region the routers may be use. WSN greater advantage towards low power consumption using just simple 4 AA batteries capable of functioning for around 2-3 years. [6]To elaborate network distance and reliability technology such as IEEE 802.15.4 and ZigBee gives a standard, low-power communication which provides mesh routing. Hence, WSN fulfills the need for real time monitoring, especially in the harsh environment too. WSN are composed of series of sensors, where the sensors are buried into the holes of earth, to provide continuous data on the landslide activity.

III. SYSTEM BLOCK DIAGRAM

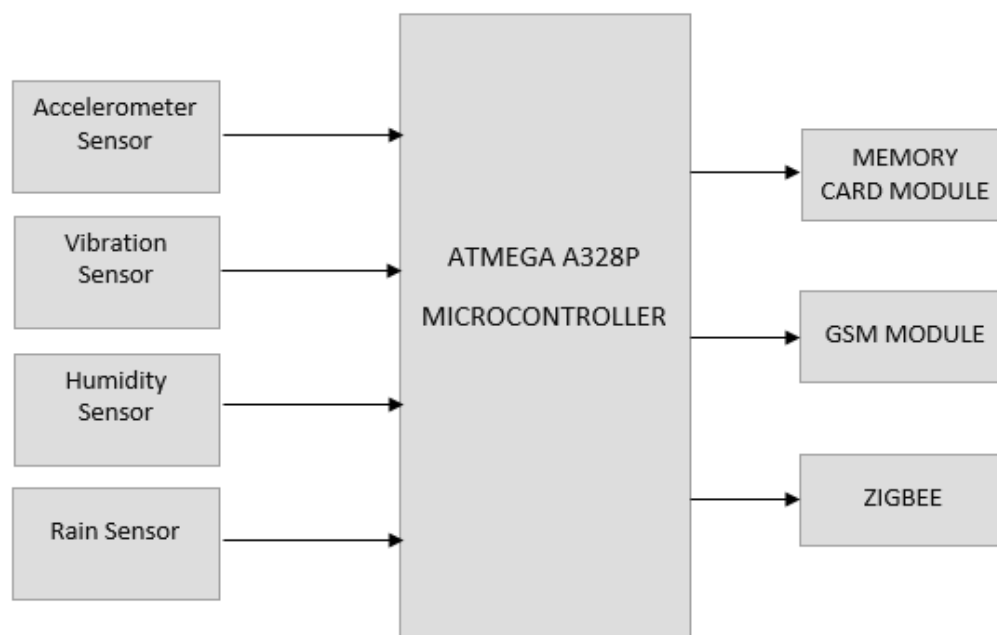


Fig. 2. Block Diagram of Transmitter Section

In order to achieve pre-warning mechanism and wider-monitoring, WSN system mainly focuses on Data acquisition, effective transmission and the accuracy of processing. WSN consist of four main component: A radio, a processor sensors, and a battery. LAN is set as the research platform. Wireless sensor network has very good scalability. In this we have the modules of Zigbee, GSM and Sensors which are interfaced with the microcontroller. The sensors used have different activity as per used. Fig.2 and Fig.3 shows transmitter and receiver section, which form the complete network for landslide pre-warning. In transmitter section the data sensed are given to processor, and as the respective sensors threshold values are exceeded then three warning information are provided for landslides. The first pre-warning goes through SMS on particular assigned mobile number using zigbee. After then as the threshold value increases the second step is to give an audio call to particular assigned mobile number having predefined message. At last the alarm is also generated if further increase in threshold values. The output value increases if the landslides along the direction of arrow on the chips have acceleration.

