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Landslide Early Warning System Using IoT

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Abstract : Early warning system are becoming one of the main pillars of disaster prevention in natural hazards especially where mitigation strategies are not realizable. Therefore, the call for multi-hazard early warning system and improvement of monitoring of natural hazard is steadily growing. However, data gathering through sensor integration as well as system independent supply of information from early warning networks are particular challenge. Because very complex information and warning chains have to be served for, standardization and interoperability plays an important role for all organizations and infrastructures being involved. This project investigates the complete information chain, starting from data gathering using wireless sensor networks via information processing and analysis to information retrieval.

Keywords : Natural hazard , sensor network

INTRODUCTION :

A landslide is the downslope movement of soil, rock, and organic materials under the effects of gravity and also the landform that results from such movement [1]. Landslides are known also as landslips, slumps or slope failure. In the beginning of 2017 several countries hit by landslide such as Colombia, Italy, Indonesia, New Zealand, India, Bosnia, Kyrgyztan. In March 31, 2017 a massive landslide hit Mocoa Columbia and at least 254 people had been killed, more than 200 were missing and at least 400 were injured [2]. An early warning system can be used to minimize the impact imposed by landslide on human, damage to property and loss of live. The ability to monitor slope movements in timely fashion will inform the people of possible slope failures – giving them adequate lead time to relocate to a safer place. This landslide early warning system integrates the rainfall sensor, accelerometer, and inclinometer with visual web-GIS (geographic information system) interface so that the factors causing the landslide and its effects (movement of the soil) can be monitor. The system is equipped with wireless telemetry so that the data obtained from accelerometers and rainfall gauges can be send to a remote monitoring or observation center and recorded.

landslide can be caused by two main factors, namely controlling factor and triggering factor. both main factors will provide mutual synergy to form landslide if there is an excessive ability threshold. the controlling factor is the factors affecting the material condition such as geology, slope, lithology, shear (fault) and invariance on rocks. the triggering factor is the factor causing the movement of materials such as rainfall, earthquake, erosion of slope and human activities [7]. slopes with inclination more than 20° have potential to move or for landslide, but slopes with inclination or sloping land has always prone to landslide depend on the geological conditions of the slopes [8]. according to type of movement there are 6 types of landslides i.e. translational, rotational, creep, topple, fall and flow as shown in figure 1 [9].

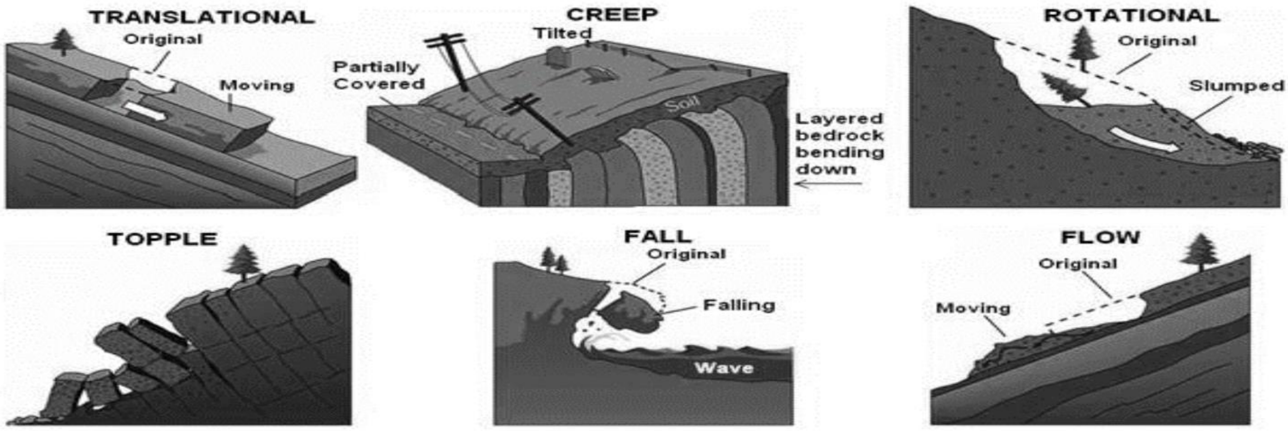


Fig 1 : TYPES OF LANDSLIDE

Research Method :

- In India, there is no such immediate communication system that addresses the common people about the landslide immediately. During the landslides, the major problem is that of the delay occurring in addressing the concerned departments and common people residing in remote areas about the landslide alert.
- Passing on the alert message information manually, consumes lots of valuable time as the information is passed from one department to the other and any loop hole can cause a severe damage. So, there is a need for making an automatic system which will immediately and simultaneously sends the alert message to everyone.

