ROOMMATE COUNTER

Digital Logic Design

Abstract

A logical circuit that keeps a count of the people present in a room.
Having both increment and decrement functionality

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Acknowledgment

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1. Introduction

Frequently, we forget to switch off lights and fans in our room when we go out. Sometimes, we are too lazy to do that. So, what if we design a system for saving energy where the system will automatically detect whether the room is empty or not and how many people are in the room with the help of sensors and counter system and will control the lights, fans, air conditioners and other necessary electronic equipment according to the presence of people in the room.

We don't want to use cameras and image receptors for the project, so instead, we are using a digital logic based circuit that is intended to be installed on a door. The door knobs will have sensors attached to them, so that we can detect if someone used the door knob and entered the room.

Limitations & Assumptions:

We have assumed certain scenarios and performed simulations according to them, we are only considering 4 bit inputs along with a single 7-Segment display so it'll count up to 9 people assuming only one person enters or leaves at a time, but this circuit can be easily expanded and made to work with different scenarios.

We will see what the counter displays after the whole cycle is completed, not before that.

Worked in a group of 2 students.

2. Problem Statement

We need to design a logical circuit that can keep a count of the people present in a room.
The circuit should have both increment and decrement functionality

3. Objectives

The objective of our project is to build a working model of a digital object counter.

Utilizing basic digital logic gates, Flipflops, 7-segmented displays and sensors and designing and building a logic circuit to accurately keep track of the number of people entering or exiting a room.

4. Methodology

To design the required circuit will use flipflops to store the count of people present in the room, and then to increment or decrement the count after someone enters or joins, we will use a 4 bit adder, the adder outputs will be sent back to the flipflop, so that the memory is updated with the new count, then we use either the adder or the flipflop outputs and connect them to the Display. Inside and outside sensors are connected to the adder, Doorframe sensor is set as the clock of our D Flipflop.

4.1 Entering Logic Cycle:

1. *Door_Outside* button on
2. *DoorFrame_Sensor* sensor on
3. *Door_Outside* button off
4. *Door_Inside* button on
5. *DoorFrame_Sensor* sensor off
6. *Door_Inside* button off

4.2 Exiting Logic Cycle:

1. *Door_Inside* button on
2. *DoorFrame_Sensor* sensor on
3. *Door_Inside* button off
4. *Door_Outside* button on
5. *DoorFrame_Sensor* sensor off
6. *Door_Outside* button off

- When we perform the Entering cycle, the number on the display is incremented by one.
- When we perform the Exiting cycle, the number on the display is decremented by one.

5. Proposed Solution

In this section, define what you have done in your project while implementing above discussed methodology which is already discussed in Section 4. In this section you will describe all your project including hardware circuit and simulation circuit for verification purpose. All text here should be written in normal style text i.e. Times New Roman, 12 size, unbolded, with justified alignment,

5.1 Circuit Diagram

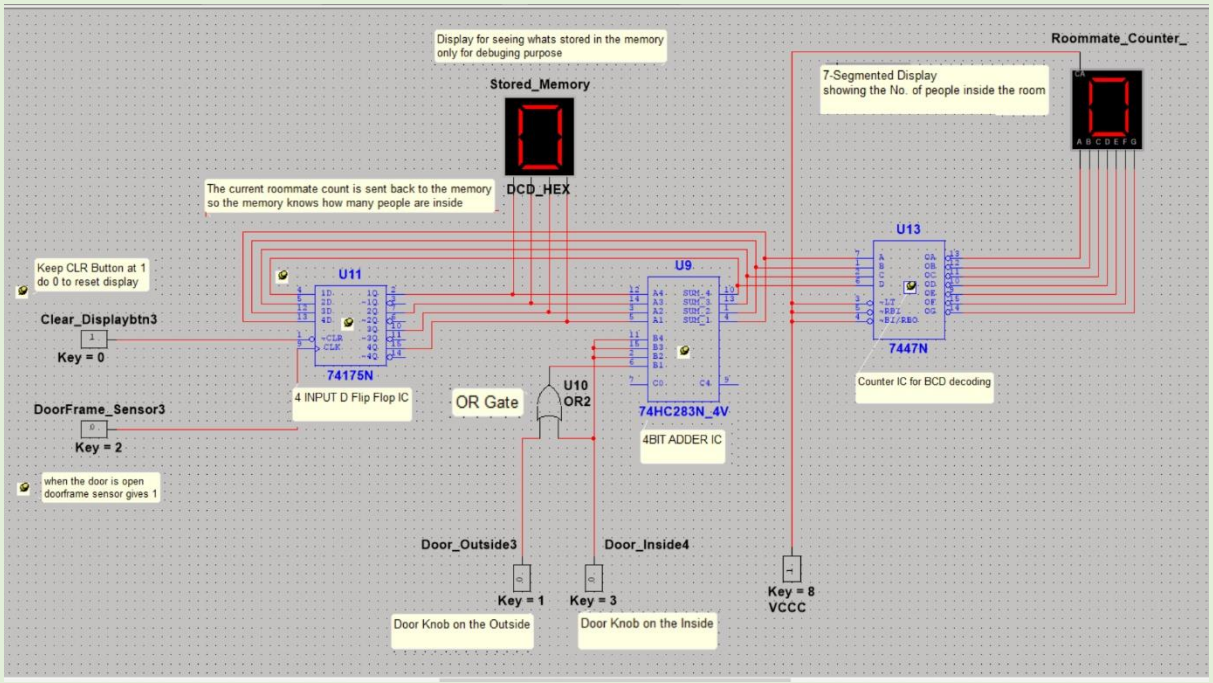

Figure 1: Labelled Circuit Diagram

5.2 Hardware Components

Integrated Circuits

1. 74HC283N - *4 BIT FULL ADDER WITH FAST CARRY*
2. 74175N - *QUAD D-TYPE FLIP FLOPS WITH CLEAR*
3. 7447 - *BCD TO SEVEN-SEGMENT DISPLAY*
4. 7432 - *OR Gate IC*

