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DCS System for Elevator

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Abstract: *The modernization of vertical transportation systems has become a crucial facet of building infrastructure, necessitating sophisticated control mechanisms to enhance efficiency, safety, and user experience. This abstract introduces a Distributed Control System (DCS) designed for elevators, leveraging advanced technologies to optimize operations and address the evolving demands of contemporary urban landscapes.*

The DCS for elevators integrates intelligent control algorithms, real-time monitoring, and predictive maintenance strategies to revolutionize the traditional elevator management paradigm. User inputs, including destination floors and call directions, are analyzer to dynamically assign elevators based on factors such as proximity, current load, and traffic patterns. This ensures optimal elevator utilization and reduces passenger wait times. Real-time monitoring capabilities empower the system to adjust dynamically to changing demands, offering a seamless and responsive experience. The DCS incorporates safety features such as emergency handling for fire alarms, power failures, and other contingencies, ensuring passenger security is paramount.

Keywords: elevator, DCS, Smartphone, Personalization, wifi module

I. INTRODUCTION

Elevators have become an integral part of our daily lives, providing efficient vertical transportation in buildings of all sizes. Modern elevators rely on advanced control systems to ensure safety, reliability, and user convenience. One such system that has revolutionized the elevator industry is the Distributed Control System (DCS). The DCS system for elevators represents a sophisticated approach to elevator management, offering enhanced performance, efficiency, and improved user experiences This project has the design, implementation, and advantages of a DCS system for elevators. It explores the key components, control algorithms, and integration of this technology to provide a comprehensive understanding of how DCS systems are shaping the future of vertical transportation. Elevators equipped with DCS offer intelligent and real-time control, predictive maintenance, energy optimization, and advanced safety features, making them an essential aspect of modern urban infrastructure

During Covid-19 pandemic we have observed that the virus is contagious. It gets transmitted from the infected personto the normal person by sharing objects, transmission of air particles in the environment if face is not properly covered and many more reasons are responsible for the transmission of virus. The main design circuit is to avoid the contact of touch in and outside the elevator system by using a smartphone. Whether the person is inside or outside the lift operation of the elevator is similar to manual operation, The purpose of designing this system was that during covid 19 pandemic the virus spread easily through contact with an elevator was the greatest source for spreading this disease, So operating an elevator in a manual way will bring more people in contact with the virus

Background

The elevator system we use as a basis for the smart elevator is a conventional simple elevator system with a single car running in its allocated elevator shaft in a typical 8-floor office building. The building resides at university campus and hosts offices for university staff, labs, computer classes, and start-up companies. The entrance floor of the building is Floor 1, whereas Floor 0 allows access to secured parking area. Floors 1–7 are used for offices, Floors 1, 3, 4, 5, and 6 have also labs and computer classes, and Floors 2 and 7 are occupied by companies. Thereby, besides employees who

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have offices in the building, the regular visitors of this building are students. The travel needs of university academic staff and students are affected by the time and location of classes taking place.

Let us now turn to the elevator system. An elevator call (a trip) is a ride between two floors, where at least one passenger is present in the elevator car. The elevator call is defined by its departure and destination floor, and the number of passengers on the call. Herein, we do not consider empty calls – trips without passengers – of interest. An elevator event is defined as any action a passenger takes with an elevator, and events are logged. In the context of the smart elevator voice commands and floor predictions are additional events captured.

Problem Statement

Inefficiency and Long Wait Times: Conventional elevator systems often suffer from inefficiencies in dispatching and handling peak traffic, leading to long wait times and overcrowded elevators during busy periods.

