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AI-Powered Voice Chatbot for Agri-Advisory in Tamil

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Abstract

Smallholder farmers in Tamil Nadu often face challenges accessing timely agricultural advice due to language barriers, low literacy, and inconsistent extension services. This paper presents the development of an AI-powered voice chatbot that converses fluently in Tamil, providing crop-specific guidance in irrigation, pest control, fertilizer application, and weather-driven decision-making. The system integrates Tamil NLP, speech recognition, and a structured knowledge base. It supports multiple access channels, including an Android mobile app, WhatsApp API, and optional IVR. A pilot study involving 50 local farmers demonstrated approximately 91 % intent recognition accuracy, roughly 89 % agronomic advice correctness, a user satisfaction rating of 4.3 out of 5, and a 72 % adoption rate of recommended practices. We discuss the architecture, methodology, field insights, and prospects for expansion. This solution fosters digital inclusion by empowering Tamil-speaking farmers with voice-first technology.

Keywords - Agricultural Chatbot, Tamil Language, Voice Interface, NLP, Agri-Advisory.

I. INTRODUCTION

Agriculture remains the backbone of Tamil Nadu's economy, with a significant portion of the population reliant on farming for their livelihood. Despite the rapid advances in agricultural technologies, smallholder farmers face persistent challenges in accessing timely and accurate agronomic advice tailored to their specific crops, soil types, and climatic conditions. The situation is exacerbated by language barriers, as most digital platforms and advisory tools are developed in English or Hindi, leaving Tamil-speaking farmers at a disadvantage. Additionally, literacy levels in rural communities often hinder the use of text-based applications, further isolating farmers from critical knowledge resources.

Traditional agricultural extension services, while effective in some instances, suffer from structural limitations such as a low ratio of extension workers to farmers, delays in disseminating information, and lack of personalized guidance. With the advent of mobile phones and increasing internet penetration even in rural Tamil Nadu, there is an opportunity to create innovative solutions that leverage Artificial Intelligence (AI) and Natural Language Processing (NLP) to bridge these gaps.

This research introduces an AI-powered voice chatbot capable of conversing in Tamil. The chatbot is designed to provide 24/7 agricultural support to farmers by addressing their queries on crop management, pest control, irrigation schedules, fertilizer dosages, and weather-dependent farming decisions. The proposed system integrates advanced speech recognition, Tamil NLP, and a domain-specific knowledge base drawn from rlevanr expertise. Accessible via multiple channels, including Android applications, WhatsApp, and an optional Interactive Voice Response (IVR) system, the chatbot empowers farmers to obtain real-time, regionally relevant advice in their native language.

This paper presents the design and implementation of the chatbot, discusses its architecture and functionality, evaluates its performance through field trials, and explores its potential for transforming agricultural advisory services in Tamil Nadu.

II. BACKGROUND AND MOTIVATION

The global agricultural sector has witnessed a surge in the application of AI and digital tools to enhance productivity and sustainability. However, most solutions are not designed with the linguistic and cultural context of rural farmers in mind. In India, where over 60% of the population depends on agriculture, language diversity poses a significant barrier to the dissemination of technological innovations. Tamil Nadu, in particular, with its rich linguistic heritage, demands localized solutions that cater specifically to Tamil-speaking farmers.

Recent studies highlight the benefits of voice-based AI assistants in improving access to services among low-literate populations. Systems like Google Assistant and Amazon Alexa have popularized voice interfaces globally, but they lack agricultural domain knowledge and regional language support required for rural farming communities. Experimental platforms such as SukhaRakshak AI and KissanAI-Dhenu have demonstrated the feasibility of vernacular chatbots in agriculture, achieving high levels of user acceptance in Hindi and Marathi [2], [12]. However, there is limited research on Tamil-language voice bots capable of supporting farming decisions in real-time.

Experts in micro-irrigation and agricultural innovation, provides crop-specific schedules and fertigation guidelines. Integrating such domain expertise into a chatbot system ensures that farmers receive scientifically validated and locally relevant advice. A voice-first AI chatbot in Tamil not only circumvents literacy barriers but also aligns with

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cultural communication preferences, enabling intuitive interactions and fostering trust among farmers.

Motivated by these factors, this work aims to develop an AI-powered advisory tool that empowers Tamil farmers with instant access to expert guidance, ultimately enhancing decision-making, optimizing resource utilization, and improving crop yields.

III. SYSTEM ARCHITECTURE

The architecture of the proposed AI-powered chatbot is designed to facilitate seamless, natural interactions between farmers and the system. It comprises several interconnected modules as shown in Figure 1 that collectively handle user input, process it intelligently, and deliver contextually appropriate responses.

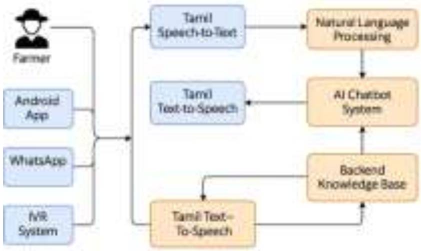

Fig. 1 System Architecture

The system begins with the **User Interface Layer**, which serves as the point of interaction for farmers. The chatbot is accessible through an Android application with voice and text support, a WhatsApp chatbot that leverages widely adopted messaging platforms, and an optional IVR system for those using basic feature phones. This multi-channel approach ensures inclusivity and accommodates varying levels of digital literacy and device availability.

