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IOT based Land Slide Detector

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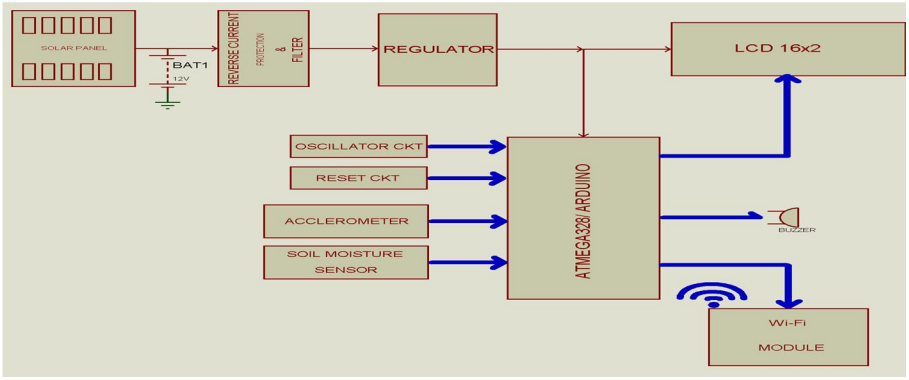
***Abstract:** Landslide is a natural disaster damaging the social life every year. It can be defined as the movement of mass of rock, debris down a slope. It occurs due to natural or manmade activities. Asia was found to be the most affected continent where 75% of landslides occurred. India also faced the loss of humans due to landslides which occurred last year during monsoon in kerala. The main aim of the proposed system is to detect those conditions which lead to the occurrence of landslide and notify it well before time so that necessary steps can be taken to reduce or save the human loss. The proposed system uses soil moisture and accelerometer sensors. Moisture sensor readings are indicative of the moisture content in the soil whereas accelerometer checks movement of land. The readings crossing the defined thresholds give alarm to local citizens to safeguard themselves. All the readings from microcontroller are also uploaded on thingspeak cloud to analyze them and alert the rescue team in case of MIDDLE and DANGER zones. The system takes 10 ms time to collect data from sensor and transmit it to things speak server is about 30 second.*

I. INTRODUCTION

A landslide is movement of a mass of rock, debris, or earth down a slope. In monsoons the rain water percolates and develops hydraulic pressure which exceeds the elastic limit of the soil or rocks. Due to this the strain gets accumulated which forces the soil and rocks to loosen their adhesive strengths entailing landslides. Landslides destroy agricultural/forest lands, road transports, destroys earth's natural environment as a whole causing great loss to life. Landslides can also be said of "Mass Wasting", which refers to any down slope movement of soil and rock due to gravity. It causes property damage, injury and death. Also, it adversely affects a variety of resources such as water supplies, fisheries, sewage disposal systems, dams and roadways for years after a slide event. The landslides occur when the slope changes from a stable to an unstable condition. This change in the stability of a slope can be caused by many factors together or alone. The Natural causes, such as, ground water pressure acting to destabilize the slope, erosion at the bottom of a slope by rivers or ocean waves, earthquakes adding loads to barely stable slope, earthquake caused liquefaction destabilizing slopes. The Manmade causes, such as, deforestation, cultivation and construction which destabilizes the already fragile slopes, vibrations from machinery or traffic. Rock avalanches, debris flows, soil movement, mud flows are the various forms of landslide. Landslides occur in rocky mountainous regions like Himalayas, konkan railways, lonavala ghats and marshy regions of kerala in India. Lanslides are hazards all over the world. Hillsides with steep slopes are prone to landslides. Landslide prediction, detection and monitoring have been done by researchers for different case studies all over the world. Landslide detection can be done by using diverse methods like visual inspection using image/video processing, satellite remote sensing, using statistical methods or using machine learning algorithms. Landslide detection can also be based on data driven approaches using wireless sensor networks (WSN). The main objective to study the landslide detection is to prevent the natural calamity by detecting its early movement. This will reduce or save the human loss caused by the landslide. Also, the objective is to find a certain way in which the sensing elements should respond quickly to rapid changes of data and send this sensed data to data analysis center. The proposed WSN/Internet of things (IoT) based landslide detection and monitoring system is a low cost, robust and delay efficient.

