Land Slide Monitoring System Using IOT

ESWARAMOORTHI R ILAVARSAN K ARUNKUMAR S MANOJ T PRABAKARAN R

Asst .prof .in Department of ECE , KSRCE , TIRUCHENGODE, Tamil Nadu , India
Student in Department of ECE , KSRCE , TIRUCHENGODE, Tamil Nadu , India

Abstract-Massive slope failures, including soil, rock, and ice movement, seriously harm the ecology, economy, and other resources. Detection, monitoring, and control are the three main problems with real-time applications. One of the key applications that has aided in the development of numerous types of technology on a big scale is the detection and monitoring of problems. This project offers a wireless sensor network system (WSNS) for dependable, effective, and efficient landslip monitoring. The system consists of a network of wireless inertial measurement unit (IMU) sensor units, a local base station for data collection, a capture server for data processing and storage, and a warning system. To determine the movement thresholds and categorise landslides, the IMU sensor data gathered by the three-axis accelerometer and three-axis gyroscope were used. This project's results lay the groundwork for next research and technical developments that will make it easier to take stabilisation or mitigation measures for landslides and forecast the severity of the damage these landslides will cause.

Keyword-IoT,Ultra sonic sensor , Accelerometer sensor , Rain sensor, blynk platform,Arduino uno board

I. INTRODUCTION

More and more people are settling in environments like steep sides that have become unsafe owing to various forms of natural hazards as a result of the continued expansion of metropolitan areas and infrastructure. Landslides are frequent catastrophes that cause significant losses in human lives and material goods. The wireless sensor techniques are the most appropriate for handling such sudden occurrences because they can react fast to sudden changes, such as unfavourable weather conditions, and transmit sensed data wirelessly to the receiver station in places where cable is impractical. Signals from sensors and detecting devices are converted into a central server utilising cable or GPRS connectivity. Cable has apparent problems such challenges with wiring and construction in danger zones, man-made destruction, and devastation from natural disasters. GPRS communication also has technical restrictions. It cannot be used in isolated mountainous regions where the signal is weak or even difficult to receive, making it difficult to construct a reliable GPRS network. There are initiatives being developed that use 302 satellite photos and a combination of digital categorization and textual analysis to locate landslip features. Hence, employing satellite images involves extensive processing, which leads to complicated calculations and makes the project more difficult to understand. These techniques are considered to be expensive and labour-intensive, though Wireless sensor networks offer a practical alternative technique to get over these restrictions.

II. LITEARTURE SURVEY

[1]E.Bruckl, F. K. Brunner, and K. Kraus, “Kinematics of a deep-seated landslide derived from photogrammetric, GPS and geophysical data,” et al.,(2006):

A Digital Photogrammetric Workstation was used to create and compare three DTMs. 293 sites in the landslip have displacement vectors that were identified. The GPS station has been moving at an average speed of roughly 3.5 cm per year since 2004, which is consistent with the mean Modern GPS technology has demonstrated its ability to track ground movement deformations as small as one centimetre. GPS sensors have the key benefit of not requiring a direct line of sight between stations. Because of this, GPS can keep track of the landslip in real time or after the fact, even in bad weather.

[2]M. Rawat, V. Joshi, B. Rawat, and K. Kumar, “Landslide movement monitoring using GPS technology: A case study of Bakthang landslide, Gangtok, East Sikkim, India,” et al.,(2011)

A land slide is a broad phrase used to describe the downward movement of soil, rock, and organic material caused by gravity. Many areas of India's north-eastern region are susceptible to landslides and moss movement.

[3]G. Herrera et al., "Multi-sensor advanced DInSAR monitoring of very slow landslides: The Tena Valley case study (Central Spanish Pyrenees)," et al.,(2013):

In this study, it is shown how combining multi-sensor and multi-temporal SAR data enhances the ability to monitor very slow landslides. The research region is the Upper Tena Valley in the Central Spanish Pyrenees, where relatively sluggish earth flows have primarily caused direct damage of an estimated 15 million euros over the past ten years. Heterogeneous displacement velocity values have been obtained using the descending orbit ERS & Envisat (2001-2007), TerraSAR-X (2008), and ascending orbit ALOS PALSAR pictures (2006-2010) and enhanced DInSAR processing of these datasets. The geometrical differences introduced by each satellite are minimised by projection along the steepest slope of LOS displacements. With the help of existing D-GPS readings, these results were compared and validated.

