M.Kumarasamy College of Engineering
NAAC Accredited Autonomous Institution
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ISO 9001:2015 Certified Institution
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EEB1204 & ELECTRON DEVICES AND CIRCUITS

LANDSLIDE DETECTOR

A PROJECT REPORT

Submitted by

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in

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M.KUMARASAMY COLLEGE OF ENGINEERING

(Autonomous Institution, Affiliated to Anna University, Chennai)

BONAFIDE CERTIFICATE

Certified that this report titled **"LANDSLIDE DETECTOR"** is the Bonafide work of SIBIDHARAN R (927624BEE091), PIRAGATHESHWARAN M (927624BEE088), SHAMEEM I (927624BEE088), SANAJAI B (927624BEE084), who carried out the work during the academic year (2025 - 2026) under my supervision.

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Engineering, Karur	Engineering, Karur

Submitted for Electron Devices and Circuits Project (TCPR) (EEB1204) viva-voce Examination held at M. Kumarasamy College of Engineering, Karur-639113 on …………..

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To emerge as a leader among the top institutions in the field of technical education

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- Produce smart technocrats with empirical knowledge who can surmount the global Challenges.
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- **DM2:** Create an innovation and product development ecosystem in core and Interdisciplinary Industrial applications leading to patents.
- **DM3:** Augment student core competency and soft skills in handling technical projects.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

- **PEO 1: Core Engineering Proficiency**

  Apply strong fundamentals in electrical and electronics engineering to solve complex problems in power systems, drives and instrumentation.
- **PEO 2: Research and Emerging Technologies**

  Pursue research and adopt emerging technologies to innovate in core and interdisciplinary domains.
- **PEO 3: Industry Readiness**

  Demonstrate technical and professional skills for successful careers in industry and entrepreneurship.

- **PEO 4: Ethics and Societal Responsibility**
  Practice engineering with ethics, sustainability and a commitment to societal well-being.

- **PO5: Engineering Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6:The Engineer and The World**: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7: Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO8: Individual and Collaborative**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.
- **PO9: Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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PROGRAM SPECIFIC OUTCOMES (PSOs)

The following are the Program Specific Outcomes of Engineering Students:

- **PSO 01: Power Systems Engineering**
  Apply comprehensive knowledge of electrical power systems to analyze, design and manage generation, transmission, and distribution networks, integrating emerging technologies and sustainable practices to contribute effectively to industry and societal needs.

- **PSO 02: Power Electronics and Drives**

  Design and develop efficient, reliable power electronic systems and motor drives with an emphasis on sustainable energy use, and inclusive technology solutions that address societal and environmental challenges.

- **PSO 03: Electronics and Instrumentation Engineering**

  Develop intelligent instrumentation and embedded systems for accurate measurements, monitoring and control in interdisciplinary domains addressing societal needs.

Abstract (Key Words)	**Mapping of POs and PSOs**
Landslide Detector, soil moisture sensing, vibration/tilt detection, MPU6050, ESP8266 IoT alerts, I2C LCD, rain sensor, real-time monitoring, buzzer alarm, sensor integration, early-warning system.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8,PO9.PO10,PO11,PO12,PSO1,PSO2 ,PSO3.

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ABSTRACT

This project focuses on the development of an autonomous landslide detection system designed to monitor, identify, and alert early signs of ground movement using an Arduino microcontroller. The system integrates soil moisture sensors, vibration and tilt sensors to accurately determine changes in soil conditions, DC buzzer alerts with an ESP8266 module for real-time warnings, and an I2C LCD display for visual indication of danger levels. When the sensors detect abnormal soil moisture, vibration, or tilt variations, the system automatically processes the data, activates the alert mechanism, and sends notifications until the instability risk is reduced. The Arduino controls all sensor readings, decision-making processes, and alert operations, ensuring real-time response and effective landslide risk detection. This project demonstrates how embedded systems and sensor integration can be combined to create a low- cost, efficient safety device capable of reducing human risk during landslide emergencies. It also highlights the potential for further enhancement through the addition of GSM modules, long- range wireless monitoring, obstacle detection, and advanced data analysis techniques.

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CHAPTER 1

INTRODUCTI ON

Landslides pose serious risks to human life, property, and the environment, making early detection and rapid warning essential for minimizing damage. Traditional landslide-monitoring methods depend heavily on human intervention, which can be dangerous and time-consuming, especially in areas where access is difficult. With advancements in embedded systems and smart sensors, autonomous landslide detection systems have emerged as a promising solution to enhance safety and reduce human involvement in hazardous situations.

This project aims to develop an Arduino-based autonomous landslide detector capable of identifying early signs of slope failure. The system is equipped with soil moisture sensors, vibration/tilt sensors like the MPU6050, and a rain sensor to detect critical changes in soil stability and environmental conditions. When instability indicators are detected, the system automatically processes the data, generates warnings, and alerts users through a buzzer, display, or wireless communication in real time.

The development of this system demonstrates how embedded electronics, sensor integration, and automation technology can be combined to create a practical safety solution. This project also serves as an educational model for understanding monitoring systems, control mechanisms, and disaster-detection technologies. With further improvements, such systems can be applied in hilly regions, highways, construction zones, and residential areas to support landslide prevention and early-warning applications.

CHAPTER 2

LITERATURE REVIEW

TITLE: Design of intelligent Landslide Detection System based on multi-sensor fusion

AUTHOR: S. Zhang,

YEAR: 2022

JOURNALNAME: Journal of Robotics & Autonomous Systems (conference/journal abstract).

