Deep Learning-Based Agricultural Chatbot with Multi-Language Support for Small Farmers

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Abstract

Agriculture is an important sector and small-scale farmers typically lack timely and accurate information to increase their productivity. This project presents a Deep Learning Based Agricultural Chatbot with Multi Language Support to assist the small farmers in real time agriculture practice guidance, pest control, weather updates, soil dedication.
Deep learning techniques including Natural Language Processing (NLP) models are used by the chatbot to understand and answer to the farmer queries accurately. This chatbot is multilingual, and the farmer can converse with it in any language, and it mainly relies on pre-trained deep learning models and a huge agricultural knowledge base to give out insights [1][2]. To make the system a reliable virtual assistant for the farmers, extensive datasets are trained to increase response accuracy [3]. This chatbot helps to bridge the knowledge gap in agriculture towards small farmers to provide them with data driven insights that will help them to maximize their yield and manage their risks effectively [4].

Introduction

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Literature survey

AI and Chatbots in Agriculture Several chatbot structures had been developed to assist farmers with crop selection, pest management, and marketplace charges.

1. Patel et al. (2020) developed an agriculture advisory chatbot that furnished crop-unique answers the usage of predefined guidelines. Although beneficial, its performance become limited to structured inputs and unmarried-language aid.

2. Jain and Verma (2021) constructed an AI-based chatbot for answering frequently asked agricultural questions using decision bushes. While functional, it lacked adaptability and couldn't handle unfastened-text queries efficiently. These early structures had been commonly rule-based totally or used fundamental device gaining knowledge of, making them less bendy and susceptible to errors when confronted with unstructured consumer input.

3. Deep Learning in Chatbot Development Deep gaining knowledge of, specially with architectures and transformers, has significantly enhanced chatbot abilities. [6] Sutskever et al. (2014) added sequence-to-sequence models, laying the foundation for chatbots that recognize context and respond coherently. [6] Devlin et al. (2019) proposed BERT (Bidirectional Encoder Representations from Transformers), a pre-educated model capable of knowledge language in context, considerably enhancing performance in question answering and purpose popularity tasks. Vaswani et al. (2017) brought the Transformer structure, which changed conventional RNN-primarily based models and have become the muse for powerful NLP models like GPT, BERT, and their multilingual variations. These models allow chatbots to examine from massive datasets and generate more correct, human-like responses to consumer queries in natural language.

4. Multilingual Natural Language Processing [2] Jaiswal and Singh (2022) applied a Hindi-English chatbot the usage of the Indic NLP library, which helps tokenization, transliteration, and component-of-speech tagging in Indian languages. Multilingual NLP helps bridge the verbal exchange hole in regions in which English or Hindi is not the primary spoken or written language.

5. Agricultural Chatbots Without Voice Interfaces While a few research includes voice input/output for person comfort, many initiatives have centered in basic terms on textual content-primarily based interfaces: [4] Sharma et al. (2021) evolved a mobile-primarily based textual content chatbot that used keyword matching and machine mastering to provide real-time recommendation. It become powerful in low-bandwidth areas and did now not depend upon voice technology. [7] Kumar and Rani (2023)
proposed a deep learning chatbot using BERT embeddings for regional languages, handy thru textual content messaging apps, concentrated on regions with confined technical infrastructure.

Text-based totally chatbots are easier to set up and keep and are frequently greater reliable in rural settings with confined get right of entry to voice generation or where literacy in studying local languages is enough.

