AERZO

Sustainable Farm System Resilience and Intelligent Surveillance for Climate Resource Optimization

Arpan Ghosh, Ahir Sarkar , Soumee Bhaumik , Ayush Das, Tanima Bhowmik and Arghya Roy

PROBLEM STATEMENT

- LOW PRODUCTIVITY: DUE TO PESTS, POOR SOIL, AND CLIMATE CHANGE.
- TECH GAP: FARMERS LACK DATA AND TOOLS.
- SLOW DETECTION: MANUAL CHECKS DELAY ACTION.
- NO LIVE DATA: POOR DECISIONS ON SOIL, CROPS, LIVESTOCK.
- PEST DAMAGE: NO EARLY ALERTS.
- HIGH LABOR: TRADITIONAL METHODS COST TIME AND MONEY.
- NO AI: MISSED INSIGHTS AND PREDICTIONS.
- NEED SMART TOOLS: SIMPLE, REAL-TIME, AI-POWERED PLATFORM.

OUR SOLUTION

AERIAL DRONE UNIT

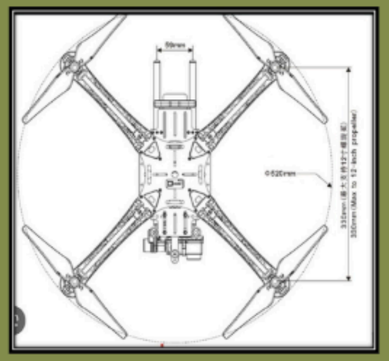
• CAPTURES LIVE RGB, IR & MULTISPECTRAL IMAGES
• DETECTS CROP HEALTH, PESTS

DEW SOIL SENSOR NETWORK

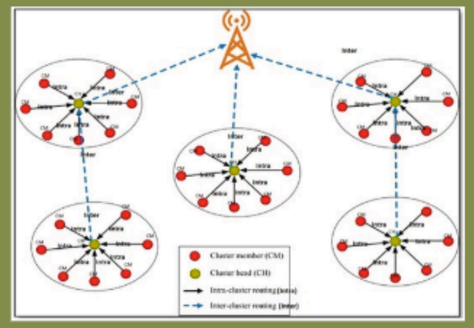
• UNDERGROUND SENSORS TRACK MOISTURE, PH, TEMP & NUTRIENTS
• LOW-POWER, ALWAYS-ON MONITORING

AI ANALYTICS ENGINE

• DIAGNOSES DISEASES & PREDICTS PESTS
• GIVES TREATMENT ADVICE & CROP PLANNING TIPS



Architecture Design of Smart Agriculture Drone



Dew Node and Data Clustering

Autonomous Flight Test

OUR SOLUTION

ECO-FRIENDLY FARMING

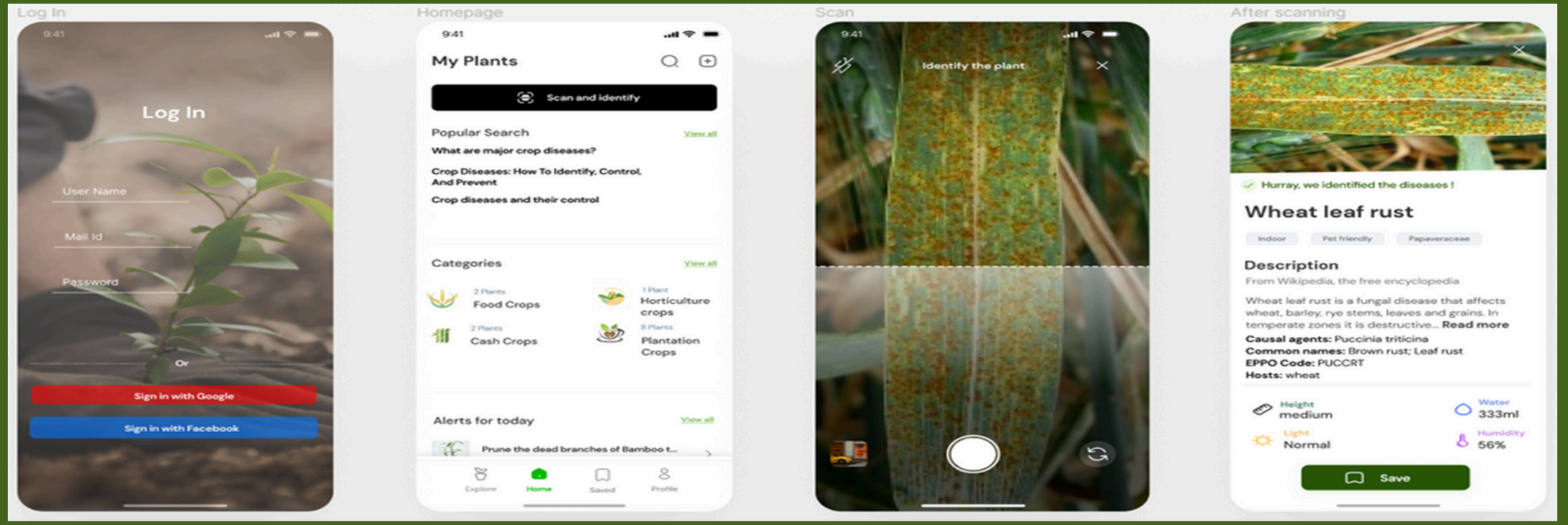
• CUTS DOWN ON CHEMICALS & WATER WASTE
• PROTECTS SOIL AND BOOSTS SUSTAINABILITY

