ENLIGHTENS THE NESCIENCE

ADITYA COLLEGE OF ENGINEERING & TECHNOLOGY

ADB ROAD, SURAMPALEM, E.G. DIST.

DEPARTMENT OF

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in the .... Laboratory during the year ....

No of Practicals Conducted [ ] No. of Practicals Attended [ ]

Signature - Faculty Incharge Signature - Head of the Department

Submitted for the Practical examination held on..

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Date: _ _ _ _ _ _ _ _ _ _ _

ABSTRACT

AI HOME ENERGY CONSUMPTION TRACKER

The AI Home Energy Consumption Tracker is an innovative application designed to help users monitor, analyze, and optimize their home energy usage. Leveraging advanced artificial intelligence and seamless integration with smart energy meters, the application provides real-time insights into energy consumption patterns. It also allows users to manually input utility bill data for comprehensive tracking.

The primary goal of the application is to empower users to make informed decisions about their energy usage, leading to cost savings and environmental benefits. The AI-driven analytics offer personalized recommendations for energy-saving opportunities, helping users reduce their carbon footprint and manage their utility expenses more effectively.

Experiment – 1 : Take any real time problem and do the following experiments.

In today's world, where environmental concerns are growing, managing household energy consumption is a top priority for many. Smart technology presents an opportunity to transform how we monitor and optimize energy use. The goal of the AI Home Energy Consumption Tracker is to provide users with a platform to monitor, analyze, and reduce their energy consumption. Whether by integrating with smart energy meters or manually entering utility bills, the app aims to empower users to control their energy usage, leading to savings and a smaller carbon footprint.

Experiment – 1.a: Write down the problem statement for a suggested system of relevance. Develop Flow-Charts to understand basic problem solving technique.

PROBLEM STATEMENT

AI Home Energy Consumption Tracker: The task is to develop a home energy consumption tracker application aimed at enabling users to monitor and analyze their energy usage effectively. The application should seamlessly integrate with smart energy meters or allow manual entry of utility bills, providing insights and recommendations for energy saving opportunities. The main objectives are to help users reduce their energy consumption, lower utility bills, and contribute to environmental sustainability.

SYSTEM REQUIREMENTS

User Management: Registration, authentication, and profile management.

Data Collection: Integration with smart meters and manual entry of utility bills.

Data Processing: Storing, retrieving, and validating energy consumption data.

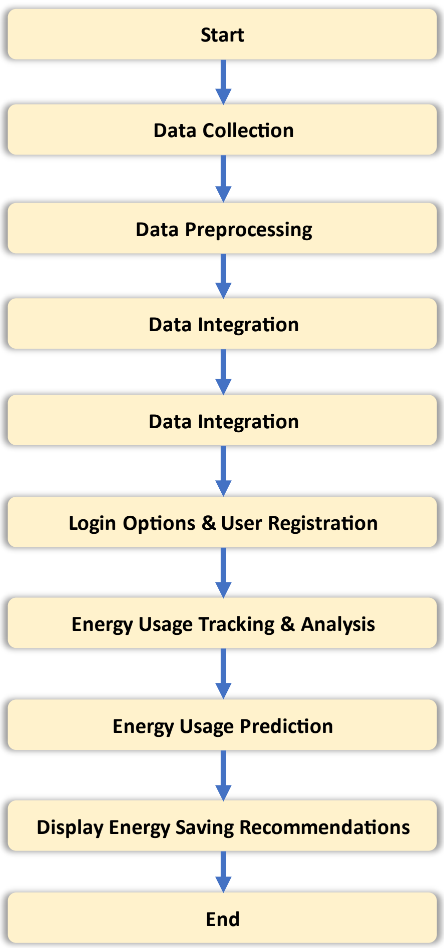
Analysis and Visualization: Data analysis, trend identification, and visualization through charts and graphs.

Recommendations: AI-based personalized energy-saving recommendations.

Notifications: Alerts and reminders for unusual consumption patterns and bill payments.

Security: Ensuring data privacy and compliance with relevant regulations.

FLOWCHART



Date: _ _ _ _ _ _ _ _ _ _ _

Experiment – 1.b: Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.

SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

INTRODUCTION

PURPOSE

The AI Home Energy Consumption Tracker project aims to empower users to monitor, analyze, and optimize their energy usage. By providing insights and recommendations, it promotes energy efficiency and sustainability in households. Objectives include enabling effective monitoring, facilitating data analysis, promoting energy saving opportunities, enhancing user engagement, and supporting environmental sustainability. Ultimately, the project aims to empower users to make informed decisions about their energy usage for a more sustainable lifestyle.

SCOPE

The scope of the AI Home Energy Consumption Tracker project encompasses the development of a user friendly application for monitoring and analyzing energy usage. Features include integration with smart energy meters or manual entry of utility bills, data processing for insights, personalized recommendations for energy saving opportunities, and interactive user dashboards. Limitations include the exclusion of hardware development for energy meters and the focus on residential energy consumption only, excluding commercial or industrial sectors. Additionally, the project does not cover utility billing or payment processing functionalities.

SYSTEM OVERVIEW

SYSTEM DESCRIPTION

The AI Home Energy Consumption Tracker is a comprehensive application designed to help users monitor, analyze, and optimize their energy usage in residential settings. The system's purpose is to empower users with insights and recommendations to promote energy efficiency and sustainability.

USER INTERFACE

The frontend component that allows users to interact with the system through a web or mobile application. It includes features such as dashboard displays, data visualization tools, and user controls.

Data Collection Module: This component collects energy consumption data from various sources, including smart energy meters, utility bills, and manual user input. It ensures accurate and timely data acquisition for analysis.

DATA PROCESSING ENGINE

Responsible for processing and analyzing the collected energy consumption data. It employs machine learning algorithms and statistical techniques to identify consumption patterns, trends, and anomalies.

RECOMMENDATION ENGINE

Utilizes the analyzed data to generate personalized recommendations and energy saving tips for users. Recommendations are based on user preferences, historical usage data, and best practices in energy management.

ALERT SYSTEM

Notifies users of any abnormal energy usage patterns, potential energy saving opportunities, or system updates. Alerts are delivered through various channels, such as email, SMS, or push notifications.

DATABASE

Stores user profiles, energy consumption data, system configurations, and historical usage information. It ensures data integrity, security, and accessibility for authorized users.

FUNCTIONALITY

Users interact with the system through the user interface, where they can view their energy consumption metrics, receive recommendations, and manage their account settings.

The system collects energy consumption data from smart meters or manual input and processes it to generate insights and recommendations.

Users receive alerts and notifications about their energy usage patterns, potential savings opportunities, and system updates.

The system continuously learns from user behavior and feedback to improve the accuracy and relevance of its recommendations over time.

SYSTEM ARCHITECTURE

The AI Home Energy Consumption Tracker system comprises:

User Interface (UI): Provides a graphical interface for user interaction.

Data Collection Module: Gathers energy consumption data from various sources.

Data Processing Engine: Analyzes data using machine learning and statistical techniques.

Recommendation Engine: Generates personalized energy saving recommendations.

Alert System: Notifies users of important events or updates.

Database Management System (DBMS): Stores and manages user data and system configurations.

INTERACTIONS

UI interacts with Data Collection Module for data retrieval.

Data is processed by the Data Processing Engine.

Recommendations are provided by the Recommendation Engine.

Alerts are triggered by the Alert System based on monitored patterns.

This architecture ensures efficient data processing, analysis, and presentation, empowering users to manage energy consumption effectively.

