NEXYS 4 NUMBER CRUNCHER

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PURPOSE

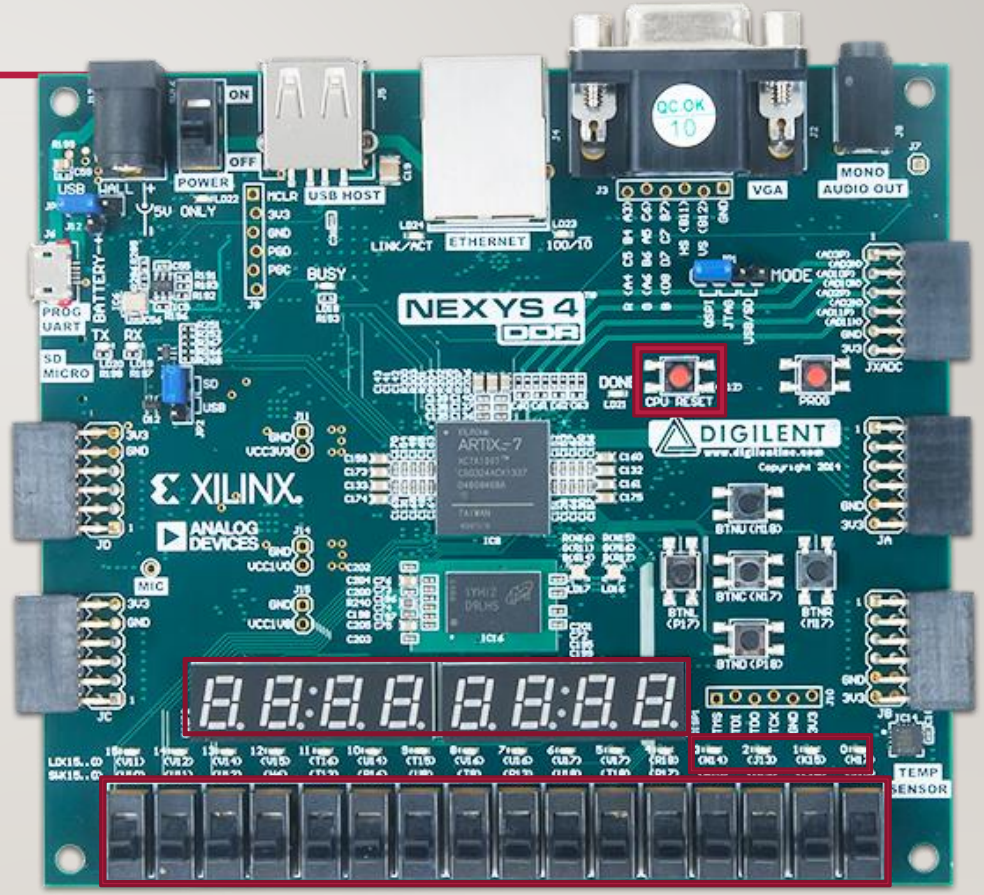
- Create a calculator useful for binary inputs
- Perform calculations quickly and easily
- Fun way to calculate small integer values
- We were hoping we could use our project on the final exam.

THE CALCULATOR FUNCTIONS

- Addition
- Subtraction (Absolute Value)
- Multiplication
- Division
- Calculations are performed using two 4-bit unsigned binary numbers as inputs (A&B). For all order dependent operations, A is considered the first input.
  - Example A÷B

FEATURED COMPONENTS

- FPGA (Nexys 4 DDR)
- Button - Clear
- Switches - Input
- LEDS - Output
- 7segment Display - Output



SWITCHES

- The switches are used to determine:
  - Unsigned 4-bit Binary input "A" : a_3, a_2, a_1, a_0 (Range: 0 – 15)
  - Unsigned 4-bit Binary input "B" : b_3, b_2, b_1, b_0 (Range: 0 – 15)
  - Which Operation will be performed: If more than one is enabled then the MSB has priority
  - If no functions are selected, addition will automatically be performed.
  - An extra switch was used to use enable the LEDS when Division is being performed