Buttons

5. -Door_Outside
6. -Door_Inside
7. -DoorFrame_Sensor
8. -Clear_Display

Other Components

9. 7-Segment Display
10. BreadBoard
11. 9v Battery
12. Resistors
13. IR Sensor

5.3 Simulation Screenshots

Scenario 0: Default State

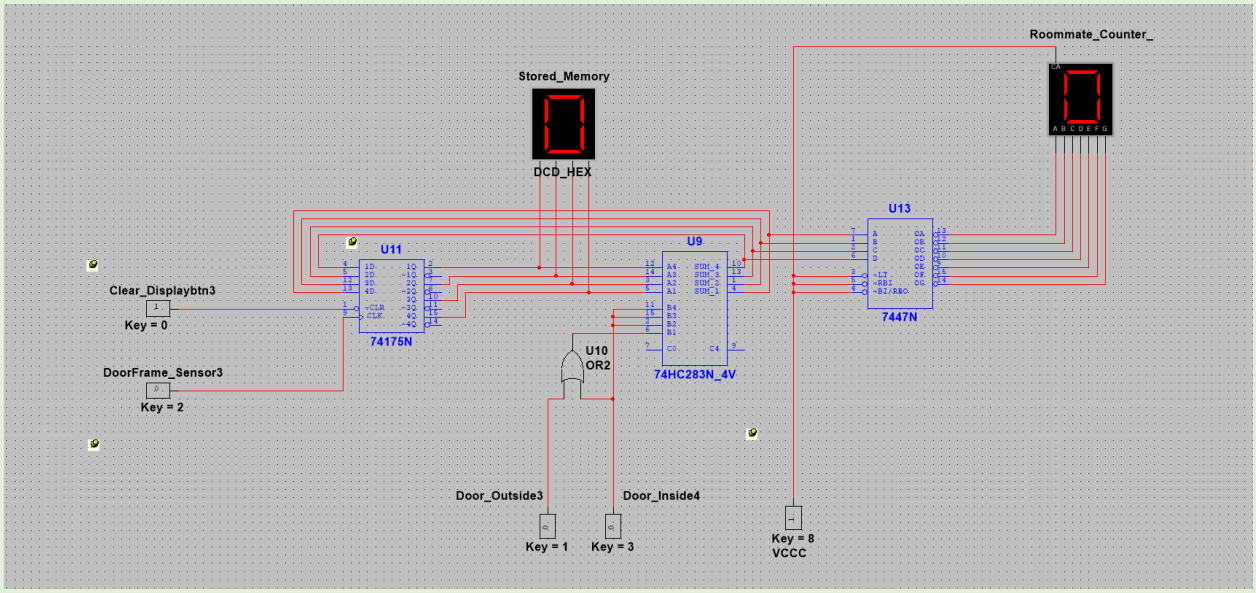

Figure 2: Scenario - Default state of the circuit

Scenario 1: When someone enters the room

1 – 1:

1. A person enters from the outside
2. Twisting the door knob from the outside (Door_Outside gives HIGH)
3. And then opening the door (DoorFrame_Sensor gives HIGH

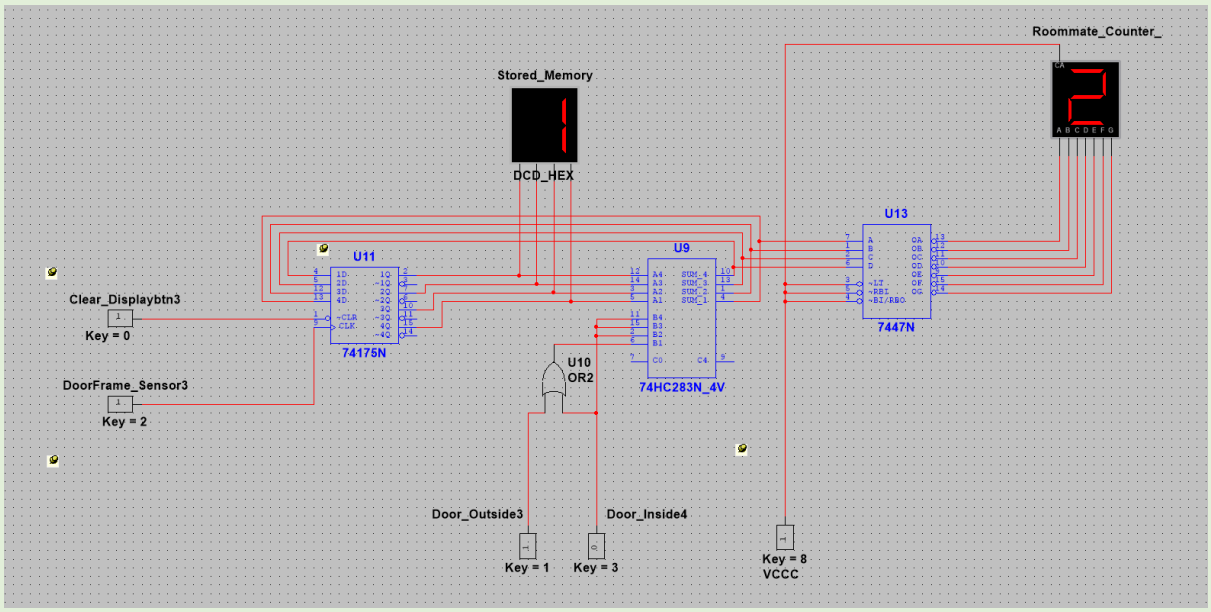

Figure 3: Scenario - When someone opens the door from the outside

1 – 2:

