Personal Project Report

Project Title: Satellite Crop Monitoring System using Remote Sensing and Streamlit Dashboard

Brief Description:

This project aims to provide farmers and agricultural stakeholders with a smart dashboard for monitoring crop health over time using satellite-based vegetation indices and true color imagery. The system allows interactive visualization of crop metrics, historical analysis, and animated growth monitoring. It is built with Streamlit and integrates mapping tools like Folium and GeoPandas to deliver a user-friendly geospatial experience.

GitHub Link for Code: https://github.com/sandipanrakshit34/satellite-crop-monitoring

Objectives:

- To track and visualize crop health using remote sensing indices (NDVI, LAI, CAB).
- To help farmers monitor changes through true color satellite imagery and time-series charts.
- To provide tools for field boundary digitization and metadata entry (crop type, season).
- To enable historical analysis using animated imagery for growth stage comparison.
- To support future integration of predictive analytics and field alert systems.

Tools/Tech Used:

- **Streamlit** (Frontend Web Dashboard)
- **Folium & streamlit-folium** (Interactive Mapping)
- **GeoPandas, Pandas, JSON, NumPy** (Data Processing)
- **Remote Sensing Metrics (NDVI, LAI, CAB)**
- **Satellite Imagery** from open datasets or pre-downloaded sources
- **Python**
- **True Color Visualization & GIF Generation**

Methodology/Implementation:

Field Setup & Interface Design:

- A home page allows users to view all existing fields on an interactive map.
- Fields are color-coded based on crop types and stored in a GeoJSON file.
- Users can draw new field boundaries using map tools and input metadata like crop type and season.

Vegetation Indices Integration:

- Users select a field and a date to view specific vegetation index maps.
- Metrics such as NDVI, LAI, and CAB are visualized over time with color-coded layers.

True Color Imagery Analysis:

- True Color satellite images can be viewed for selected dates and fields.
- A processed image is shown alongside download options.

Time-Series Analysis & GIF Creation:

- A historical visualization section allows users to select a time range and generate animated GIFs to track crop development.
- Images are processed sequentially and compiled into downloadable time-lapse animations.

Data Management:

- A commit system ensures changes are saved only after visual verification.
- Users can reject or accept newly added field data to maintain dataset integrity.
- Source data is archived before every commit to avoid accidental data loss.

Validation:

- Functional validation was conducted through simulated data entries and real-time interaction testing.
- Each component (field creation, visualization, time-series chart, GIF generation) was tested for responsiveness and correctness.
- Performance was assessed in terms of dashboard usability and correctness of rendered data layers.

Results/Performance:

- Enabled successful interactive monitoring of crop health through vegetation indices.

- Users can visually explore how crops evolve over time using True Color images and time-lapse GIFs.
- Simplified the data entry and visualization workflow for farm-level monitoring using only a browser interface.
- The platform is extendable and ready for future integration of machine learning-based prediction and alert systems.

Future Work:

- **Predictive crop yield modeling** using historical data and weather APIs.
- **Field comparison tools** for benchmarking crop performance.
- **Integration of meteorological data** (e.g., rainfall, temperature).
- **Automated alerts** based on vegetation index thresholds.
- **User profile management** for multi-farmer support.

Conclusion:

The **Satellite Crop Monitoring System** successfully demonstrates how remote sensing data and modern web technologies can be combined to empower farmers and agricultural researchers. Through an interactive Streamlit dashboard, users can monitor field-specific crop health, explore historical trends, and visualize true-color imagery with ease.

The project serves as a step towards **data-driven agriculture**, offering real-time insights, interactive mapping, and temporal analysis in a user-friendly interface. With its modular structure, the system is well-positioned for future enhancements like predictive analytics, alert systems, and integration with weather and soil data.

This solution not only enhances situational awareness for stakeholders but also promotes sustainable and informed farming practices.