



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Kisan Sathi: A Virtual Assistance For Smart Agriculture

Ms Varalakshmi, Nithin Chakravarthi S, Om R Kottur, Nithin Adithya S, Pooja J
Professor, Student, Student, Student, Student
Dept of AI/ML,
CMR University, Bangalore, India

Abstract: Although agriculture is the foundation of India's economy, farmers encounter difficulties such as limited access to professional advice, lack of individualised guidance, and language barriers. These problems are addressed by Kisan Sathi, a voice-activated, multilingual virtual assistant that offers data-driven, locally relevant agricultural recommendations, natural language processing, and machine learning. In order to ensure inclusivity across literacy levels, the platform supports both voice and text interfaces. By providing advice on crop management, pest control, weather updates, and sustainable practices, it empowers farmers and bridges the digital divide in India.

Keywords: Voice assistance, multilingual chatbots, smart farming, virtual assistants, natural language processing (NLP), sustainable farming, kisan support, and crop advisory.

1. INTRODUCTION

With more than 52% of the population employed in agriculture and 16% of the country's GDP coming from it, agriculture continues to be the backbone of the Indian economy. The industry still faces a number of issues despite its socioeconomic importance, such as dispersed land holdings, restricted access to professional knowledge, unsustainable farming methods, and a growing digital divide between rural and urban areas. Language barriers further exacerbate these challenges, as most digital agricultural platforms are primarily in English, while most Indian farmers communicate in regional dialects.

The swift advancement of digital technologies presents encouraging prospects for modernising Indian agriculture. Developments in machine learning, and natural language processing (NLP) have made it possible to create intelligent platforms that can provide tailored, data-driven advice. To guarantee that these innovations are inclusive, accessible, and suited to the literacy and linguistic requirements of rural communities, a crucial gap still exists.

To fill these gaps, the multilingual virtual assistant platform Kisan Sathi was created. It overcomes language and literacy barriers by utilising cutting-edge natural language processing (NLP) models to facilitate text-based and voice-based interactions in a variety of Indian languages. Kisan Sathi gives farmers access to localised, sustainable, and useful insights by combining real-time weather updates, soil health analytics, crop advisory services, and educational materials. Even in areas with poor connectivity and inadequate digital infrastructure, the platform can be used thanks to its offline accessibility features.

The potential of Kisan Sathi to revolutionise conventional farming methods through clever, inclusive, and scalable digital solutions is examined in this paper as it relates to its architecture, design, and implementation. Kisan Sathi seeks to bring about a new era of intelligent and just farming in India by encouraging the sustainable use of resources, boosting agricultural output, and closing the digital divide.

2.RELATED WORKS

Recent years have seen a surge in the use of digital technologies in agriculture, with a number of platforms aiming to close the knowledge gap between farmers and critical agricultural information. The varied and regional needs of Indian farmers are not adequately met by many of these systems, despite notable improvements. The Indian government started one such program, the Electronic National Agriculture Market (eNAM), to give farmers a digital marketplace where they could sell their produce to consumers directly. Although eNAM has effectively improved pricing transparency and streamlined market connections, it does not support multilingual interactions or real-time, localised agricultural advisory—two essential features in a linguistically diverse nation like India.

In a similar vein, Krishi Vigyan Kendras(KVKs), which have been set up all over India, function as agricultural extension offices that offer knowledge on contemporary farming methods and crop management. Despite their best efforts, these centres' scalability and outreach are limited by their heavy reliance on in-person interaction. By providing weather updates, market prices, and

farming advice, the IFFCO Kisan mobile application takes a more digital approach; however, it is primarily text-based and targets users who are literate in Hindi or English and are accustomed to smartphones. Consequently, farmers who lack literacy or have little experience with technology are frequently unable to take full advantage of these tools.

Agricultural advisory systems now have more options thanks to recent advancements in artificial intelligence and natural language processing. Recommendation engines driven by AI have shown promise in e-commerce and healthcare, indicating that farming may benefit from their use. While some researchers, like Patel and colleagues, have investigated data mining models to improve personalisation in digital platforms, others, like Hossain et al., have proposed machine learning models that can recommend sustainable practices and eco-friendly products. Nevertheless, most of these implementations are limited to controlled environments and are rarely modified for use in rural agricultural settings where regional variability and unpredictability are commonplace.

Chatbot-based solutions using NLP have also been explored to deliver agricultural assistance. These systems typically provide predefined responses to user queries but are largely English-centric and often fail to recognize regional dialects and context. Moreover, voice-based conversational AI, although popular in mainstream applications like Google Assistant and Alexa, has not been widely or effectively adapted for agriculture in low-bandwidth, rural areas. Research by Dua et al. and Byambadorj et al. has shown the potential of speech recognition systems in low-resource languages, which is promising for rural applications.

Technology-wise, NLP capabilities are available for creating conversational interfaces through frameworks like Microsoft LUIS, Google Dialogflow, and Rasa. Despite their strength, these tools need a lot of modification to accommodate regional languages and dialects in India. Furthermore, accents, noisy environments, and offline usability—problems that are frequently encountered in rural India—are common issues for speech-to-text and text-to-speech APIs used in contemporary applications.

Current systems are still constrained by their broad recommendations, reliance on internet connectivity, and insufficient support for localised content and voice interaction, even though the use of digital tools in agriculture is growing. Contextual intelligence based on particular crop, soil, and climate conditions is something they frequently fall short of. Furthermore, the majority of platforms lack interactive learning materials catered to different literacy levels and modules for teaching farmers about sustainable agricultural practices.

