Crop Disease Detection and Pest Control

For the Tea Industry

GROUP
35

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Introduction

60% Sri Lanka's tea industry faces **crop losses** due to diseases and pests

Tea cultivation in Sri Lanka faces significant challenges due to crop diseases and pests, impacting yield and quality. Our innovative solution integrates Cloud, Edge, and Fog Computing to enable real-time monitoring, early disease detection, and precision pest control ensuring sustainable and efficient farming.

Identifying Problem & Solution in Smart Agriculture

Real- World Problem in Tea Industry

- **Early detection of crop diseases and pests.**
- **Delayed responses due to manual inspections.**
- **Overuse of pesticides, leading to environmental harm**
- **Lack of real – time monitoring a large farms**

Proposed Hybrid Solution

Edge Layer (Field-Level)

Real-time monitoring & instant response.

- Capture real-time data.
- Edge AI devices detect disease symptoms early.
- Reducing cloud usage & saving bandwidth.

Tools: IoT cameras,sensors, TensorFlow Lite

Fog Layer (Local Farm-Level)

Intermediate processing & decision-making.

- Aggregates edge data .
- If pests or disease are detected:
  - **spraying starts in affected areas.**
  - Farmers receive instant alerts on mobile apps.

Tools: Local servers, edge AI models

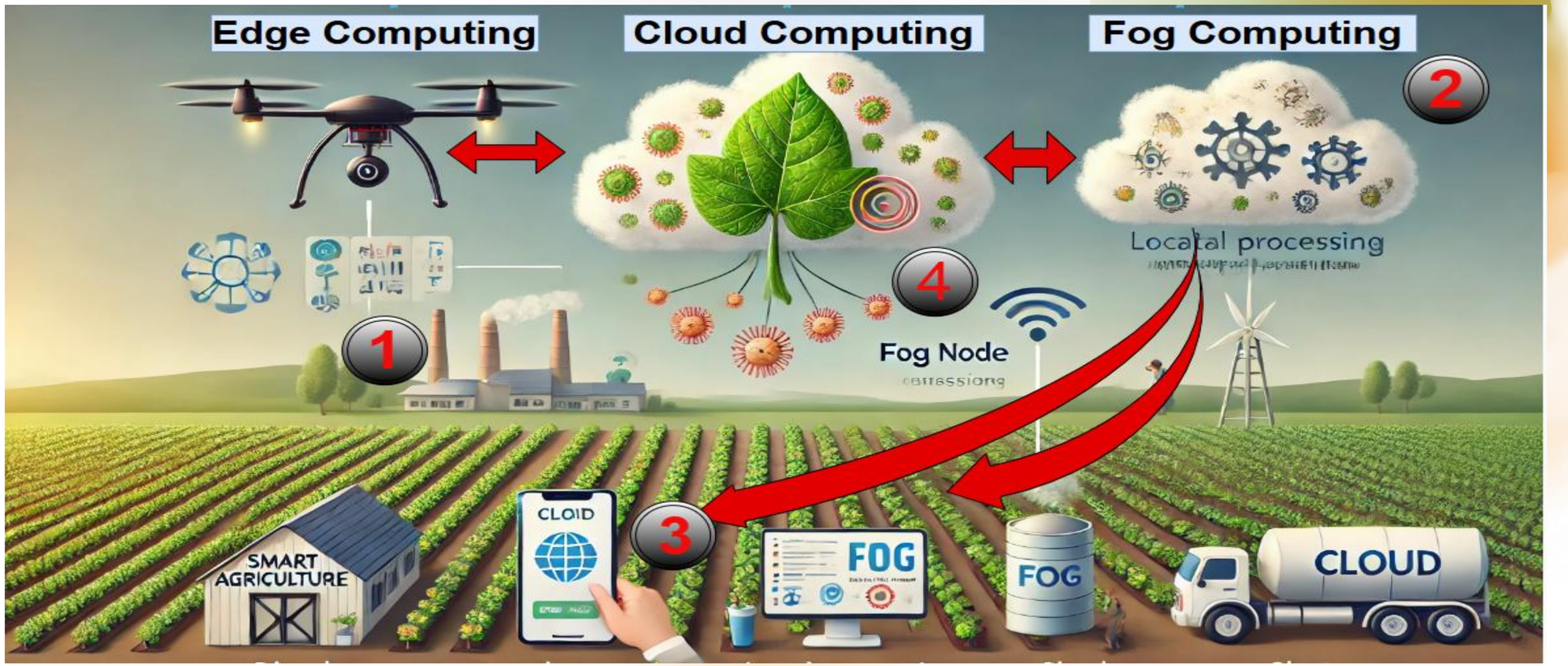
Cloud Layer (Centralized)

