SMART INDIA HACKATHON 2024

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- **Problem Statement ID – SIH1638**
- **Problem Statement – AI-Driven Crop Disease Prediction and Management System**
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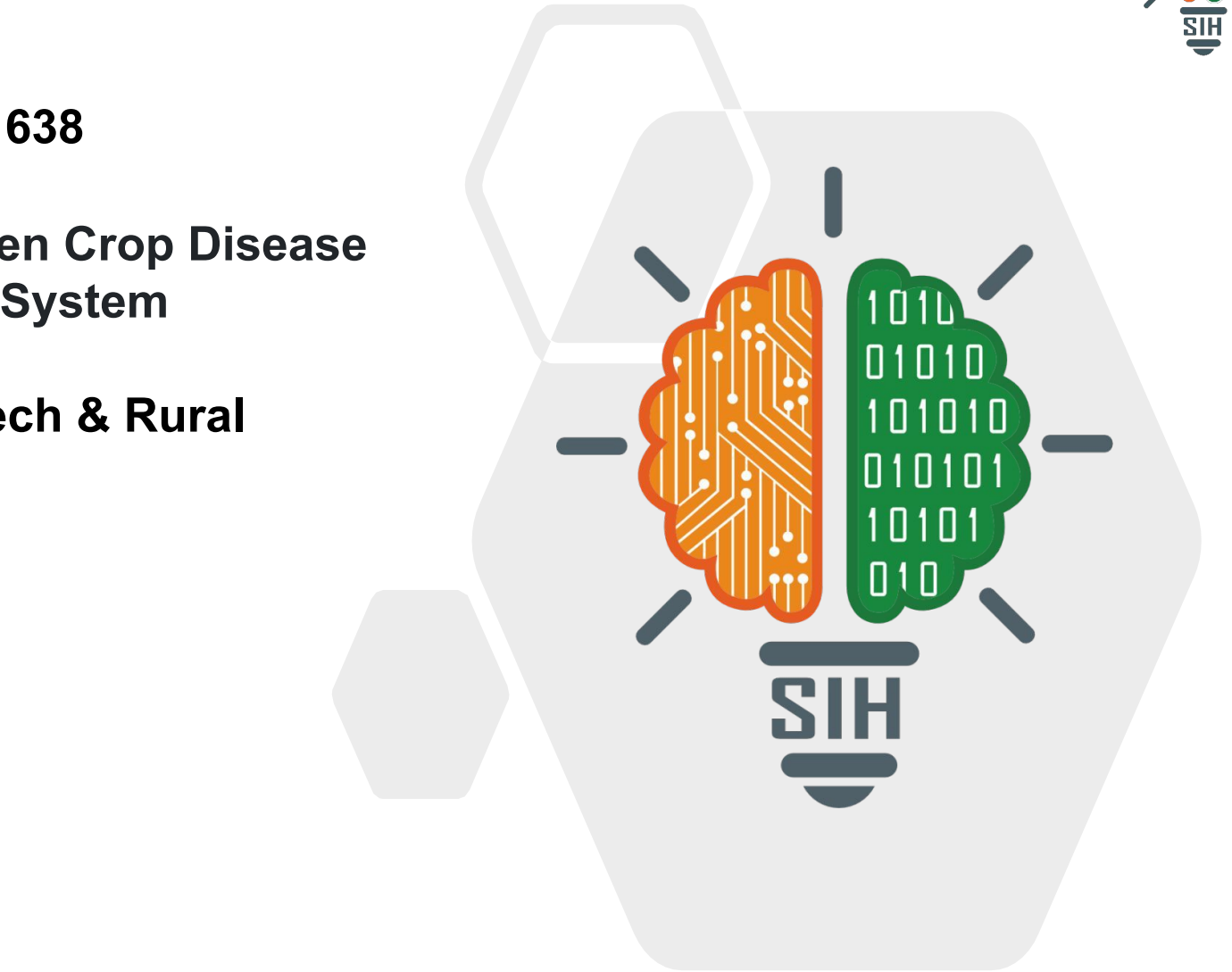
- **Theme – Agriculture,Food-Tech & Rural development.**
- **PS Category – Software**
- **Team ID – 13225**
- **Team Name – Ecovigils**



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CropCare AI: Comprehensive Solution for Disease Prediction and Prevention

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IDEA / SOLUTION:

Development of a comprehensive crop disease prediction system with two key components:

- Software (Website/App Functionality):
  - **Users upload** crop images or gather **real-time data** via hardware.
  - location data/ **GPS** captures **temperature and humidity** of the area.
  - System predicts disease and provides:
    - Symptoms
    - Preventive measures and solutions.

- Hardware (Integrated Design):
  - **Multiple sensors** capture real-time **crop health data**.
  - **Durable, weatherproof casing** ensures reliable operation.
  - **Real-time data analysis** for accurate **disease identification**.

