

INFOSYS SPRINGBOARD VIRTUAL INTERNSHIP 6.0 COMPLETION REPORT

Team Details

Batch Number:10

Start Date: 22-NOV-2025

Internship Duration: 8 Weeks

Team Number: 3

Vaishnavi M -Technical lead

1. Project Title

Smart Home Energy Management System (SHEMS)

2. Project Objective

The objective of the **Smart Home Energy Management System (SHEMS)** is to design and develop a secure and efficient web-based application that enables users to monitor, control, and optimize electricity usage within a smart home environment.

The system aims to:

- Provide **secure authentication** with role-based access
- Enable **smart device monitoring and control**
- Track **real-time energy consumption**
- Offer **analytics dashboards** for insights
- Support **automation and scheduling**
- Enforce **admin-level energy policies** to prevent excessive usage

The ultimate goal is to reduce energy wastage and promote smart, energy-efficient living.

3. Project Description in Detail

The **Smart Home Energy Management System (SHEMS)** is a full-stack web application developed using Spring Boot, MySQL, and Thymeleaf. It provides a digital platform that allows users to control electrical devices and monitor energy consumption in an efficient and structured manner.

Secure Authentication & Role Management

- Implemented using Spring Security
- Separate roles for User and Admin
- Secure login and registration system
- Role-based access to features and data

Smart Device Management

Users can manage their devices through:

- Adding new smart devices
- Turning devices ON or OFF
- Viewing current device status
- Each device is linked to its respective user account to maintain data privacy

Real-Time Energy Tracking

- Energy usage is calculated using device power rating multiplied by usage duration
- Energy data is recorded and stored continuously in the database
- Enables monitoring of electricity consumption at the device level

Analytics & Dashboards

The system provides dashboards that display:

- Daily and weekly energy usage trends
- Device-wise energy consumption comparison
- Identification of peak usage periods
- Estimated cost based on energy consumption

Administrators can also view:

- High energy-consuming users
- Top energy-consuming devices across the system

Scheduling & Automation

- Users can set ON and OFF times for devices
- Background schedulers automatically control device states

- Helps reduce manual effort and unnecessary power usage

Admin Energy Policy Enforcement

- Admins can define energy usage limits and active time windows
- If a device exceeds the defined threshold:
 - The device is turned OFF automatically
 - The enforcement action is recorded in system logs

Overall, SHEMS functions as a complete smart energy management solution by integrating secure access, device control, real-time monitoring, analytics, automation, and policy enforcement.

4. Timeline Overview

Week	Activities Planned	Activities Completed
Week 1	Understanding the project idea and choosing tools	Participated in analyzing smart energy solutions and defining system requirements. Contributed to selecting Spring Boot for backend development and MySQL for database storage. Assisted in dividing tasks among team members and planning the project roadmap.
Week 2	Planning user access and data storage	Helped design user and admin authentication flow with role-based access control. Contributed to designing database schemas for storing user details and device information. Assisted in ensuring data consistency and proper relationships between tables.
Week 3	Designing system flow and module structure	Contributed to mapping the overall system architecture and data flow. Helped design module interactions between users, devices, and energy data. Assisted in planning how energy tracking integrates with device control.
Week 4	Developing device management features	Worked on developing device management features to add, view, and control devices. Assisted in implementing ON/OFF functionality and validating device status updates.

Week 5	Improving energy tracking logic	Studied appliance power consumption patterns and contributed to refining energy calculation logic. Assisted in improving accuracy of estimated energy usage based on device type and usage time.
Week 6	Implementing energy monitoring	Contributed to implementing energy usage calculation using device power and runtime. Assisted in storing energy usage records in the database for historical tracking.
Week 7	Connecting modules and creating dashboards	Helped integrate authentication, device management, and energy monitoring modules. Assisted in developing dashboards to display energy consumption trends in a user-friendly format.
Week 8	Adding automation and finishing the project	Assisted in implementing device scheduling and basic automation features. Supported development of admin-level energy control functionalities.

5a. Key Milestones

Milestone	Description	Date Achieved
Project Kickoff	Requirement analysis and planning	22-NOV-25
Prototype / First Draft	Authentication and device management Completed	Week 4
Mid-Term Review	Review of energy tracking and dashboards	Week 6
Final Submission	Completion of all modules and documentation	Week 8
Presentation	Final system demonstration	Week 8

5b. Project Execution Details

The project followed a **modular development approach** across eight weeks. The initial phase focused on implementing **secure authentication and role-based access**. After ensuring secure login functionality, the team developed the **smart device management module** where users could add and control devices.