DESCRIPTION:

This paper presents an intelligent landslide detection architecture that fuses multiple sensors (soil moisture, vibration/tilt, and environmental sensors) to perform continuous terrain monitoring and early-warning generation. The authors discuss sensor fusion strategies to improve detection accuracy in unstable ground conditions and demonstrate prototype results showing enhanced reliability over single-sensor systems.

TITLE: A Multi-Sensor Terrain-Instability Detection Model for Landslide Monitoring

AUTHOR: S. Li

YEAR:2022

JOURNALNAME: MDPI Sensors (special issue)

DESCRIPTION: The work proposes a sensor-fusion–based detection model (enhanced ML variant) tailored for landslide prediction tasks, demonstrating how combining soil- moisture, vibration, and tilt data can increase detection accuracy under varying environmental conditions. The study highlights the benefits of multi-sensor analytics for early-warning and real-time terrain monitoring and discusses deployment considerations for unstable and remote regions.

TITLE: Sensor Fusion of a 2D Laser Scanner and Environmental Monitoring Sensors

AUTHOR: J. Gleichauf, C. Pfitzner, S.

YEAR: May, 2017,

JOURNALNAME: Proceedings / Conference Paper (Scitepress)

DESCRIPTION: This research investigates fusing 2D LiDAR with environmental sensors such as soil-moisture, tilt, and vibration modules to improve terrain-movement detection in low-visibility or unstable-ground conditions. Their approach enhances accuracy in identifying early signs of slope failure and supports reliable real-time monitoring for landslide-prone regions.

TITLE: Fusion of Radar, LiDAR, and Environmental Sensors for Landslide Hazard Detection.

AUTHOR: P. Fritsche et al.,

YEAR: 2017,

JOURNALNAME : Robotics hazard detection paper.

DESCRIPTION: The authors demonstrate that multi-modal fusion (radar, LiDAR, soil-moisture, and vibration sensing) significantly improves the detection of slope instability compared to single-sensor approaches. Their

results support integrating complementary sensors in landslide monitoring systems for robust and reliable early-warning performance in real-world terrain conditions.

TITLE: Landslide Detection Using Image-Based Pre-Processing and Computer Vision

AUTHOR: J. Ryu et al.,

YEAR: 2021

JOURNALNAME: Applied Sciences.

DESCRIPTION: This paper explores appearance-based preprocessing methods for vision-based landslide detection (visible-spectrum imaging), showing improved accuracy by analyzing soil displacement patterns and surface deformation features. It presents algorithms that can be adapted to low-cost camera modules for enhanced visual monitoring of unstable slopes and early terrain instability detection.

TITLE: An Autonomous Arduino-Based Landslide Detector(laboratory / prototype studies)

AUTHOR: M. H. Ali et al.,

YEAR: 2018

DESCRIPTION: Several practical studies and project papers demonstrate Arduino- based landslide detection prototypes that combine soil-moisture sensors, MPU6050 vibration/tilt modules, rain sensors, IoT communication units, and buzzer alert systems to monitor ground conditions and provide early warnings of potential slope movement.TITLE: Sensor-Fusion Based Terrain-Instability Detection Algorithm for Landslide Monitoring

AUTHOR: Kim &

Keller **YEAR:** 2017

JOURNALNAME:

DESCRIPTION: This work develops an algorithm that fuses soil-moisture, vibration, and tilt-sensor data to efficiently identify early signs of slope instability. It presents detection strategies that improve response time and enhance reliability for real-time monitoring on autonomous or remote sensing platforms.

TITLE: Landslide Detection Using Soil Moisture and Ground-Vibration Sensing

AUTHOR: H. Bordbar,

YEAR:2022 **JOURNALNAME:**

DESCRIPTION: The article discusses the physical principles behind soil-moisture measurement and ground-vibration sensing, sensor selection, and filtering techniques to reduce false alarms from environmental noise. It provides guidance on sensor calibration, threshold tuning, and electronic conditioning that are directly applicable when choosing and configuring sensors for landslide-detection systems.

