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Agrisathi: A Multilingual AI-Based Advisory Platform for Smallholder Farmers in India

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ABSTRACT

India is home to over 120 million smallholder farmers, yet more than 80% lack timely access to expert agricultural advice, modern tools, or reliable markets, resulting in frequent crop losses, low productivity, and a widening digital divide. This paper presents AgriSathi, a multilingual, voice-assisted mobile platform designed to bridge these gaps by offering personalized crop advisory and real-time disease detection using artificial intelligence (AI). The platform integrates a regional-language voice assistant, image-based plant disease recognition, and a gamified community engagement model (AgriCreds) that incentivizes peer-to-peer support. Additionally, AgriSathi connects users to government schemes and verified agri-input providers, making it accessible even to digitally inexperienced farmers. This study outlines the system's architecture, technical methodologies, AI models employed, and its potential socio-economic impact on India's agricultural ecosystem.

Key Words: Agri-Tech, Ai in Agriculture, Multilingual Voice Assistant, Disease Detection, Decision Support System, Agricreds, Farmer Advisory System

1. INTRODUCTION

India's agricultural sector supports over 120 million small and marginal farmers, yet the majority face persistent challenges in accessing timely, personalized, and credible agricultural advice. Despite the rise of digital agri-tech platforms, fewer than 30% of farmers utilize such services, primarily due to language barriers, low literacy levels, limited awareness, and inconsistent internet access in rural regions. This gap leads to frequent crop mismanagement, undiagnosed diseases, reliance on chemical-heavy inputs, and a general decline in productivity and income.

Moreover, most existing advisory tools fail to account for the diversity of India's agro-climatic zones, regional farming practices, and crop-specific variations. Critical needs such as early disease detection, real-time expert consultation, and access to certified agricultural inputs remain largely unmet. There is also a lack of platforms that effectively engage farmers or incentivize them to adopt better practices.

To address these challenges, we propose AgriSathi, a multilingual, AI-driven mobile platform tailored for smallholder farmers. AgriSathi integrates voice-based crop advisory, image-driven disease detection, and a community-powered engagement model called AgriCreds, which rewards helpful users with redeemable credits. The platform further provides access to government schemes, expert consultations, and localized agricultural recommendations empowering digitally inexperienced users with actionable knowledge and sustainable tools. This paper describes the architectural design of AgriSathi, the core technologies involved, and its potential to advance inclusive and data-driven farming practices in India.

2. LITERATURE SURVEY

The integration of digital technologies in agriculture has grown rapidly in recent years, particularly in crop monitoring, disease detection, and advisory services. Multiple agri-tech platforms have emerged globally and within India, leveraging artificial intelligence, machine learning, and mobile applications to address common challenges

faced by farmers. However, these tools often lack localization, personalization, and inclusivity, especially for smallholder farmers with low digital literacy.

Plantix, a widely used app, allows users to upload photos for AI-based disease detection and treatment suggestions. While effective, it primarily caters to literate users and is not fully localized for India's diverse languages and dialects. Kisan Suvidha, a government-backed application, provides weather forecasts, market prices, and pest alerts, but it lacks real-time interaction and intelligent decision support. Platforms like Krishi Network and AgriApp attempt to close the advisory gap by connecting users to experts, yet they rely heavily on scheduled calls, manual responses, and text-heavy interfaces. These are not always accessible to farmers in Tier-2 and Tier-3 rural areas who are often unfamiliar with such digital systems.

Kamilaris and Prenafeta-Boldú (2018) demonstrated the potential of deep learning in agriculture, especially for disease identification and yield prediction. Despite this, the application of AI in real-world field conditions particularly in resource-limited regions remains underutilized due to complex interfaces and lack of on-ground integration. While gamification has proven successful in increasing engagement in sectors like education and healthcare, its application in agriculture, especially for farmer training, participation, and advisory services is still limited. Few platforms offer community-driven, reward-based models that foster knowledge sharing and peer engagement. This review highlights the need for a voice-first, AI-enabled, and gamified mobile platform that not only delivers accurate crop guidance but also promotes inclusivity, interactivity, and localized content. AgriSathi emerges as a promising solution to fill this critical gap.