Problem Statement:

- Land sliding in general described as down sliding of rock, soil and organic material due to various parameters under the influence of gravity , soil moisture and climatic conditions determine the strength of the land. If due to any of these conditions the sand and rock of certain level deviates from its own state leading to slide Various external parameters like environment issues and other problems also affect the strength of the land
- Earth quakes: which produce shock and vibrations forms a significant factor in some hill area
- Construction: heavy industries and building constructions need big foundations which create internal vibrations.
- Rainfall: intense or heavy rainfall prone areas will always be in danger of land-slides especially hilly areas.
- Under-Ground Constructions: human activities including various transportation constructions like roadways and railways leading to steam erosions, heat wave actions.

Design Methodology:

- In this project we are making system which will gives alert of any unusual activity by sensors, in which we are using common and cheap sensor which generally used in smartphone like accelerometer and pressure sensor which give data when any movement soil or increase in pressure we also added sensor like temperature and altitude.
- As a brain of project we used AURDINO UNO which is cortex-m3 based and it is cheap and need low level of programming
- For communication protocol we are using NRF24L01 and ESP8266 , where NRF24L01 is used for multipoint connection device. Its trans-receiver device so we place one module at transmitter end which means it will send the collected data to second module which we are using as base receiver
- And this collected at base receiver which is second NRF module is passed to WIFI module which is ESP8266 this wifi module connected through internet which send data to thingspeak server which represent collected into graph plot which is update at every 15 second interval with the proper plotting we can keep data of all sensor with any unusual activity we can alert local people and local authorities.

Block Diagram:

