Smart Irrigation System using Soil Moisture and Weather Data

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Learning Objectives :

- **Understand the application of machine learning in agriculture**, particularly in irrigation automation.
- **Learn how to preprocess and handle real-world sensor data** for training classification models.
- **Build and train a multi-output machine learning model** using Random-Forest to predict multiple outputs simultaneously.
- **Apply AI techniques to solve water wastage problems** through precise sprinkler control decisions.
- **Use Stream-lit to develop a real-time, interactive web-based system** for farmers to input sensor values and get sprinkler status instantly.
- **Develop practical skills in Python, pandas, scikit-learn, and job-lib** for building and deploying end-to-end AI solutions.

Source : www.freepik.com/

Tools and Technology used :

Programming & Development:

- **Python 3.11** – Programming language used for all backend logic
- **Jupyter Notebook** – Used for initial model training and experimentation
- **Visual Studio Code (VS Code)** – Used to build and organize the final app

Libraries & Frameworks:

- **Pandas** – For handling sensor data and preprocessing
- **Numpy** – For converting input arrays before prediction
- **scikit-learn** – For model training (RandomForest + MultiOutputClassifier)
- **Joblib** – To save and load the trained .pkl model file
- **Streamlit** – For developing the interactive web interface with sliders

Deployment & Execution:

- **Streamlit Localhost** – Used to test and run the web app on browser
- **Command Prompt / Terminal** – To execute the app.py

Methodology :

- **Data Collection :**
  → Collected a dataset with 20 sensor (0 – 1 values)

- **Data Preprocessing :**
  → Separated input (X) and output (y), checked for clean data

- **Model Training :**
  → Trained a Random Forest model to predict sprinkler ON/OFF status

- **Model Saving :**
  → Saved the trained model using .pkl(Farm_Irrigation_System.pkl) file

- **Deployment :**
  → Built a web app using Streamlit to input sensor values and show output

- **Testing :**
→ Tested by changing slider values and checking predicted results

- **Final Review** - Verified system accuracy and user-friendly working of the app

Problem Statement:

- Traditional irrigation methods often lead to **overwatering or underwatering**, causing **water wastage, crop stress**, and **reduced agricultural productivity**.
- Farmers manually operate sprinklers based on guesswork or fixed schedules, without real-time data from the field.
- There is a critical need for a **smart, automated irrigation system** that can make **data-driven decisions** using soil sensor readings to control water usage efficiently.