3. MATERIALS AND METHODS

The AgriSathi platform is designed as a modular, scalable, and farmer-centric solution that leverages artificial intelligence (AI), multilingual voice support, and gamified community engagement to serve smallholder farmers in India. This section describes the technical architecture, tools, and implementation strategies used to build the system.

3.1. System Architecture

AgriSathi consists of the following major components:

- A mobile frontend built for low-end smartphones
- A backend server managing user actions and data flow
- AI-based services for voice query processing and disease classification
- A PostgreSQL relational database for secure data storage
- Integration with third-party APIs for weather, soil, and payment services

3.2 System Flow

User authentication is managed using phone number or OTP-based verification. GPS fetches the user's region for personalized crop advice (Location Detection). Users interact via a Voice Query Input or an Image Upload for Disease Diagnosis, both processed by AI. Users engage in the Community Forum + AgriCreds. Earned AgriCreds are used for Expert Access and Redemption (e.g., product purchases).

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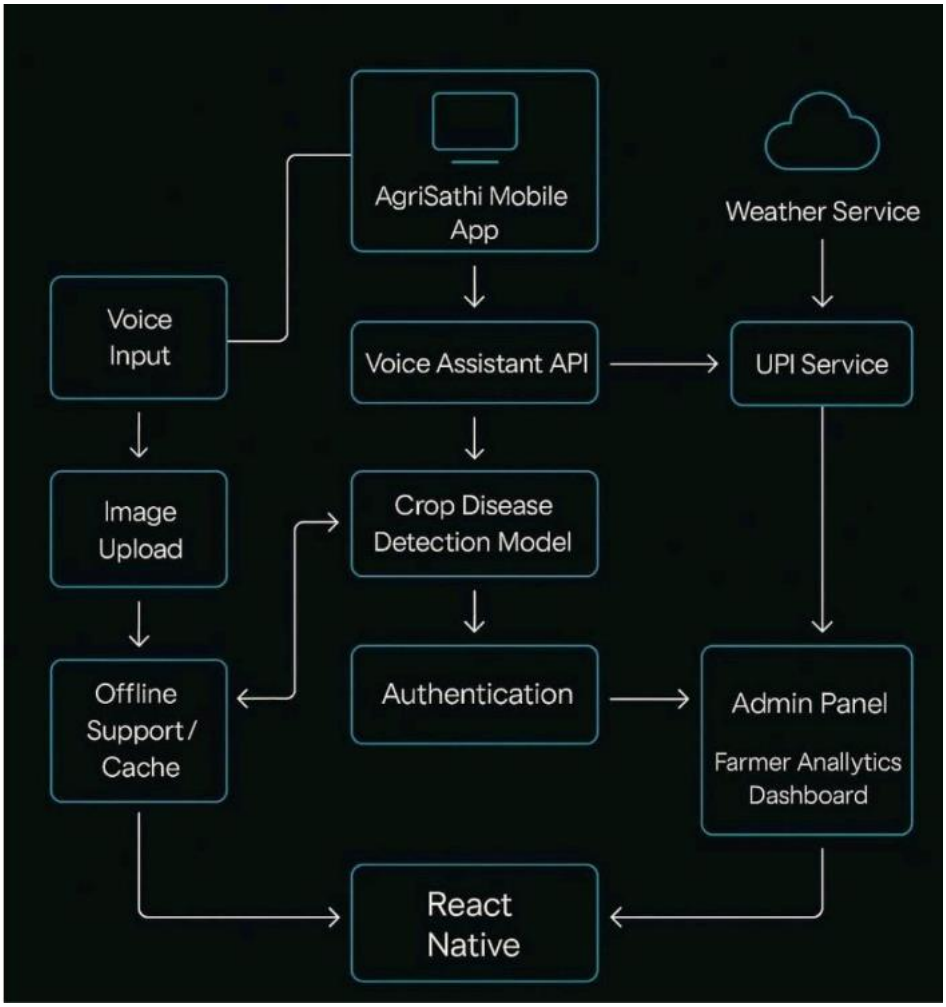

Figure 1: High-level system architecture of the AgriSathi app showing data flow between mobile frontend, backend services, AI modules, and the database.