Long-term storage & advanced analytics.

- Stores historical farm data.
- Trains large-scale AI models for better predictions.
- Provides farmer dashboards & alerts.

Tools: AWS S3, Google Cloud AI.

How Our System Works



1. **A drone ,sensors (Edge)** captures images and real time data of a diseased leaf.
2. **Fog nodes** process the image locally, confirming it’s a fungal infection.
3. **An immediate alert** is sent to the farmer’s phone, suggesting treatment.
4. **The cloud** updates disease trends across regions, improving future predictions.

TOOLS & TECHNOLOGIES

Edge Computing

- Cameras ,Drones and Sensors
- Audio sensors
- Lightweight AI models (TensorFlow Lite)
- Local SQLite database
- MQTT
- Federated Learning

Fog Computing

- Advanced AI (PyTorch/Scikit-learn)
- SMS alerts (Twilio API)
- TimescaleDB

Cloud Computing

- Cloud storage (AWS S3)
- AI models (TensorFlow/PyTorch)
- Centralized database (PostgreSQL)
- SMS alerts (Twilio)

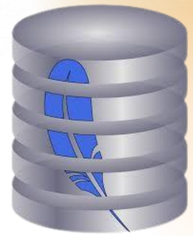
Data Management, Processing & Analysis

Data Collection & Initial Processing

Edge Computing

IoT devices

AI Models

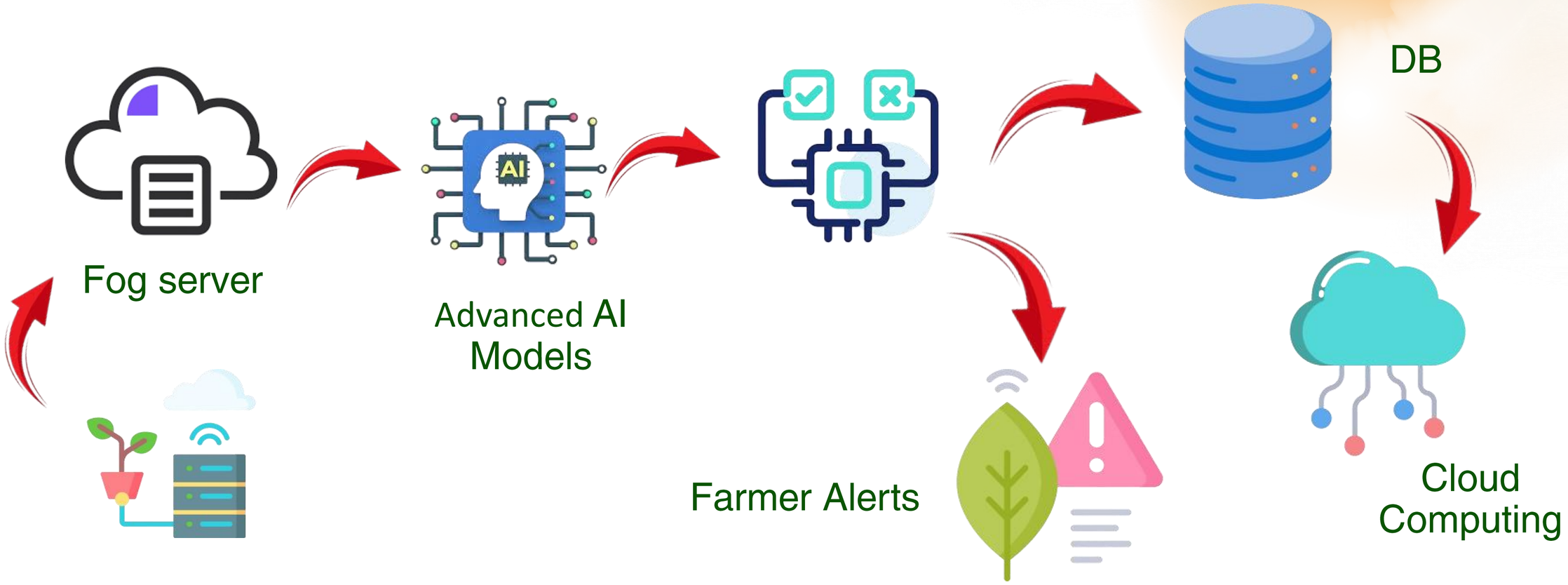


SQLite DB

Fog computing

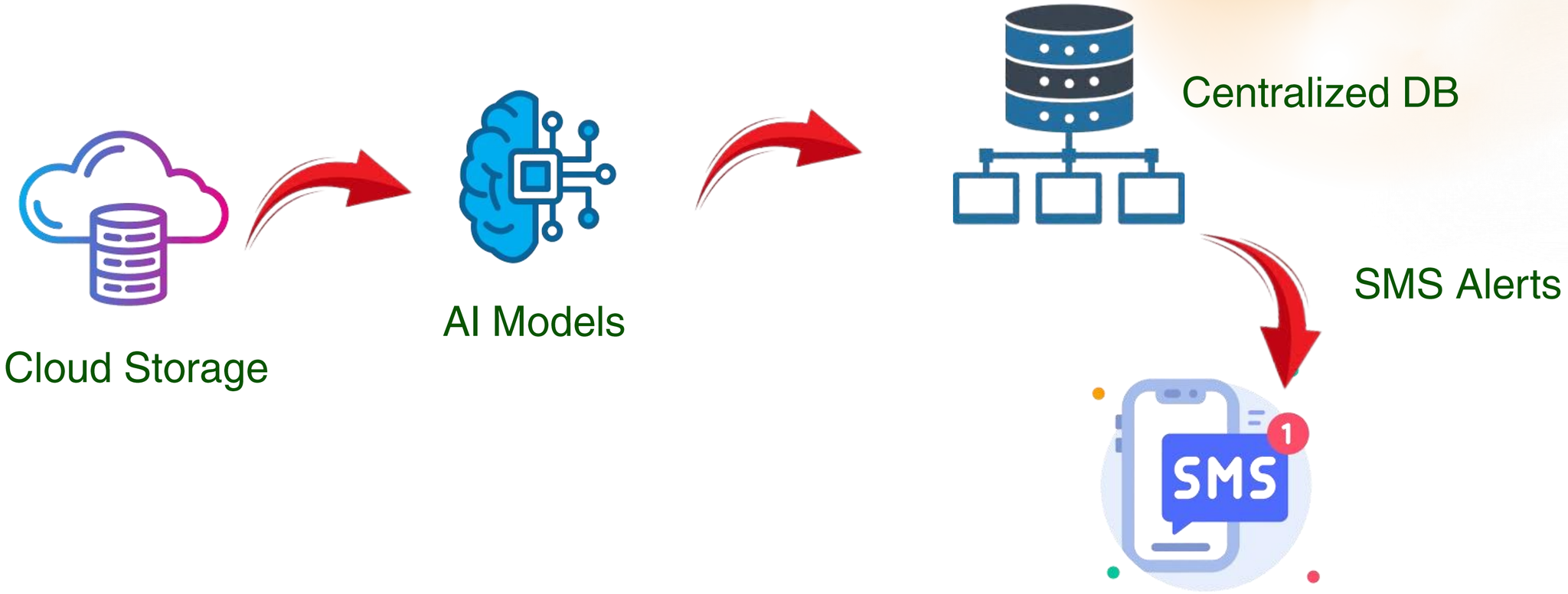
Local AI Processing & Decision Making

Fog Computing



Data Storage & Analysis

Cloud Computing



Trade-offs in Cloud, Edge & Fog Computing: Latency, Bandwidth & Scalability

Cloud Computing

Centralized, high scalability, but higher latency and bandwidth usage

Edge Computing

Decentralized, low latency, reduces bandwidth, but limited scalability

Fog Computing

Intermediate layer, balances latency and bandwidth while offering moderate scalability

