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DESIGNING ADVANCED AND SAFETY LIFT WITH LOW POWER USING VERILOG

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Abstract. This paper presents the design and implementation of a counter-based lift system with integrated safety features. The proposed system utilizes a counter-based approach to control the lift's movement, ensuring accurate and reliable floor positioning. Advanced safety features, including overload protection, and emergency stop functionality, are incorporated to prevent accidents and ensure passenger safety. The system is designed using a combination of software components. Experimental results demonstrate the system's ability to operate safely and efficiently, making it suitable for use in various applications, including residential, commercial, and industrial settings.

I.INTRODUCTION

In modern urban environments, elevators or lifts have become an essential part of multi-story buildings, offering efficient and reliable vertical transportation. Ensuring the safety and smooth operation of these lift systems is of paramount importance, especially in high-rise buildings where any malfunction could result in significant risks to passenger safety.

Traditionally, lift control systems rely on hardware components such as relays, sensors, and microcontrollers to manage operations like floor selection, door control, and safety features. While these hardware-based solutions are effective, they come with challenges such as high implementation costs, complex maintenance, and limited flexibility when modifications or upgrades are needed.

To address these challenges, this project proposes a Safety Lift System implemented entirely using Verilog HDL (Hardware Description Language), focusing on counter logic to control and monitor lift operations. The absence of physical hardware components not only reduces costs but also allows for flexible testing and rapid prototyping through simulation.

A lift, also known as an elevator, is a vertical transportation device used to move people or goods between different floors or levels in a building. Lifts have become an integral part of modern architecture, especially in high-rise buildings, commercial complexes, hospitals, and residential apartments. They provide a convenient and efficient way of overcoming the challenges posed by multi-story structures.

The basic functionality of a lift involves moving a cabin or platform vertically within a shaft, controlled by a system of motors, pulleys, and safety mechanisms. The lift car moves between floors, stops at desired levels, and allows passengers to board or alight. Modern lifts are equipped with advanced control systems to ensure smooth, safe, and reliable operations.

II.EXISTING SYSTEM

The diagram presented shows a block representation of an elevator controller named elevator.v=. This controller takes several inputs and produces multiple outputs, each serving a specific purpose within the elevator's operational framework. The primary inputs include BUTTONS_IN, BUTTONS_OUT_UP, and BUTTONS_OUT_DN, which correspond to internal and external user commands to move to specific floors or request the elevator from outside the cabin. The outputs include DOORS_OPENED, DIR_UP, DIR_DN, MOTOR, and FLOOR_NUM, which indicate the elevator's current operational state and control its movement and door mechanism.

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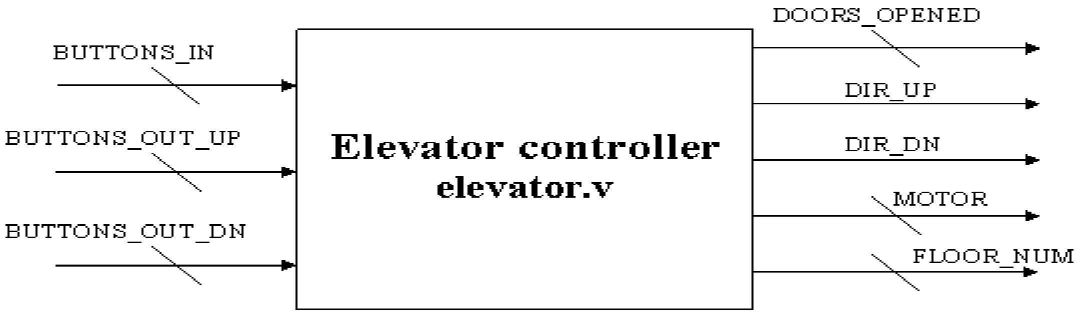

Fig :1. Lift control system

Input Signals and Their Functions

The input signals to the elevator controller are essential for processing user requests and determining the elevator's movement. The BUTTONS_IN input represents the internal buttons within the elevator cabin, allowing passengers to select their desired floor. This input typically consists of multiple binary signals, each corresponding to a specific floor number. When a button is pressed, the associated signal is activated, prompting the controller to queue the floor request and initiate movement if necessary.