KEY FEATURES

Real Time Monitoring: Track energy usage instantly.

Data Analysis: Gain insights into consumption patterns.

Personalized Recommendations: Receive tailored energy saving tips.

User Friendly Interface: Intuitive design for easy navigation.

Alert System: Get notified of anomalies and opportunities.

Customization: Adjust settings to fit individual needs.

Historical Analysis: Review past usage trends.

Efficiency Tracking: Monitor progress toward goals.

Integration: Seamlessly connect with smart devices.

ASSUMPTIONS AND DEPENDENCIES

ASSUMPTIONS

- Stable internet access for user interaction.
- Availability of energy data from smart meters or utility bills.
- User engagement with energy saving recommendations.
- Accuracy of external energy consumption data.
- Basic user understanding of energy concepts.

DEPENDENCIES

- Third party APIs for data retrieval.
- Compatibility with smart meters and IoT devices.
- Compliance with privacy regulations.
- Cooperation from utility providers.
- Reliable internet connectivity.
- Trained machine learning models for data analysis.

FUNCTIONAL REQUIREMENTS

Sensor Integration: Smart energy meters are integrated into the system through standardized communication protocols such as Zigbee or Wi Fi. The system retrieves real time energy consumption data from the smart meters at regular intervals. Integration includes authentication mechanisms to ensure data security and privacy.

Data Processing: Collected energy consumption data is processed using machine learning algorithms and statistical analysis techniques. Data is cleaned, normalized, and aggregated to identify consumption patterns, trends, and anomalies. Processed data is stored in a secure database for further analysis and retrieval.

User Interaction: Users interact with the system through a user friendly interface accessible via web or mobile applications. They can input manual data, such as utility bill information or energy saving actions taken, to supplement automated data collection. Users can view insights and recommendations generated by the system based on their energy usage data and preferences.

Alert System: The system monitors energy consumption patterns in real time and triggers alerts for abnormal usage or potential energy saving opportunities. Alerts are delivered to users through various channels, including email, SMS, push notifications, or in app notifications. Users can customize alert thresholds and preferences based on their individual needs and preferences.

Calibration: If necessary, the system includes calibration mechanisms to ensure the accuracy and reliability of energy consumption measurements. Calibration processes may involve periodic checks and adjustments to sensor readings or algorithm parameters to maintain precision over time.

These functional requirements collectively enable users to effectively monitor, analyze, and optimize their energy consumption through the AI Home Energy Consumption Tracker system.

NONFUNCTIONAL REQUIREMENTS

PERFORMANCE

Response Time: The system should respond to user interactions within 2 seconds.

Throughput: It should support more than 100 concurrent users without degradation.

Scalability: The system should horizontally scale to handle increased load by adding more resources or nodes.

RELIABILITY

Uptime: The system should be available at least 99.9% of the time.

Fault Tolerance: It should automatically failover and recover from faults to ensure continuous operation.

Error Handling: Errors should be gracefully handled, with informative messages provided to users for troubleshooting.

AVAILABILITY

Planned Downtime: Any planned maintenance or downtime should be communicated to users in advance.

Redundancy: Critical components should have backup systems to ensure continuous operation.

Load Balancing: Traffic should be evenly distributed across servers to prevent overloads.

SECURITY

Data Encryption: Sensitive data should be encrypted to protect it from unauthorized access.

Access Control: Access to the system should be controlled based on users' roles and permissions.

Audit Trails: Logging should be implemented to track user activities for accountability and auditing purposes.

MAINTAINABILITY

Modular Design: The system should be designed in a modular way to facilitate easy updates and enhancements without disrupting the entire system.

Documentation: Comprehensive guides should be provided for developers and administrators to understand and maintain the system.

Version Control: Code should be managed using Git to track changes and facilitate collaboration among developers.

PORTABILITY

Cross Platform Compatibility: The system should support major platforms to ensure accessibility for users on different devices and operating systems.

Containerization: Docker should be used for deployment versatility, allowing the system to be easily deployed across different environments.

USER INTERFACE

DASHBOARD DISPLAY

- Energy usage data displayed with charts and summaries.
- Customizable layout and metrics.
- Includes comparisons and trend analysis.

ALERTS AND WARNINGS

- Clearly displayed notifications for issues.
- Color-coded severity (e.g., red for critical).
- Users can acknowledge or dismiss alerts.

USER CONTROLS

- Intuitive input controls for data and settings.
- Access to features like insights and recommendations.
- Designed for easy navigation and use.

SYSTEM CONSTRAINTS

Hardware Constraints: Limited processing power and compatibility issues with hardware components.

Software Constraints: Dependencies on thirdparty software and performance limitations.

Regulatory Constraints: Compliance with privacy regulations and industry standards.

Environmental Constraints: Impact of environmental factors on hardware reliability and energy efficiency.

APPENDICES

GLOSSARY

Smart Energy Meter: A device that measures electricity, gas, or water usage and communicates this information back to the utility company for monitoring and billing purposes.

Manual Entry: The process of inputting data into the system manually, typically done by users entering information from utility bills or other sources directly into the application.

Data Processing: The manipulation and analysis of data to extract meaningful insights or information, such as identifying patterns, trends, or anomalies in energy consumption data.

Dashboard: A visual interface that displays key metrics, insights, and data summaries in a centralized location, providing users with an overview of their energy usage and efficiency.

Alert System: A feature that notifies users of important events or conditions, such as abnormal energy usage patterns or potential energysaving opportunities, typically through notifications or messages.

Calibration: The process of adjusting or finetuning sensors or measurement devices to ensure accuracy and consistency in the data they collect and report.

Performance: The speed, responsiveness, and efficiency of the system in processing data, generating insights, and providing feedback to users.

Reliability: The ability of the system to consistently perform its intended functions accurately and dependably, without failures or errors.

Availability: The degree to which the system is accessible and operational when needed, typically measured as uptime or the percentage of time the system is available for use.

Security: Measures implemented to protect the confidentiality, integrity, and availability of data within the system, including encryption, authentication, and access control mechanisms.

Maintainability: The ease with which the system can be maintained, updated, and modified over time, including factors such as code readability, documentation, and modular design.

Portability: The ability of the system to be deployed and run on different platforms, environments, or devices without requiring significant modifications or adjustments.

TEST CASES

User Registration and Login: Ensure users can register and log in securely.

Sensor Integration: Verify accurate data collection from smart meters or manual entry.

Data Processing and Analysis: Confirm correct processing of energy data and generation of insights.

User Interface: Validate clear and intuitive dashboard display and navigation.

User Interaction: Test ease of manual data input and customization of settings.

Performance Testing: Ensure the system handles data volumes and usage loads effectively.

Security Testing: Verify robust encryption, authentication, and protection against vulnerabilities.

Compatibility Testing: Validate functionality across browsers, devices, and operating systems.

Regression Testing: Confirm new updates don't reintroduce previously fixed issues.

STAKEHOLDER LIST

End Users: The individuals or households using the energy consumption tracker app, responsible for providing feedback and inputting data.

Project Sponsor: Provides financial and organizational support, defines project goals, and approves major decisions.

Project Manager: Oversees project planning, execution, and monitoring, acting as the main point of contact for communication.

Development Team: Designs, develops, and tests the application, ensuring its functionality and reliability.

Data Providers: Supply energy consumption data to the system, ensuring its accuracy and timely delivery.

Regulatory Authorities: Define and enforce regulations related to data privacy, security, and consumer rights.

Quality Assurance Team: Tests the application for bugs, verifies fixes, and ensures its quality meets requirements.

