ENERGY CONSUMPTION MONITORING SYSTEM

**Objectives:**

The primary objective of this project is to design and implement an energy consumption monitoring system using Python. This system will enable real-time monitoring and analysis of energy usage, contributing to energy efficiency and cost savings.

**Scope:**

The scope of this project encompasses the following key aspects:

* + Measurement and monitoring of electricity consumption.
  + Data collection, storage, and analysis.
  + Real-time visualization and reporting.
  + Implementation of energy efficiency measures.

**System Architecture:**

1. Sensor Selection and Installation:

1.1 Sensor Types:

* + Electricity meters
  + Current clamps

1.2 Sensor Calibration:

Sensors will be calibrated according to manufacturer guidelines to ensure data accuracy.

2. Data Retrieval:

Python scripts will be developed to collect data from sensors via Modbus communication protocols.

3. Data Management:

3.1 Database Selection:

The system will utilize the MySQL database to store collected energy consumption data.

3.2 Database Schema:

The database schema will include tables for timestamped energy consumption data, sensor IDs, and other relevant metadata.

4. Data Logging:

A data logging mechanism will be implemented to record energy consumption data at regular intervals. Timestamps will be included for each data entry.

5. Data Visualization:

5.1 Visualization Tools:

* + Matplotlib
  + Seaborn
  + Plotly

5.2 Dashboard Development:

A web-based dashboard will be created using the Dash framework to display energy consumption trends, real-time data, and key metrics.

6. Data Analysis:

6.1 Data Analysis Tools:

* + Pandas
  + NumPy

6.2 Analysis Objectives:

* + Identify energy consumption trends.
  + Detect anomalies and irregularities.
  + Provide insights for energy efficiency improvements.

7. Alerts and Notifications:

An alerting system will be implemented to send email notifications when energy consumption exceeds predefined thresholds or when anomalies are detected.

8. Energy Reports:

Periodic reports will be generated in PDF format using the ReportLab library. These reports will summarize energy consumption data and provide insights for optimization.

9. Energy Efficiency Measures:

Based on data analysis, energy-saving strategies will be developed and implemented to reduce consumption and enhance efficiency.

11. Testing and Calibration:

Regular testing and calibration of sensors and data collection components will be conducted to ensure accurate data collection.

12. Maintenance and Sustainability:

A maintenance plan will be established to monitor the health of the system, including sensor maintenance and software updates. Sustainability considerations include code efficiency and resource optimization.

13. Feedback and Iteration:

Feedback from users and stakeholders will be collected regularly to drive continuous improvement in the system's performance and features.