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System to check the healthiness of earthing system and alert staff in case of any malfunction

Project Title :	System to check the healthiness of earthing system and alert staff in case of any malfunction
Theme :	Safety
Project Category :	Hardware model
Abstract :	In large parking and station areas, many electrical pole lights are installed, each with earth leakage protection systems. But if these systems fail, they can create serious safety risks for the public. Checking the earthing systems across such a large area also requires a lot of manpower. This project proposes a sensor-based monitoring system to solve these problems. The system will continuously check the condition of earth leakage currents, ensure that earthing connections are working properly, and measure the resistance of the earthing system. It will send real-time data from the electrical panels to a central monitoring location. If any faults or issues are found, the system will give clear audio and visual warnings to alert the maintenance team immediately. By automating the process, this solution improves safety, reduces manual effort, and ensures the earthing system works reliably across the area.
Current Stage of the project :	Idea Phase
Objective of the project :	Failure of earth leakage protection systems poses safety risks. Manual inspection of earthing systems is labor-intensive. Sensor-based monitoring system proposed. Continuous monitoring of earth leakage currents and earthing connections. Regular measurement of earthing system resistance. Real-time data transmission to a central monitoring hub. Enhances safety and reduces manpower requirements. Ensures reliable earthing system functionality across large areas.
Problem statement :	System to check the healthiness of earthing system and alert staff in case of any malfunction;
Proposed solution :	The proposed solution is a smart earthing health monitoring system that utilizes sensors to measure earth resistance, leakage currents, and conductor continuity in real-time. These sensors interface with a microcontroller (e.g., ESP32 or Arduino) to proce
Methodology :	To implement the project, integrate sensors to monitor earth resistance, continuity, and leakage currents with a microcontroller (e.g., ESP32 or Arduino) for data processing. Use communication modules like GSM or Wi-Fi for real-time alerts and add local alarms (buzzer and LEDs). Develop software to read sensor values, trigger alarms, and log data. Assemble the components, test under simulated conditions, and deploy the system in a pilot location. Ensure it is

	calibrated for accuracy and capable of providing real-time alerts and data logging, with scope for future enhancements like cloud integration and predictive maintenance.
Working :	The system works on the principle of real-time monitoring, fault detection, and alerting using sensor-based automation. Sensors installed at key points measure critical parameters such as earth resistance, leakage currents, and the continuity of earthing connections. These sensors send data to a microcontroller or processing unit, which analyzes the readings against predefined safety thresholds. If any deviation from the acceptable range is detected, the system identifies it as a fault. It then triggers an alert using audio alarms, visual indicators, and remote notifications like SMS or app-based alerts to inform the maintenance team. Data from all panels is transmitted to a centralized location for efficient monitoring of the entire setup. Additionally, the system records the data for historical analysis, identifying trends, and planning preventive maintenance. This automated process ensures early fault detection, timely maintenance, and improved public safety.
Key features/innovations :	1. Real-Time Monitoring: Tracks system health. 2. Fault Detection: Identifies safety issues. 3. Instant Alerts: Notifies maintenance team. 4. Centralized Control: Monitors from one location. 5. Data Logging: Stores performance data. 6. Automation: Minimizes manual checks. 7. Safety Compliance: Meets safety standards. 8. Remote Access: Enables remote monitoring. 9. Scalability: Easily expandable. 10. Cost Efficiency: Reduces costs and labor.
Expected outcomes :	The system is expected to provide real-time monitoring of the earthing system, continuously checking critical parameters such as earth resistance, leakage currents, and continuity of earthing connections. It will detect any faults or deviations from safety standards promptly, triggering alerts via audio, visual, and remote notifications to inform the maintenance team. Data from multiple panels will be collected and transmitted to a central location for efficient management. The system will also log performance data for historical analysis, helping in trend identification and preventive maintenance. Ultimately, the system will enhance safety, reduce manual labor, and ensure quick responses to faults, improving overall reliability and public safety.
Software used :	- Integrated Development Environment (IDE): Arduino IDE, Thonny. - Programming Language: C/C++ (Arduino), Python (Raspberry Pi). - Simulation Software: Proteus, Tinkercad, LTSpice. - Communication Libraries: GSM Library, ESP8266WiFi library. - Data Visualization/Logging Tools: ThingSpeak, Excel, Firebase. - Alert Notification Tools: Blynk, Twilio, Telegram Bot API. - LCD Display Library: LiquidCrystal.h (for Arduino). - Version Control System: Git, GitHub. - Serial Monitor/Debugger: Arduino IDE Serial Monitor. - Circuit Design Software: Fritzing, Eagle, KiCAD.

