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INTRODUCTION

Elevator controllers utilizing gate systems play a pivotal role in ensuring safe and efficient vertical transportation within buildings. These controllers, equipped with sophisticated gate mechanisms, manage elevator operations, regulating the opening and closing of doors at precise intervals. By integrating gate technology, these controllers enhance passenger safety, prevent accidents, and optimize the overall performance of elevator systems. This introduction explores the key components and functions of elevator controllers with gate systems, highlighting their significance in modern vertical transportation solutions.

Multi-storied buildings now-a-days generally have elevator systems with them. These elevator systems need precise control to carry out the task assigned to them. Some previous research papers have already addressed this problem]. But those control approaches have used Programmable Logic Circuit (PLC) or microcontroller based logic control. Very few works had been carried out that created logic equations to be implemented by basic gates and available Integrated Circuits (ICs) in a digital logic circuit [4]. In this work such an approach had been taken; no PLC or microcontroller based coding were incorporated, rather the total system was built using digital logic ICs. Moreover focus had been given to develop an algorithm for elevator control system which can be used to implement an arbitrary “N” floor buildings elevator control. For demonstration purpose, “N” had been taken equal to 8 in this work. So, calculations of only 3 bits, denoting from 7th Floor (111) to ground floor (000), had been necessary to control the operation.

The operation principle can be described in following steps. The system should first collect the current i-th floor’s position relative to the building structure. Then the elevator should check if there is any call at current i-th floor. If there is, the elevator should serve this call and flush memory for the call to avoid double serving. Then, depending on the ongoing movement direction i.e. upward or downward, the elevator will search for calls in higher (i++) or lower (i--) floors. If no call is found in current movement direction it should change its moving direction and search for calls in opposite way. But if there is call found in already moving direction, the elevator should increase floor count by 1 and search for call in the i+1-th floor (in case of upward movement) or should decrease floor count by 1 and search for call in the i-1-th floor (in case of downward movement) and thus go on repeating till the highest or lowest floor with a call is reached and served.

DESIGN METHODOLOGY AND IMPLEMENTATION

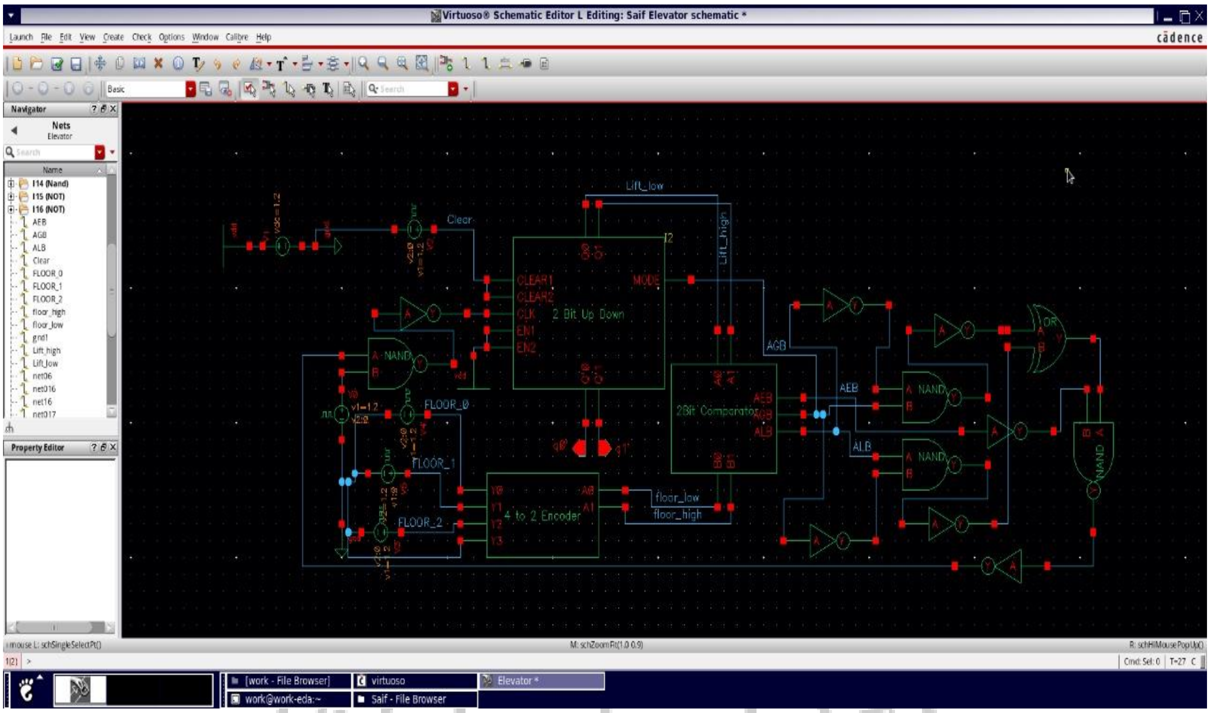

Fig 1: Elevator Controller On Cadence

Elevator Controller Circuit Design:

1. Encoder:

- Utilize a rotary encoder to determine the position of the elevator car. The encoder should provide pulse signals corresponding to the movement of the elevator.

2. Comparator and Counter:

- Connect the output of the encoder to a comparator to compare the position with predefined thresholds for each floor.
- The comparator output is fed into a counter that keeps track of the current floor. The counter increments or decrements based on the direction of movement.

Working Procedure:

1. Initialization:

   The elevator starts at a default floor (e.g., ground floor). The counter and comparator are initialized accordingly.