II. LITERATURE REVIEW

Elevator control systems have transitioned from mechanical relay-based systems to digital control systems (DCS) incorporating advanced technologies such as microprocessors and sensors (Smith, 2018). This evolution has been driven by the need for greater efficiency, safety, and adaptability in vertical transportation. DCS systems offer several advantages over traditional elevator controls, including improved ride quality, reduced wait times, and enhanced safety features (Chen et al., 2020). By leveraging real-time data and intelligent algorithms, DCS systems optimize elevator operations to meet the dynamic demands of modern buildings and passengers. Intelligent dispatching algorithms play a crucial role in optimizing elevator performance and passenger experience. Research has shown that algorithms based on destination control and predictive analytics can significantly reduce wait times and elevator congestion (Wu et al., 2019). These algorithms analyze passenger traffic patterns and dynamically allocate elevator resources to minimize passenger travel time and energy consumption. Safety and reliability are paramount in elevator systems, and DCS integration has been instrumental in enhancing both aspects. Real-time monitoring and diagnostics capabilities enable early detection of potential issues, allowing for proactive maintenance and reducing the risk of accidents (Ding et al., 2021). Additionally, safety features such as emergency braking and door reopening mechanisms are seamlessly integrated into DCS systems to ensure passenger protection Data-driven approaches have revolutionized elevator maintenance practices by enabling predictive maintenance models and condition-based monitoring. By analyzing operational data collected from sensors and control systems, maintenance tasks can be optimized to maximize elevator uptime and extend equipment lifespan (Li et al., 2019). This proactive approach reduces maintenance costs and minimizes disruptions to building operations. Integration of elevator DCS systems with building automation systems (BAS) enables greater interoperability and efficiency in building management. By sharing data and coordinating operations with other building systems such as HVAC and lighting, DCS systems contribute to overall energy savings and occupant comfort (Zhang et al., 2020). This integration streamlines facility management processes and enhances the overall performance of the building User-centered design principles are essential in the development of elevator DCS systems to ensure a positive passenger experience. Research has emphasized the importance of intuitive user interfaces, clear communication features, and accessibility options for passengers with diverse needs (Zhao et al., 2018). By prioritizing usability and user satisfaction, DCS systems can enhance passenger confidence and comfort during elevator travel Future trends in elevator DCS systems include advancements in artificial intelligence, edge computing, and remote monitoring capabilities. Researchers envision autonomous elevator operation, predictive maintenance drones, and personalized passenger experiences as potential innovations shaping the future of vertical transportation (Liu et al., 2022). These developments hold the promise of further improving efficiency, safety, and sustainability in elevator systems

III. METHODOLOGY

Elevator System Architecture

The smart elevator system is based on the existing conventional elevator built by Corporation – a global leader in the elevator and escalator industry. Our building has two independent elevators, each running in its own shaft. For the smart elevator, we use only one of these elevators. In addition to the existing elevator system, the following devices were installed in the elevator car to add the main features of Smart elevator (Fig. 1):

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A RGB camera from Basler with Ethernet communication, 4MP resolution global shutter. The camera is installed in the corner of the elevator facing the doors, and is able to capture video stream up to 15fps covering the area of elevator entrance and most of the cabin. The images captured by the camera are used as an input for face detection algorithm to detect human faces.

Four Intel Real Sense depth cameras with dual infrared light sensors located over the elevator ceiling cover. These are used to detect passenger movement and locations within the elevator car, including exiting the elevator car.

Microphone and speaker which allow the passengers to control the elevator through voice commands using either Estonian or English as the command language. Presently, the passengers can request the elevator to take them to a specific floor to a floor of an employee by stating employee name, and in addition ask about weather forecast and current date and time

