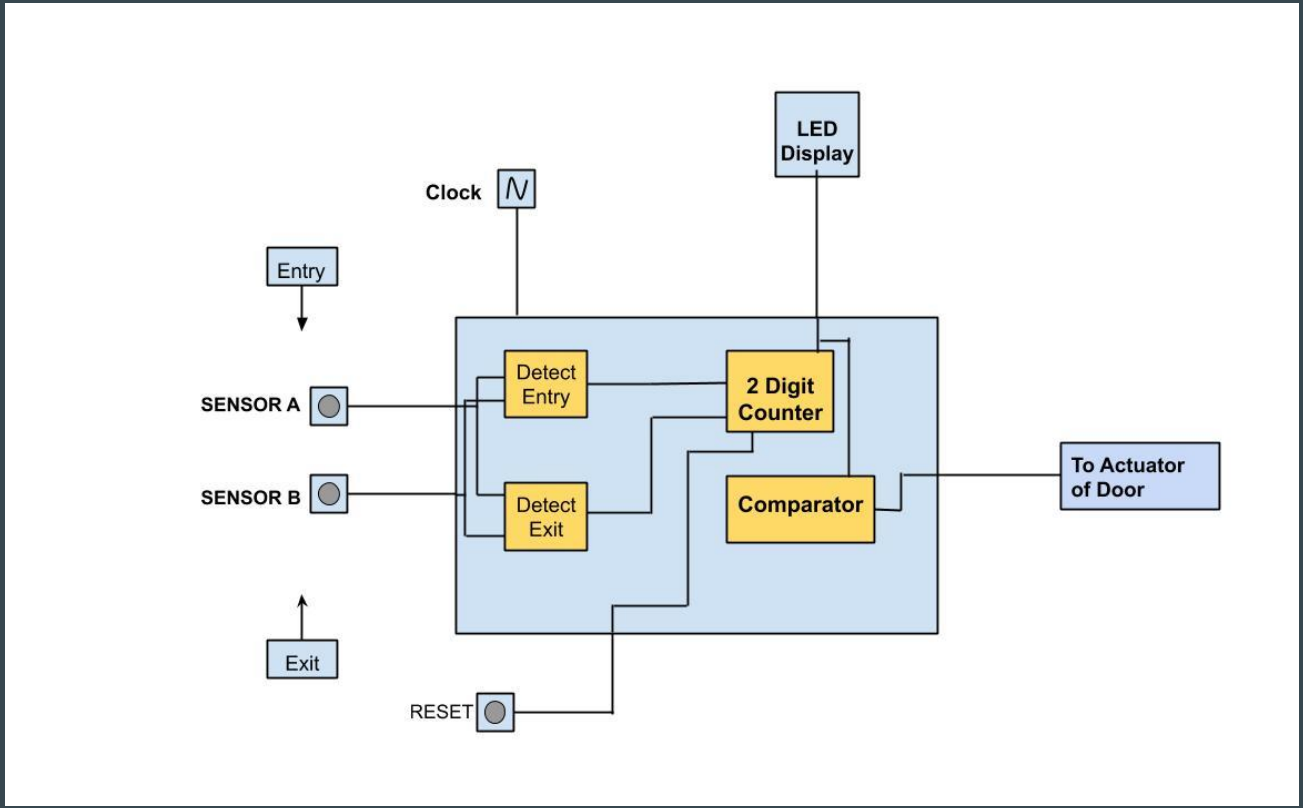
