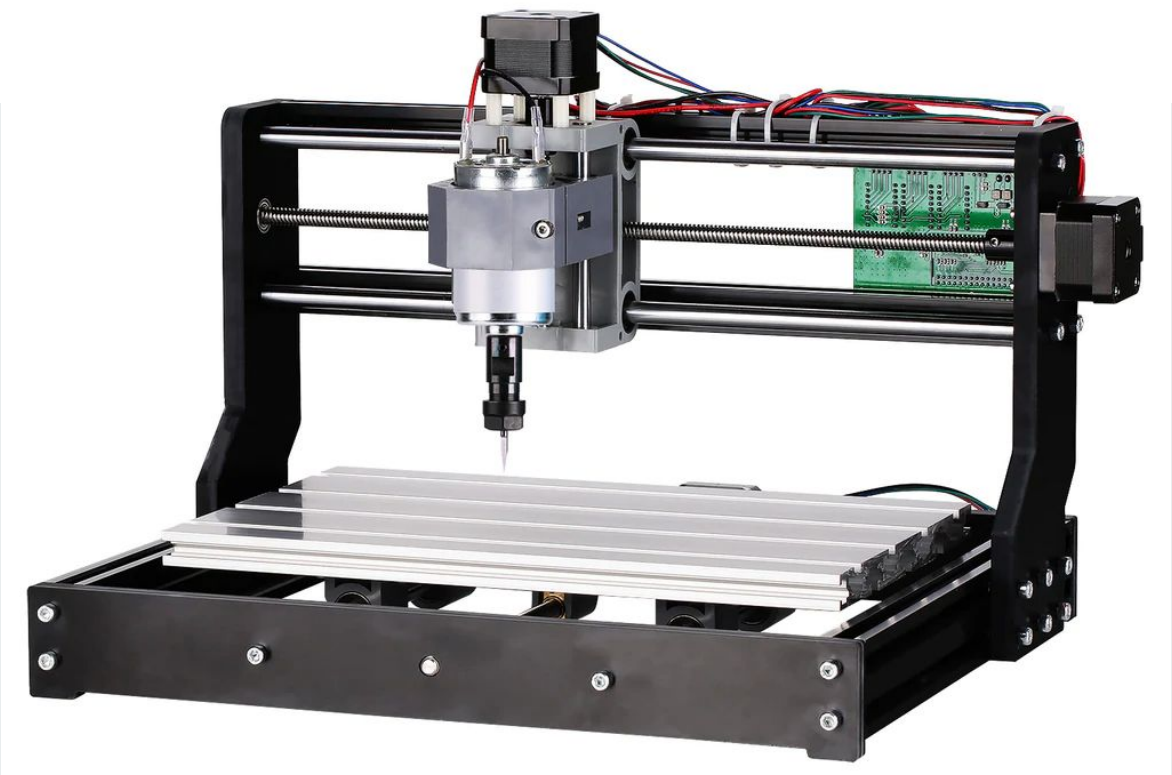


ECE 544 Final Project
Manual CNC Cutting Machine

Alex Beaulier, Josiah Sweeney - June 8th, 2022

Summary

- Functional Overview
- IP Development
- Physical System
- Hardware and Circuit Diagram
- FreeRTOS
- Demo
- QA

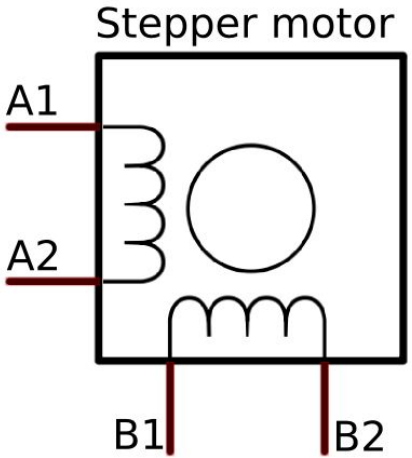
Functional Overview

Manual CNC Cutting machine

- Each axis is driven by a stepper motor for full XYZ motion for an end of arm tooling(EOAT) to be used.
- OLED displaying XYZ coordinates.
- PMOD Joystick for manual movement in XY directions.
- Buttons for movement in Z direction
- Switches for triggering Watchdog shutdown and turning on the EOAT
- EAOT wired to Relay integrated on PMOD port with emergency switch.
- FreeRTOS OS for control of machine.