Maintenance and Support Team: Provides ongoing maintenance, updates, and technical support for the application.

External Consultants or Experts: Offer specialized knowledge or skills relevant to the project as needed.

Community or Environmental Groups: Provide input on the application's design and features to ensure it aligns with sustainability goals.

Experiment – 1.c: Using COCOMO model estimate effort.

BASIC COCOMO MODEL

The Basic COCOMO model is a straightforward way to estimate the effort needed for a software development project. It uses a simple mathematical formula to predict how many person-months of work are required based on the size of the project, measured in thousands of lines of code (KLOC).

INTERMEDIATE COCOMO MODEL

The basic COCOMO model assumes that the effort is only a function of the number of lines of code and some constants evaluated according to the different software systems. However, in reality, no system's effort and schedule can be solely calculated based on Lines of Code. For that, various other factors such as reliability, experience, and Capability. These factors are known as Cost Drivers (multipliers) and the Intermediate Model utilizes 15 such drivers for cost estimation.

DETAILED COCOMO MODEL

Detailed COCOMO goes beyond Basic and Intermediate COCOMO by diving deeper into project-specific factors. It considers a wider range of parameters, like team experience, development practices, and software complexity. By analyzing these factors in more detail, Detailed COCOMO provides a highly accurate estimation of effort, time, and cost for software projects. It's like zooming in on a project's unique characteristics to get a clearer picture of what it will take to complete it successfully.

CALCULATION

BASIC COCOMO MODEL

Project Size: 10000 lines of code (LOC)

COCOMO Model: Organic

EAF: 1.0(Neutral Adjustment)

Effort(E) = $a * (KLOC)^b * EAF$

a = 2.4 a = 1.05 Size = 10000 LOC(KLOC) EAF = 1.0

Effort(E) = 2.4 * $(10)^{1.05}$

$\approx 2.4 * 11.047$

$\approx\ 26.5128\ Persons - Months$

$\boldsymbol{E \quad \approx 27\ Persons - Months}$

Time(T) = $c * (E)^d$

= $2.5 * (27)^{0.38}$

= $2.5 * 3.4987$

= 8.7465

$(\boldsymbol{T}) \approx \mathbf{9}$ **Months**

People Required = $\frac{E}{T}$

= $\frac{27}{9}$

People Required = 3(Persons Required)

INTERMEDIATE COCOMO MODEL

For this project we having considering the values for developer having very low in programming languages experience (PCAP), very high in required software reliability extent (RELY), Nominal in application of software engineering methods (MODP).

- Very low in programming language experience (PCAP) = 1.42
- Very high in required software reliability extent (RELY) = 1.40
- Nominal in application of software engineering methods (MODP) = 1.00

EAF = Effort Adjustment Factor

EAF = 1.42 x 1.40 x 1.00

EAF = 1.988

Here, a = 2.4, b = 1.05, c = 2.5, d = 0.38, lines of code = 39000

Effort (E) = $a * (KLOC)^b * EAF$

= $2.4 * (39)^{1.05} * 1.988$

$\boldsymbol{E} \approx \mathbf{223}\ \boldsymbol{Persons - Months}$

Time(T) = $c * (E)^d$

= $2.5 * (223)^{0.38}$

$(\boldsymbol{T}) \approx \mathbf{20}$ **Months**

Persons – Required = $\frac{E}{T}$

$$= \frac{223}{20}$$

$$\boldsymbol{Persons - Required = 11\ (Persons\ Required)}$$

Experiment – 1.d: Perform Estimation of effort using FP Estimation for chosen system.

To perform Function Point (FP) estimation for the chosen system, we need to break down the application into various functional components and then estimate the effort required for each component.

Identity the functional user requirements

User Authentication & Authorization

- User Registration
- Login
- Password, Password Reset
- User Roles

1. Data Input
   - Integration with smart energy meters to automatically track energy consumption.
   - Manual entry of utility bills, including meter readings, tariff information, and billing period.
2. Data Visualisation
   - Displaying energy consumption data in various formats such as graphs, charts, and tables.
   - Ability to view consumption trends over time (daily, weekly, monthly, etc.).
   - Comparative analysis of energy usage between different periods.
3. Analysis and Reporting
   - Generating reports and insights on energy consumption patterns.
   - Identifying energy-saving opportunities based on consumption data.
   - Providing recommendations for optimizing energy usage.
4. Notifications and Alerts
   - Sending notifications to users for unusual energy usage patterns or when certain thresholds are exceeded.
   - Reminders for bill payment deadlines or meter readings.
5. Settings and Preferences
   - Allow users to customize settings such as preferred units, billing cycle, and notification preferences.

External Inputs (EI)

- Data Input - 2

External Output (EO)

- Data Visualisation - 1

- Analysis & Reporting – 1

External Inquiries (EQ)

- Analysis & Reporting – 1
- Queries for insights and Recommendations - 1

Internal Logical Files (ILF)

- Data Input – 1
- User Authentication - 1

External Interface Files (EIF)

- Data Input – 1
- Integration with smart Energy Meters - 1

The Counts are

- Number of External Inputs (EI): 2
- Number of External Outputs (EO): 2
- Number of External Inquires (EQ): 2
- Number of Internal Logical Files (ILF): 2
- Number of External Interface Files (EIF): 2

These counts are essential for further analysis in estimation such as Function point analysis.

Compute the Unadjusted Function Points (UFP)

$$\text{UFP} = \sum(Count * weight)$$

Or

$$\text{UFP} = \sum_{i=1}^{5}\sum_{j=1}^{3} z_{ij}w_{ij}$$

w_{ij} = It is entry of the i^{th} row and j^{th} column of the table.

z_{ij} = It is the count of number of functional units of type I that have been classified as having the complexity corresponding to columns.

	Low	Average	High
External Inputs (EI)	3	4	6
External Outputs (EO)	4	5	7
External Inquires (EQ)	3	4	6

Internal Logical Files (ILF)	7	10	15
External Interface Files (EIF)	5	7	10

EI = 2 X 6 12

EO = 2 X 5 10

EQ = 2 X 4 8

ILF = 2 X 10 20

EIF = 1 X 10 10

UFP = 12 + 10 + 08 + 20 + 10 = 60

Calculate the value Adjustment Factor (VAF)

Let's assume average complexity rating of 3 for all.

Degree of Influence = 14 x 3 = 42

VAF = 0.65 + (0.01 x Total Degree of Influence)

Let's calculate the Adjusted Function Points (AFP)

AFP = UFP X VAF

= 60 x 1.07

AFP = 64.02

Estimation Effort

Effort = $\frac{AFP}{Producting\ Rate}$

$= \frac{64.02}{20}$

$$Effort \approx 3\ Persons - Months$$

Experiment – 1.e: Analyze the Risk related to the project and prepare RMMM plan.

The AI Home Energy Consumption Tracker Project involves several potential risks that need to be identified and mitigated to ensure successful project competition.

1. RISK IDENTIFICATION

TECHNICAL RISKS

- Integration Challenges: Difficulty in integrating with various smart energy meters due to compatibility issues.
- Data Accuracy: Inaccurate data from smart meters or manual entries leading to unreliable insights.
- AI Model Accuracy: The AI algorithms may not provide accurate or useful recommendations.
- Scalability: The application might face performance issues as the user base grows.

OPERATIONAL RISKS

- Development Delays: Delays in the development phase due to unforeseen technical challenges.
- Resource Availability: Lack of skilled personnel, particularly in AI and data integration.
- Regulatory Compliance: Non-compliance with local or international regulations regarding data privacy and energy usage.

