



KrushMitra: A Bilingual AI-Based Digital Support System for Farmers in Karnataka

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Abstract--Farmers often have to consult different sources for weather forecasts, crop problems, soil information, agricultural prices, government assistance, and day-to-day farm records. KrushMitra is designed as a single mobile platform that brings these activities together for farmers in Karnataka. The application combines a conversational agricultural assistant with image-based crop and soil analysis, weather information, market-related information, crop suggestions, government-scheme discovery, farm record management, and an equipment-rental facility. A digital Farm Passport is used to organize information about farms, plots, crops, irrigation, fertilizers, and farming operations.

The prototype is implemented as an Android application using Kotlin and Jetpack Compose. Room Database is used for local data handling, while Firebase services support authentication, cloud functions/data, and AI-related services. The application also incorporates location-based information and Kannada language support. The overall objective is to reduce the need to move between separate agricultural applications and to present useful farm information in a form that can be accessed through a mobile phone.

Keywords--smart farming, agricultural AI, Kannada, crop diagnosis, soil analysis, farm management, weather advisory, agricultural marketplace

1. INTRODUCTION

Agriculture is one of the most important sectors contributing to food security, employment, and economic development. Farmers increasingly require timely and reliable information to make decisions related to crop selection, soil management, irrigation, crop protection, weather conditions, and agricultural markets. However, access to such information is often fragmented across different sources and applications. Farmers may need to depend on separate services for weather updates, market prices, soil information, disease identification, government schemes, and farm record management. This fragmentation can make agricultural decision-making more difficult, particularly for farmers who have limited access to digital technologies and technical agricultural expertise. The rapid development of Artificial Intelligence (AI), mobile computing, cloud services, and digital agriculture provides opportunities to address these challenges. AI-based systems can assist in analyzing agricultural data, identifying crop diseases from images, providing recommendations, and delivering conversational assistance to users. Mobile applications further improve accessibility by bringing multiple agricultural services directly to farmers through smartphones. However, an effective agricultural platform should not focus on a single function alone; it should provide a combination of agricultural advisory, farm management, crop health monitoring, market information, and other essential services within an accessible environment. The proposed system combines AI-assisted agricultural services with digital farm management functionalities. It provides an AI-based agricultural assistant through which users can obtain agricultural guidance, while image-based modules support soil analysis and crop disease identification.

The platform also incorporates weather information, agricultural market and APMC-related information, crop recommendations, agricultural schemes, and crop-related guidance. In addition to advisory services, KrushiMitra AI provides structured digital management of farming activities. Farmers can maintain information about their farms, fields, crops, irrigation practices, sowing and harvesting activities, and other farming records. The Farm Passport component provides a digital representation of important farm information, including crop history, yield, expenses, revenue, soil information, and farming activities. The system also includes an agricultural equipment marketplace that enables farmers and equipment owners to participate in equipment rental and booking activities. The application is implemented using Kotlin and Jetpack Compose for the Android user interface, with Room Database for local data management and Firebase-based services for authentication, cloud functionality, and AI integration. AI-related functionality is supported through Firebase Vertex AI components. The application also incorporates location-based services for agricultural and weather-related information and provides multilingual support, including Kannada, to improve accessibility for regional users. The primary objective of KrushiMitra AI is to provide a unified digital platform that brings together agricultural advisory, crop health analysis, soil-related assistance, weather information, market intelligence, farm management, government scheme information, and agricultural equipment services. By integrating these functionalities within a single mobile application, the proposed system demonstrates an approach toward making agricultural information and digital tools more accessible and organized for farmers. The system is intended to support informed farm management and contribute to the broader adoption of technology-driven and data-assisted agricultural practices.