The BUTTONS_OUT_UP input corresponds to external call buttons located on each floor, used when passengers request the elevator to move upward. Similarly, BUTTONS_OUT_DN represents external buttons that request the elevator to move downward. These external buttons are typically located on the landing of each floor and serve as crucial inputs for the controller when the elevator is not already present at that floor. The elevator controller must efficiently prioritize these requests, especially when multiple floors are involved, to optimize the travel path and minimize waiting time.

These inputs are processed by the controller using digital logic circuits, such as flip-flops and multiplexers, which store the state of each button press and manage the queue of pending floor requests. The embedded software running on the controller processes these inputs to determine the optimal movement strategy, taking into account factors such as the current position of the elevator, the direction of travel, and the status of the doors.

Output Signals and Their Roles

The elevator controller produces several output signals that directly influence the movement and door operations of the elevator cabin. The DOORS_OPENED signal indicates whether the elevator doors are currently open or closed. This output is crucial for ensuring passenger safety, as the doors must remain securely closed while the elevator is in motion. When the elevator arrives at a designated floor, the controller activates the DOORS_OPENED signal to allow passengers to enter or exit. A delay or timer mechanism ensures that the doors remain open for a sufficient period before automatically closing.

The DIR_UP and DIR_DN signals specify the direction of elevator movement. The controller sets DIR_UP when the elevator is moving upward and DIR_DN when moving downward. These directional signals are essential for controlling the motor driver circuit, which determines the rotation of the motor to achieve upward or downward motion. Additionally, the direction signals may also be used to illuminate directional indicators within the elevator cabin and on each floor, informing passengers of the elevator’s current travel direction.

The MOTOR output signal controls the actual activation of the elevator motor. The motor istypically an electric motor coupled with a gearbox and a traction mechanism, which moves the elevator cabin along the guide rails. The MOTOR signal is activated when the controller determines that the elevator needs to move to a different floor. During movement, the DIR_UP or DIR_DN signals dictate the motor's rotational direction. Safety features are integrated to halt the motor if any malfunction or obstruction is detected.

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Lastly, the FLOOR_NUM output indicates the current floor number where the elevator cabin is stationed. This output is typically displayed on a digital panel inside the elevator and on external displays located at each floor. The FLOOR_NUM output is updated in real time as the elevator ascends or descends, providing continuous feedback to passengers.

III PROPOSED SYSTEM

A Safety Lift System is an essential component of modern multi-story buildings, ensuring the secure and efficient vertical movement of passengers and goods. The primary goal of a safety lift system is to provide reliable transportation while maintaining user safety and comfort. In addition to fundamental motion control, safety lifts also incorporate auxiliary features like lighting and ventilation (fan) to enhance passenger convenience.

In the context of Digital Design and Embedded Systems, Verilog is a powerful hardware description language (HDL) used to model and implement such systems. Designing a safety lift system in Verilog involves creating a digital control system that manages the elevator's movement, safety features, and environmental controls like lighting and fans.

The Safety Lift System is an essential component in modern multi-story buildings, ensuring safe and efficient vertical transportation of passengers and goods. The flow diagram of the safety lift system outlines the systematic functioning and control logic required to operate the lift. The system starts by initializing the necessary parameters and checking the power status. If the power is off, the system activates voice announcements, turns on the lights, and keeps the doors open to ensure safety. Once the power is restored, the lift proceeds to the weight-checking stage to verify if the load inside the elevator cabin is within the specified limit.