CHAPTER 3

PROPOSED METHOLOGY

1. BLOCK DIAGRAM

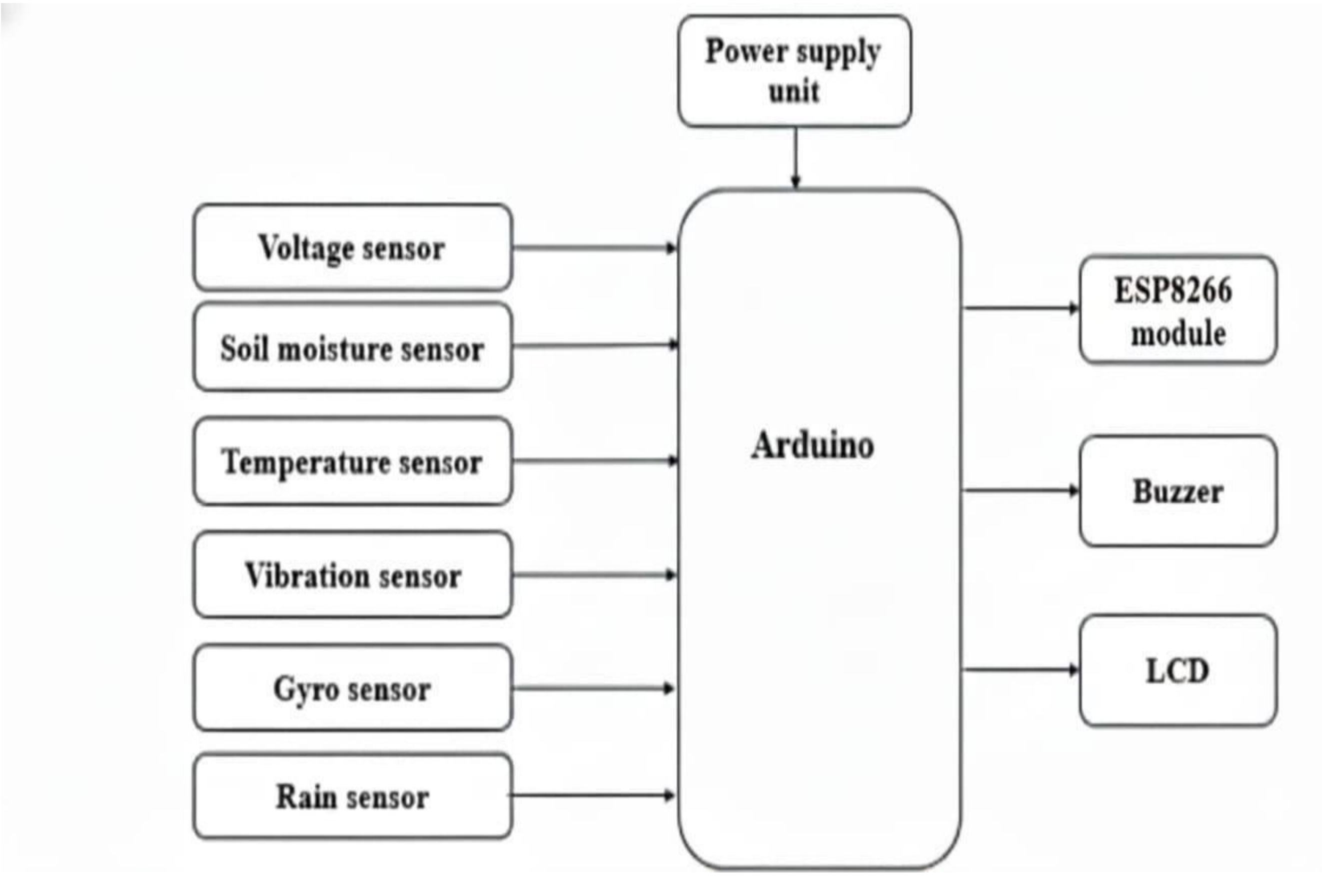


Figure no 3.1 Block diagram Land Slide Detector

2. Block Diagram Description

The autonomous landslide detection system is developed to provide an efficient and safe solution for identifying early signs of slope instability using embedded electronics and sensor-based automation. The system is centered around an Arduino microcontroller, which acts as the main control unit for processing input signals and coordinating all operations. A soil-moisture sensor, vibration sensor, gyro/tilt sensor, and rain sensor are mounted at the monitoring site, continuously measuring ground conditions and detecting environmental changes. When any sensor identifies abnormal readings— such as excessive moisture, ground vibration, or tilt shift—it sends an analog or digital signal to the Arduino, indicating the type and severity of the instability. Upon receiving this data, the Arduino processes the information and activates the alert system, which includes a buzzer, LCD display, and GSM module for wireless communication. This enables the system to provide immediate warnings and notify users or authorities about potential landslide risks. To ensure continuous and reliable operation, a solar-powered battery unit supplies energy through the power-management circuit, allowing uninterrupted monitoring in remote areas. Once the Arduino evaluates the data and determines a threshold breach, it triggers the alarm mechanisms, ensuring quick awareness and timely preventive action. The entire system operates in a coordinated manner, allowing early detection, real-time monitoring, and rapid alert generation without human involvement. This makes the project a valuable low-cost prototype for understanding the principles of sensing technology, sensor integration, embedded control, and automation in disaster-prevention applications. It also demonstrates how intelligent monitoring systems can reduce risks and support safety efforts in landslide-prone environments.