3.2. Multilingual Voice Assistant

The voice-based advisory system is powered by:

- Google Cloud Speech-to-Text API for voice transcription
- Indic NLP Library for regional language detection and translation
- A custom rule-based engine that processes queries and maps them to structured responses or ML modules

This component enables farmers to interact with the system using their native language, regardless of literacy level.

3.3. Image-Based Disease Detection

The image detection module uses:

- TensorFlow/Keras to train a Convolutional Neural Network (CNN) for disease classification
- OpenCV for image preprocessing (resizing, noise reduction, and normalization)
- A dataset built on PlantVillage and field images collected during pilot testing

The model predicts the disease category and recommends treatment protocols. Initial accuracy exceeds 85% in controlled tests.

3.4. Community and AgriCreds System

To promote engagement and learning:

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- Farmers can post questions or share knowledge via a forum-style interface
- Posts can be upvoted/downvoted by others
- Contributors earn AgriCreds, which can be used to unlock premium features such as Expert consultations and discounts on certified seeds or bio-inputs

This gamification mechanism increases platform stickiness and supports a culture of community-driven learning. The system is monitored and periodically reset during seasonal cycles to encourage continual participation.

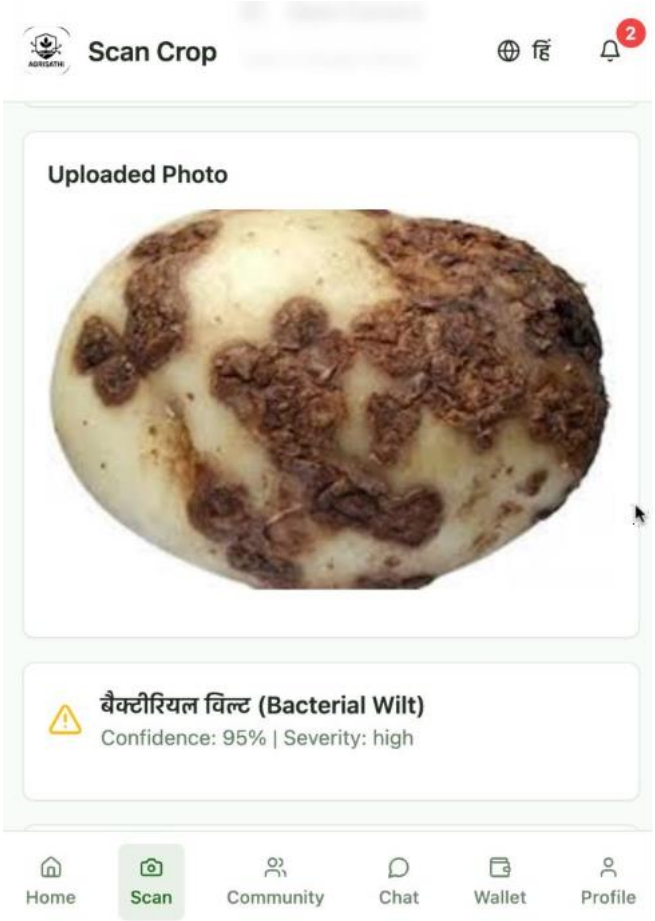

Figure 2: In-app community forum where users share tips, earn AgriCreds, and interact with peers.

3.5. Backend and Database

The backend is developed using Flask (Python) or Node.js and connects to a PostgreSQL database for managing User authentication, profile details, community posts, AgriCred transactions, uploaded crop images and results, expert response logs, and payment and reward redemptions. PostgreSQL was selected for its relational consistency and extensibility. The backend is deployed on a cloud-based platform (e.g., Heroku or AWS), ensuring scalability and easy regional rollout.

3.6. Personalization Engine

The system uses:

- OpenWeather API for weather forecasts
- Indian Soil Health Card database (where accessible)
- Crop cycle data and user history

This data is used to personalize crop advisory, fertilizer usage, and disease alerts. Recommendations are region-specific and update dynamically based on environmental conditions.

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3.7. Payment Integration

AgriSathi integrates a UPI-based payment module using Razorpay API , enabling farmers to redeem AgriCreds for seeds, bio-inputs, or services and make secure, instant transactions within the app. This feature supports trusted, verified transactions between farmers and agri-input providers or experts.