II. RELATED WORK

The application of artificial intelligence and digital technologies in agriculture has received considerable attention in recent years. Researchers have explored machine learning, deep learning, computer vision, Internet of Things (IoT), and mobile applications to assist farmers in crop monitoring, disease identification, soil assessment, weather prediction, and agricultural decision-making. These developments demonstrate the potential of technology to improve access to agricultural information and support data-driven farming practices. Several studies have investigated deep learning-based crop disease detection using leaf images. Convolutional Neural Networks (CNNs) have been widely applied to classify healthy and diseased plant leaves based on visual symptoms. Such approaches can assist farmers in identifying diseases at an early stage and obtaining appropriate management information. However, many existing disease-detection systems concentrate primarily on image classification and do not provide an integrated platform containing other agricultural services such as farm management, market information, weather advisories, and government schemes. Machine learning and image-processing techniques have been explored for identifying soil characteristics and recommending suitable crops based on soil and environmental conditions. These systems can support farmers in selecting appropriate crops and improving resource utilization. Nevertheless, soil-related applications are frequently developed as independent systems, requiring users to access separate platforms for other agricultural requirements. Weather-based agricultural advisory systems have also been developed to provide information regarding temperature, rainfall, humidity, and other environmental parameters. Weather information is particularly useful for decisions related to irrigation, sowing, harvesting, and crop protection. Similarly, agricultural market information systems provide farmers with information regarding crop prices and market conditions. Although these services can improve farmers' access to information, their functionality is often distributed across different applications and online platforms. Digital farm management systems have further contributed

III. PROPOSED METHODOLOGY

1. Background and Problem Statement

Agricultural decisions depend on several changing factors. A farmer may need to identify a disease from a leaf image, understand whether irrigation is required, check the expected weather, examine market information, or determine eligibility for a government scheme. When these services are distributed across different websites and applications, the farmer must repeatedly enter information and interpret results from unrelated systems.

KrushiMitra addresses this fragmentation by treating the farm as the central unit of information. Instead of considering weather, crops, field records, disease identification, and government support as unrelated services, the application places them within one mobile environment. Information entered about a farm or plot can therefore be used when presenting later recommendations.

The application is intended particularly for users who prefer Kannada. Its interface and agricultural assistance features are designed to reduce language-related barriers while retaining access to digital farming services. The system is not intended to replace agricultural experts; rather, it acts as a digital assistance layer that organizes information and provides preliminary guidance.

2. Existing Work and Motivation

Recent agricultural research has examined machine learning, computer vision, IoT, remote sensing, and mobile applications for individual agricultural tasks. Disease recognition systems can classify symptoms from plant images, while smart-farming research has explored AI-supported irrigation, crop monitoring, and farm decision systems. Other work has examined large-scale agricultural data, conversational systems, and digital tools for farmers. A common limitation of such solutions is specialization. A system may focus on disease recognition without maintaining farm records, or it may provide weather

information without connecting it to individual plots. KrushiMitra is motivated by the need for a broader application in which these services can coexist.

The proposed platform therefore combines several functions: an AI conversation interface, image analysis, weather information, agricultural-market information, crop recommendations, scheme discovery, equipment access, and structured farm records. This integrated approach is intended to provide a more continuous digital workflow for the farmer.

3. Proposed Application

KrushiMitra is organized around four major groups of functionality.

3.1 Intelligent Agricultural Assistance

The Krushi AI component accepts farmer questions and produces agricultural guidance. The conversation layer is intended for questions that may involve crops, farm activities, weather-related decisions, or general agricultural information. The response process can use available farm context so that guidance is not limited to a generic answer.

3.2 Image-Based Field Support

Farmers can provide images for analysis. The processing pipeline prepares the image, sends it through an AI model, interprets the classification or detected condition, and converts the result into understandable agricultural guidance.

The conceptual workflow is:

Image → preparation → AI examination → condition identification → interpretation → farmer guidance

The same design can be applied to different visual agricultural inputs, including plant symptoms and soil-related observations.