1. The person removes their hand from the door knob on the outside (Door_Outside gives LOW)
2. Then they use the door knob on the inside (Door_Inside goes HIGH)

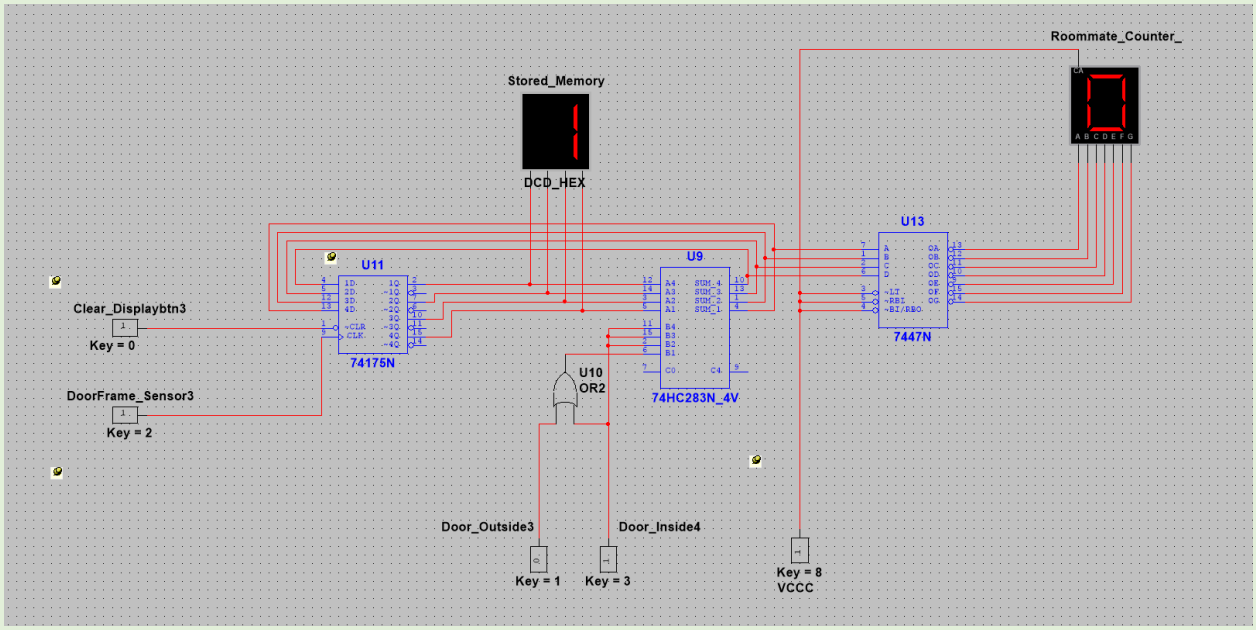

Figure 4: When someone enters the room from the outside

1 – 3:

1. Then they finally close the door from the inside (DoorFrame_Sensor goes LOW)
2. And lastly, they remove their hand from the inside door knob (Door_Inside goes LOW)
3. The memory is stored as 1 and 1 is displayed on the Roommate_Counter

