PARSHWANATH CHARITABLE TRUST'S
A.P. SHAH INSTITUTE OF TECHNOLOGY
Department of Computer Science and Engineering
Data Science

Smart Home Energy Forecasting using ARIMA Prediction.

Student ID	Group Member
23107088	Kalpesh Remje
23107061	Aditya Vishe
22107057	Chirag Rajiwale
23107090	Harsh Patil

Project Guide
Ms. Ashwini Parkar

Outline

- Introduction
- Literature Survey of the existing systems
- Limitations of the existing systems
- Problem statement
- System Design
- Technologies and methodologies
- Implementation
- Conclusion
- References

Introduction

- In today's energy-conscious world, efficient electricity usage is crucial to reduce costs and environmental impact.
- Smart Energy Forecast predicts future household electricity consumption to help users make informed decisions.
- The system collects historical energy usage data and uses the ARIMA model to forecast future consumption.
- The name **"Smart Energy Forecast"** highlights a platform that helps users anticipate energy needs, promoting efficiency and sustainability..

Introduction

➢ **Objectives:**

- To collect and preprocess household energy consumption data for analysis.
- To predict future energy usage trends using the ARIMA (AutoRegressive Integrated Moving Average) model.
- To provide device-wise energy consumption insights for efficient usage management.
- To generate short-term forecasts to help users plan and reduce energy wastage.

Literature Survey of the existing system

Sr. No.	Title	Author(s)	Year	Outcomes	Methodology	Result
1.	[1] Forecasting Energy Consumption Using ARIMA	Hyndman R.J.	2018	Showed that ARIMA is highly reliable for short-term energy consumption forecasting.	Applied ARIMA statistical model on historical consumption data to capture seasonal patterns.	The result proved ARIMA to be efficient and accurate for short-term prediction.
2.	[2]Smart Meter Data Analysis	Brockwell & Davis	2016	Highlighted the role of time-series forecasting in analyzing household energy data.	Used time-series methods to process and interpret smart meter readings.	The study demonstrated that time-series analysis improves understanding of usage behavior.
3.	[3]Energy Dashboards for Households	Athanasopoulos G.	2019	Proved that dashboards improve user awareness and help reduce wastage.	Developed interactive dashboards to visualize household energy usage trends.	The results showed increased awareness and reduction in unnecessary energy use.

Literature Survey of the existing system

Sr. No.	Title	Author(s)	Year	Outcomes	Methodology	Result
4.	[4] Sustainable Energy Practices	Singh, A., Varshney, S., & Chauhan, S.	2020	Stressed that combining monitoring with recommendations improves efficiency.	Reviewed systems integrating data analysis with sustainability practices.	The result showed that energy-saving tips encourage long-term behavioral change.

Limitations of existing systems

- **Energy use predictions are often missing or inaccurate:** Most systems show current energy use but don't give clear forecasts. This makes it hard for users to plan and save energy in advance**.**

- **Generic advice for saving energy:** Tips provided are often general and do not consider user's specific device usage or habits, making them less effective in helping households save energy.

- **Disconnected real-time and forecast data:** Many systems treat real-time energy usage and future predictions separately instead of integrating them to deliver useful insights and recommendations.

Limitations of existing systems

- **Dependence on internet and power availability:** Smart home systems relay heavily on continuous internet and electricity. Interruptions can cause loss of monitoring and control capabilities.

- **High setup and maintenance costs:** Installing and maintaining a full smart home energy system can be expensive and sometimes requires professional expertise, adding to the overall cost.

- **Limited device compatibility:** Systems often support only specific brands or device types, which means users can't control all their appliances from a single platform.

Problem statement

Households often lack clear insights into future energy use, leading to wasted energy and higher bills. Existing systems provide generic advice that ignores user habits and struggle with device compatibility, limiting predictive insights and control. There is a need for a simple, user-friendly system that leverages historical consumption data to generate accurate forecasts, enabling smarter decisions to save both energy and money.

