JSPM's
Rajarshi Shahu College of Engineering, Tathawade, Pune
(An Empower Autonomous Institute under Savitribai Phule Pune University)

Department of Computer Science and Business Systems
Artificial Intelligence Mini Project
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Title of Project<<Smart RainWater Harvesting Management System>>

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Introduction

- **Objective:** To provide an AI-powered solution for intelligent rainwater harvesting by using real-time weather data, rainfall forecasting, and optimized water usage planning.

- **Scope:** The project fetches NASA weather data, generates 7-day rainfall forecasts, optimizes water consumption with a genetic algorithm, and simulates tank levels through an interactive Streamlit dashboard**.**

- **Mapping With SDG Goal:**

  - **SDG 6: Clean Water and Sanitation**
  - **SDG 11: Sustainable Cities and Communities**
  - **SDG 13: Climate Action**

- **Key Features:**

  - Real-time NASA weather data integration
  - LSTM neural network for 7-day rainfall forecasting
  - Genetic algorithm for smart water usage optimization
  - Interactive Streamlit dashboard with Plotly visualizations
  - Tank simulation and location-based analysis

Algorithm Used

For Rainfall Forecasting

- **Chosen Algorithm: LSTM Neural Network**
- **Reason for Selection:**
  - It is ideal for time-series forecasting, which is necessary for predicting rainfall from historical data.
  - It can learn long-term dependencies in weather patterns, making forecasts more accurate.
  - Advantages:
  - High accuracy in modeling complex, non-linear data like rainfall patterns.
  - Effectively captures how weather data changes over time to improve predictions.

For Water Usage Optimization

- **Chosen Algorithm: Genetic Algorithm**
- **Reason for Selection**:
  - It is powerful for solving complex optimization problems with multiple constraints, like tank capacity and daily water usage.
  - It excels at searching through many possible solutions to find an optimal water usage plan that minimizes shortages.
  - Advantages:
  - It is robust and flexible, easily adapting to different constraints and scaling as needed.
  - It can find effective solutions for non-linear problems where traditional methods might not work well

Module

- **fetch_live_data_nasa.py**
  - **Implementation:** This module handles the integration with the NASA POWER API. It makes API calls to fetch real-time, daily weather data such as rainfall, temperature, and humidity for a user-defined location.
- **predict_live.py**
  - **Implementation:** This module uses a pre-trained LSTM (Long Short-Term Memory) neural network built with TensorFlow/Keras. It takes 30 days of historical rainfall data as input to generate a 7-day forecast.
- **ga_optimization.py**
  - **Implementation:** This module contains the genetic algorithm responsible for optimizing water usage. It creates a smart consumption plan designed to minimize water shortages by considering constraints like tank capacity and daily usage patterns.
- **tank_simulation.py**
  - **Implementation:** This module simulates the water level in the storage tank over time. It uses the output from the forecasting and optimization modules to create a realistic model of how the water level will change, helping to visualize the system's effectiveness.
- **dashboard.py**
  - **Implementation:** This is the main application file. It uses the Streamlit framework to build the interactive web dashboard. It integrates all the other modules, allowing the user to input data, run the models, and visualize the results using Plotly charts

Methodology & Results

Methodology:

- Data Acquisition: Collect real-time rainfall data via the NASA POWER API.
- AI Modeling: Forecast rainfall with an LSTM model and optimize water usage with a Genetic Algorithm.
- System Integration: Build an interactive Streamlit dashboard to control the models and visualize results.
- Validation: Test model accuracy (RMSE) and simulate system performance to validate effectiveness.

Results & Conclusion:

- The project delivers an effective AI-based system for smart rainwater management, providing accurate forecasts and optimized usage plans.
- Future scope: Planned enhancements include multi-location support, IoT sensor integration, and a mobile app.

References

- **Optimized scenario for rainfall forecasting using genetic algorithm-based artificial neural network**

This paper shows how a Genetic Algorithm can optimize a neural network for rainfall forecasting, directly combining your project's two main technologies.

- **Research on Rainfall Prediction Based on LSTM and Attention Mechanism**

This study improves LSTM accuracy by adding an Attention Mechanism, which helps the model focus on the most critical historical data—a great potential enhancement for your project.

- **Genetic algorithm for optimization of water distribution systems**

A foundational paper confirming that Genetic Algorithms are a powerful and well-established method for optimizing complex water distribution systems, validating your approach.