

AI-Based Farmer Query Support and Advisory System

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Abstract - Agricultural productivity largely depends on timely access to accurate and region-specific information; however, farmers often face difficulties in obtaining expert guidance when it is most needed. This paper presents a full-stack AI-based farmer query support and advisory system designed to provide accessible, real-time assistance through a user-friendly digital platform. The system introduces a dual-login mechanism, allowing farmers to access services through a voice-enabled interface, while agricultural students and experts register with their regional details and domain expertise to offer localized and specialized support. Once authenticated, farmers can explore multiple features, including real-time market price analysis, an educational platform with curated video resources, and information on government schemes. A key component of the system is the voice query assistant, which enables farmers to raise queries using natural speech. These queries are initially routed to agricultural students based on region and domain expertise identified through keyword analysis. After receiving a response, farmers can provide feedback indicating their satisfaction level. If the response is deemed unsatisfactory, the query is automatically escalated to domain experts and AI-based chatbot services to ensure accurate and reliable guidance. The chatbot provides instant responses for common queries, while experts handle complex or domain-specific issues. The interaction between farmers, students, and experts is facilitated through a simple and intuitive chat interface. By integrating voice technology, Artificial Intelligence, and human expertise, the proposed system enhances accessibility, ensures multi-level query resolution, and reduces dependency on traditional advisory methods. The solution aims to improve agricultural efficiency, promote digital inclusion, and strengthen the connection between farmers and knowledge resources.

Keywords - Artificial Intelligence, Smart Agriculture, Farmer Advisory System, Voice-Based Interface, Chatbot, Full Stack Application, Region-Based Recommendation, Agricultural Support System, Market Price Analysis, Digital Farming, Expert System, Natural Language Processing, Multi-Level Query Routing, Feedback-Based Escalation

I. INTRODUCTION

Agriculture continues to play a vital role in sustaining livelihoods, particularly in regions where farmers depend heavily on timely guidance for decision-making. However, access to reliable and location-specific agricultural information remains a major challenge due to the limited availability of experts and delays in traditional advisory methods. In many cases, farmers are unable to receive immediate assistance during critical stages such as

crop disease occurrence, irrigation planning, or market selling decisions. To address these issues, a digital solution that combines accessibility, real-time communication, and intelligent support becomes essential.

The proposed system introduces a full-stack, AI-driven farmer advisory platform that simplifies the interaction between farmers, agricultural students, and domain experts. The application is designed with multiple user roles, including farmers, agricultural students, and experts. Farmers can access the system through a voice-based login mechanism, making it highly usable even for individuals with minimal technical knowledge. After authentication, users select their geographical region, such as North Karnataka or South Karnataka, followed by their specific district. This region-based classification ensures that the guidance provided is relevant to local farming conditions, including soil type, climate, and crop patterns.

Agricultural students register into the system by providing their credentials along with regional details and domain expertise (such as crops, fertilizers, or pesticides). This enables the platform to initially map farmers' queries to the most appropriate student based on both location and subject expertise. Domain experts are also registered in the system to handle advanced or escalated queries requiring deeper knowledge.

The application dashboard offers multiple functionalities, including real-time market price analysis, an educational platform with curated video content, information on government schemes, and a voice-enabled query assistant. The query assistant acts as the core component of the system, allowing farmers to raise questions using voice input. These queries are first routed to agricultural students based on region and keyword-based domain identification. After receiving a response, farmers can provide feedback indicating whether they are satisfied with the answer.

If the response is not satisfactory, the system automatically escalates the query to domain experts and AI-based chatbot services. The chatbot provides instant responses for frequently asked questions, while experts handle more complex and domain-specific issues. This multi-level query resolution mechanism ensures improved accuracy, faster response time, and continuous support.

Additionally, the system incorporates a chat interface similar to widely used messaging platforms, ensuring familiarity and ease of communication. By integrating voice technology, Artificial Intelligence-based query handling, and human expertise within a single platform, the system enhances accessibility, reduces response time, and improves the overall efficiency of agricultural advisory services.

This approach not only supports better decision-making for farmers but also promotes digital inclusion and knowledge sharing within the agricultural ecosystem, as highlighted in recent studies on AI-driven agricultural systems [1], [4].