[4]J. S. Marciano et al., "Monitoring system for deep-seated landslides using locally-developed tilt and moisture sensors: System improvements and experiences from real world deployment," et al.,(2014):

Several villages in the Philippines that are located close to steep, unstable slopes face a major threat from landslides. In this study, improvements in the tilt and soil moisture sensors-based alternative instrumentation for deep-seated landslip monitoring are described. The sensor column for the real-time landslide monitoring system is sunk in a borehole in the unstable slope that can be as deep as 40 metres. Tri-axial accelerometers for tilt measurements and capacitive sensors for soil moisture are both included in each column, which is made up of segments measuring 0.5 to 1 m..

[5]Geomorphol, "Spatial and temporal analysis of a global landslide catalogue," et al.,(2016)

There is surprisingly little data on the historical occurrence of landslides at the global scale, despite the fact that landslide inventories are essential to enable inquiries into where and when landslides have happened and may occur in the future. This study introduces a brand-new global landslip catalogue (GLC), which is based on news articles, web databases, and other sources. The 5741 sites in the GLC provide as a base for analysing regional and temporal changes in landslip activity from 2007 to 2013. In the world, landslides were reported most frequently between July and September. Asia, North America, and Southeast Asia are where most events took place. Less than 5% of the fatalities, in contrast, were reported in North America, which raises questions about major underreporting in other regions as well as possible disparities between developing and developed regions.

III. PROPOSED SYSTEM

The sensor Ultrasonic ranging module HC-SR04 in this instance offers a non-contact measurement function between 2 and 400 cm with a 3 mm ranging precision. Ultrasonic transmitters, receivers, and control circuits are all included in the modules. The fundamental working principle:

- ✓ The Module automatically sends eight 40 kHz signals and checks to see if a pulse signal is received
- ✓ using an IO trigger for at least a 10us high level signal.
- ✓ If the signal is returned at a high level, the period between sending and receiving an ultrasonic signal is the time of high output IO duration.
- ✓ The sensor is attached to an Arduino microcontroller, and the trigger function and return pulse detection are written into the software.
- ✓ The test distance is equal to (high level time * sound velocity (340M/S) / 2).

The ADXl345 accelerometer uses I2C connection to operate. This 3-axis accelerometer is capable of measuring both static and dynamic acceleration forces. A common example of a static force is the gravitational pull of the earth, but dynamic forces can be brought on by vibrations, movements, and other events. The metre per second squared (m/s2) unit of acceleration measurement.

The data made by accelerometer sensors, however, are typically expressed in "g," or gravity. The gravitational constant of the earth is one "g," or 9.8 metres per second squared. The parameters are shown in an LCD and updated in an Internet of Things application using a WIFI module called ESP8266. The rain sensor's output is digital and produces a high signal when it detects rain. It is connected to the microcontroller's digital pin.

IV. BLOCK DIAGRAM

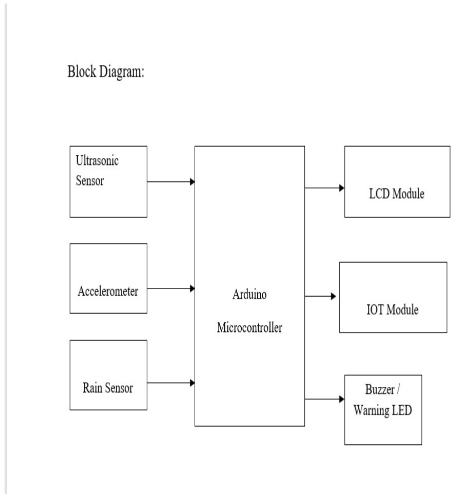

Fig: 1. Block Diagram Proposed Methodology

V. HARDWARE DESCRIPTION

A. ARDUNIO UNO BOARD

The ATmega328 is a type of single-chip microcontroller manufactured by Atmel Corporation in the megaAVR family. The architecture of this Arduino Uno is based on Harvard architecture with 8 bitRISC processor core. Some of other boards developed by Arduino include Arduino Pro Mini, Arduino Nano, Arduino Due, Arduino Mega, and Arduino Leonardo.

