SMART INDIA HACKATHON 2025

TITLE PAGE

- **Problem ID –** SIH25015
- **Title -** Intelligent Pesticide Sprinkling System

  Determined by the Infection Level of a Plant
- **Theme** - Agriculture, FoodTech & Rural Development
- **PS Category-** Hardware
- **Team Name -** Neuro Verse

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IDEA TITLE

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Proposed Solution

- An **integrated rover/drone system** with **cameras and sensors** to detect plant diseases and pests in real-time using computer vision & AI models.
- Equipped with a targeted spray mechanism that applies **pesticides/fertilizers only where required**, and data is stored/displayed on a **mobile/web dashboard** for farmers.

How It Addresses the Problem

- Reduces manual effort and expert dependency by **automating monitoring**, while minimizing excessive pesticide usage for **cost savings & environmental safety**.
- Enables **early and accurate detection** of crop issues, ensuring timely intervention to save plants, improve yield**,** and **crop quality**.

Innovation & Uniqueness

- **Combines AI-powered disease detection** with autonomous targeted spraying in a single integrated solution, enhancing precision farming.
- **Scalable and adaptable system** that works across different crops, farms, and disease types, with real-time IoT analytics for actionable farmer insights.

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TECHNICAL APPROACH

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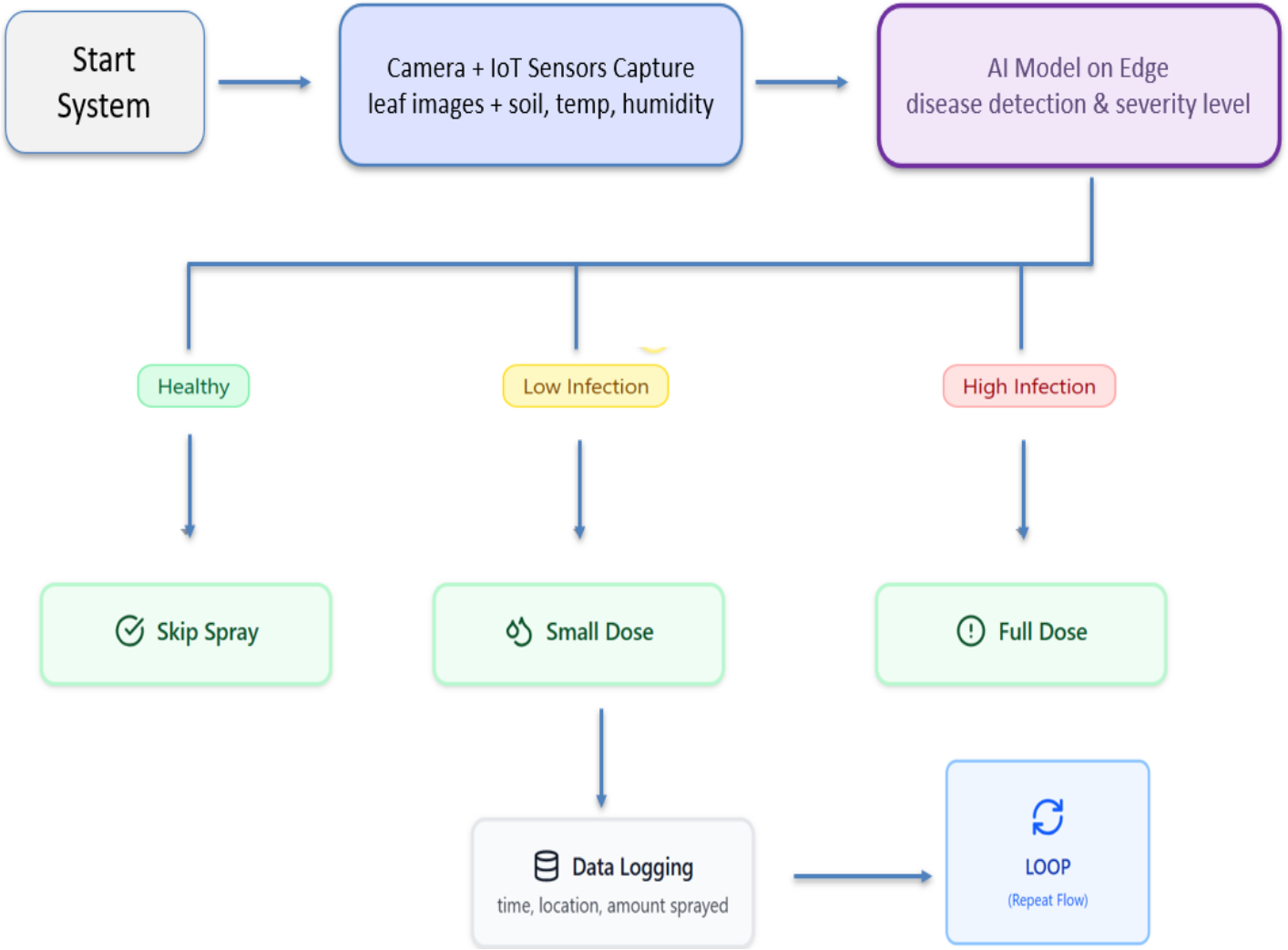