System Design

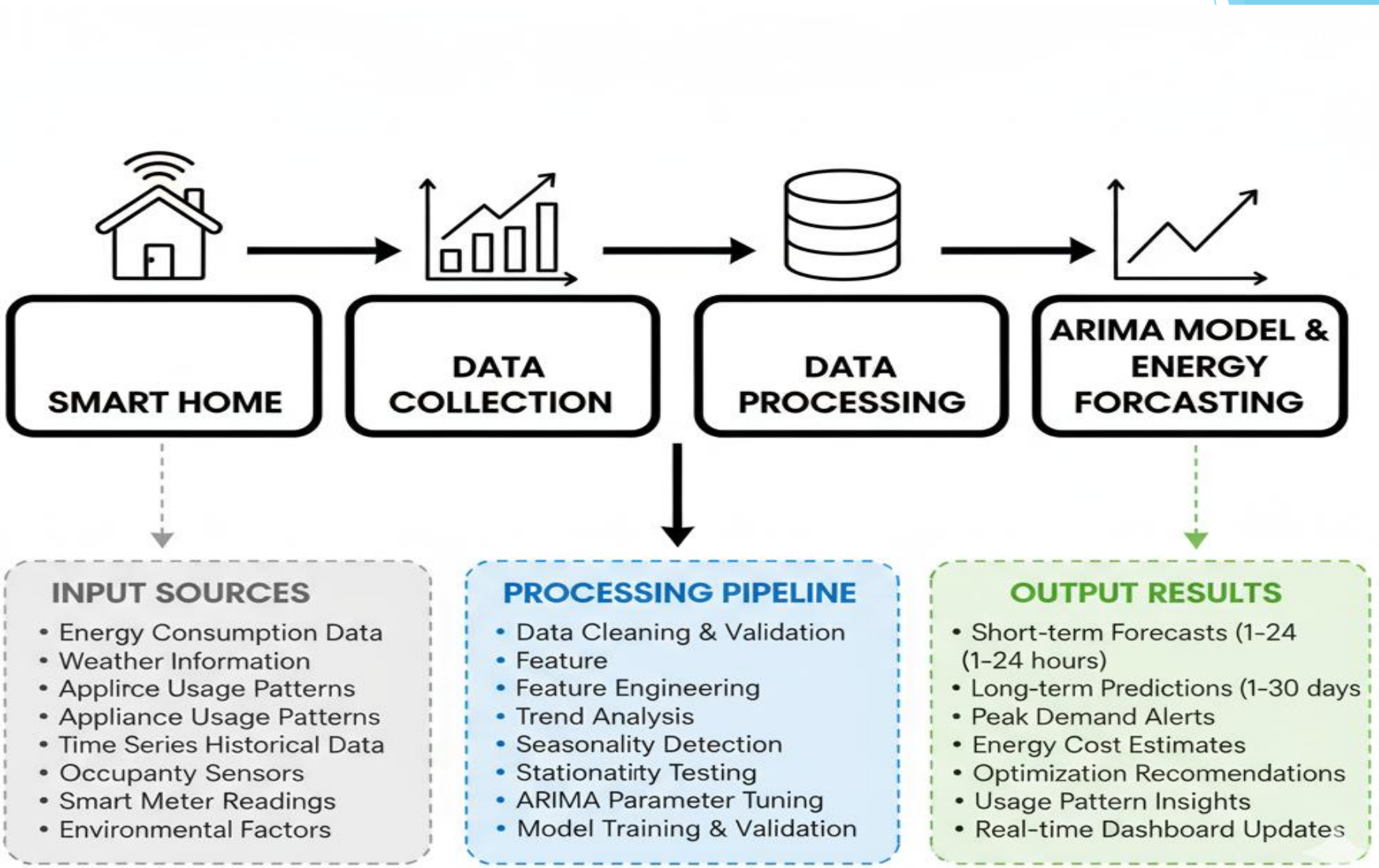


Fig 1: System Design for ARIMA Model

Technologies

- **Frontend Development:**
  - HTML, CSS
  - JavaScript
  - Chat.js
- **Backend Development:**
  - Flask
  - Flask-JWT
  - Flask-CORS
  - **Models/Analytics:** Statistical energy consumption trends, anomaly detection logic for abnormal usage patterns, and predictive analysis scripts.
  - **Data Set:** CSV files (Devices, Energy Data, Rates, Trends) — total of (1000x5)rows across 5 datasets.