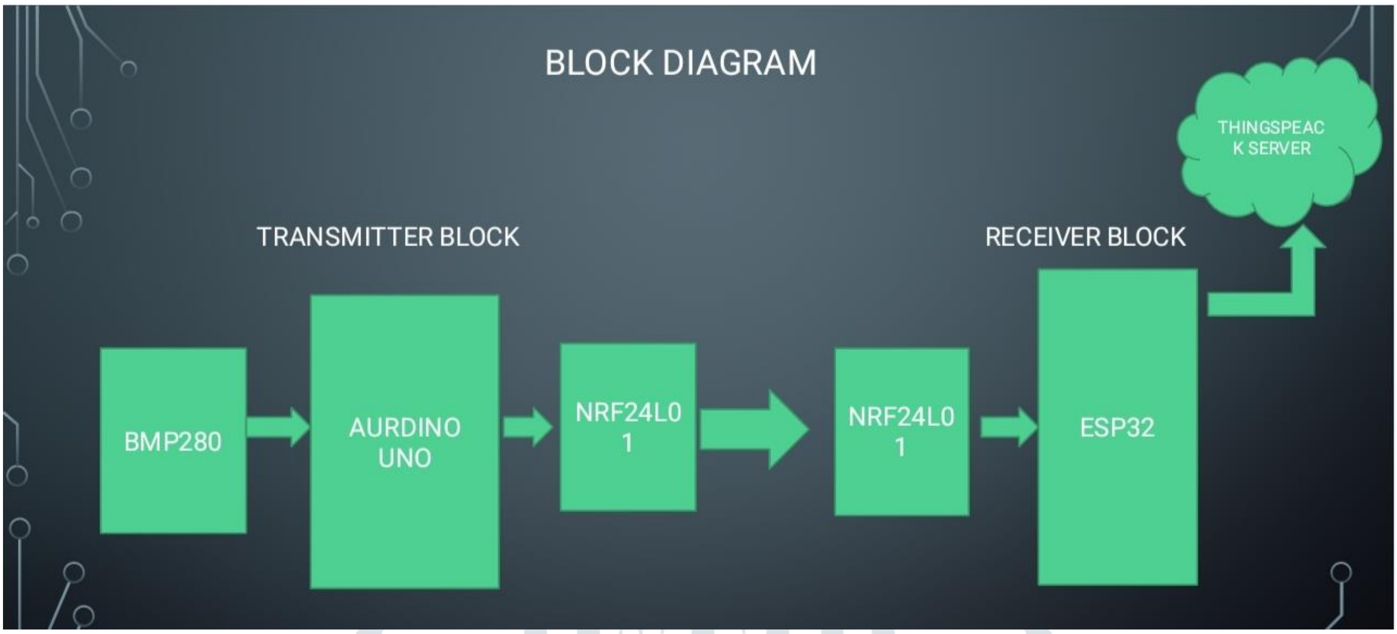
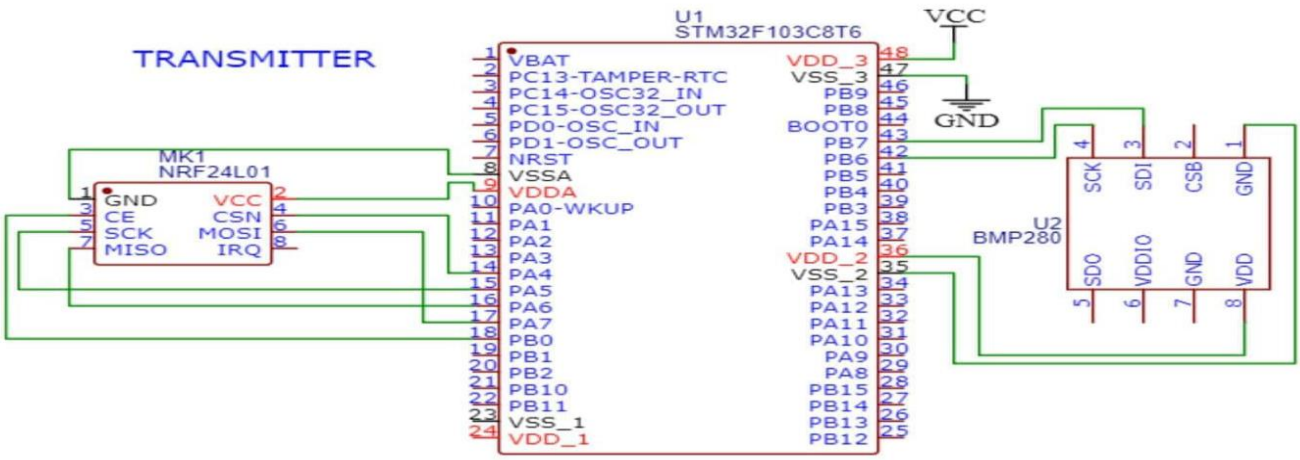