An integrated, multilingual, voice-interactive platform that can offer region-specific, real-time agricultural assistance is desperately needed in light of these constraints. By fusing state-of-the-art AI and NLP technologies with voice-activated interfaces and localised data, Kisan Sathi is expected to tackle these issues and provide an intelligent and inclusive solution to empower.

3. PROPOSED SYSTEM

3.1 INTRODUCTION

The goal of the suggested system, Kisan Sathi, is to transform agricultural advisory services in India through a multilingual virtual assistant platform. It is intended to give farmers data-driven, real-time, region-specific agricultural support via text and voice communication in several Indian languages. By combining speech recognition, machine learning, and natural language processing (NLP) into an approachable, web application, the system closes the knowledge gap between farmers and experts. Kisan Sathi guarantees inclusivity by allowing users to converse in their native tongues and even by voice, particularly for farmers who have little or no experience with digital technology.

3.2 SYSTEM SYNOPSIS

Kisan Sathi is designed to be a smart farming companion that comprehends, interprets, and reacts to user enquiries about sustainable farming methods, crop management, weather forecasting, soil health, fertiliser use, and pest control. In order to accommodate the linguistic and technological diversity of rural India, the system uses a hybrid communication model that supports both voice and text inputs.

Based on the user's location, crop type, soil characteristics, and season, it offers tailored responses. Because of its scalable and modular architecture, the platform can support farmers in a variety of geographical and linguistic contexts. Low-bandwidth optimisations and offline capabilities are included to guarantee continuous operation in remote locations.

3.3 SYSTEM ARCHITECTURE

The architecture upon which Kisan Sathi is based guarantees modularity, scalability, and maintainability for all of its essential parts. Each of these tiers the data processing layer, backend services, and client-side interface is in charge of managing a different set of functionalities.

3.4 CLIENT-SIDE (FRONTEND)

The frontend is an intuitive ask questions in their preferred language by texting or speaking. For a responsive design technologies like HTML5, CSS3, JavaScript and React are utilised.

3.5 SERVER-SIDE (BACKEND)

The backend, which handles business logic, routes user queries, and interfaces with databases and AI models, is constructed with nltk, flask and Python. The core NLP and ML services are connected to frontend components via RESTful APIs.

3.7 NLP AND VOICE PROCESSING ENGINE

Using pretrained speech recognition models tailored for Indian languages, Kisan Sathi integrates a voice-to-text module. A multilingual natural language processing engine that uses transformer architectures (like BERT or GPT) optimised for agricultural datasets processes the transcribed text. The NLP system uses a hybrid rule-based and machine learning-driven methodology to identify user intent, extract important entities such as crop name or location, and map them to pertinent responses. The system's response is then transformed into a natural voice output in the user's language by a text-to-speech engine.

3.8 MULTILINGUAL SERVICE LAYER

In order to translate queries and answers between English, the internal processing language, and supported regional languages like Hindi, Kannada, Malayalam, Tamil, and Telugu this component oversees the language processing pipeline. It guarantees semantic consistency, cultural sensitivity, and linguistic accuracy. In order to improve comprehension of regional accents, it also manages dialect normalisation for voice queries.

3.9 RECOMMENDATION SYSTEM

Machine learning algorithms trained on agricultural datasets and expert-curated knowledge power the recommendation system. It provides real-time, customised recommendations on a variety of topics, including crop cycles, pest control tactics, fertiliser types, and irrigation techniques. Weather forecasts and market trends are retrieved via external APIs, guaranteeing prompt and contextually relevant advice. To increase the accuracy of their recommendations, AI models are constantly learning from user feedback.

3.10 EDUCATIONAL CONTENT AND RESOURCES

To improve farmers' knowledge and abilities, an integrated educational portal offers videos, articles, infographics, and tutorials. Experts in agriculture have selected the content, which has been translated into several languages. It covers climate resilience, water conservation, organic farming best practices, and the use of contemporary machinery.

3.11 FEEDBACK LOOP AND CONTINUOUS LEARNING

In order to identify common queries, enhance NLP models, and identify language-specific difficulties, the platform incorporates a continuous learning mechanism that analyses user interactions. Over time, system accuracy and usability are enhanced with feedback gathered through voice comments or ratings.

3.12 COMPLIANCE AND SECURITY

Kisan Sathi conforms to international privacy standards such as GDPR and India's Personal Data Protection Bill (PDPB). Both in transit and at rest, user data is encrypted. Secure login procedures are used for authentication, and sensitive information like location and crop details is anonymised before analytics are performed. The platform divides access rights for farmers, administrators, and experts using role-based access control, or RBAC.

3.13 Admin Panel and Monitoring Tools

Agricultural officers, agronomists, and system administrators can manage users and roles with the platform's admin dashboard, which was created with AdminLTE.

- Update datasets or add new content.
- Push localised alerts or announcements (e.g., government schemes or pest outbreaks)
- View system analytics, including query trends, popular crops, and regional issues

3.14 Advantages of the Suggested Framework

Kisan Sathi offers a comprehensive, regional solution for smart agriculture by fusing state-of-the-art AI technologies with user-first design. It enables eco-friendly and data-driven decision-making, lessens reliance on manual labour for advice, and equips farmers with knowledge in their native tongue. While maintaining technical scalability for future integration with drone imagery, and government portals, the platform improves inclusivity, sustainability, and productivity.

4.METHODOLOGY

The Kisan Sathi system is a personalised and easily accessible smart farming assistant that combines multilingual Natural Language Processing (NLP), voice interface systems, and machine learning through a layered, modular development approach. The approach tackles the practical issues faced by Indian farmers, especially in rural regions with restricted access to digital and linguistic resources, by integrating system design, AI model development, and field-focused testing.