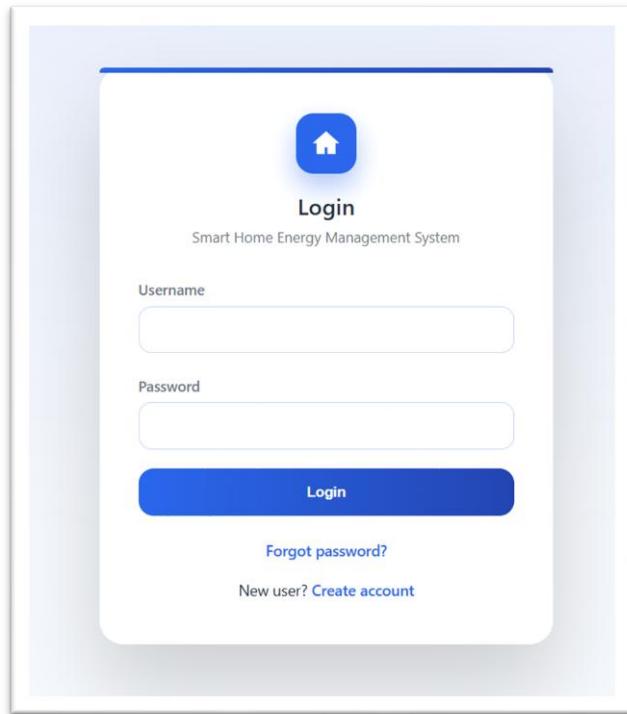
Next, the **real-time energy tracking module** was implemented to calculate energy usage based on device power and usage duration. This data was then visualized using dashboards. Following this, **automation and scheduling features** were added using background schedulers. Finally, **admin-level energy policies** were implemented to control excessive energy consumption automatically.

Continuous testing and integration ensured that all modules worked smoothly together.

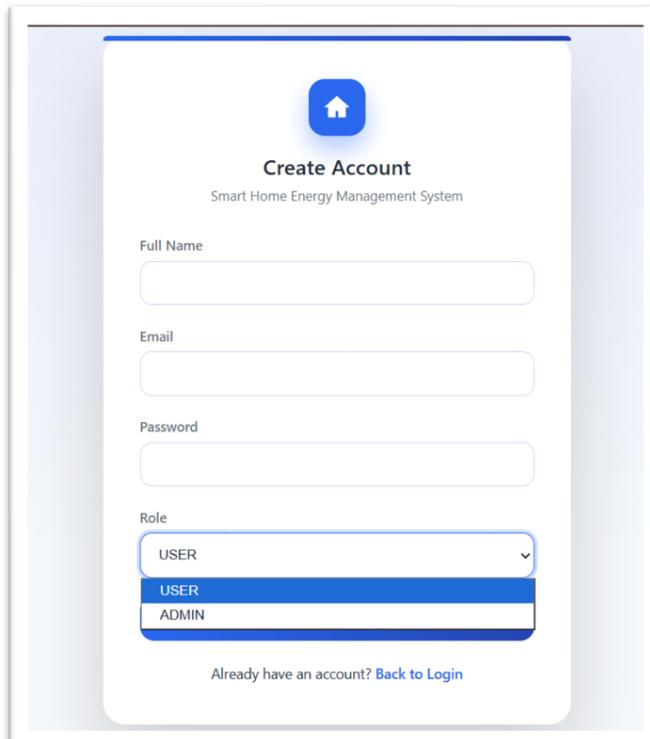
6. Snapshots / Screenshots

This section includes screenshots of the Smart Home Energy Management System demonstrating:

- **User Login Page**



- **User Registration Page**



- **User Dashboard**

The dashboard displays the following key metrics:

- TOTAL DEVICES:** 4
- ACTIVE DEVICES:** 4
- INACTIVE DEVICES:** 0
- TODAY'S ENERGY USAGE:** 3.600 kWh (Approx Cost: ₹21.60)

My Devices

Name	Type	Location	Power (W)	Status	Energy Today	Usage Level	Actions
Kitchen Refrigerator	Refrigerator	Kitchen	180.0 W	ON	0.288 kWh	LOW	<button>Toggle</button> <button>Delete</button>
Television	Television	Living Room	120.0 W	ON	0.192 kWh	LOW	<button>Toggle</button> <button>Delete</button>
Bathroom Geyser	Microwave	Balcony	1200.0 W	ON	1.920 kWh	MEDIUM	<button>Toggle</button> <button>Delete</button>
Water Pump	Water Pump	Garage	750.0 W	ON	1.200 kWh	MEDIUM	<button>Toggle</button> <button>Delete</button>

- **Smart Device Management Screen**

Add a Smart Device

Enter your appliance details so SHEMS can monitor and control it.

Example: Living Room AC • Type: Air Conditioner • Location: Bedroom • Power: 1500W

Device Name	Device Type
Bedroom Fan	Fan
Installation Location	Power Rating (Watts)
Bedroom	75

Connected Devices

All registered smart devices linked to your account.