3. Circuit diagram

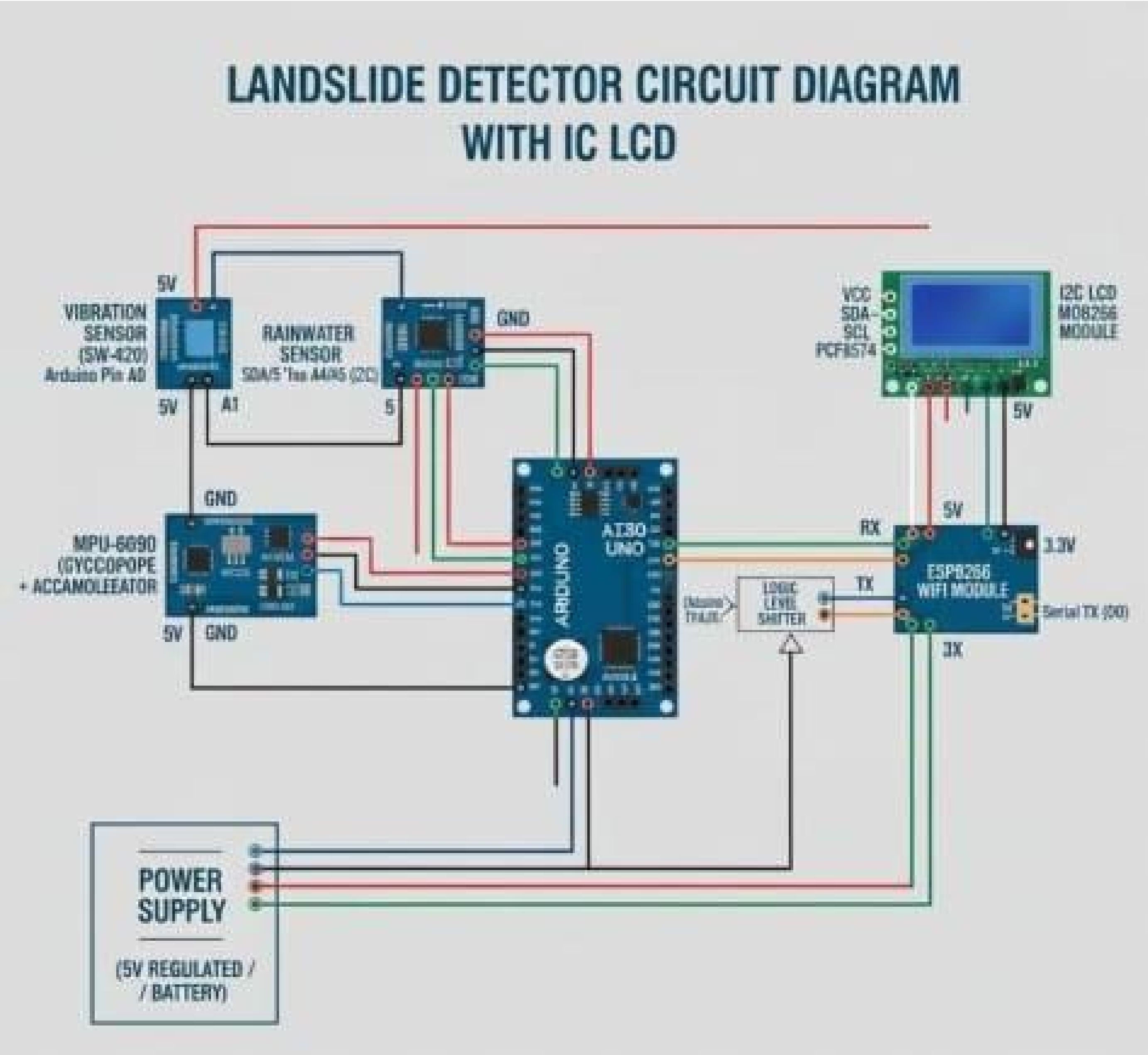


Figure no 3.2 Circuit diagram for the Landslide Detector

4. Key Circuit Elements and Description

Power Supply Unit

The power supply system provides the required DC voltage for the entire landslide monitoring setup. A rechargeable battery pack (typically 9V or 12V) powers the Arduino board, soil- moisture sensors, vibration/tilt sensors, rain sensor, and GSM module. The Arduino's onboard voltage regulator ensures a stable +5V supply for all sensing and control circuitry. This allows the system to operate safely and continuously without needing external power.

Soil Moisture Sensor

The soil moisture sensor is placed in the ground to detect water saturation levels that contribute to landslides. This sensor measures soil conductivity and outputs analog signals whenever it senses increased moisture that may indicate instability. The analog outputs are fed into the microcontroller. By monitoring moisture trends, the system identifies early warnings of potential slope failure.

Vibration/Tilt Sensor (MPU6050)

The MPU6050 vibration and tilt sensor detects small ground movements that precede landslides. It receives control signals from the Arduino and converts motion into accurate digital outputs. The system can detect vibration spikes, tilt changes, or sudden shifts based on the sensor data. This unit ensures stable and sensitive detection of soil displacement.

Rain Sensor

The rain sensor monitors rainfall intensity near the site. As rainfall is a major trigger for landslides, this sensor provides continuous input to the system. Its readings are controlled and processed depending on the sensor outputs.

Gyro Sensor

The gyro sensor is responsible for detecting angular changes in the soil or structure. It receives angle-based signals from the Arduino. When a slope shift is detected, the gyro sensor provides data that helps the system interpret ground movement direction for effective early detection.

GSM Module / Buzzer Alerts

A GSM module or buzzer is used to send alerts when dangerous conditions are detected. The alert unit is controlled either through digital pins or relay control, allowing the Arduino to activate it safely. When triggered, the GSM module sends an SMS warning, and the buzzer provides an audible alert, helping notify nearby residents or authorities.

Microcontroller (Arduino UNO)

The Arduino UNO is the main control unit of the landslide detection system. It reads soil-moisture, vibration, tilt, gyro, and rain sensor inputs, processes instability conditions, and generates appropriate alerts. It also controls the GSM module and buzzer when the system detects dangerous readings. Overall, the Arduino coordinates sensing, monitoring, and alerting operations effectively.

Interconnecting Wires and Signal Flow

All components are interconnected using jumper wires for power and signal transmission. Power wires distribute voltage from the battery to the Arduino, sensors, GSM module, and buzzer. Signal wires carry sensor outputs to the microcontroller and alert signals from the Arduino to the output devices. Arrows in the circuit diagram represent the flow of signals, showing how information moves from sensors → Arduino → alert systems.