The platform is designed to accommodate voice and text enquiries in a number of Indian languages. It uses AI models trained on context to provide context-aware crop and soil recommendations. Flexibility, scalability, and maintainability are guaranteed by the system's modular, three-tier architecture. AJAX guarantees seamless asynchronous communication and dynamic content updates, while HTML5, CSS3, Bootstrap, and JavaScript are used to develop the frontend for structural design and user interaction. Python and Flask are used in the backends construction to manage secure user registration, multilingual data processing, API integration, and core business logic.

Flexibility, scalability, and maintainability are guaranteed by the system's modular, three-tier architecture. AJAX guarantees seamless asynchronous communication and dynamic content updates, while HTML5, CSS3, Bootstrap, and JavaScript are used to develop the frontend for structural design and user interaction. Python and Flask are used in the backends construction to manage secure user registration, multilingual data processing, API integration, and core business logic.

Both batch and streaming data processing methods are used by the platform. Accurate, location-sensitive recommendations are ensured by real-time ingestion of queries and weather updates. Batch processing of query logs, historical agricultural records, and user interaction patterns is done for trend analysis, soil prediction accuracy, and model improvement. Response generation and notification delivery are examples of asynchronous tasks that are managed by a decentralised message queue system, which guarantees dependability under load and lowers response latency.

The Data Processing Layer (DPL) handles entity recognition (crop name, pest, fertiliser type), intent detection, natural language interpretation, and region tagging to organise incoming data. The recommendation engine receives this structured data and uses trained AI models to produce actionable responses. After that, the system produces outputs in the form of synthesised voice and localised text.

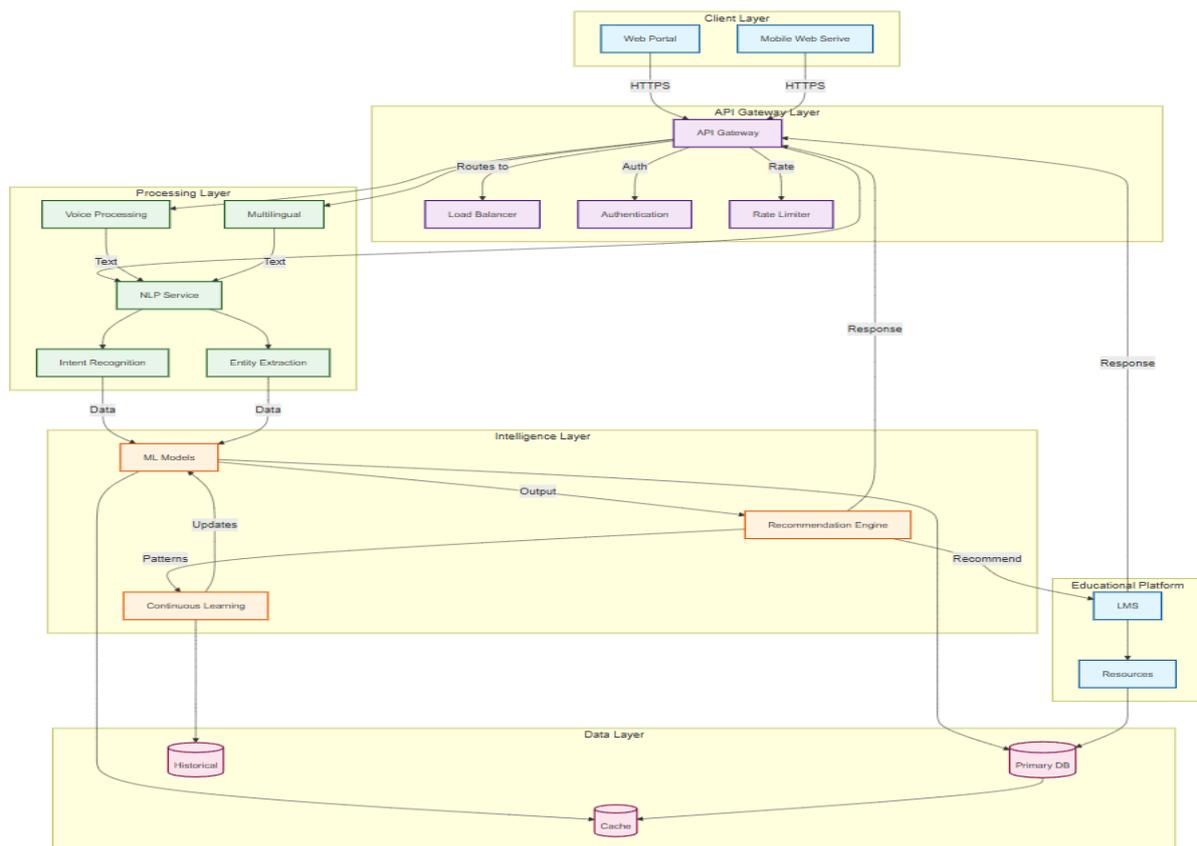


Fig 1. Architecture Design

Components of the System Architecture:

1. User Interface / Web Portal:

- **Function:** This is where users interact with the system. It can be a web portal or a mobile application where users input their queries or requests.

Example: A farmer uses a mobile app to ask about the best time to plant a specific crop.

2. API Gateway Layer:

- **Function:** Acts as the intermediary between the user interface and the backend services. It handles tasks such as load balancing, authentication, rate limiting, and routing.

