SMART INDIA HACKATHON 2025

- **Problem Statement ID-** 25063
- **Problem Statement Title-** Developing a cost-effective solution for detecting the breakage of Low Voltage AC Distribution Over Head conductors
- **Theme-** Disaster Management
- **PS Category-** Hardware
- **Team ID-**
- **Team Name-** Mavericks

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SMART POLE GUARD

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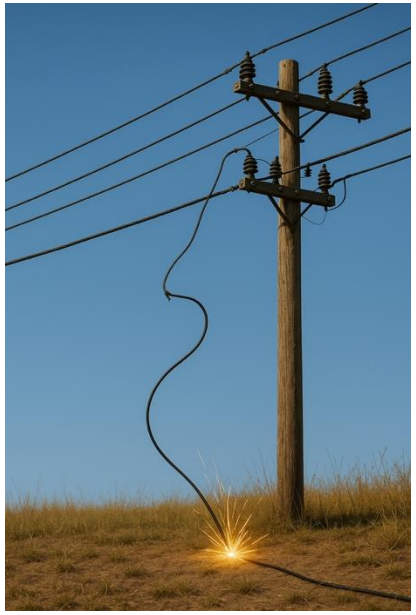
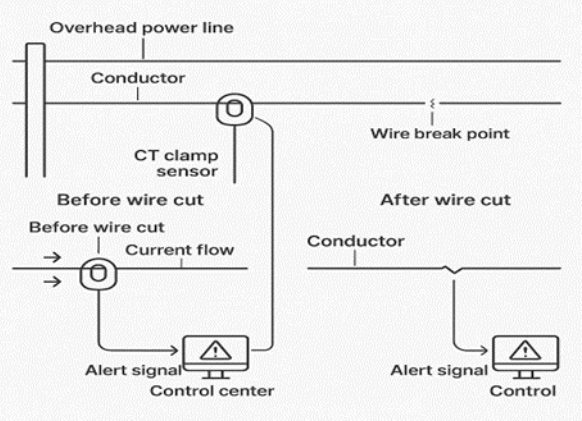
Problem:

- Kerala has seen several **deaths** from **electrocution**
- **Broken** live conductors on ground require 2-8 hours to **manually** detect





Recent Incident:

13-year-old boy dies of **electrocution** from sagging live wire at school in **Kerala**

PROBLEM	SOLUTION	INNOVATION
• Electrocution	• Fast detection	Edge computing
• Slow detection	• Saves lives	Solar energy
• Immediate isolation	• Immediate isolation	WiFi & LoRa
		Machine learning
		Non-invasive installation

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TECHNICAL APPROACH

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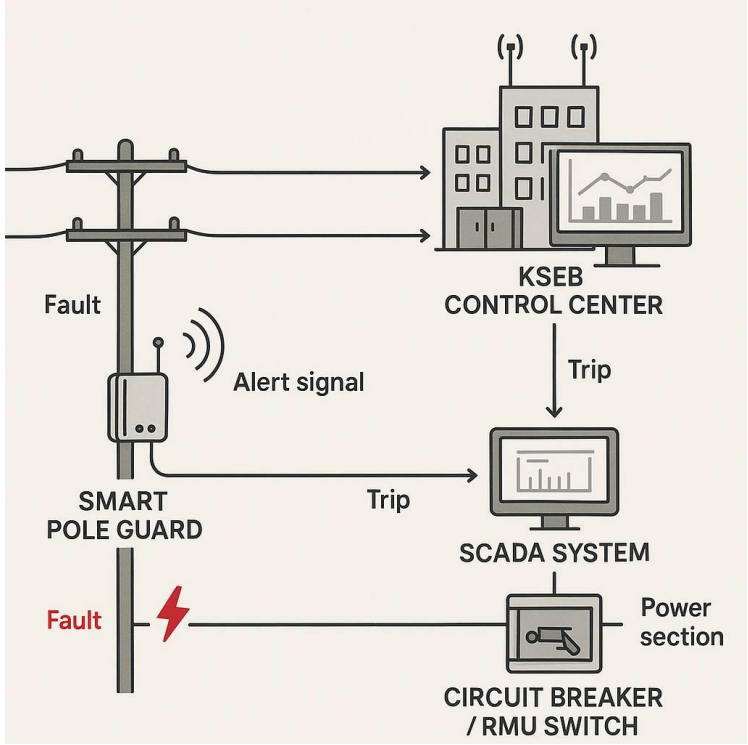
Technologies Used:

- **Hardware:** ESP32 microcontroller, CT clamp sensor, ZMPT101B
- **Power System:** 5W Solar panel + 3.7V LiPo battery
- **Communication:** WiFi + LoRaWAN
- **AI/ML:** K-Nearest Neighbours algorithm (edge computing)
- **Programming:** C++ (firmware), Python (ML), React (dashboard)
- **Enclosure:** IP65 waterproof, UV-resistant housing