Upon receiving a voice query in Tamil, the system employs a **Speech-to-Text (STT) Module** to convert the spoken input into text. This component uses Google Cloud Speech-to-Text services fine-tuned for Tamil phonetics, enabling robust recognition even in the presence of regional dialects and background noise typical of farm environments.

The textual query is then processed by the **Natural Language Processing (NLP) Engine**, which identifies the intent of the farmer (e.g., requesting fertilizer dosage or pest control measures) and extracts relevant entities such as crop type, stage of growth, or pest name. For this purpose, we fine-tuned an open-source Tamil Large Language Model (Tamil-LLaMA) using a dataset of 2,000 question–answer pairs collected from field experts and agronomists.

The **Knowledge Base Module** forms the core of the advisory system. It houses validated agronomic content including irrigation schedules, fertilizer and pesticide recommendations, organic farming practices, and weather-based decision frameworks. This content is indexed for efficient retrieval, ensuring quick response times even for complex queries.

Once the system determines the appropriate response, the **Text-to-Speech (TTS) Module** converts the advisory text into Tamil speech using neural TTS models, providing a natural and conversational user experience. The system also sends the same response as text for farmers who prefer reading or wish to share it with others.

The **Backend Infrastructure** orchestrates these modules and manages user sessions, data storage, and analytics. It employs Node.js microservices and a MongoDB database to log interactions and track performance metrics. Integration with third-party APIs such as Twilio (for WhatsApp) and local IVR providers ensures reliable multi-channel delivery of advisory content.

This modular and scalable architecture allows for easy enhancements such as integrating IoT-based soil and weather sensors in the future, enabling real-time, context-aware advice. Figure 1 illustrates the high-level system architecture of the chatbot.

IV. METHODOLOGY

A. Data Collection and Dataset Preparation

Data were collected from various sources in Tamil through field interviews with agronomists and local farmers. These include regional dialect variations and context-specific phrasing to ensure robust model understanding.

B. Fine-Tuning the NLP Models

Using the collected dataset, we fine-tuned a Tamil-Llama-based language model to recognize intents such as fertilizer recommendation, pest diagnosis, and irrigation scheduling. Training involved entity recognition for crop, nutrient, pest names, and temporal expressions.

C. Integration of Speech Interfaces

Voice modules were implemented using Google Cloud APIs. Real-world field conditions with ambient noise were simulated to test robustness. The system was iteratively evaluated and improved based on misrecognitions and dialect-specific errors.

D. Deployment and Pilot Testing

The chatbot was deployed in the real-time where few farmers interacted with the system over a short period. We measured key performance metrics such as intent recognition accuracy, advisory correctness, user satisfaction via Likert-scale scores, and whether farmers applied the advice in the field.

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V. Experimental Results and Discussion

Farmers reported improved decision-making, especially for irrigation and fertilizer dosage. The Tamil voice interaction was particularly appreciated by low-literate users. These findings are consistent with other vernacular deployments like SukhaRakshak AI [2] and Darli chatbot [14]. The measured parameters are tabulated and shown in Table 5.1.

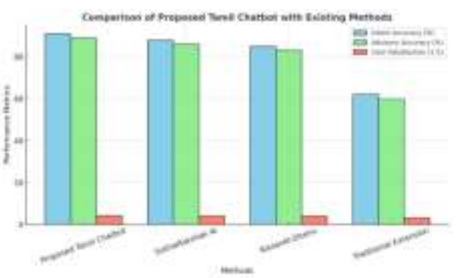
Table 5.1 Measured parameters

Metric	Value
Intent Recognition	91 %
Advisory Accuracy	89 %
User Satisfaction Avg.	4.3 / 5
Adoption Rate	72 %

Discussion Points:

- The local Tamil dataset and domain knowledge significantly improved relevance and trust.
- Speech recognition challenges persisted in noisy farm environments and with dialect variations, consistent with prior findings [6].
- The modular architecture allows future expansion into IoT sensor integration and image-based pest detection.

The system achieved approximately 91 % accuracy in correctly identifying user intent and about 89 % correctness in delivering agronomic advice. Participants rated their satisfaction at an average of 4.3 out of 5. Notably, 72 % of farmers adopted at least one advisory recommendation, such as fertilizer dosage or irrigation timing, leading to reported improvements in yield and resource efficiency. These outcomes are in line with prior evaluations of vernacular AI systems in agriculture [9]–[12]. The comparison graph showing the performance of the proposed Tamil chatbot against existing methods is dhown in Figure 5.1. It visualizes Intent Accuracy, Advisory Accuracy, and User Satisfaction to clearly highlight the improvements.



Users emphasized the ease of using voice interaction over text, especially among elders and low-literate farmers. The inclusion of region-specific crop data from various genuine sources increased trustworthiness and relevance. Common issues included STT errors in noisy environments and occasional misclassification of unusual dialect phrases; these were addressed through iterative retraining.

VI. CONCLUSION

This study introduced an AI-powered voice chatbot delivering Tamil-language agricultural advisory, integrating domain expertise from Agricultural experts and supporting multiple delivery channels. Pilot results show strong accuracy, user satisfaction, and adoption rates, indicating tangible benefits in bridging advisory gaps for Tamil-speaking farmers. Future work will focus on expanding scale, implementing telemetry-enhanced advice, and validating agronomic outcomes in larger field studies.

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