If the system detects an overload, typically caused by more than ten members or excessive weight, it prevents the door from closing and issues a warning, ensuring that the lift does not move under unsafe conditions. After confirming that the load is within the safe limit, the system checks the destination floor and compares it with the current position. Depending on whether the target floor is above or below the current floor, the lift moves upward or downward accordingly. The movement continues until the lift reaches the desired floor, where it stops, opens the doors, and manages environmental controls like lighting and ventilation to ensure passenger comfort.

The flowchart demonstrates how the system prioritizes safety through continuous monitoring and automatic control while maintaining an efficient and user-friendly operation. By combining safety features with automated environmental management, the safety lift system ensures reliable and convenient transportation in modern buildings.

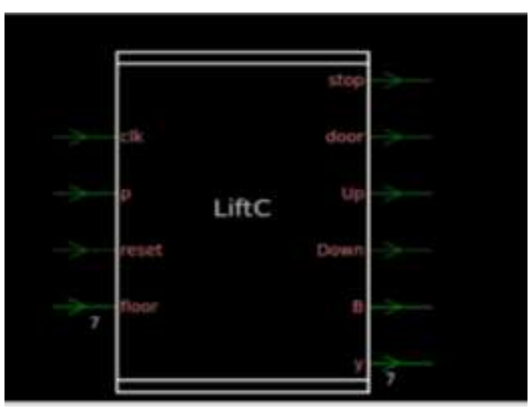

Fig:2. Pin diagram of lift

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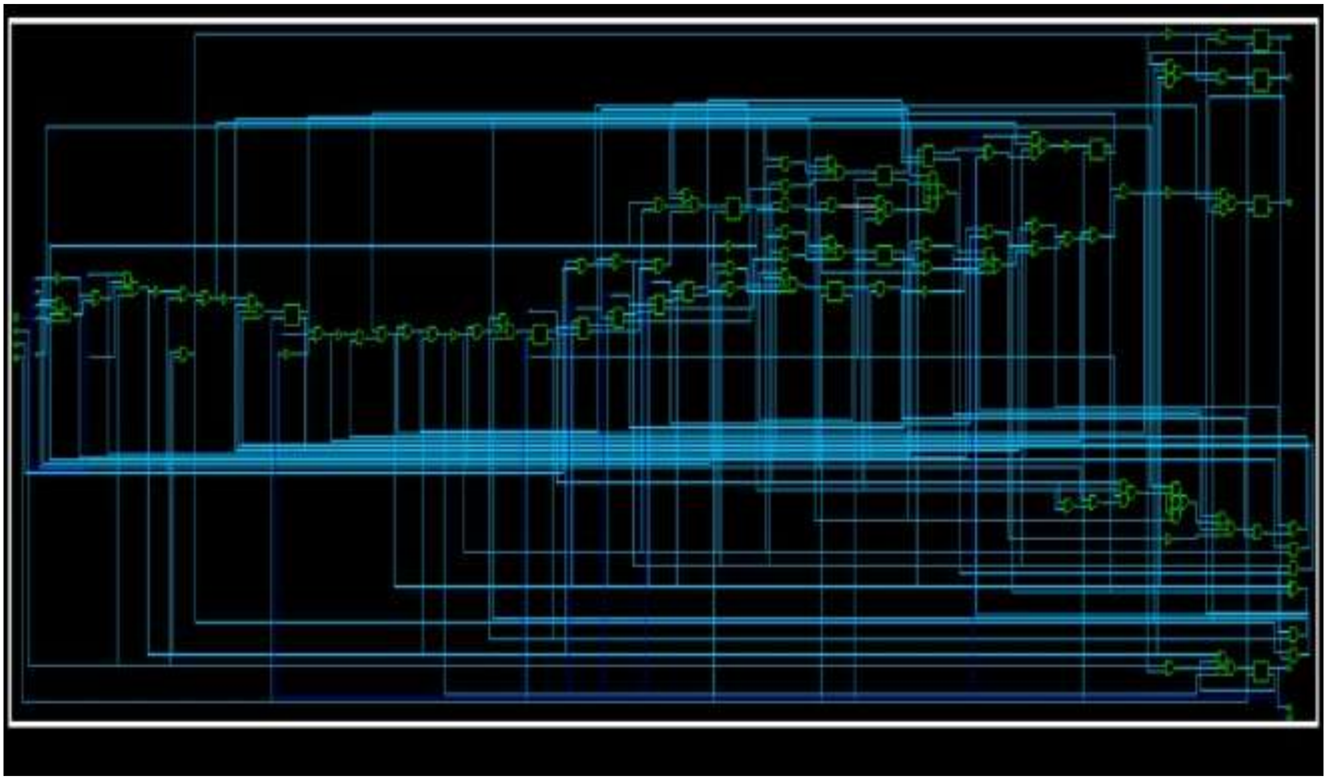