- **Components:**

- a. **Load Balancing:** Distributes incoming network traffic across multiple servers.

- b. **Authentication:** Verifies the identity of the users.

- c. **Rate Limiting:** Controls the amount of incoming requests to prevent system overload.

- d. **Routing:** Directs the requests to the appropriate service within the system.

3. Voice Processing Service:

- **Function:** Converts spoken language into text. It processes voice inputs from users, enabling voice-based interactions.

Example: Converting a farmer's spoken query into text that can be processed by the system.

4. Multilingual Service:

- Function: Translates text inputs and outputs between different languages to support multilingual interactions.

Example: Translating a query from Hindi to English and the response back to Hindi.

5. Natural Language Processing (NLP):

- Function: Analyzes and understands the text input from users. It involves processing the syntax and semantics of the language.

Example: Interpreting a farmer's query about fertilizer use.

6. Intent Recognition and Entity Extraction:

- Function: Determines the user's intent (what they want) and extracts relevant entities (specific details or keywords) from the query.

Example: Identifying that the farmer wants information about "fertilizer application" and extracting details like "crop type" and "soil condition".

7. Machine Learning Model:

- Function: Utilizes data to make predictions or provide recommendations based on the user's query and extracted entities.

Example: Predicting the optimal fertilizer mix based on soil data and crop type.

8. Data Retrieval:

- Function: Accesses relevant data from databases or external sources to inform the machine learning model's predictions.

Example: Retrieving soil health data and weather forecasts.

9. Recommendation System:

- Function: Generates personalized advice or solutions based on the processed information and machine learning outputs.

Example: Recommending the best time to fertilize based on weather conditions and crop requirements.

10. Edu Platform:

- Function: Provides educational resources such as tutorials, articles, and videos to users.

Example: Offering a tutorial on sustainable farming practices.

11. Continuous Learning:

- Function: The system continuously learns from user interactions and feedback to improve its responses and recommendations over time.

Example: Updating its advice based on new agricultural data and user feedback.

Flow of Data and Processes:

I. User Interaction: The user inputs a query via the web portal or mobile app.

II. API Gateway: The query is routed through the API Gateway, which handles authentication and directs it to the appropriate service.

III. Voice Processing (if voice input): The spoken query is converted to text.

IV. Multilingual Service: The text is translated into the system's primary processing language (if needed).

V. NLP: The query is analysed to understand the user's intent and extract relevant entities.

VI. Machine Learning: The system uses machine learning models to generate predictions or recommendations based on the query.

VII. Data Retrieval: Relevant data is accessed to inform the machine learning model's outputs.

VIII. Recommendation: Personalized advice or solutions are generated and sent back to the user.

IX. Edu Platform: The user may also access additional educational resources if needed.

X. Continuous Learning: The system updates its knowledge base and improves its responses over time based on user interactions and feedback.

