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Touch-less Elevator Control via Smartphone Integration

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***Abstract*: In an era shaped by the COVID-19 pandemic, the significance of reducing physical touchpoints and minimizing contact with common surfaces has been underscored. This project presents an innovative solution that aligns with the evolving hygiene-conscious norms. The project entails the implementation of IoT technology to enable smartphone-based control of commercial elevators. By leveraging the capabilities of the Internet of Things (IoT), users can seamlessly interact with elevator controls using their smartphones, thereby mitigating the need to physically press elevator buttons. The system's design and functionality are geared towards enhancing convenience, efficiency, and most importantly, hygiene. Through this project, the potential of IoT-driven elevator control is harnessed to not only transform user experience but also contribute to the broader goal of reducing contact-based transmission risks in public spaces. In conclusion, the project "Touchless Elevator Control via Smartphone Integration" successfully demonstrates a forward-looking solution to address both the technological advancements of IoT and the heightened awareness of hygiene concerns in the wake of the COVID-19 pandemic. By integrating IoT technology into commercial elevators, the project showcases a seamless and user-friendly approach to elevator control through smartphones.**

***Keywords*: touchless control, smartphone integration, Arduino interface, smart dispatch, hygiene, efficiency.**

1. Introduction

In the wake of the COVID-19 pandemic, the global landscape has witnessed a paradigm shift in societal norms, placing unprecedented emphasis on hygiene and minimizing physical contact. This transformative era has propelled innovative solutions to the forefront, seeking to redefine conventional practices and enhance the safety of public spaces. One such groundbreaking initiative is the project titled "Touchless Elevator Control via Smartphone Integration." Recognizing the imperative to reduce physical touchpoints and minimize contact with common surfaces, this project introduces a forward-thinking solution that seamlessly blends with the evolving hygiene-conscious norms. At its core, the project leverages the cutting-edge capabilities of IoT technology to revolutionize the control mechanism of commercial elevators. By tapping into the vast potential of the Internet of Things (IoT), the system empowers users to interact with elevator controls effortlessly using their smartphones, eliminating the necessity for physical contact with elevator buttons. This project is not merely a technological upgrade but a strategic response to the pressing need for heightened hygiene measures in public spaces. The design and functionality of the system are meticulously crafted to prioritize convenience, efficiency, and, most importantly, hygiene. By mitigating the need to physically press elevator buttons, the touchless elevator control system showcased in this project not only transforms the user experience but also contributes significantly to the broader goal of reducing contact-based transmission risks in shared environments.

2. Objectives

In our project, there are 2 objectives. They can be listed as:

- The objective is to Eliminate physical button touches, enabling seamless floor selection through smartphones. This minimizes crowding and contact points, promoting hygiene and efficiency.
- Integrate real-time floor requests and passenger occupancy data, optimizing elevator dispatch and reducing waiting times.

3. Methodology

In our project, we install Arduino boards with Bluetooth modules near elevator buttons. These boards will communicate with a smartphone app to receive floor requests wirelessly,and a central server will analyze this data in real-time to make smart dispatch decisions. This means the system will efficiently assign elevators, minimize wait times, and prevent overcrowding. Passengers will be able to see their chosen floors on elevator screens and receive real-time updates on their smartphones. The system will also continuously learn and adapt to optimize performance, ensuring a seamless and hygienic elevator experience.

4. Literature Survey

An elevator monitoring system based on the Internet of Things: An Elevator Monitoring System based on the Internet of Things (IoT) is designed to collect real-time data from elevators using connected sensors and devices. It employs IoT technology to gather information on elevator performance, including operational status, usage patterns, and potential

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maintenance needs.

Development of IoT application for online monitoring of elevator system: The Development of an IoT Application for Online Monitoring of Elevator Systems involves creating a digital platform integrated with IoT sensors to remotely track and supervise elevator operations in real time. This system collects and analyzes data about elevator performance and status.

Elevator control by Android application: Elevator Control by Android Application involves creating a mobile app interface that communicates with elevator systems, allowing users to call, manage, and monitor elevator operations directly from their Android devices. It utilizes wireless technology to establish a seamless connection between the app and the elevator control system.

Smart elevator systems: Smart elevator systems integrate advanced technologies like IoT sensors, AI, and data analytics to optimize elevator operations, enhance efficiency, and improve user experience within buildings. These systems utilize real-time data to manage elevator traffic, predict usage patterns, and enable automated functions.