PROBLEM RESOLUTION:

This system helps farmers proactively manage crop health, aligning with Sustainable Development Goals (SDGs) by enabling:

- Early Detection **(SDG 8):** Reduces crop losses**.**
- Enhanced Productivity **(SDG 12):** Boosts yield, reduces waste.
- Sustainable Farming **(SDG 13):** Minimizes chemicals, protects environment.
- Informed Decisions**:** Provides actionable farm insights.
- Improved Food Security**:** stable food production.

FORMULA:

$$\text{DRS} = w_T \cdot T_{\text{risk}} + w_H \cdot H_{\text{risk}} + w_{NPK} \cdot NPK_{\text{deviation}} + w_I \cdot I_{\text{stress}}$$

$$\text{Total Disease Risk (TDR)} = \text{DRS} \times 100$$

$$T_{\text{risk}} = \begin{cases} 1 & \text{if } T > 30^\circ C \text{ or } T > T_{\text{general}} + 2^\circ C \\ 0 & \text{otherwise} \end{cases}$$

$$NPK_{\text{deviation}} = \left| \frac{\text{Measured NPK} - \text{Ideal NPK for Stage}}{\text{Ideal NPK for Stage}} \right|$$

$$I_{\text{stress}} = 1 - I$$

$$H_{\text{risk}} = \begin{cases} 0.3 \text{ if } 40\% < H \leq 60\% \\ 0.6 \text{ if } 60\% < H \leq 80\% \\ 1 \text{ if } H > 80\%,\ 0 \text{ if } H \leq 40\% \end{cases}$$

* *Weights w_T, w_H, w_{NPK}, and w_I to be adjusted based on field data or expert analysis.*

CropCare AI: Comprehensive Solution for Disease Prediction and Prevention

UNIQUE VALUE PROPOSITIONS:

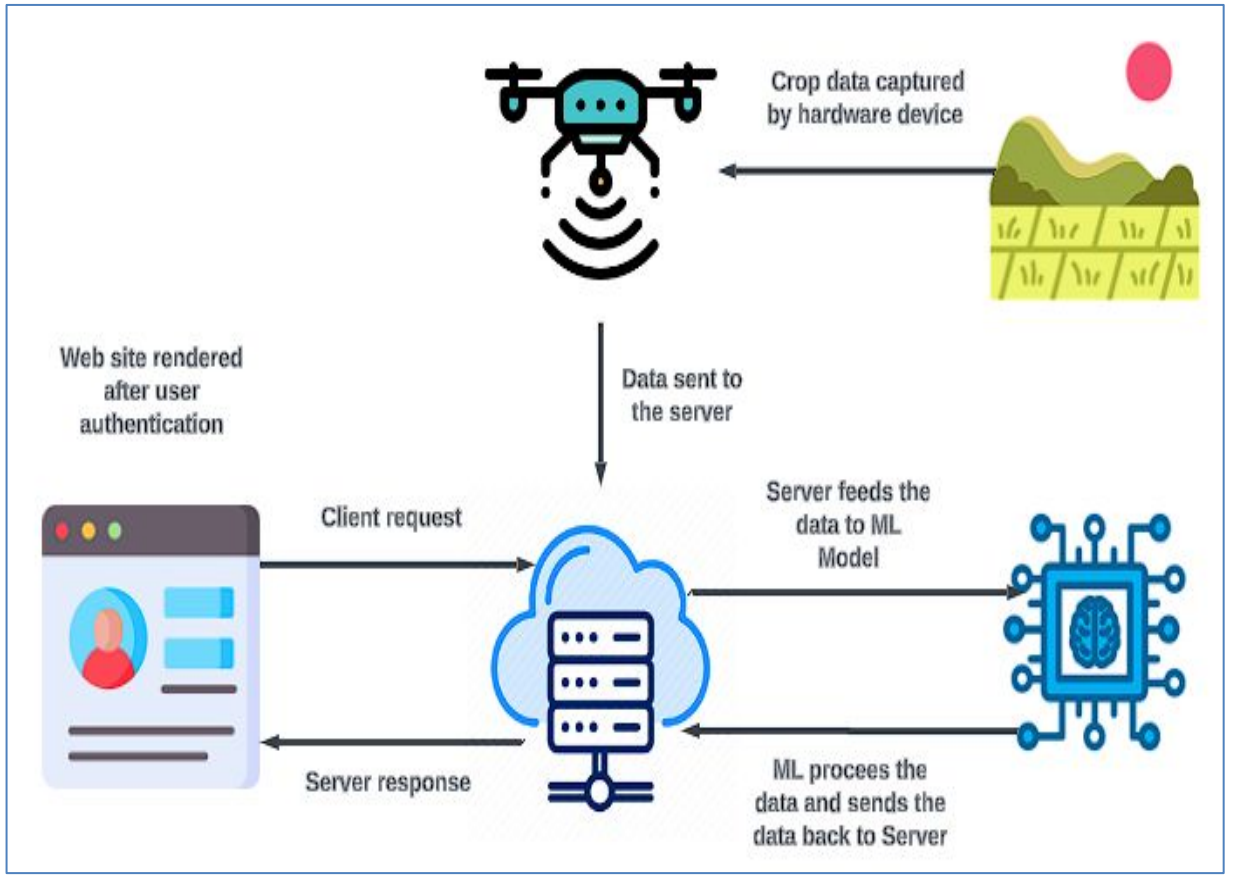
HARDWARE

- Integrated **hardware component** combining advanced environmental and imaging sensors in a **compact, cost-effective** design, for real-time crop health monitoring and disease management.
- **Dynamic Disease Risk Score (DRS) Model**: Our team-developed framework predicts crop disease risks using real-time data on temperature, humidity, nutrients, and vegetation stress. It features adjustable weights for precise, adaptable risk assessment.

SOFTWARE

- **Multilingual** support and **Real-time chatbot** assistance.
- Timely **SOS alerts** to farmers for immediate action against disease threats.
- **Automated Reporting** to deliver regular crop health updates, enabling farmers to track progress.

PROCESS FLOW ARCHITECTURE:



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TECHNICAL APPROACH

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SOFTWARE

Component	Technology/Model	Purpose
Front-end	HTML, CSS, JavaScript, Java, Kotlin	To build a responsive, user-friendly web and mobile application.
Machine learning models		
1.Image-processing	CNN Model: Efficient Net	Efficient and accurate processing of diverse crop images (RGB, NDVI, thermal) to detect diseases.
2.Environmental data processing	GRU (Gated Recurrent Unit)	Captures patterns in time-series environmental data (e.g., temperature, humidity) for disease predictions.
3.Disease outbreak prediction	XGBoost	Combines image and environmental data predictions for robust results, handling mixed data types
Backend(Database)	SQLite3	Stores collected data (images, metrics, predictions, user interactions, disease details) for analysis.
Backend Framework	Django	Manages backend processes, data, and machine learning model integration.

HARDWARE

Equipment	Functions	Price (₹)
Housing and mounting system	Protects sensors from environment; mounts on drones/poles	Rs.1,000-4,000
RGB Camera with NDVI Filter	Captures crop images; analyses NDVI for plant health	Rs.9,000-15,000
Thermal sensor	Monitors crop temperature to detect stress or disease	Rs.7,000-8,000
Environmental sensors	Measures humidity, soil moisture, and NPK levels	Rs.1,700-2,800
GPS Module	Provides geospatial location for data mapping	Rs.800-1,200
Power system	Powers sensors via battery or solar panels	Included in housing
TOTAL		19000 -31-000

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FEASIBILITY AND VIABILITY

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1.FEASIBILITY ANALYSIS

- Technical: Integrates with **drones**,existing **poles** and introduces **stationery versions** for small-scale farmers.
- **Business Approach**: Cost mitigation through **subsidies**, **cooperative ownership**, and **crowdfunding**.
- Market: **User-friendly interface** and **training programs** drive rapid adoption.
- Operational: Provides **actionable insights** to help farmers make informed decisions.

2.POTENTIAL CHALLENGES AND RISKS

- Technical: Addressing **integration** and **resource allocation**.
- Financial: Overcoming **cost barriers** with **innovative financing**.
- Market: Building **trust** through **education** and **training**.
- Operational: Ensuring **data accuracy** and **reliability**.

3.STRATEGIES FOR OVERCOMING CHALLENGES

- Methods: **User-centric design** and **training** for high adoption.
- Principles: **Cooperative ownership** and **collaborative purchasing**.
- Strategies: **Crowdfunding**, **grants**, and **subsidies** for affordability.
- Algorithms: **AI-driven data interpretation** for accuracy and insights.

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IMPACT AND BENEFITS

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POSITIVE IMPACTS, BENEFITS OF CROP DISEASE PREDICTION SYSTEM:

Improvement:

- Healthier Crops: Early detection boosts **yields** and **quality**.
- Informed Choices: **Data-driven decisions** optimize farming practices.

Economic Benefits:

- Increased Productivity: Higher **yields**, improved **market value**.
- Cost Savings: Reduced **input** and **labor costs** through optimized practices.
- New Market Opportunities: Access to **premium markets** and **diversified crops**.

Social Benefits:

- Enhanced Food Security: Improved **crop health** and access to **best practices**.
- Community Resilience: Strengthens local **food supply** and **economies**.

Environmental Benefits:

- Resource Efficiency: Conserves **water**, **fertilizers**, and **energy**.
- Waste Reduction: **Less chemical use** and minimized **crop loss** through targeted interventions.

RESEARCH AND REFERENCE:

- https://www.kaggle.com/datasets/dhamur/cotton-plant-disease
- https://www.sciencedirect.com/science/article/pii/S2667305323001035
- https://www.earthsense.co
- https://onlinelibrary.wiley.com/doi/10.1155/2022/1812025