MacBot Farmer Assistant

1.1 Introduction

In Kenya and many other African countries, agriculture continues to be a major force behind economic growth. Macadamia nuts are one of the high-value crops that have become well-known due to its nutritional and economic worth. However, growing macadamias organically poses special difficulties, particularly for smallholder farmers who have little access to technical assistance, real-time data, and professional advice.

1.2 Problem Statement

Even if organic farming is becoming more popular, small-scale macadamia farmers still face a number of obstacles: Restricted availability of knowledgeable agronomic guidance based on organic standards. The incapacity to determine if the soil and environmental circumstances are suitable for planting due to lack of enough resource that help the farmers. Inadequate communication of best practices for harvesting, certification, and pest control
Lack of access to extension services because of financial constraints or distance .Many farmers suffer from lower yields, poor nut quality, and restricted market access for certified organic products in the absence of timely and accurate information.

1.3 The Solution

MacBot Farmer Assistant is an AI-powered Chabot and prediction tool designed to assist farmers practicing organic macadamia farming. Built using modern machine learning, natural language processing (NLP), and interactive interfaces, MacBot aims to bridge the knowledge and support gap for these farmers who practice organic farming for macadamia in Kenya.

1.4 Objectives

The main goal of this project is to create an intelligent digital assistant that enhances decision-making in organic macadamia farming. Specific objectives include;

1. To Design an AI Chabot to provide expert-level responses on organic macadamia farming practices.

2. To build a machine learning model to predict favorable farming conditions based on environmental and farm data.
3. To develop a web-based user interface using Streamlit to enable easy interaction with the system.

Methodology

a. System Architecture

4. MacBot Farmer Assistant consists of two major components:

   1. AI Chabot – Built using the Llama model and OpenAI API, this component processes farmer queries and responds with natural, context-aware advice.

   2. Prediction Module – A supervised machine learning model (Random Forest) that uses input features (Soil pH, Rainfall, Acreage, Tree Count) to predict if the farming conditions are favorable.

b. Tools and Technologies

The following tools were used to during the project implementation phase;

- Streamlit was used for web application frontend.
- Llama and OpenAI models used in Natural Language Understanding to provide responses for the Chabot.
- Scikit-Learn for training Machine learning model and that is Random Forest
- Pandas for data processing that include data cleaning and data transformation.
- Python for Backend and logic integration of modules

c. Data Collection

The model was trained using a dataset that includes historical information on:

- Soil pH levels across regions
- Average seasonal rainfall
- Land size in acres
- Number of trees per acre
- Season

Missing data was handled using imputation techniques, and the dataset was split into training and test sets (80/20) to evaluate performance.

Conclusion

MacBot Farmer Assistant presents a transformative approach to supporting organic macadamia farmers by integrating artificial intelligence into everyday agricultural decision-making. By offering expert guidance through a conversational Chabot and leveraging predictive analytics for farm condition assessment, the tool empowers smallholder farmers with actionable insights and accessible knowledge.

Its user-friendly interface, built on Streamlit, ensures inclusivity, while its adaptability opens doors for future improvements like multilingual support and voice interaction. Ultimately, MacBot contributes to more sustainable, productive, and informed organic farming practices across Kenya and beyond.

