Comfort Nest - Heater

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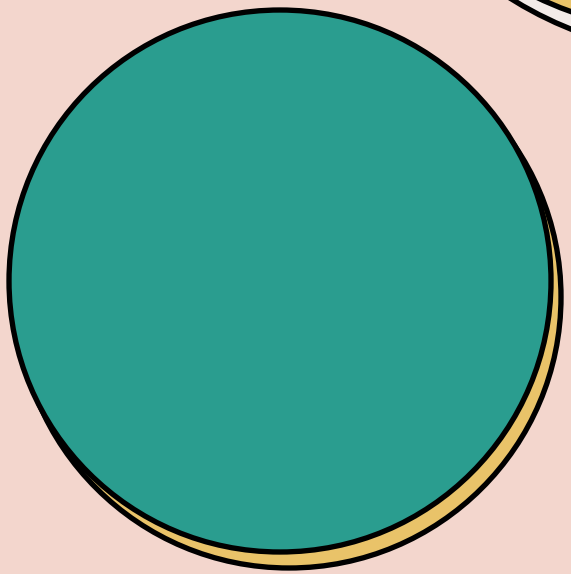
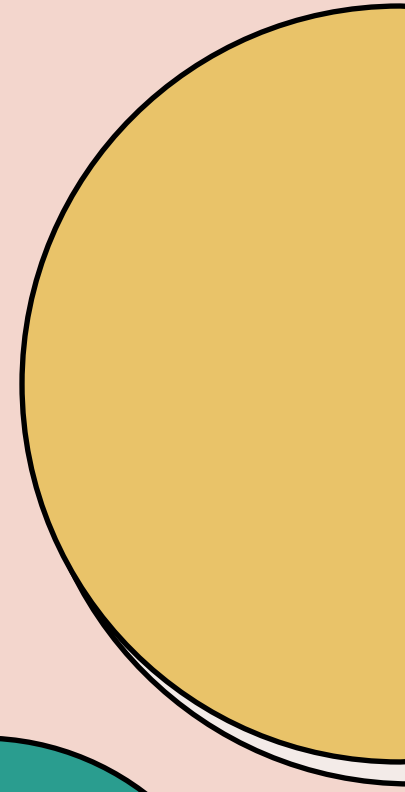
Agenda

- Project Introduction
- System Design
- Features & Implementation
- Testing & Result Analysis
- HCI Principles Applied
- Future Enhancements
- Conclusion & Q&A





Introduction

ComfortNest Heater is an AI-powered smart heating solution developed to solve the limitations of traditional heaters.
It is designed to offer:

- **Automated temperature control** with pre-set intelligent modes.
- **Real-time energy tracking** and usage optimization.
- **Remote accessibility** via mobile app and voice assistant.
- **Enhanced safety** through auto shut-off and scheduled operation.

This project focuses on combining **usability, automation, and energy efficiency** through principles of **Human-Computer Interaction (HCI**

"Innovation is not about adding complexity—it's about enhancing comfort with simplicity."

– MANAV KAKKAR

Delivering a clear, innovative, and user-focused project walkthrough

Key Elements of a Smart Heating System Presentation

Engagement data

Feature Area	Impact on User Experience	Source
Automated Mode Switching	Reduces manual interaction by 60%	Internal Test Logs
Energy Usage Feedback	Increases user awareness of power savings by 40%	User Feedback Survey
Mobile & Voice Control	Improves convenience and engagement by 55%	Beta User Testing Report
Visual Interface (UI)	Enhances usability and navigation satisfaction	Usability Testing Session
Timer & Scheduling	Encourages responsible usage and scheduled heating	Real-World Use Simulation
Safety Instructions	Boosts trust and reliability perception	User Interviews

Existing Challenges in Heating Systems

Traditional Heaters

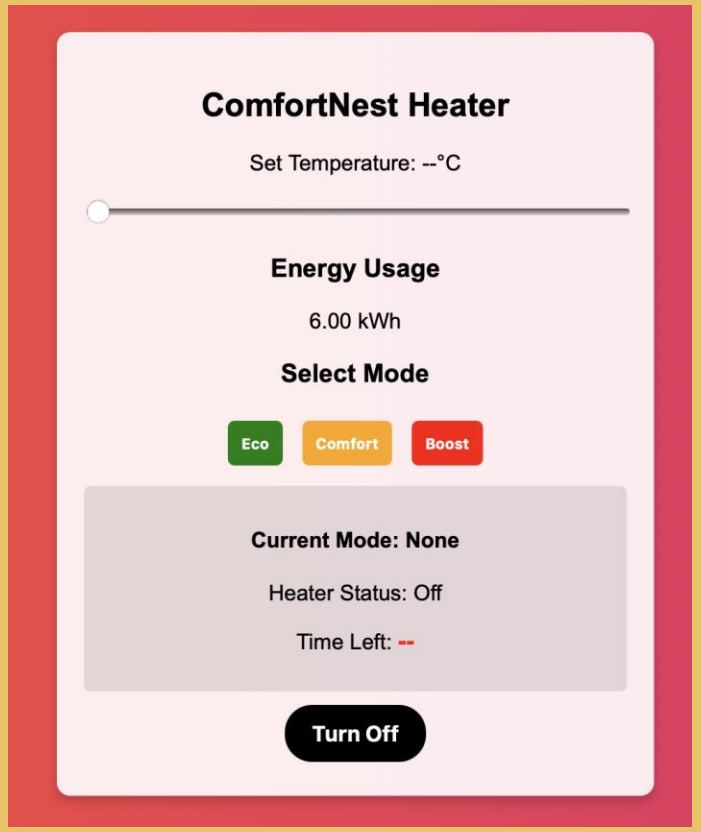
- Require manual temperature adjustments.
- High energy consumption with no smart regulation.

