Sustainers

SMART INDIA HACKATHON 2024

Problem Statement ID: SIH1525

Title: Innovating for Sustainability:
Driving Smart Resource Conservation (Energy & Water) in Home Appliances (Refrigerators, Air Conditioners, Washing Machines and Desert Air Coolers)

Organization: Godrej Appliances

Theme: Smart Resource Conservation

Category: Software

Team Name: Sustainers

Team ID: 19533

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Abstract:

- Refrigerators, air conditioners, washing machines, and desert air coolers use a lot of **energy** and **water**, raising **utility costs** and **environmental impact.**
- **"Innovating for Sustainability"** aims to make **home appliances** smarter and more **resource-efficient.**
- Using **IoT** and **smart sensors**, the system monitors and optimizes **appliance usage**. It provides **suggestions** to conserve resources based on **real-time data** and **predictive algorithms.**
- Reduces **energy** and **water usage** by **15%-20%**, leading to **cost savings** and a **smaller carbon footprint.**
- Supports **global sustainability goals**, helping households reduce their **environmental impact** while staying comfortable.

Objectives:

- Enhance appliance performance with real-time monitoring and machine learning.
- Promote sustainability by reducing household carbon and water footprints.
- Encourage behavioural changes towards sustainable living.
- Increase user awareness and engagement in resource conservation.
- Contribute to consumer cost savings through efficient appliance use.

Problem Statement:

- **Traditional home appliances** operate without considering their **environmental impact**, often consuming excessive amounts of **energy** and **water.**
- For instance, standard **refrigerators** run continuously at set temperatures, **air conditioners** operate inefficiently, **washing machines** use preset water levels, and **desert air coolers** lack **smart controls** for efficient operation.
- These inefficiencies contribute to **resource waste** and **higher utility costs**.
- Some of the problems faced are:
  - **Energy Waste**: Inefficient use of power due to static operating modes.
  - **Water Inefficiency**: Appliances like washing machines and air coolers use more water than necessary.
  - **User Awareness**: Limited feedback to users about their energy and water consumption.

Proposed Solution:

- A **comprehensive software platform** is proposed to **monitor, analyse, and optimize energy** and **water consumption** in home appliances.
- By providing **real-time insights** and **actionable recommendations**, the platform empowers users to manage resources efficiently, reducing both **utility costs** and **environmental impact**.

Features:

1) Real-Time Monitoring

The platform tracks appliance usage using **IOT sensors** and provides **real-time data** on **temperature** and **humidity**, enabling users to monitor their resource usage effectively of each connected appliance.

2) Advanced Data Analytics

Utilizing IoT sensor data, the platform analyses **consumption trends** and detects inefficiencies. For example, it can identify **abnormal energy use** in a refrigerator, indicating potential issues.

3) Optimization Algorithms

The platform uses **real-time data** and **user preferences** to suggest **energy** and **water-saving adjustments** through its optimization algorithms.

4) Conservation Recommendations

Personalized tips are provided based on usage patterns, such as shifting laundry to **off-peak hours** or adjusting **air conditioner settings**. Behavioural insights help users adopt more mindful habits, like ensuring refrigerator doors are properly sealed.

5) Remote Access and Smart Alerts

Through a **web interface**, users can remotely monitor and control appliances. **Real-time notifications** alert users to **excessive resource consumption**, potential **malfunctions**, or needed **maintenance**.

Software Flow:

1) User Profile

The system collects user details like **appliance type, model,** and **usage habits** to **personalize the experience.**

2) Appliance Monitoring

Sensors gather real-time data on appliance usage of **temperature** and **humidity** for **threshold comparison** and performance analysis.

3) Data Processing

Machine learning algorithm: a **linear regression model** used for **predictive analysis** and identifying relationships between variables like **Power Rating** and **Usage Duration** to predict **energy** and **water consumption** & **threshold comparison** of Temperature and Humidity values for **inefficiency** detection, and opportunities for **improvement.**

4) Optimization Suggestions

The system offers **personalized tips**, such as adjusting **usage times**, switching to **eco-modes**, or changing **settings** for better efficiency.

5) User Feedback

Users provide feedback on the suggestions, helping the system understand their **effectiveness** of suggestions.

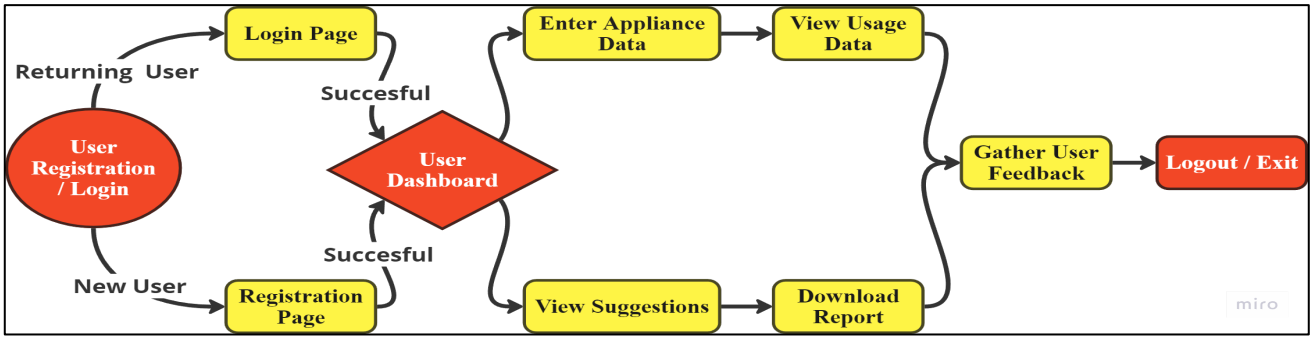
6)Report Generation

The system generates **reports** summarizing **appliance performance, energy usage, inefficiencies**, and offering suggestions for **long-term optimization**.