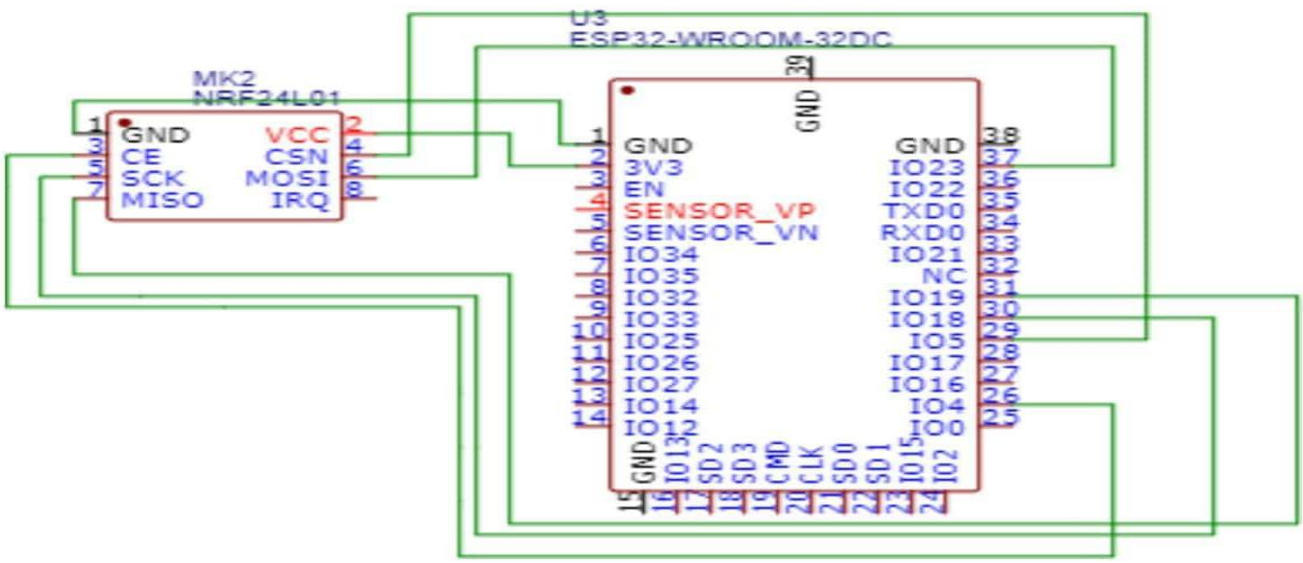
Fig 2: Block Diagram

- Our project is generally based on giving alert of warning of natural disaster like landslide, earthquake, lava eruption, etc. we are focusing on landslide detection on mountains or ghat areas so assuming these conditions we selected sensor, microcontroller, communication module and data display devices.
- As heart of our project we selected aurdino uno, it is m3 cortex based microcontroller core that runs at 72MHz max. Software libraries are available that allow users to program the chip using the Arduino IDE. and for sensing device we used BME/P280 barometric sensor. The BME280 sensor module reads barometric pressure, temperature, and humidity. Because pressure changes with altitude, you can also estimate altitude. NRF24l01 is trans-receiver module used for communication protocol and sending data we used ESP32 as IOT device which upload data to thingspeak server.

Circuit Diagram:



RECEIVER



Working:

Our project is generally based on giving alert of warning of natural disaster like landslide, earthquake, lava eruption, etc. we are focusing on landslide detection on mountains or ghat areas so assuming these conditions we selected sensor, microcontroller, communication module and data display devices.

As heart of our project, we selected stm32F103c8, it is m3 cortex-based microcontroller core that runs at 72MHzmax.Software libraries are available that allow users to program the chip using the Arduino IDE. and for sensing device we used BME/P280 barometric sensor. The BME280 sensor module reads barometric pressure, temperature, and humidity. Because pressure changes with altitude, you can also estimate altitude. NRF24l01 is trans receiver module used for communication protocol and sending data we used ESP32 as IOT device which upload data to thingspeak server

Transmitter end is consist of BMP/E280,STMBLUEPILL and NRF-MODULE. Connection are follow vcc and ground pin of bme 280 is connected to 3.3v of stm and ground respectively module Pin CSN- PA4 of stm, like MOSI-PA7 ,CE-PB0,CSK-PA5 and MISO-PA6 respectively. In transmitter end first sense the signal and this signal is given STM32 using SPI method than this data process and get data in term of barometric pressure, temperature, and humidity. And this readed data is given to NRF module which is transreceiver module and it can work as mesh network and frequencies used is permissible.

In receiver end Pin CSN- D5 of stm, like MOSI-D23 ,CE-D4,CSK-D18 and MISO-D19 respectively. Data Sended to receiver NRF module which is in form of FSK modulated data and data is given ESP32 which WIFI module used as IOT device which collected data is send to thingspeak server which plot the data into form of graphs which is update after every 15 second so authorities will noticed the changes and can Give alert to local people and evacute areas

RESULTS AND DISCUSSION:

Fig 3 : Results

CONCLUSION :

The BME280 Sensor Data from Transmitter is received by Receiver/Gateway. The Gateway displays the received data like temperature, humidity, pressure, and altitude on the Serial Monitor. Similarly, you can monitor the data online on Thing-speak Server. For that, go to the private view of Thing-speak Server. The data will be logged on after the interval of 15 seconds. To make the device better, we can implement the Sleep Mode feature and change Data Sending Interval. A landslide early warning system with accelerometers and a rainfall sensor equipped with Wi-Fi for remote monitoring purposes was developed. The advantages of this system are real time monitoring, remote monitoring, and can be used to monitor multiple points in observation area at once. The results show that the system can display and store slope and acceleration data caused by soil movement and deformation, as well as display and print graph of acceleration, angle and rainfall during monitoring.

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