ElevateX:

The Future of Crowd - Aware Elevators

TEAM MEMBERS:

Shobhit Poddar: _____
Ujjawal Singh: _____
Raushan Kumar: _____
Suryansh Subham: _____
Ashutosh Kumar: _____

SUPERVISED BY
Prof. (Dr.) Sheli Sinha Chaudhuri

NETAJI SUBHASH ENGINEERING COLLEGE
(Affiliated to MAKAUT, Approved by AICTE)

_____
Supervisor

Extended Comparison Report: ElevateX Smart Lift System vs. Patent US11772931B2

---

1. Introduction

This report presents an in-depth comparison between two innovative elevator control systems designed to modernize and optimize the vertical transportation infrastructure:

- **ElevateX**: A project conceptualized and developed by a student team, ElevateX is a crowd-aware, IoT-integrated smart lift system designed to prioritize floor service dynamically using real-time human presence detection. It uses microcontrollers and sensors to monitor waiting passengers on each floor and adjusts lift movement accordingly.
- **Patent US11772931B2**: A formally granted patent titled *"Smart Elevator Control System and Method"*, which introduces a predictive, data-driven method to schedule elevator stops. This system emphasizes improving operational efficiency by learning from historical call data and adjusting service patterns based on usage trends.

The purpose of this report is to evaluate these two systems side by side, identify overlapping features, highlight distinctions in approach and implementation, and explain why ElevateX offers novel contributions to the field of intelligent elevator systems.

---

2. Detailed Comparison Table

Feature / Aspect	Patent US11772931B2	ElevateX Smart Lift System
Primary Objective	To optimize elevator scheduling and reduce wait time by analyzing call history and movement patterns	To minimize wait time and maximize efficiency using real-time crowd data and priority-based decision-making
Technology Core	Uses a centralized server-based control unit, collecting data over time to predict user demand patterns	Utilizes ESP32 microcontrollers and floor-based IR/camera sensors to determine real-time occupancy and urgency
Sensing Mechanism	Dependent on elevator call button data, usage logs, and floor selection statistics	Relies on IR sensors or cameras placed on each floor to count the number of waiting passengers

Data Processing	Focuses on pattern recognition, learning behavior from repeated elevator usage trends	Implements a weighted algorithm based on people count and priority zones (e.g., hospitals, schools) to compute service order
Hardware Architecture	General hardware abstraction; emphasis on control logic rather than hardware specifics	Clear and specific hardware structure: ESP32, L298N motor driver, servo motor, relays, and Wi-Fi modules
Interface and Control	Presumed integration into building's internal control panels and systems	Fully interactive via a mobile application (Blynk/Firebase) that offers live monitoring, control commands, and alerts
Decision Logic Type	Predictive logic based on machine learning or rule-based pattern detection	Real-time, deterministic logic with scoring functions that adapt to changing floor conditions
Connectivity	Networked control; likely designed for enterprise-scale building automation	Wireless communication via Wi-Fi, enabling decentralized and modular control of lift operations
Remote Accessibility	May require integration with building management software (not explicitly defined)	Built-in remote access via smartphone and web dashboard, accessible in real time by administrators or users
Intended Deployment	High-rise commercial buildings, business complexes, or transport hubs	Hospitals, educational institutions, residential complexes, malls, smart cities, and industrial areas
Energy Efficiency Strategy	Reduces idle movement through smart scheduling based on historical usage	Minimizes lift operations during low-priority periods or light occupancy by calculating real-time demand
Access Control	Not explicitly covered in detail within the patent	Future-ready with provisions for biometric authentication (face, fingerprint), RFID access, or role-based permissions
AI/ML Integration	Uses AI/ML for learning user behavior patterns and anticipating peak usage	Future scope includes integrating AI for pattern prediction, occupancy trends, and floor call forecasting

Cost-Effectiveness	No cost or affordability aspects covered	Designed with low-cost components for maximum affordability and modular implementation in resource-limited environments
Scalability and Flexibility	Intended for centralized deployment across large buildings	Modular architecture allows for expansion to multiple floors, coordination of multiple lifts, and component-based upgrades

---

3. Key Similarities

- **Focus on Optimization**: Both systems aim to replace traditional elevator control logic with smarter algorithms to improve efficiency and reduce waiting times.
- **Automation and Intelligence**: Each approach incorporates autonomous decision-making, leveraging either historical or real-time data.
- **Infrastructure Integration**: Both systems are designed to work in multi-story buildings and are capable of expanding with additional modules or updates.
- **Adaptability**: Both are adaptable for various building types and can be customized for special-use scenarios (e.g., medical or commercial settings).

---

4. Key Differences and Technical Implications

Aspect	Patent System	ElevateX System
Data Dependency	Dependent on past elevator usage logs and analytics	Independent and adaptable to live conditions through direct environmental sensing
Real-Time Responsiveness	Indirect; updates based on observed patterns over time	Highly responsive; recalculates priorities continuously based on real-time input
Hardware Implementation	Conceptual; mostly theoretical and design-driven	Practical; fully implemented with hardware, wiring, and functional prototype

Innovation Edge	Predictive model, useful in large buildings with steady patterns	Priority-based floor routing using actual human presence, optimal for dynamic environments
System Complexity	Likely higher in software; needs significant backend processing	More complex on the hardware side but manageable with microcontroller logic
Security Features	Assumed integration into secure systems; not elaborated	Proposed extensions to include RFID, facial ID, and secure access protocols
Monitoring & Feedback	Minimal; backend-dependent	Real-time alerts and updates via mobile apps, dashboards, and optional displays

---

5. Unique Contributions and Strengths of ElevateX

- **Real-Time Decision Making**: Unlike the patent which relies on patterns, ElevateX makes decisions based on current needs—critical in hospitals, schools, and other dynamic spaces.
- **Crowd-Based Logic**: The system does not just respond to button calls but reacts to actual presence, which reduces false calls and idle trips.
- **Mobile and Cloud-Integrated Interface**: Offers user-friendly control and visibility through mobile applications, integrating easily with platforms like Blynk and Firebase.
- **Affordable Hardware Design**: Uses cost-effective components while maintaining high performance, making it suitable for budget-conscious institutions.
- **Prototype Proven**: Unlike many theoretical designs, ElevateX includes a working prototype validated through testing and real-time simulations.
- **Future-Focused Roadmap**: With plans for ML-enhanced predictions, biometric security, voice/gesture recognition, and smart energy optimization, the system is built for evolution.
- **Educational and Commercial Relevance**: The project balances technical innovation with practical feasibility, making it ideal for both academic research and real-world deployment.

---

6. Conclusion

The comparative analysis highlights that both systems aim to revolutionize elevator operations but adopt fundamentally different approaches. The patented system (US11772931B2) focuses on predictive scheduling informed by historical usage data, which is suitable for buildings with stable usage patterns. In contrast, ElevateX emphasizes **real-time, context-aware prioritization**, making it significantly more effective in variable, high-traffic, or emergency-prone settings.

ElevateX stands out by offering:

- Practical implementation with real hardware and software
- Real-time responsiveness
- Modular and cost-effective design
- User-friendly app integration
- A clear roadmap for future enhancements including AI and access control

This project demonstrates strong innovation potential and addresses key limitations in traditional elevator systems, marking it as a competitive, scalable, and smart solution for modern buildings.