Zijja Plantation Management System

Requirements Specification & System Summary

Executive Summary

Zijja is a modern agricultural technology platform designed for large-scale ornamental plant nurseries to track plant lot readiness, growth, and health in real-time. The system eliminates manual recordkeeping, reduces plant write-offs through timely harvest notifications, and provides comprehensive visibility into plantation operations through QR-code enabled field updates and AI-powered insights.

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1. Business Objectives

Primary Goals

- **Real-time Visibility**: Provide instant access to plant lot readiness status for harvest and sale decisions
- **Eliminate Manual Processes**: Replace paper-based recordkeeping with digital, automated tracking
- **Reduce Write-offs**: Minimize plant losses through timely harvest notifications and health monitoring
- **Streamline Operations**: Enable efficient field updates via QR scanning and centralized management
- **Data-Driven Decisions**: Support planning and delivery scheduling through comprehensive reporting

Success Metrics

- 50% reduction in plant write-offs due to missed harvest timing
- 80% improvement in data accuracy compared to manual methods
- 90% adoption rate among field staff within 3 months
- 25% improvement in harvest planning efficiency

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2. User Roles & Permissions

Manager (Full Access)

Responsibilities:

- Complete system administration and oversight
- Strategic planning and operational management
- Quality control and approval workflows

Permissions:

- ✅ Manage users, zones, locations, and plant species
- ✅ View all plant data across all locations
- ✅ Generate and export all reports
- ✅ Approve/override field updates
- ✅ Configure system settings and notifications

- ✅ Access AI insights and recommendations

Field Staff (Limited Access)

Responsibilities:

- Daily plant lot monitoring and updates
- Data collection and photo documentation
- On-ground health assessment

Permissions:

- ✅ Scan plant lot QR codes
- ✅ Update growth data (height, diameter)
- ✅ Upload photos and health status
- ✅ Mark lots as ready/not ready
- ❌ Cannot edit species configurations
- ❌ Cannot access financial or strategic reports
- ❌ Cannot manage users or system settings

Analytics & Reporting Users (View-Only)

Responsibilities:

- Data analysis and reporting
- Harvest projections and planning support
- Performance monitoring

Permissions:

- ✅ View dashboards and analytics
- ✅ Download Excel/PDF reports
- ✅ Analyze harvest projections and zone health
- ✅ Access historical data and trends
- ❌ Cannot modify plant data
- ❌ Cannot manage system configurations

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3. Core System Features

🌿 Plant Lot Tracking

Description: Comprehensive tracking system for individual plant lots throughout their lifecycle.

Key Components:

- **Auto-generated Lot ID**: Format: `[Species Code]-[Location Code]-[YYYYMMDD]-[Sequential Number]`
  - Example: `RSE-GH01-20241201-001` (Rose, Greenhouse 01, Dec 1 2024, Lot 001)
- **Core Attributes:**
  - Species information (name, variety, growth parameters)
  - Location and zone assignment
  - Planted date and estimated harvest date

    - Current measurements (height, diameter)
    - Health status (Excellent, Good, Fair, Poor, Critical)
    - Readiness status (Not Ready, Ready, Harvested)
- **QR Code Generation**: Unique code for each lot enabling mobile scanning
- **Lifecycle Tracking**: From planting to harvest with status transitions

📷 Field Updates via QR Scan

Description: Mobile-first interface for field staff to update plant data efficiently.

Workflow:

1. Field staff opens mobile app
2. Scans QR code on plant lot marker
3. System loads current lot information
4. Staff updates:
    - Average height measurement
    - Average diameter measurement
    - Health status selection
    - Photo upload (multiple angles)
    - Notes/observations
5. System auto-calculates readiness based on growth criteria
6. Updates are timestamped and logged

Auto-Readiness Logic:

- When height ≥ target height AND days ≥ minimum growth period
- Override capability for managers
- Notification triggered when status changes

📍 Location & Zone Management

Description: Hierarchical organization of plantation areas with detailed tracking.

Structure:

- **Locations**: Main plantation sites
- **Zones**: Subdivisions within locations
- **Zone Attributes:**
    - Soil type and pH levels
    - Irrigation system details
    - GPS coordinates
    - Climate conditions
    - Capacity (max plant lots)

Functionality:

- Assign plant lots to specific zones
- Track zone utilization and capacity
- Monitor zone-specific performance metrics

- GPS mapping integration for field navigation

🧠 AI-Powered Health Insights

Description: Machine learning analysis of plant photos and growth data to provide actionable insights.