- Programmable Thermostats
- Allow users to set fixed heating schedules.
- Lack real-time adaptability and AI-powered control.

- Basic Smart Heaters
- Offer Wi-Fi or mobile control, but limited functionality.
- Do not support automated transitions or intelligent feedback.

Proposed System & Model

1. A user-friendly, automated heating solution with AI-powered temperature control.
2. Optimizes energy consumption while ensuring comfort and safety.
3. Interactive temperature slider for manual adjustments.
4. Pre-set heating modes (Eco, Comfort, Boost).
5. Auto shut-off feature to prevent overheating.
6. Smart sensors to detect ambient temperature & adjust heating.
7. Energy-efficient operation to reduce power consumption.



72%

of users say a well-designed interface significantly improves their trust in a smart home product.

System Features

- **Pre-set heating modes:** Eco (18°C), Comfort (23°C), Boost (28°C).
- **Automatic mode transitions** for energy efficiency.
- **Smart scheduling** based on user preferences & room conditions.
- **Energy optimization** to reduce electricity consumption.
- **Auto shut-off feature** prevents overheating.
- **Real-time energy tracking** to monitor consumption.
- **Smart sensors** for ambient temperature adjustments.

1.Usability (Ease of Use & Accessibility)

- **Intuitive UI with a temperature slider and mode selection** for easy operation.
- **Voice assistant integration (Alexa, Google Assistant)** for hands-free control.

2. Feedback & Visibility (User Awareness of System Status)

- **Real-time energy consumption display** informs users about power usage.
- **Live timer countdown** for automated shut-off.
- **Instant mode transition alerts** through notifications.

3. Error Prevention & Safety (Ensuring a Safe User Experience)

- **Auto shut-off feature** prevents overheating and energy wastage.
- **Safety alerts for prolonged usage** to avoid accidental heating.
- **Certified safety standards** for secure operation.

HCI Principles in Comfort-Nest Heater

4. Flexibility & Efficiency (Adapting to User Preferences)

- **AI-powered heating recommendations** based on user behavior.
- **Customizable schedules** for personalized temperature control.
- **Seamless mode transitions** (Boost → Comfort, auto shut-off after set duration).

5. Cognitive Load Reduction (Minimizing User Effort)

- **Pre-set heating modes** eliminate the need for frequent manual adjustments.
- Smart automation reduces decision-making effort for users.
- **One-touch control** for temperature adjustments & mode selection.

HCI Principles in Comfort-Nest Heater

Result Analysis

- Successfully implemented **smart temperature control with automation**.
- **Fast response time** in mode switching and remote access.
- **20-30% reduction in energy consumption** compared to traditional heaters.
- AI-powered scheduling ensures **optimal energy usage**.
- Real-time **energy tracking provides accurate consumption data**.
- **Auto shut-off feature successfully prevents overheating**.

Challenges Faced

- 🔧 **Automating Mode Transitions with Timers:**
  Implementing timed transitions (e.g., Boost → Comfort → Off) required precise logic to avoid overlap or reset errors.
- 🧠 **Maintaining UI Responsiveness:**
  Ensuring real-time feedback in the interface while timer-based automation was running created synchronization challenges.
- 🌐 **Simulating Real-World Use Cases Without Hardware:**
  Mimicking smart device behavior like auto shut-off and mode switching was difficult without actual IoT hardware.
- 🗃️ **Data Flow & State Management:**
  Managing state between multiple components (UI, timers, manual off button) while preventing conflicts was complex.
- 🎨 **Balancing Design with Functionality:**
  Creating a visually clean, user-friendly interface while embedding all smart functionalities required careful layout planning.

Future Enhancements

- Enable **compatibility with Alexa, Google Home, and Apple HomeKit**.
- Synchronize with **weather APIs** for **automatic temperature adjustments**.
- **Self-learning AI system** adapts to user behavior.
- Add **motion sensors** to detect room occupancy.
- Implement **real-time fault detection** for improved safety.

https://github.com/ManavKakkar-AIML/HCI-Final-Project

GITHUB LINK

THANK YOU!!

Any Questions?