CHAPTER 4
RESULT AND DISCUSSION

1. HARDWARE EXPERIMENTAL SETUP

The hardware implementation of the landslide detector integrates essential electronic and sensing components to enable soil movement detection, environmental monitoring, and alert generation. The system uses a microcontroller as the central control unit, interfaced with sensors such as MPU6050 (vibration/tilt), soil moisture sensor, and rain detector to identify early landslide indicators. A buzzer and communication module are mounted for real-time alerts, and each sensor provides continuous data to the controller. The device is built on a durable mounting platform that supports all modules, while the power supply—typically rechargeable batteries with a 7805-voltage regulator—ensures continuous and stable operation. All components are assembled with proper wiring, ensuring reliable sensing, signal transfer, and alert activation for effective landslide detection.

Transmission (Landslide Detection & Alert Flow)

The proposed landslide detection system operates on real-time monitoring and response, where vibration, moisture, and rainfall sensors continuously observe environmental conditions and send data to the microcontroller. When unusual vibration, soil instability, or high moisture levels are detected, the corresponding sensor immediately transmits a digital or analog signal to the controller. The data transmission within the system —from sensors to controller and controller to alarm module—ensures quick reaction during potential landslide conditions. The microcontroller processes sensor readings, checks threshold levels, activates the buzzer, and sends wireless alerts if a communication module is present. This constant communication between sensing and alert units ensures accurate detection, quick warnings, and effective hazard prevention.

Receiver Unit (Microcontroller Processing & Hazard Response Mechanism)

In this landslide detection system, the receiver unit refers to the microcontroller section that receives signals from all sensors and triggers the correct alert mechanism. When abnormal soil movement or dangerous moisture levels are detected, the sensors send signals to the microcontroller, which interprets the intensity and severity of the readings. The controller then activates the buzzer for immediate warning and may trigger wireless transmission to notify remote users. The power supply section, consisting of a transformer, bridge rectifier, filter capacitor, and 7805 voltage regulator, provides a stable 5V supply for all modules, ensuring smooth sensing and response. The microcontroller continuously monitors vibration patterns, moisture percentages, and rainfall status to provide reliable and timely hazard detection.

Display (LCD) Results Interpretation

During testing, the LCD display provided clear real-time feedback, showing soil vibration status, moisture level readings, and rainfall detection output. When any sensor detected abnormal conditions, the LCD displayed messages such as “Landslide Risk Detected,” enabling operators to monitor environmental changes instantly. If soil moisture increased rapidly or vibration intensity crossed the danger threshold, the LCD updated the status immediately, while alert indicators showed that warnings had been activated. The display also showed system parameters such as tilt angle or sensor values, offering better insight into environmental conditions. This ensured accurate monitoring during testing and validated the landslide detector's early-warning performance.

Communication, Detection Accuracy & Alert Response

The internal communication between sensors, microcontroller, buzzer, and display proved highly reliable during evaluation. The sensors detected soil movement and environmental variations quickly, and the microcontroller responded instantly, demonstrating excellent accuracy under different terrain and moisture conditions.

The buzzer alerted without delay, producing a clear warning signal. The system effectively identified early landslide indicators and maintained stability even when environmental conditions changed rapidly. Throughout the trials, there was no signal interference, false triggering, or noticeable delay, confirming system robustness. The results proved that the detector can sense early movement, analyze multi-sensor input, and warn users effectively.

Overall System Performance (Real-Time Environmental Monitoring)

In addition to accurate detection, the landslide detector demonstrated strong real-time performance. As soon as a risk condition was sensed, the system activated its alarm module and displayed warning messages, mimicking a real hazard alert mechanism. The integration of soil moisture sensing, vibration detection, and rainfall monitoring provided a coordinated early- warning action. The system consistently responded to environmental changes, issued alerts efficiently, and returned to standby mode once conditions stabilized. This verified the effectiveness of the landslide detector as a compact, autonomous safety prototype suitable for hilly regions, construction sites, and disaster-prone areas.

2. HARDWARE COMPONENTS DESCRIPTION

Arduino UNO (Microcontroller Unit)

The Arduino UNO acts as the central processing unit of the landslide detection system and is responsible for monitoring all sensor operations. It receives input signals from the MPU6050 vibration sensor, soil moisture sensor, and rain detector, processes them using the ATmega328P microcontroller, and generates appropriate output signals for the buzzer, alert module, and display unit. With multiple digital and analog I/O pins, the Arduino enables smooth interfacing with environmental sensors and warning devices. Its internal clock, stable 5V operation.

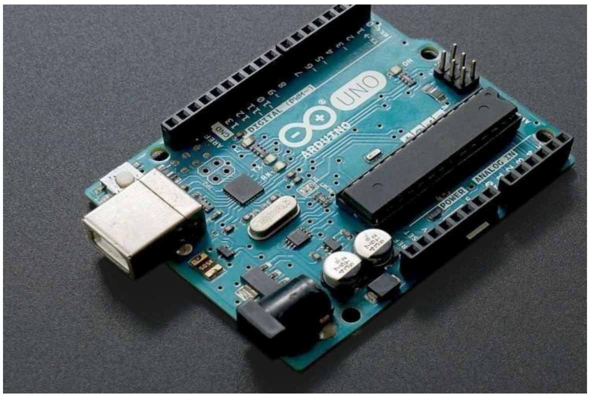


Figure no 4.1 Arduino UNO

MPU6050VibrationSensorModule

The MPU6050 vibration sensor module is designed to detect sudden ground movements, tremors, or abnormal vibrations that may indicate an upcoming landslide. It consists of a 3-axis accelerometer and 3-axis gyroscope that convert motion changes into electrical signals, which are fed to the Arduino. When mounted firmly on the detection platform, the sensor monitors continuous vibration patterns and identifies unusual seismic shifts. This arrangement helps the system recognize early signs of slope instability with high accuracy. The high sensitivity and fast response time of the MPU6050 make it ideal for real- time landslide prediction and hazard monitoring.