3.3 Farm Information Services

The application presents weather conditions, market information, crop suggestions, and government schemes. Location information can be used to provide geographically relevant content. Scheme search can consider farmer and land-related conditions so that users can locate potentially applicable programs.

3.4 Digital Farm Records

Farm information is stored in a structured manner. A farm can contain multiple plots, and each plot can maintain information such as crop, cultivated area, crop condition, irrigation requirements, fertilizer activities, and other farming operations. The Farm Passport provides a consolidated representation of these records.

4. Development Approach

The application follows a farmer-centered development model. The first stage is collection of information supplied by the farmer or obtained through connected services. The information is then processed according to its type. Text queries are passed to the conversational processing component. Images are prepared and analyzed by the image-processing component. Farm records are handled through the application data layer. External information such as weather, location, market data, and schemes can then be combined with stored farm details.

The general decision-support sequence is:

Farmer input → data processing → AI/information analysis → contextual interpretation → decision support → agricultural information

The design separates user-interface responsibilities from data and AI operations. This makes it possible to extend individual modules without redesigning the entire application.

5. Technical Architecture

The prototype is an Android application developed with Kotlin and Jetpack Compose. Compose provides the interface layer, while Room Database supports structured local storage. Firebase services are used for authentication and cloud-based application functions, including AI-related integration. Location services are used where geographic context is required.

The principal architecture layers are:

- Presentation layer – screens, navigation, forms, dashboards, and Kannada interface elements.
- Input layer – collection of text, images, farm details, and user selections.
- Processing layer – preparation and interpretation of user inputs.
- AI layer – conversational and image-oriented AI functions.

- Agricultural information layer – weather, market, scheme, and crop-related services.
- Farm data layer – farms, plots, crops, irrigation, fertilizers, and activities.
- Decision-support layer – combines relevant information and prepares recommendations.
- Cloud/external-service layer – authentication, cloud data, AI services, and connected information sources.

This layered structure is intended to support future expansion while keeping individual services logically separated.

6. Main User Features

6.1 Home Dashboard

The dashboard gives the farmer an overview of the application. It can display profile and location information, farm details, crop information, recommendations, equipment-related content, and weather information. Kannada interface support is included.

6.2 My Farm

The prototype demonstrates a farm of 5.0 acres divided into three plots:

Plot A1 – Paddy – 2.0 acres

Plot B1 – Ragi – 1.5 acres

Plot C1 – Sugarcane – 1.5 acres

6.3 Crop Information

For Plot A1, the prototype records Paddy (Gangavathi Sona) on 2.0 acres and displays a crop-health value of 94%. The application can associate crop information with recommendations and farm activities.

6.4 Recommendations

The demonstrated system provides examples such as an irrigation recommendation for Plot A1 and a fertilizer-related recommendation for Plot B1. These examples illustrate how the application can connect stored plot information with decision support.

6.5 Weather

Weather information is presented for Mandya, Karnataka, including temperature, apparent temperature, rainfall probability, wind, humidity, and hourly information. The purpose is to place weather data alongside farm information so that the farmer can consider environmental conditions during planning.

6.6 Government Schemes

The schemes section supports searching agricultural programs using conditions such as land area and farmer category. Both Karnataka-level and central-government schemes are represented in the application.

6.7 Equipment Access

The equipment section is intended to connect farmers with agricultural machinery available for rental. The prototype includes an example listing for a Mahindra 575 DI Bhoomiputra tractor.

6.8 Agricultural Market Information

Market-related information is included as a separate service so that farmers can access agricultural price information without leaving the application. The module is part of the broader objective of placing frequently required farming information in one location.

7. Farm Passport Concept

The Farm Passport is one of the central organizational features of KrushiMitra. Instead of keeping farm information only in isolated screens, the passport concept provides a structured record of the farmer's agricultural resources and activities.

A passport can represent:

- farm and plot details;
- cultivated crops and areas;
- irrigation information;

- fertilizer and other farm activities;
- crop-health observations;
- recommendations connected with individual plots.