4. IMPLEMENTATION

The implementation of AgriSathi focused on building a user-friendly, robust, and scalable mobile application that caters specifically to smallholder farmers with limited digital exposure. The development process was executed in multiple phases, optimizing for accessibility, responsiveness, and modular integration of AI services.

4.1. User Interface and Experience (UI/UX)

The mobile app interface was designed using Figma, keeping the primary user base of low-literacy farmers in mind. The UI follows a voice-first and icon-driven layout, with support for local languages (Hindi, Kannada, etc.). The core design principles included minimal text, voice prompts and audio feedback, clear, colorful icons, and offline-friendly interactions. The frontend was developed using React Native, ensuring cross-platform compatibility (Android & iOS) with minimal resource usage.

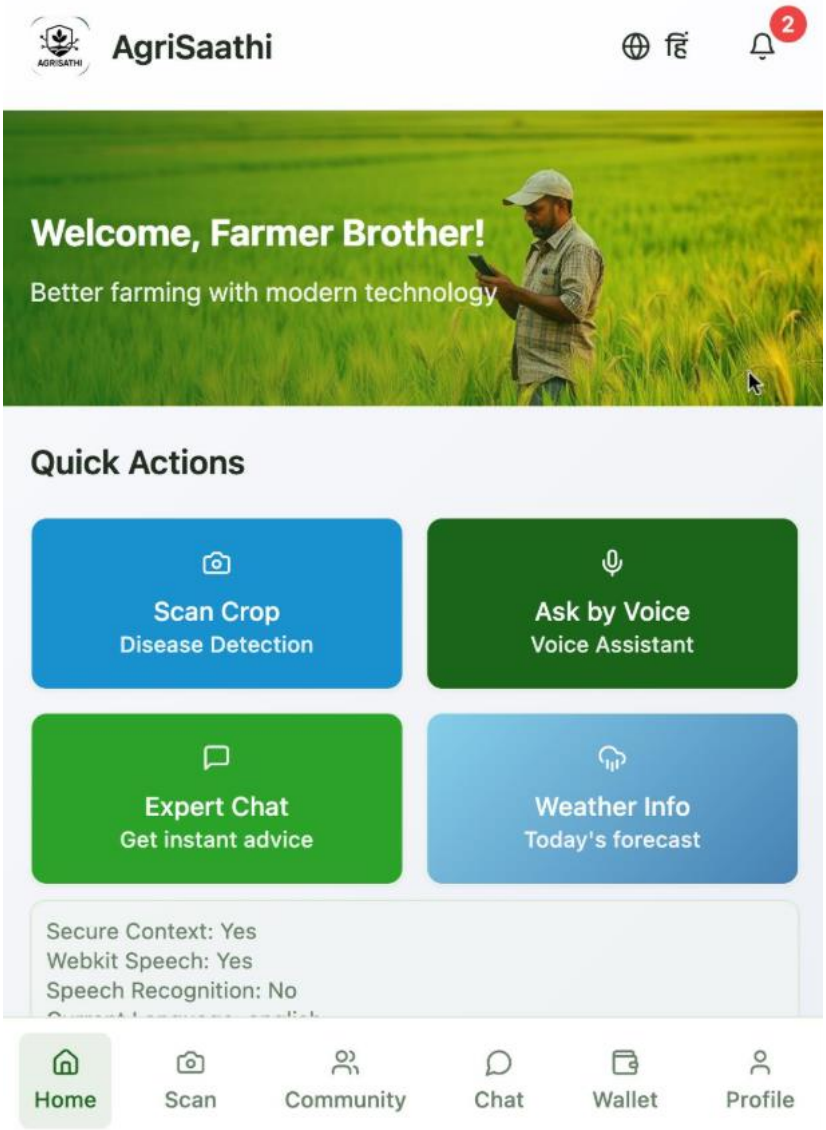

Figure 3: AgriSathi's regional-language interface using voice-first interaction for low-literacy users.