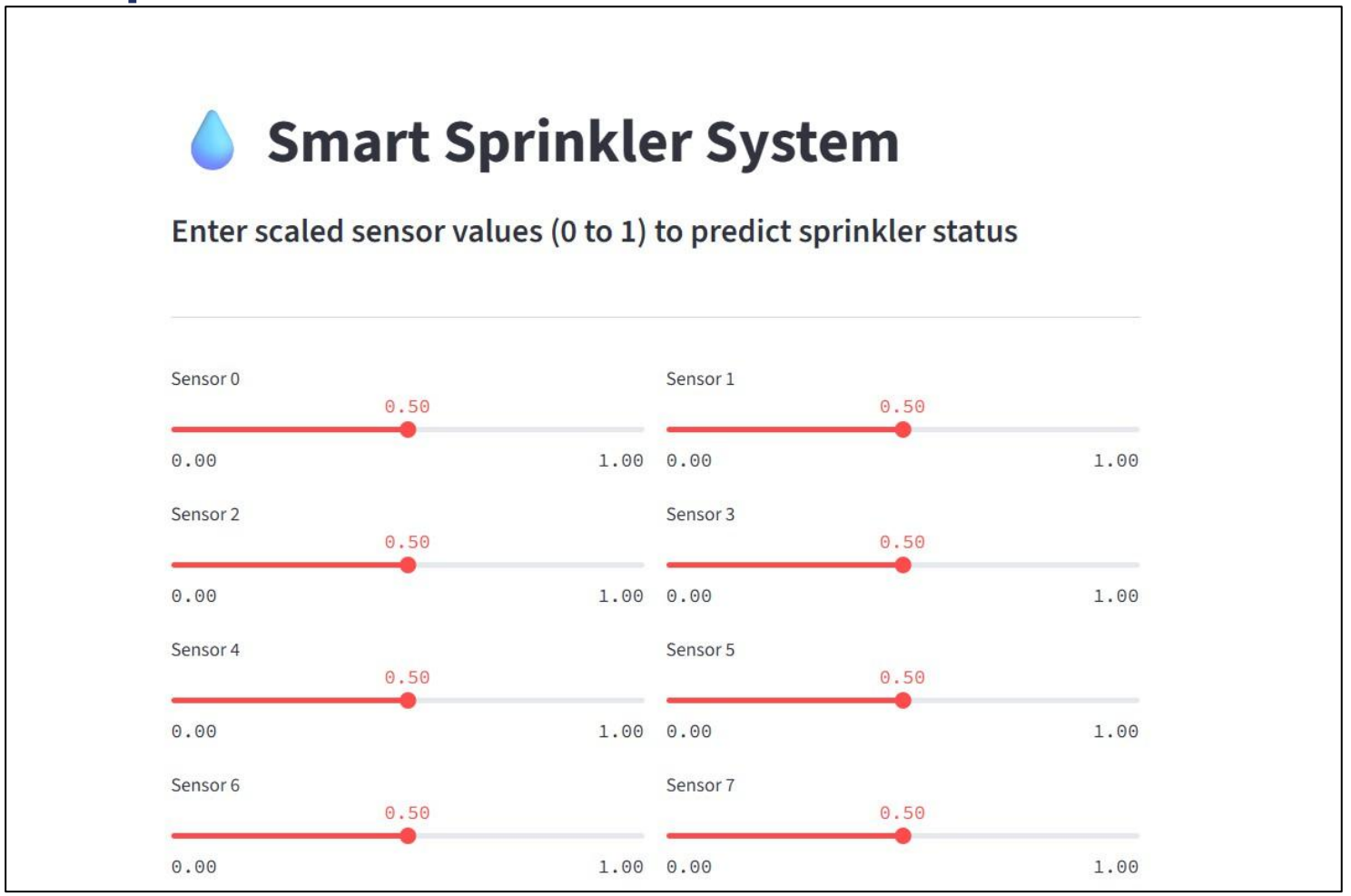
- **Finally -** Traditional irrigation lacks real-time decision-making, leading to water wastage and reduced crop productivity — highlighting the need for a smart, sensor-driven automated irrigation system.