Block Diagram



II. METHODOLOGY

Arduino uno/ Atmega328 microcontroller (32Kb programming memory, 2kb ram), Acclerometer ADXL335/ ADXL345 to detect acceleration change sense in particular amount. Soil moisture sensor (to sense moisture in soil). LCD 16x2 to show conditions on LCD screen. Buzzer to alert the conditions. Wi-Fi to connect with server of things speak & sends data it over server. Solar panel to give power supply to the circuit. To program arduino board arduino 1.8.12 software used. Layout is designed with proteus simulator software.

III. EXPECTED RESULT

The readings of Soil Moisture sensor are used to decide the zone. The threshold values change according to the soil type and its characteristics. The accelerometer is used to check any movement of soil due to earth's vibration. The output values of accelerometer are mapped with the reference values to use it as a Seismograph device. The value mapped consists of instrumental intensity, acceleration, velocity, perceived shaking and potential damage columns. If the shaking ismore, acceleration will be more and thus can cause heavy damage. All the output values of accelerometer are mapped according to acceleration column and corresponding intensity is being published to monitoring station.

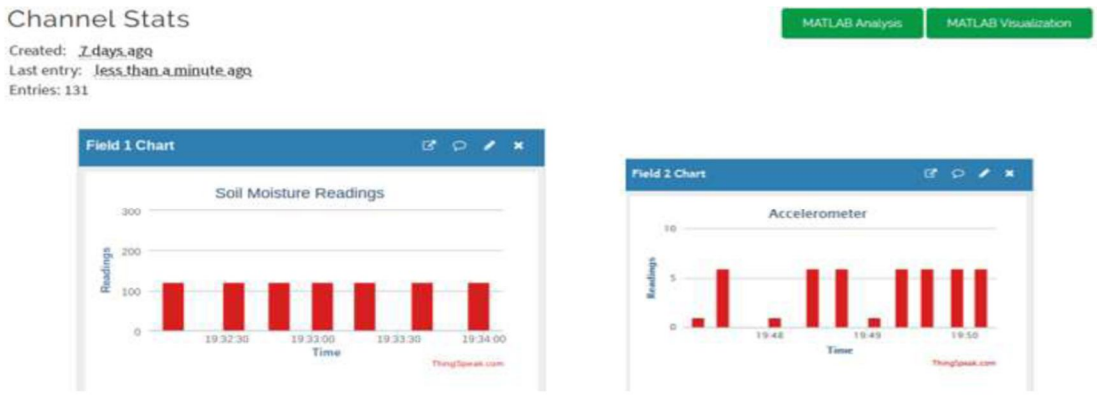


Figure shows the graphical representation of sensed values from soil moisture sensor and accelerometer which are uploaded on ThingSpeak cloud.

IV. CONCLUDING REMARKS & FUTURE SCOPE

The landslide detection system is successfully implemented as a prototype. All the sensors and other stuff works as per the expectations. The sensors effectively sense the surrounding conditions and give the readings. Based on readings, the prediction of landslide is achieved successfully. The system senses data and transmits it continuously. When Wi-Fi tries to connect with Wi-Fi it consumes 1.6 Watt (i.e. 320mA current is drawn with 3.3V supply voltage) and when NodeMCU gets connected to Wi-fi and sends data it consumes 0.49 Watt (i.e.98mA current at 3.3V supply voltage).

To minimize power consumption and increase the battery backup, the NodeMCU can be operated in duty-cycled mode. The system takes 10 ms time to collect data from sensor and transmit it to microcontroller, additional 10 sec time is required to upload data from microcontroller to ThingSpeak cloud. In order to cover large area, say 1000 sq. ft., approximately 375 nodes are required where one node consist of one soil moisture and one accelerometer. The proposed system uses 8-bit multiplexer, considering this, approximately 188 multiplexers and NodeMCU's are required to cover the aforementioned area. If the system uses 16-bit multiplexer, then approximately 94 multiplexers and NodeMCU's would be required. As the system uses raspberry pi at the monitoring center, machine learning can be implemented in the system through python programming in future work. We can use the same technique for iot based automatic dam level monitor and control system. By just replacing input single soil moisture sensor with float type multiple float sensors to acknowledge water level in dam. If level is full or overflow automatic controller door opens and water flows to decrease water level in dam. Microcontroller commands to wi-fi module to upload dam water level to the server. Graphical data shows on thing spak server to represent the water level. This type of project can be used in automatic irrigation systems to view the agricultural parameters in graphical format on things speak server and control the automation parameter like automatic watering system, automatic waterlevel controlling system.

