

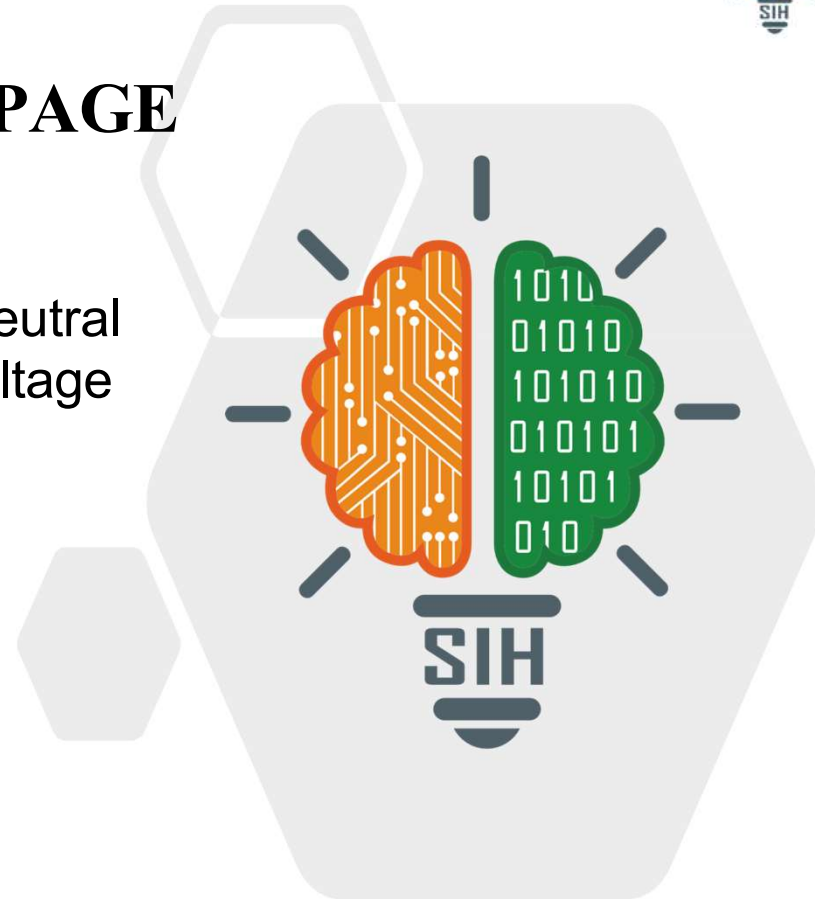
SMART INDIA HACKATHON 2025



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TITLE PAGE

- **Problem Statement ID** –SIH25063
- **Problem Statement Title-** Real-time neutral conductor breakage detection in low voltage distribution networks
- **Theme-** Disaster management
- **PS Category-** Hardware
- **Team ID-**
- **Team Name** – TEAM KANYARAASHI



Real-time neutral conductor breakage detection

IDEA / SOLUTION :

Introduction In low-voltage power distribution, the neutral conductor plays a very important role in keeping voltages balanced. If the neutral wire breaks, it can cause serious problems like unbalanced voltages, damage to electrical equipment, fire hazards, and even safety risks.

- ❖ Continuous monitoring of phase-to-neutral voltages..
- ❖ Real-time detection of abnormal unbalance.
- ❖ Automatic alerts to users.
- ❖ Relay-based automatic disconnection to prevent damage.
- ❖ Can integrate with IoT for remote monitoring and safety enhancement

Problem Resolution :

- ❖ Measure the voltages of each phase with respect to neutral in real-time.
- ❖ Compare the measured values with balanced conditions.
- ❖ If any abnormal unbalance is found → it means the neutral is broken.
- ❖ System will take action: Send an alert to the user. Or disconnect supply using a relay to protect appliances

Unique Value Propositions (UVP) :

