Project: Development and Testing of an Intelligent Adaptive System for Virtual Home Environment Management

Overview: This project requires you to transform the conceptual model designed in the earlier coursework into a functional software system. Your task includes programming, verifying, and validating the system while analyzing its performance. The delivered software should demonstrate intelligent and adaptive behavior for managing a virtual house's environment effectively.

Project Components:

Part 1: Software Delivery (38/50 Marks)

Develop a software application that models and manages the environmental conditions (temperature and humidity) of a virtual house. The application should incorporate intelligent adaptive features to optimize user satisfaction.

Software Requirements:

1. **Implementation Language:**

   Develop the system in **Java**, **Python**, or **Anylogic**.

2. **Functional Requirements:**

   - The software should process a provided training dataset to predict and manage the indoor temperature and humidity every **15 minutes**.
   - The predicted indoor temperature, and humidity values should be output to a .csv file with one row for each 15-minute interval.

3. **Environmental Control Methods:**

   The system must utilize two mechanisms for controlling the indoor environment:

   a. Mechanical Ventilation:

   - Operates for 15 minutes and aligns the indoor temperature and humidity with outdoor conditions.
   - When switched off, indoor conditions revert to their original state in 15 minutes.

   b. Storage Heaters:

   - Increase indoor temperature by **0.5°C** every 15 minutes.
   - This effect lasts for 4 hours, but the heaters can only be used **twice per day**.
   - Note: If mechanical ventilation is active, it negates the heating effect for the remaining duration of the 4-hour heating period.

4. **Additional Requirements:**

   - Include data cleaning to handle missing, inconsistent, or noisy values in the training data.
   - Perform feature selection to identify the most influential attributes affecting temperature and humidity.

- Utilize Long Short-Term Memory (LSTM) as one of the selected machine learning algorithms for prediction and compare its performance with other machine learning models of your choice.

Assessment Criteria:

- **Data Preprocessing and Management (8 Marks):** Assess the effectiveness of data cleaning, noise handling, and dataset preparation for training, alongside the quality of feature selection in identifying key variables for temperature and humidity predictions.
- **Intelligent and Adaptive Behavior (7 Marks):** Demonstration of intelligent and adaptive behavior.
- **Model Performance and Comparison (8 Marks):** Evaluate the accuracy and efficiency of the selected machine learning models in predicting indoor environmental conditions, comparing their results to highlight strengths and weaknesses in the context of the problem domain.
- **User Satisfaction (7 Marks):** Enhancement of user satisfaction, evaluated through a hidden formula based on the indoor temperature and humidity generated by your software.
- **Code Usability and Effectiveness (8 Marks):** The solution must be user-friendly and well-documented for seamless operation.

Part 2: Short Report & Presentation (12/50 Marks)

- **Report:** Submit a concise report that includes:
  - **Quantitative Performance Metrics:** Discuss metrics demonstrating the effectiveness of your approach and the benefits derived.
  - **Qualitative Requirements:** Evaluate how well the solution met the requirements outlined in Assignment 1.
- **Presentation:** Prepare a presentation that:
  - Clearly explains the conceptual modeling design from Project 1.
  - Describes the intelligent adaptive model developed in Project 2.
  - Highlights the design choices, challenges, and solutions in both parts.

Submission Deliverables:

Package the following into a single zip file and upload it to the Assignment 2**:**

1. **Software:**
   - Include all necessary code files.
   - Provide a comprehensive README file with instructions for running the software.
2. **Output Data:**
   - A .csv file containing the predicted indoor temperature, and humidity values for each 15-minute interval within the specified time frame.
3. **Report and Presentation:**
   - A PDF document summarizing the system's performance and adherence to client requirements.
   - A presentation explaining the key aspects of the system, including design choices and challenges.