Jackson Cornell
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2554-1449

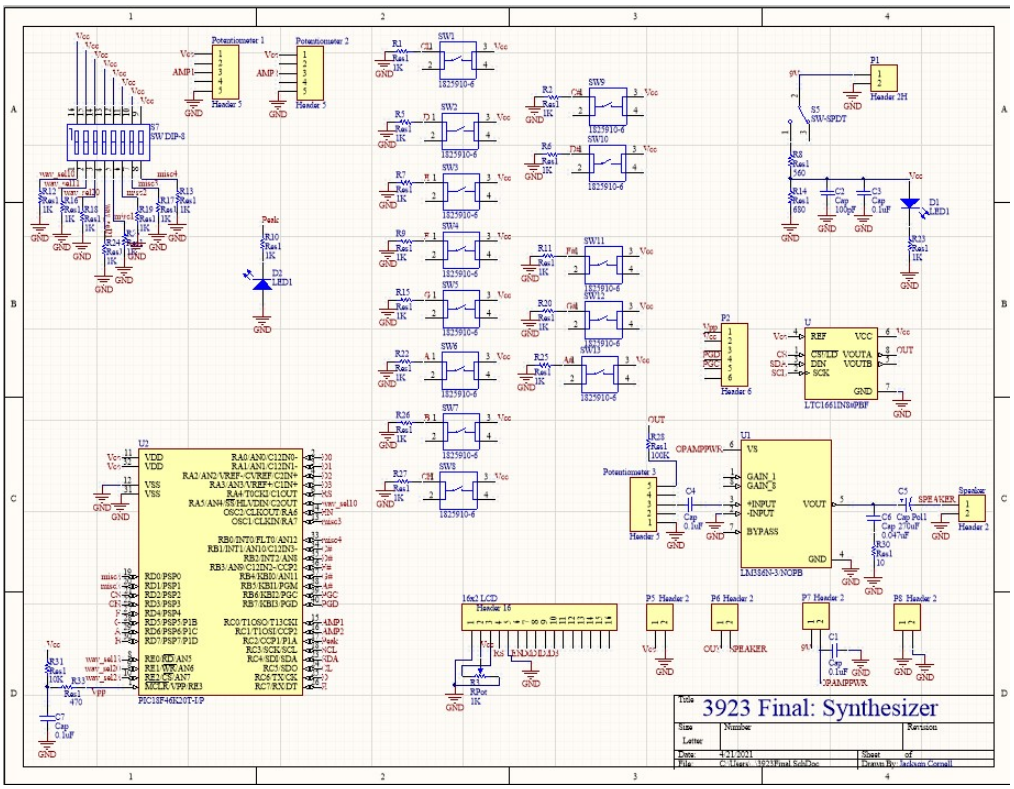
FINAL PROJECT – Report

Introduction

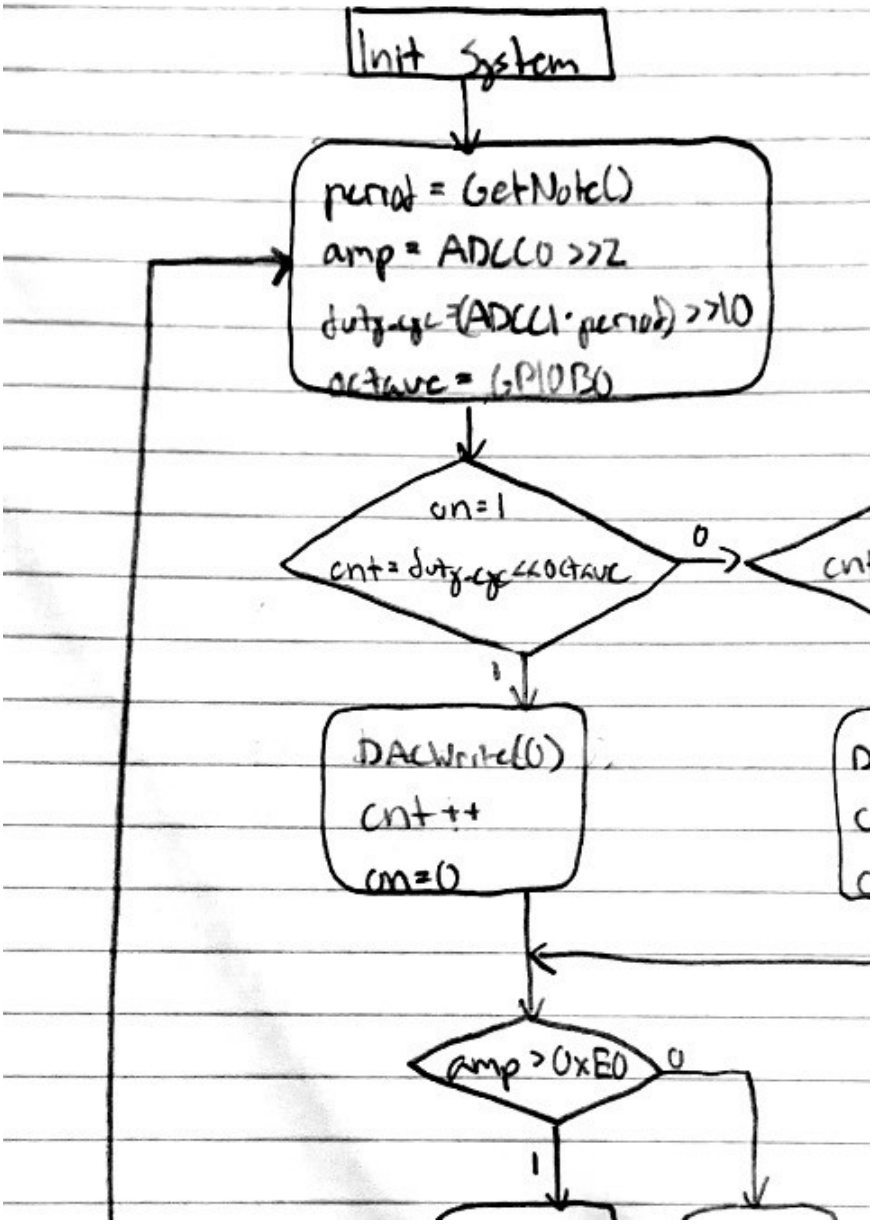
The design implements a two-octave, 13 key synthesizer that outputs a square wave with adjustable pulse width, volume, and gain. The keys are implemented using pushbuttons, and the octave is selected using a switch. The octave being played is outputted to the LCD, and an LED turns on if the signal is at risk of clipping. The sound is amplified to a speaker using the LM386.

Design

The design uses a PIC18F47 microprocessor to process all digital inputs and outputs. Two potentiometers are used to interface with the processor's ADC, 13 pushbuttons and a switch are digital inputs, and an LED, the LTC1661 DAC, and an LCD are digital outputs. The board can be powered either by a 9V battery or by the DAD. An LM386 op-amp amplifies the output of the LTC1661 to an 8 ohm speaker, with a third potentiometer used to control the gain.



The software continuously checks which buttons are being pressed, which position the switch is in, and the analog values of the potentiometers. These inputs are used to calculate the output frequency, pulse width, and amplitude. The software ensures that the signal goes high for 'pulse-width' amount of time and low for 'period – pulse-width' amount of time. When high, the value written to the DAC is a value between 0x00 and 0xFF as controlled by an ADC input. If the octave select changes, the new octave value (either 1 or 2) is outputted to the LCD.



