Touchless Elevator Floor Selection Using Proximity Sensor and PLC

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***Abstract*—In modern buildings, elevators are essential for vertical transportation. However, conventional elevator systems require users to press buttons for floor selection, which can lead to hygiene issues due to frequent physical contact. This paper presents a touchless elevator floor selection system using proximity sensors and a Programmable Logic Controller (PLC).**
The proposed system detects the presence of a user's hand using proximity sensors placed near floor selection panels. The detected signal is transmitted to the PLC, which processes the input using ladder logic programming and activates the corresponding floor selection mechanism. This system eliminates physical contact, thereby improving hygiene and reducing the risk of infection transmission. The system is reliable, cost-effective, and suitable for implementation in public environments such as hospitals, malls, and offices.

***Keywords*— PLC, Proximity Sensor, Elevator Automation, Touchless Technology, Smart Systems**

I. INTRODUCTION

Elevators are one of the most important systems in multi-storey buildings. They provide fast and efficient transportation between floors. Traditional elevator systems rely on push-button interfaces for selecting floors. While these systems are simple and effective, they require physical contact, which may lead to hygiene concerns.
After global health challenges such as pandemics, there has been a growing demand for touchless technology in public systems. Touchless systems reduce human contact with surfaces, thereby minimizing the spread of germs.
This research focuses on designing a touchless elevator control system using proximity sensors and PLC. The proximity sensor detects hand movement without contact, and the PLC processes the signal to control the elevator system. This approach enhances safety and demonstrates the application of industrial automation in daily life.

II. PROCEDURE FOR PAPER SUBMISSION

A. Review Stage

The manuscript for the project *"Touchless Elevator Floor Selection using Proximity Sensor and PLC"* was prepared and submitted electronically for review. The paper was formatted in a two-column layout including system block diagrams, circuit diagrams, flowcharts, tables, and experimental results. Figures and tables were properly adjusted to ensure all data and images were clearly visible and readable. The review process included checking the project objectives, methodology, PLC programming logic, sensor operation, and overall system performance.

B. Final Stage

After acceptance of the paper, the authors completed the copyright form as required. The final manuscript submission included the corrected research paper, project report, diagrams, tables, and implementation details of the touchless elevator system. All modifications suggested during the review stage were incorporated before final submission.

III. LITERATURE REVIEW

The development of elevator control systems has evolved significantly from simple relay-based mechanisms to advanced automation systems using PLC, sensors, and intelligent technologies. This section reviews existing research related to elevator automation, touchless systems, and proximity sensor-based control.

1. Conventional Elevator Control Systems

Early elevator systems were based on relay logic and electromechanical switches, which were simple but had several limitations such as high maintenance, slow response, and lack of flexibility. With the advancement of automation, PLC-based elevator control systems replaced relay-based systems due to their reliability and efficiency. A study on PLC-based

elevator control systems demonstrated that PLC provides better control, reduced wiring complexity, and improved system reliability compared to traditional methods .
Another research work highlighted that PLC systems allow implementation of ladder logic and function block diagrams to efficiently manage elevator operations such as floor selection, door control, and motion scheduling .However, these systems still rely on physical push buttons, which do not address hygiene concerns.

2. PLC-Based Intelligent Elevator Systems
Modern research focuses on improving elevator efficiency using intelligent control techniques. A study on PLC-based elevator systems emphasized that PLC offers low maintenance cost, high reliability, and easy programmability, making it suitable for industrial and commercial applications .
Further advancements include the use of fuzzy logic with PLC, where elevator movement is optimized based on parameters such as position, direction, and load. This approach improves system efficiency and reduces waiting time .Despite these improvements, most PLC-based systems still depend on manual input through buttons, which limits their usability in hygienic environments.

3. Touchless Elevator Technologies
After the COVID-19 pandemic, research shifted towards touchless and contactless control systems to reduce the spread of infections.One study proposed a smartphone-based touchless elevator control system, where users can operate elevators using mobile applications. This system improves convenience and reduces physical contact but requires internet connectivity and smartphone access .
Another research introduced voice-controlled elevator systems using speech recognition and IoT technology. These systems allow users to select floors through voice commands, improving accessibility and hygiene. However, they may face issues such as noise interference and recognition errors .Recent studies on AI-based non-contact elevator systems show that integrating AI and IoT can provide smart and adaptive control, but these systems are complex and expensive for small-scale implementation .