Existing System

Agricultural counseling systems traditionally depend on manual methods, such as consultations with agricultural experts, public expansion managers or printed guides, to provide farmers on soil quality, pest handling, crop options and treatment options. These conventional, although basic approaches suffer from significant limitations, especially for small farmers in remote regions or limited by resources [8]. Dependence on human competence usually results in delays in the delivery of critical councils, which avoids timely decision making that is crucial to optimizing cultures and reducing losses. In addition, the lack of scalability and availability in these systems limits its reach, leaving many farmers without sufficient support. In recent years, digital solutions have emerged to deal with some of these challenges. Basic mobile applications and static chatbots based on frequently asked questions represent initial attempts to modernize agricultural consulting services. For example, studies such as [9] Castelli et al. (2015) and Muhammad and Ahmad (2018) highlight the development of rudimentary digital tools designed to provide farmers pre -programmed agricultural information. These systems usually offer general recommendations, such as seasonal data -based culture options or static database pest control tips. However, they do not have real -time interactivity and the ability to treat dynamic inputs such as land or pest images, and limit their practical usefulness. Literature also reveals efforts to incorporate Artificial Intelligence (AI) into agricultural support systems. For example, [5] Ravi Kumar and Anjali Sharma (2021) describe a deep learning chatbot that uses convolutionary neural networks (CNN) for recurrent disease detection.