Trade-offs: Latency, Bandwidth, and Scalability

Computing Model	Latency	Bandwidth Usage	Scalability	Best For
Cloud	High	High	Very high	AI, Big Data, Web Apps
Edge	Low	Low	Limited	IoT, AR/VR, Self-driving Cars
Fog	Medium	Medium	Moderate	Smart Cities, Industrial IoT

Choosing the Right Model

Cloud	✔ Best for large-scale, non-time-sensitive applications
Edge	✔ Best for real-time, low-latency applications
Fog	✔ Best when a balance of latency and scalability is needed
Future Trends	✔ Hybrid architectures, AI-driven edge computing, impact of 5G

Strengths & Weaknesses

Cloud Computing

✓ High computational power for large datasets and AI models

✓ Scalable for large farms with centralized data storage

✓ Best for predictive analytics and long-term trend analysis

✕ High latency due to data transmission to remote servers

✕ Requires a stable internet connection, making it less suitable for remote farms

✕ Expensive due to ongoing cloud storage and processing costs

Strengths & Weaknesses

Fog Computing

✓ Balances real-time processing and cloud capabilities

✓ Reduces latency while supporting complex analytics

✓ Moderate cost compared to fully cloud-dependent systems

✗ Requires additional infrastructure (local farm servers)

✗ More maintenance than cloud-only or edge-only systems

✗ Not as instantaneous as edge computing

Strengths & Weaknesses

Edge Computing

✓ Real-time disease and pest detection with minimal latency

✓ Works offline, reducing dependence on cloud connectivity

✓ Lower data transmission costs by processing data locally

✗ Limited processing power compared to cloud computing

✗ Requires optimized AI models for low-power devices

✗ Device failures can impact data accuracy