A. OBJECTIVES

The primary objective of the proposed AI-based farmer query support and advisory system is to create an efficient and accessible platform that enables farmers to obtain timely, accurate, and region-specific agricultural guidance. The system is designed to bridge the communication gap between farmers, agricultural students, and domain experts by providing a structured mechanism through which farmers can easily raise their queries and receive appropriate responses. By incorporating a voice-based interface, the platform ensures that even users with limited technical knowledge can interact with the system comfortably, thereby improving usability and inclusiveness.

Another important objective of the system is to facilitate real-time and structured interaction between farmers and agricultural students based on their geographical location and domain expertise. The system initially routes farmer queries to agricultural students by analyzing keywords in the query to identify the relevant domain (such as crops, pesticides, or irrigation). This domain- and region-based mapping ensures that queries are handled by individuals with appropriate knowledge of local farming conditions, thereby improving the relevance and quality of the responses.

An additional objective is to incorporate a feedback-driven escalation mechanism. After receiving a response from the agricultural student, farmers can indicate whether they are satisfied with the solution. If the response is not satisfactory, the system automatically escalates the query to domain experts and AI-based services for further assistance. This

multi-level query resolution approach ensures higher accuracy, reliability, and continuous support for farmers.

In addition to human-assisted support, the system aims to provide uninterrupted advisory services through the integration of an AI-powered chatbot. This component is responsible for handling frequently asked questions and providing instant responses when required. The objective is to ensure that farmers are not left without guidance at any time, thereby improving the responsiveness and availability of the platform. The chatbot also helps in maintaining consistency in responses for common agricultural issues.

The system also focuses on delivering additional value-added services such as real-time market price analysis, access to educational video content, and information about government schemes. These features are intended to improve farmers' awareness, support informed economic decision-making, and encourage the adoption of modern agricultural practices. Overall, the objective of the system is not only to provide advisory support but also to promote digital inclusion, enhance productivity, and contribute to the development of a more connected and informed agricultural ecosystem.

II. LITERATURE REVIEW

The advancement of digital technologies has significantly influenced the agricultural sector, leading to the development of various advisory systems aimed at assisting farmers in decision-making. Over time, multiple approaches such as government helplines, mobile-based agricultural applications, and ICT-enabled extension services have been introduced to provide farming-related information. These systems have contributed to improving awareness among farmers; however, they often rely on manual communication methods, which can result in delays and limited accessibility, especially in rural and remote areas [6], [7].

Several existing solutions focus on delivering generalized recommendations related to crop management, irrigation practices, and pest control. While these platforms provide useful insights, they frequently lack region-specific customization, which is essential in agriculture due to variations in soil conditions, climate, and crop patterns. Moreover, many systems do not support real-time interaction between farmers and experts, making it difficult for farmers to receive immediate assistance during urgent situations. The absence of continuous support further limits their effectiveness, particularly when expert availability is restricted.

Recent research has explored the use of Artificial Intelligence and machine learning in agriculture, including applications such as crop prediction, disease detection, and smart irrigation systems [1], [4]. However, these systems are often limited by predefined datasets and may not fully address complex or context-specific queries. Additionally, many digital platforms are not designed with simplicity in mind, making them less suitable for users with limited technical literacy. AI-powered chatbots have also been introduced to automate responses to frequently asked questions [9], but they may lack the contextual

understanding required for domain-specific agricultural problems.

The proposed system addresses these gaps by introducing a multi-level hybrid advisory approach. In contrast to existing systems, farmer queries are first routed to agricultural students based on region and domain expertise identified through keyword analysis. A feedback mechanism is incorporated to evaluate the quality of responses provided. If the farmer is not satisfied, the query is escalated to domain experts and AI-based chatbot services to ensure accurate and reliable guidance. This structured escalation process improves response quality, ensures continuous support, and reduces dependency on a single source of information.

By combining human expertise, feedback-driven query refinement, and AI-based assistance, the proposed system enhances accessibility, enables real-time and domain-specific interaction, and improves the overall effectiveness of agricultural advisory services.

III. PROPOSED SYSTEM

The proposed system is a full-stack AI-based agricultural advisory platform designed to connect farmers with region-specific agricultural students and domain experts while ensuring continuous support through an AI chatbot. The system consists of three primary user roles: farmers, agricultural students, and experts.

Farmers access the system using a voice-based login mechanism, where they provide basic details such as name and location. After authentication, the system categorizes users based on region (North Karnataka or South Karnataka) and district. This classification is used to map farmer queries to relevant users based on both location and domain requirements.

