EE−224 Project

Team 7

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Digital Numeric Lock

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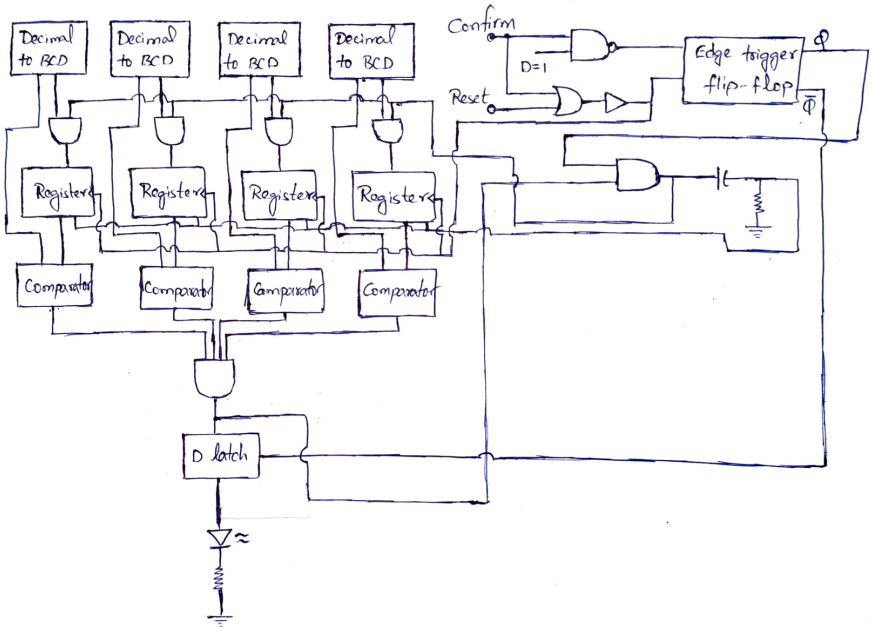
Contents

1 User Instructions

The user needs to follow the instructions listed below for the smooth functioning of the numeric digital lock.

- The lock will be locked by default, it's default password will be 0000.
- The user has to enter the password into the digital pad. They need not press the confirm button after entering the password.
- If the password entered is correct, the lock will become unlocked.
- The user can reset the password by pressing the reset button once. After doing this, they will be asked to enter the original password and then enter the new password. After doing this, the user needs to press the confirm button so that the changes are saved.
- **Precaution:** The reset and confirm buttons need to be pressed only when the user wants to reset the password.

2 Circuit Diagram and Overview



The circuit has 2 different modes of operation:

- Standard Mode
- Reset Mode

2.1 Standard Mode

In this mode, the circuit functions as standard digital lock, in which the lock will unlock if we input the correct password and will stay lock if an incorrect password is entered. The input is given by the 4 Decimal-to-BCD encoders, which convert the numeric input into 4*4 (as there are 4 digits) binary bits. The entered password will be compared to the correct password using a comparator. The correct password is stored in four 4-bit registers. If all the input bits match the correct bits, the output will be high which is given to a D latch whose output represents the locked/unlocked state. Enable of the D latch will always be high, except when the reset button is pressed, in which case it will be 0 and the lock is jammed until the user exits the reset mode.

2.2 Reset Mode

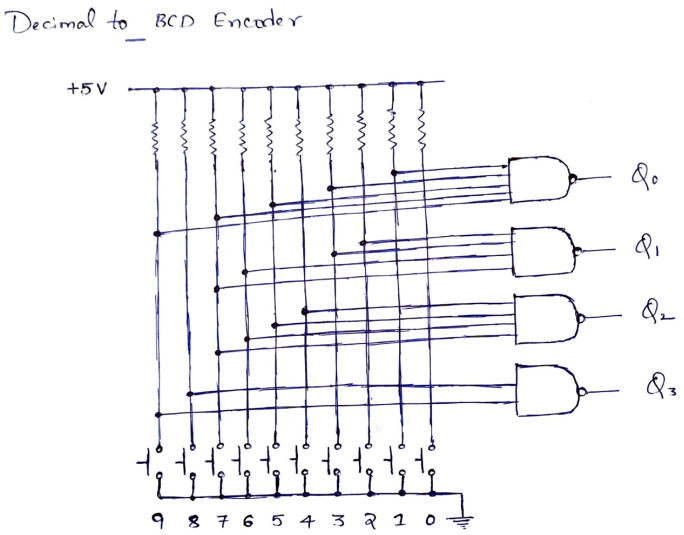
In this mode, the numeric lock is jammed so as to prevent the lock from accidentally unlock while attempting to reset the password. To enter reset mode, the reset button needs to be pressed. After doing this, we enter the old correct

password which sends a high signal to the AND gate with Q. This clears the registers and the LOAD is set to High. After this, we input the new password which is loaded into the registers. Finally, we press the confirm button which sets the AND gate output to LOW and the D latch is enabled again, which is nothing but the Standard mode.