Summary of Strengths & Weaknesses

Feature	Cloud Computing	Edge Computing	Fog Computing
Where Data is Processed?	✅ Powerful cloud servers handle large AI models. ❌ Data is processed far from the farm.	✅ Processing happens directly on devices (drones, sensors) for immediate action. ❌ Devices have limited processing power.	✅ Data is processed on local farm servers before reaching the cloud. ❌ Requires additional farm infrastructure.
Speed (Latency)	❌ Slow – Data must travel to the cloud and back, causing delays.	✅ Ultra-fast – Data is processed instantly on-device.	✅ Fast – Local processing reduces cloud dependency.
Real-Time Pest Control	❌ Delayed response – Pests may spread before action is taken.	✅ Immediate – Drones detect and spray pesticides instantly.	✅ Quick response – Local server processes data and coordinates pesticide spraying.
Internet Requirement	❌ High – Needs stable internet to send data to the cloud.	✅ None – Works offline, ideal for remote farms.	✅ Low – Works offline but syncs with the cloud when needed.
Data Bandwidth Usage	❌ High – Large image and video files need to be sent to the cloud.	✅ Low – Only essential data is processed and stored.	✅ Moderate – Only analyzed data is sent to the cloud.
Computational Power	✅ High – Can process large datasets and complex AI models.	❌ Limited – Processing depends on device capabilities.	✅ Moderate – Local servers provide more power than edge devices but less than the cloud.
Cost	❌ Expensive – Ongoing cloud storage and processing fees.	✅ Cost-effective – One-time investment in edge devices, no cloud fees.	✅ Moderate – Some local infrastructure costs, but reduced cloud dependence.

Thank You

Q&A

Session