This structure can reduce repeated entry of the same information and provide a foundation for future personalized services.

8. Information and AI Flow

Different input types follow different processing paths.

For an image:

Image capture → preprocessing → AI analysis → classification/interpretation → result → agricultural guidance

For a farmer question:

Question → query processing → AI model → response generation → contextual agricultural guidance

For farm decision support:

Farm data + external information → processing → analysis → contextual decision support → recommendation

The purpose of these flows is not simply to generate an AI response. The application attempts to connect the response with farm-related information that has already been recorded.

IV. Advantages of the Proposed System

KrushiMitra provides several functions through one mobile application rather than requiring farmers to use separate tools. The integrated design can simplify access to weather, schemes, market information, crop support, image analysis, and farm records.

The platform also offers the following practical benefits:

- support for Kannada-speaking users;
- centralized farm and plot information;
- less dependence on handwritten farm records;
- image-assisted identification of agricultural conditions;
- plot-specific recommendations;
- access to weather and market information;
- searchable government-scheme information;
- equipment-rental support;
- mobile access to agricultural assistance;
- modular design for adding future services.

The combination of stored farm information and AI services also creates a foundation for more personalized digital agriculture applications.

V. Prototype Results

The prototype demonstrates an integrated navigation structure containing Home, Market, Weather, Schemes, Equipment, and Krushi AI sections. Kannada content is incorporated into the user interface. The farm-management demonstration records 5.0 acres in three plots, with paddy, ragi, and sugarcane as the example crops. The paddy plot is associated with the Gangavathi Sona variety and a displayed crop-health value of 94%. Sample recommendations are connected to individual plots.

The weather screen demonstrates location-based information for Mandya. The schemes module provides search-oriented access based on farmer and land conditions. The equipment module demonstrates machinery access through a tractor listing. Together, these screens show how multiple agricultural functions can be represented within a single application.

VI. Discussion

The prototype indicates that a mobile agricultural platform can combine several forms of assistance within one workflow. The most important design idea is the connection between farm records and other services. A weather value, crop record, recommendation, or scheme search becomes more useful when it can be considered in relation to the farmer's stored

information. The Kannada interface is another important part of the system because technical agricultural services are only useful when users can understand and interact with them. The application therefore treats regional-language support as part of the user experience rather than as an optional translation layer.

The current prototype demonstrates functionality and integration, but the available results do not establish numerical performance for every AI component. Measures such as disease-classification accuracy, quality of soil analysis, recommendation usefulness, response latency, usability, and long-term field impact require controlled evaluation. Expert assessment and trials with farmers would be necessary before making claims about real-world effectiveness.

VII. Future Development

Future versions can extend the current platform through larger agricultural datasets, improved image models, additional regional languages, richer location-aware services, and stronger connections between farm history and recommendations.

Potential evaluation work should include:

- testing image-analysis accuracy with field photographs;
- measuring the relevance of AI-generated agricultural responses;
- evaluating recommendation quality with agricultural experts;
- conducting usability studies with farmers;
- measuring response time under practical network conditions;
- studying the usefulness of the Farm Passport during repeated farming activities;
- conducting field trials across different crops and locations.

These activities would provide evidence for the practical performance of the proposed system.

VIII. Conclusion

KrushMitra presents a mobile approach for bringing several agricultural support functions into one bilingual application. The prototype combines conversational AI, image-based agricultural analysis, weather information, market access, government schemes, crop recommendations, equipment rental, and digital farm records.

Its Farm Passport model gives the system a structured way to retain farm and plot information, while the Kannada interface is intended to improve accessibility for regional users. The current prototype demonstrates the feasibility of integrating these components in an Android environment using Kotlin, Jetpack Compose, Room, Firebase, AI services, and location-aware features. Further field testing and quantitative evaluation are required to establish the accuracy, usability, and practical impact of the system.

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