# **Al Assistant for Farmers: A Multilingual Crop Advisory System**

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## **Abstract**

This project introduces a lightweight, yet powerful agricultural AI assistant designed to provide farmers with instant access to critical farming knowledge in their preferred language. Built using **Streamlit** and powered by **Groq's Llama3** language model, the system democratizes access to agricultural expertise through an intuitive interface. The assistant addresses two core agricultural needs: answering general farming queries and generating customized crop care plans. By offering multilingual support (currently English and Hindi), the system helps overcome language barriers that often prevent farmers from accessing critical information. This solution represents a practical application of generative Al to address real world agricultural challenges in accessibility, knowledge distribution, and localization.

**Keywords:** Generative AI, Large Language Models, Agricultural Technology, Groq, Llama3, Multilingual Support, Crop Management, Farmer Advisory System.

# **Introduction**

The agricultural sector faces significant challenges in knowledge dissemination, with critical information often inaccessible to those who need it most due to technical language, educational barriers, or language constraints. The AI Assistant for Farmers addresses these gaps by providing an accessible interface to agricultural expertise through generative AI.

Unlike many existing agricultural solutions that focus solely on predictive analyses or require complex sensor networks, this system emphasizes knowledge democratization through:

1. An intuitive question-answering interface for general agricultural queries.
2. Customized crop care plan generation for small-scale farmers.
3. Multilingual capabilities to serve diverse farming communities.
4. A lightweight implementation that requires minimal computational resources.

The system creates an adaptable platform that meets diverse agricultural information needs while maintaining simplicity and efficacy. This makes it particularly valuable in regions where farmers have limited access to agricultural extension services or technical resources.

# **Related Work**

The integration of AI in agriculture has seen significant growth, with various systems addressing specific aspects of farming challenges:

Recent studies have explored using large language models for agricultural advisory systems but highlighted challenges in local adaptation and multilingual capabilities. Other research has focused on crop-specific AI applications, particularly for disease detection and yield prediction through computer vision.

Building on these foundations, the AI Assistant for Farmers addresses several gaps in existing agricultural AI solutions:

* It prioritizes natural language interaction over complex interfaces
* It focuses on practical advice delivery rather than purely predictive analytics
* It incorporates multilingual capabilities essential for diverse farming communities

It generates customized care plan adaptable to small scale farming operation.

# **System Architecture**

* 1. **Technical Components**

The AI Assistant for Farmers is built on a streamlined architecture:

* + 1. **Frontend Interface** - Implemented using Streamlit, providing an intuitive web-based user interface accessible across devices.
    2. **Language Model Integration** - Powered by Groq's API to access the LIama3-8b-8192 model.
    3. **Language Selection System** - Allows users to choose output language preferences.
    4. **Two Core Modules:**
       - Question-answering system for general farming queries.
       - Crop care plan generator for small-scale farmers.
  1. **LLM Selection and Integration**

The system utilizes Groq's implementation of the LIama3-8b-8192 model, selected for:

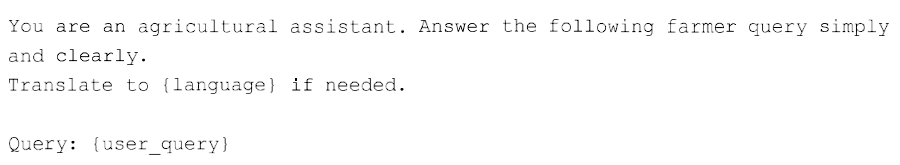
* Strong performance on agricultural domain tasks.
* Efficient inference speed for real time responses.
* Multilingual capabilities.
* Relatively compact model size suitable for scaling.

The model is accessed through Groq's API, with carefully crafted prompts designed to elicit domain- specific agricultural knowledge and advice.

* 1. **Prompt Engineering**

Prompt engineering critical to the system's effectiveness. Two primary prompt templates are implemented:

**For general queries:**



**For crop care plan generation:**

A close up of text

AI-generated content may be incorrect.