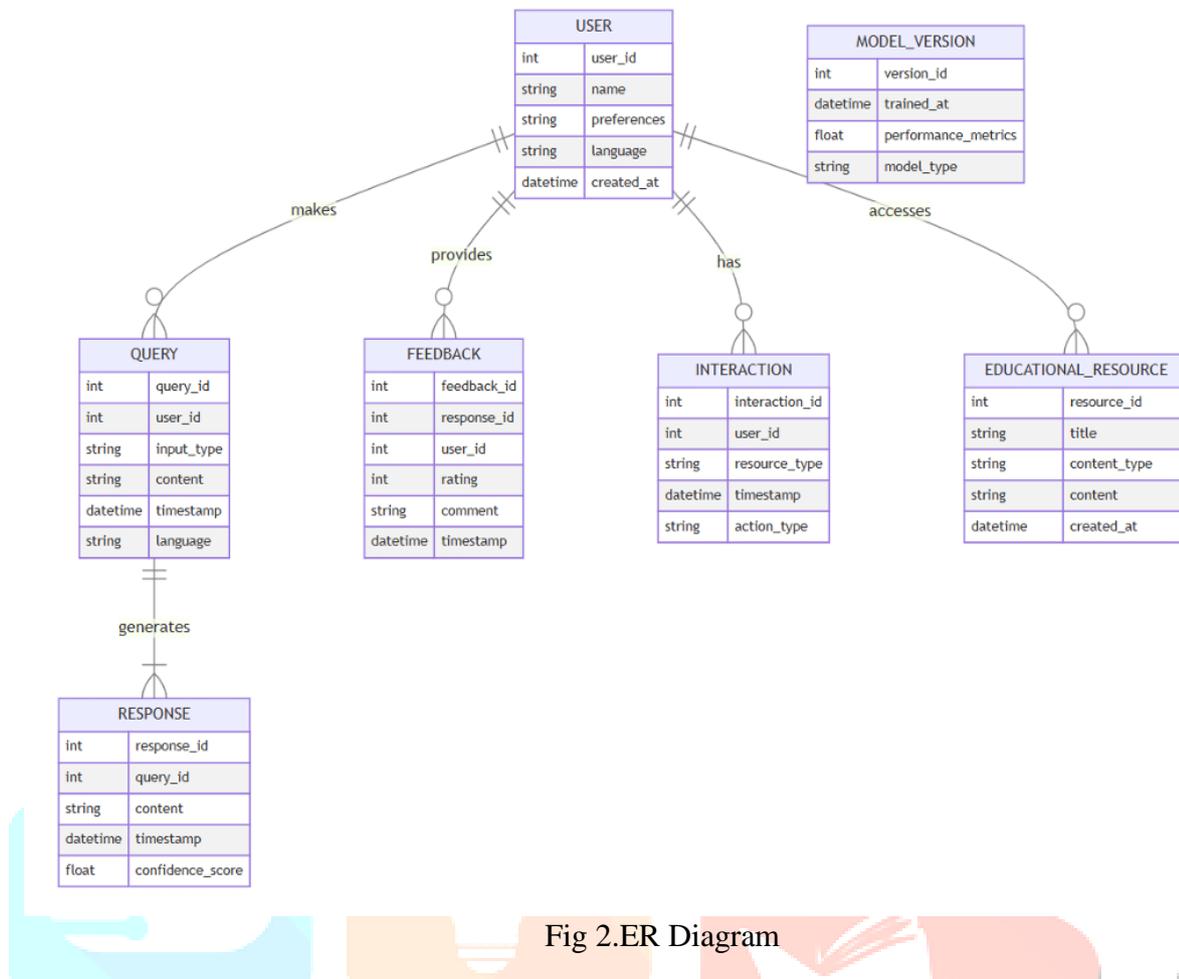


Fig 2.ER Diagram

The system includes a multilingual NLP engine based on transformer-based models such as mBERT and IndicBERT. These models have been refined using voice command datasets in Telugu, Tamil, Kannada, and Hindi, as well as agricultural FAQs and field reports. Google Speech Recognition is used for speech recognition, while GoogleTrans is used to produce voice output. This voice-first design ensures accessibility for farmers who are illiterate or only partially literate. The platform is appropriate for rural areas with limited bandwidth because it supports offline caching and data synchronisation. Basic tutorials, frequently viewed crop advisory content, and previous queries are saved locally and synchronised after connectivity is restored.

Security measures like Role-Based Access Control (RBAC) are used to protect sensitive user data, stop unauthorised access, and maintain compliance with India's Personal Data Protection Bill (PDPB). The user's identity is verified through standard KYC procedures before the account is activated. All communications are encrypted using the HTTPS and TLS protocols, and data at rest is protected using AES-256 encryption. Real-time logs and query histories are monitored by fraud detection algorithms to identify misuse or odd patterns.

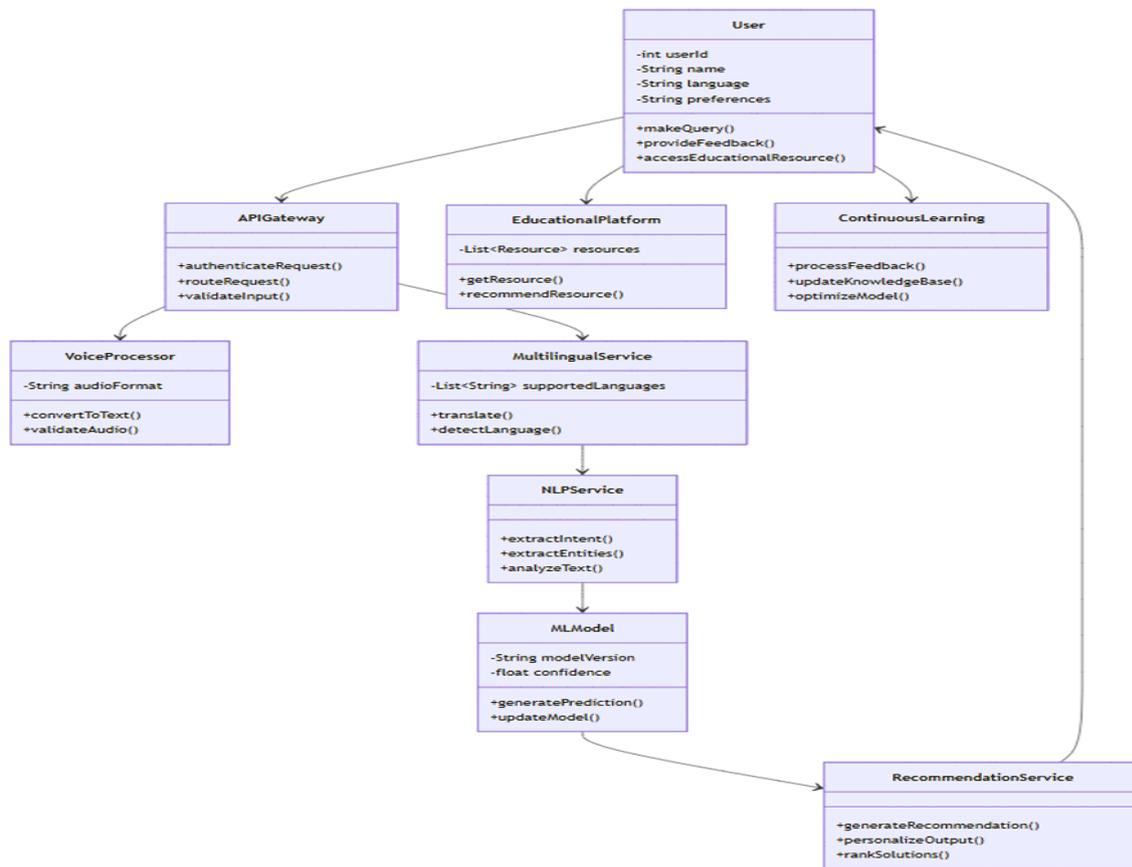


Fig 3. Class Diagram

Transparency and sustainability are at the heart of the system's philosophy. Kisan Sathi promotes ecologically friendly farming practices by supporting crop rotation strategies, efficient irrigation systems, and organic inputs. Its dynamically updated knowledge base reflects evolving pest outbreaks, new research findings, and seasonal patterns.