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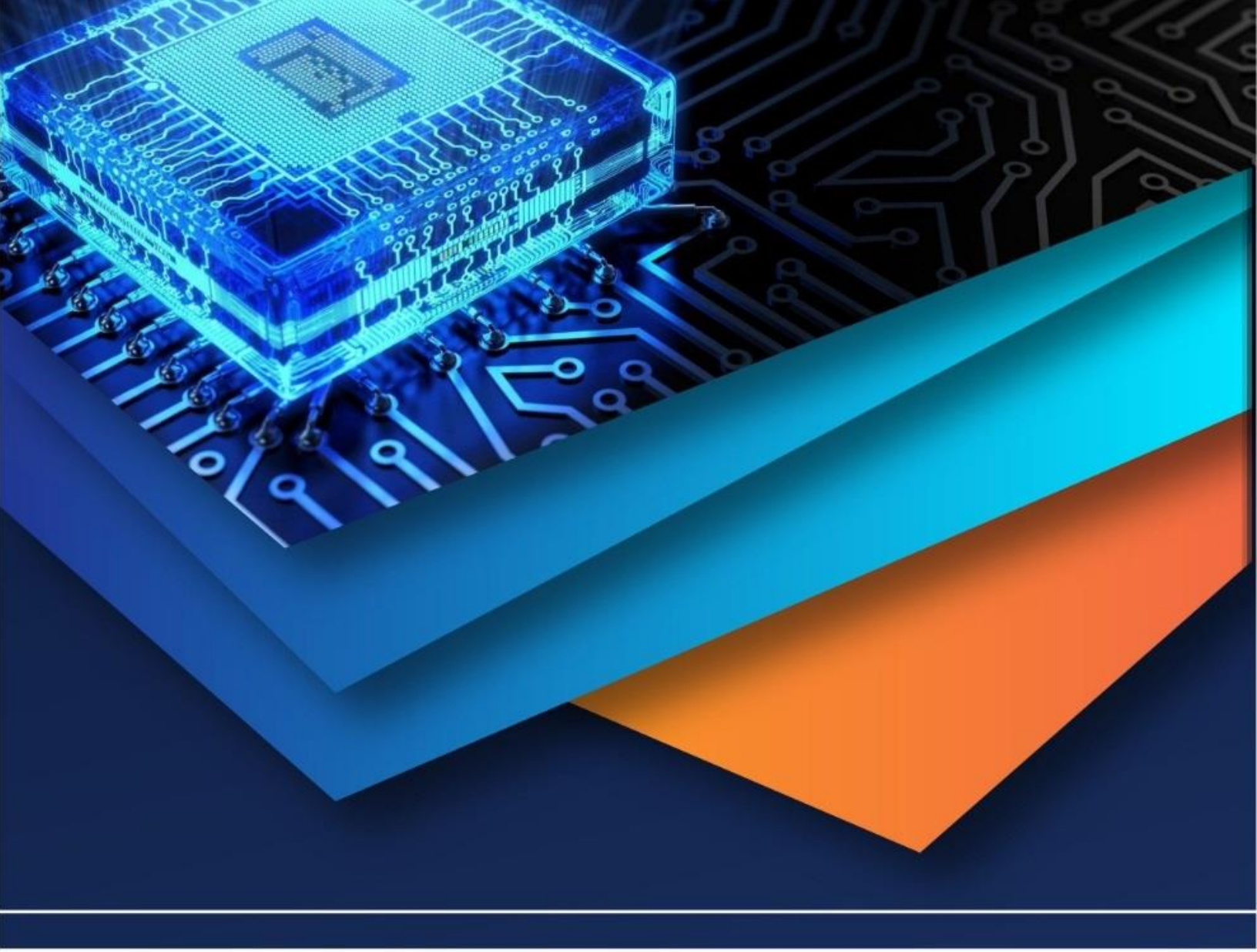

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