FINANCIAL RISKS

- Budget Overruns: Project costs exceeding the initial budget due to underestimation of resources or unexpected expenses.
- Funding Shortfalls: Insufficient funding to complete the project or maintain operations post-launch.

MARKET RISKS

- User Adoption: Low adoption rates due to lack of interest or competition from similar products.
- Market Changes: Rapid changes in technology or market demand that make the application obsolete.

SECURITY RISKS

- Data Breaches: Unauthorized access to user data leading to privacy issues.
- System Vulnerabilities: Potential vulnerabilities in the application that can be exploited by attackers.

2. RISK ANALYSIS

Each identified risk is analyzed based on its likelihood and impact, and prioritized accordingly.

Risk	Likelihood (1-5)	Impact (1-5)	Priority
Integration Challenges	4	4	High
Data Accuracy	3	5	High
AI Model Accuracy	3	4	Medium
Scalability	3	4	Medium
Development Delays	3	4	Medium
Resource Availability	4	3	Medium
Regulatory Compliance	2	4	Medium
Budget Overruns	3	4	Medium
Funding Shortfalls	2	5	High
User Adoption	3	4	Medium
Market Changes	2	4	Medium
Data Breaches	3	5	High
System Vulnerabilities	3	4	Medium

3. RISK ASSESSMENT

The Risk Assessment identifies and priorities and potential risks associated with the AI HOME ENERGY CONSUMPTION TRACKER project. To manage potential issues, ensuring the successful delivery of reliable, secure, and user-friendly application.

4. RISK MONITORING AND REVIEW

Effective risk monitoring ensures that the project stays on track by identifying potential issues early and taking corrective actions promptly. The outlined monitoring activities, metrics, and review frequencies provide a structured approach to managing risks throughout the project lifecycle. Regular reviews and updates to the risk monitoring plan are essential to adapt to any changes and ensure ongoing risk management.

RMMM PLAN SUMMARY TABLE FOR AI HOME ENERGY CONSUMPTION TRACKER PROJECT

Risk Description	Likelihood	Impact	Mitigation	Monitoring	Management
Integration Challenges	High	High	Research standards, partner with manufacturers	Track integration progress, regular testing, issue tracker	Allocate resources, consult experts
Data Accuracy	Medium	High	Implement validation, cross-verify data	Automated checks, data audits, anomaly alerts	Update algorithms, support for data correction
AI Model Accuracy	Medium	High	Use quality data, test/refine models	Evaluate performance, compare outcomes, user feedback	Update models, incorporate feedback
Scalability	Medium	High	Design for scalability, use cloud infrastructure	Monitor performance metrics, server/database load	Optimize app, scale resources
Development Delays	Medium	High	Agile practices, set realistic milestones	Track milestones, regular progress meetings	Adjust timelines/resources, proactive action
Resource Availability	High	Medium	Hire/train personnel, use contractors	Monitor capacity/workload, track turnover rates	Adjust staffing, timely recruitment/training
Regulatory Compliance	Medium	High	Stay updated on regulations, engage legal experts	Review compliance requirements, internal audits	Update policies, ensure compliance
Budget Overruns	Medium	High	Detailed budget, monitor expenditures	Compare actual vs. budget, review financial reports	Reallocate funds, secure additional funding
User Adoption	Medium	High	Market research, user-friendly design, marketing	Track user metrics, satisfaction surveys	Adjust strategies, improve features
Data Breaches	Medium	High	Encryption/security measures, regular audits	Monitor logs, intrusion detection systems	Incident response plan, quick resolution
System Vulnerabilities	Medium	High	Regular scans, timely updates, penetration testing	Track vulnerabilities, monitor patch times	Regular updates, apply patches
Market Changes	Medium	Medium	Monitor trends, gather intelligence, review strategy	Analyze trend reports, competitive analysis	Adapt strategy, innovate continuously

Date: _ _ _ _ _ _ _ _ _ _ _ _

Experiment – 1.f: Develop Time-line chart and project table using PERT or CPM project scheduling methods.

To estimate the total cost for RMMM, we will sum up the costs for each mitigation strategy.

Mitigation Strategy	**Estimated Cost ($)**
Partner with smart meter manufacturers	10,000
Implement advanced encryption and security	15,000
Regular audits and compliance checks	8,000
Develop robust validation algorithms	12,000
Continuous model training and validation	20,000
Implement redundant systems and backups	10,000
Hire a compliance officer	5,000
Develop user-friendly interfaces and tutorials	7,000
Strict budget monitoring and control	6,000
Use agile project management practices	4,000
Total	**97,000**

To calculate the RMMM cost estimation using the given formula:

The total estimated cost for implementing these mitigation strategies is $97,000. Assuming the total project cost is $500,000.

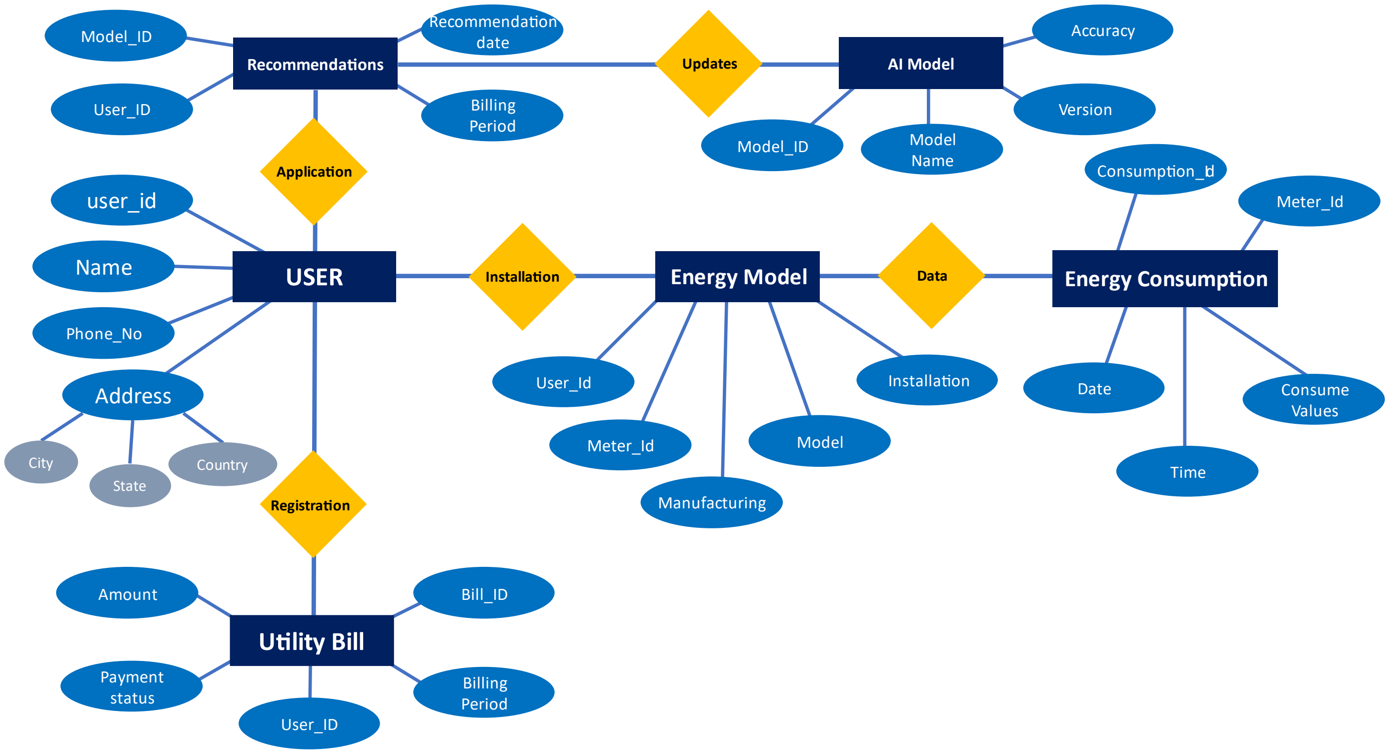
RMMM Cost Estimation = $\frac{\text{Total Cost of all Risks}}{\text{Total Assumed Cost of RMMM}}$

RMMM Cost Estimation = $\frac{97000}{500000}$

RMMM Cost Estimation ≈ 0.194

This means that approximately 19.4% of the total project cost is allocated for managing and mitigating risks.