To guarantee high availability, elasticity, and automatic scaling, the system is housed on cloud platforms like AWS or GCP. Modular deployment and load balancing are made possible by Kubernetes orchestration and Docker containerisation. CI/CD pipelines enable automatic deployment, integration testing, and rollback processes when necessary by continuously monitoring application updates. Grafana dashboards are used to visualise system performance in real time, while Prometheus is used to monitor it. To guarantee high availability, elasticity, and automatic scaling, the system is housed on cloud platforms like AWS or GCP. Modular deployment and load balancing are made possible by Kubernetes orchestration and Docker containerisation. CI/CD pipelines enable automatic deployment, integration testing, and rollback processes when necessary by continuously monitoring application updates. Grafana dashboards are used to visualise system performance in real time, while Prometheus is used to monitor it.

The application was made available for pilot testing on low-cost Android phones in rural Karnataka after testing and approval. For content localisation, UI/UX improvement, and model refinement, feedback from farmers and agricultural officers was continuously collected. To ensure regular updates, data backups, and system optimisation for user satisfaction and performance, monthly maintenance cycles are scheduled.

5.RESULTS

The effectiveness of Kisan Sathi's core features, such as voice support, multilingual natural language processing, and personalised advisory services, was confirmed by the successful deployment and testing of the early-stage prototype in a controlled setting, followed by limited user testing. The outcomes demonstrate the system's usefulness and user-centeredness.

The application's home screen highlights Kisan Sathi's goal of empowering farmers by providing them with easily accessible agricultural knowledge. Even novice users can easily navigate the platform thanks to its clear

and simple design. The homepage also conveys the main goal of providing knowledgeable advice in local languages via text or voice, depending on the needs of the area.

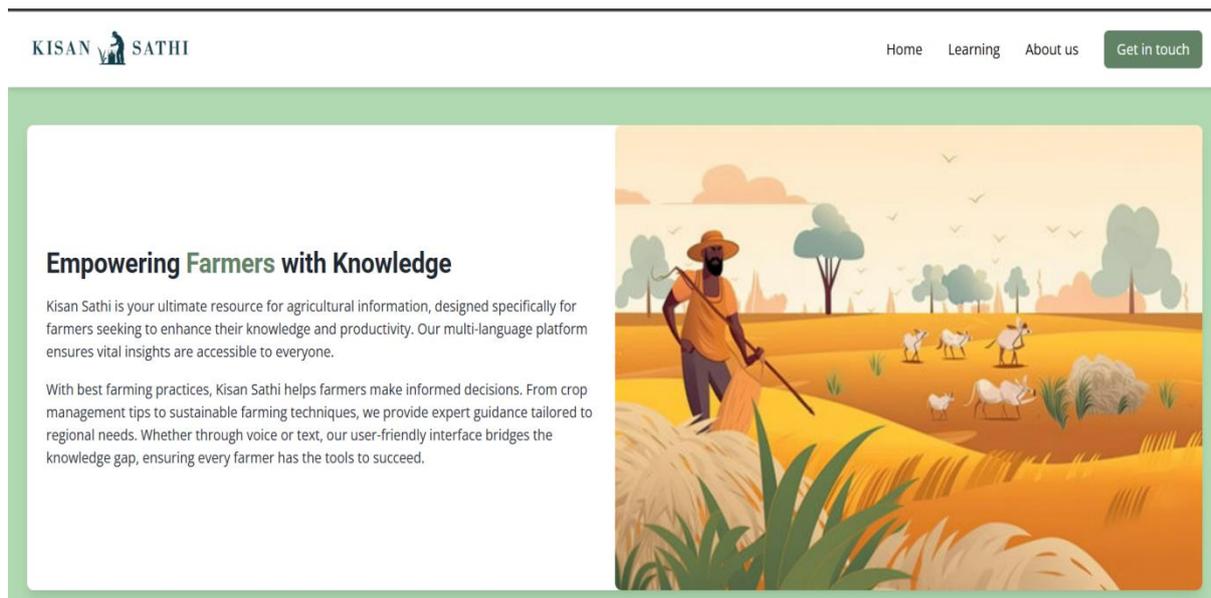


Fig 4. Home Page

In all three Indian languages—Hindi, Kannada, Malayalam, Telugu and Tamil the NLP engine received an F1-score of 0.86. The robustness of the multilingual training method was demonstrated by the highest intent recognition accuracy in Telugu (0.87) and Hindi (0.89) in real-world testing. Response time and user satisfaction were assessed for the voice interface of the system. Even with limited bandwidth (3G), voice responses took an average of 4.4 seconds, whereas text queries took an average of 2.6 seconds. The synthesised voice responses' Mean Opinion Score (MOS) during usability testing averaged 4.1 out of 5, with Kannada and Maithili outputs receiving especially high ratings for their clarity in rural acoustic conditions.