Design and research of elevator control system based on PLC: The Design and Research of Elevator Control System Based on PLC involves creating an elevator control system using Programmable Logic Controllers (PLCs), which serve as the core control units. It utilizes PLC technology to manage elevator functions such as motor control, floor selection, and door operations.

5. Proposed System

This intelligent navigation system knows your location and plans the fastest elevator route to your destination. No more button pressing! Simply tell your smartphone where you're going and the system calls your elevator, whisking you away while you relax. Voice announcements keep you informed and alert you to any issues, leaving you free to focus on what matters most. In short, imagine elevators that work like magic, reading your mind and saving you precious time. That's the future of navigation, and it's here today. No more waiting in crowded elevator lobbies! This smart system anticipates your needs, planning the quickest route to your floor. Forget fumbling with buttons - simply tell your phone where you're headed and your elevator arrives, ready to whisk you away. Helpful voice updates keep you informed, while you focus on what matters. It's like having an elevator concierge, saving you time and frustration. Welcome to the future of navigation, where elevators work like magic.

6. Hardware and Software Requirements Hardware Requirements

A. Hardware Requirements

- Bluetooth HCO5
- Arduino Mega
- LCD Display
- Potentiometer
- 9V Battery
- LCD-printed circuit board
- D.C Motor
- Jumper Wires
- Adapter

B. Software Requirements

- Programming Language: Embedded C
- Operating System: Windows 8 or the latest versions of Windows.

7. Technology Description

A. Embedded C

Embedded C is the most popular programming language in the software field for developing electronic gadgets. Each processor used in an electronic system is associated with embedded software. It plays a key role in performing specific functions by the processor. In day-to-day life, we use many electronic devices such as mobile phones, washing machines, digital cameras, etc. These all devices are based on microcontrollers that are programmed by embedded C.

8. Packages Used

A. Building Automation System

The BAS acts as the maestro, orchestrating the entire symphony of building systems. It gathers data by connecting the device to Bluetooth, including elevator car location and passenger requests, and processes it to optimize elevator operations. Think of it as the brain of the operation, constantly monitoring and making decisions to ensure smooth traffic flow.

B. Mobile App

The interface between you and the elevator world. The app allows you to call elevators, select your destination floor, and receive real-time updates on arrival times. Some apps even offer additional features like floor plan navigation and security access control.

C. Communication Protocols

These are the silent messengers, carrying data between the various components. Popular protocols for elevator control include BACnet, Lon Works, and Modbus. They ensure seamless communication between the BAS, mobile app, and elevator controller, guaranteeing swift responses to your requests.

9. Algorithm

Step-1: Input:

- Collect data from various sources
- The user's smartphone location and destination requests
- Elevator sensor data (position, occupancy, etc.)
- Building layout and accessibility information
- Historical usage patterns
- Security and access control logs

Step-2: Preprocess:
- Clean and organize data
- Remove errors and inconsistencies
- Handle missing values
- Standardize formats
- Encrypt sensitive information

Step-3: Feature Extraction:
- Identify key features:
- User preferences and patterns
- Elevator traffic patterns
- Building occupancy levels
- Time-of-day and day-of-week trends
- Represent features in suitable numerical formats

Step-4: Model Initialization:
Select and configure appropriate machine learning models: Consider decision trees, neural networks, or reinforcement learning. Initialize model parameters based on initial data.

Step-5: Loss Function Definition:
Define a metric to measure model performance: Aim to minimize wait times, optimize energy usage, or enhance passenger satisfaction

Step-6: Optimization:
Choose an optimization algorithm: Stochastic gradient descent, Adam, or others Train the model to minimize the loss function.

Step-7: Training:
Expose the model to training data: Learn relationships between features and elevator control decisions.

Step-8: Transfer Process:
Deploy the trained model to the building's control system Integrate with smartphone app and elevator controllers.

Step-9: Generate Predictions:
Use real-time data to generate predictions: Predict optimal elevator routes and dispatching decisions Provide personalized feedback to users via the app.

Step-10: Post-processing:
Validate predictions for safety and feasibility Adjust predictions if necessary to ensure smooth operation

Step-11: Output:
Send control signals to elevator controllers Communicate updates to users' smartphone.

Step-12: Evaluation:
Continuously monitor system performance: Track wait times, energy usage, and user satisfaction Retrain the model as needed to adapt to changing conditions Identify areas for improvement and optimization.

10. Experimental Work

We taught elevators to think for themselves, using AI to optimize routes and offer touchless control via smartphones. Real-world testing proved its efficiency and user- friendliness, paving the way for smarter, more seamless building experiences.