4. Proximity Sensor-Based Systems
Proximity sensors play a key role in developing touchless systems. These sensors detect objects without physical contact and are widely used in industrial automation. According to research, proximity sensors operate using various technologies such as inductive, capacitive, ultrasonic, and infrared sensing, enabling reliable object detection in different environments .
In elevator systems, proximity sensors can replace push buttons by detecting hand gestures or presence. A study using infrared proximity sensors demonstrated that touchless input can be effectively implemented in elevator systems to reduce contact-based transmission risks .Additionally, research in human-machine interaction shows that proximity sensing improves safety and enables intuitive control systems without direct contact .
5. Sensor-Based Automation in Elevator Systems
Sensor-based automation has been widely applied in elevator systems for safety and control. A study on safety-featured elevator systems using PLC incorporated sensors such as limit switches and proximity sensors to control elevator movement and ensure safe operation .
These systems demonstrate that sensors can be effectively integrated with PLC to automate elevator operations. However, most implementations focus on safety and control rather than user interface improvements like touchless selection.

IV. SYSTEM ARCHITECTURE

The proposed touchless elevator floor selection system is designed using a modular architecture consisting of three main layers: the input layer, control layer, and output layer. The input layer includes proximity sensors placed near each floor selection panel. These sensors detect the presence of a user’s hand without requiring physical contact and generate corresponding electrical signals. Each sensor is assigned to a specific floor, enabling accurate floor selection.
The signals from the proximity sensors are sent to the control layer, which consists of a Programmable Logic Controller (PLC). The PLC acts as the central processing unit of the system and is programmed using ladder logic. It receives input signals from the sensors, processes them according to predefined logic, and determines the appropriate output action. The PLC ensures reliable operation, fast response, and proper sequencing of commands.
The output layer consists of devices such as LED indicators, relay modules, and the elevator control system. Based on the processed input, the PLC

activates the corresponding output, indicating the selected floor and controlling the movement of the elevator. The overall system operates in a real-time environment, ensuring smooth and efficient performance. This architecture provides a simple, reliable, and hygienic solution for elevator operation by eliminating the need for physical contact. It is modular in design, easy to implement, and can be extended for advanced automation features in future applications.

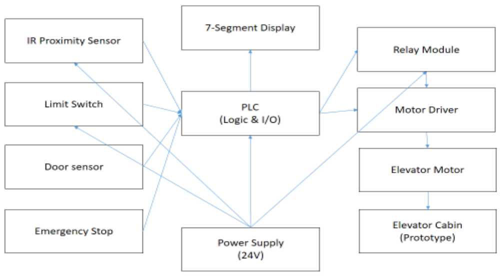


Fig. Touchless Elevator Floor Selection-Block Diagram

V. METHODOLOGY

1. System Design and Planning

The system design begins with the development of a structured architecture that divides the overall system into three main parts: input system, control system, and output system. The input system includes proximity sensors and limit switches, the control system consists of a PLC, and the output system includes display units, relay modules, and motor control mechanisms. Each component is carefully selected based on its reliability, cost-effectiveness, and compatibility with industrial automation standards. The system is designed in such a way that multiple floor selections can be handled efficiently using separate sensors assigned to each floor.

2. Selection of Components

The selection of components plays a crucial role in ensuring the proper functioning of the system. Proximity sensors are used to enable touchless operation by detecting the presence of a user's hand without physical contact and generating electrical signals accordingly. Limit switches are incorporated to detect the exact position of the elevator cabin and ensure accurate stopping at the selected floor. A Programmable Logic Controller (PLC) is used as the main control unit due to its reliability and real-time processing capability. The output devices include a 7-segment display for indicating the selected floor, a relay module to interface between the PLC and motor, and a motor driver along with the elevator motor to control the movement of the elevator. A regulated 24V DC power supply is used to provide stable and consistent power to all system components.

3. Input Signal Acquisition

The input signal acquisition process begins when a user places their hand near a proximity sensor. The sensor detects the presence of the object and generates an electrical signal without requiring any physical contact. This signal is then transmitted to the PLC input terminals. At the same time, limit switches continuously monitor the position of the elevator cabin and provide feedback signals to the PLC, indicating the current floor position. These inputs are essential for accurate system operation and real-time decision-making.

4. PLC Programming and Control Logic

The PLC is programmed using ladder logic, which is widely used in industrial automation systems due to its simplicity and effectiveness. Each proximity sensor is assigned a specific input address, and corresponding outputs are defined to control the elevator system. When a sensor is activated, the PLC processes the input signal and executes the programmed logic to trigger the appropriate output. Interlocking logic is implemented to prevent multiple floor selections at the same time, ensuring safe and sequential operation. Additionally, feedback from limit switches is used to ensure that the elevator stops precisely at the selected floor. The PLC continuously scans inputs, processes logic, and updates outputs in real time.

5. Output Control and Elevator Operation

After processing the input signals, the PLC generates output signals to control the elevator system. These signals activate the relay module, which acts as an interface between the PLC and the motor control circuit. The relay then drives the motor through the motor driver, allowing the elevator to move in the required direction, either upward or downward. Simultaneously, the 7-segment display is activated to indicate the selected floor to the user. When the elevator reaches the desired floor, the corresponding limit switch is triggered, and the PLC stops the motor, ensuring accurate positioning and smooth operation.