Figure no 4.2 MPU6050 Vibration Sensor

MPU-6050(ACCLEROMETER+GYROSCOPE) Module

The MPU-6050 is a 6-axis motion tracking sensor that combines a 3-axis accelerometer and a 3-axis gyroscope in one chip. It measures tilt, rotation, and movement of an object using I²C communication.

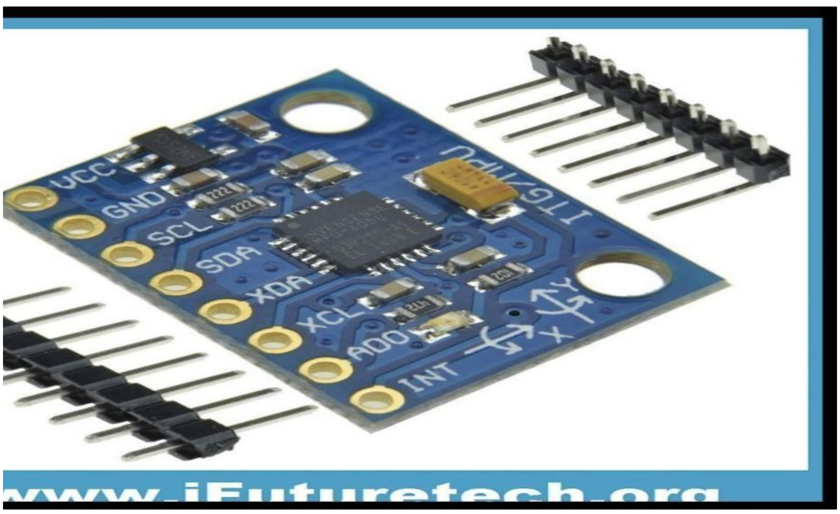


Figure no 4.3 MPU-6050(ACCLEROMETER+GYROSCOPE) Module

Rain Drop Sensor Module

The rain drop sensor detects the presence and intensity of rainfall, which is a major triggering factor for landslides. The module includes a conductive rain detection board and a comparator circuit to output digital or analog signals depending on rain quantity. Signals from the sensor are sent to the microcontroller for processing. When rainfall increases, the system recognizes a higher risk of soil absorption and instability. This sensor is critical for predicting landslide

Figure no 4.4 Rain Drop Sensor

ESP8266 Wi-Fi Module

The ESP8266 module provides wireless communication for transmitting landslide warning data to cloud platforms or mobile devices. It receives processed information from vibration, rain, and soil moisture sensors, then sends alerts through Wi-Fi to a monitoring server or IoT dashboard. The module supports real-time updates, allowing users to remotely track environmental conditions and landslide risk levels.

With its built-in TCP/IP stack and digital I/O pins, the ESP8266 ensures reliable data communication, enabling early warning notifications and continuous monitoring from any location

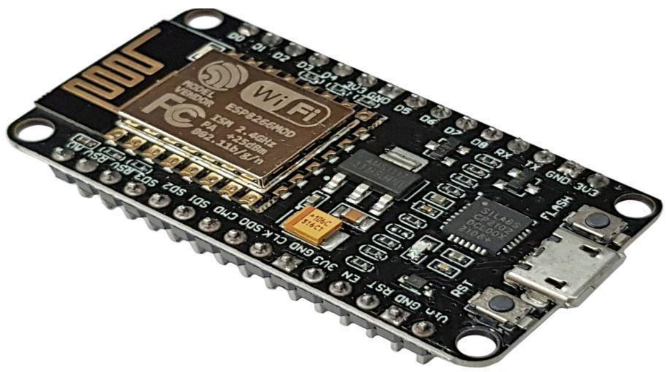
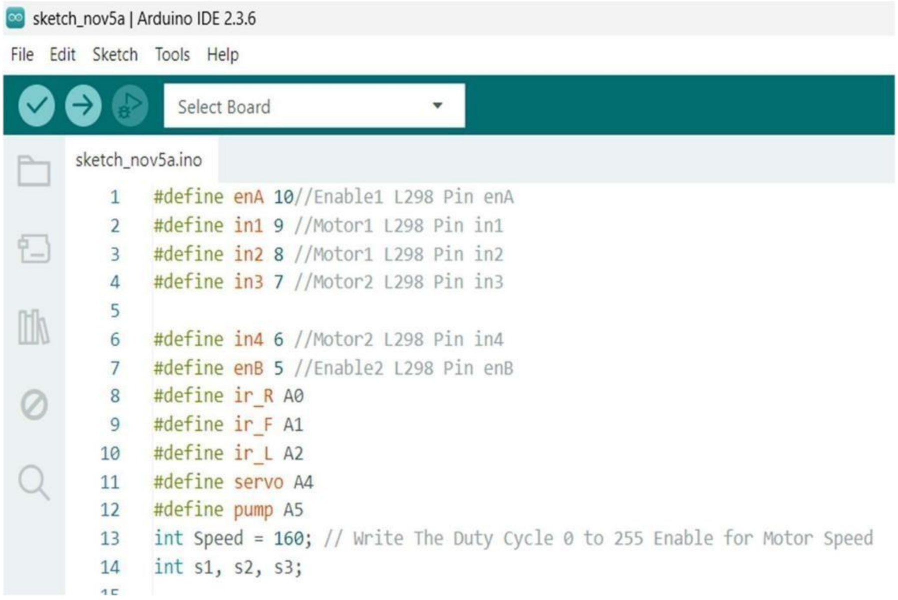


