Digital Logic Design (CE221) Project Proposal

Digital Logic-Based Elevator Control with Real-Time Feedback

Group Members

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Project Introduction

Brief Overview:

This project focuses on designing and implementing a fully operational floor elevator control system using digital logic circuits. The elevator will simulate essential functionalities such as floor selection, direction indication, and real-time status feedback. Key components include breadboards, 7-segment displays for floor indication, up/down counters for floor tracking, and logic gates (NAND, NOR) for control logic. Flip-flops will provide memory for system states, while decoders and comparators will handle floor selection and comparison.

User interaction will be facilitated through buttons, with optional LEDs indicating elevator direction and door status. A shift register will introduce controlled delays for realistic operation, and a buzzer will provide auditory feedback during floor transitions or at specific events. This project demonstrates the practical application of digital logic principles and circuit design, aiming to create a functional prototype suitable for educational purposes and real-world elevator control system simulation.

Motivation:

We chose this idea because it encapsulates a complex yet relatable system. It provides an excellent opportunity to integrate various digital components—such as counters, decoders, and logic gates—into a cohesive and functional design. Elevators are a critical example of how digital systems manage real-life challenges, making this project both educational and highly relevant.

Through this project, we aim to develop a deeper understanding of digital logic design while enhancing our problem-solving and circuit-building skills. Our goal is to create a system that is not only functional but also demonstrates efficient floor selection, accurate status indication, and user-friendly interaction. By doing so, we aspire to showcase the practical potential of digital logic circuits in solving real-world challenges.

Scope:

Our project aims to design and implement a digital elevator control system using fundamental hardware components such as logic gates, flip-flops, counters, encoders and display drivers (7-segment display). The system will simulate the operation of an elevator in a multi-story building, focusing on effective use of combinational and sequential circuits to handle user requests and elevator operations.

Detailed Description of Features

- **Floor Selection**: Push buttons will be used for each floor, allowing users to request the elevator. The system will prioritize these requests and process them based on pre-defined logic.

- **Direction Indicator**: LEDs will indicate whether the elevator is moving up or down.

- **Current Floor Display**: A 7-segment display or LED array will show the current floor the elevator is on, driven by combinational logic.

- **Door Control**: A simulated door mechanism using LEDs, where lights represent doors opening and closing. This will be controlled by timers and flip-flops to manage the duration.

- **Request Memory**: A circuit using flip-flops or latches will store floor requests until they are serviced.

- **Emergency Stop**: A switch, to immediately stop the elevator, overriding all other operations.

- **Sequential Logic (Flip-flops/Latches)**: The elevator's movement and floor requests will be handled by sequential circuits, ensuring the correct order of operations.

