Project Report
Digital Clock

Submitted by:

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Abstract

In this project, an ATtiny 4313 along with a 16x2 LCD will be used to create a digital clock. The proposed capabilities of the digital clock include functions to set and display the current time, reset the clock to default 12:00:00 or 0:00, and set a standard alarm.

Introduction

Every individual must possess the capability to know the current time as well as to be alerted to a time of their choosing. As such, clocks are an important part of the daily lives of human beings. This report entails the details of the development process used to develop a digital clock. This clock is designed primarily through the use of the Atmel AVR 8-bit microcontroller, the ATtiny 4313. The clock allows the user to set and display the current time in both 12-hour and 24-hour formats. It also acts as an alarm for any time set by the user. All input by the user is controlled using 8 pin push buttons. Finally, the clock is to be powered by the 110v JPS main as well as a back-up power supply.

System Description and Specifications

The clock is used to measure, verify, keep, and indicate time. It should operate in both 12 and 24 hour formats, respectively.

Clock Display:
• The clock display is implemented on an alphanumeric LCD.
• The display allows for the display of six digits: format HH:MM:SS
• The clock operates in both 12 and 24 hour modes, respectively. One at any given time.

Minimum Clock Functions and Features:
• Set : to set the current time.
• Reset : to set the default time to 12:00:00 or 0:00 where applicable.
• Alarm : Standard alarm feature of a clock/watch.

Clock Power Sources:
• Operates primarily from the 110V JPS main.
• A battery backup with uninterrupted operation.

Packaging:

• The clock should be PCBed.

Design Section-Hardware

Hardware Block Diagram

The diagram below displays the ATtiny 4313 microcontroller, which is responsible for all processes related to the digital clock and its intended functions. Also, present within this diagram are the 16x2 alphanumeric display, a buzzer used for the alarm, the intended power supply, push buttons used for input, and finally the data and control lines.

Digital Clock Hardware Block Diagram:

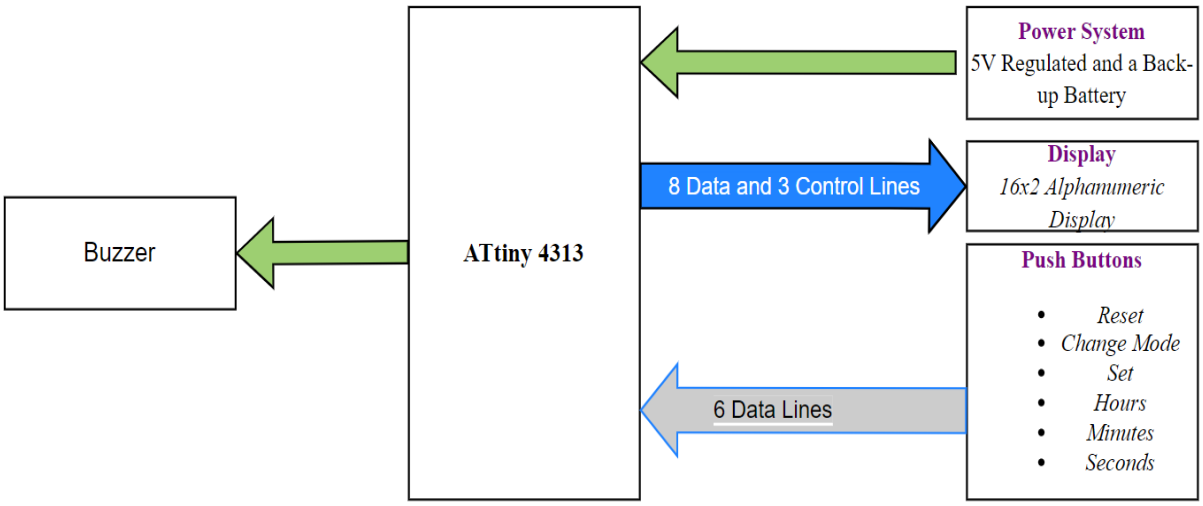


Figure 1. Block Diagram of Digital Clock System

Digital Clock Hardware Schematic

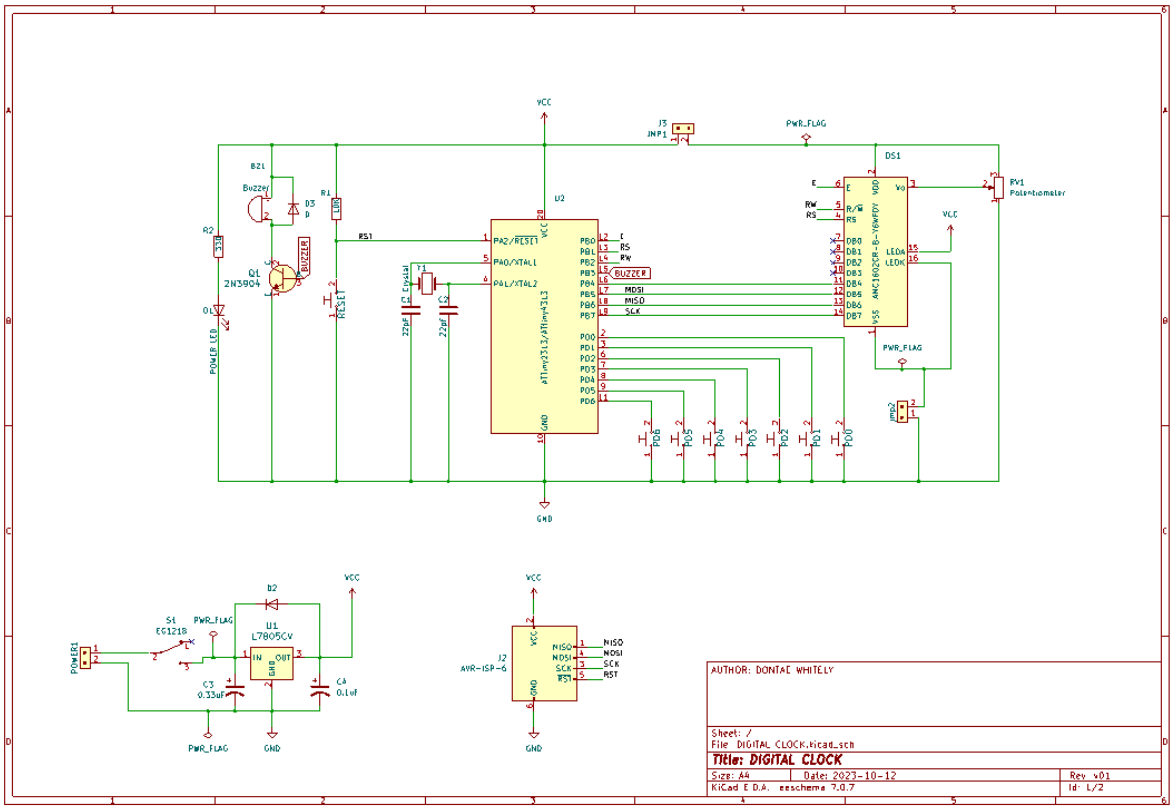


Figure 2. Digital Clock Schematic Diagram with Power Supply

