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Complete Energy Consumption Forecasting

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ABSTRACT

The present draft describes a proposed electricity-consumption analysis and personalized energy recommendation system. The system is intended to process historical electricity-consumption records and, where available, bill-related data to identify usage patterns, compare consumption across periods, detect increases or decreases, and generate explanations and practical recommendations intended to support energy awareness. A software pipeline may validate and preprocess source data, construct time-based consumption features, apply statistical or machine- learning methods to identify patterns, and present the resulting comparisons and recommendations through a user interface. The system may include data-quality checks, model evaluation, and a record of the evidence used to generate each recommendation. The present document is a preliminary technical draft based on the project concept; the exact implementation, technical contribution, experimental results, applicant details, and inventor details must be confirmed before filing. No claim of measured accuracy or patentability is made in this draft.

1. INTRODUCTION

Electricity consumers may find it difficult to understand why consumption or a bill changes from one billing period to another. A bill amount alone may not explain whether the change is associated with energy usage, billing-period length, tariff differences, or another factor. Basic dashboards can display readings but may not provide a clear, evidence-based explanation or a useful next step.

The proposed Energy with AntiGravity project is intended to organize electricity data, compare periods, identify consumption patterns, and provide understandable recommendations. The implementation should distinguish measured facts from estimates and should not imply access to a utility's private consumer records unless an authorized data source is actually available.

2. SYSTEM OVERVIEW

The proposed system accepts electricity-related records from authorized datasets, user-provided bill information, or other permitted sources supported by the implementation. It validates the inputs, aligns comparable time periods where possible, calculates relevant consumption and bill differences, and analyzes patterns. The results are presented as comparisons, potential contributing factors, and recommendations that can be checked against the underlying data.

- Data import and source validation module
- Data cleaning and preprocessing module
- Billing-period and consumption comparison module
- Consumption-pattern analysis module
- Explanation and recommendation module
- Model evaluation and result validation module
- Dashboard and reporting module

3. METHODOLOGY

3.1 Data collection

The system may use permitted historical electricity datasets, meter readings supplied by a user, or bill information manually entered by a user. The final implementation must identify the actual source, fields, collection frequency, and applicable permissions. It must not represent public benchmark data as an individual household's live meter data.

3.2 Data preprocessing

Input records are checked for missing values, invalid timestamps, duplicated entries, inconsistent units, and outliers. Data-cleaning decisions should be logged so that downstream results can be traced to the processed inputs.

3.3 Period comparison and feature construction

Where the data permits, the system calculates differences between a current period and a previous comparable period. Potential features include total energy consumed, average daily consumption, day-of-week or time-of-day patterns, and the change in bill amount. If billing periods differ in length or tariff information is unavailable, the system should disclose that limitation and avoid attributing the entire bill change to consumption alone.

3.4 Pattern analysis

Statistical analysis and, if implemented and validated, machine-learning models may be used to identify recurring patterns, unusual changes, or likely periods of elevated usage. The final specification should name only the algorithms actually used and should describe how training, validation, and testing are separated to avoid data leakage.

3.5 Explanation and recommendation generation

Recommendations are generated from detected patterns and available evidence. Each recommendation should state the observation that prompted it, the relevant period, and any uncertainty or missing data. The system should label a possible contributing factor as a hypothesis unless the available data supports a stronger conclusion.

3.6 Evaluation

The implementation should be evaluated using appropriate metrics for its actual tasks. Forecasting may be evaluated using metrics such as MAE or RMSE; anomaly detection and classification require task-appropriate measures. Recommendation usefulness should be assessed separately from prediction accuracy. Results must be inserted only after experiments have been run and documented.

4. SYSTEM ARCHITECTURE

The proposed architecture may include the following logical layers, subject to confirmation against the actual codebase:

4.1 Data layer

Stores or reads authorized electricity records, billing-period details, processed features, analysis outputs, and model-evaluation results.

