

RAITA MITRA – AGRI MACHINERY RENTAL SERVICE

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Introduction:

Agriculture remains the backbone of the Indian economy, and more than half of the population depends on it for their livelihood. Despite its importance, the sector, particularly small and marginal farmers, continues to face significant challenges. One of the most pressing issues is the limited access to modern agricultural machinery. Farm equipment such as tractors, tillers, and harvesters has the potential to enhance productivity and reduce manual labour. However, high ownership costs, seasonal utilization, and limited local availability prevent most farmers from acquiring and using this machinery efficiently. In India, most farmers cultivate less than two hectares of land, making it financially difficult to purchase expensive equipment. Conversely, those who do own machinery often experience long periods of under-utilization, especially during off-seasons. This imbalance highlights a fundamental inefficiency: while resources exist, their accessibility and use remain unevenly distributed.

To address this gap, the Machinery Access – Revolution for Farmers (MARF) platform is proposed. MARF is a cloud-based, bilingual (Kannada and English) solution designed to improve accessibility to farm equipment through a rental model. It enables farmers to search for machinery in their locality, check availability via a calendar, compare pricing, and choose rental options. For equipment owners, MARF provides a platform to list machinery, manage bookings, and generate income during idle periods.

The system integrates features such as real-time booking, secure payments through UPI, geolocation-based search, and instant notifications. Furthermore, it offers trained operators for farmers without formal machinery training, along with advanced functionalities like equipment usage analytics.

Objectives:

1. Create a cloud-based platform for renting or lending farm equipment. List the objectives 2 of project
2. Enable affordable access for small or mid-sized farmers.
3. Provide real-time equipment availability, secure booking, and easy payments.

4. Integrate geolocation, language support, and trust mechanisms (ratings or reviews).
5. Build a supportive community space for knowledge exchange and farmer help.

Methodology:

Architecture Design:

- The system uses a modular Flask-based architecture:
- Authentication Module: JWT tokens, password hashing, secure password reset
- User Module: Role-based access (Farmer, Owner, Operator)
- Equipment Module: CRUD operations, location tagging
- Booking Module: Create, approve, reject, track status
- Payment Module: Stripe integration for secure transactions

Database Design:

- Entities defined:
- User → user_id, name, email, password, role
- Equipment → equipment_id, owner_id, name, type, price, availability, location
- Booking → booking_id, user_id, equipment_id, date, status, payment_status
- Designed using Flask SQLAlchemy ORM for easy object-relational mapping.

User Interface (UI) Design:

- Simple pages for Index, Equipment, Operator, Booking Invoice
- Icons, cards, and forms designed for rural user clarity
- Kannada & English text integration for accessibility

Implementation of Modules:

Each module was implemented according to SDS.

Authentication Module

- User signup/login using JWT
- Password hashing using Passlib
- Email verification and secure token generation with ItsDangerous + Flask-Mail

Equipment Management Module

- Owner can add, edit, delete equipment
- Images and details stored in SQLite
- Location-based search using Leaflet

Booking System

- Farmer selects equipment, checks availability, books using form

- Owner receives approval/rejection options
- Payment gateway integrated with Stripe

Operator Module

- Optional operator hiring
- Operators listed with contact and availability

Invoice Generation

- Booking invoice automatically generated after payment
- Includes price, date, farmer details, and equipment details

Technology & Tools Setup:

- Based on the project document, the following tools were set up:
- Frontend: HTML5, CSS3, JavaScript (ES2024)
- Backend: Flask 3.1.2, Flask-SQLAlchemy, Flask-JWT-Extended, Passlib
- Geolocation: Leaflet 1.9.4
- Payment: Stripe (2025 version)
- Database: SQLite 3.50.4
- Development Tools: VS Code, Git & GitHub

Result and Conclusion:

- A functional web platform that enables farmers to easily rent agricultural machinery.
- Real-time equipment availability with secure booking and payment features.
- Multilingual, user-friendly interface (Kannada & English) suitable for rural users.
- Increased equipment utilisation and income opportunities for machine owners.
- Location-based equipment search with accurate distance calculation.
- Transparent, middleman-free system improving affordability and accessibility for farmers.

The cloud-powered agricultural equipment rental platform provides a practical, affordable, and scalable solution to one of the most persistent challenges in modern agriculture - the limited access to mechanization for small and marginal farmers. By enabling direct digital interaction between farmers and equipment owners, the platform eliminates intermediaries, promotes transparency, and ensures equitable access to machinery.

The integration of a multilingual interface, real-time booking, operator hiring, and secure payments enhances user confidence and ease of use. Technical design built on a scalable cloud infrastructure ensures the platform's reliability, adaptability, and continuous availability, even under variable rural connectivity conditions. Furthermore, advanced analytics enhance operational insights, security, and trust among stakeholders.

Beyond its immediate functional benefits, this platform contributes to a larger mission of supporting sustainable farming practices, reducing resource wastage, and empowering rural communities through digital inclusion. It stands as a model for how technology can democratize access to essential agricultural resources while fostering collaboration and economic growth within farming ecosystems.

References:

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Project Outcome & Industry Relevance:

Agriculture and Farming Industry

The MARF platform directly supports farmers, equipment owners, and agricultural service providers by improving access to machinery, reducing operational costs, and increasing productivity.

Agricultural Equipment Rental & Service Industry

The project aligns with existing machinery rental ecosystems and enhances them through digitalization.

Website: <https://www.jfarmservices.in>

Academic & Research Institutions

Institutions working on digital agriculture, rural technology adoption, and AI-based systems can benefit from this project.

Website: <https://www.uasbangalore.edu.in>

Future Scope:

The future scope of this project includes:

1. Future development of the platform will focus on enhancing intelligence, accessibility, and scalability. One of the primary advancements will be the integration of AI-powered demand prediction and dynamic pricing. Instead of relying only on current booking data, the system will learn seasonal patterns and locality-based needs using machine learning models.
2. Approaches such as LSTM for sequence forecasting, Random Forest for pattern learning, and ARIMA for time-series trends can help the platform predict which equipment will be in high demand before the season begins. By using these models together, the system can offer more accurate suggestions, reduce last-minute shortages, and help farmers plan their rentals with confidence.
3. In the future, the platform will also strengthen data privacy by protecting sensitive information such as user details and location data. This includes using stronger encryption, improving consent-based location sharing, and aligning with India's Data Protection Act (DPDP 2023) to ensure farmers' data remains secure and handled responsibly.