Technologies

- **Security:**
  i. JWT (Authentication)
  ii. bcrypt (Password hashing)

Methodology

1. **Data Collection**:

   Collect real-time and historical energy consumption data from smart home devices (e.g., AC, fridge, lights) using the web dashboard and backend APIs.

2. **Data Cleaning and Preprocessing:**

   a) **Filtering:** Remove outliers, correct device readings, and fill missing data for accurate analysis.

   b) **Formatting:** Convert timestamps and normalize power units for consistency.

3. **Feature Engineering:** Analyze usage patterns like device ON/OFF cycles, peak usage hours, and seasonal variations to create new model features.

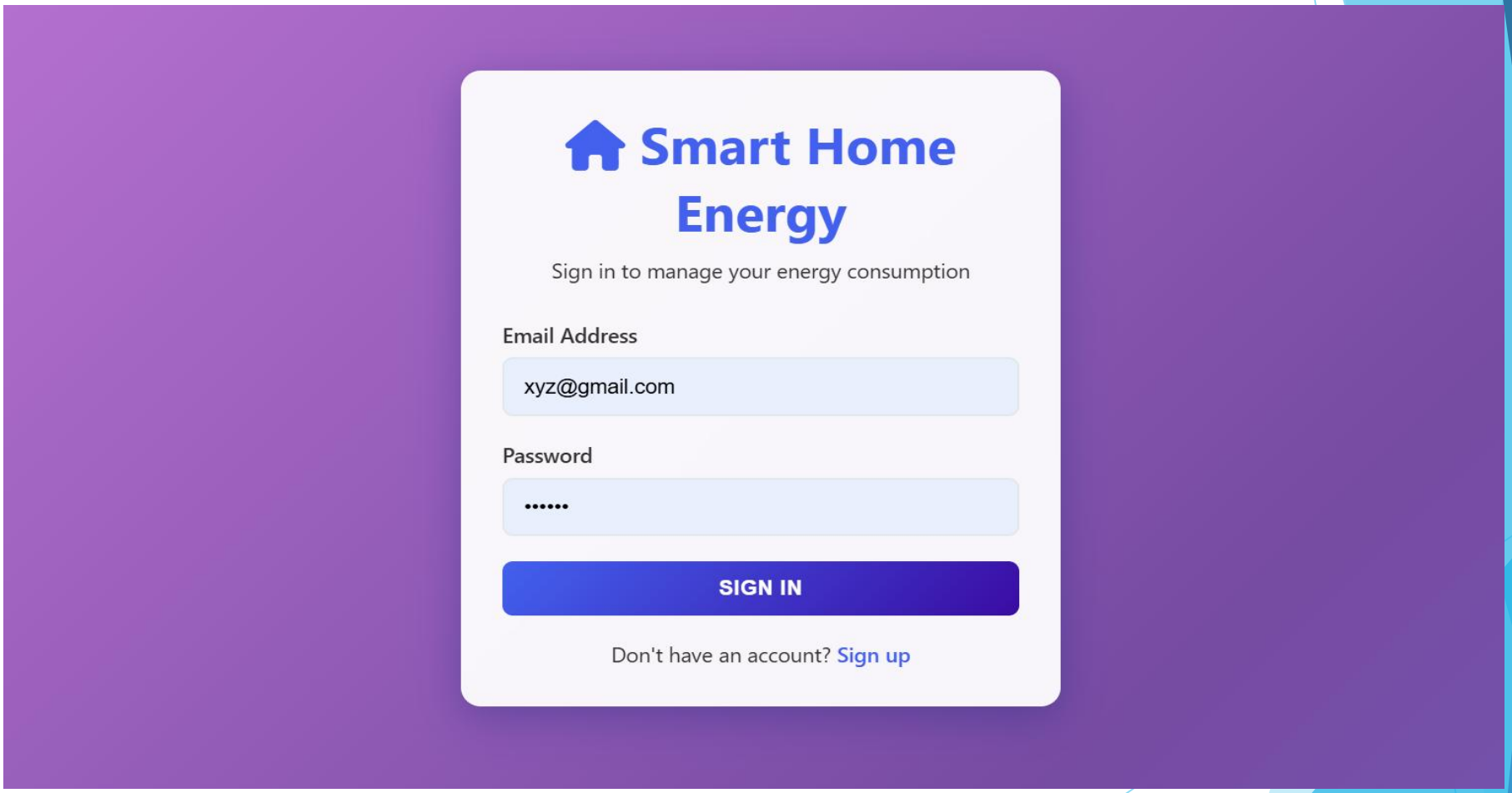
4. **Algorithm Selection:** Use ARIMA (AutoRegressive Integrated Moving Average) for time series forecasting of future energy consumption.