NAME	TYPE	LOCATION	STATUS	ACTIONS
Kitchen Refrigerator	Refrigerator	Kitchen	ON	<button>Toggle</button> <button>Delete</button>
Television	Television	Living Room	ON	<button>Toggle</button> <button>Delete</button>

- Energy Analytics Dashboard



- **Scheduling & Automation Screen**

The screenshot shows the 'Device Scheduling' section of the SHEMS interface. On the left is a dark sidebar with navigation links: Home, Dashboard, Devices, Analytics, **Scheduling** (which is highlighted), and Logout. The main content area has a blue header bar with the title 'Device Scheduling' and a subtitle 'Automate your device ON/OFF timings'. Below this is a 'Add New Schedule' form with fields for 'DEVICE' (set to 'Television'), 'ON TIME' (set to '19:15'), 'OFF TIME' (set to '19:17'), and a 'Save Schedule' button. A note below the form says 'Time uses 24-hour format (Example: 13:00 = 1 PM)'. To the right of the form is a circular timer graphic showing '00:00:45' with a progress bar and a small icon. Below the timer is a table titled 'Existing Schedules' with columns: DEVICE, ON TIME, OFF TIME, DEVICE STATUS, and ACTIONS.

- **Admin Dashboard**

The screenshot shows the 'Admin Dashboard' section of the SHEMS interface. The left sidebar includes links for Home, Dashboard, Devices, Energy Policies, Analytics, and Logout. The main dashboard features a blue header bar with the title 'Admin Dashboard', the message 'Logged in as: Admin', and a toggle switch. Below the header are four summary boxes: 'Total Users' (4), 'Total Devices' (8), 'Active Devices' (6), and 'Inactive Devices' (2). Underneath these is a table titled 'Registered Users' with columns: Name, Email, Total Energy (kWh), Peak Usage, and Action. The table lists four users: Admin, Fahim Shaik, User, and Student, along with their respective details and a 'Delete' button. At the bottom of this section is a blue 'Manage All Devices' button.

- Admin Energy Policy Management

SHEMS

Energy Policy Enforcement

During the selected time window, devices exceeding the energy threshold will be **automatically turned OFF**.

Create Energy Policy

Policy Name	Energy Threshold (kWh)
<input type="text"/>	0.0
Start Time	End Time
<input type="text"/>	<input type="text"/>
Scope	
All Users	<input type="button" value="Create Policy"/>

Existing Policies

Name	Time Window	Threshold	Scope	Status	Active Now	Action
Peak Hour Limit	18:00 - 22:00	2.0 kWh	ALL_USERS	DISABLED	—	Toggle

localhost:8080/admin/policies

- Admin Analytics Overview

SHEMS

Admin Energy Analytics

System Overview

Total Energy Today 4.34 kWh	Total Energy This Week 10.98 kWh	Active Devices 6
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Top 5 Energy Consuming Devices (Today)

Energy (kWh)

Device	Energy (kWh)
Bathroom Geyser	2.1
Water Pump	1.3
Kitchen Refrigerator	0.6
Television	0.2
Bedroom Fan	0.1

These screenshots collectively represent the complete system workflow

7. Learnings & Skills Acquired

- Hands-on experience with **Spring Boot full-stack development**
- Implementation of **Spring Security** and role-based authentication
- Understanding of **real-time energy calculation logic**
- Dashboard design and **data visualization concepts**
- Use of **background schedulers** for automation
- Database design using **MySQL and Spring Data JPA**
- Experience with **admin-level monitoring and control features**
- Improved debugging, integration testing, and modular design skills
- Strengthened teamwork and technical documentation skills

8. Challenges Faced

Challenge 1: Role-Based Access Control

Problem: Securing system features for different user roles

Solution: Implemented Spring Security with role-based authorization

Challenge 2: Accurate Energy Calculation

Problem: Maintaining reliable real-time energy tracking

Solution: Used power rating × usage duration formula

Challenge 3: Module Integration

Problem: Ensuring smooth interaction between modules

Solution: Followed modular design with continuous testing

Challenge 4: Automation Timing Accuracy

Problem: Ensuring scheduled actions execute correctly

Solution: Used background schedulers with validation logic

Challenge 5: Policy Enforcement Logic

Problem: Automatically controlling devices exceeding energy thresholds

Solution: Implemented admin-defined policies with enforcement and logging

9. Testimonials from Team

The team collaborated effectively throughout the internship by dividing responsibilities, conducting regular discussions, and supporting each other during development and testing.

This teamwork helped complete the project on time and strengthened both technical and communication skills.

10. Conclusion

The **Smart Home Energy Management System (SHEMS)** successfully demonstrates a real-world smart energy solution integrating authentication, device control, real-time tracking, analytics, automation, and policy enforcement. This project significantly improved our understanding of full-stack development and real-time system design.

11. Acknowledgements

We sincerely thank our mentor and **Infosys Springboard** for their continuous guidance and support throughout the internship. Their feedback and encouragement played a vital role in the successful completion of this project.