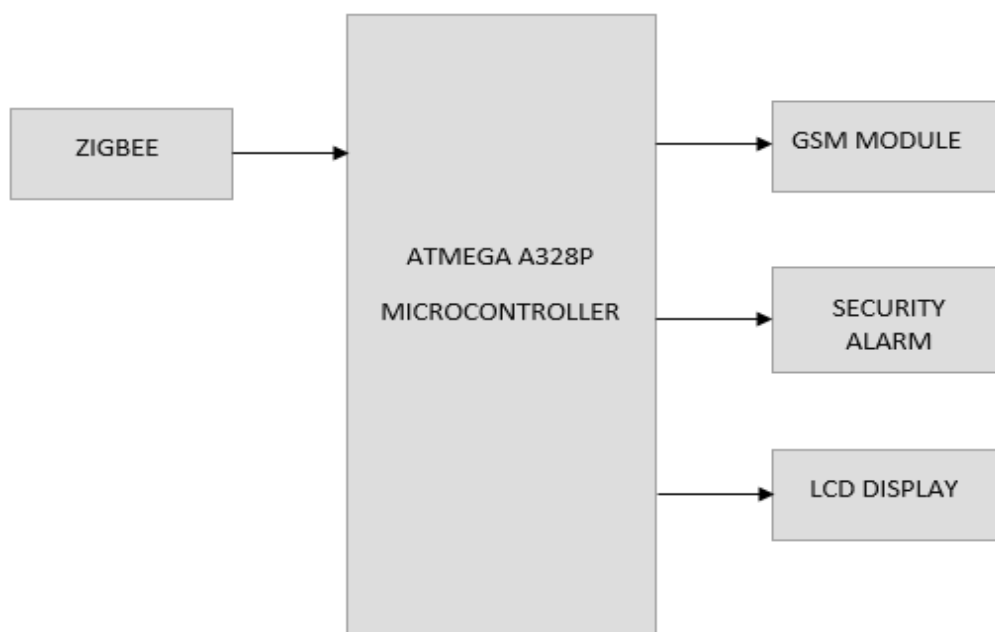


Fig. 3. Block Diagram of Receiver Section

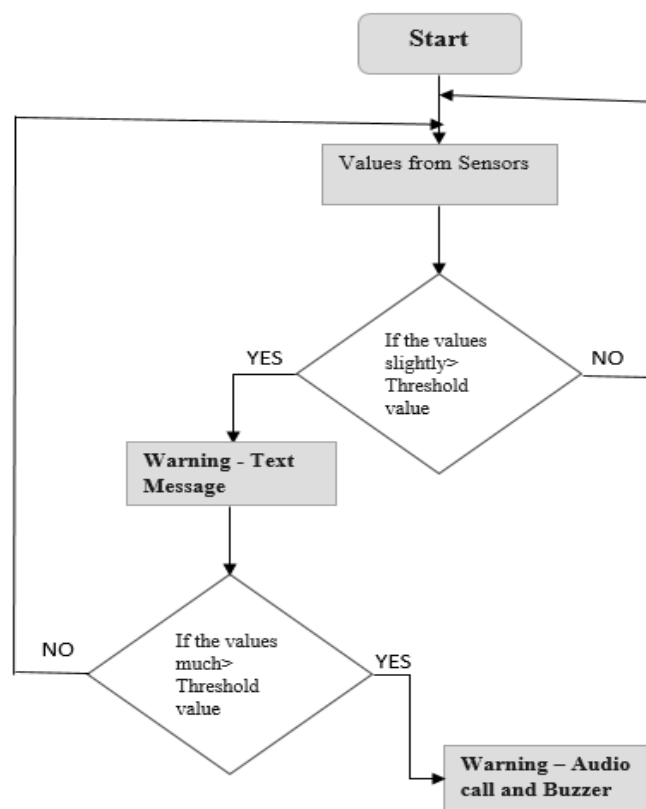
3.1 Sensors Used For Measurements

Different types of sensors are used for measuring the parameter related to land. As shown in Fig.2 there are four types of sensor mentioned, which measures the parameter of Land such as soil moisture, angle change of any slope, water measurement in the hill where shear strength holds by soil or rock. One of the most common inertial sensors is the accelerometer, a dynamic sensor capable of a vast range of sensing. Accelerometers are available that can measure acceleration in one, two, or three orthogonal axes. There are considerable advantages to using an analog accelerometer as opposed to an inclinometer such as a liquid tilt sensor – inclinometers tend to output binary information (indicating a state of on or off), thus it is only possible to detect when the tilt has exceeded some thresholding angle. The below table 2 shows the sensor used and their tasks.

Table 2. Sensors Used and Their Task

Sensors	Task
Accelerometer Sensor	Calculate Angle for Slope of Land.
Vibration Sensor	Measurement of Any Critical Vibrational Values.
Humidity Sensor	Additional Moisture Measurement.
Rain Sensor	In case Heavy Rainfall, So for Measurement of Changes in Water Table Height.

IV. PROGRAMMABLE LOGIC



The various details collected from the sensors are first given to microcontroller used. A user defined threshold value is set as such there may be possibility of occurrence of landslide hazard .Very first when the values obtain from sensors becomes slightly greater than the set threshold values, an immediate defined text message is send to authorized mobile number. As further increase in the values much greater than set threshold value, an audio call is done and finally a sound alarm is also generated which can alert the nearby places.

V. ADVANTAGES

- Seismic Hazard landslide and Earthquake monitoring.
- Safety and security.
- Safety for the humans and vehicles.

- Real time monitoring.
- Low power consumption.

VI. CONCLUSION

The proposed work is for monitoring the hazard of landslides and by measuring the parameters related to landslides the hazard is pre-warned before it occur. The proposed system is with wireless sensor network which collects data and transfers it wirelessly using Zigbee for further analysis in order to give quick response. If any possibility of occurrence of hazard is noticed the alerts are given through Wireless Sensor Network. By use of WSN any mechanical or geo-physical sensor can be interfaced easily for protection of human losses as well as economic losses.

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