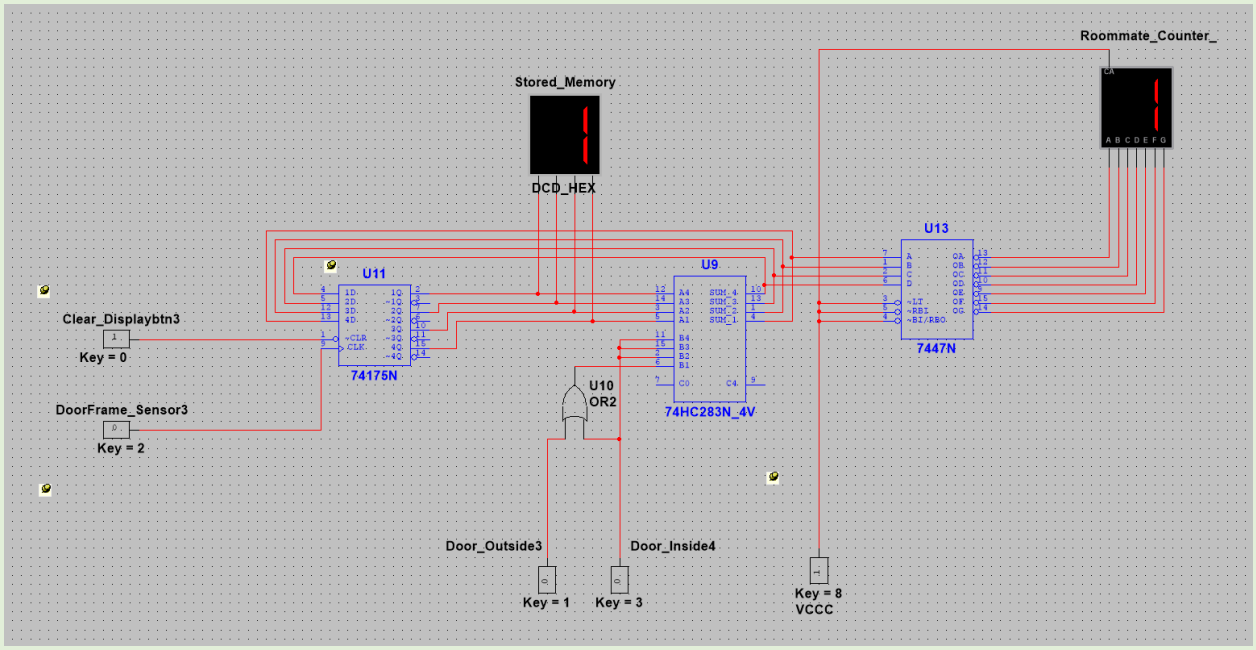

Figure 5: When the person closes the door from the inside

Scenario 2: Another person enters the room

2 – 1:

1. Twisting the door knob from the outside (Door_Outside gives HIGH)
2. And then opening the door (DoorFrame_Sensor gives HIGH)

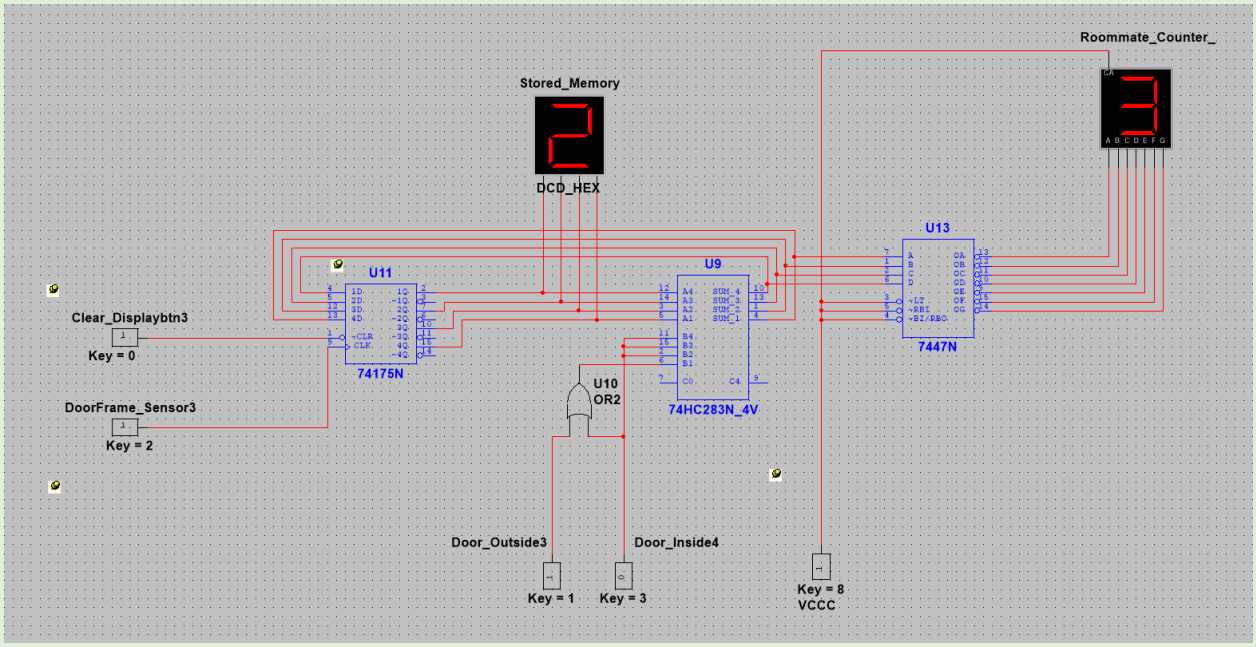

Figure 6: Screnario – A Second person opens the door from the outside

2 – 2:

1. The person removes their hand from the door knob on the outside (Door_Outside gives LOW)
2. Then they use the door knob on the inside (Door_Inside goes HIGH)

