

SENSORS BASED EARLY WARNING SYSTEM FOR LANDSLIDES

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Abstract: A landslide, also known as a landslip or mudslide, is a form of mass wasting that includes a wide range of ground movements, such as rock falls, deep failure of slopes, and shallow debris flows. Typically, pre-conditional factors build up specific sub-surface conditions that make the slope area prone to failure, whereas the actual landslide often requires a trigger before being released. This system aims in creating an autonomous Landslide detection using sensors, which detect the pre conditions of landslide then it will inform the warning message to nearby disaster management officials , police station and etc.

Keywords: Landslide, Early warning system(EWS), sensors.

1. INTRODUCTION

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity. Landslides can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. In landslide prone areas, risk mitigation must often face problems related to economical resources, environmental impact and logistic issues. Early warning systems (EWSs) are cost-effective means to reduce the risk with a low environmental and economical impact. In this paper an arduino based system is designed which detects the landslide pre conditions in hilly or plateau region in order to save life of civilians. Sensors used are very accurate as well as should pose high sensitivity so that even minor detection by it will trigger alarm and broadcast message as early as possible to Nearby region and disaster management officials. It can also be used during the landslide prediction mapping.

2. METHODOLOGY

2.1 Block Diagram

This block diagram represents the various components of this system and how they are related to each other.