EASY-TO-USE DASHBOARD

• VISUAL MAPS, ALERTS & REPORTS
• DESIGNED FOR ALL FARMERS—NO TECH SKILLS NEEDED

SMARTER, FASTER FARMING

• AUTOMATES TASKS & REDUCES LABOUR
• HELPS MAKE REAL-TIME DECISIONS & INCREASE YIELD



AT A GLANCE

Quality Crop Monitoring

Utilizing innovative UAV systems for accurate, real-time crop development and wellness tracking.

Soil Condition Measurement

Utilizing sensors for measuring soil quality to provide comprehensive data to farmers at their fingertips

Smooth Data Collection and Transfer

Establishing an IoT infrastructure for seamless data sharing, enabling efficient data analysis and transfer

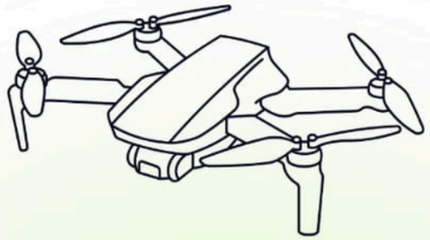
Empowering Farmers

Implementing innovative technologies for data-driven, efficient, and sustainable smart agriculture

Sustainability and Efficiency

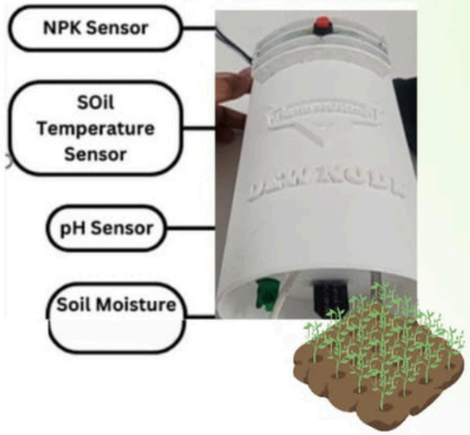
Optimizing components with 3D designs, using a highly affordable multispectral camera for improved data measurement.