3 Component wise overview

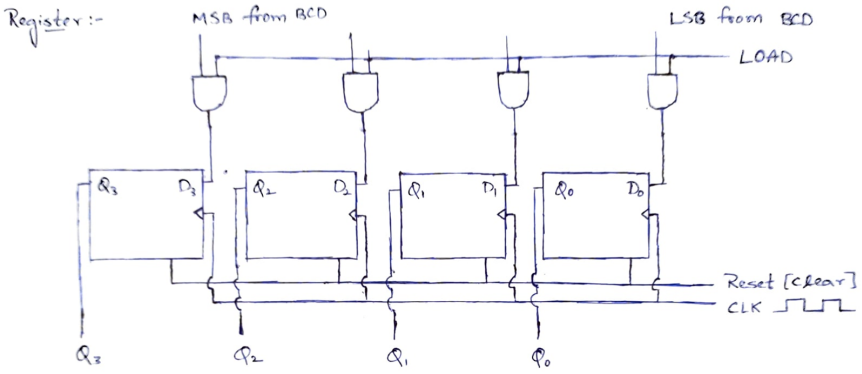
We have explained the overall working of the circuit. Now we will explain how each component works and what it's role is.

3.1 Decimal-to-BCD Encoder



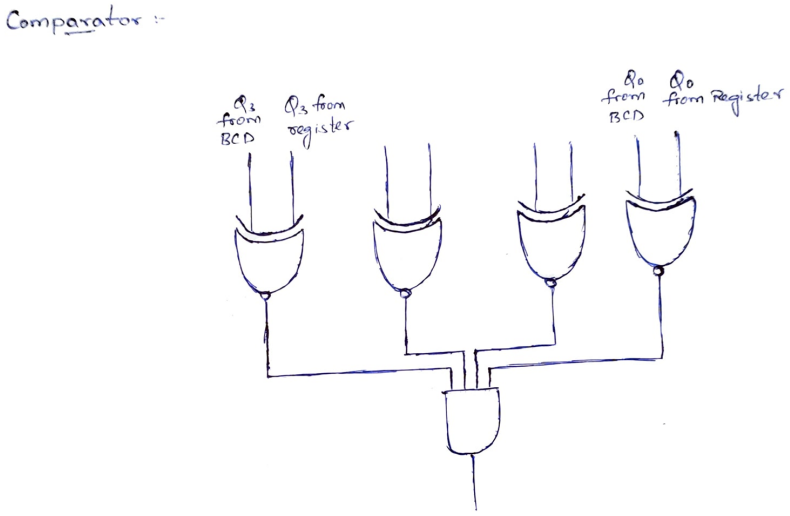
The above diagram shows the logic circuit for the Decimal-to-BCD coverter. The input is one digit between 0 to 9 and the output is a 4 bit conversion of the input. This step is required as we need to use bits for easier operation of the circuit.

3.2 Register



The registers are used to store the 4 digit password. Each register stores one number in 4 bit binary representation. When LOAD is Low, the stored bits cannot be changed, this functionality is necessary because we need to compare the entered password and the correct password. If LOAD is high (reset mode), the password will be reset with the next clock pulse.

3.3 Comparator



Each comparator compares 1 entered number and one correct number. This is why we use 4 comparators for the 4 numbers. The comparator gives a HIGH output when all the 4 bits match and gives a LOW output even if one of the bits does not match. This bit-wise comparision is achieved by using XNOR gates.

3.4 Edge Triggered Flip flop

This is a standard clocked D Latch flip flop. D is set to be HIGH. The clock is an OR operation of Reset and Confirm followed by a buffer gate (added to prevent race condition). The Confirm and D undergo a NAND operation, which is the actual D for the clocked D Latch. When Reset is HIGH, Q is set to HIGH and when Confirm is HIGH, Q is set to LOW.