Methodology

5. **Model Training and Evaluation:** Train ARIMA with historical data, validate prediction accuracy, and tune parameters to improve future forecasts and reduce error.

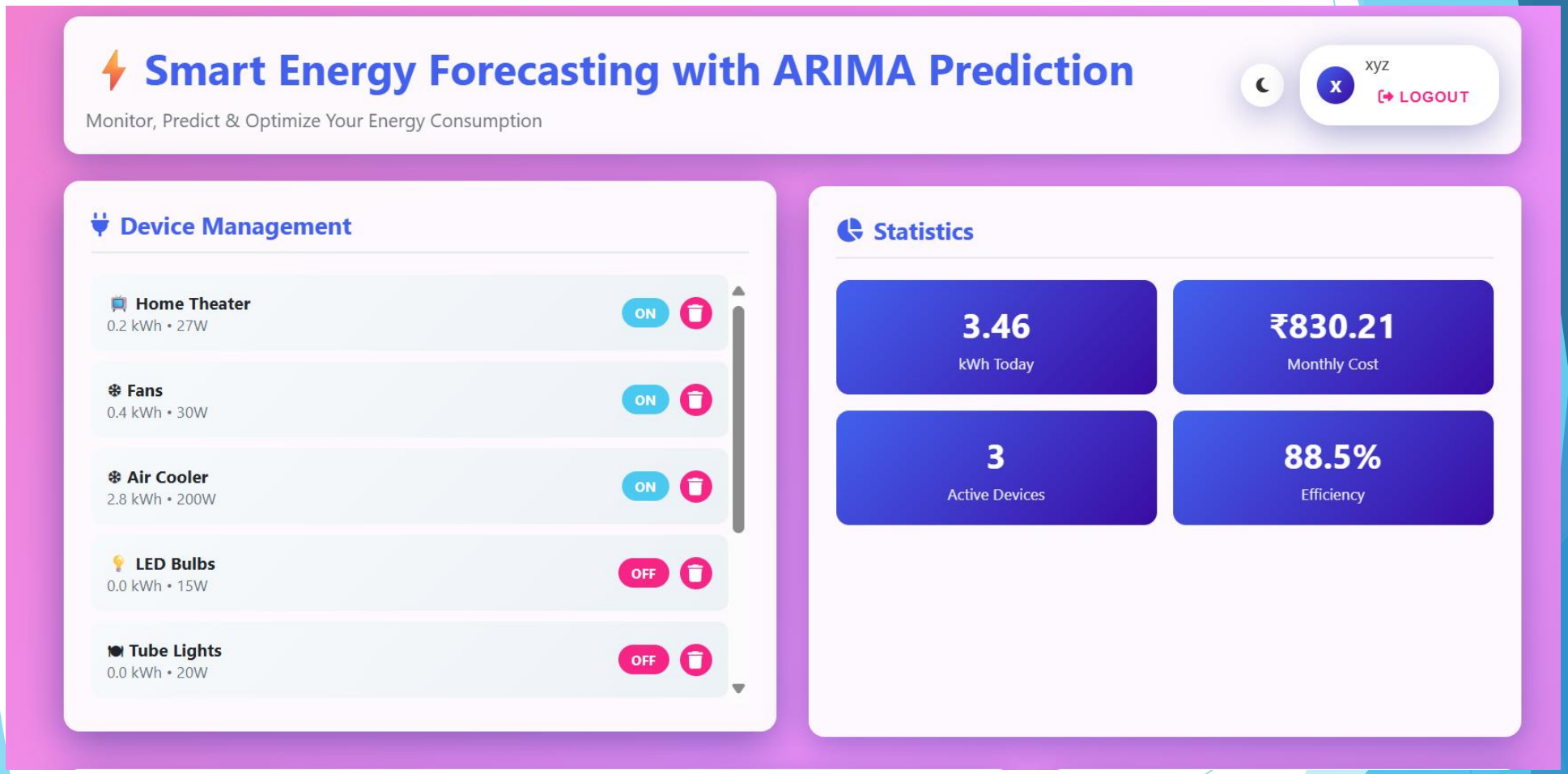
Implementation

1.User Login Page



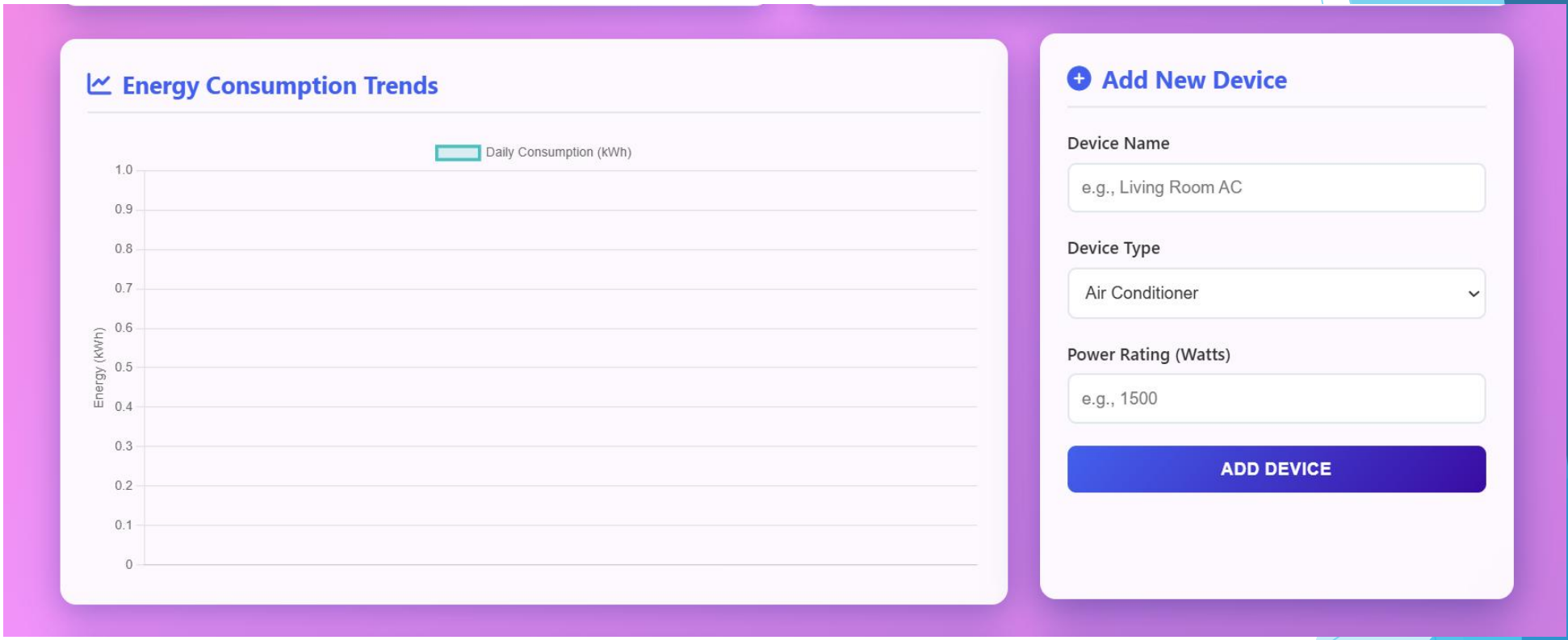
Implementation

2.Dashboard



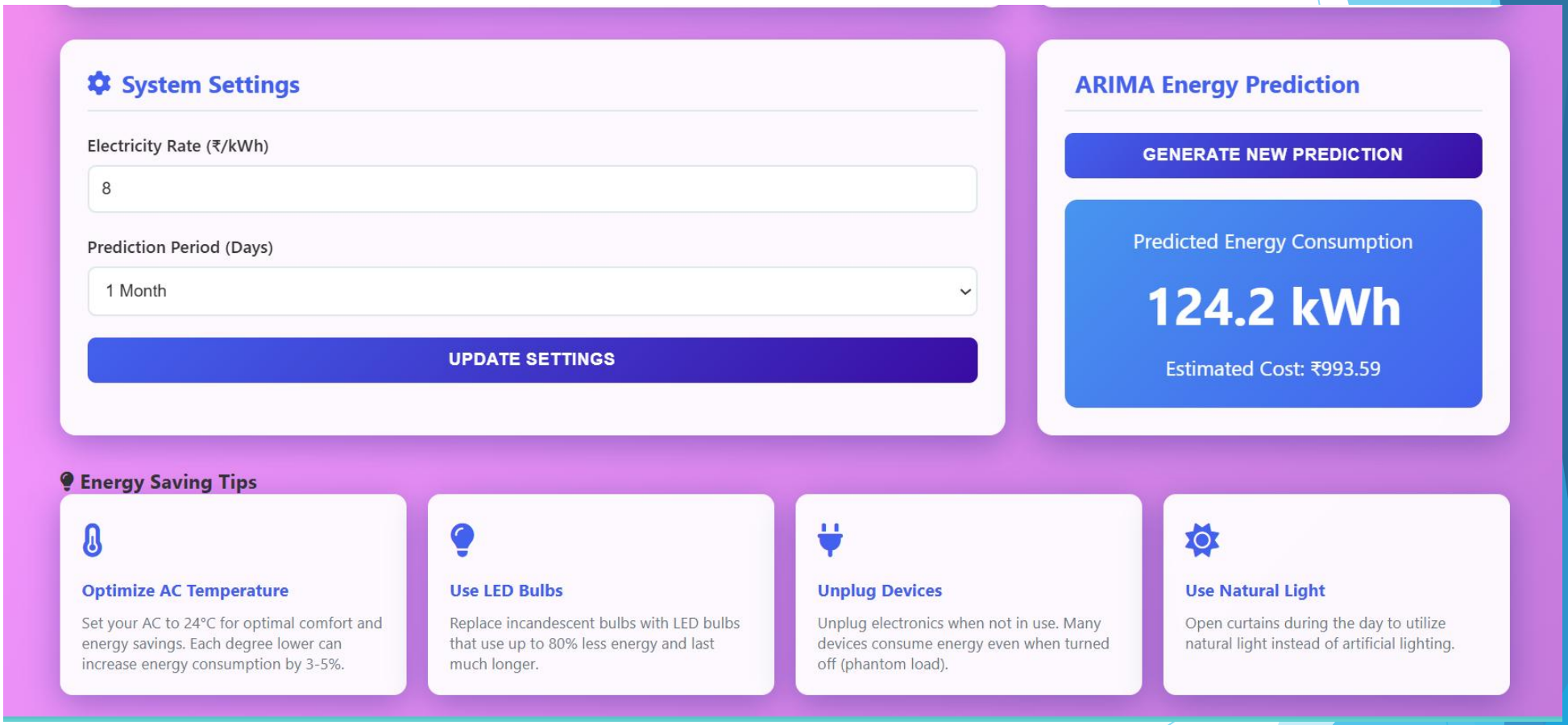
Implementation

3.Energy Consumption Trends



Implementation

4.ARIMA Prediction



Conclusion

•The Smart Home Energy Management System offers a combined solution of real-time monitoring, control, and energy consumption prediction to help users manage household energy better.

•By using the ARIMA forecasting model, the system accurately predicts future energy use, allowing users to plan ahead and reduce unnecessary costs.

•The user-friendly web dashboard lets users control their appliances, track consumption trends, and receive personalized tips to save energy effectively.

•The system's secure and robust backend ensures privacy and reliable performance while promoting overall energy conservation and sustainable living.

References

[1] Flask Framework Documentation

Official docs for Flask web framework used in backend development.

https://flask.palletsprojects.com/

[2] ARIMA Time Series Forecasting (statsmodels)
Guide and API reference for ARIMA model implementation in Python.
https://www.statsmodels.org/stable/generated/statsmodels.tsa.arima.model.ARIMA.html

[3]Energy Management Systems Literature (IEEE Journals)
Research articles on smart energy systems and forecasting methods.
https://ieeexplore.ieee.org/Xplore/home.jsp

Thank You...!!