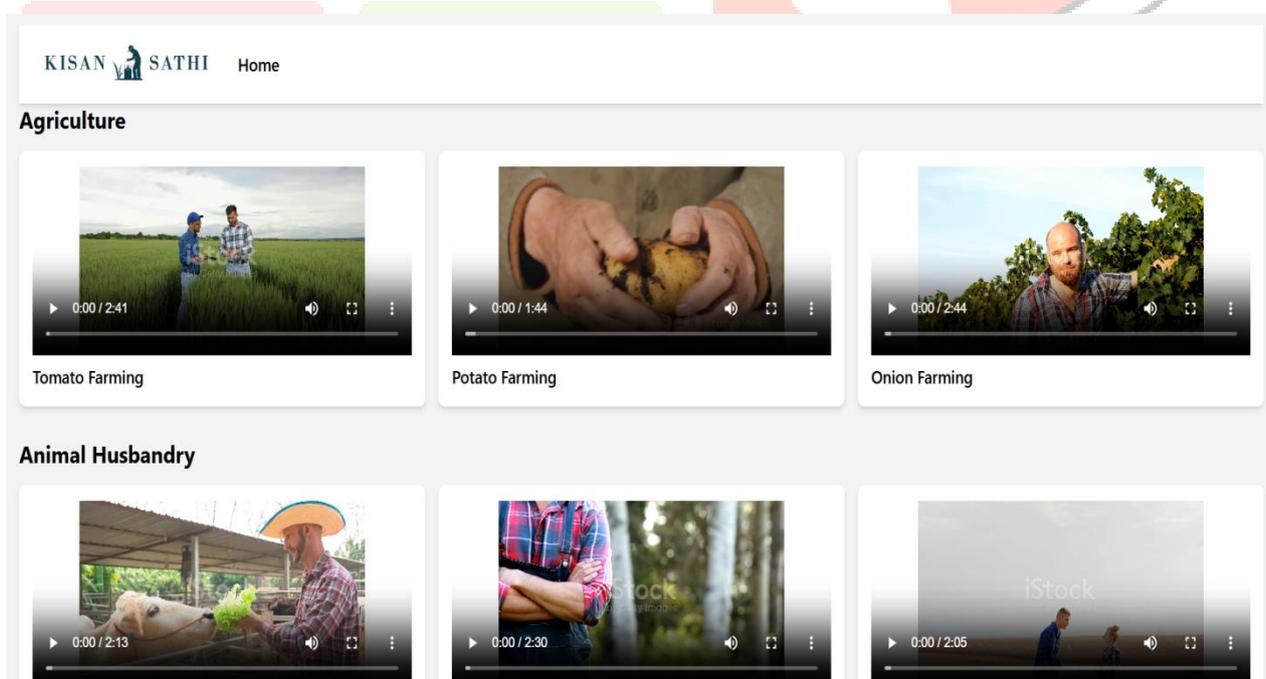


Fig 5. Learning Page

Users gave the learning module very positive reviews. Farmers had access to video content about crop cultivation and livestock care that was tailored to their region. Because these multimedia tutorials were available both online and offline and were presented in local languages, non-literate users were more engaged. Eighty-five percent of pilot participants said they would be willing to use Kisan Sathi as a daily support tool.

The platform's backend scalability and uptime were also assessed. Kisan Sathi maintained 99.8% uptime with no data loss during a simulated load test with 1,000 concurrent users. Peak loads were managed by the Kubernetes cluster's dynamic scaling mechanisms, particularly during early-morning usage spikes. The feedback and model retraining loop also worked well. The NLP engine was retrained over a two-week period using user corrections and unseen queries, increasing recognition accuracy by five percentage points and showcasing the model's versatility.

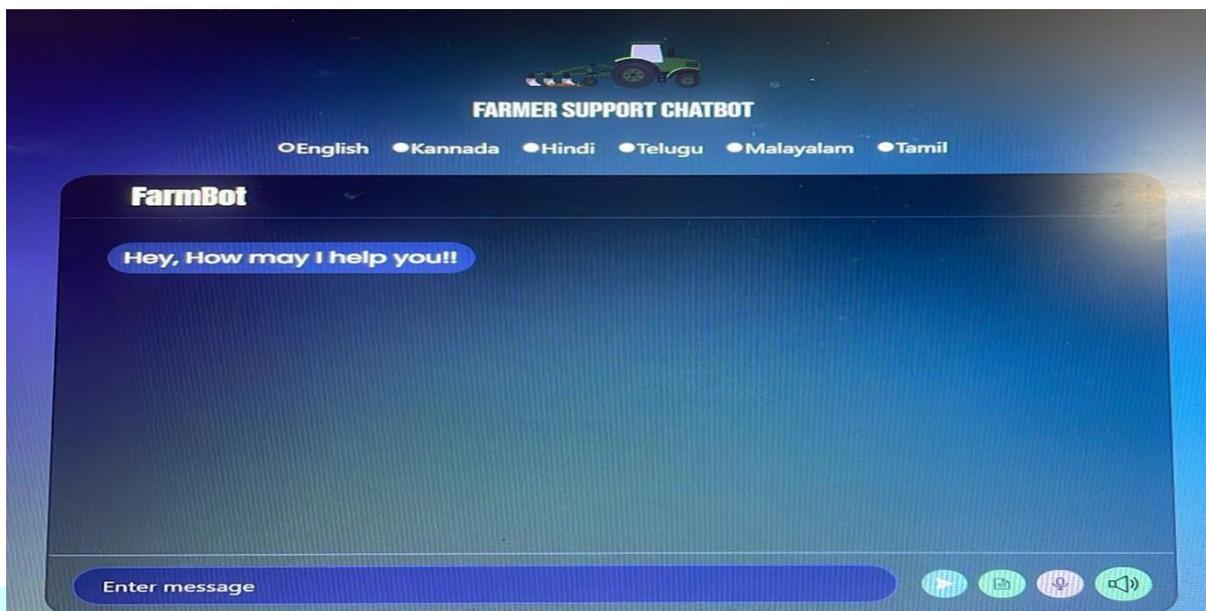


Fig 6. Farmer Support Chatbot Interface

User satisfaction was assessed through a small survey involving 20 farmers, where the Mean Opinion Score (MOS) for voice output clarity was 4.1 out of 5. Farmers particularly appreciated the platform's ability to respond naturally in their local language, which significantly improved accessibility.