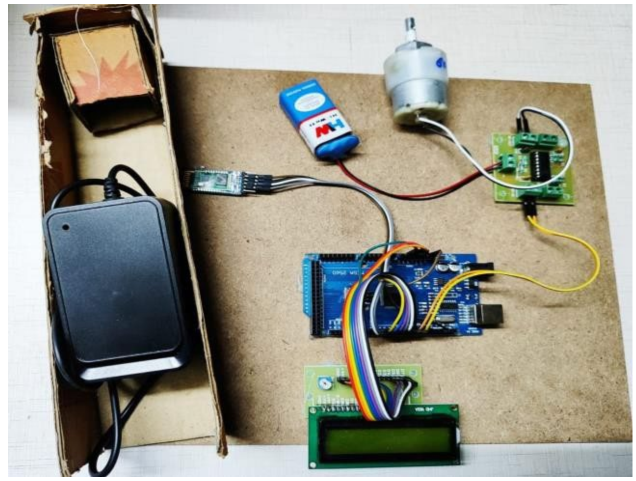

Fig. 1. Hardware model

11. Testing

A. Testing

Testing involves the preparation of test data for individual module assessment and subsequent field validation. System testing ensures the collective functionality of all system components, validating their unified operation. Thoughtful test data selection is imperative, covering a spectrum of conditions. The testing phase, integral to the implementation state, ensures the accurate and efficient operation of the system before actual deployment. Key testing strategies encompass unit testing for module correctness, integration testing for seamless collaboration, and system testing for overall functionality. Acceptance testing verifies adherence to user requirements, while performance, security, and usability testing enhance system robustness and reliability across diverse conditions and scenarios.

B. System Testing

Testing stands as a fundamental aspect in information technology, inseparable from system and project endeavors. Its significance lies in validating readiness to progress, and assessing the capability to endure challenging situations. The criticality of pre-development testing cannot be understated, serving as a method to ensure that software is equipped to withstand the demands of specific scenarios. Before user deployment, thorough testing is essential to ascertain the software's effectiveness in fulfilling its intended purpose. This proactive approach not only justifies progression but also safeguards against potential issues, underscoring the indispensable role of testing in the comprehensive life cycle of software development, particularly within the realm of information technology.

C. Module Testing

To identify errors systematically, each module undergoes individual testing, allowing for error detection and correction without impacting other modules. Corrections are made if the program fails to fulfill the specified functions, ensuring the desired outcomes. Adopting a bottom-up approach, all modules are tested individually, starting from the smallest and progressing to higher levels. This includes separate testing for each module within the system; for instance, the job classification module undergoes isolated testing. Various jobs are employed in testing, assessing their approximate execution times, and comparing the results with manually prepared outcomes. This meticulous, step-by- step testing strategy ensures system integrity and accurate functionality.

D. Integration Testing

Following module testing, integration testing is implemented to address potential errors that may arise during module linkage. This testing phase ensures the seamless connection of all modules, identifying and rectifying any errors that may occur in the process. The comprehensive testing of the entire system results in accurate testing outcomes. Consequently, the system successfully maps jobs with resources, demonstrating the correct functionality of the interconnected modules. This approach enhances the reliability of the system by verifying its ability to integrate modules effectively, contributing to the accurate mapping of jobs and resources within the overall system.

E. Acceptance Testing

Upon user confirmation of the system's accuracy without major issues, a final acceptance test is conducted. This test ensures the system aligns with the initial goals, objectives, and requirements established during analysis, avoiding unnecessary time and cost wastage through user and management involvement in acceptance tests. Once the system meets these criteria, it is deemed acceptable and ready for operation. This streamlined process minimizes resources expended on unnecessary testing and guarantees that the system fulfills its intended purpose as outlined in the analysis phase.

12. Conclusion

Conclusively, the "Touchless Elevator Control via Smartphone Integration" project emerges as a timely and innovative response to the challenges posed by the COVID- 19 pandemic. The incorporation of ok IoT technology not only reflects a forward-thinking approach but also aligns with the contemporary emphasis on hygiene-conscious practices. By allowing users to effortlessly control commercial elevators through their smartphones, the project successfully reduces physical touchpoints, contributing to enhanced convenience and efficiency. This initiative not only transforms the user experience but also addresses broader public health concerns by minimizing contact-based transmission risks in shared spaces. Overall, the project serves as a commendable example of leveraging IoT advancements to meet evolving societal needs, showcasing a practical and user-friendly solution that anticipates and responds to the changing dynamics of our times.

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