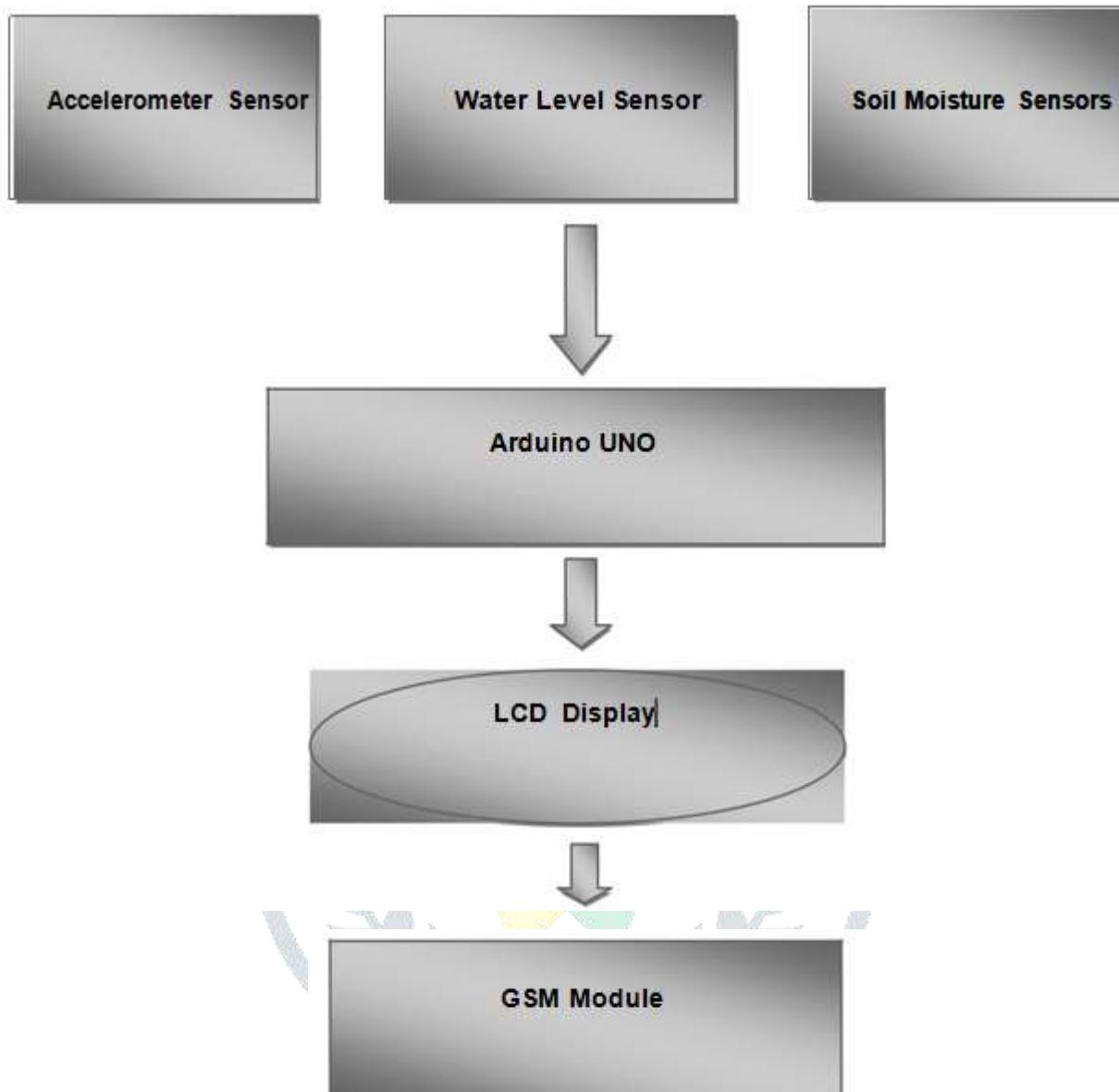


Figure 2.1 Block Diagram

2.2 Circuit Diagram

In this circuit diagram, the connections of various components of this system are shown. The two main sensors which are used to detect the pre conditions for landslide to be occurred are connected to arduino. Also the other components like LCD display, GSM module etc are also shown connected with arduino.