AT A GLANCE

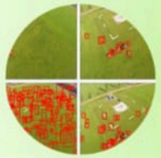


DATA COLLECTION ····> MACHINE LEARNING ····> USER INTERFACE

AERIAL AND SOIL DATA COLLECTION



CROP RECOMMENDATION



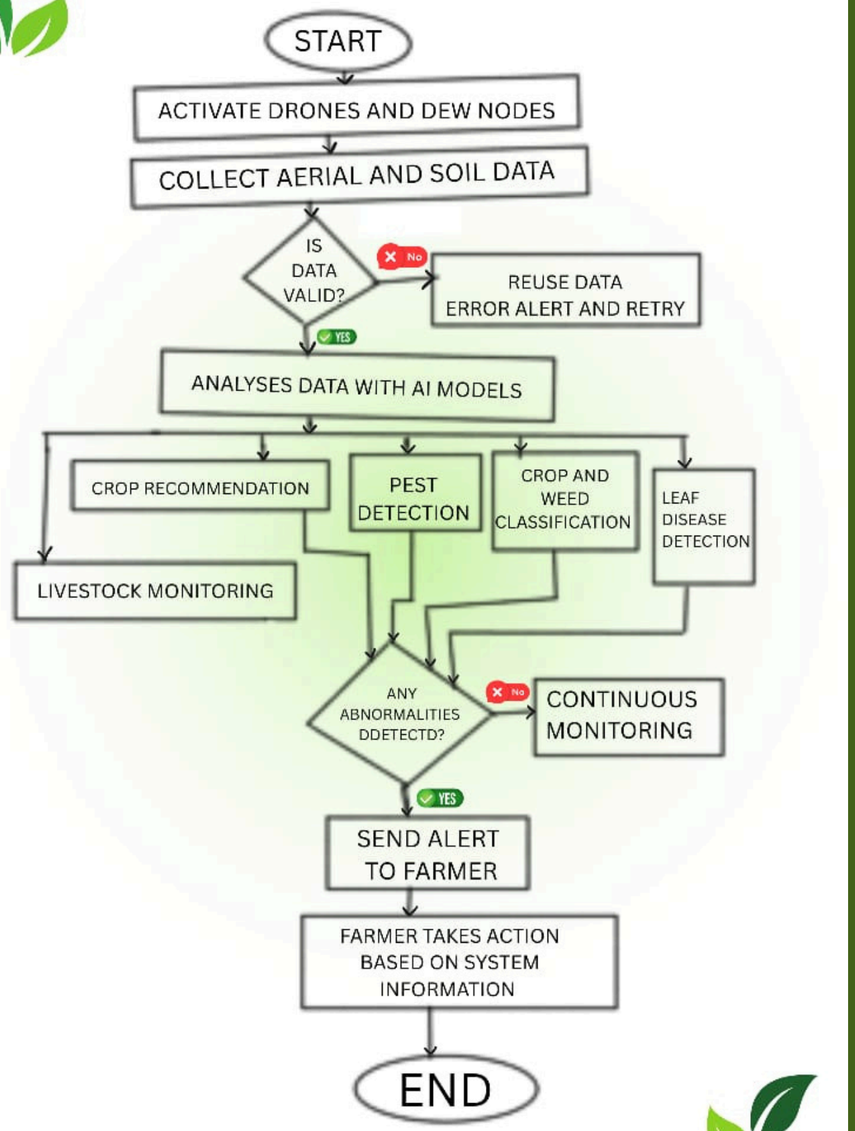
LIVESTOCK MONITORING

PEST DETECTION

CROP AND WEED CLASSIFICATION

LEAF DISEASE DETECTION

EASY TO USE APP WITH ALERT SYSTEM FOR FARMERS



METHODOLOGY

Our Smart Farming Solution:

- **AI + Drones + Soil Sensors + User Interface**
- **Enables data-driven, real-time decision-making**

Hardware:

- **Drones (RGB, multispectral, thermal)**
- **Raspberry Pi(image processing, crop disease detection and crop and weed classification)**
- **DEW nodes (pH, temp, NPK, moisture)**
- **Wireless, low-power setup**

Data:

- **Drones → Aerial images**
- **Sensors → Soil data**
- **Preprocessing: Noise removal, normalization**

Autonomous Flight

- **Follows GPS or AI paths**
- **Uses RTK-GPS or visual SLAM**

Multispectral/RGB Camera

- **Captures crop images for health/stress**
- **Detects chlorophyll via multispectral imaging**

