Dr. Cotton: An Interactive Chatbot for Cotton Crop Management

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INTRODUCTION

AI-powered decision support systems are transforming agriculture by facilitating **data-driven crop management**. This work presents a **chatbot** that integrates **artificial intelligence** and **digital twin** models to support decisions such as **yield forecasting**, **irrigation scheduling,** and **growth regulator use**.

Through a conversational interface, the system provides **actionable recommendations** based on processed canopy information from **UAV-derived imagery**. This enables users to make **informed decisions** and **improve productivity.**

RESEARCH QUESTIONS

- How can AI-powered chatbots enhance decision-making in precision agriculture?
- What is the impact of integrating a digital twin model into an agricultural chatbot for yield prediction?

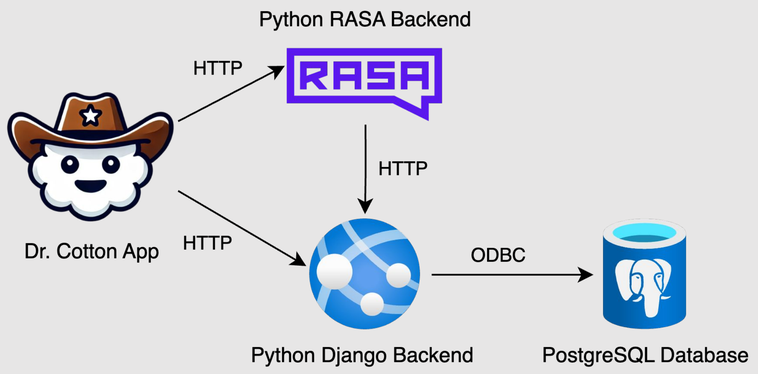
METHODOLOGY

Using a conversational interface, AI models, and field-collected data, this system supports data-driven crop management. **UAV imagery** is processed to monitor canopy development, while a **digital twin model** simulates crop growth to forecast yield and detect critical areas. Farmers interact with the system via natural language queries through a **Flutter**-based mobile app. The **RASA**-powered chatbot interprets user intent and delivers context-specific recommendations, such as whether to apply growth regulators. As new data is gathered, the system refines its outputs, enabling accurate and adaptive **management** throughout the season.

SYSTEM ARCHITECTURE

- **Flutter:** Provides an intuitive mobile interface for seamless user experience.
- **RASA:** Enables intelligent chatbot interactions by interpreting user intent and triggering appropriate responses.
- **Django:** Handles user queries, processes agricultural data, and interacts with the database.
- **PostgreSQL DB:** Stores historical data for canopy features, predictions, and user interaction logs.

IMPLEMENTATION DIAGRAM

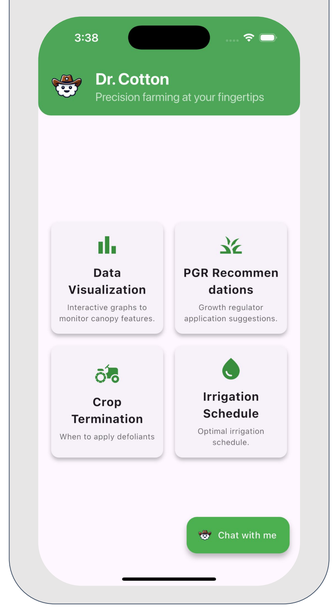


KEY FEATURES

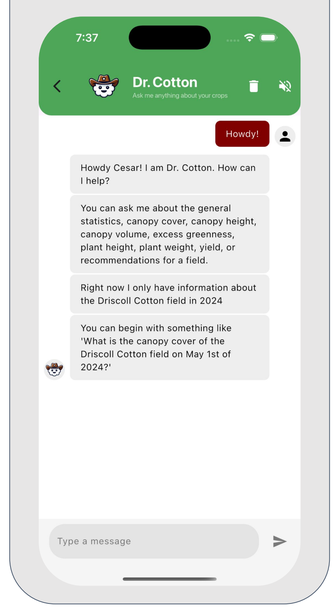
- Query **canopy features** to support crop management decisions, such as:
  - Canopy cover
  - Canopy height
  - Canopy volume
  - Excess greenness
- Provide **yield predictions** based on digital twin simulations.
- Generate **heatmaps** for all canopy characteristics to identify critical field sections and support targeted interventions.
- Offer **growth regulator recommendations** based on field conditions.
- Deliver **responses through a natural language interface**, allowing intuitive access to complex agronomic data.
- Enable **informed decision-making** by combining processed UAV-derived imagery with predictive modeling.