IP Development

There is no pre-existing IP for the PMOD Step, used to drive the 3 stepper motors, thus IP had to be created.



FULL STEP 2 PHASE-Ex.,
WHEN FACING MOUNTING END (X)

STEP	A	B	A\	B\		CCW
1	+	+	-	-	↓	↑
2	-	+	+	-		
3	-	-	+	+		
4	+	-	-	+	CW	

IP Development

IP Imported for Joystick

- Uses SPI Communication
- Returns 8-bit XY position

https://digilent.com/reference/pmod/pmodjstk2/reference-manual

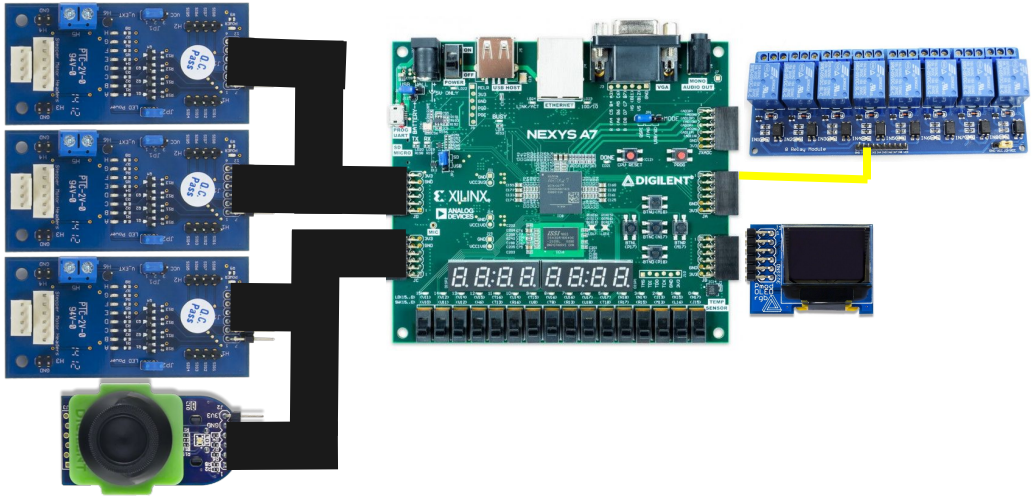
Physical Layout - Nexys A7

JA - Relay pin 7

JB - PMOD OLED

JC - Joystick Top Row, Z Axis Bot Row

JD - Y Axis Top Row, X Axis Bot Row

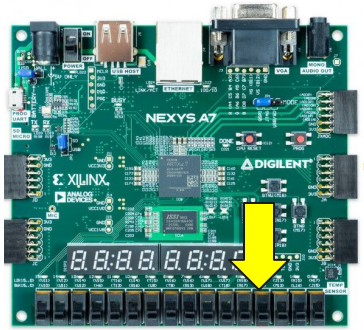


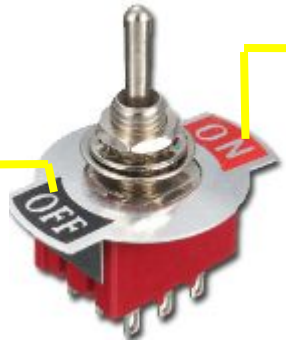
Physical Layout - Relay

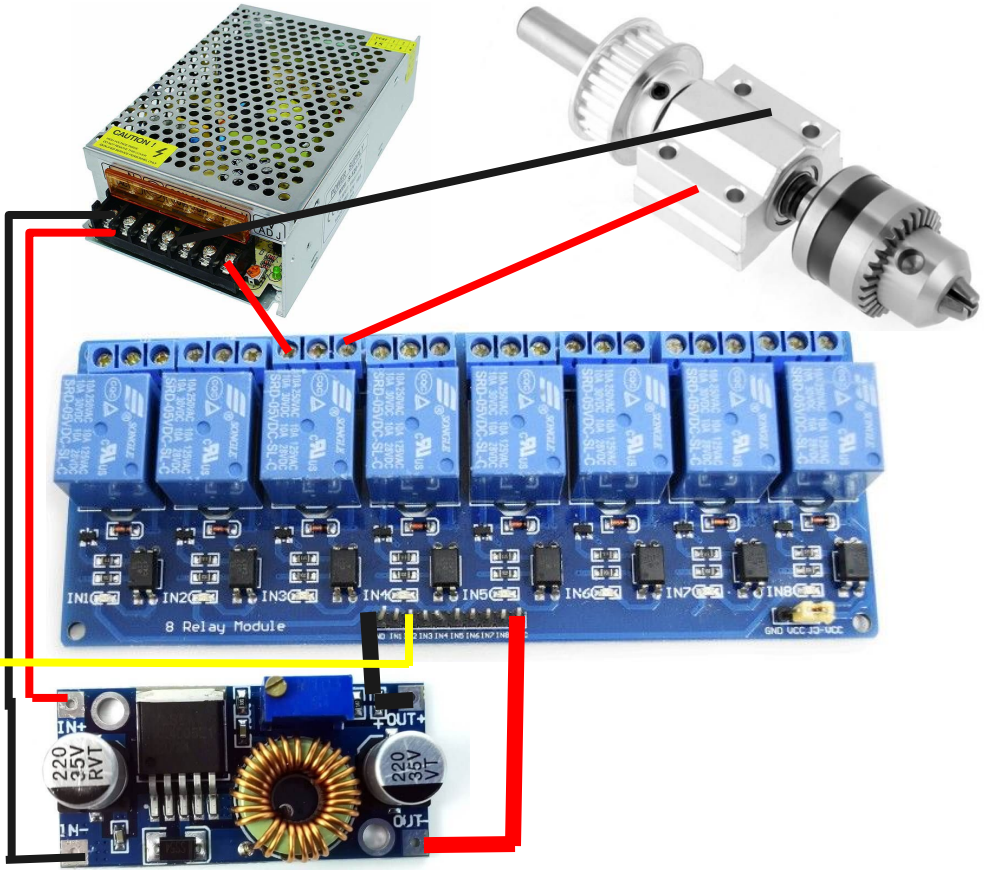
Active low output, single pin

Added buck converter from 12V supply

Added secondary emergency switch