METHODOLOGY

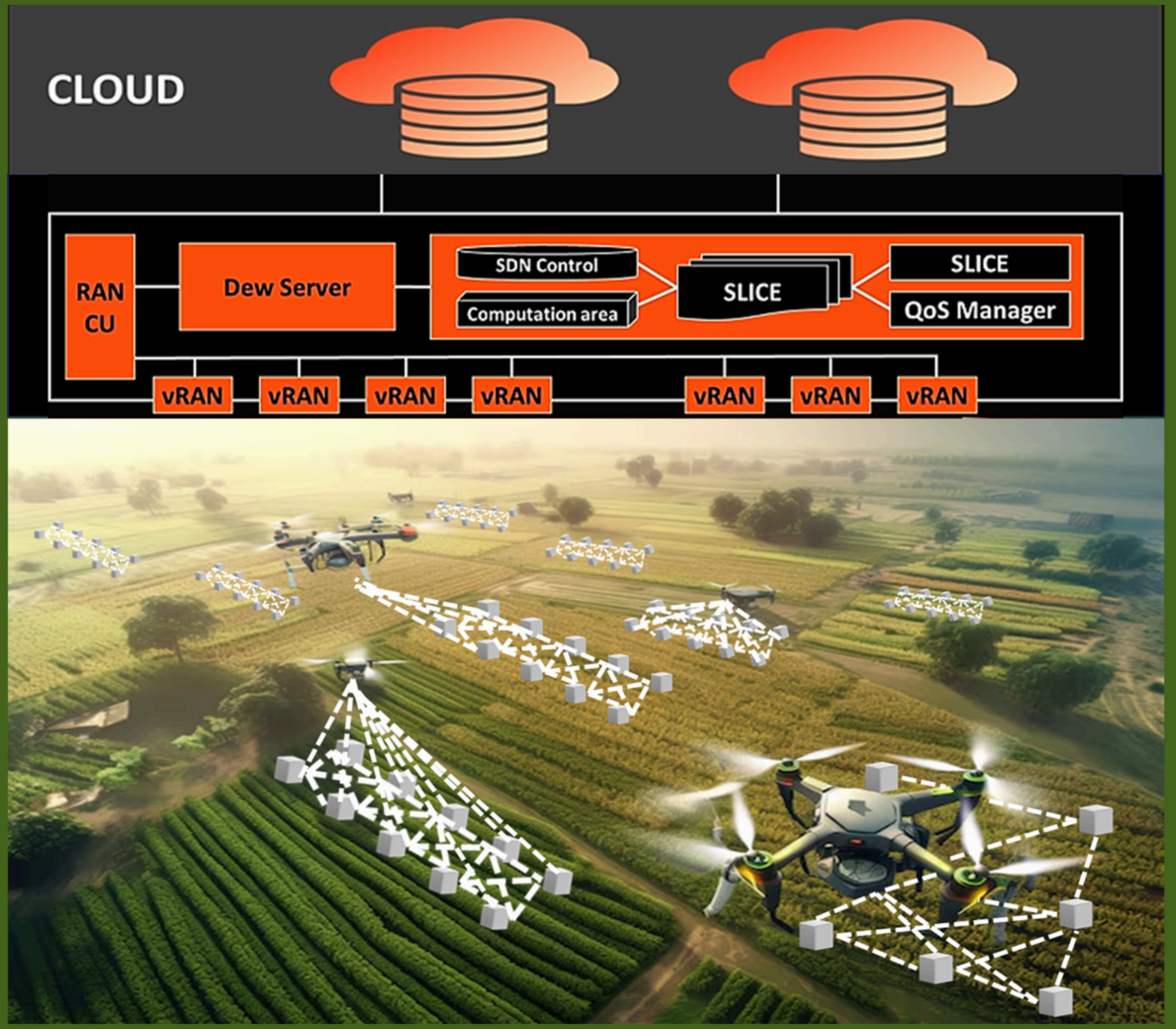
AI-Based Detection

- Classifies healthy, diseased, or weed-affected crops
- Uses YOLO, ResNet, other deep learning models

Real-Time Data Processing

- Sends geotagged alerts via Wi-Fi or 4G
- Syncs with farm dashboards or software

INTEGRATION MODEL



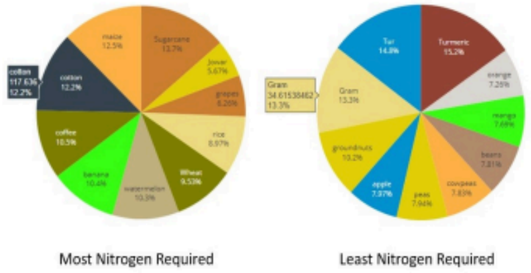


Fig. 3. Nitrogen(N) Crop Summary Comparison

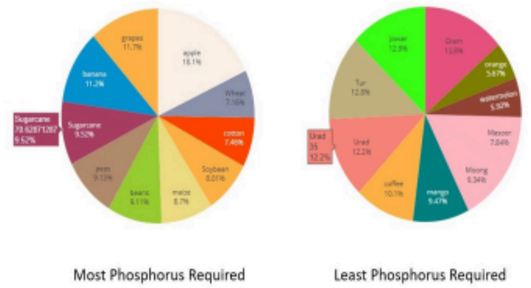


Fig. 4. Phosphorus(P) Crop Summary Comparison

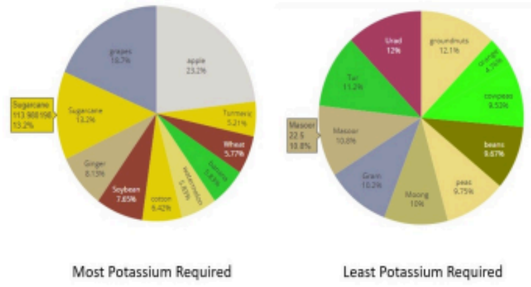


Fig. 5. Potassium(K) Crop Summary Comparison

Reliable Soil Monitoring with DEW Nodes

- **Real-Time Multi-Parameter Tracking**

Monitored temperature, pH, moisture, and NPK across critical field zones.