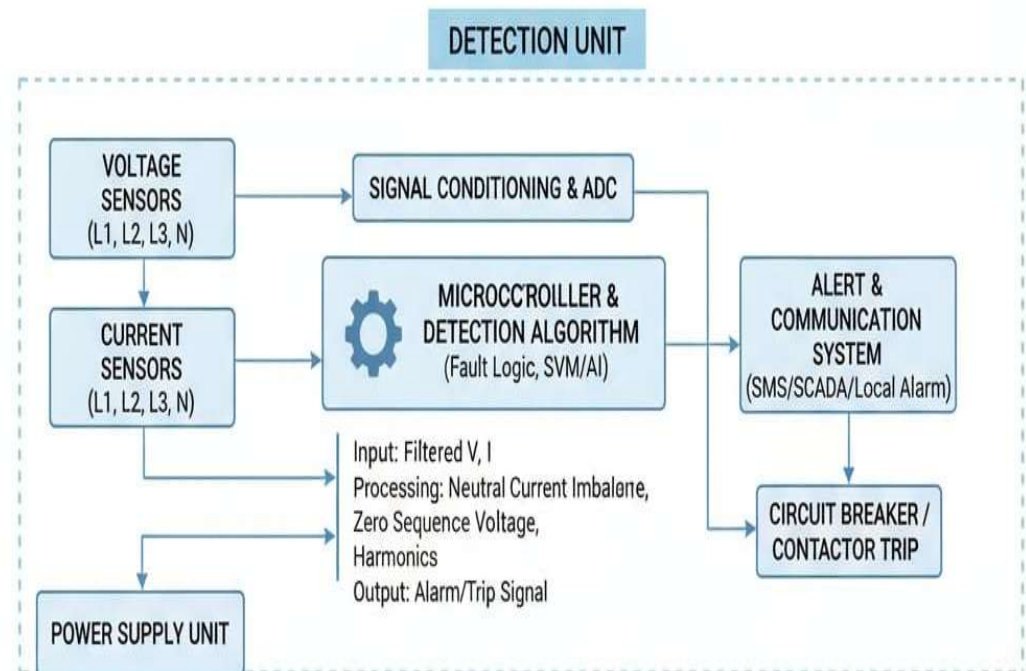
- ❖ Real time safety – Detects neutral conductors breakage instantly before damage happens
- ❖ Low cost solution – Uses simple sensors and microcontroller ,making affordable and scalable.
- ❖ Automatic protection – Not only alerts and it can disconnects the supply automatically.

BLOCK DIAGRAM



- **Scripting Languages:**
Arduino C++/Embedded – For programming microcontroller(ESP32/Arduino)
- **Database:**
SQLite - local storage of voltage/current reading and logs devices.
MongoDB- Centralized storage for cloud integration, large-scale IOT data, and alerts.
- **Security:**
AES : To protect sensitive sensor data and event logs before storage/transmission.
HTTPS protocol: For secure data transmission from devices to cloud/dashboard.
- **Model:**
Rule-based detection (current code): threshold-based imbalance check for neutral break.

REAL-TIME NEUTRAL CONDUCTOR BREAKAGE DETECTION (LV DISTRIBUTION)





FEASIBILITY

❖ Technical feasibility

- Software tools like arduino IDE , MATLAB are widely available and easy to use.
- IOT , threshold-based detection logic are proven and reliable

❖ Economy feasibility

- Hardware cost is low.
- Scalable solution-same can be used for homes and industries.

❖ Operational feasibility

- Easy to install in existing distribution systems.
- Automatic alerts and protection make it user-friendly

❖ Scalability feasibility

- Can start as a standalone system for households.
- Supports future upgrades like predictive algorithms.

CHALLENGES

❖ Accurate detection

- Differentiating Between normal voltage fluctuation and actual neutral breakage.

❖ Hardware reliability

- Voltage sensors must be calibrated correctly

❖ Real time processing

- Ensuring microcontroller processes data fast enough to trigger immediate protection.

❖ Integration with IOT

- Stable internet connectivity require for remote monitoring.

❖ Power supply issues

- System itself should remain powered during faults or volage fluctuations.

IMPACT AND BENEFITS



Impact	Benefits
Enhanced safety	Real time Detection
Prevents fire hazards and electrical accidents by detecting neutral breakage in real time.	-neutral failures identified instantly.
Protection and appliances	Automatic Protection
-saves households and industrial equipment from voltage imbalance damage.	-relay disconnection prevents costly damage.
User Awareness	Easy installation
-provides alerts that help user act quickly and avoid risks.	-can be added to existing systems without major changes .



RESEARCH

1. Background Research

- In low-voltage distribution networks, neutral wire failure leads to unbalanced voltages, which cause equipment damage, fire hazards, and safety risks.
- Current protective devices (MCBs, RCCBs, Fuses) do not detect neutral breakage in real time.

2. Existing Studies / Benchmarks

- IEEE Standards highlight the need for improved protection in low-voltage systems.
- Indian Standard IS 732 & IS 3043 focus on safety in earthing and wiring but lack real-time monitoring for neutral failures.

3. Market Research

- Growing demand for smart meters, IoT devices, and power quality monitoring in India's smart grid mission.
- The Smart Grid market is projected to cross USD 140 Billion by 2030 (MarketsandMarkets).

REFERENCE

❖ Research Papers / Technical Studies

- A. Majumder, "Detection and Mitigation of Neutral Conductor Failures in Low-Voltage Networks," IEEE Transactions on Power Delivery, 2019.
- R. Gupta & S. Kumar, "IoT Based Monitoring of Distribution Systems for Smart Grids," International Journal of Electrical Power & Energy Systems, 2021.

❖ Arduino IDE and MicroPython Documentation.

- MATLAB/Simulink Official Documentation.
- MongoDB Official Documentation.

❖ 5. Web Resources

- Government of India, Ministry of Power – National Smart Grid Mission.
- IEEE Xplore Digital Library – <https://ieeexplore.ieee.org>.