Capabilities:

- **Photo Analysis**: Identify potential diseases, pests, or growth issues
- **Growth Pattern Analysis**: Compare against healthy growth benchmarks
- **Treatment Recommendations**: Suggest specific interventions
- **Risk Assessment**: Predict potential problems before they become critical
- **Disease Detection**: Early identification of common plant diseases

AI Model Features:

- Image classification for health assessment
- Anomaly detection in growth patterns
- Predictive modeling for harvest timing
- Integration with external weather and soil data

📊 Dashboard & Reporting

Description: Comprehensive analytics and reporting suite for operational insights.

Manager Dashboard:

- Total lots by status (Ready, Not Ready, Harvested)
- Health status distribution across all locations
- Harvest readiness timeline (next 30/60/90 days)
- Zone performance comparison
- Recent alerts and notifications
- Key performance indicators (KPIs)

Report Types:

- **Species Reports**: Performance by plant variety
- **Zone Reports**: Location-specific analytics
- **Time Period Reports**: Historical analysis and trends
- **Health Reports**: Disease and treatment tracking
- **Harvest Reports**: Readiness and delivery planning

Export Formats:

- PDF: Formatted reports for stakeholders
- Excel: Raw data for further analysis
- CSV: Data integration with other systems

👤 User Management

Description: Role-based access control with comprehensive user administration.

Features:

- User registration and profile management
- Role assignment and permission control
- Activity logging and audit trails
- Enable/disable user accounts
- Password reset and security management
- Multi-location access control

🔔 Notifications & Alerts

Description: Proactive notification system for timely decision-making.

Notification Types:

- **Harvest Alerts**: Lots approaching readiness
- **Health Warnings**: Plants showing signs of distress
- **Overdue Updates**: Lots without recent field updates
- **System Alerts**: Technical issues or maintenance
- **Delivery Reminders**: Scheduled harvest deadlines

Delivery Methods:

- In-app notifications
- Email alerts
- SMS for critical alerts
- Push notifications on mobile devices

📅 Monthly Lot Readiness Planner

Description: Forward-looking planning tool for harvest and delivery coordination.

Features:

- Monthly readiness projections by species
- Comparison with delivery commitments
- Capacity planning and resource allocation
- Seasonal trend analysis
- Export planning calendars

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4. User Stories & Acceptance Criteria

Epic: Plant Lot Management

User Story 1: Add New Plant Lot

As a Manager
I want to create new plant lots with automatic ID generation
So that I can efficiently track plants from planting to harvest

Acceptance Criteria:
- System generates unique Lot ID based on species, location, and date
- Manager can select species from predefined list
- System calculates estimated harvest date based on species growth parameters
- QR code is automatically generated for printing
- Lot is assigned to selected zone with capacity validation
- Initial status is set to "Not Ready"

User Story 2: Field Data Update

As Field Staff
I want to scan QR codes to quickly update plant information
So that I can efficiently maintain accurate growth records

Acceptance Criteria:
- QR scan opens lot details immediately
- Height and diameter inputs accept decimal values
- Photo upload supports multiple images
- Health status selection from predefined options
- System validates data before saving
- Timestamp and staff ID are automatically recorded
- Readiness status updates automatically when criteria are met

User Story 3: Readiness Monitoring

As a Manager
I want to monitor plant readiness across all locations
So that I can optimize harvest timing and reduce waste

Acceptance Criteria:
- Dashboard shows real-time readiness counts by location
- Visual indicators distinguish between ready and not-ready lots
- Filter options by species, location, and date range
- Manual override capability for readiness status
- Bulk actions for multiple lot management
- Export ready lots list for harvest planning

Epic: Reporting & Analytics

User Story 4: Generate Harvest Reports

As an Analytics User
I want to generate detailed harvest reports
So that I can analyze plantation performance and plan deliveries

Acceptance Criteria:
- Filter reports by date range, species, location, and zone
- Include growth metrics, health statistics, and readiness trends
- Export options in PDF and Excel formats
- Scheduled report generation and email delivery
- Comparative analysis between different time periods
- Visual charts and graphs for key metrics

User Story 5: Health Monitoring Dashboard

As a Manager
I want to view plant health status across my plantation
So that I can quickly identify and address potential issues

Acceptance Criteria:
- Color-coded health status visualization
- Drill-down capability from overview to individual lots
- AI-generated health insights and recommendations
- Historical health trend analysis
- Alert notifications for critical health issues
- Treatment tracking and outcome measurement