Implementation Process:



System Architecture:

Overhead Conductor → Current Transformer (CT) Sensor → Voltage Sensor → ESP32 Controller → Edge AI Processing → Communication Module → KSEB Control Center → Emergency Response

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FEASIBILITY AND VIABILITY

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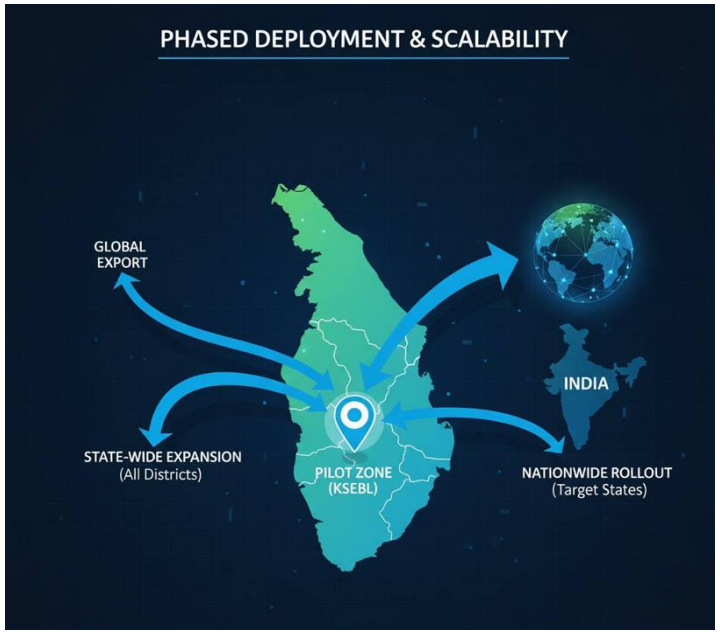
Analysis of Feasibility:

- **Technical:** Proven IoT components (ESP32, CT sensors)
- **Economic:** highly cost-effective than manual detection
- **Integration:** Workable with existing SCADA systems from KSEB established protocols (e.g., IEC 60870-5-104)
- **Scalable:** Modular design supports mass deployment across Kerala

Potential Challenges and Risks:	Strategies for Overcoming Challenges:
Weather resistance	**IP65 waterproof enclosure**
Power reliability	**Solar + LiPo battery**
Communication range	**Multi-protocol communication** (WiFi + LoRaWAN)
Installation complexity	**Non-invasive CT clamps**



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IMPACT AND BENEFITS

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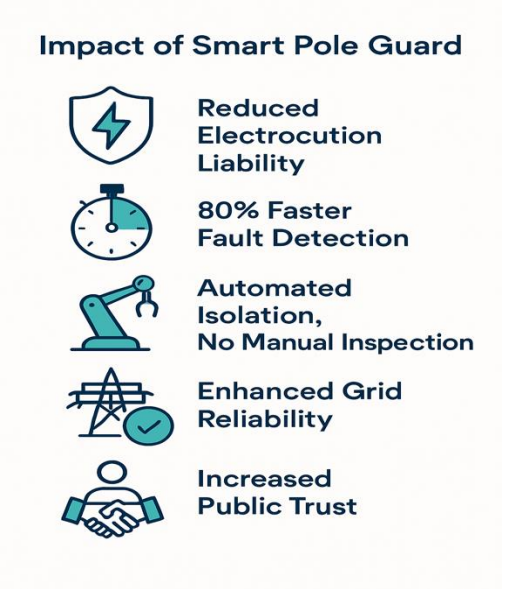
Potential Impact :

KSEB (Primary Beneficiary):

- Electrocution liability claims can be less
- 80% reduction in fault detection time (2-8 hours → <150ms)
- Automated fault isolation - no manual inspection needed
- Enhanced grid reliability and public trust



Key Benefits:

- **Economic:** Highly cost-effective compared to manual inspections
- **Social:** Protects lives and builds public trust in utilities
- **Environmental:** 100% solar-powered; zero operational emissions
- **Operational:** Non-invasive install, self-diagnostic, real-time alerts

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RESEARCH AND REFERENCES

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- Non-Invasive Current Measurement Using CT Clamps – Texas Instruments Application Note
- ZMPT101B Voltage Sensor Datasheet – Makerfabs
- ESP32 Technical Reference Manual – Espressif Systems
- LoRaWAN Specification v1.0.3 – LoRa Alliance
- Edge AI on Microcontrollers: K-Nearest Neighbors Implementation – TensorFlow Lite for Microcontrollers
- SCADA Integration Best Practices – IEEE Power & Energy Society
- Solar-Powered IoT Systems Design – Journal of Renewable and Sustainable Energy
- Kerala State Electricity Board Safety Guidelines – KSEB Official Website