÷ × − +

A Functions Enable B

7SEGMENT DISPLAY

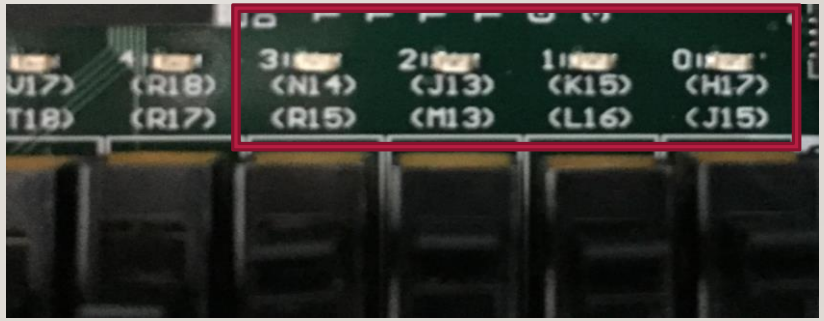
- The Values displayed on the 7segment display are all shown as decimal value (base 10)
- Seven 7segment displays were used to show:
  - The Value of A and B (Range 0 – 15)
  - The Output Value (Range 0 – 225)
    - During Division the quotient will appear on the 7segment display

A B Output

LEDS

- LEDS are only used during the Division Operation
  - They are used to display the value of the remainder "R" in unsigned binary
  - LED<3> is the MSB
  - LED<0> is the LSB
  - All other LEDs on the board are disabled