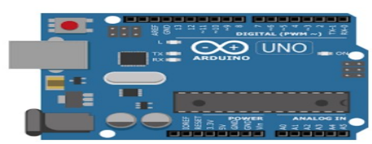

Fig: 2 Arduino Uno board

*Working***-** The Arduino Uno is one type of microcontroller board based on ATmega328, and Uno is an Italian term which means one. This board has a power jack, 14-digital I/O pins, 6- analog Inputs, a crystal oscillator at16 MHz, a USB connection, a RST button, and an ICSP header pins. All these operations can be used by connecting the microcontroller board to a computer. The power supply to this board is given with the help of a to DC adapter, a USB cable, or a battery.

Features

- ✓ It is an easy USB interface. This makes interface with USB and acts like a serial device.
- ✓ It is a 16 MHz clock which is fast enough for most applications.

- ✓ There is an ICSP connected which acts as a port and is necessary to re-bootload the chip if it corrupts and can no longer used to your computer.
- ✓ It has a 32 KB of flash memory for storing the code.
- ✓ An on-board LED is attached to digital pin 13 used for debugging purpose.
- ✓ Finally, the board has a reset button, when pressed it resets the program on the chip.

Characteristics

Power Supply

The Arduino Uno board power supply is given with the help of a USB cable or an external power supply. The external power supplies mainly used is a DC adapter otherwise a battery. The power adapter is attached to the Arduino Uno board by plugging into the power jack of the Arduino board. Similarly, the battery is connected to the Vin pin and the GND pin of the POWER connector. The suggested operating voltage range will be 6 volts to 12 volts.

Input & Output

The Arduino uno board has 14 digital pins that can be used as input & output. The functions like pinMode(), digitalWrite(), & Digital Read() are used for this.

UART PINS RX(0) and TX(1): This pin's are used to transmit & receive TTL serial data, and the pins are connected to the USB to TTL Serial chip like ATmega8U2 or equivalent ones.

External Interrupts (Pin 2 & Pin ***3):*** External pins can be connected to activate an interrupt over a change in value at the pins.

PWM Pins (3, 5, 6, 9, 10, & 11): This pin gives 8-bit PWM o/p by writing the function analogWrite().

SPI Pins (Pin-10 (SS), Pin-11 (MOSI), Pin-12 (MISO), Pin-13 (SCK): These pins are used for SPI-communication,.

LED (Pin-13): The inbuilt LED is connected with pin-13 (digital pin). When there is HIGH-value in the pin, the LED is OFF and the LED is ON, whenever the pin is LOW.

I2C (SCL) Pin-4 (SDA) & Pin-5: It supports Two Wire Interface-communication with the help of the Wire library.

AREF (Reference Voltage): The reference voltage is for the analog inputs with function analogReference().

Reset Pin: This pin is used for reset the microcontroller i.e., program starts from first step.

Memory

The memory size of this Atmega328 Arduino microcontroller is - flash memory-32 KB for storing code, SRAM-2 KB and EEPROM-1 KB.

B. IoT (Internet of Things)

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

Characteristics

- ✓ *Connectivity***.** This doesn't need much further explanation. Devices, sensors, they need to be connected: to an item, to each other, actuators, a process and to 'the Internet' or another network.
- ✓ *Things***.** Anything that can be tagged or connected as such as it's designed to be connected. From sensors and household appliances to tagged livestock. Devices can contain sensors or sensing materials can be attached to devices and items.
- ✓ *Data***.** Data is the bond of the Internet of Things, the first step towards action and intelligence.
- ✓ *Communication***.** Devices get connected so they can communicate data and this data can be analysed.
- ✓ *Intelligence***.** The aspect of intelligence as in the sensing capabilities in IoT devices and the intelligence gathered from data analytics (also artificial intelligence).
- ✓ *Action***.** The consequence of intelligence. This can be manual action, action based upon decisions concerning phenomena (for instance in climate change decisions) and automation, often the most important piece.
- ✓ *Ecosystem***.** The place of the Internet of Things from a perspective of other technologies, communities, goals and the picture in which the Internet of Things fits.