Fig:3. internal architecture of lift

IV RESULTS AND ANALYSIS

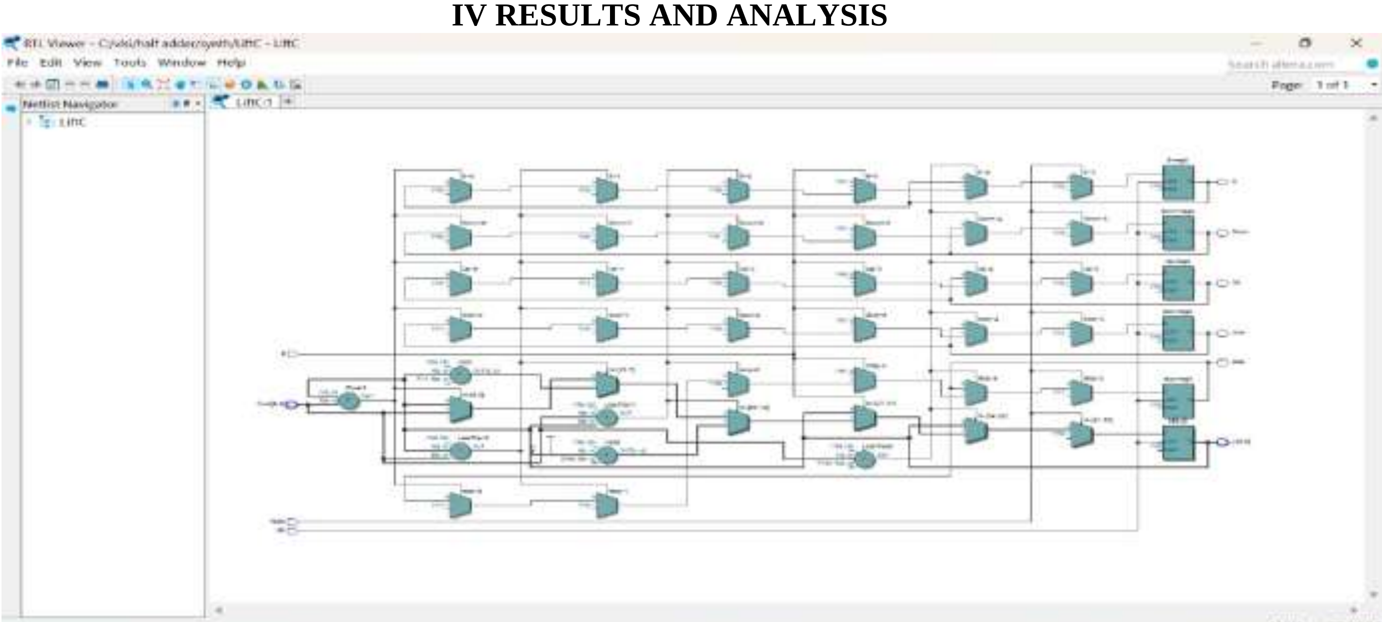

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Fig.4. RTL schematic diagram.