RESULTS

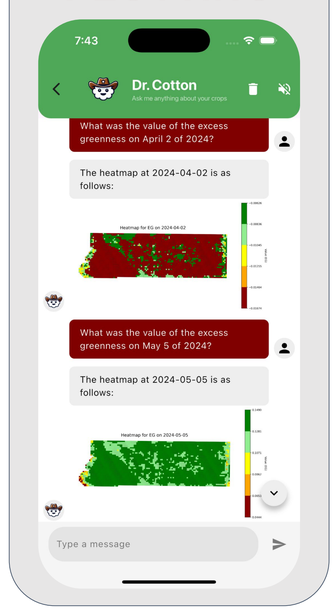
WELCOME SCREEN



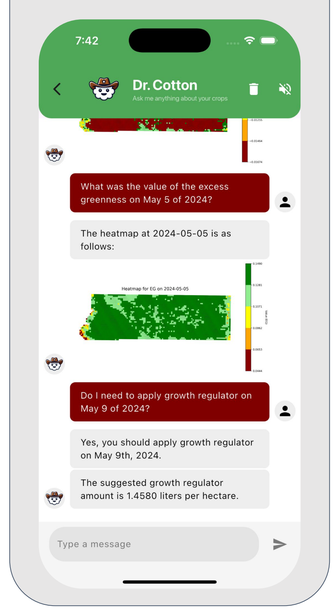
INTERACTIVE CHATBOT



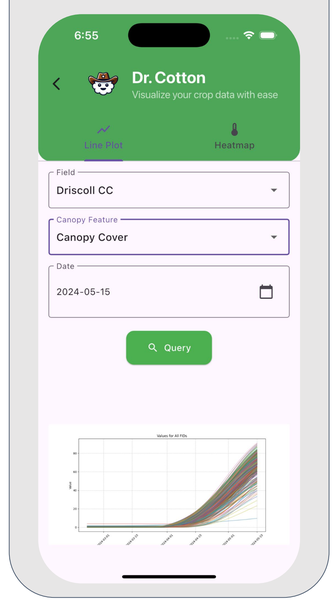
HEATMAP PLOTTING



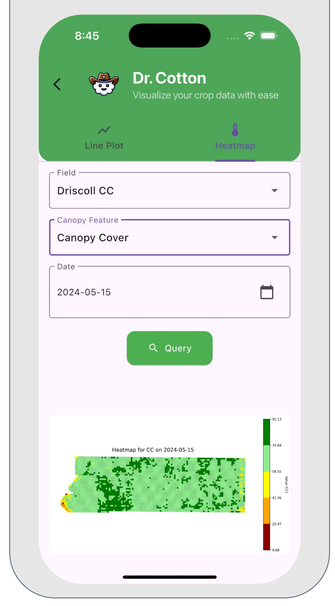
PGR APPLICATION



LINE CHART PLOT VIEW



HEATMAP PLOT VIEW



FUTURE WORK

Future versions of the tool will include **financial decision support**, therefore helping farmers to evaluate the **cost-effectiveness** of several interventions. Upcoming improvements include **irrigation scheduling** and **crop termination assistance**, therefore increasing **accuracy** and **data-driven crop management**.

CONCLUSIONS

This tool offers a **revolutionary approach** to crop management by integrating **AI**, **digital twins**, and **natural language processing**. It turns complex agronomic data into **actionable insights** through a **chatbot interface**, empowering farmers make **sustainable** and **effective decisions**. The project strengthens the connection between **digital tools** and **real-world farming challenges**, contributing to a **smarter, more resilient agricultural sector.**