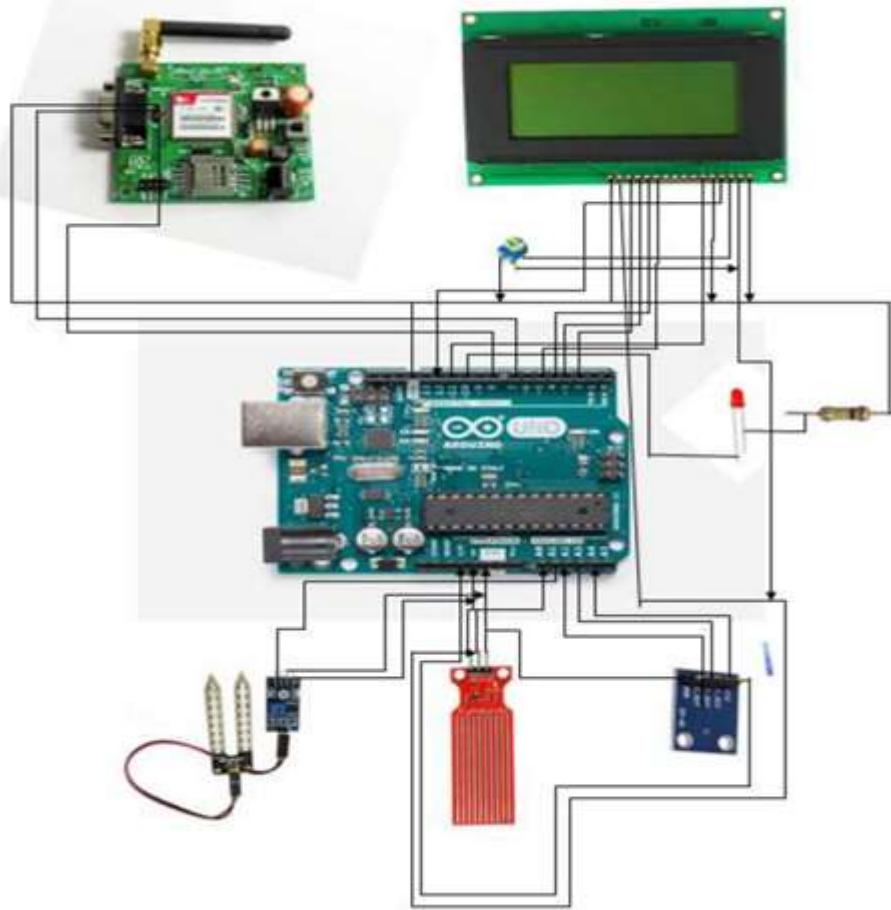


Figure 2.2 Circuit Diagram

3. OPERATION

As we already discussed that landslide can be caused by multiple causes. These factors could be rainfall, snowmelt, changes in water level, stream erosion, changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. In the proposed system we have used two sensors that is water level sensor and other is accelerometer sensor. These sensors detects the water level changes or can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration respectively. If any of the sensor will detect the pre conditions of landslide then it will inform the warning message to nearby disaster management officials , police station and etc. using GSM module.

4. CONCLUSIONS

Landslides is a serious threat to the civilians worldwide and also provide major challenges to agriculture, flora and fauna, and infrastructure in specific regions(mainly hilly areas) all across the world. The design implemented in this system is of a landslides early warning detection using sensors that is controlled by Arduino is working satisfactorily. Landslide early warning detection can save hundreds of life of civilians. Apart from saving life of civilians, it helps to save resources in specified regions.

5. FUTURE SCOPE

- A future scope would be to install camera near sensor because it can provide real time image of sensors conditions that is whether it is working properly or not, to check positions of sensor or through camera it can be easily identified whether sensors are damaged or not.
- Another advancement which can be done is “Special bar code allocation with GPRS”. If any vehicle or individual entering the landslide prone area then they should be provided with special bar code so that if they are in danger or sensors detected the landslide preconditions then they can be easily identified with exact location in order to save them from landslide.
- We can also use GPR sensor technology for the detection of Landslides in the future. GPR stands for Ground penetration radar. This technology can help to detect the plate movements in ground level. It can be also be able to things like slope elevation, soil degradation, ground water phenomenon

6. REFERENCES

- [1] Schlögel R, Doubre C, Malet J, Masson F. Geomorphology Landslide deformation monitoring with ALOS / PALSAR imagery : A D-InSAR geomorphological interpretation method. *Geomorphology* [Internet]. Elsevier B.V.; 2015;231:314–30.
- [2] Benoit L, Briole P, Martin O, Thom C, Malet J, Ulrich P. Monitoring landslide displacements with the Geocube wireless network of low-cost GPS. *Eng Geol* [Internet]. Elsevier B.V.; 2015;195:111– 21.
- [3] Crawford MM, Bryson LS. Assessment of active landslides using field electrical measurements. *Eng Geol* [Internet]. Elsevier; 2018;233(June 2017):146–59.
- [4] Yu Z, Dai H, Zhang Q, Zhang M, Liu L. Optik High-resolution distributed strain sensing system for landslide monitoring. *Opt - Int J Light Electron Opt* [Internet]. Elsevier GmbH.; 2018;158:91– 6.
- [5] Bovenga F, Pasquariello G, Pellicani R, Re A, Spilotro G. Catena Landslide monitoring for risk mitigation by using corner reflector and satellite SAR interferometry : The large landslide of Carlantino (Italy). 2017;151:49–62.
- [6] Biansoongnern S, Plungkang B, Susuk S. Development of Low Cost Vibration Sensor Network for Early Warning System of Landslides. *Energy Procedia*
- [7] Casagli N, Cigna F, Bianchini S, Hölbling D, Füreder P, Righini G, et al. Remote Sensing Applications : Society and Environment Landslide mapping and monitoring by using radar and optical remote sensing : Examples from the EC-FP7 project SAFER. *Remote Sens Appl Soc Environ* [Internet]. Elsevier; 2016;4:92–108.
- [8] Guerriero L, Guerriero G, Grelle G, Guadagno FM, Revellino P. Brief Communication : A lowcost Arduino based wire extensometer for earth flow monitoring. 2017.