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4.2. Voice Assistant Integration

The voice interaction module was built by integrating Google Cloud Speech-to-Text API for capturing and transcribing voice input, the Indic NLP library for language classification and translation, and custom rule-based logic to map voice queries to specific crop-related domains. A caching layer was used to reduce latency and ensure smoother interactions even on slower devices or networks.

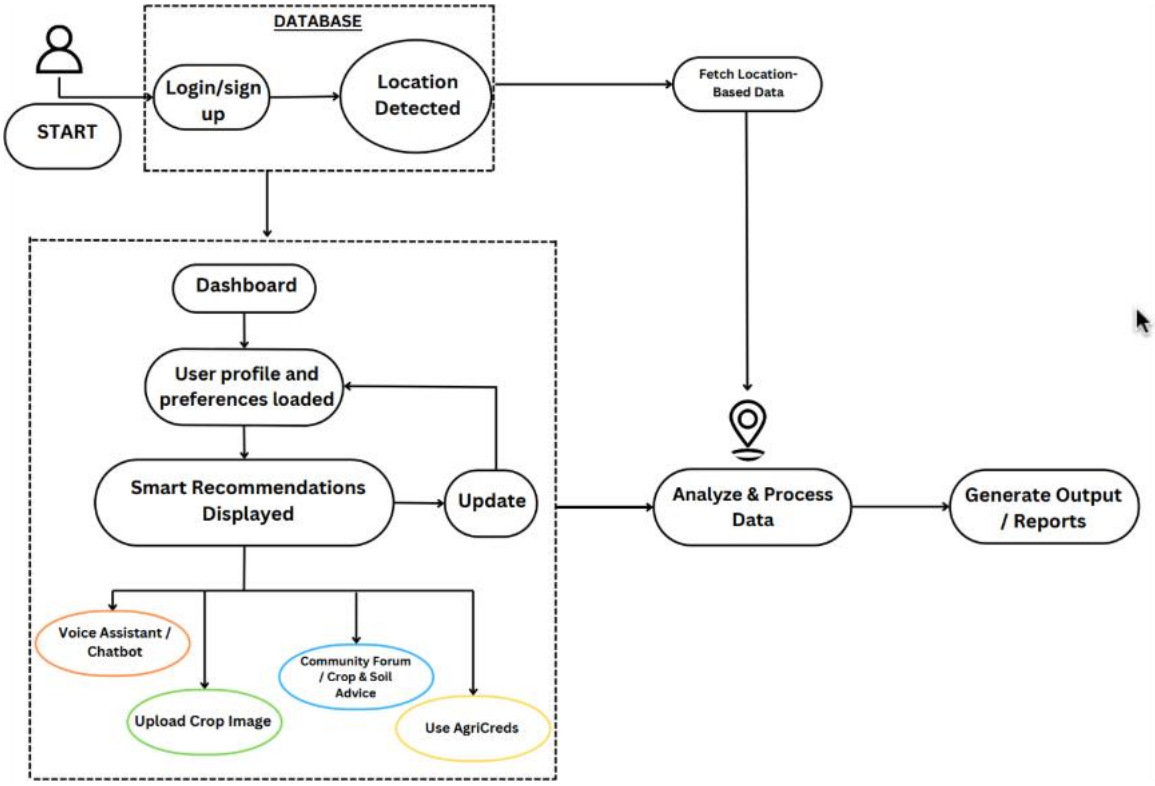

Figure 4: User interaction flow within AgriSathi app, from voice input to community engagement and AgriCred rewards.

4.3. AI-Powered Disease Detection

For disease detection, a Convolutional Neural Network (CNN) model was trained using TensorFlow and Keras. Input images are preprocessed using OpenCV to improve clarity and contrast. The system returns the detected disease name, severity level (mild/moderate/severe), and recommended first-line treatment and prevention methods. The model currently supports common crops like tomato, potato, maize, and chili, with plans to expand coverage.

Table 1. Core Technologies and Tools Employed in AgriSathi

Component	Technology/Tool	Purpose
Mobile Frontend	React Native, Figma	Cross-platform UI development and design
Voice Assistant	Google Cloud Speech-to-Text, Indic NLP Library	Multilingual voice transcription and language processing
Disease Detection	TensorFlow, Keras, OpenCV	CNN training, disease classification, and image preprocessing
Backend Server	Python (Flask) or Node.js	Modular API development, business logic
Database	PostgreSQL	Secure, relational data storage and management
Payments	Razorpay API (UPI-based)	Instant, secure in-app transactions

Figure 1: AgriSathi's regional-language interface using voice-first interaction for low-literacy users.