6. System Integration
System integration involves connecting all the components according to the designed architecture. The proximity sensors and limit switches are connected to the PLC input module, while the PLC outputs are connected to the relay module, display unit, and motor driver. Proper wiring and signal connections are ensured to maintain system stability and avoid errors. The integration process ensures that all components work together efficiently as a complete system.

7. Testing and Validation
After assembling the system, testing and validation are carried out to evaluate its performance. The system is tested under various conditions to check sensor detection accuracy, PLC response time, correct floor selection, and proper stopping using limit switches. Observations show that the system successfully detects hand movement without contact, selects the correct floor, and ensures smooth elevator operation. These results confirm the reliability and effectiveness of the proposed system.

8. Safety and Reliability Considerations
Safety and reliability are important aspects of the system design. Limit switches are used to prevent over-travel of the elevator and ensure safe stopping at each floor. The PLC provides controlled and reliable operation by executing predefined logic. The relay module offers electrical isolation between the control and power circuits, enhancing safety. Additionally, a stable 24V DC power supply ensures uninterrupted system operation and prevents failures.

9. Working Sequence of the System
The working sequence of the system begins when the user places their hand near a proximity sensor, which detects the presence and sends a signal to the PLC. The PLC processes this input using ladder logic and activates the corresponding output. The relay module is triggered, and the motor starts moving the elevator in the required direction. The 7-segment display indicates the selected floor. As the elevator reaches the desired floor, the limit switch is activated, and the PLC stops the motor, completing the operation.

VI. COMPONENTS

1. Proximity Sensors
Proximity sensors are essential components in the touchless elevator system as they enable contactless floor selection. These sensors operate by detecting the presence of an object, such as a human hand, within a certain range without any physical interaction. In this project, the sensors generate an electrical signal when a user brings their hand near them, which is then sent to the PLC as an input signal. Each proximity sensor is assigned to a specific floor, allowing users to select their desired floor in a hygienic and user-friendly manner. The use of proximity sensors eliminates the need for physical buttons, thereby reducing the risk of contamination and improving safety in public environments.

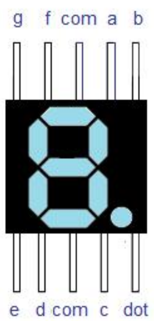
2. Limit Switches
Limit switches are used to determine the exact position of the elevator cabin at different floors. These are electromechanical devices that are activated when the elevator reaches a predefined position. Once activated, they send a signal to the PLC indicating that the desired floor has been reached. This helps the system to stop the motor precisely at the correct location. Limit switches also play a crucial role in ensuring safety by preventing over-travel of the elevator, thereby protecting both the system and the users from potential damage or accidents.

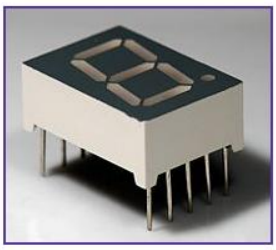
3. Programmable Logic Controller (PLC)

The Programmable Logic Controller (PLC) is the core component of the system and acts as the brain of the entire operation. It receives input signals from the proximity sensors and limit switches, processes them using ladder logic programming, and generates appropriate output signals to control the elevator system. The PLC operates in real time, continuously scanning inputs, executing control logic, and updating outputs. Its reliability, flexibility, and robustness make it ideal for industrial automation applications. In this project, the PLC is responsible for managing floor selection, controlling motor movement, handling safety conditions, and ensuring smooth operation of the elevator.

4. 7-Segment Display

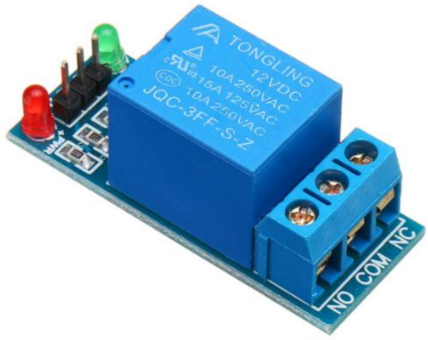
The 7-segment display is used to provide visual feedback to the user by displaying the selected floor number. It consists of seven individual segments that can be illuminated in different combinations to represent numerical digits. The display is controlled by the PLC, which activates the corresponding segments based on the selected floor. This component enhances user interaction by clearly indicating the current or selected floor, making the system easy to understand and operate.