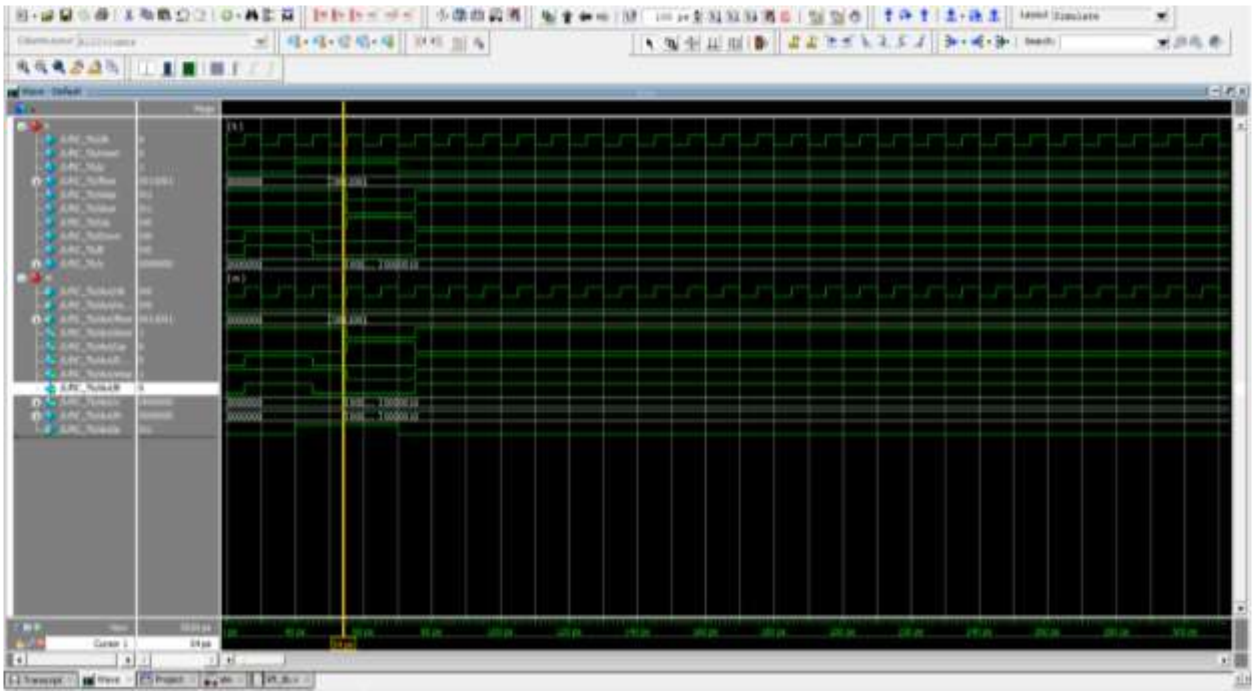

FIG:5.WAVE FORM

V CONCLUSION

The design and implementation of a safety lift system using Verilog demonstrate the seamless integration of embedded system concepts with modern automation and safety requirements. By leveraging Verilog's robust hardware description capabilities, the system ensures reliable and efficient operation while prioritizing passenger safety and comfort. The inclusion of advanced safety features such as overload detection, power failure management, automated lighting, and ventilation control enhances the overall functionality and reliability of the lift system.The successful implementation of the safety lift system not only highlights the effectiveness of digital design methodologies but also showcases how real-time monitoring and control can be achieved through precise logic programming. This project serves as a practical solution for modern infrastructure, where safety, efficiency, and user convenience are of utmost importance. Furthermore, the flexibility and scalability of the Verilog-based design make it suitable for various applications ranging from residential buildings to industrial environments.In conclusion, the Verilog-based safety lift system is an innovative and practical approach to addressing the challenges of vertical transportation, offering a reliable, safe, and efficient solution that meets contemporary safety standards and user expectations.

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