These prompts are designed to:

* Establish the agricultural context for the model.
* Request simple, clear responses suitable for diverse literacy levels.
* Specify translation requirements based on user language preference.
* Focus on practical, actionable advice.

# **Key Features and Functionalities**

* 1. **Multilingual Support**

A core feature of the system is language flexibility, currently supporting:

* English (default)
* Hindi

This addresses a critical need in agricultural advisory systems, as many farmers in developing regions face language barriers when seeking agricultural information. The translation is handled directly by LLM rather than requiring separate translation services, streamlining the architecture.

**4.2** **General Agricultural Question-Answering**

The system provides responses to a wide range of agricultural queries, including but not limited to:

* Crop disease identification and treatment.
* Fertilizer selection and application.

Pest control methods.

* Irrigation practices
* Soil health management
* Harvest timing and techniques

**4.3 Customized Crop Care Plans**

The crop care plan generator creates weekly management schedules customized to:

* Specific crop requirements.
* Small-scale farming contexts.
* Basic irrigation, fertilization, and pest management needs.

This feature helps farmers implement structured approaches to crop management without requiring extensive agricultural training.

# **Implementation Details**

* 1. **Development Environment**
* Python 3.9+
* Streamlit 1.28.0+ for the web interface.
* Groq Python client for API integration.
  1. **User Interface Design**

The Streamlit interface includes:

* A clean, mobile-friendly layout.
* Language selection dropdown in the sidebar.
* Separate sections for quest on-answering and crop care plan generation.
* Minimal text input requirements for ease of use.
* Clear output Formatting.
  1. **API Integration**

The system integrates with Groq's API through a dedicated function that:

* Handles authentication using the API key.
* Manages request formatting and transmission.
* Provides error handling for failed requests.
* Returns formatted responses to the user interface.

# **Advantages and Limitations**

* 1. **Advantages**
* **Accessibility:** Simple interface usable across devices with minimal training.
* **Language Support:** Multilingual capabilities overcome significant barriers to information access.
* **Low Resource Requirements**: Lightweight implementation suitable for deployment in areas with limited computational infrastructure.
* **Practical Focus:** Emphasis on actionable advice rather than purely theoretical information.
* **Modularity:** Easy to extend with additional features or language support.
  1. **Limitations**
* **Connectivity Dependency:** Requires internet access to function.
* **Model Knowledge Boundaries:** Limited to information available in the LLM's training data.
* **Verification Mechanisms:** Lacks integration with external data sources to verify advice.
* **Limited Crop Database:** Currently has no structured database of crop-specific information.

# **Future Directions**

Future versions could implement:

* Expanded language support for additional regional languages.
* Integration with local weather data for context-aware recommendations.
* Image-based disease identification capabilities.
* Offline functionality for areas with intermittent connectivity.
* Voice interface for users with limited literacy.
* Region-specific agricultural practice recommendations.
* Integration with structured agricultural databases for enhanced accuracy.

# **Conclusion**

The AI Assistant for Farmers demonstrates the potential of generative AI to transform agricultural knowledge dissemination through an accessible, multilingual approach. By leveraging Groq's implementation of the Llama3 model, the system provides expert agricultural advice and generates customized crop care plans in the farmer's preferred language.

The system's lightweight design makes it particularly suitable for deployment in areas with limited computational resources while still offering sophisticated capabilities. The focus on multilingual support directly addresses one of the most significant barriers in agricultural knowledge acces

While the current implementation represents a valuable tool for immediate agricultural information needs, future enhancements in regional customization, knowledge verification, and connectivity options would further increase its utility and impact. The system serves as both a practical tool for farmers and a foundation for more advanced agricultural AI applications.

By bridging the gap between complex agricultural information and practical farming implementation, the AI Assistant for Farmers contributes to the broader goal of leveraging technology for sustainable agricultural development and improved food security.

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