Figure no 4.5 ESP8266 Wi Fi Module

SOFTWARE IMPLEMENTATION

The software implementation of the landslide detection system involves developing a unified microcontroller program that continuously reads environmental sensor inputs, processes real-time geological data, and updates the alert or display unit. The program begins by configuring the microcontroller’s input and output pins, enabling ADC channels for the soil- moisture sensor, and initializing I^2C communication for the MPU6050 vibration module. Once initialization is complete, the software enters an infinite loop where it repeatedly monitors vibration patterns from the MPU6050 to detect ground movement, checks rainfall intensity using the rain drop sensor, and measures the soil moisture level through analog-to-digital conversion. Each raw sensor value is filtered using averaging or threshold validation to eliminate noise, ensuring accurate interpretation of slope stability conditions. The program then processes all readings to determine whether the ground is stable, moderately risky, or in a potential landslide state, and transmits the corresponding alerts through the LCD or the ESP8266 Wi-Fi module for remote monitoring.

Pin Configuration & Global Variables

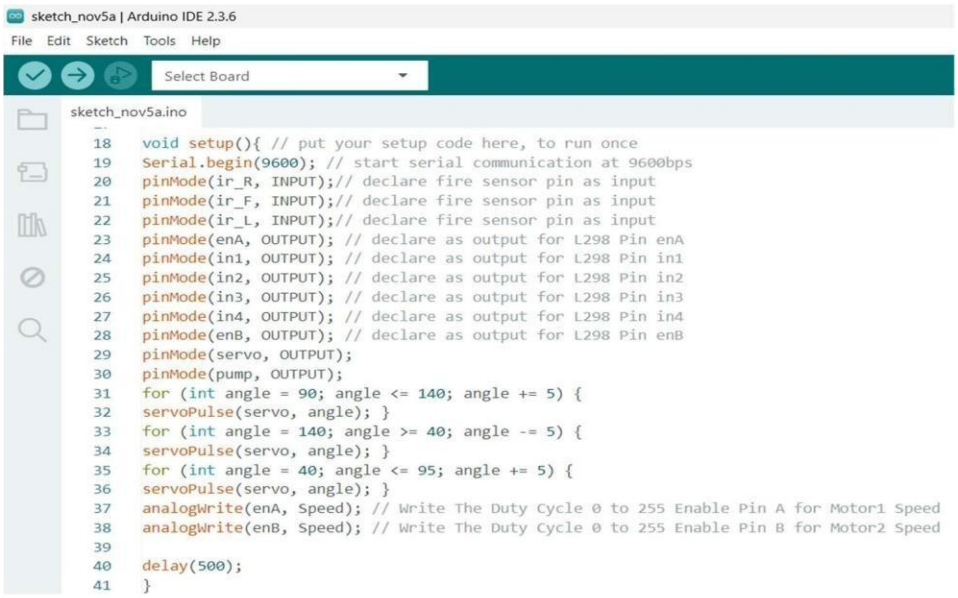



```
#define enA 10//Enable1 L298 Pin enA
#define in1 9 //Motor1 L298 Pin in1
#define in2 8 //Motor1 L298 Pin in2
#define in3 7 //Motor2 L298 Pin in3

#define in4 6 //Motor2 L298 Pin in4
#define enB 5 //Enable2 L298 Pin enB
#define ir_R A0
#define ir_F A1
#define ir_L A2
#define servo A4
#define pump A5
int Speed = 160; // Write The Duty Cycle 0 to 255 Enable for Motor Speed
int s1, s2, s3;
```

Figure no 5.1 Pin Configuration & Global Variable

System Initialization




```
void setup(){ // put your setup code here, to run once
Serial.begin(9600); // start serial communication at 9600bps
pinMode(ir_R, INPUT);// declare fire sensor pin as input
pinMode(ir_F, INPUT);// declare fire sensor pin as input
pinMode(ir_L, INPUT);// declare fire sensor pin as input
pinMode(enA, OUTPUT); // declare as output for L298 Pin enA
pinMode(in1, OUTPUT); // declare as output for L298 Pin in1
pinMode(in2, OUTPUT); // declare as output for L298 Pin in2
pinMode(in3, OUTPUT); // declare as output for L298 Pin in3
pinMode(in4, OUTPUT); // declare as output for L298 Pin in4
pinMode(enB, OUTPUT); // declare as output for L298 Pin enB
pinMode(servo, OUTPUT);
pinMode(pump, OUTPUT);
for (int angle = 90; angle <= 140; angle += 5) {
servoPulse(servo, angle); }
for (int angle = 140; angle >= 40; angle -= 5) {
servoPulse(servo, angle); }
for (int angle = 40; angle <= 95; angle += 5) {
servoPulse(servo, angle); }
analogWrite(enA, Speed); // Write The Duty Cycle 0 to 255 Enable Pin A for Motor1 Speed
analogWrite(enB, Speed); // Write The Duty Cycle 0 to 255 Enable Pin B for Motor2 Speed

delay(500);
}
```