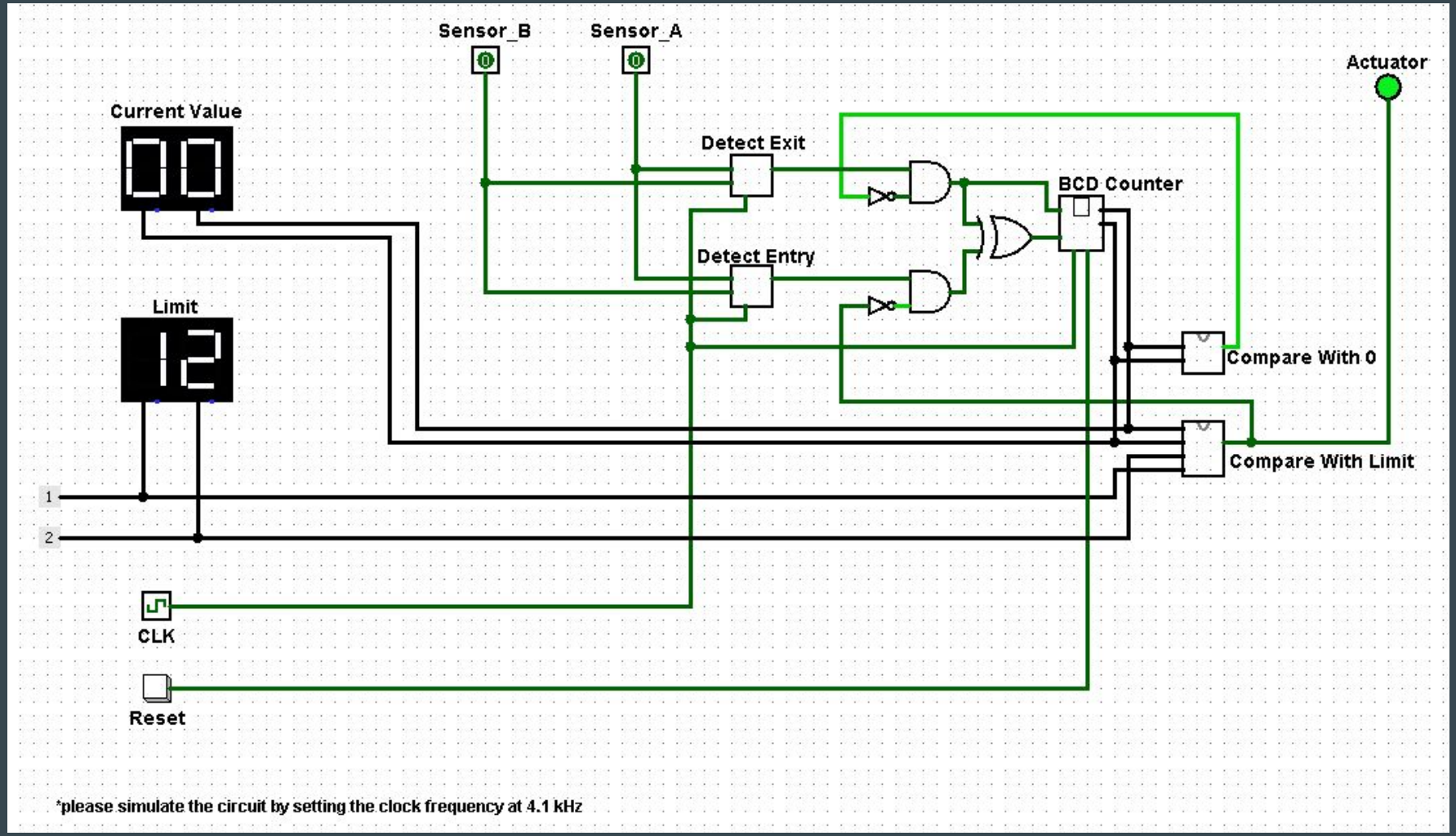
Design Assignment
Group 96 - Q3