4.2 Processing layer

Validates inputs, cleans records, aligns periods, computes comparison metrics, and prepares features for analysis.

4.3 Analysis layer

Performs rule-based or statistical comparisons and runs only those predictive or machine-learning models that are implemented and evaluated.

4.4 Recommendation layer

Maps supported observations to actionable suggestions, records the basis for each suggestion, and communicates uncertainty where evidence is incomplete.

4.5 Presentation layer

Displays previous-versus-current comparisons, consumption trends, detected patterns, recommendation explanations, and limitations in a user-facing dashboard or report.

5. MODULE DESCRIPTIONS

Data Import and Validation Module

Accepts supported files or user-entered records and checks schema, units, date fields, and source completeness.

Preprocessing Module

Handles missing or invalid values and produces a documented, consistent dataset for analysis.

Bill and Consumption Comparison Module

Compares available periods and reports absolute and percentage changes, while distinguishing energy consumption from monetary bill changes.

Pattern Detection Module

Identifies recurring usage trends or unusual changes using implemented rules or validated analytical models.

Explanation Module

Connects displayed findings to source records and calculated metrics so users can inspect why a result was produced.

Recommendation Module

Provides practical suggestions based on identified patterns and labels uncertain explanations appropriately.

Evaluation Module

Measures model performance against held-out data and records limitations, baselines, and test conditions.

Dashboard and Reporting Module

Displays trends, comparisons, findings, and recommendations in an understandable format.

6. POTENTIAL TECHNICAL CONTRIBUTION TO BE ESTABLISHED

A patent application should identify a specific technical contribution rather than rely only on the general use of machine learning, a dashboard, or the idea of recommending electricity savings. The project team should determine and document what, if anything, is technically new in the implemented data-processing workflow, comparison method, anomaly-detection process, or generation and validation of recommendations. This section must be revised after reviewing the code, test results, and relevant prior patents and publications.

These are proposed drawing descriptions only; actual figures should be prepared to match the implemented system.

8. EXAMPLES AND EXPERIMENTAL RESULTS

Insert a reproducible example using authorized data. Report the dataset source, time span, number of records, preprocessing steps, baseline method, test procedure, and observed results. Do not insert illustrative or invented accuracy figures as if they were experimental results.

9. CONCLUSION

The proposed system is intended to make electricity-consumption information easier to compare and interpret by combining data validation, period-based analysis, pattern identification, and evidence-linked recommendations. The final technical description must be aligned with the working implementation. Whether the invention meets Indian patentability requirements can be determined only after an appropriate prior-art search and legal assessment.

10. CLAIMS

1. A computer-implemented system for analyzing and forecasting electricity consumption, comprising a data collection module, a data validation module, a preprocessing module, a consumption analysis module, and a recommendation module configured to process electricity consumption records and generate consumption insights.

2. The data collection module receives historical electricity consumption records, meter readings, or user-provided electricity bill information from authorized data sources.

3. The data validation module identifies missing values, invalid timestamps, duplicated records, inconsistent measurement units, and abnormal data entries before further processing.

4. The preprocessing module transforms validated electricity consumption records into a consistent dataset suitable for consumption analysis and forecasting.

5. The consumption analysis module compares electricity consumption across current and previous billing periods to determine absolute and percentage changes in energy usage.

6. The system adjusts consumption comparisons for differences in billing-period duration when sufficient data is available.

7. A pattern detection module identifies recurring electricity consumption patterns and unusual changes using implemented statistical methods or validated machine-learning models.

8. A forecasting module estimates future electricity consumption using historical consumption data and temporal features, subject to validation of the forecasting model.

9. The recommendation module generates personalized energy-saving recommendations based on identified consumption patterns, calculated changes, and available supporting data.

10. A dashboard and reporting module displays historical consumption, forecasted consumption, period comparisons, detected patterns, and recommendations while indicating relevant data limitations.

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