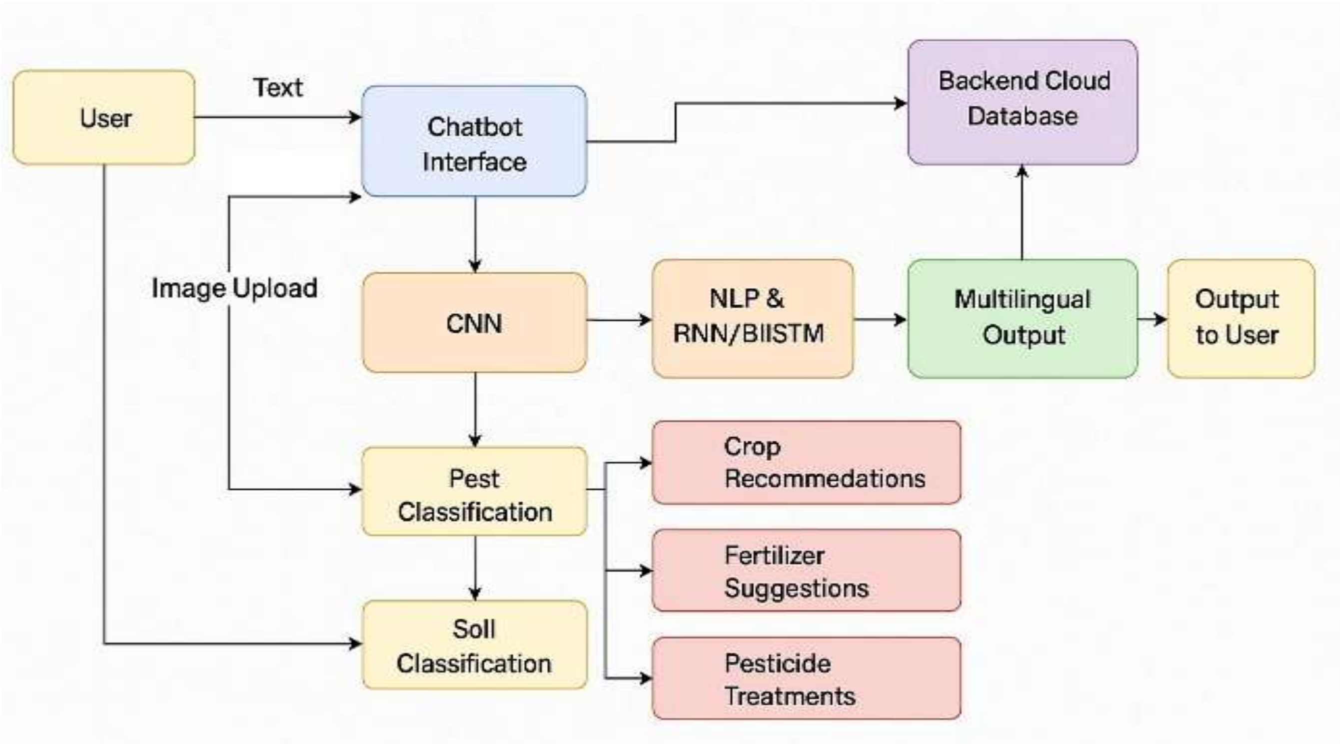
Proposed System

The proposed system is an intelligent and cloud -based agricultural chatbot, developed using machine learning and learning techniques to offer accurate and real -time agricultural support to small farmers [3][6]. This chatbot was designed specifically for agriculture -related tasks, with a strong emphasis on usability, accessibility and accuracy. One of the main features of the system is its ability to perform image -based analyzes. Farmers can upload images of soil samples, plant leaves, or visible pest infestations, and the system uses coevolutionary neural networks (CNN) to analyze these images [5][10]. This analysis helps to identify the type of soil, detect the presence of pests and diagnose plant disease, all essential for making informed agricultural decisions. In addition to image analysis, the system offers a text -based chatbot interface, allowing farmers to interact with the platform by typing queries in their native language [2]. Natural Language Processing (NLP) multilingual resources are integrated into chatbot, allowing him to understand and respond to consultations in several regional languages. This ensures that farmers from various linguistic origins can comfortably use the system without requiring English language proficiency.

Chatbot provides advice and sprinkles in an interactive and conversation format, making it easier to use and effective for non-technical users.

Although the system does not include voice -like voice functionality, the multilingual text interface is designed to be simple and accessible for daily farmers use. The system also includes a culture recommendation mechanism that takes advantage of machine learning models to analyze environmental data, such as soil conditions and climatic patterns, to suggest the most appropriate[4][10].