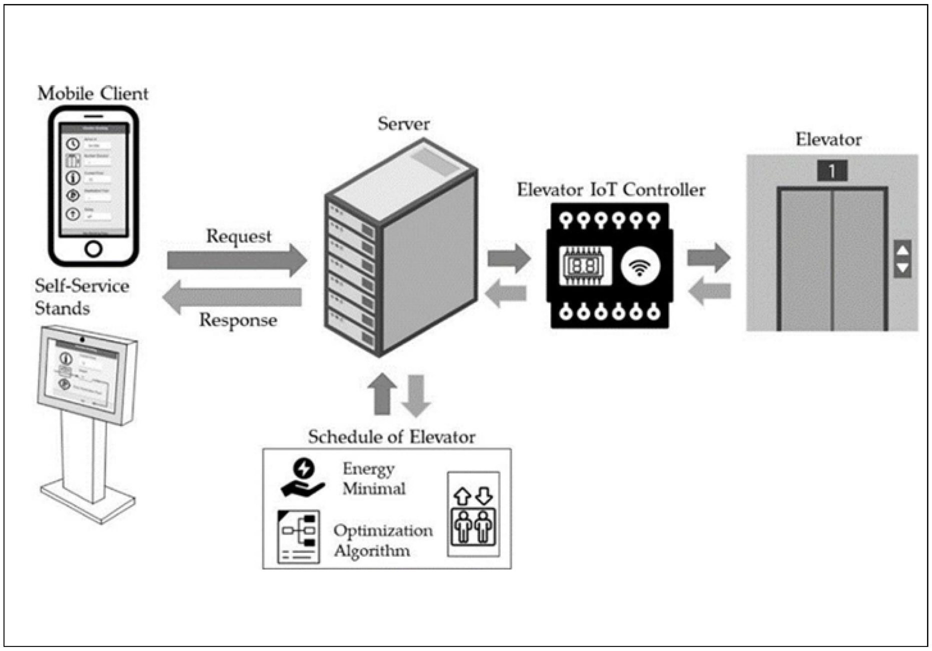

Fig 1. The Elevator system Architecture

Working

Smartphone-operated elevators utilize mobile technology to enhance user experience and provide convenient access to elevator services. Here's how a smartphone-operated elevator typically works. Users download a dedicated mobile application provided by the elevator manufacturer or building management onto their smartphones. Upon installation, users may need to register an account, authenticate their identity, and link their smartphone to the elevator system. The mobile application communicates with the elevator system via a wireless connection, typically using Bluetooth or Wi-Fi technology Users may need to pair their smartphones with specific elevators or elevator banks within a building to access the desired functionality. To operate the elevator using their smartphones, users must authenticate their identity through the mobile application. This may involve entering a PIN code, scanning a QR code, or using biometric authentication methods such as fingerprint or facial recognition. Once authenticated, users can use the mobile application to select their desired destination floor or elevator car. The application may display a list of available elevators and their current locations, allowing users to choose the most convenient option. Users can remotely call an elevator to their current location or summon it to a specific floor using the mobile application This feature is particularly useful in buildings with multiple elevator banks or during peak traffic times when traditional call buttons may be crowded or inaccessible. The mobile application provides real-time status updates on elevator availability, estimated arrival times, and car occupancy Users can track the location and movement of elevators in the building, allowing them to plan their journey more efficiently Smartphone-operated elevators incorporate security features to prevent unauthorized access and ensure passenger safety Authentication mechanisms, encryption protocols, and secure communication channels protect user data

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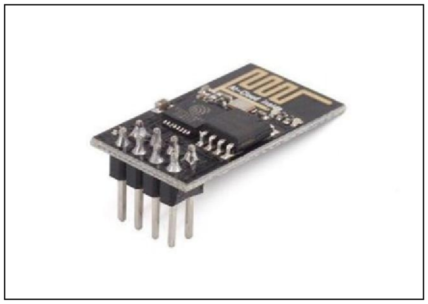
and prevent tampering or hacking attempts Smartphone-operated elevators may be integrated with building management systems to enable additional features such as access control, visitor management, and energy optimization Integration with smart building technologies allows for centralized monitoring, remote diagnostics, and predictive maintenance of elevator systems. Overall, smartphone-operated elevators offer a convenient and user-friendly alternative to traditional elevator controls, allowing users to access elevator services quickly and securely using their smartphones. By leveraging mobile technology, these elevators enhance efficiency, accessibility, and user experience in modern buildings and facilities