Figure 2: High-level system architecture of the AgriSathi app showing data flow between mobile frontend, backend services, AI modules, and the database.

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4.4. Gamification and AgriCreds Logic

Each user action, such as posting a tip, uploading a crop image, or answering a question, is tracked and rewarded with AgriCreds. Points are stored in a centralized ledger with basic rules, such as +5 for posting helpful advice and +3 for receiving upvotes. AgriCreds can be exchanged for live chat sessions with agronomists or discounts on verified seeds, tools, or fertilizers.

4.5. Security and Data Privacy

Security was implemented using JWT-based authentication for secure user sessions and HTTPS encryption for all network transactions. Regular input validation and sanitization prevent misuse or injection attacks, and role-based access is used for experts and admins. Farmer data is anonymized for analytics and stored following data privacy best practices.

5. RESULTS AND DISCUSSION

The initial implementation of AgriSathi was evaluated through functionality tests, simulated user interactions, and early feedback from target users, including smallholder farmers and agri-experts. The results indicate strong potential for adoption, usability, and performance in real-world rural environments.

5.1. Model Performance

The disease detection model, trained on the PlantVillage dataset and field-generated images , achieved the following metrics on the test set: Accuracy: 86.7%; Precision: 84.9%; Recall: 85.2%; F1-Score: 85.0%. The model successfully identified common diseases in crops like tomato, paddy, and chili under varying conditions. Misclassifications were typically associated with poor image quality or overlapping symptoms.

5.2. Voice Assistant Evaluation

The multilingual voice assistant was tested in Hindi, Kannada, and English. Recognition accuracy (Google STT + Indic NLP) was 91.3% for short agricultural phrases. The average response time was less than 2 seconds for common queries. The user comprehension score was 8.6/10 based on farmer feedback.

5.3. User Engagement and Gamification

A prototype test with 15 farmers showed that 93% were able to ask questions and post on the community forum without prior training. Moreover, 87% found AgriCreds motivating and expressed willingness to return regularly. The average session duration increased to over 6 minutes compared to less than 2 minutes on traditional apps like Kisan Suvidha. This confirms that the gamified structure boosts engagement and encourages knowledge sharing.

5.4. Community Support and Expert Access

The community Q&A board allowed farmers to ask crop-specific questions, share field images for peer review, and upvote responses to earn AgriCreds. Simulated expert chats were well-received, with 11 out of 15 users preferring chat-based expert advice over phone calls due to cost, flexibility, and clarity.

6. LIMITATIONS

A few limitations were identified during the initial phase : limited crop coverage in the current disease detection model (only 4 major crops supported) , dependency on good image quality and internet connectivity for optimal performance , and a need for improvement in multilingual NLP for less common dialects.

7. CONCLUSION

This paper presented AgriSathi, a multilingual, AI-driven mobile platform designed to empower smallholder farmers in India by bridging gaps in agricultural advisory, early disease detection, and community engagement. The integration of voice-based queries, image-based disease diagnosis, and a gamified peer support system addresses key challenges such as low digital literacy and lack of timely expert access.

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The system architecture and pilot evaluations demonstrate that AgriSathi is not only technically feasible but also practically impactful. The disease detection model achieved over 85% accuracy, and the voice assistant functioned reliably across multiple Indian languages. Early user engagement results suggest that the platform encourages knowledge sharing and motivates recurring usage through its AgriCreds reward system.

For future development, the focus will be on expanding the disease detection model to support a broader range of crops and pests, enhancing dialect support through fine-tuned NLP models, and integrating offline functionality for low-connectivity regions. The platform will also focus on scaling partnerships and incorporating predictive analytics for weather, yield forecasting, and market trends. AgriSathi demonstrates the potential of combining AI, gamification, and voice-based systems to transform agricultural advisory into an inclusive, engaging, and data-driven experience.

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