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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
6.091 Hands-On Introduction to EE Lab Skills
Laboratory No. 5 Digital Circuits
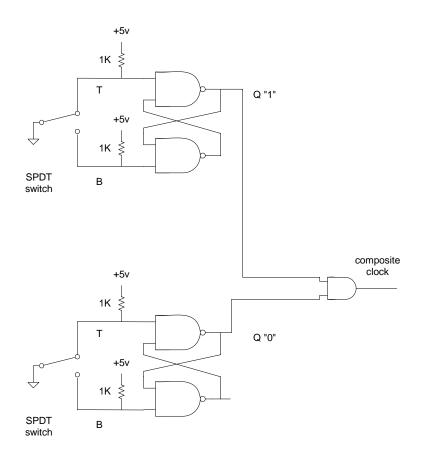IAP 2008

1 Objective

In this laboratory, you will build and debug a digital lock. You may implement the lock with a 4 bit or 8 bit code. One pushbutton switch is a "1" button. The other pushbutton is a "0" button.   When the correct sequence of code is pressed, an LED will light indicating that the lock is "unlocked". This LED signal can be used to disable a siren, etc.

1.1 Block Diagram

The first step in a design is to lay out a block diagram of the design. This allows the engineer to get a high level view of the design. In the section below, sketch the block diagram of the digital lock. Show the inputs, control circuit and output. The inputs are two pushbuttons, a gate is used to form a composite clock, the shift register and the decoder form the control unit.

1.2 Debounce Circuit

As a first step in the digital lock, two debounce circuits are used create a clock for the shift register. Wire up both debounce circuits and verify the operation. The pinouts for the NAND (74LS00) gates and AND (74LS08) are attached at the end. The NAND and AND gates are available from the drawers.
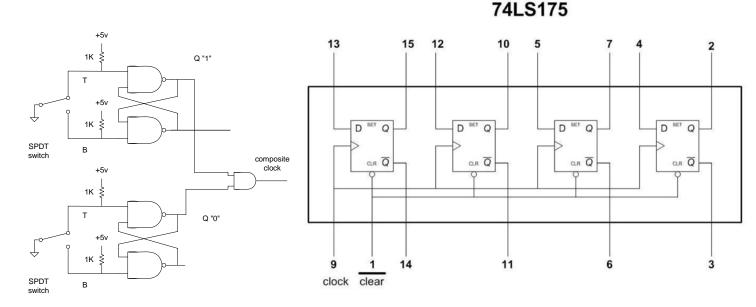

Verify with an oscilloscope that the debounce circuits function properly and a composite clock is generated.

1.3 Shift Register

Wire up shift register using a 74LS175. Add 4 leds (with 470 ohm resistor) to the Qbar output to aid in the debugging. As data is clocked in, you should see the data shift between the flip flops. The leds are NOT shown in this schematic. You can also ask to use a pre-built led display for debugging from a LA or the instructor.
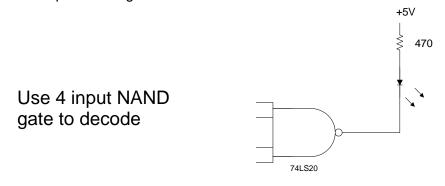
How should the pushbuttons and debounce circuit be wired to the shift register? How do you tell which button was pressed (hint: what is pin 7 of the 74LS175 used for)?
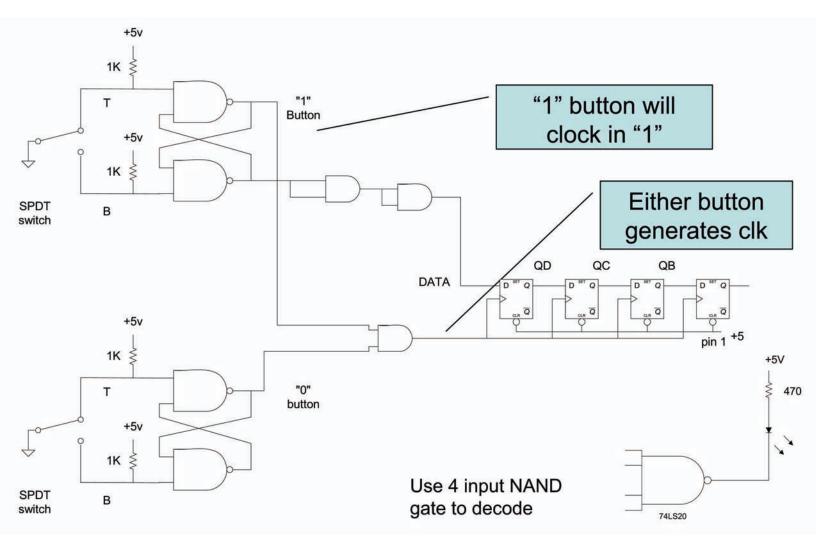
What should pin 1 of the 74LS175 be tied to?

(A larger schematic is attached at the end for your use.)

If you circuit is wired correctly, you should be able to clock in a series of "1" and "0". Now select your code and wired appropriate outputs of the shift register to turn on the led with the 4 input NAND gate

Use 4 input NAND gate to decode

Digital Lock

"1" button will clock in "1"

Either button generates clk

Use 4 input NAND gate to decode