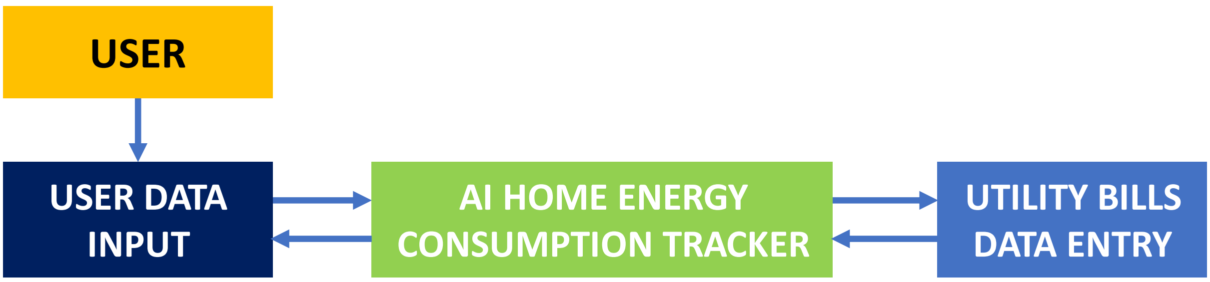
Experiment – 1.g: Draw E-R diagrams, DFD, CFD and structured charts for the project.



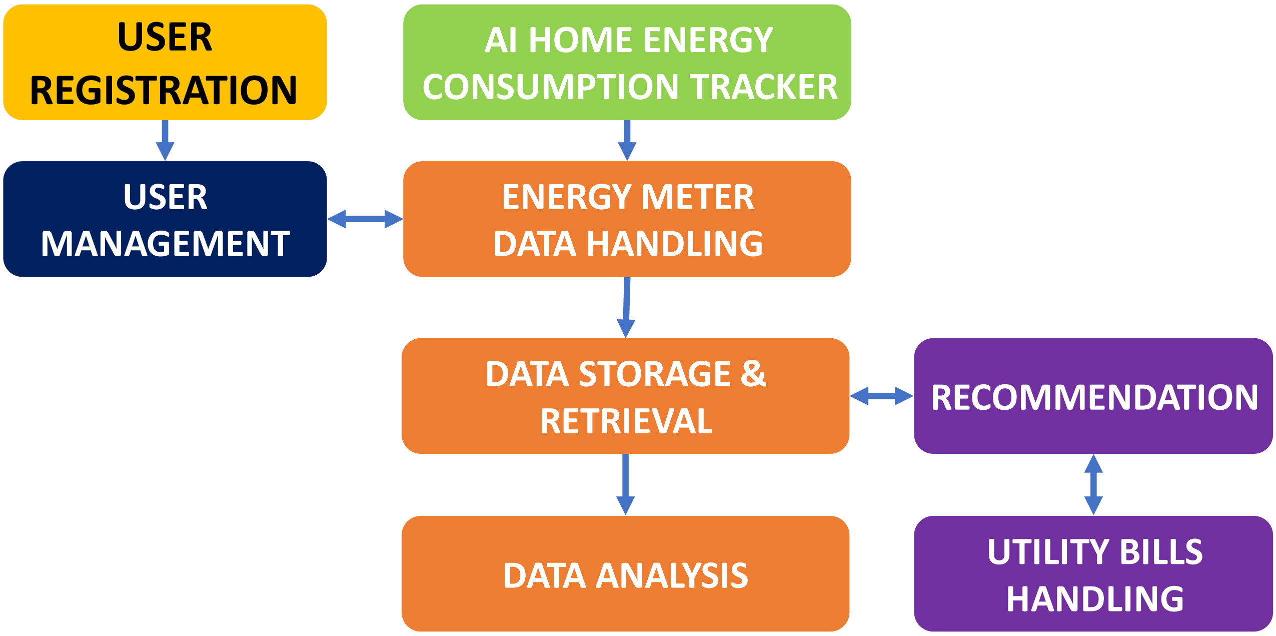
ER DIAGRAM

DATA FLOW DIAGRAMS (DFD)