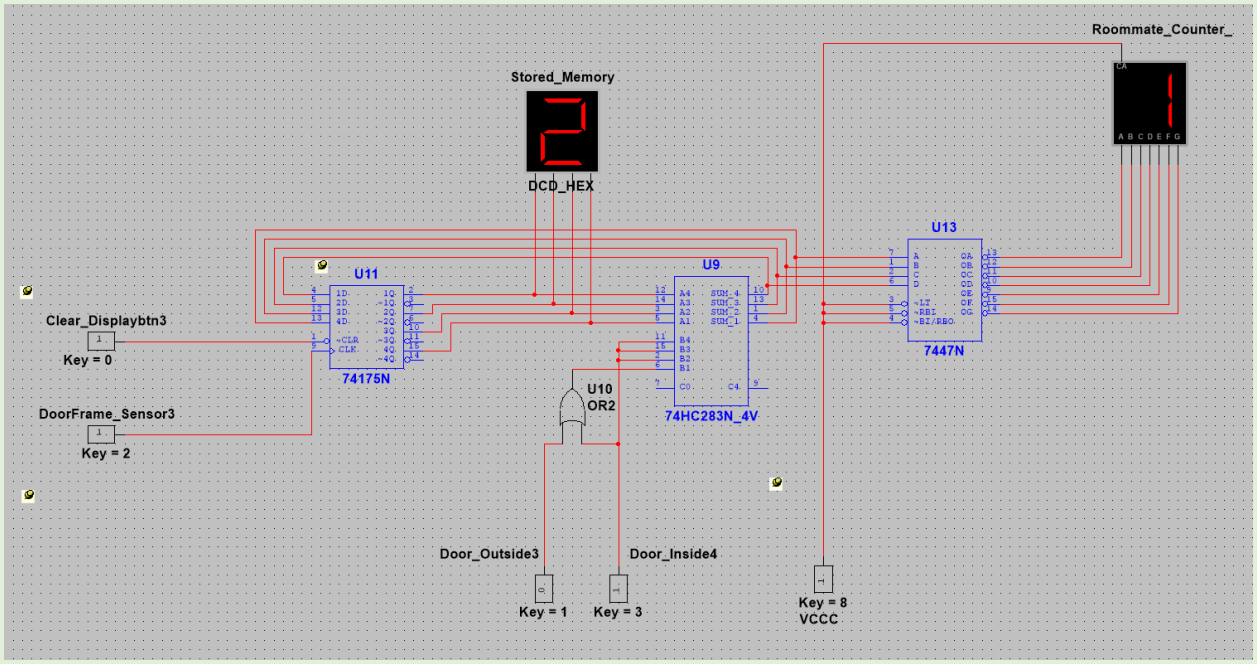

Figure 7: The second person enters the room

2 – 3:

1. Then they finally close the door from the inside (DoorFrame_Sensor goes LOW)
2. And lastly, they remove their hand from the inside door knob (Door_Inside goes LOW)
3. The memory is stored as 1 and 2 is displayed on the Roommate_Counter

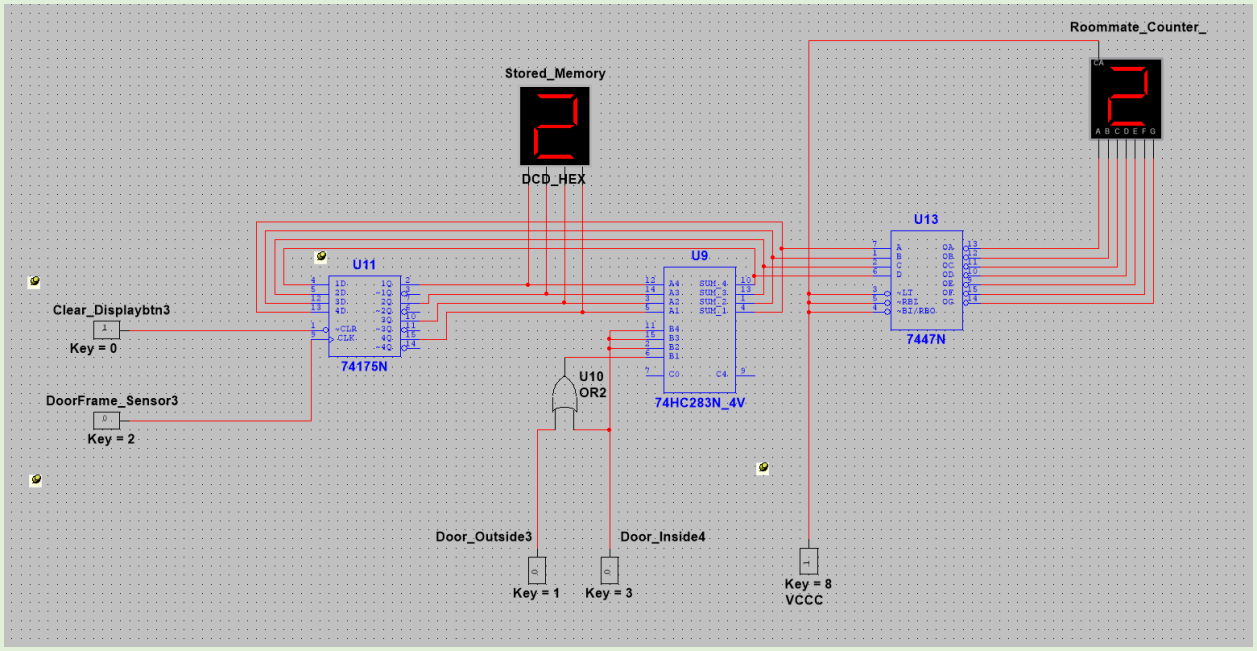

Fig 8: The second person closes the door from the inside

Scenario 3: Someone leaves the room

3 – 1:

1. Twisting the door knob from the inside (Door_Inside gives HIGH)
2. And then opening the door (DoorFrame_Sensor gives HIGH)