Figure no 5.2 System Initialization

Servo Control Module

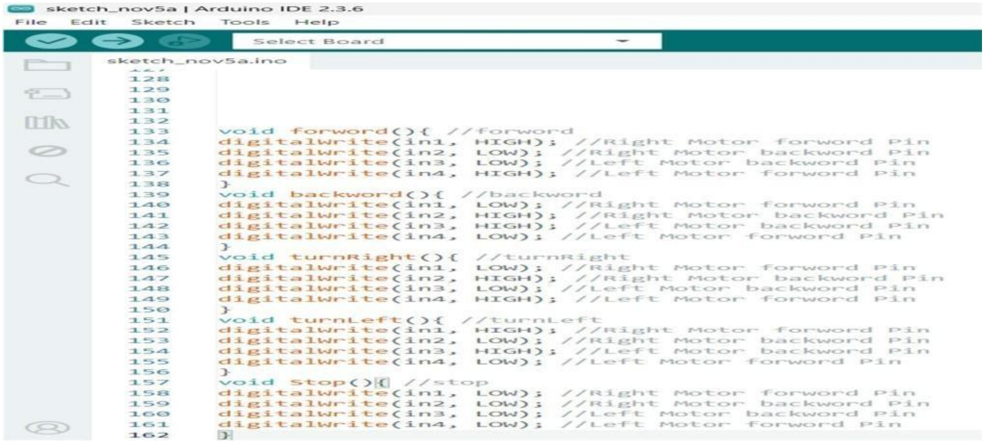
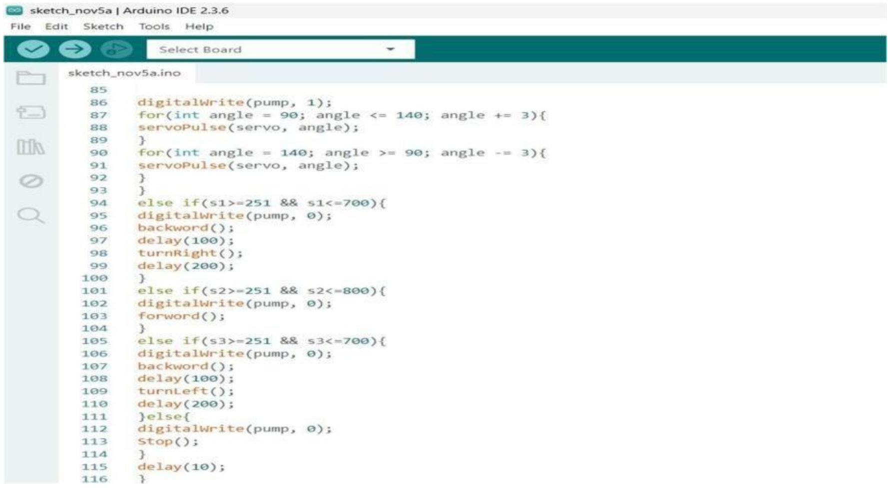


Figure no 5.3 Servo Control Module

Motor Control Module

Figure no 5.4 The Motor Control Module

Main Decision Logic



sketch_nov5a | Arduino IDE 2.3.6

File Edit Sketch Tools Help

Select Board

sketch_nov5a.ino

```
digitalWrite(pump, 1);
for(int angle = 90; angle <= 140; angle += 3){
servoPulse(servo, angle);
}
for(int angle = 140; angle >= 90; angle -= 3){
servoPulse(servo, angle);
}
}
else if(s1>=251 && s1<=700){
digitalWrite(pump, 0);
backword();
delay(100);
turnRight();
delay(200);
}
else if(s2>=251 && s2<=800){
digitalWrite(pump, 0);
forword();
}
else if(s3>=251 && s3<=700){
digitalWrite(pump, 0);
backword();
delay(100);
turnLeft();
delay(200);
}else{
digitalWrite(pump, 0);
Stop();
}
delay(10);
}
```

Figure no 5.5 Main Decision Logic

CHAPTER 5
CONCLUSION

The developed autonomous landslide detection system successfully demonstrates an efficient, low-cost, and intelligent monitoring platform capable of predicting landslide risks using real-time environmental sensor data and automated analysis. By integrating vibration sensors, soil-moisture sensing, rainfall detection, wireless transmission, and a microcontroller- based decision system, the device is able to identify early warning signs, assess slope stability, and transmit alerts without human intervention. The implemented software ensures quick response, accurate ground-movement detection, and coordinated data processing, making the system highly reliable for early-warning applications in disaster-prone areas. This prototype highlights the potential of embedded systems and IoT in geohazard monitoring and can be further enhanced with cloud analytics, long-range communication, solar powering, and advanced prediction algorithms for real-world deployment.

Future Scope :

The landslide-detection system developed in this project provides a strong foundation for future improvements that can significantly enhance its field performance. Advanced geotechnical sensors such as GNSS displacement modules or MEMS tiltmeters can greatly increase accuracy and detection reliability. Terrain-mapping technologies like LiDAR or ultrasonic depth sensors will support monitoring of soil displacement and surface deformation. Wireless communication modules including LoRa, NB-IoT, or cloud-based dashboards can enable remote monitoring and automated emergency alerts. With upgrades in sensor fusion, long- term data logging, and AI-based prediction models, the system can evolve into a robust, intelligent landslide-monitoring network suitable for hilly regions, construction zones, and disaster-management applications.

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