Agricultural students register using their credentials along with regional information and domain expertise (such as crops, fertilizers, or pesticides). Similarly, experts are registered with advanced domain specialization. The backend stores this information and retrieves suitable students or experts based on farmer location and the nature of the query. The system dashboard provides key features such as real-time market price analysis, educational resources through video content, government scheme information, and a voice query assistant. The voice query assistant allows farmers to raise queries using natural speech, which are then processed using keyword analysis to identify the relevant domain.

In the proposed workflow, farmer queries are initially routed to agricultural students based on region and domain expertise. Once a response is provided, the farmer is given the option to provide feedback indicating whether the answer is satisfactory. If the response is not satisfactory, the system automatically escalates the query to domain experts and AI-based chatbot services for further assistance. The chatbot provides immediate responses for frequently asked queries, while experts handle more complex and domain-specific problems.

The interaction between farmers, students, and experts is facilitated through a chat interface similar to common messaging applications, ensuring ease of use and familiarity.

The system utilizes a cloud-based database to store user data, queries, feedback, and responses, ensuring scalability, real-time synchronization, and efficient performance [2], [3].

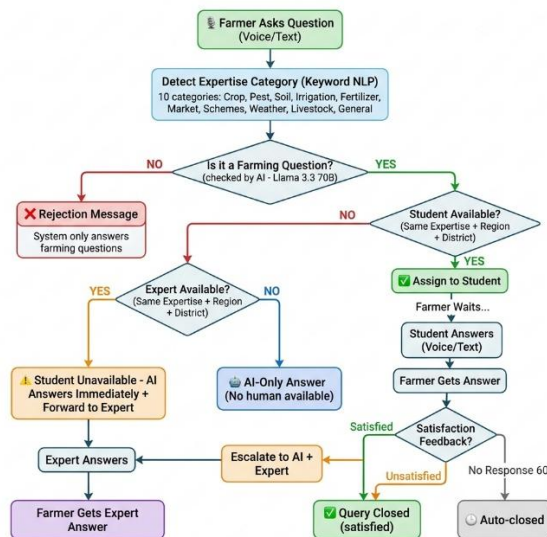


Fig 1. Farm Query Advisory System – Complete Query Routing Flow - This diagram shows the **smart query flow** where a farmer's question is first analysed using NLP to detect the domain (crop, pest, etc.). The query is then routed to an available agricultural student; based on farmer feedback, it may be escalated to an expert or handled by an AI chatbot. This ensures **multi-level, accurate, and real-time advisory support**.

IV. METHODOLOGY

The proposed system follows a structured and modular methodology to ensure efficient interaction between farmers and agricultural support resources. The development approach is based on a full-stack architecture that integrates frontend, backend, database, and AI components to deliver real-time advisory services. The system begins with user authentication, where multiple login mechanisms are implemented. Agricultural students and experts register using standard credentials along with their regional information and domain expertise, while farmers access the system through a voice-based login process by providing basic details such as name and location. This design ensures accessibility for farmers and structured data management for support users.

Once authenticated, the system processes the user's regional input, which includes classification into broader zones such as North Karnataka or South Karnataka, followed by specific district selection. This region-based mapping is further enhanced by domain-based classification, where queries are analysed to identify their subject area (such as crops, pesticides, or irrigation). The backend system stores and manages both regional and domain information using a cloud database, enabling efficient retrieval and intelligent routing of queries to the most appropriate agricultural student or expert. This ensures that the advisory

provided is context-aware and relevant to local agricultural conditions.

The core functionality of the system lies in its query handling and routing mechanism. Farmers can raise queries using a voice-enabled assistant available on the dashboard. The voice input is converted into text using speech processing techniques and then analysed to extract keywords and determine the relevant domain. Based on this analysis, the query is initially routed to an available agricultural student matching the region and domain expertise. The interaction between the farmer and the student is facilitated through a chat interface designed similar to common messaging applications, ensuring ease of communication and familiarity.

A feedback mechanism is incorporated after the student provides a response. Farmers can indicate whether they are satisfied with the solution. If the response is satisfactory, the query is marked as resolved. If not, the system automatically escalates the query to domain experts for further analysis and resolution. This feedback-driven escalation ensures improved accuracy and multi-level support.

In addition to expert escalation, the system integrates an AI-powered chatbot to provide immediate responses for frequently asked or general queries. The chatbot processes queries using Natural Language Processing techniques [9] and matches them with predefined knowledge sources to generate appropriate responses. The chatbot can function both as a fallback when no student is available and as a supplementary support mechanism during escalation.