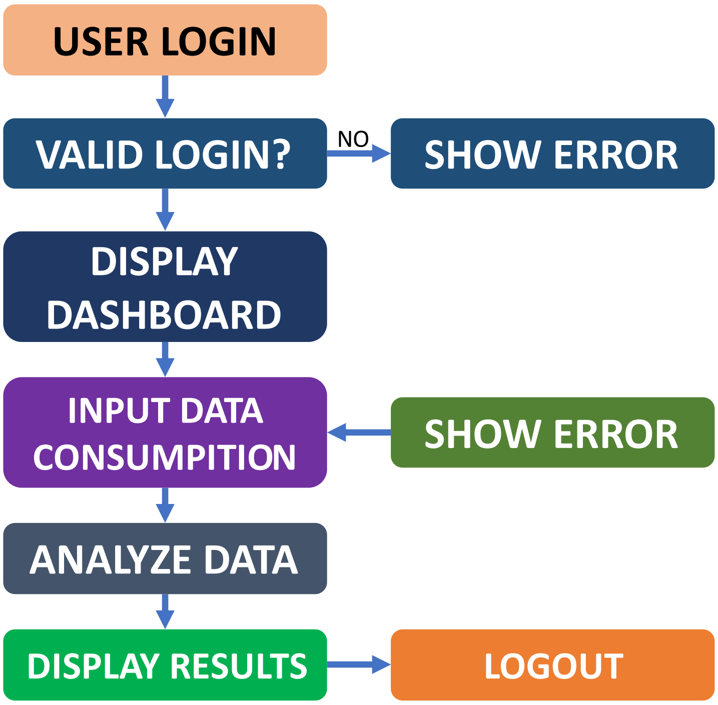
DFD LEVEL – 0



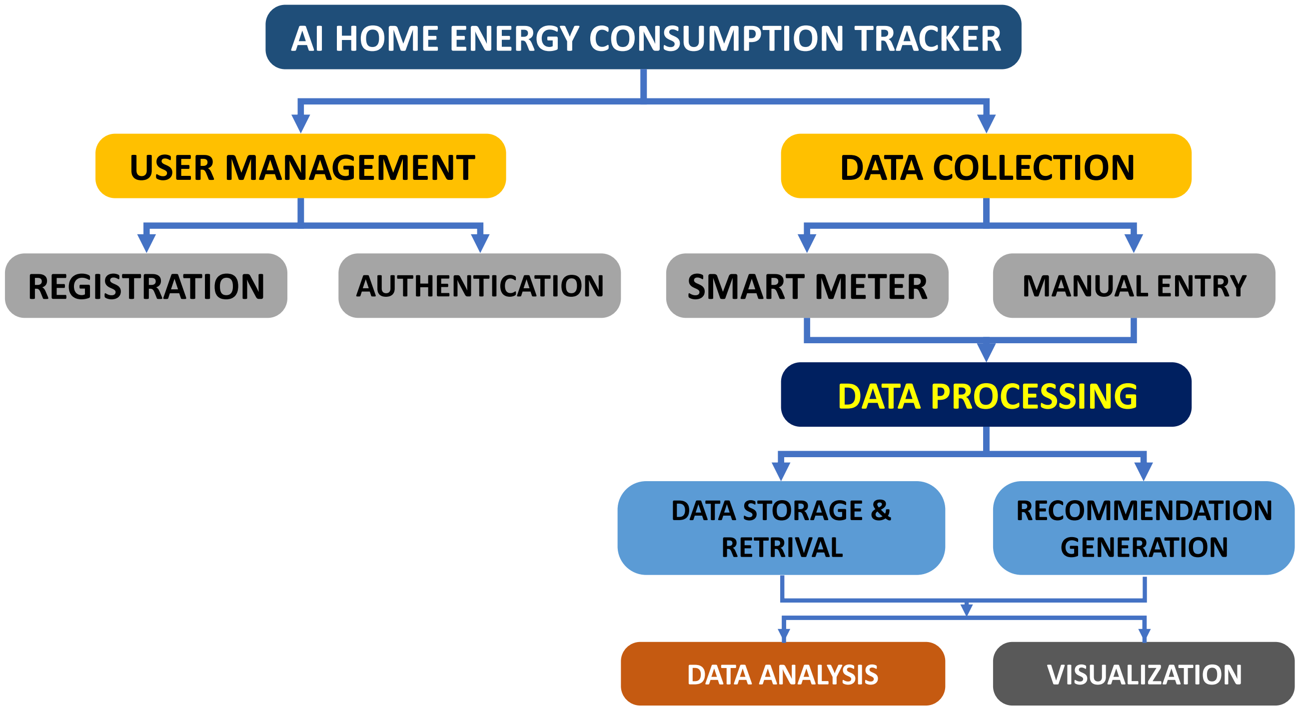
DFD LEVEL – 1



CONTROL FLOW DIAGRAMS (CFD)



STRUCTURED CHART



Experiment – 1.h: Design of Test cases based on requirements and design.

Module 1	
Project Name:	AI Home Energy Consumption Tracker
Module Name:	Login Name
Reference Document:	User Login Requirements Specification (ULRS) v1.2
Created by:	GEDDAM SRIRAM
Date of creation:	MAY 10 2024
Date of review:	MAY 15 2024
Reviewed by:	SECURITY SPECIALIST B DURGA PRASAD

TEST CASE ID	TEST SCENARIO	TEST CASE	PRE-CONDITION	TEST STEPS	TEST DATA	EXPECTED RESULT	POST CONDITION	ACTUAL RESULT	STATUS (PASS/FAIL)
TC_LOGIN_001	Verify the login of the AI Home Energy Tracker	Enter valid User Name and valid Password	Need a valid User Account to do login	1. Enter User Name 2. Enter Password 3. Click "Login" button	Valid User Name Valid Password	Successful login	User dashboard is shown	User dashboard is shown	PASS
TC_LOGIN_002	Verify the login of the AI Home Energy Tracker	Enter valid User Name and invalid Password	Need a valid User Account to do login	1. Enter User Name 2. Enter Password 3. Click "Login" button	Valid User Name Invalid Password	A message "The email and password you entered don't match" is shown	Login page is shown again	A message "The email and password you entered don't match" is shown	PASS
TC_LOGIN_003	Verify the login of the AI Home Energy Tracker	Enter invalid User Name and valid Password	Need a valid User Account to do login	1. Enter User Name 2. Enter Password 3. Click "Login" button	Invalid User Name Valid Password	A message "The email and password you entered don't match" is shown	Login page is shown again	A message "The email and password you entered don't match" is shown	PASS
TC_LOGIN_004	Verify the login of the AI Home Energy Tracker	Enter invalid User Name and invalid Password	Need a valid User Account to do login	1. Enter User Name 2. Enter Password 3. Click "Login" button	Invalid User Name Invalid Password	A message "The email and password you entered don't match" is shown	Login page is shown again	A message "The email and password you entered don't match" is shown	PASS
TC_LOGIN_005	Verify the logout functionality	Click the logout button	User must be logged in	1. Click "Logout" button	-	User is logged out and redirected to the login page	Login page is shown again	User is logged out and redirected to the login page	PASS

Module 2	
Project Name:	AI Home Energy Consumption Tracker
Module Name:	Data Entry
Reference Document:	Data Entry Module Specification (DEMS) v1.0
Created by:	GEDDAM SRIRAM
Date of creation:	MAY 20 2024
Date of review:	MAY 25 2024
Reviewed by:	DATA ANALYST SK ABU SALEEM

Test Case	Test Scenario	Test Case Description	Pre-Condition	Test Steps	Test Data	Expected Result	Post Condition	Actual Result	Status (PASS/FAIL)
TC_DATA_ENTRY_001	Verify manual data entry	Enter valid consumption data	Need a valid User Account to do login	1. Log in to the application	Valid Consumption Data	Data is successfully saved	Data entry confirmation is shown	Data is successfully saved	PASS
TC_DATA_ENTRY_002	Verify manual data entry	Enter invalid consumption data	Need a valid User Account to do login	1. Log in to the application	Invalid Consumption Data	An error message is shown	Data entry page is shown again with error	An error message is shown	PASS
TC_DATA_ENTRY_003	Verify auto-saving functionality	Partially enter data and navigate away	Need a valid User Account to do login	1. Log in to the application	Partially Entered Data	Data is saved automatically	Data entry is saved as draft	Data is saved automatically	PASS

Module 3	
Project Name:	AI Home Energy Consumption Tracker
Module Name:	Data Visualization
Reference Document:	Data Visualization Requirements (DVR) v2.1
Created by:	GEDDAM SRIRAM
Date of creation:	JUNE 5 2024
Date of review:	JUNE 10 2024
Reviewed by:	VISUALIZATION EXPERT V BHARGAV RAM

TEST CASE ID	TEST SCENARIO	TEST CASE DESCRIPTION	PRE-CONDITION	TEST STEPS	TEST DATA	EXPECTED RESULT	POST CONDITION	ACTUAL RESULT	STATUS (PASS/FAIL)
TC_DATA_VISUAL_001	Verify data visualization	View consumption data	Need consumption data in the system	1. Log in to the application 2. Navigate to visualization page	Data for export (e.g., sample data)	Consumption data is displayed graphically	Visualization dashboard is shown	Consumption data is displayed graphically	PASS
TC_DATA_VISUAL_002	Verify data export functionality	Export data visualization	Need consumption data in the system	1. Log in to the application 2. Navigate to visualization page 3. Click "Export" button	Data for export (e.g., sample data)	Data visualization is exported in chosen format (CSV, PDF, etc.)	Data is exported successfully	Data visualization is exported in chosen format (CSV, PDF, etc.)	PASS

Date: _ _ _ _ _ _ _ _ _ _ _

Module 4	
Project Name:	AI Home Energy Consumption Tracker
Module Name:	AI Recommendations
Reference Document:	Recommendations Engine Specification (RES) v3.0
Created by:	GEDDAM SRIRAM
Date of creation:	JUNE 20 2024
Date of review:	JULY 28 2024
Reviewed by:	AI SPECIALIST Y VENKATA RAVI