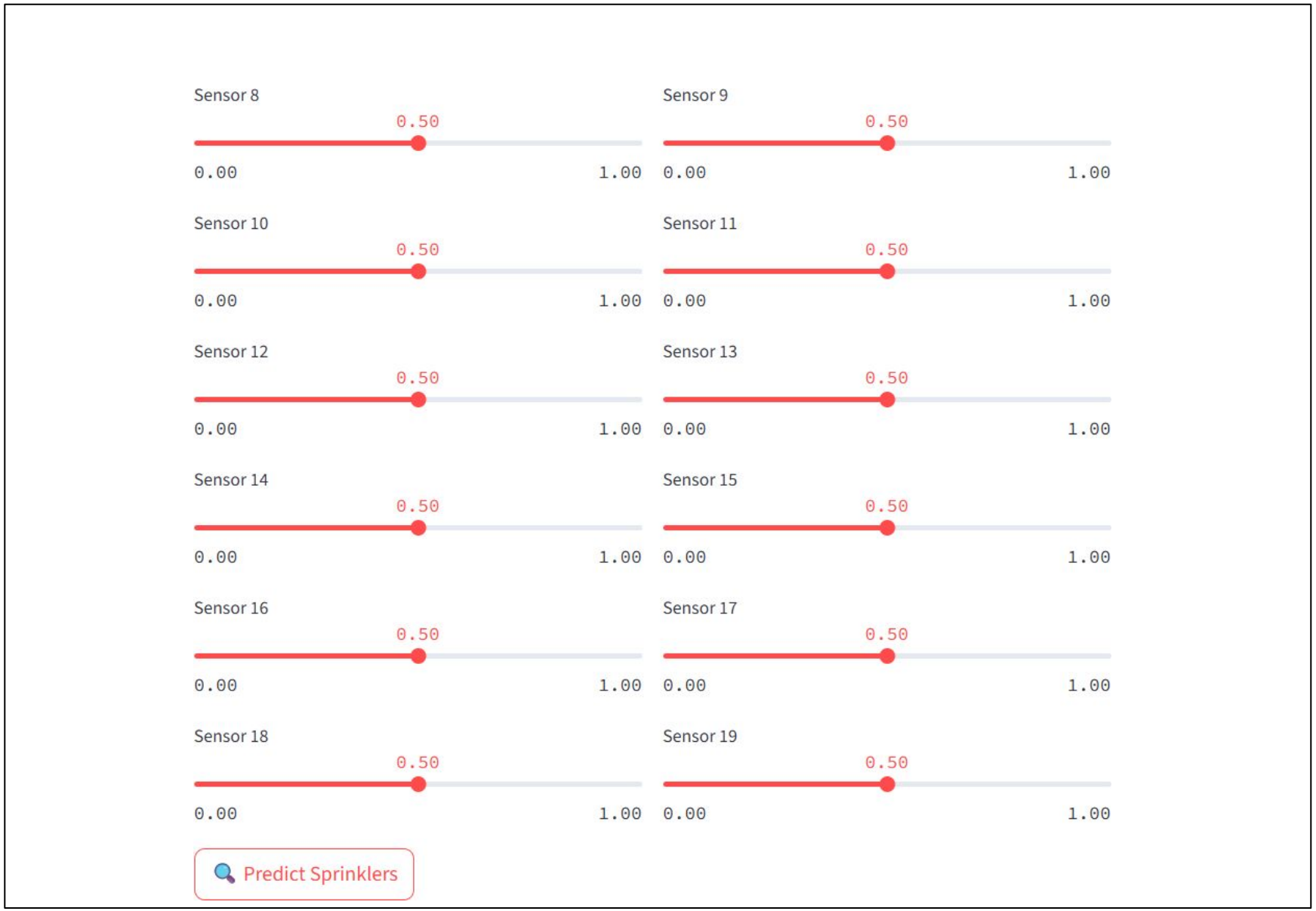
Solution:

- ✔ Developed a **smart irrigation system** using machine learning
- ✔ Used **soil sensor data (20 inputs)** to monitor field conditions
- ✔ Predicted **ON/OFF status** sprinklers automatically
- ✔ Built an **interactive web app** using Streamlit for real-time input and output
- ✔ Reduced water wastage and manual intervention in irrigation

GitHub Link : https://github.com/Sayedsabvali/Smart_irrigation/blob/main/Irrigation_System.ipynb

Screenshot of Output:




Sensor 8
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Sensor 10
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Predict Sprinklers

Sensor 16

0.50

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Sensor 17

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Sensor 18

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Sensor 19

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🔍 Predict Sprinklers

✅ Prediction Complete!

🌿 Sprinkler Status:

Sprinkler 0: 🟢 ON

Sprinkler 1: 🟢 ON

Sprinkler 2: 🔴 OFF

ℹ️ Note: This model predicts for only 3 sprinklers.

Conclusion:

- ✔ Successfully built a **smart irrigation system** using machine learning
- ✔ The system predicts sprinkler status based on real-time sensor values
- ✔ Automates irrigation decisions, reducing water wastage and human effort
- ✔ Built a Streamlit app with sliders for real-time input
- ✔ Helps save water and reduce manual work in farming
- ✔ Demonstrated practical use of AI and web apps in solving real-world problems