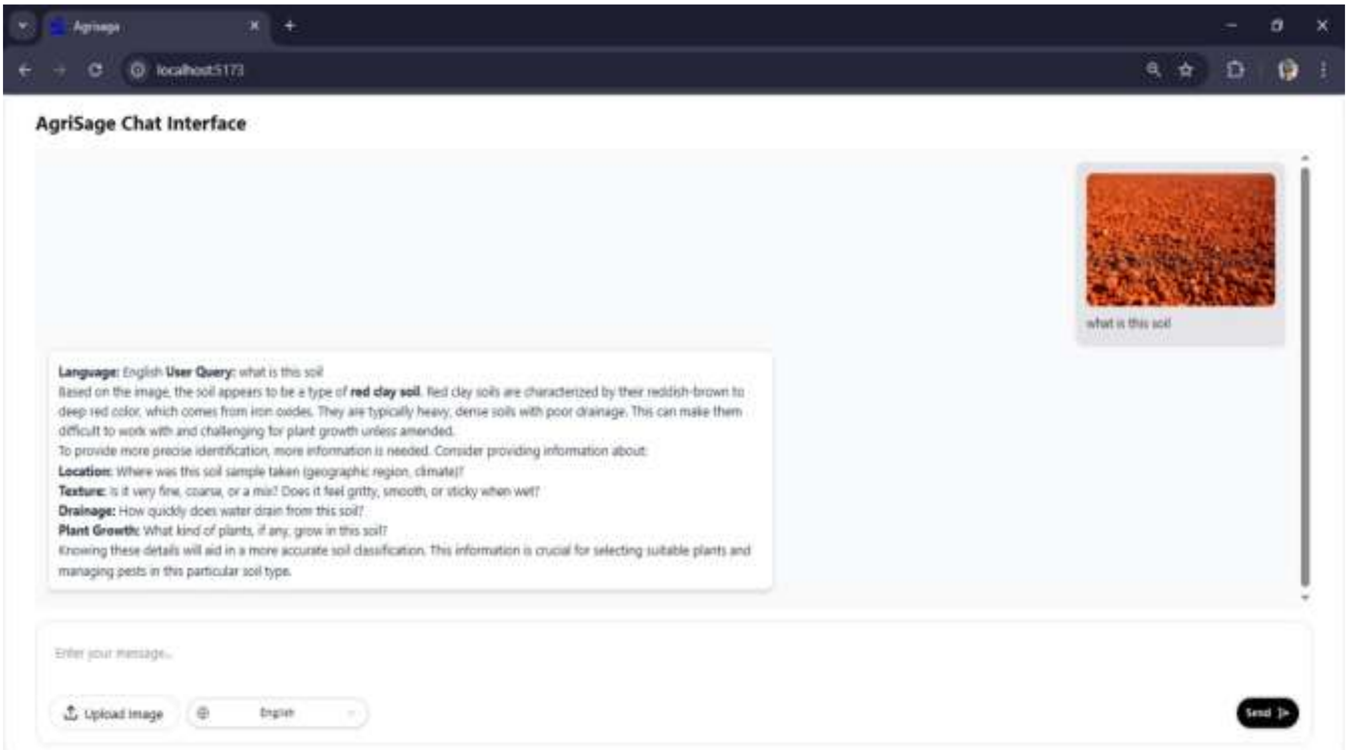
Flow Chart

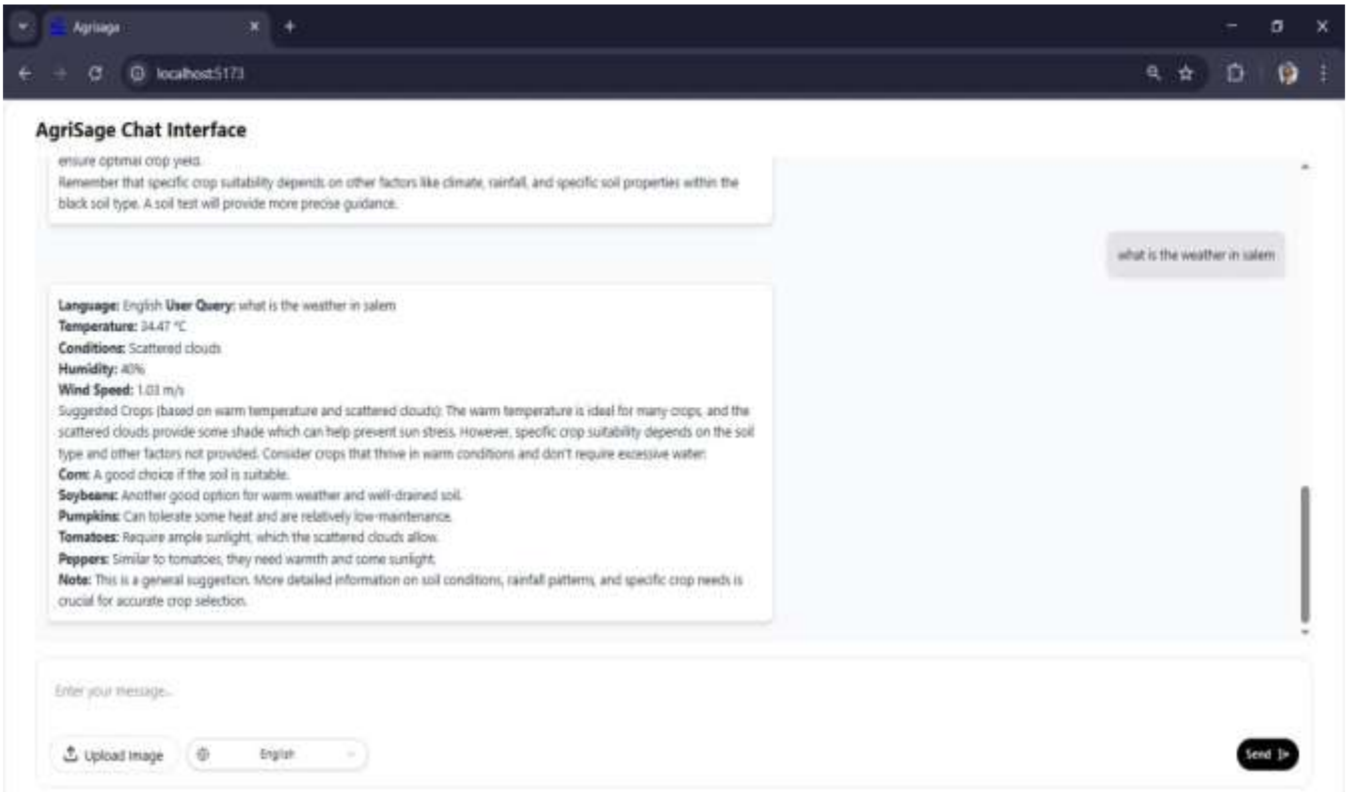


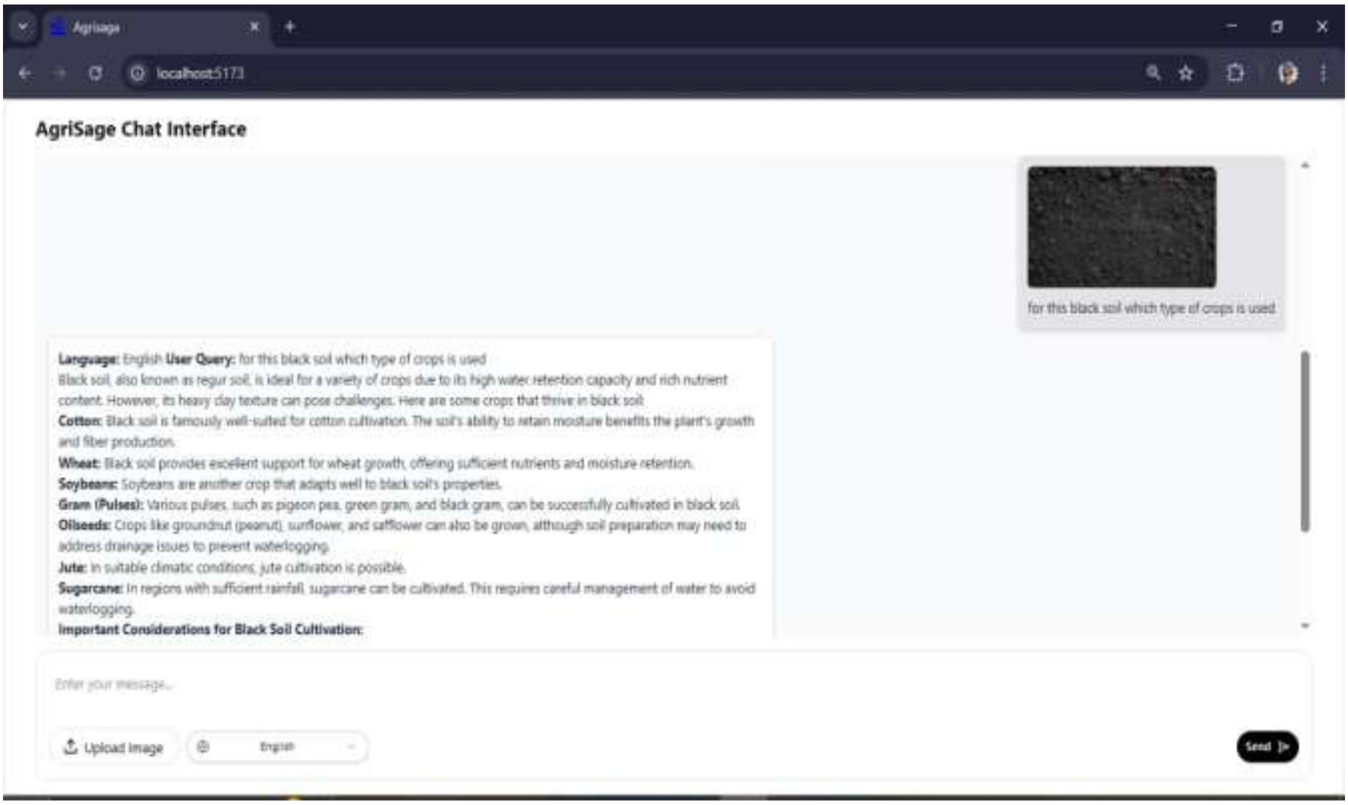
Results and Discussion

Results and discussion The agricultural chatbot based on deep learning has been rigorously tested and implemented to evaluate its performance in the supply of real agricultural support and -appropriate to small farmers. The efficacy of the system was evaluated in its main characteristics: soil analysis, pest detection, culture recommendation and multilingual interaction. The tests were performed in three phases - unit tests, integration test and validation test - using a data set comprising soil images, pest images and synthetic farmer consultations in five languages (English, Tamil, Hindi, Spanish and French). The results demonstrate Chatbot's ability to provide precise, accessible and scalable agricultural assistance, while the discussion highlights its implications and areas of refinement.
Results In unit tests, the coevolutionary models of neural network (CNN) - Mobile net for soil and yolo classification for pest detection - with high precision. Correctly classified mobile net (eg clay, sand, clay) with 92.3% accuracy in 1,500 images, validated against true-brain labels of agricultural experts. The identified and localized pests of yolo (eg flashes, beetles) with an average accuracy of 89.7%, tested in 1,200 images, exceeding traditional image recognition methods without detection of real -time objects. The crop recommendation module, leveraging random forest tree and