Designing a circuit that counts the number of people in a room

Top Level Block Diagram:




Sensor_B
Sensor_A
Actuator
Current Value
Detect Exit
BCD Counter
Detect Entry
Limit
Compare With 0
Compare With Limit
1
2
CLK
Reset
*please simulate the circuit by setting the clock frequency at 4.1 kHz

Assumptions:

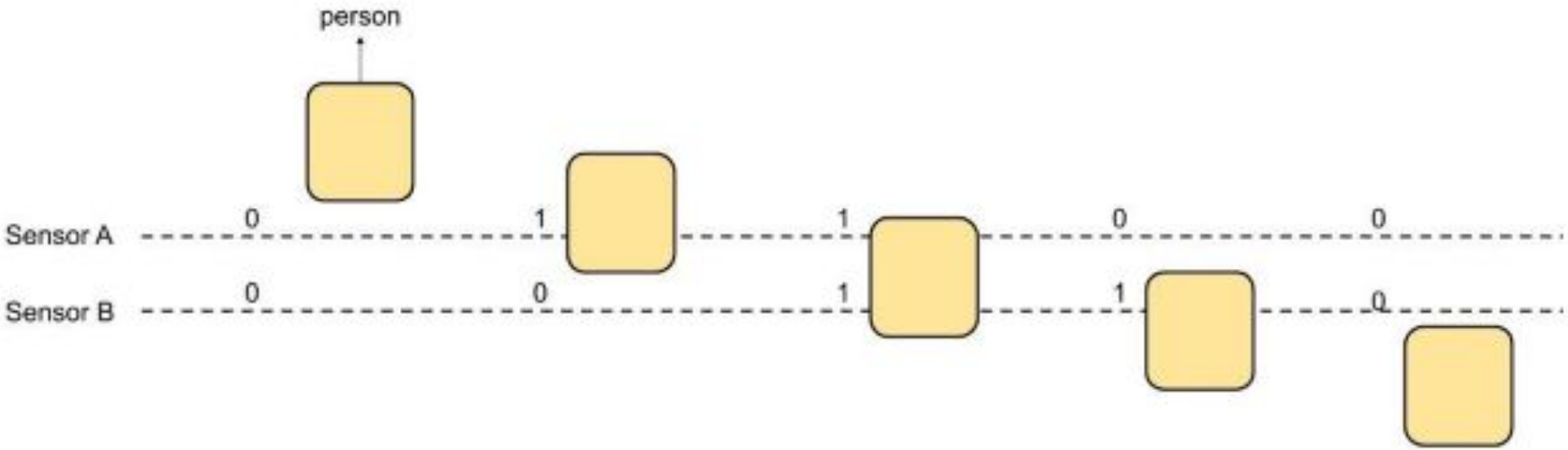
1. A person who has once passed through the first sensor from either side, and is standing in front of both the IR sensors, or in front of the successive sensor he/she cannot make a U-Turn to return back.

2. Not more than one person can pass through the door at a time i.e. only if a person has exited/entered completely can the next person enter/exit.

3. Two people cannot come from either side of the door simultaneously.

Design Methodology and Logic:

Path of entry:



*The signals from the sensor are also mentioned for a particular instant beside the person block.

Synchronous over Asynchronous:

1. In the given problem, we don't have control over the input, i.e. we cannot control when a person will enter through the door. Two options: Asynchronous or Synchronous with high clock frequency
2. Synchronous because:

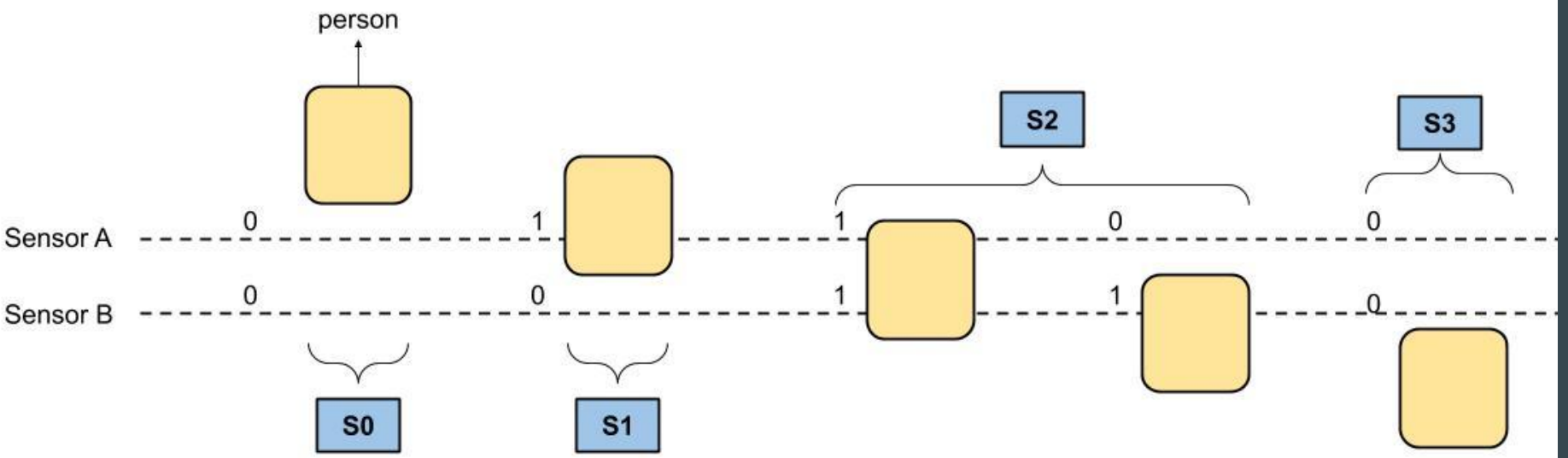
   a. We wanted a glitch free and clean design. (Also the reason for moore over mealy FSM)

