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ECE 447-201

Lab 5 Report

Introduction

This lab has tasked us with creating a Reverse Polish notation calculator using debounced timer ISRs on a 4x4 matrix keypad. The keypad will be the main input for the program, which will allow the user to input numbers and operators to be calculated. The numbers will act as themselves, while the letters A, B, C, and D will act as the mathematical operators. All the inputs will be visible on the MSP430's LCD. We will be using a stack data structure to store the calculator's data and will display the size of it on the LCD using the battery segment. In case of overflow, the user is to be notified by the "!" notification on the LCD and the overflowed number will be truncated to the last 6 digits. The columns of the matrix keypad will be on GPIO pins 8.4-7 and the rows will be on pins 2.1-4. All keypresses will be tied to interrupts and debounced. The state machine will be implemented to determine how the program responds to inputs and what it will display on the LCD. Pressing button S2 will enter scrolling mode, which will allow the user to scroll up and down using S1 and S2 respectively. Pressing "#" will echo the current number back on the stack, while in scrolling mode, and "*" will exit scrolling mode.

Microcontroller Concept

Microcontroller on-chip peripherals used:

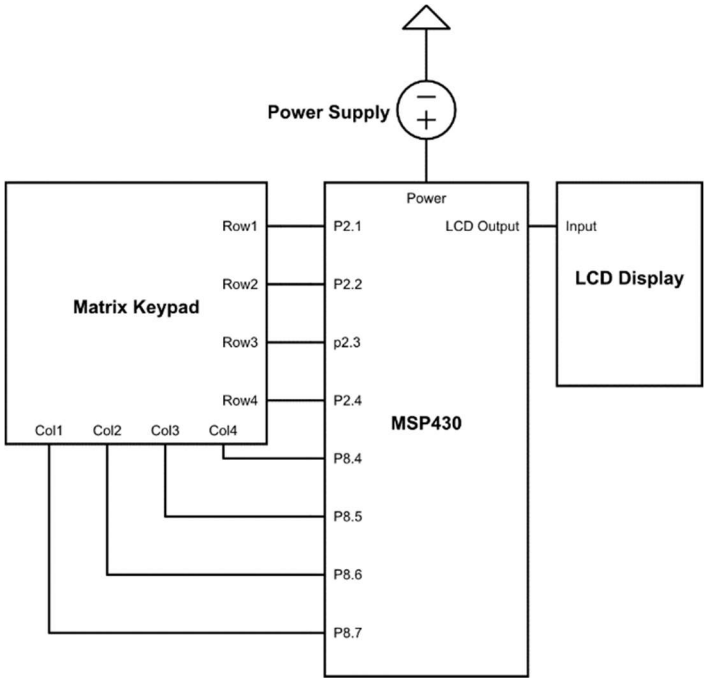
- GPIO pins 8.4-7, 2.1-4
- LCD
- Buttons S1, S2

The GPIO pins 8.4-7 will be connected to the columns of the matrix keypad while pins 2.1-4 will be connected to the rows. We will need both columns and rows to detect which button has been pressed. We are using these pins because they are readily available and the best way to collect input.