Alongside the query system, the platform also provides additional functionalities through the dashboard, including real-time market price analysis, educational video resources, and information on government schemes, which are dynamically retrieved and presented to the user.

Overall, the methodology adopts a hybrid and multi-level approach that combines human expertise, feedback-based refinement, and artificial intelligence to provide continuous, reliable, and region-specific agricultural advisory services.

TABLE 1
SYSTEM MODULE DESCRIPTION

Module Name	Input	Process	Output	Technologies Used	Description
Farmer Login	Name, Location (voice/text)	Authentication & region mapping	Logged-in farmer	React, Firebase	Simple login for farmers using voice
Student Login	Name, Region, Expertise	Store & validate data	Student profile	FastAPI, Firebase	Registers agricultural students
Expert Login	Name, Domain Expertise	Store expert data	Expert profile	FastAPI, Firebase	Registers domain experts
Voice Query Assistant	Voice input	Speech-to-text + NLP	Query text	NLP, Speech API	Converts voice into text query
Query Routing	Query text	Keyword analysis & mapping	Assigned student/expert	FastAPI	Routes query based on region & domain
Feedback Module	User feedback	Satisfaction check	Escalation decision	Backend logic	Triggers escalation if needed
Chatbot Module	Query text	AI processing	Instant answer	AI / NLP	Provides quick responses
Dashboard	User actions	Data fetch & display	UI output	React	Shows features & results

V. RESULTS AND DISCUSSION

The developed system was tested to evaluate its performance, usability, and response efficiency. The voice-based login system successfully allowed farmers to access the platform with minimal effort, making it suitable for users with limited technical knowledge. The region- and domain-based mapping ensured that queries were directed to appropriate agricultural students initially, resulting in relevant and context-specific responses. The introduction of a feedback mechanism significantly improved the quality of advisory services. Farmers were able to indicate whether the responses provided by agricultural students were satisfactory. In cases where the responses were not satisfactory, the system successfully escalated queries to domain experts and AI-based services. This multi-level query resolution approach enhanced accuracy and ensured that farmers received reliable guidance even for complex problems. The AI chatbot demonstrated the ability to provide instant replies to frequently asked questions, reducing waiting time when human support was unavailable or during escalation. The integration of a chat-based interface improved communication clarity and user experience by providing a familiar interaction environment. Additionally, features such as market price analysis and educational resources enhanced the overall usefulness and practicality of the system. Overall, the system showed improved efficiency in delivering agricultural advisory services, with faster response times, better accessibility, and higher reliability compared to traditional methods. The combination of Artificial Intelligence and human expertise, along with feedback-driven refinement, contributed to a scalable and effective solution for modern agricultural challenges [1].

VI. RESEARCH LIMITATIONS

Despite the effectiveness and practical applicability of the proposed AI-based farmer query support and advisory system, certain limitations exist that may impact its overall performance and scalability. One of the primary limitations is the dependency on internet connectivity, as the system relies on cloud-based services for data retrieval, query routing, expert communication, and chatbot functionality. In rural areas where network availability is inconsistent or weak, farmers may experience delays or interruptions while accessing the platform, which can reduce the efficiency of real-time advisory support. Another limitation is the availability of agricultural students and domain experts within specific regions. Since the system routes queries based on both location and domain expertise, the quality and timeliness of responses depend on the presence and responsiveness of registered users in that area. Although the system incorporates a feedback-driven escalation mechanism, delays may still occur if both students and experts are unavailable or inactive. In such cases, the system relies on the AI chatbot, which may not always handle complex or highly specific agricultural queries effectively. The accuracy of the system is also influenced by user input, particularly during the login and query submission process. Incorrect or unclear voice input

from farmers may lead to improper region mapping, incorrect domain identification, or misinterpretation of queries, affecting the relevance of the responses provided. Additionally, variations in local languages, accents, and speech patterns can pose challenges for the voice recognition component, potentially reducing system reliability for diverse user groups. Furthermore, the current implementation is limited in terms of advanced features such as real-time weather integration, crop disease detection using images, and predictive analytics for yield optimization. While the system provides essential advisory support through a multi-level query resolution approach, it does not yet incorporate these advanced capabilities, which could further enhance decision-making for farmers. The geographical scope is also restricted to specific regions, such as North and South Karnataka, limiting its applicability on a larger scale. Overall, while the system successfully addresses several challenges in agricultural advisory services, these limitations highlight areas for improvement and future enhancement. Addressing these constraints can further strengthen the system's effectiveness, scalability, and adaptability in diverse agricultural environments.

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