   b. Asynchronous could get more complex as EXIT and ENTRY need to be detected simultaneously

   c. All group members were more confident about their knowledge on synchronous design of circuits when we started designing the project

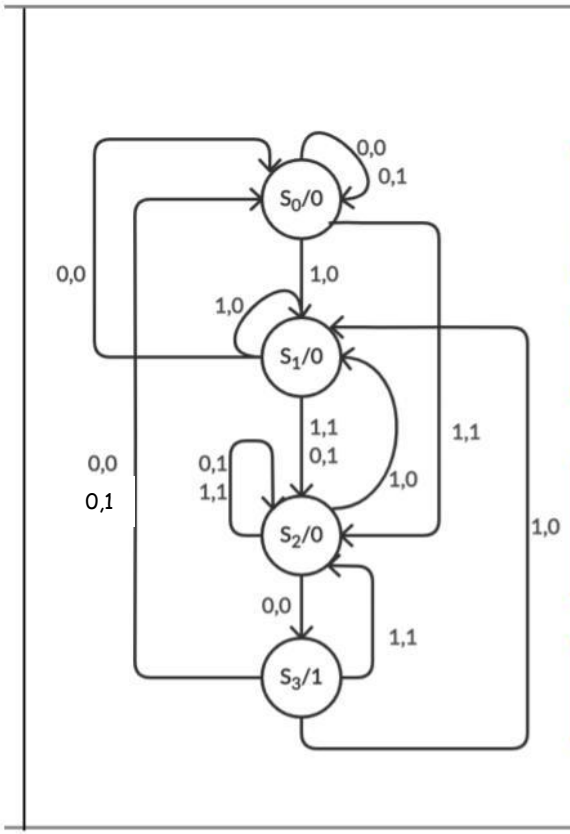
Design Methodology and Logic:

Path of entry:



*The signals from the sensor are also mentioned for a particular instant beside the person block.

State Diagram: (for entry)