C. BLYNK APP – IOT PLATFORM

- ✓ IOT devices like Arduino, Raspberry Pi, and similar ones can be remotely controlled with the Blynk IOT Platform's iOS and Android apps.
- ✓ It works similarly to a digital dashboard where one may create a project's graphic interface by simply dragging and dropping widgets.
- ✓ No particular board or shield is bound to Blynk. As opposed to that, it's your preferred supporting hardware.
- ✓ Whether your Arduino or Raspberry Pi is connected to the Internet by Wi-Fi, Ethernet, or this new ESP8266 chip, Blynk will get you online and prepared for the Internet of Your Things.

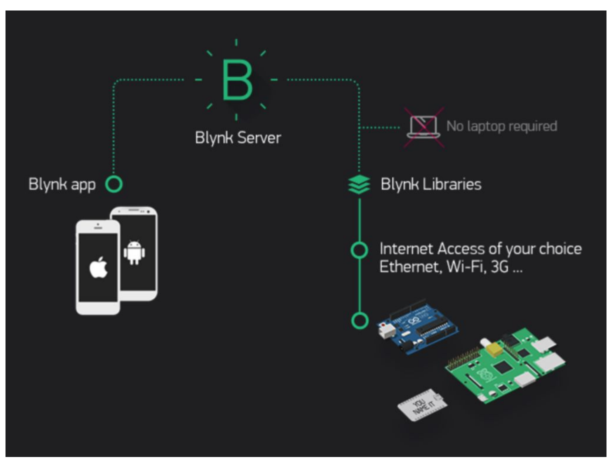

Fig 3 IOT Platform in Blynk App

D. ULTRA SONIC SENSOR HC SR 04

A transmitter and a receiver are both part of the HC-SR04 ultrasonic sensor. This sensor measures the distance to the target. Here, the distance between the sensor and an item will be determined by the time it takes for waves to transmit and receive. This sensor employs non-contact technologies and sound waves. This sensor can accurately and damage-free measure the distance needed to reach the target. This sensor has a range of 2 cm to 400 cm.

Sonar is used by the HC-SR04 ultrasonic sensor to determine how far an object is from the sensor. With excellent precision & steady readings, it offers an exceptional range of non-contact detection. Ultrasonic transmitter and receiver are two of its two modules. This sensor has a wide range of uses, including direction and speed measurement, medical imaging, sonar, humidifiers, wireless charging, non-destructive testing, and ultrasonography.

Fig: 4 HC SR04 Ultrasonic Sensor

E. ACCELEROMETER SENSOR

A body's acceleration is the rate at which its velocity changes in relation to time. Relative theory states that there are two forms of acceleration depending on the relative object used to quantify the acceleration. The correct acceleration is the actual physical acceleration of the body in relation to inertia, or the observer at rest in relation to the object being measured.

The coordinate acceleration depends on the choice of observers and coordinate system. This is not the same as appropriate acceleration. The electromechanical tool used to gauge an object's proper acceleration is an accelerometer sensor.

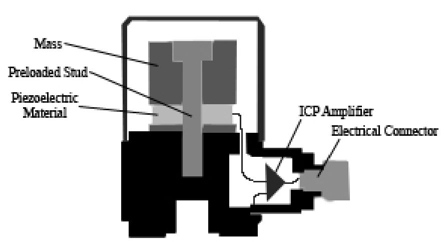

Fig:5 Piezo Accelerometer Sensor

F. RAIN SENSOR

Given how erratic the weather is, it's simple to leave your skylights open, only for it to start raining out of nowhere, endangering the area below. But, you can avoid this with the help of this rain sensor.