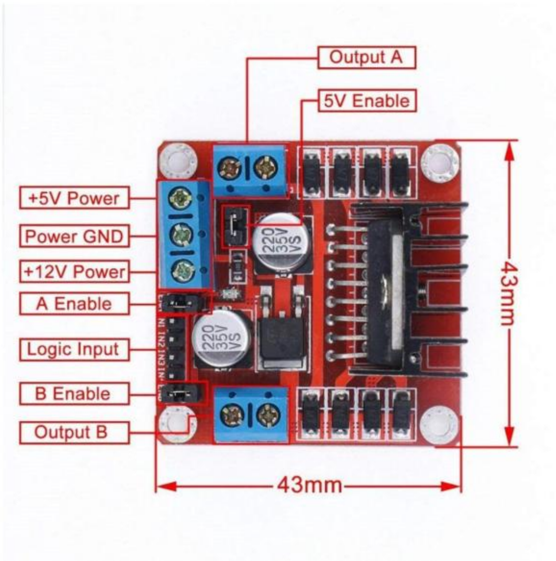
5. Relay Module

The relay module acts as an interface between the PLC and the high-power motor control circuit. Since the PLC operates at low voltage and current levels, it cannot directly control the motor. The relay module allows the PLC to switch higher voltage circuits safely by using electromagnetic switching. It provides electrical isolation between the control system and the power system, thereby protecting the PLC from damage due to high voltage or current. This ensures safe and reliable operation of the entire system.



6. Motor Driver

The motor driver is responsible for controlling the operation and direction of the elevator motor. It receives control signals from the relay module and converts them into appropriate electrical signals required to drive the motor. The motor driver ensures smooth acceleration, direction control, and efficient functioning of the motor. It plays a key role in determining whether the elevator moves upward or downward based on the input provided by the PLC.



7. Elevator Motor
The elevator motor is the main actuator in the system, responsible for the movement of the elevator cabin between floors. It operates based on the control signals received from the motor driver. Depending on the direction of rotation, the motor moves the elevator either upward or downward. The performance of the motor directly affects the speed, efficiency, and smoothness of the elevator operation. Therefore, a reliable and efficient motor is essential for proper system functioning.

8. Power Supply (24V DC)
The power supply unit provides the necessary electrical energy required for the operation of all components in the system. In this project, a regulated 24V DC power supply is used to ensure stable and consistent voltage levels. It supplies power to the PLC, sensors, relay module, and other electronic components. A stable power supply is crucial for maintaining system reliability and preventing malfunctions due to voltage fluctuations or interruptions.

VII. CONCLUSION

The proposed touchless elevator floor selection system using proximity sensors and PLC has been successfully designed and implemented to provide a hygienic, efficient, and user-friendly solution for modern elevator systems. The system eliminates the need for physical contact by replacing conventional push buttons with proximity sensors, thereby reducing the risk of contamination and improving safety in public environments such as hospitals, offices, and commercial buildings. The integration of a Programmable Logic Controller (PLC) ensures reliable and real-time control of the system, enabling accurate floor selection, smooth elevator movement, and precise stopping through the use of limit switches.

The ladder logic programming implemented in the PLC plays a crucial role in processing input signals and controlling the output devices effectively. The use of a relay module and motor driver ensures safe interfacing between low-power control circuits and high-power motor operations. Additionally, the inclusion of a 7-segment display enhances user interaction by providing clear visual feedback of the selected floor. The system has been tested under various conditions and has demonstrated accurate performance, quick response time, and reliable operation.

Overall, the proposed system offers a simple, cost-effective, and scalable solution for touchless elevator control. It can be further enhanced by integrating advanced technologies such as IoT, wireless control, or voice-based systems to improve functionality and user convenience. This project highlights the potential of automation and smart control systems in developing safer and more efficient infrastructure for modern society.

REFERENCES

[1] S. Patil and M. Kulkarni, “Design and Implementation of Touchless Elevator Control System Using PLC,” *International Journal of Engineering Research & Technology (IJERT)*, vol. 11, no. 6, pp. 850–854, 2022.
[2] R. Sharma and A. Verma, “Smart Elevator System Using Contactless Sensors and Automation,” *International Journal of Scientific Research in Engineering and Management (IJSREM)*, vol. 6, no. 7, pp. 1–5, 2022.
[3] P. Singh and K. Yadav, “PLC Based Intelligent Elevator Control System,” *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, vol. 10, no. 4, pp. 1200–1206, 2021.
[4] M. R. Khan and S. Ali, “Touchless Human Machine Interface for Public Systems Using Proximity Sensors,” *IEEE Access*, vol. 9, pp. 150000–150010, 2021.
[5] V. Gupta and N. Jain, “Automation of Elevator System Using PLC and IoT,” *International Journal of Innovative Research in Technology (IJIRT)*, vol. 9, no. 1, pp. 200–205, 2023.
[6] A. Deshmukh and P. Patil, “Contactless Control Systems for Smart ldings Using Sensors,” *International Journal of Engineering Applied Sciences and Technology (IJEAST)*, vol. 7, no. 2, pp. 500–505, 2022.