- **High Accuracy & Validation**

Achieved 97.1% average accuracy, validated against lab tests across various crops and plots.

- **Low Error Margin**

Maintained a consistent margin of error within ±3%.

- **Robust, Low-Power IoT Architecture**

Used microcontrollers with MQTT for wireless data transmission to a Raspberry Pi edge system; ensured local backup in low-connectivity zones.

- **Fast & Reliable Performance**

Average data latency under 2 seconds; system proven effective in real-world farming conditions.

High-Accuracy ML for Sustainable Crop Planning

- **Dataset: 6,000+ samples with temp, rainfall, pH, and nutrients**
- **Top Models: RF (99.39%), SVM (98.48%), LightGBM (98.43%)**
- **Best Performer: Hybrid Ensemble – 99.48% accuracy**
- **Results: Highly precise, location-specific crop recommendations**
- **Impact: Higher yields, better soil-crop match, lower failure risk**

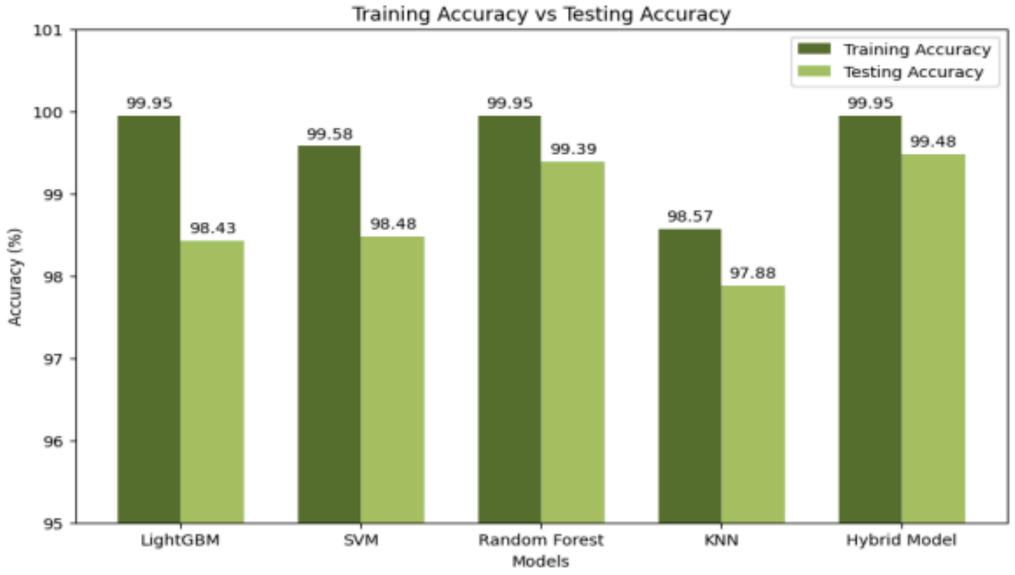


Fig. 6. Visual Representation of Training and Test accuracy

Drone Imaging + YOLOv9 for Smart Pest Control

1. **Advanced Imaging: Drones used thermal and multispectral cameras for aerial crop monitoring.**
2. **Fast Detection: YOLOv9 applied for real-time identification of pests, weeds, and diseases.**
3. **Weed Detection Accuracy: 86.8% accuracy, 91.1% precision, 84.84% F1-score.**
4. **Targeted Response: Enabled site-specific herbicide application.**
5. **Eco-Friendly Impact: Reduced chemical use and minimized environmental harm.**