TEST CASE ID	TEST SCENARIO	TEST CASE DESCRIPTION	PRE-CONDITION	TEST STEPS	TEST DATA	EXPECTED RESULT	POST CONDITION	ACTUAL RESULT	STATUS (PASS/FAIL)
TC_DATA_VISUAL_001	Verify data visualization	View consumption data	Need consumption data in the system	1. Log in to the application 2. Navigate to visualization page	User credentials: username, password	Consumption data is displayed graphically	Visualization dashboard is shown	Consumption data is displayed graphically	PASS
TC_DATA_VISUAL_002	Verify data export functionality	Export data visualization	Need consumption data in the system	1. Log in to the application 2. Navigate to visualization page 3. Click "Export" button	User credentials: username, password; Format: CSV	Data visualization is exported in chosen format (CSV, PDF, etc.)	Data is exported successfully	Data visualization is exported in chosen format (CSV, PDF, etc.)	PASS
TC_RECOMM_001	Verify AI-based recommendations	Generate recommendations	Need consumption data in the system	1. Log in to the application 2. Navigate to recommendations page	User credentials: username, password	AI-based recommendations are displayed	Recommendations dashboard is shown	AI-based recommendations are generated and displayed	PASS
TC_RECOMM_002	Verify recommendations download	Download recommendations report	Need consumption data in the system	1. Log in to the application 2. Navigate to recommendations page 3. Click "Download Report" button	User credentials: username, password; Format: PDF	Recommendations report is downloaded	Report is downloaded successfully	Recommendations report is downloaded	PASS

Experiment – 2: Using UML/JAVA, design Abstract Factory design pattern.

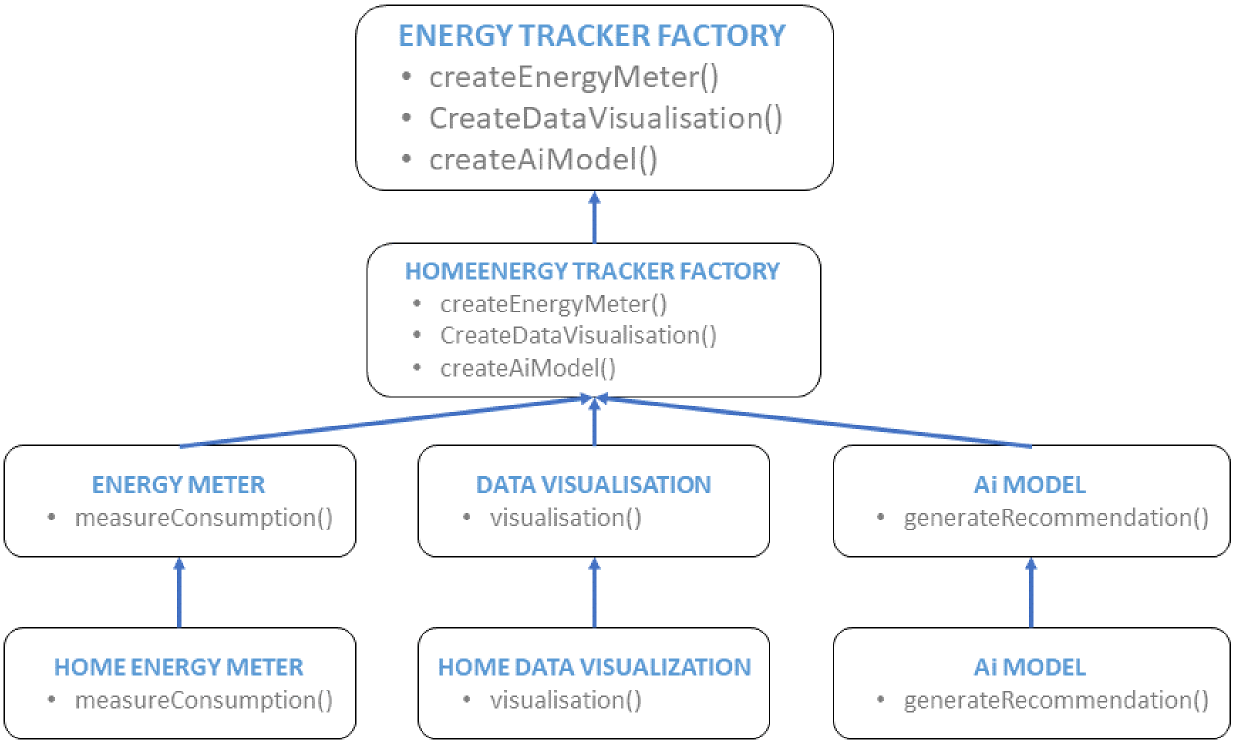
Abstract Factory: Interface for creating abstract products.

Concrete Factory: Concrete implementation of the Abstract Factory to create actual products.

Abstract Product: Interface for a type of product.

Concrete Product: Concrete implementation of the Abstract Product.

Client: Uses the Abstract Factory and Abstract Product interfaces to interact with the products.



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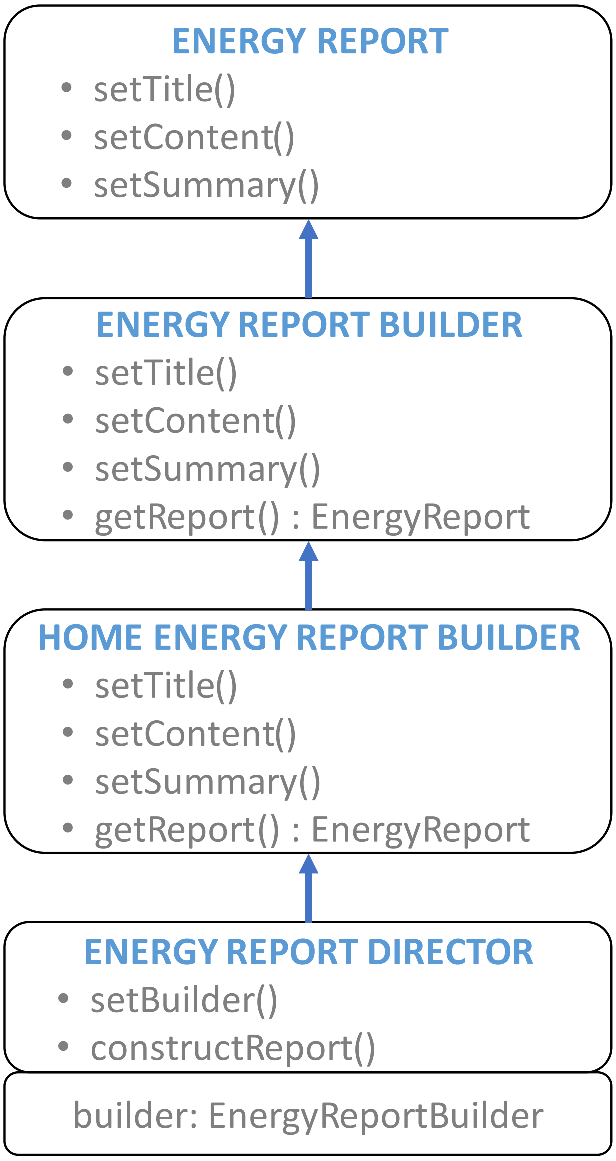
Experiment – 3: Using UML/JAVA, design Builder design pattern.