This sensor can be used to monitor rain or slushy snow/hail and transmit closure requests to electronic shutters, windows, awnings, or skylights whenever the rain is detected.

VI. RESULT

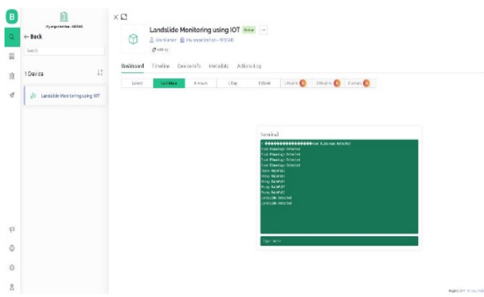

Fig 6blynkplatform

VII. CONCLUSION

Landslides have obviously grown to be a major issue in mountainous and hilly areas. Several people lost their lives as well as their property as a result of the landslip disaster. Hence, landslide detection systems use sensor values to send out alerts prior to landslides. Hence, it will aid in reducing landslide-related losses. The proposed effort is for monitoring the risk of landslides, and by measuring the parameters connected to landslides, the risk is forewarned before it occurs. The suggested system uses RF to gather data and wirelessly communicate it using a ZIGBEE module for additional analysis and quick reaction. Alerts are sent via a remote computer whenever there is even the slightest indication that a hazard might develop. For the prevention of both human losses and financial losses, any mechanical or geophysical sensor can be simply interfaced via WSN.

REFENENCES

[1] Pengfei Zhang, Ido Nevat, Gareth Peters, Gaoxi Xiao and Hwee-Pink Tan,Event Detection in Wireless Sensor Networks in Random Spatial Sensors Deployments, IEEE Transactions on Signal Processing (DOI 10.1109/TSP.2015.2452218).

[2] Thomas Blaschke, BakhtiarFeizizadeh, and Daniel Hoelbling, Object-Based Image Analysis and Digital Terrain Analysis for Locating Landslides in the Urmia Lake Basin, Iran, IEEE Journal Of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 7, No. 12, December 2014.

[3] Sijing Ye, Dehai Zhu, Xiao Chuang Yao, Nan Zhang, Shuai Fang, and Lin Li, Development of a Highly Flexible Mobile GIS-Based System for Collecting Arable Land Quality Data,IEEE Journal Of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 7, No. 11, November 2014.

[4] Linda Moser, Stefan Voigt, Elisabeth Schoepfer, and Stephanie Palmer, Multitemporal Wetland Monitoring in Sub-Saharan West-Africa Using Medium Resolution Optical Satellite Data, IEEE Journal Of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 7, No. 8, August 2014.

[5] Ping Lu, André Stumpf, Norman Kerle, and Nicola Casagli, Object-Oriented Change Detection for Landslide Rapid Mapping,IEEE geoscience and remote sensing letters, vol. 8, no. 4, July 2011.

[6] Maneesha V. Ramesh, Real-time Wireless Sensor Network for Landslide Detection, Third International Conference on Sensor Technologies and Applications 2009.

[7] He Yue Shun and Zhang Wei, The Research on wireless sensor network for landslide monitoring, international journal on smart sensing and intelligent systems vol. 6, no. 3, June 2013.

[8] Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - *Journal of ELECTRICAL ENGINEERING,* Vol.63 (6), pp.365-372, Dec.2012.
[9] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- *Springer, Electrical Engineering*, Vol.93 (3), pp.167-178, September 2011.
[10] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- *Taylor & Francis, Electric Power Components and Systems*, Vol.39 (8), pp.780-793, May 2011.
[11] Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- *Iranian Journal of Electrical & Electronic Engineering*, Vol.8 (3), pp.259-267, September 2012 G.Neelakrishnan, K.Anandhakumar, A.Prathap, S.Prakash "Performance Estimation of cascaded h-bridge MLI for HEV using SVPWM" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:750-756
[12] G.Neelakrishnan, S.N.Pruthika, P.T.Shalini, S.Soniya, "Perfromance Investigation of T-Source Inverter fed with Solar Cell" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:744-749