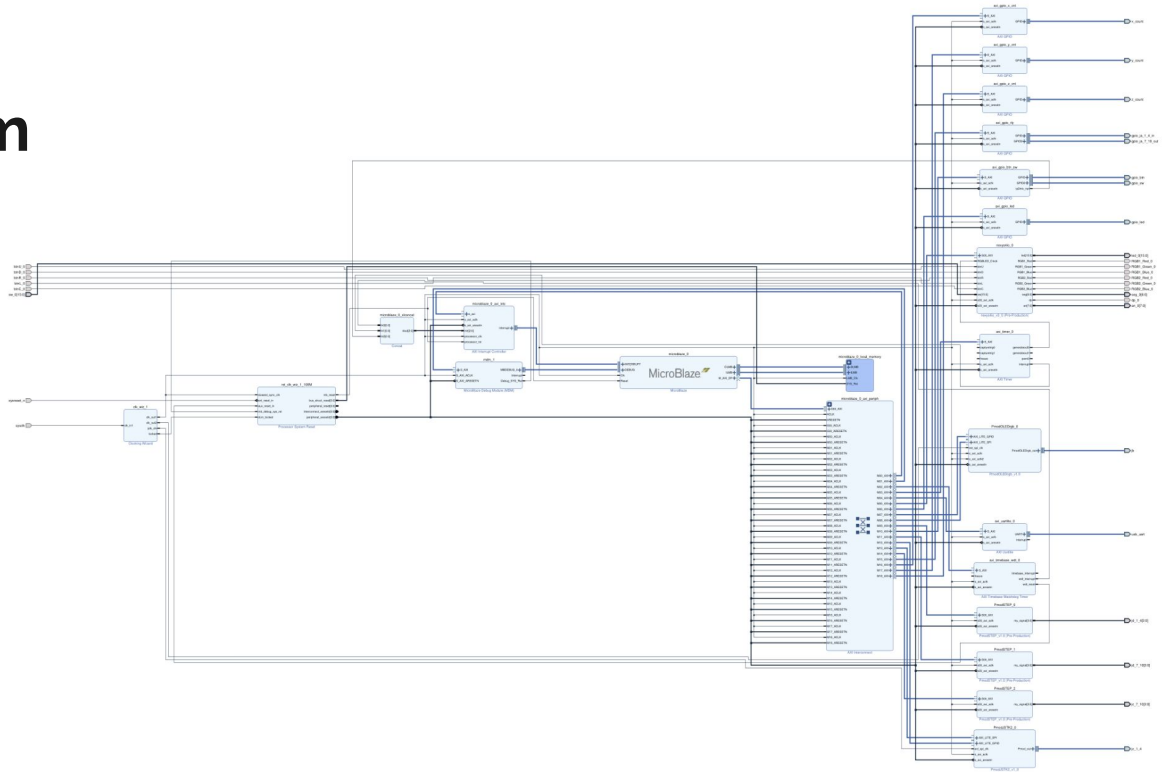




Hardware Diagram

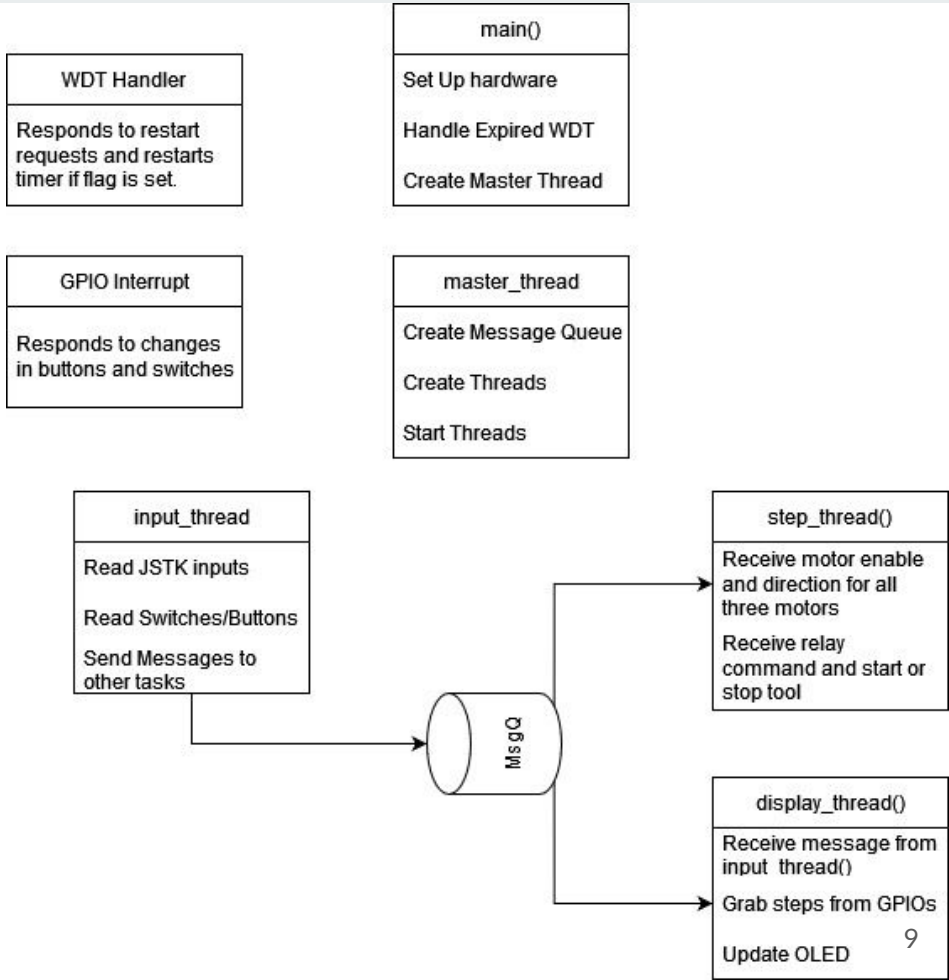
Hardware Design Includes:

- 6 GPIOs
  - X,Y,Z Buttons,
  - Relay, LED
- 3 PMODSteps
- 1 PMODJSTK2
- 1 Nexys4io
- 1 PMODOLEDrgb
- 1 WDT
- 1 UartLite



RTOS Tasking Background

For this project, we used a similar threading model to project 3, as this was similar in concept, but just more motor control.



Demo

BackUp Video

QA