Epic: User Management & Access Control

User Story 6: Manage User Permissions

As a Manager
I want to control user access based on their roles
So that I can maintain data security and operational efficiency

Acceptance Criteria:
- Role-based permission assignment (Manager, Field Staff, Analytics)
- User activation/deactivation without data loss
- Activity audit trail for all user actions
- Location-specific access control
- Password policy enforcement
- User profile management with contact information

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5. System Architecture & Technical Requirements

Technology Stack

- **Frontend**: Next.js with Tailwind CSS for responsive design
- **UI Components**: ShadCN UI for consistent design system
- **Backend**: Node.js with Express.js framework
- **Database**: MySQL for structured data storage
- **Authentication**: JWT-based role-based access control
- **QR Code**: Dedicated library for generation and scanning
- **AI/ML**: Integration with image recognition APIs

- **Cloud**: Scalable deployment with automatic backups

Performance Requirements

- **Response Time**: <2 seconds for QR scan to data load
- **Uptime**: 99.9% availability during business hours
- **Concurrent Users**: Support 100+ simultaneous field staff
- **Data Storage**: Scalable to millions of plant lot records
- **Mobile Performance**: Optimized for 3G/4G network conditions

Security Requirements

- **Data Encryption**: All data encrypted in transit and at rest
- **Access Control**: Role-based permissions with audit logging
- **Authentication**: Multi-factor authentication for managers
- **Data Backup**: Daily automated backups with 30-day retention
- **Compliance**: Agricultural data protection standards

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6. User Experience Flows

Flow 1: Plant Lot Creation

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Manager Login → Dashboard → Add New Lot → Select Species →
Choose Location/Zone → Set Planting Details → Generate QR →
Print QR Label → Confirm Creation → Return to Dashboard
```

Flow 2: Field Update Process

```
Field Staff Login → Scan QR Code → View Current Data →
Update Measurements → Upload Photos → Select Health Status →
Add Notes → Save Updates → Confirm Success → Scan Next Lot
```

Flow 3: Readiness Review

```
Manager Login → Dashboard → View Ready Lots → Filter by Location →
Review Individual Lots → Verify Readiness → Approve for Harvest →
Generate Harvest List → Export for Operations Team
```

Flow 4: Report Generation

```
Analytics User Login → Reports Section → Select Report Type →
Set Filters (Date/Species/Location) → Preview Report →
Choose Export Format → Generate Report → Download/Email
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7. AI Integration Specifications

Image Analysis Capabilities

- **Disease Detection**: Common ornamental plant diseases
- **Growth Assessment**: Visual growth quality evaluation
- **Pest Identification**: Early pest detection and identification

- **Environmental Stress**: Signs of water, nutrient, or light stress

Recommendation Engine

- **Treatment Suggestions**: Evidence-based treatment recommendations
- **Timing Optimization**: Optimal harvest timing predictions
- **Resource Allocation**: Efficient resource distribution recommendations
- **Risk Mitigation**: Proactive risk identification and prevention

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8. Implementation Roadmap

Phase 1: Core Functionality (Months 1-3)

- User authentication and role management
- Basic plant lot creation and tracking
- QR code generation and scanning
- Simple field update interface
- Basic dashboard and reporting

Phase 2: Advanced Features (Months 4-6)

- AI-powered health insights
- Advanced reporting and analytics
- Notification system
- Mobile app optimization
- Zone and location management

Phase 3: Enhancement & Scale (Months 7-9)

- Advanced AI features
- Integration capabilities
- Performance optimization
- Advanced reporting features
- User experience refinements

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9. Success Metrics & KPIs

Operational Metrics

- Plant lot accuracy: >95%
- Field update frequency: Daily for all active lots
- Harvest timing optimization: 90% accuracy within 3 days
- User adoption rate: 90% of field staff using system regularly

Business Impact

- Reduction in plant write-offs: 50% decrease
- Time savings: 40% reduction in administrative tasks
- Reporting efficiency: 70% faster report generation
- Decision-making speed: 60% faster harvest decisions

Technical Performance

- System uptime: 99.9%
- Response time: <2 seconds for core functions
- Mobile performance: <3 seconds on 3G networks
- Data accuracy: >99% with automated validation

Conclusion

The Zijja plantation management system represents a comprehensive solution for modern ornamental plant nurseries, combining real-time tracking, AI-powered insights, and user-friendly interfaces to optimize plantation operations. Through careful implementation of these requirements, the system will deliver significant improvements in operational efficiency, cost reduction, and decision-making capabilities.