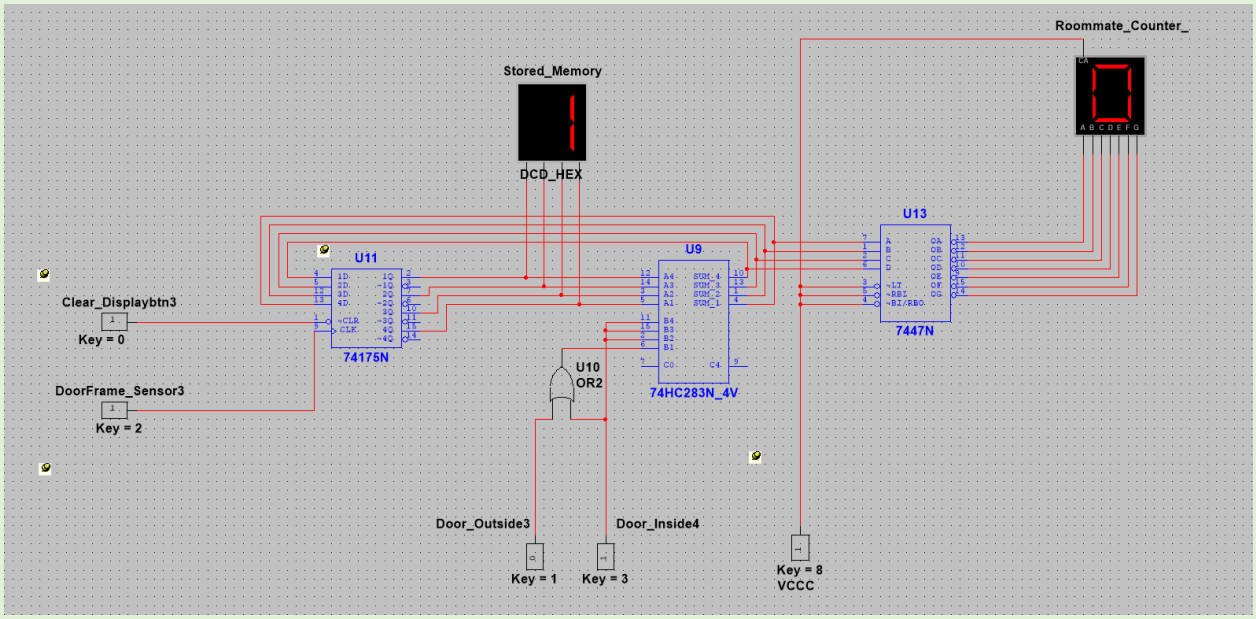

Figure 9: The person opens the door from the inside

3 – 2:

1. The person removes their hand from the door knob on the inside (Door_Inside gives LOW)
2. Then they use the door knob on the outside (Door_Outside goes HIGH)

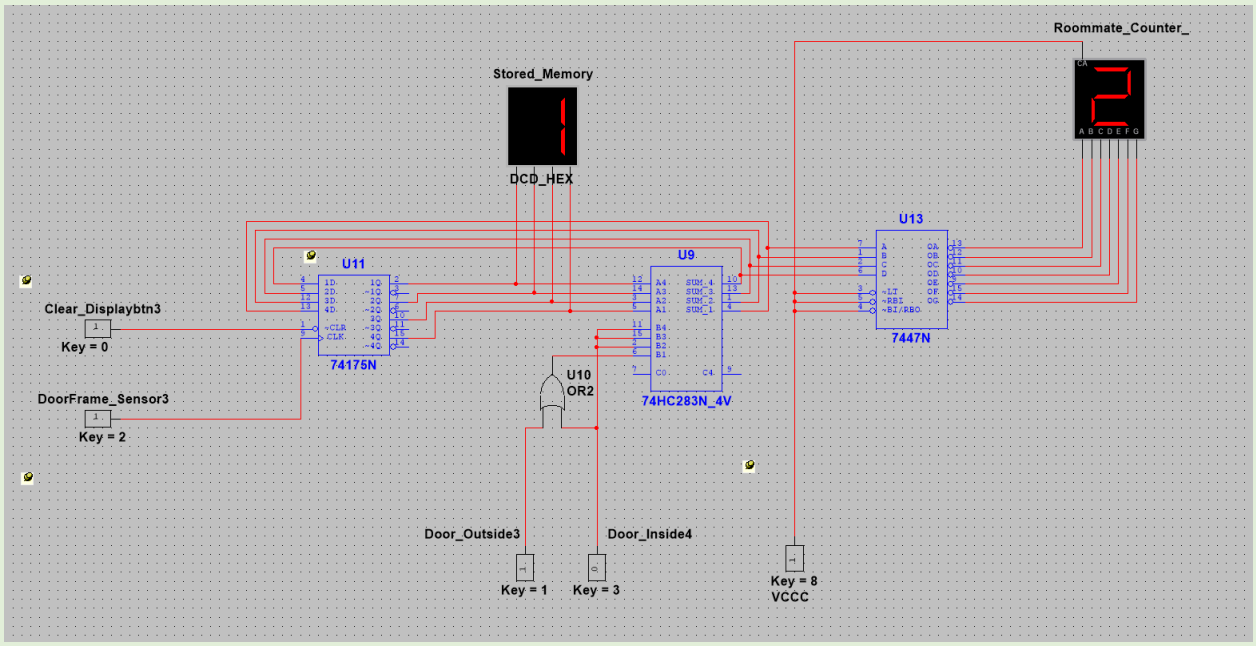

Figure 10: The person leaves the room

3 – 3:

1. Then they finally close the door from the outside (DoorFrame_Sensor goes LOW)
2. And lastly, they remove their hand from the outside door knob (Door_Outside goes LOW)
3. The memory was stored as 2, we decremented 1 from the memory and finally 1 is displayed on the Roommate_Counter
4. The new memory is now stored as 1