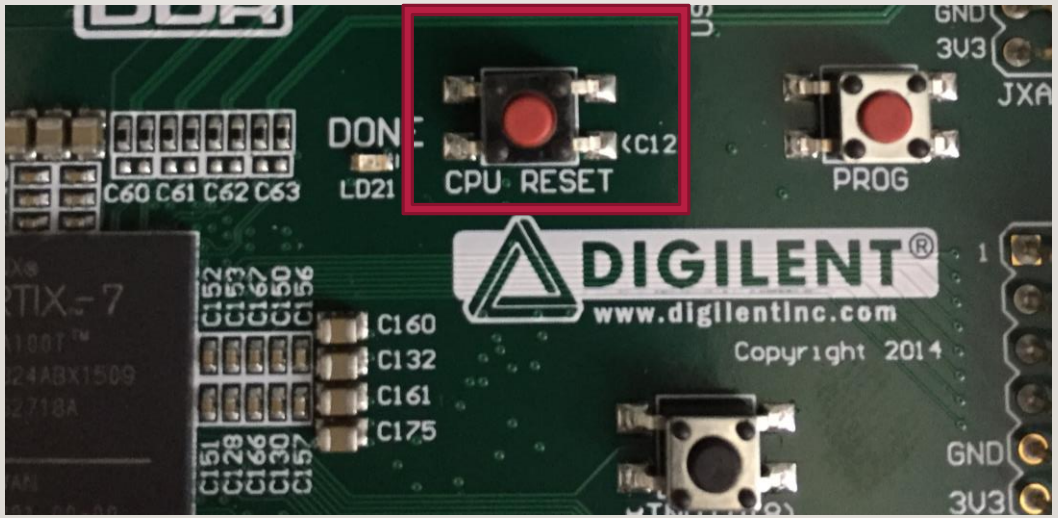
Remainder

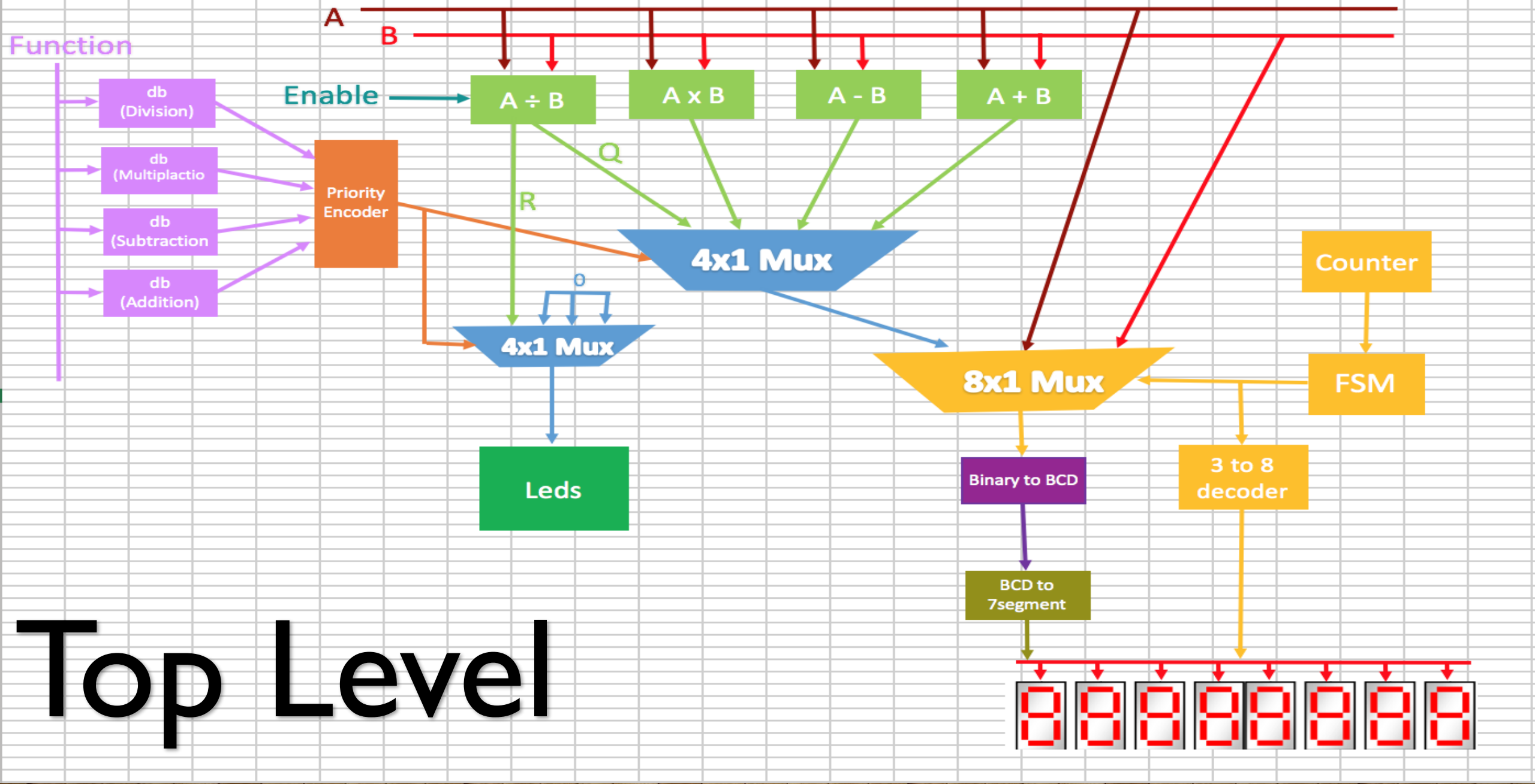


KEYPAD

- CPU RESET (Button ”C12”) is used to reset the board if the need ever arises

Reset




A
B
Function
db (Division)
db (Multiplactio
db (Subtraction
db (Addition)
Enable
A ÷ B
A x B
A - B
A + B
Priority Encoder
Q
R
0
4x1 Mux
4x1 Mux
Leds
Counter
8x1 Mux
FSM
Binary to BCD
3 to 8 decoder
BCD to 7segment

Top Level

POSSIBLE IMPROVEMENTS

- Improve the range to include 5 or 6 bit inputs
- Include negative values in the range
- Use a keyboard as an input
- Only make the display show up with a button is pressed