7) Continuous Improvement:

The system updates its algorithms based on **user feedback** to provide **better recommendations** over time.

User Module:



1. User Registration/Login

- **New users** go through the registration process.
- **Returning users** log in directly.

2. User Dashboard

After successful login, users access the dashboard where they can manage their appliances.

3. Enter Appliance Data

Users input or update data about their appliances, such as usage details.

4. View Usage Data

The system displays energy and water consumption data for each appliance.

5. View Suggestions

Users receive personalized tips to optimize energy and water usage and expected reduction.

6. Download Report

Users can download a summary report of their usage and optimization suggestions.

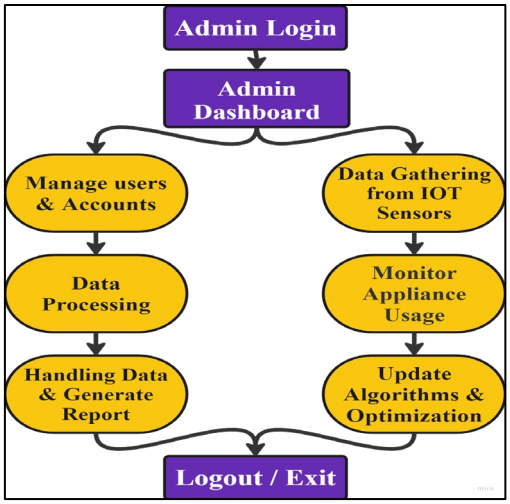
7. Gather User Feedback

The system collects feedback from users on how helpful the suggestions are.

8. Logout/Exit

Users can log out or exit the platform when finished.

Admin Module:



1. Admin Login

Admins log in to access their control panel.

2. Admin Dashboard

Once logged in, the admin dashboard is displayed, providing access to all management tools.

3. Manage Users & Accounts

Admins can manage user accounts, including registration, access, and settings.

4. Data Processing

Data collected from users and appliances is processed for analysis.

5. Handling Data & Generate Report

The system generates reports based on the processed data, providing insights for optimization.

6. Data Gathering from IoT Sensors
IoT sensors provide real-time data on appliance usage and resource consumption.
7. Monitor Appliance Usage
Admins can monitor the performance and usage of connected appliances.
8. Update Algorithms & Optimization
Based on the data gathered, algorithms are updated to improve appliance efficiency.
9. Logout/Exit
Admins can log out or exit the platform when done.

Impacts:

1) Empowers Users
The system gives users **real-time data** and **recommendations** to make better decisions about energy and water use, **lowering bills** and promoting **sustainable habits**.

2) Encourages Sustainability
By optimizing appliance usage, the system helps reduce energy and water waste, supporting **environmental conservation** and **reducing household carbon footprints**.

3) Increased Convenience
Automation reduces the need for manual adjustments, ensuring appliances **run efficiently** with minimal effort, improving overall **convenience** and **quality of life.**

Benefits:

1. Social Benefits

The project raises awareness about **sustainable living**. It helps households save energy and water, encouraging a community shift towards better **resource management**. As more people use this system, it boosts overall **conservation efforts.**

2. Economic Benefits

By optimizing appliance use, the system cuts down on **utility bills**. This saves money and motivates users to keep up with energy and water-saving practices, leading to **long-term financial benefits**.

3. Environmental Benefits

Reducing energy and water use lowers **carbon emissions** and helps tackle **climate change** and **water scarcity.** The system supports sustainability by helping people minimize their **environmental impact** and protect **natural resources.**

Costing:

Hardware:

- **ESP32 board:** 350 -450 INR
- **DHT22 sensor:** 150 - 200 INR.

Cloud Services:

AWS IoT Core/Blynk Cloud: Free tier or minimal cost for small-scale usage.

Software:

Open-source tools (Apache Spark, Python, Scikit-learn, Pandas).

Overall Costing: 1000-1500 INR

Overall, the system is designed to be **cost-effective**, utilizing affordable hardware and open-source software, with minimal ongoing cloud service costs.

Revenue Generation:

1) **Subscription Model:** Offer a one-time payment for **premium features**, covering the duration of the appliance's **warranty period.**
2) **Appliance Manufacturers**: Partner with appliance makers to include the system in their products, creating **smart, energy-efficient appliances.**

Results:

- **Energy Efficiency:** A **15-20% reduction** in energy consumption was observed across different appliances.
- **Water Conservation**: The modified washing machines showed up to **20% savings** in water use.

Conclusion:

- The **Sustainers project** provides an effective solution to **energy** and **water wastage** in home appliances by leveraging **IoT, cloud services,** and **machine learning.**
- **Real-time monitoring** and **optimization suggestions**, users can improve appliance efficiency, lower costs, and contribute to sustainability.
- The system's architecture, based on **affordable hardware** and **open-source tools**, ensures that the project is accessible and cost-effective for consumers.
- Comprehensive **report generation** provides users with insights into appliance performance, helping them make informed decisions for **long-term resource management**.
- Future enhancements could include adding more sensors and improving **machine learning models** to further enhance **accuracy and efficiency**.