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Group 11

CS M152A

Lab 4 Proposal

**Project Description**

We propose to implement a basic integer calculator. Our implementation will have functions for add, subtraction, multiply, and (truncated) divide. In addition, we will have 4 registers, similar to the implementation of Lab 1. Unlike Lab 1, however, we plan to display the results of the selected register with the four LED 7-segment displays instead of the UART interface. Using buttons and switches, users can specify which register to operate on, what operations to perform (add, multiply, subtract, divide), and what to display (registers, most recent calculation, etc.).

**Design**

***Inputs:***

**clk** - Used to make clocks for other functionality (display, counters, etc.)

Operations (Default)

**btnU** - *Multiplication:* enter digit editing mode and multiply the current register by the input

**btnD** - *Division:* enter digit editing mode and divide the current register by the input

**btnL** - *Subtraction:* enter digit editing mode and subtract the input from the current register

**btnR** - *Addition:* enter digit editing mode and add the input to the current register

**btnS** - *Memory:* enter memory mode

Operations (Digit Editing Mode)

**sw[0]** - set to 1 to use a negative number; 0 for positive number

**btnU** - Increase the current digit by one

**btnD** - Decrease the current digit by one

**btnL** - Move the cursor by one digit to the left

**btnR** - Move the cursor by one digit to the right

**btnS** - Exit Digit Editing mode with the currently displayed number as input to the calculator

Operations (Memory Mode)

**btnL** - Change to the register to the left

**btnR** - Change to the register to the right

**btnD** - Reset the currently displayed register to zero

**btnS** - Select the current register and exit memory mode

Operations (PEMDAS, Stretch Goal)

**sw[1]** - set to 1 to immediately switch into PEMDAS mode.

**btnU** - *Multiplication:* request calculator multiply the two registers displayed

**btnD** - *Division:* request calculator divide the two registers displayed

**btnL** - *Subtraction:* request calculator subtract the two registers displayed

**btnR** - *Addition:* request calculator add the two registers displayed

Once 3 operations are requested, the calculator executes the operations in the correct order and briefly displays the result

***Outputs*:**

**Seven-Segment Display** - Displays value of current register, all decimals lit up for negative #s

Alternates between register number and value if in Memory Mode

Flashes the digit being adjusted in Digit Editing Mode

Displays the number of the two registers currently being operated on in PEMDAS mode

***Structure:***



***Modules:***

**make\_clocks** - uses input **clk** to make additional clocks used for the calculator implementation

**registers** - holds the recorded value for each “register” value; handles selecting active register

**calculate** - fed active register, input value, and operation; does the number crunching

**display** - displays the output; handles blinking

**Rubric (out of 100):**

* Display (20): Show current register value, immediately updates after operations
* Basic Functionality (30): Calculator successfully performs arithmetic operations when requested upon button press
* Memory (40): User can cycle between registers that store input
  + Storage (30): four independent registers
  + Display (10): When cycling, alternates between register and register number
* Stretch Goal - PEMDAS Mode (10): Flicking a switch allows users to operate on four registers at once and specify which operations to perform on all four, to