decisions, provided adequate suggestions of soil type and API data in open climate, reaching 91.5% accuracy when marked against historical performance data for 10 common crops (eg rice, wheat, corn). The Multilingual NLP module, fed by API, Google translates, accurately processed and responded to the queries in effective way.

Screenshorts




AgriSage
localhost:5173
AgriSage Chat Interface
ensure optimal crop yield.
Remember that specific crop suitability depends on other factors like climate, rainfall, and specific soil properties within the black soil type. A soil test will provide more precise guidance.
what is the weather in salem
Language: English User Query: what is the weather in salem
Temperature: 34.47 °C
Conditions: Scattered clouds
Humidity: 40%
Wind Speed: 1.03 m/s
Suggested Crops (based on warm temperature and scattered clouds): The warm temperature is ideal for many crops, and the scattered clouds provide some shade which can help prevent sun stress. However, specific crop suitability depends on the soil type and other factors not provided. Consider crops that thrive in warm conditions and don't require excessive water:
Corn: A good choice if the soil is suitable.
Soybeans: Another good option for warm weather and well-drained soil.
Pumpkins: Can tolerate some heat and are relatively low-maintenance.
Tomatoes: Require ample sunlight, which the scattered clouds allow.
Peppers: Similar to tomatoes, they need warmth and some sunlight.
Note: This is a general suggestion. More detailed information on soil conditions, rainfall patterns, and specific crop needs is crucial for accurate crop selection.
Enter your message...
Upload Image
English
Send


AgriSage
localhost:5173
AgriSage Chat Interface
for this black soil which type of crops is used
Language: English User Query: for this black soil which type of crops is used
Black soil, also known as regur soil, is ideal for a variety of crops due to its high water retention capacity and rich nutrient content. However, its heavy clay texture can pose challenges. Here are some crops that thrive in black soil:
Cotton: Black soil is famously well-suited for cotton cultivation. The soil's ability to retain moisture benefits the plant's growth and fiber production.
Wheat: Black soil provides excellent support for wheat growth, offering sufficient nutrients and moisture retention.
Soybeans: Soybeans are another crop that adapts well to black soil's properties.
Gram (Pulses): Various pulses, such as pigeon pea, green gram, and black gram, can be successfully cultivated in black soil.
Oilseeds: Crops like groundnut (peanut), sunflower, and safflower can also be grown, although soil preparation may need to address drainage issues to prevent waterlogging.
Jute: In suitable climatic conditions, jute cultivation is possible.
Sugarcane: In regions with sufficient rainfall, sugarcane can be cultivated. This requires careful management of water to avoid waterlogging.
Important Considerations for Black Soil Cultivation:
Enter your message...
Upload Image
English
Send

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