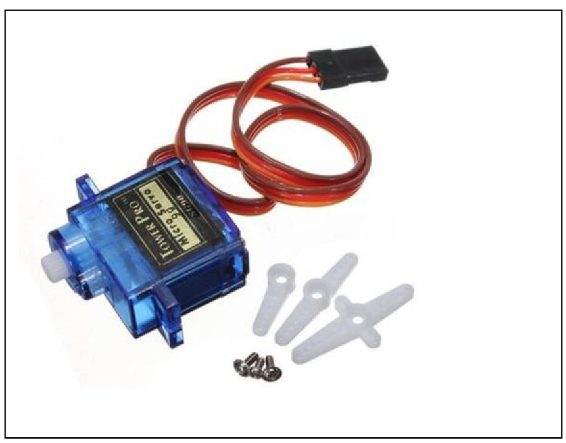
IV. SYSTEM DESCRIPTION

ESP-01



The ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module is a compact and powerful module that enables Wi-Fi connectivity for a wide range of electronic projects its size, it offers reliable and robust wireless communication capabilities. It operates on the 2.4 GHz frequency band and supports standard Wi-Fi protocols such as 802.11 b/g/n, providing compatibility with a wide range of Wi-Fi networks and routers It is built around the ESP8266 microcontroller, which integrates Wi-Fi functionality, making it an excellent choice for Internet of Things (IoT) applications and wireless networking. With its small form factor, the ESP-01 module is ideal for projects with space limitations.

Servo Motor



Servo motors are versatile and reliable devices that provide precise and controlled motion in a wide range of applications. Their ability to offer high precision, variable speed, and fast response makes them indispensable in industries where accurate motion control is essential. it consists of a motor coupled with a feedback device, such as an encoder or resolver, that provides information about the motor's position to a controller. Servo motors operate in a closed-loop control system, where the feedback signal from the position sensor is continuously compared with the desired position setpoint

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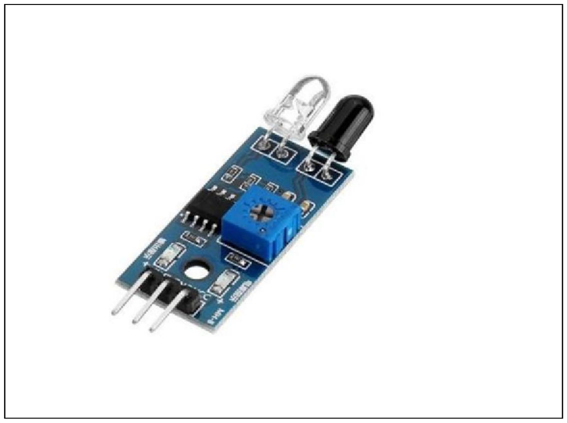
IR-Sensor

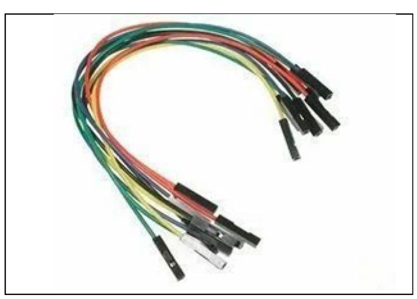


Infrared (IR) sensors are devices that detect and respond to infrared radiation, commonly used for proximity sensing, object detection, and motion detection applications. They typically consist of an IR emitter and receiver pair, with the receiver detecting changes in IR radiation caused by the presence or absence of objects. The detection range of an IR sensor refers to the maximum distance over which it can detect objects

LCD Display 8*2

This 8x2 Character LCD Display Module is available with or without LED backlight options and offers various LCD panel colors, including gray, yellow/green, and blue. LCD display module with an 8x2 display format is well-suited for integration into various small-scale measuring instruments and monitoring devices The WH0802A1 is an 8-character by 2-line LCD display module (8x2 Character LCD Display Module) with a module dimension of 58.0 x 32.0 mm and an active area size of 27.81 x 11.5 mm (1.18" diagonal). It operates with a 5V power supply, compatible with 3V, while the negative voltage is limited to 3V