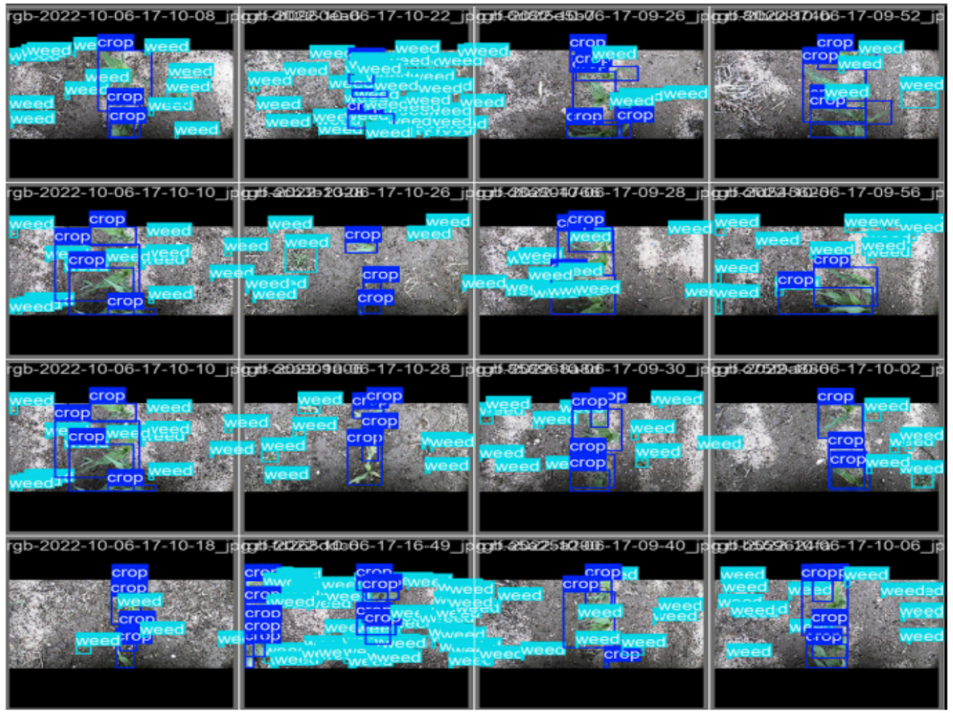


Fig. 7. Crop and Weeds Detection in Intelligent Farm Surveillance System

Pest Detection Performance:
Accuracy: 99.4%
Precision: 98.9%
Recall: 99.0%
Ensured early hotspot identification to prevent widespread infestation.

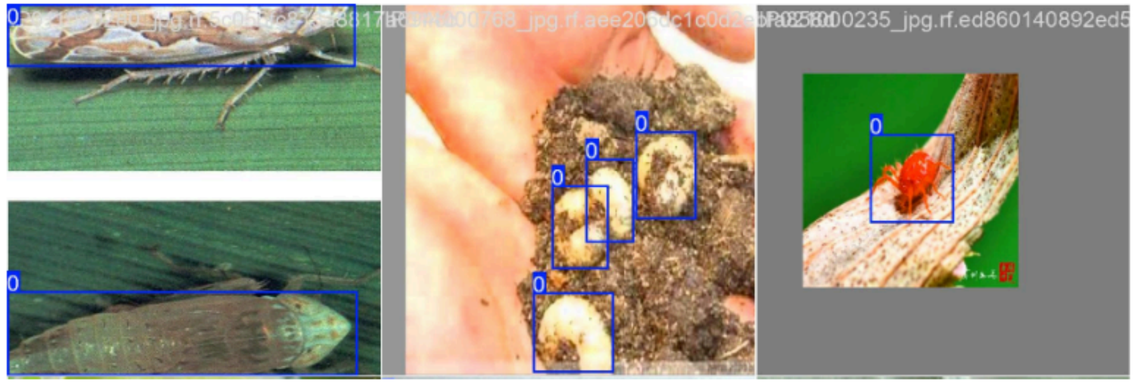


Fig. 8. Pest Detection in Intelligent Farm Surveillance System

Leaf Disease Classification:
Detected bacterial, viral, fungal infections
Accuracy: 95.1%
Enabled precise treatment and minimized pesticide overuse.