Materials

- 1 PIC18F47K40 Microcontroller - $2.75
- 1 16x2 LCD – $10.95

- 1 LTC1661 - $4.16
- 1 8 Ohm Speaker – 0.95
- 1 Switch Bank - $1.45
- 3 10K Potentiometers - $2.37
- 1 10K Trimmer - $0.85
- 4 0.1 uF capacitor - $0.40
- 1 100 pF capacitor - $0.10
- 1 0.047 uF capacitor - $0.10
- 1 270 uF capacitor - $0.90
- 1 10 Ohm Resistor – $0.10
- 1 470 Ohm Resistor – $0.10
- 1 560 Ohm Resistor – $0.10
- 1 680 Ohm Resistor – $0.10
- 23 1 KOhm Resistor – $2.30
- 1 10 KOhm Resistor – $0.10
- 1 100 KOhm Resistor – $0.10
- 1 SPST switch - $2.15
- 1 Red LED - $0.25
- 1 Green LED - $0.25
- 13 Tactile Pushbutton Switches - $1.30
- Header Pins - $1.50
- PCB Manufacturing - $9.40
- **TOTAL -** $42.73

Conclusion

For the most part, the design works as intended. There were, however, mistakes in the PCB. The header for the snap-in programmer has a pin not connected to ground, and the data pins for the 16x2 LCD were routed to the wrong pins. In both cases, the correct pins were wire wrapped to the correct locations, and in the case for the LCD, the incorrect PCB traces were cut with a knife to disconnect the incorrect pins. Additionally, a voltage divider was used instead of a voltage regulator to step down the 9V battery to 5V. However, this did not cause any problems in functionality of the design.