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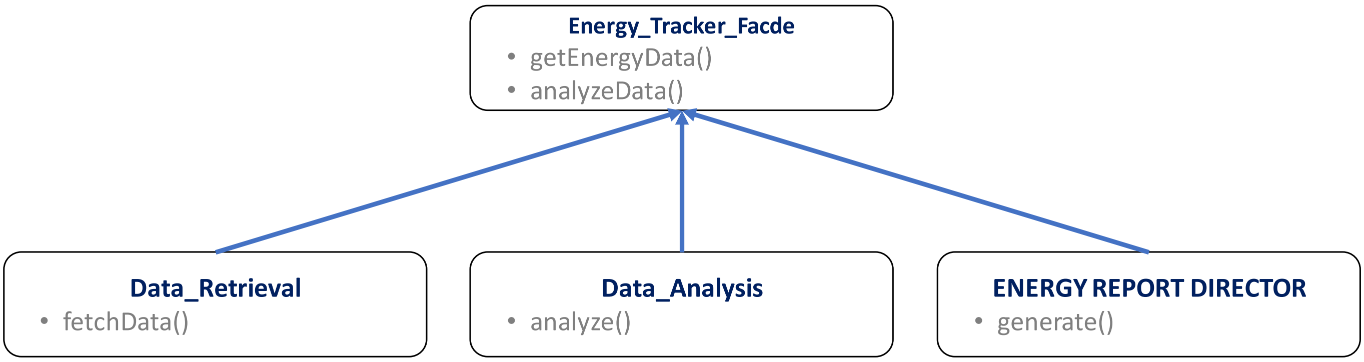
Experiment – 4: Using uml/java, design facade design pattern.



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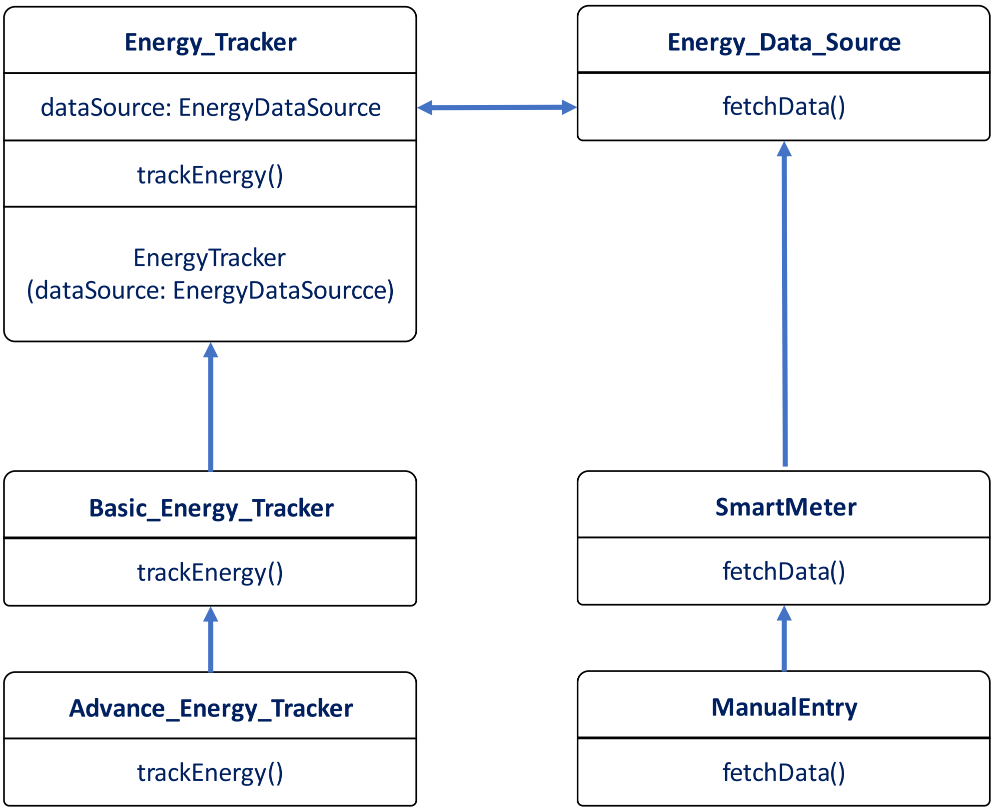
Experiment – 5: Using UML/JAVA, design Bridge design pattern.



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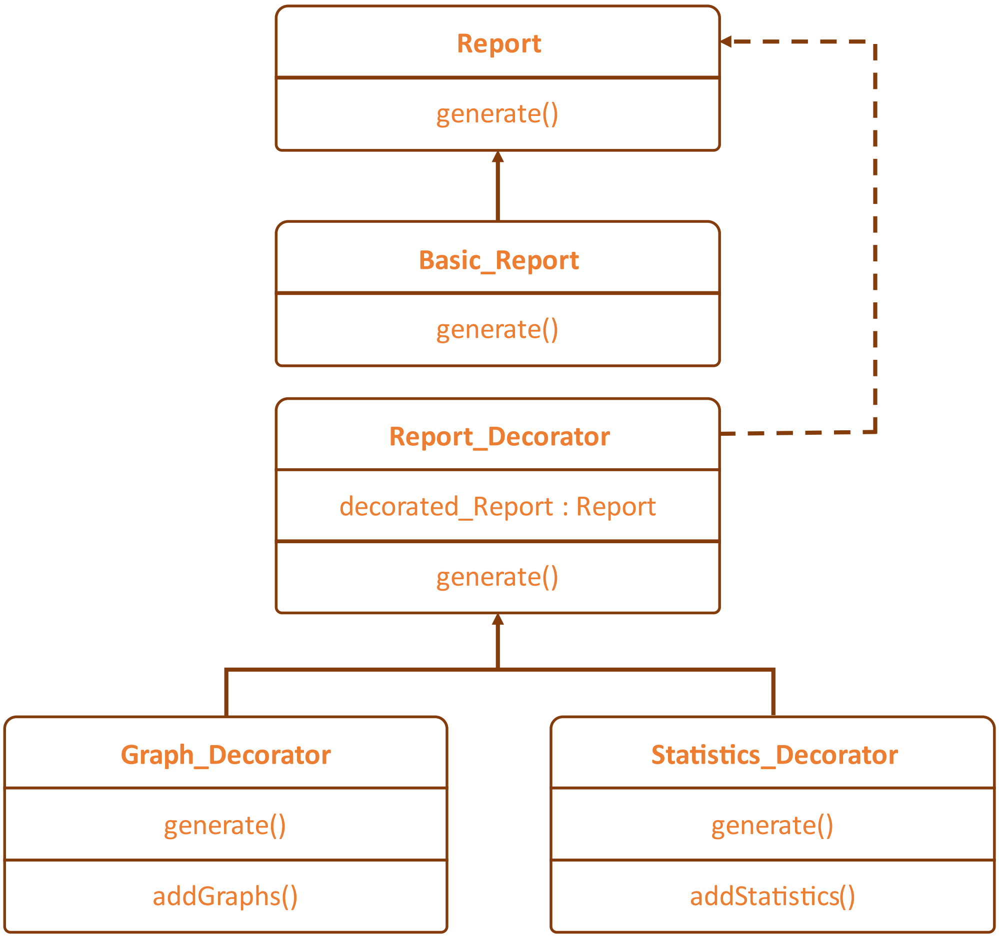
Experiment – 6: Using UML/JAVA, design Decorator design pattern.



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