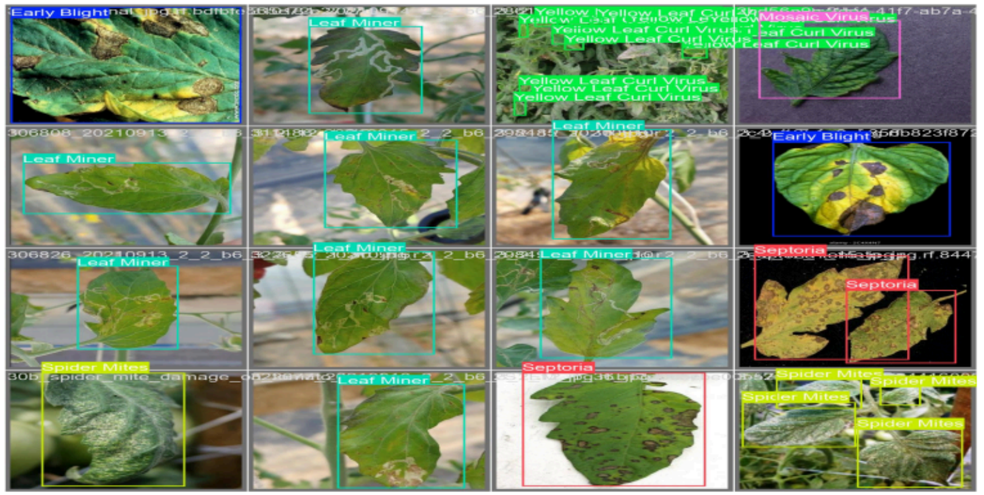


Fig. 9. Leaf Disease Detection in Intelligent Farm Surveillance System

Monitoring for Livestock

- **Real-Time Tracking: Drones accurately monitored livestock movement across the farm.**
- **Health Analysis: AI assessed motion and gait to detect distress or illness.**
- **Smart Surveillance: Live location mapping and automated anomaly alerts.**
- **Labor Efficiency: Reduced need for manual livestock tracking.**
- **Improved Welfare: Enabled proactive, data-driven animal care and management.**

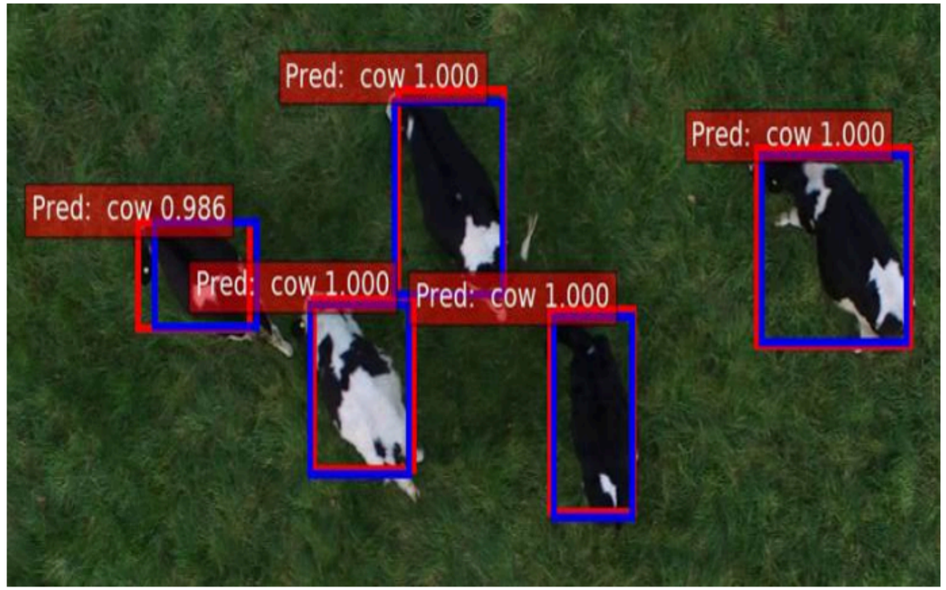


Fig. 10. Livestock Monitoring in Intelligent Farm Surveillance System

Environmental Impact & Operational Efficiency

- Farm inspection time reduced by 65%
- Pesticide and fertilizer usage reduced by 30–40%
- Crop yield increased by 18–22% through early diagnosis and better crop-soil matching
- Real-time soil moisture data prevented over-irrigation
- Low-power IoT devices and optimized drone paths minimized energy consumption
- Reduced resource wastage and supported sustainable farming practices

Conclusion

- Enables smarter, real-time farming decisions through drones, sensors, and AI.
- Improves crop yield and health with early detection and precise recommendations.
- Reduces input costs and environmental impact via targeted resource use.
- Designed for scalability and rural adoption, making advanced tech accessible to all farmers.
- Paves the way for sustainable, data-driven agriculture with room for future AI innovation.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