Appendix

Figure 1.1

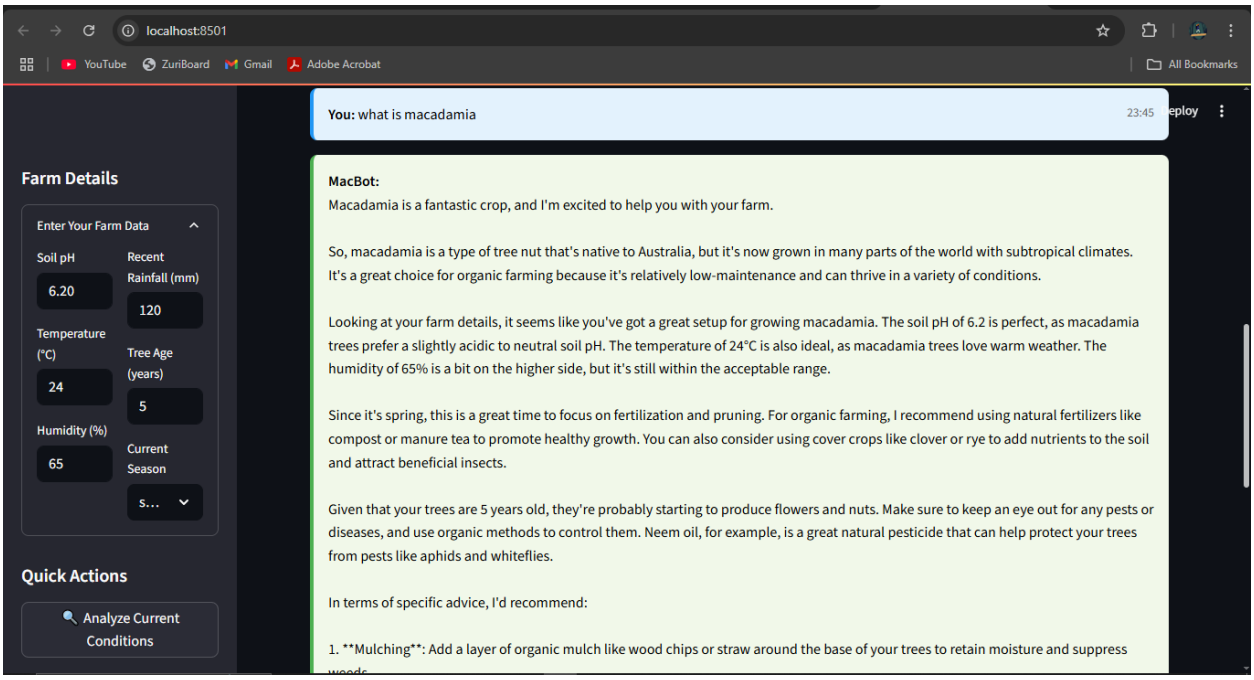
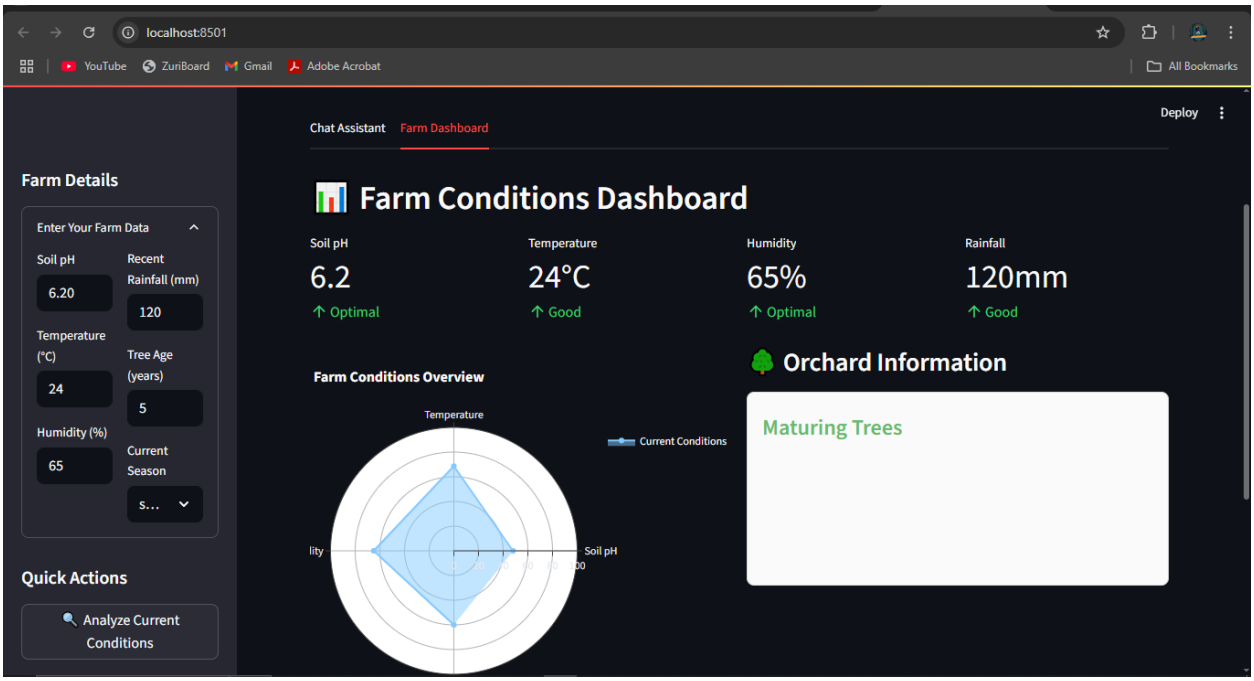


Figure 4.2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Farm Details
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Soil pH
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Recent Rainfall (mm)
120
Temperature (°C)
24
Tree Age (years)
5
Humidity (%)
65
Current Season
S...
Quick Actions
Analyze Current Conditions
Farm Conditions Dashboard
Soil pH
6.2
Optimal
Temperature
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