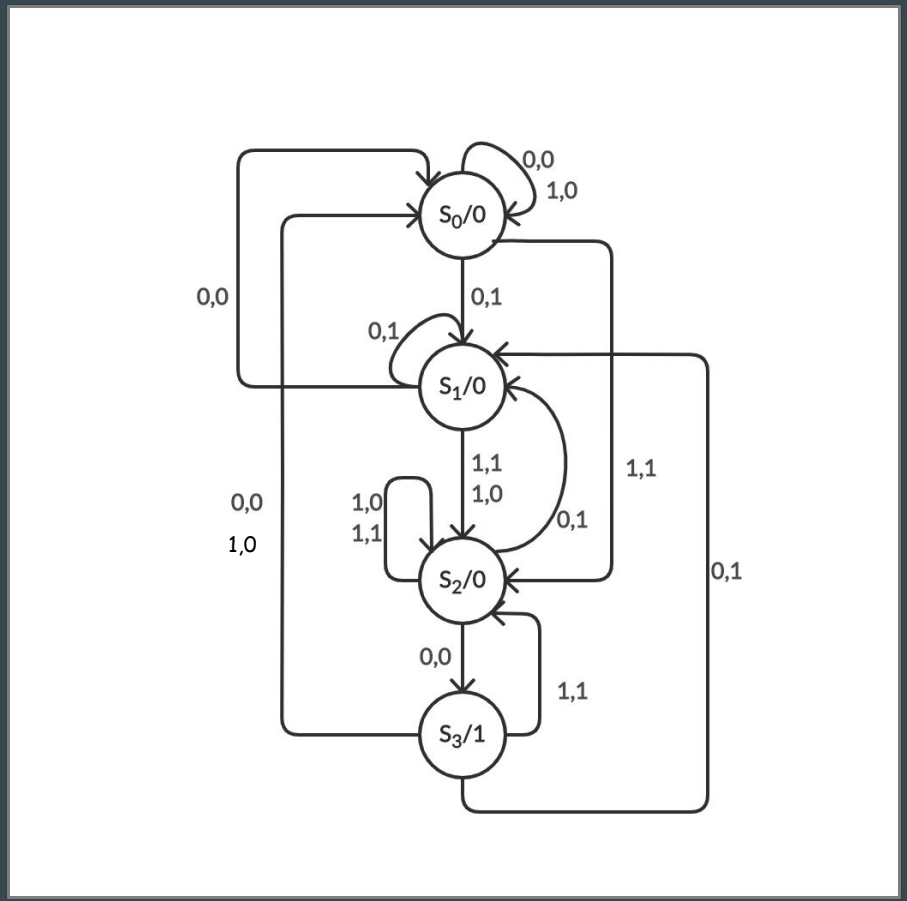
S0: Either no one in front of both the sensors, or a person has entered from sensor B, which means an exit. So will remain in the same state

S1: The person is standing in front of Sensor A in this state.

S2: The person is either standing in front of both Sensor A and Sensor B, or only in front of Sensor B in this state.

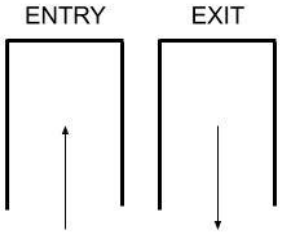
S3: The person has just passed the door, making the input of Sensor B from HIGH to LOW.

State Diagram: (for exit)

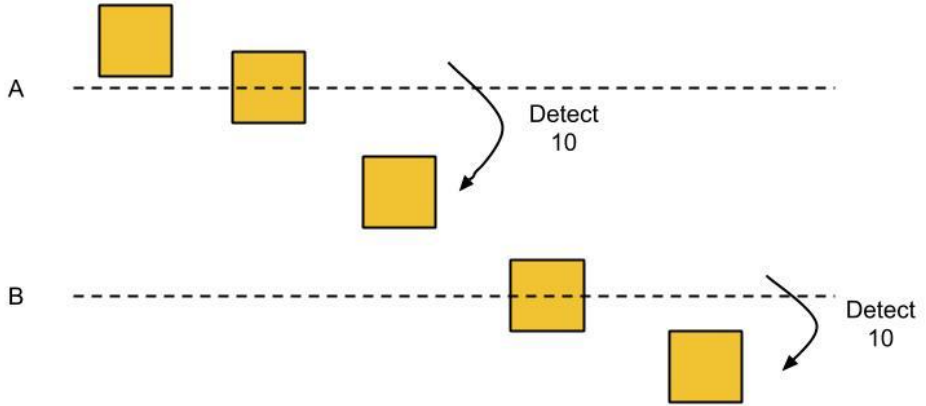


Design Evolution:

DRAFT 1:



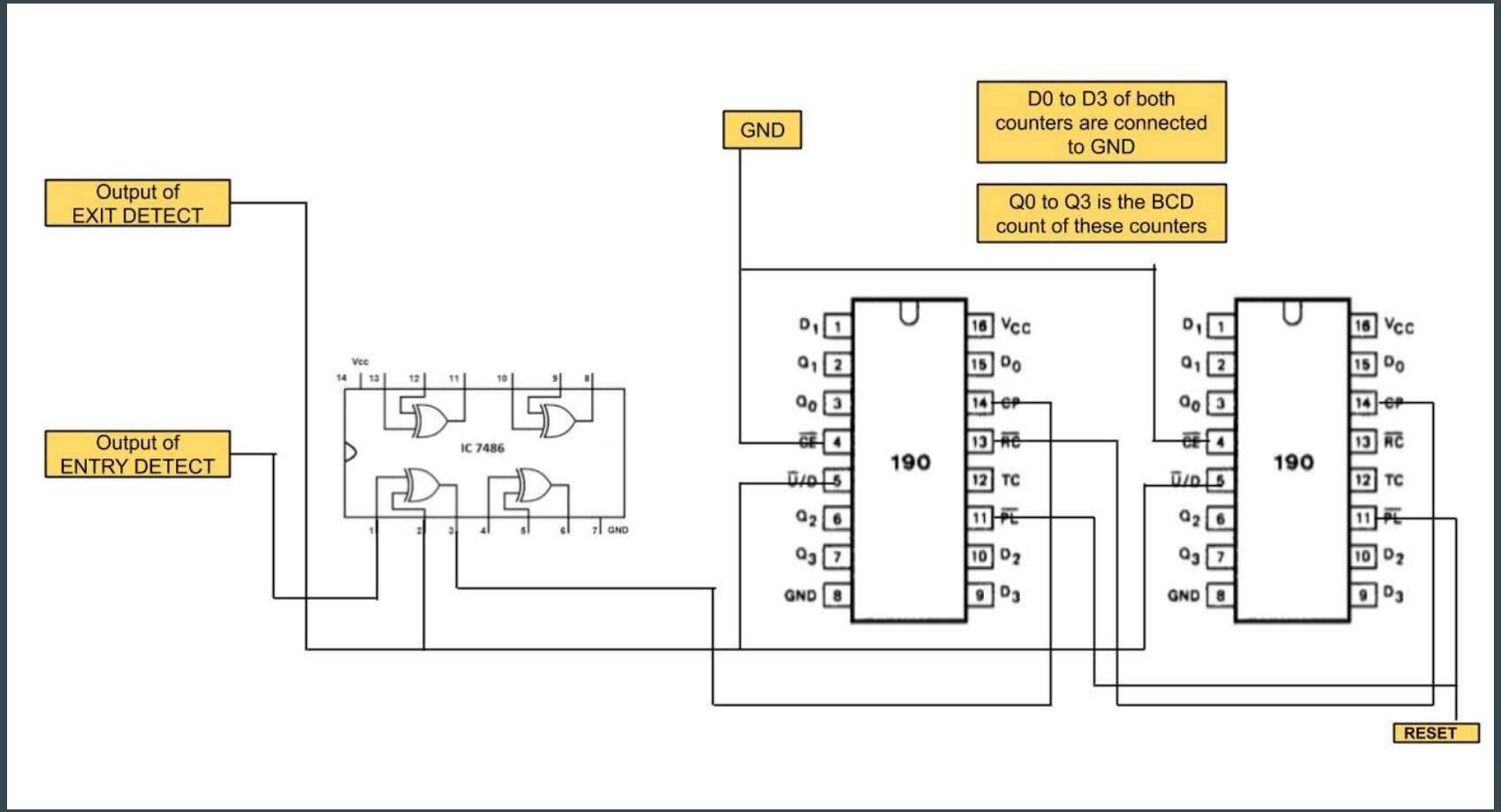
DRAFT 2:



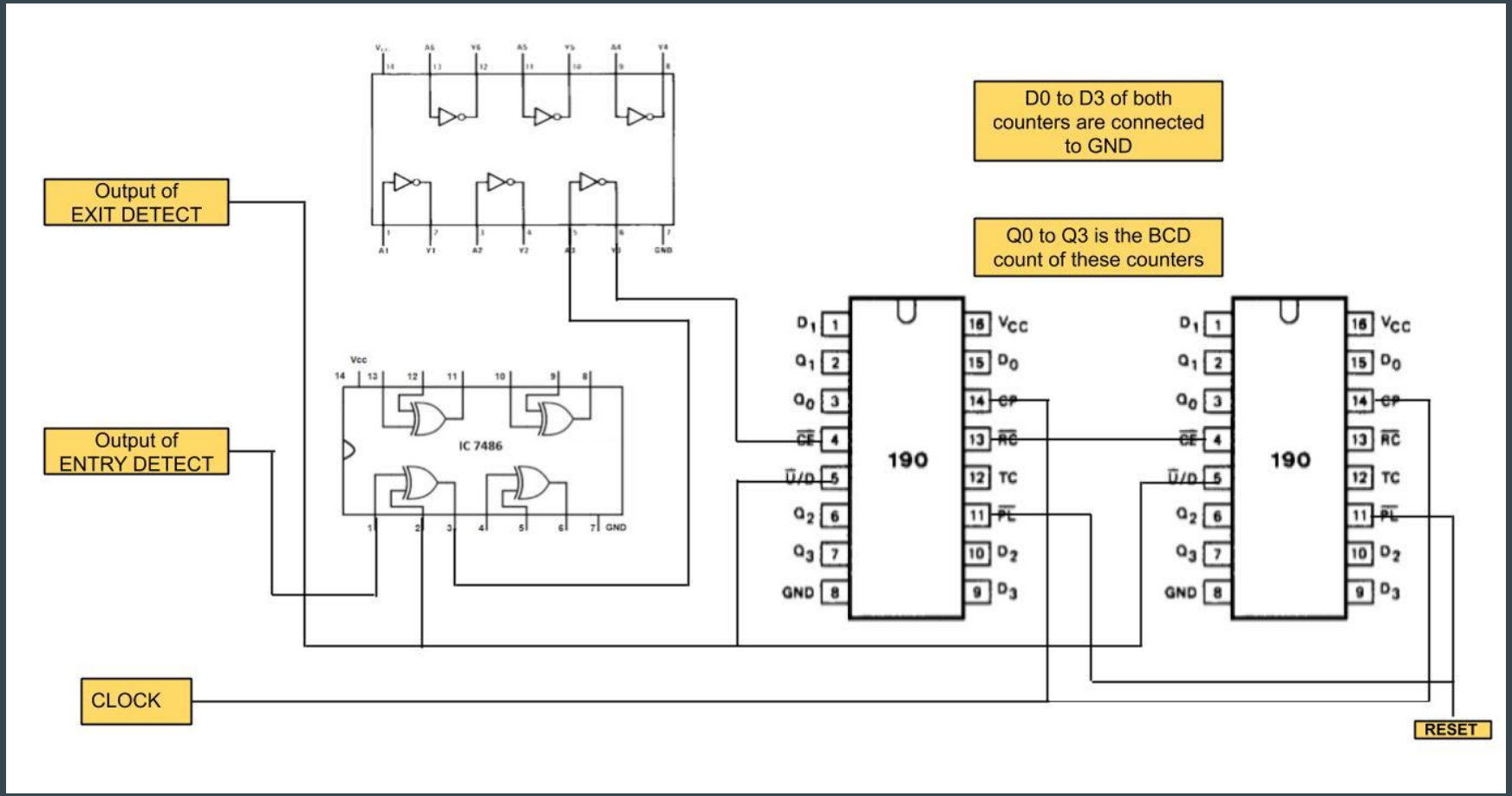
Logisim Implementation:

1. Entry Detect
2. Exit Detect
3. Counter
4. Comparator

74HCT190 (async) :



74HCT190 (sync) :



Additional Functionalities:

1. Detect a U-Turn
2. User Input for limit of people entering the room
3. Emergency override switch
4. Indicator of ENTER/EXIT for person next in line

Thank You

Efforts by:

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