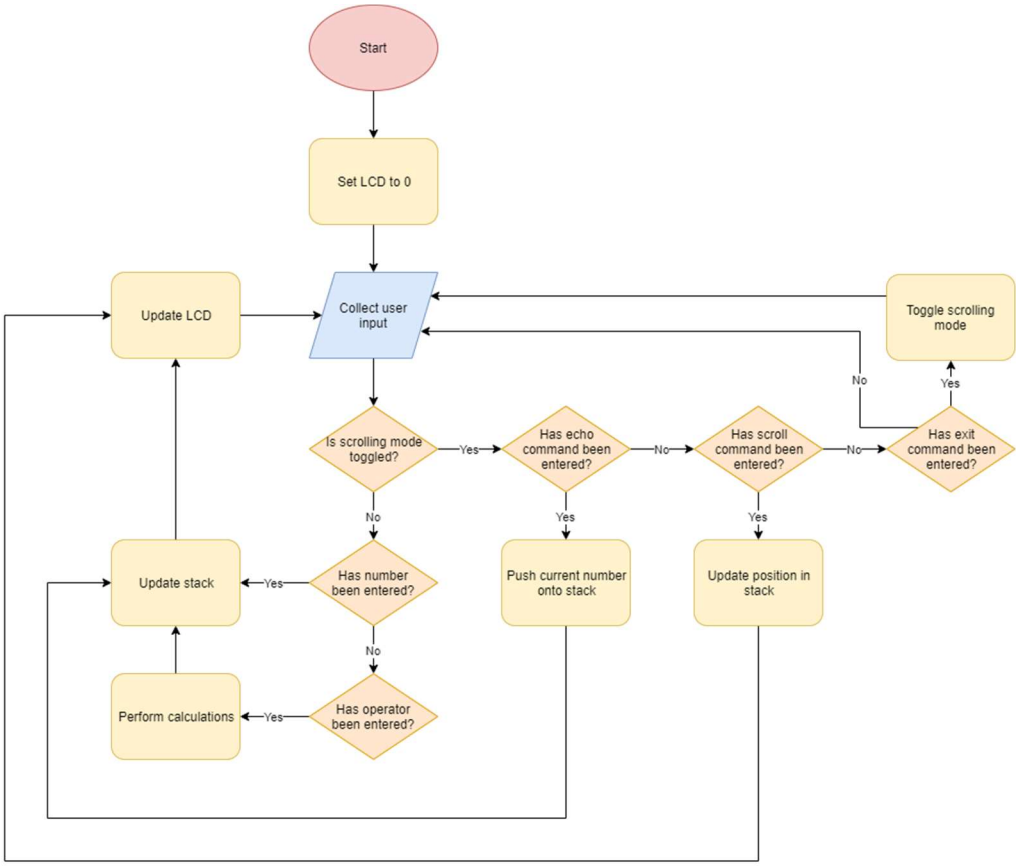
The LCD will display all numeric and operator data that has been input. It will also display the size of the stack using the battery segment. We are using the LCD because it is the best way to display numeric data to the user.

Onboard buttons S1 and S2 will be used in the stack scrolling mode. S1 will scroll up and S2 will scroll down. These buttons are used because they are the most readily available.

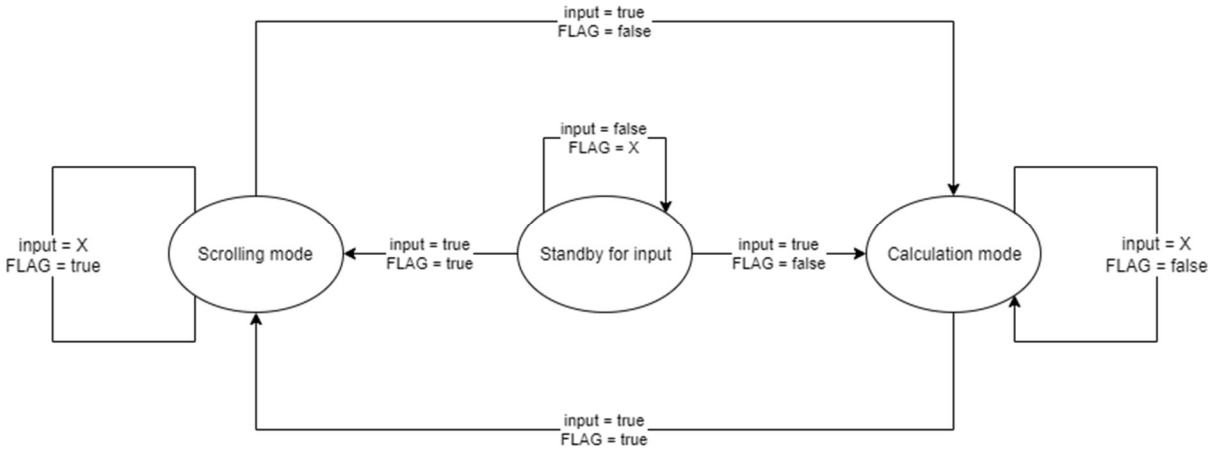
Hardware Design



Software Design



State Machine



Conclusion

My lab's outcome successfully created an RPN calculator on the MSP430. There were some issues integrating the matrix keypad into the MSP430, and interrupts, but all bugs were ironed out. All functionalities are implemented as well as scrolling mode.