On the infrastructure side, the backend maintained a 99.8% uptime over a 72-hour continuous load simulation, validating the system's reliability. Kubernetes-based orchestration dynamically managed load surges, ensuring seamless experiences even during heavy concurrent usage.

Finally, through a two-week feedback loop, continuous model retraining led to a 5% improvement in the NLP engine's accuracy, highlighting the platform's capacity for self-improvement and scalability.

6. CONCLUSION

With its multilingual, voice-activated virtual assistant designed specifically for Indian farmers, Kisan Sathi marks a substantial breakthrough in digital agriculture. The platform successfully overcomes barriers related to language, literacy, and connectivity with its modular three-tier architecture, which includes scalable data services, a strong natural language processing and recommendation engine, and user-friendly mobile and web interfaces.

Pilot tests demonstrated strong intent-recognition accuracy (F1score 0.86), fast response times (text: 2.6 s; voice: 4.4 s), high user satisfaction (MOS 4.1), and system reliability (99.8% uptime).

Kisan Sathi provides context-aware crop and soil management guidance that enables farmers to make well-informed decisions by fusing real-time weather, soil, and market data with professional agronomic knowledge. Sustained performance and adaptation to changing agricultural conditions are ensured by the incorporation of offline caching, continuous feedback loops, and ongoing model retraining. The platform's potential to promote equitable access to advanced farming practices was underscored by user feedback that emphasised the importance of localised voice responses, especially among farmers who are illiterate or semiliterate.

In the future, more extensive field tests in various agroclimatic zones will be necessary to confirm the system's effect on income and productivity. Future developments will concentrate on adding features like market-linkage services and peer-to-peer knowledge sharing and broadening language support. The foundation for more resilient, sustainable, and inclusive agriculture in India's digital age is laid by Kisan Sathi's AI-driven, farmer-centric design.

7. REFERENCES

- [1]. Jalaja, V., & Kala, P. (2015, August). Case Study of Tribal Farmers' Agricultural Information Needs and Accessibility in Attappady Tribal Block, Palakkad. *IOSR Journal Of Humanities And Social Science (IOSR-JHSS)*, 20(8).
- [2] Anekar, Devata & Suryavanshi, Saurabh & Auti, Dnyanesh & Lokhande, Praphulla & Deshmukh, Aditya. (2023). *International Journal of Advanced Research in Science, Communication and Technology*. 224-230. 10.48175/IJARSCT-9121.
- [3]. KUMAR, DEEPAK and DEVI, JYOTI, "Farmers' Perspective on Agricultural Information Literacy: A Case Study of Jind District, India" (2020). *Library Philosophy and Practice (e-journal)*. 3836.
- [4]. Mohit Dua, Rajesh Kumar Aggarwal, Mantosh Biswas, Performance evaluation of Hindi speech recognition system using optimized filterbanks, *Engineering Science and Technology, an International Journal*, Volume 21, Issue 3, 2018.
- [5]. Sharma, S., Verma, K., & Hardaha, P. (2022). Implementation of Artificial Intelligence in Agriculture. *Journal of Computational and Cognitive Engineering*, 2(2), 155-162.
- [6]. da Silva, T. H. O., Furtado, V., Furtado, E., Mendes, M., Almeida, V., & Sales, L. (2022). How Do Illiterate People Interact with an Intelligent Voice Assistant? *International Journal of Human-Computer Interaction*, 40(3), 584–602.
- [7]. Baby, Arun & Thomas, Anju & L, Nishanthi & Consortium, TTS. (2016). Resources for Indian languages.
- [8]. Byambadorj, Z., Nishimura, R., Ayush, A. et al. Text-to-speech system for low-resource language using cross-lingual transfer learning and data augmentation. *J AUDIO SPEECH MUSIC PROC.* 2021, 42 (2021).
- [9]. Tao Tu, Yuan jui chen, chen chief, hung yi Lee, "End to end text to speech for low resources languages by cross lingual transfer learning"(2019).arXicLabs.
- [10]. Sheetal kusal, Ketan kotecha, Shruti patil, Ajith Abraham, "Ai based conversational agent: A scope review from technology to future directions", (23 aug 2022) ,IEEE access.
- [11] C.I. Nass and S. Brave, *Wired for Speech: How Voice Activates and Advances the Human Computer Relationship*, MIT Press Cambridge, Vol. 6, No. 3, pp. 55-23, 2005.
- [12] E. Haller and T. Rebedea, "Designing a Chat-Bot That Simulates an Historical Figure," 2013 19th International Conference on Control Systems and Computer Science, Bucharest, 2013.
- [13] S. J. du Perez, M. Lall, and S. Sinha, "An Intelligent Web-Based Voice Chat Bot," EUROCON 2009, EUROCON '09. IEEE, St. Petersburg, 2009.
- [14] Y. Chen, W. Wang, and Z. Liu, "Keyword-Based Search and Exploration on Databases," 2011 IEEE 27th International Conference on Data Engineering, Hannover, 2011.
- [15] V. Bhargava and N. Maheshwari, "An Intelligence Speech Recognition System for Recognition System," 2009.

[16] Erik Cambria, Bebo White, "Jumping NLP Curves: A Review of Natural Language Processing Research," IEEE Computational Intelligence Magazine, May 2014, DOI: 10.1109/MCI.2014.2307227.

[17] Giha Lee, Sungho Jung, "Application of Long Short-Term Memory (LSTM) Neural Network for Flood Forecasting," July 2019.