Connecting Wires

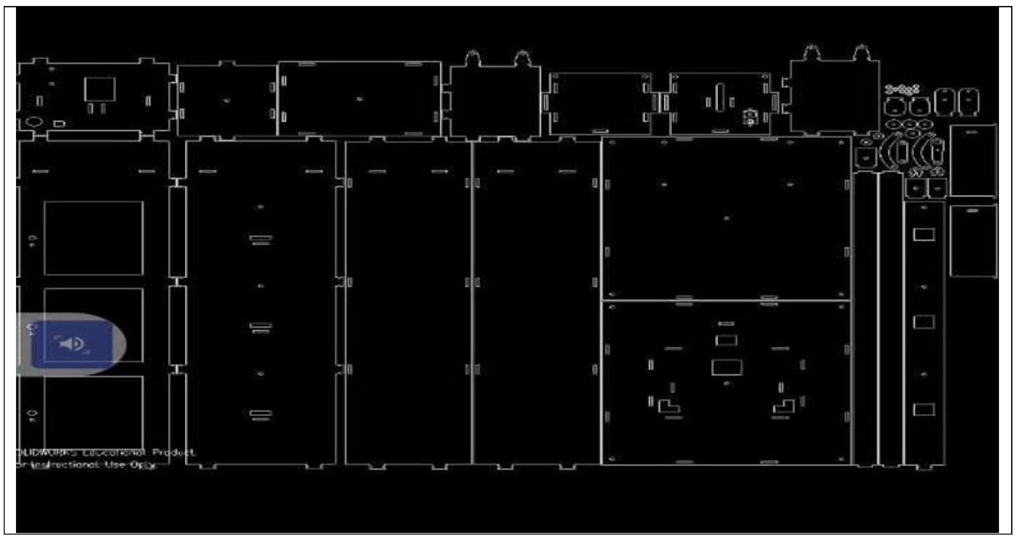


Different colors of the cables can be used for easy identification of power supplies, ground, control, input and output points, · These are reliable and can be used for reliable and quick connection Note: Actual products may differ from image, description and specifications in few cases. These different cables and connectors can be used in between CCB, Breadboard, assembled PCB's, microprocessors, power supplies and all other circuit elements easily

SOFTWARE REQUIRED

- Arduino IDE for coding
- Java Eclipse
- CAD

DESIGN OF ELEVATOR



ANDROID APP

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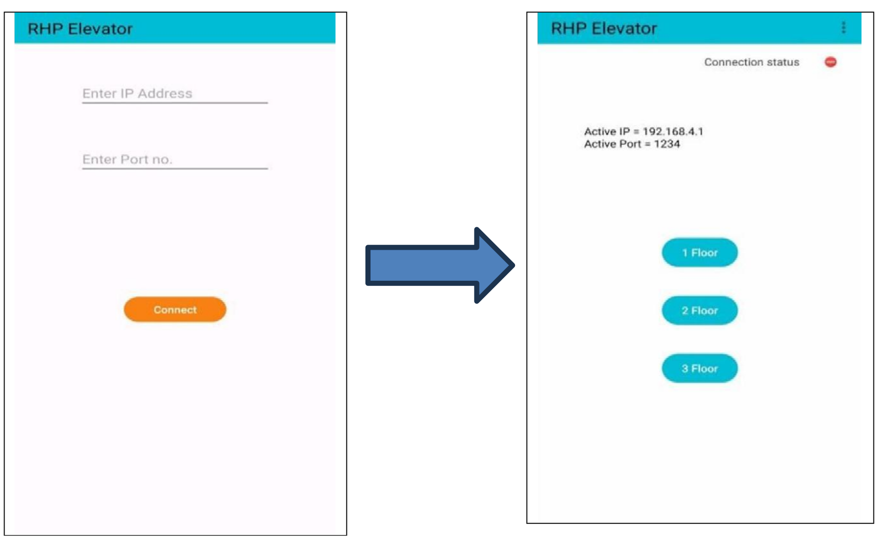

We have Created own Android app for a rewarding and fulfilling project. Used Java programming languages to write apps logic. Using this app we can operate elevator through mobile phone. This is the wireless smartphone elevator application

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V. CONCLUSION

DCS systems represent a transformative evolution in elevator technology, revolutionizing vertical transportation in buildings of all types and sizes. By harnessing the power of digital control and automation, DCS systems elevate the elevator experience to new heights, delivering enhanced performance, safety, and efficiency for passengers and building owners alike. As technology continues to advance, DCS systems are poised to play an increasingly integral role in shaping the future of vertical transportation, driving innovation and progress in the built environment.

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