Hardware used :	- Microcontroller (e.g., Arduino UNO, ESP32) - Voltage Sensor (e.g., ZMPT101B) - Current Sensor (e.g., ACS712 5A, 20A, or 30A) - Earth Resistance Measurement Circuit - Relay Module (e.g., 5V or 12V) - Buzzer/Alarm (e.g., Active buzzer module) - Display (e.g., 16x2 LCD, OLED) - Wireless Module (e.g., ESP8266, GSM SIM800L, LoRa) - LEDs (e.g., Red, Green, Yellow) - Push Buttons/Keypad (e.g., Standard push buttons, 4x4 keypad) - Lightning Arrester - Optocoupler (e.g., PC817) - Power Supply (e.g., 5V/12V DC) - Resistors (e.g., 1kΩ, 10kΩ) - Capacitors (e.g., 0.1µF, 10µF) - Enclosure (e.g., Waterproof/Dustproof box) - Jumper Wires (e.g., Male-to-male, Female-to-male)
Important design aspect :	1. Earthing Resistance Measurement - Formula: R = V/I - Where: - R = Resistance (Ω) - V = Voltage across the earthing system (V) - I = Current flowing through the earthing system (A) 2. Fault Detection and Alert System - Compare calculated resistance with predefined threshold values (e.g., 2Ω). - Trigger relay and activate buzzer if threshold exceeded. 3. Power Supply - Ensure stable and adequate power for components. - Choose 5V/12V regulated supply. 4. User Interface and Feedback - Use LCD to display resistance and system status. - LEDs for system health status (Green for healthy, Red for fault). - Push buttons for calibration or manual reset. Software Design and Calculation 1. Sensor Data Collection and Processing - Read voltage using an ADC pin (Arduino) connected to ZMPT101B. - Read current using an ADC pin connected to ACS712. - Calculate resistance using R = V/I. 2. Fault Detection - Compare calculated resistance with threshold value. - Trigger relay and activate buzzer if resistance exceeds threshold. 3. Alert System - Turn on buzzer and relay for fault detection. - Optionally, send SMS or remote alert via GSM or IoT module. 4. Power Management - Implement sleep modes or low-power components as needed. 5. Calibration - Calibrate sensors to ensure accurate readings. - Provide manual calibration through push buttons or keypad. ### Example Code Snippets for Calculation 1. Current and Voltage Measurement: ```cpp float voltage = analogRead(voltagePin) * (5.0 / 1023.0); float current = (analogRead(currentPin) - 512) * (5.0 / 1023.0) / 0.185; float resistance = voltage / current; ``` 2. Fault Detection Logic: ```cpp float threshold = 2.0; if (resistance > threshold) { digitalWrite(relayPin, HIGH); digitalWrite(buzzerPin, HIGH); lcd.print("Fault Detected"); } else { digitalWrite(relayPin, LOW); digitalWrite(buzzerPin, LOW); lcd.print("System Healthy"); } ```
This project gives a :	New solution to a old problem
Write the value addition/advantages over existing solutions :	1. Enhanced Public Safety: Early fault detection prevents hazards. 2. Minimized Labor: Reduces the need for manual inspections. 3. Quick Response: Real-time alerts ensure immediate action. 4. Efficient Management: Centralized control for easier supervision. 5. Preventive Maintenance: Historical data helps avoid future issues. 6. Lower Costs: Cuts down on manual work and system downtime. 7. Adaptable: Can be expanded to monitor more systems. 8. Reliability: Ensures compliance with safety regulations. 9. Remote Monitoring: Allows

	access from any location. 10. Optimized Resources: Streamlines maintenance tasks and resource usage.
Specific areas of application :	1. Parking Lots: Monitoring earthing systems of street lights and security lighting. 2. Railway Stations: Ensuring the safety of electrical systems in station lighting and platforms. 3. Industrial Plants: Monitoring large electrical systems to ensure safety and efficiency. 4. Solar Power Plants: Ensuring proper grounding of solar panel systems. 5. Commercial Buildings: Managing earthing systems for lighting and electrical infrastructure. 6. Power Distribution Stations: Monitoring earth resistance and leakage currents in high-voltage equipment. 7. Public Parks: Maintaining safety for outdoor lighting and electrical installations. 8. Hospitals: Ensuring the safety of critical medical equipment with grounded systems. 9. Substations: Ensuring the safety and reliability of electrical systems. 10. Construction Sites: Monitoring temporary electrical systems for worker safety.
Impact of the solution :	The proposed solution significantly enhances safety, reliability, and operational efficiency across sectors by ensuring continuous monitoring of earthing systems, which are critical for protecting equipment and personnel. In industrial and commercial settings, it minimizes downtime, prevents costly damage, and ensures compliance with safety regulations. For utilities and renewable energy installations, it supports uninterrupted operations and proactive maintenance, reducing risks of electrical failures. By automating monitoring and providing real-time alerts, the solution fosters a shift toward smarter, data-driven infrastructure management, addressing key challenges in safety and maintenance.
Commercial viability :	A system designed to monitor the health of an earthing system and alert staff in case of malfunctions holds significant commercial potential across industrial, commercial, and residential sectors. By integrating sensors to measure earth resistance, detect conductor continuity, and monitor leakage currents with real-time data processing via microcontrollers, this system ensures compliance with safety standards and prevents equipment damage due to electrical faults. The inclusion of predictive maintenance features, remote alerts through GSM or IoT connectivity, and data logging further enhances its value proposition. With applications ranging from industrial plants to renewable energy installations, the system aligns with the growing demand for safety and reliability, offering a scalable solution for proactive maintenance and regulatory compliance, thus ensuring its viability in a safety-conscious market.
Do you seek incubation support from DIPEX? :	Yes