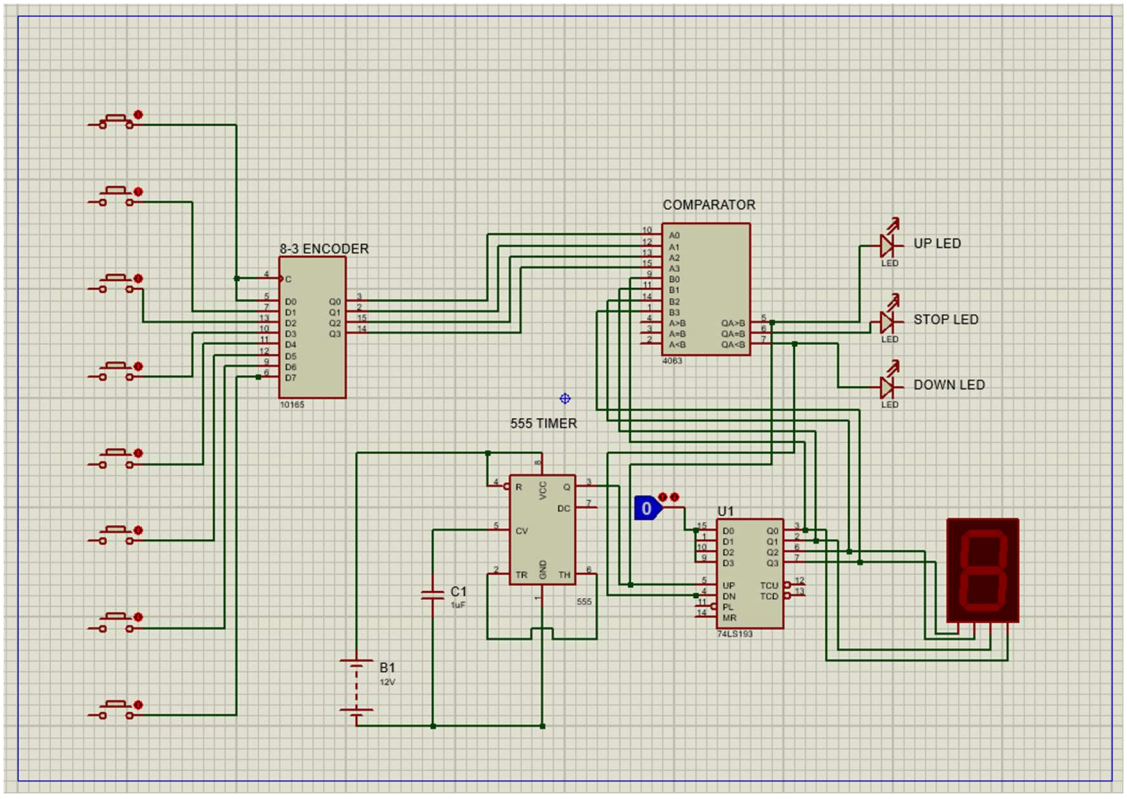
Objective and Potential Real-World Applications

Our goal is to apply and integrate digital logic design principles in creating an elevator control system that manages multiple requests efficiently using only basic digital components. This project will reinforce the understanding of sequential circuits, combinational circuits, and timing considerations. Given below are some of the potential real-world applications of our project.

Potential Real-World Applications:

- **Elevator Systems**: Insights from this project are applicable in designing efficient and safe elevator systems for residential and commercial buildings.
- **Automated Control Systems**: Concepts from this project can be applied to other automation systems like conveyor belts, car park barriers, and automated gates.
- **Educational Purposes**: This project can serve as a learning tool for understanding the practical application of digital logic in real-world systems.

Logical Circuit Diagram (to be refined):



Note: Door mechanism and multiple floor requests handling mechanisms are to be included as well in the future, as we are still exploring the potential features we might add in our project.

Component List with Specification

1. Seven Segment Display

- To show the floor number

2. Push Buttons

- Represent floor call buttons
- **Voltage Rating**: Typically, 5V-12V.

3. **LEDs**

- For indicating status (Direction (up/down) and stop)
- Type: Standard LED
- Forward Voltage: ~2V (red) or ~3V (green).
- Current: ~20mA.

4. Comparator (4063)

- Compare the current floor (from the counter) with the requested floor (from the encoder).
- 4-bit magnitude comparator
- **Inputs**: Two 4-bit binary numbers

5. **555 Timer**

- Function: Generates precise time delays.
- Specifications: Operating voltage 4.5V-16V, adjustable timing.

6. 8-to-3 Encoder (10165)

- Encodes the floor request into a 3-bit binary number

7. Counter (74LS193)

- Tracks the current floor.
- Specifications: Synchronous counter, Voltage: 5V, Max Frequency = 25MHz

Interaction of the Components

When a button is pressed, it sends a signal to the 8-to-3 Encoder (10165) to encode the requested floor.

Encoder receives the signals from the push buttons and sends 3-bit encoded data to the **Comparator** (4063) and the **Counter** (74LS193). Comparator compares the current floor (from the counter) with the requested floor (from the Encoder).

UP Led lights up when the requested floor is higher than the current floor. Down Led lights up when the requested floor is lower than the current floor. Stop Led lights up when the requested floor equals the current floor.

555 Timer drives the **Counter** (74LS193) to increment or decrement the floor number. Counter then sends the current floor value (binary) to the **Comparator** and the **7-Segment Display.** Seven segment display receives the input in binary and displays the current floor number in decimal

Note: As more features are included, the interaction between the components will become more complex than our current model.

The End