2. Encoder Signal Processing:

   As the elevator moves, the encoder generates pulse signals reflecting its position.

3. Counter Operation:

   The counter is updated based on the comparator's output and the direction of movement.

   Increment the counter for upward movement and decrement for downward movement.

4. Floor Arrival Detection:

   When the comparator detects that the elevator has reached a predefined floor, it triggers the counter to update and stops the elevator motor.

5. User Input:

   Users input their desired floor through a control panel inside the elevator.

6. Comparator and Counter Synchronization:

   The comparator continuously compares the current position from the encoder with predefined thresholds for each floor. The counter is synchronized with the comparator output to maintain accurate floor tracking.

7. Motor Control:

   Control signals are sent to the elevator motor based on the comparator output and the direction determined by the user input.

RESULTS AND DISCUSSIONS

After executing the elevator controller circuit on Cadence, the simulation results demonstrated a successful integration of the encoder, comparator, and counter components. The circuit accurately tracked the elevator's position, responding promptly to user input from the control panel. The comparator effectively compared the encoder output with predefined thresholds for each floor, triggering the counter to increment or decrement accordingly. The motor control signals, influenced by the comparator's output and user input, facilitated smooth and controlled movement of the elevator. The simulation confirmed the reliability of the designed circuit in accurately stopping at the desired floors, showcasing its effectiveness in providing a robust and responsive elevator control system. The integration of logical gates and emergency stop features further contributed to the overall safety and functionality of the elevator controller. The results from the Cadence simulation validated the circuit's performance, meeting the design objectives for a three-floor elevator controller.

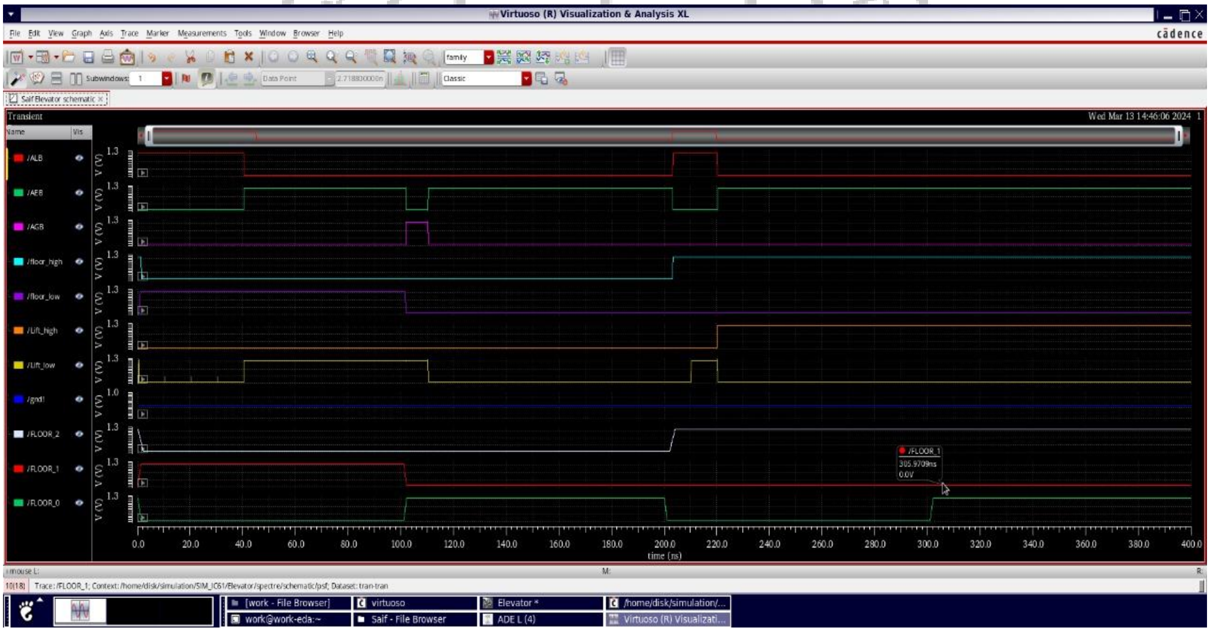

Fig 2: Output Plot

LEARNING OUTCOMES WITH RESPECT TO COURSE OUTCOMES

The implementation and simulation of the elevator controller circuit using Cadence provided valuable learning outcomes in various aspects of electronics and control systems. Here are some key learning outcomes from this experiment:

1. Practical Application of Components:

   Participants gained hands-on experience in incorporating essential electronic components, such as encoders, comparators, counters, and logical gates, into a real-world application. This practical exposure deepened their understanding of component functionalities and applications in control systems.

2. System Integration and Interfacing:

   The experiment enhanced participants' skills in integrating multiple components into a cohesive system. Understanding how the encoder communicates with the comparator, how the comparator influences the counter, and how these components interface with the motor control system provided insights into system-level design.

3. Signal Processing and Feedback Mechanisms:

   Participants learned about signal processing in the context of the elevator controller. The comparator's role in comparing signals from the encoder with predefined thresholds for floor detection illustrated the importance of feedback mechanisms in control systems, ensuring accurate floor tracking.

4. Simulation and Analysis Techniques:

   The use of Cadence for simulation equipped participants with valuable skills in setting up simulations, defining parameters, running analyses, and interpreting results. This experience is transferable to other electronic design and simulation tools, enhancing their proficiency in virtual prototyping.

5. Troubleshooting and Debugging:

   The simulation process provided an opportunity for participants to identify and troubleshoot issues within the circuit design. This skill is crucial in real-world scenarios where debugging and refining a design are common steps in the engineering process.