Technologies to be Used

1. Programming Languages
- Python
- JavaScript
- HTML/CSS

2. Frameworks & Libraries
- Django
- React.js
- TensorFlow / PyTorch
- OpenCV
- MQTT
- Deep Learning
- PostgreSQL

3. Hardware Components
- Raspberry Pi 4
- ESP32
- **Sensors**:
  - Soil Moisture Sensor
  - Temperature & Humidity Sensor (DHT22)
  - Air Quality Sensor (MQ-135)
  - Light Sensor (BH1750)
  - Rain Sensor
- Rover Kit
- Camera Module
- Sprayer System
- Power Supply

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FEASIBILITY AND VIABILITY

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Feasibility Analysis

- Technically Practical: Uses a compact rover platform ideal for navigating farm terrain
- Cost-Effective: Rovers are simpler and cheaper than humanoid robots
- Field-Ready: Designed for real-world conditions — dust, uneven soil, and long hours
- Scalable: Can be deployed across farms of different sizes and crop types

Challenges & Risks

- Disease Detection Accuracy – Similar symptoms across diseases
- Lighting Variability – Outdoor conditions affect image quality
- Battery Drain – Continuous movement + image processing = high power usage
- Terrain Navigation – Mud, slopes, or crop density may block movement
- Connectivity Gaps – Remote farms may lack GSM/Wi-Fi signal

Strategies to Overcome Challenges

- Train AI on diverse crop images – Improve detection accuracy
- Use HDR cameras + preprocessing filters – Normalize lighting
- Optimize power usage – Sleep cycles + solar charging
- Add obstacle sensors – IR or ultrasonic for smart navigation
- Offline data logging – Sync alerts when signal returns

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IMPACT AND BENEFITS

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- **Reduced Chemical Use**: Only diseased plants are treated. Precision spraying cuts pesticide use by ~9%; vision systems save up to 60% spray & boost efficiency by 61%.
- **Environmental Protection**: Less runoff & drift; precision farming avoided ~30M lbs herbicide & 100M gallons fuel use.
- **Cost Efficiency**: Lower chemical & fuel use; automation saves labor, reports ~6% fuel savings.
- **Data-Driven Decisions**: Infection/spray logs create outbreak maps & AI models for future prediction.
- **Worker Safety**: Reduces farmer exposure to toxic chemicals via automation.
- **Higher Yields & Quality**: Early detection prevents disease spread; yields increase ~4% with healthier crops & better quality.

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RESEARCH AND REFERENCES

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- **Machine-Vision Sprayers** – Vision-based canopy sensing & adaptive control cut pesticide use by ~60%.

MDPI Sensors, 2025

- **AI Disease Detection** – CNN/YOLO/ViT models achieve high-accuracy crop pest & disease classification.

IEEE Access, 2022

- **IoT Smart Sprayers** – GNSS + sensor networks enable variable-rate, cloud-monitored spraying.

Cleaner Production, 2024

- **Sensor Networks** – IoT + ML enable real-time crop stress monitoring & smart interventions.

Frontiers / MDPI Reviews

- **Case Studies** – IIT Kharagpur ultrasonic sprayer, Wadhwani AI apps, Chinese orchard robots.

ResearchGate