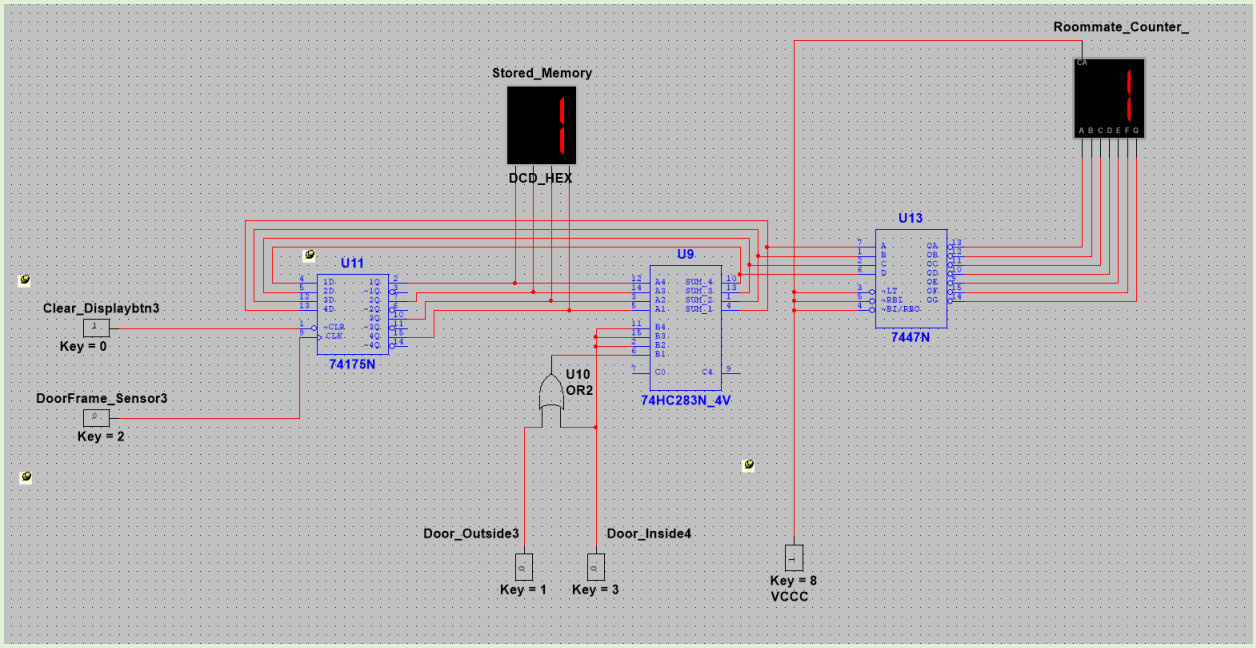

Figure 11: the person closes the door from the outside

Scenario 4: The counter is to be RESET

- The Clear_Display button is given a LOW signal to reset the circuit

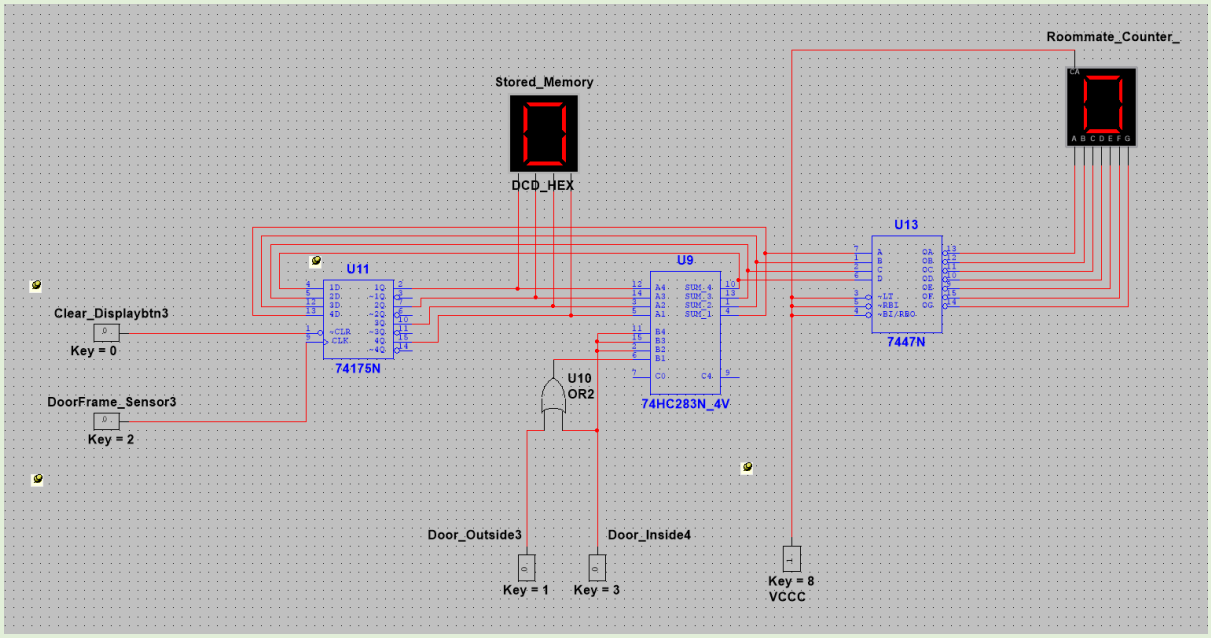

Figure 12: The circuit gets RESET

6. Results & Discussion

When we repeated the entering cycle 2 times we saw that the display showed 2

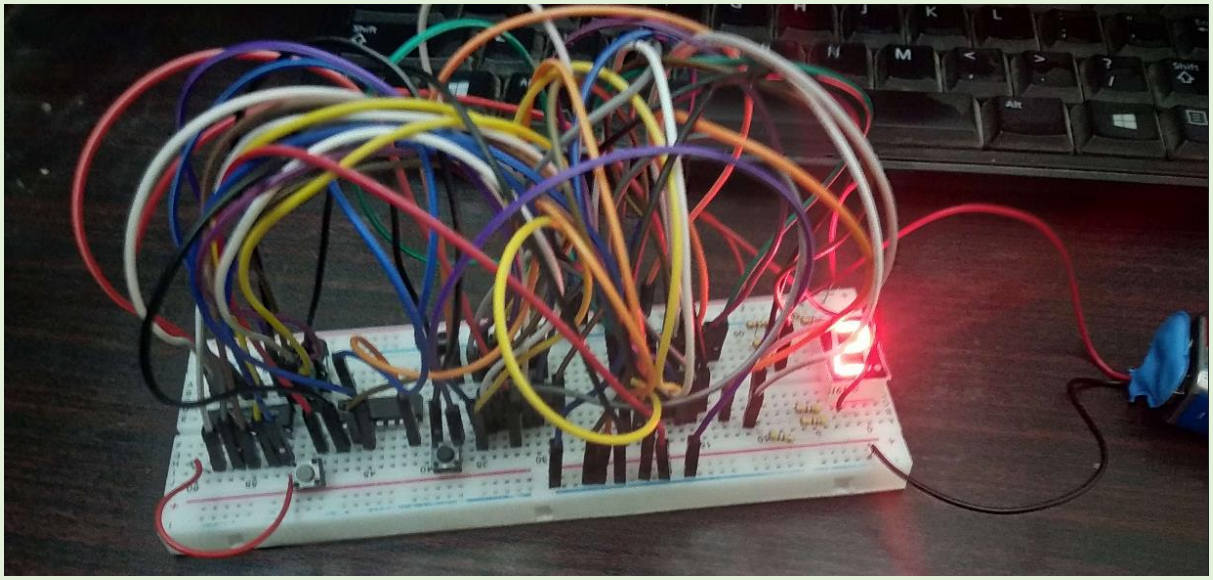

Figure 13: Display showing 2 people inside the room

Then after repeating the exiting cycle 2 times we see the display has gone to 0 (2 – 2 = 0)
We see the same situation after pressing the reset button

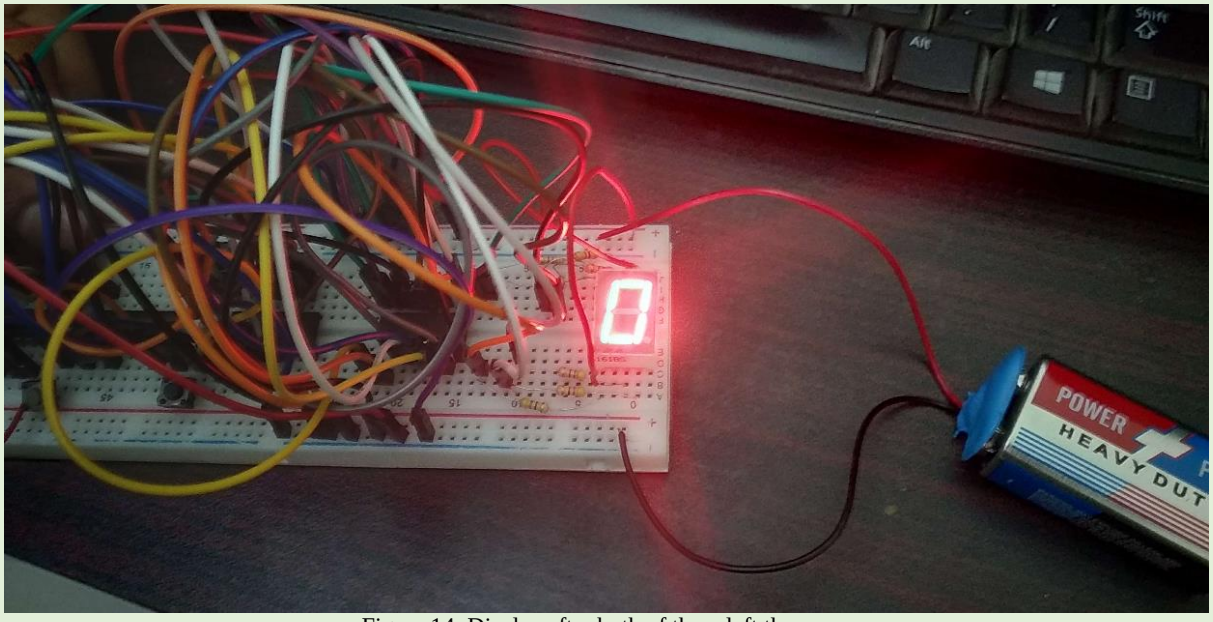

Figure 14: Display after both of them left the room

7. Conclusion

The counter we have designed is based on digital circuit design therefore memory requirements of this system are quite low.

The idea of this project revolves around the need of a counter that would display the number of people in a room.

It will be installed on a door, sensors on both door knobs, and one on the door frame. When someone comes and enters the room, the counter would be incremented by 1, when someone leaves the room, the counter would be decremented by 1, and the circuit retains memory with the help of a D Flip Flop, when we want to reset the memory and the display, we just press the reset button and it does the job.

8. References

https://lambdageeks.com/d-flip-flop-circuit-working-truthtable-differences/

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9. Appendix

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