Digital Clock Hardware PCB

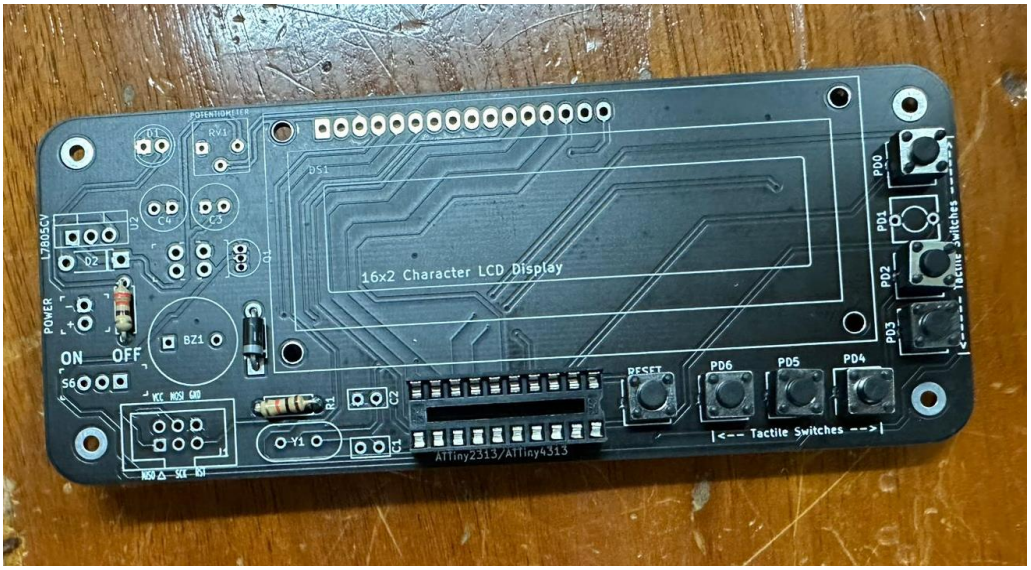


Figure 3. Illustration of Digital Clock Layout

Digital Clock Power Supply and Backup Battery

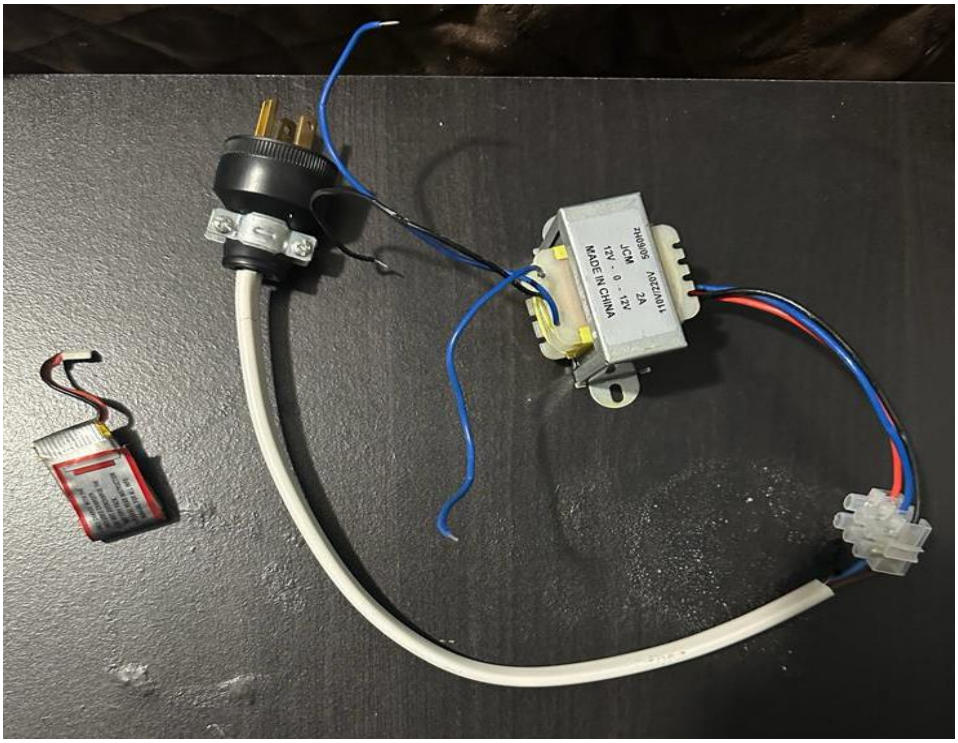
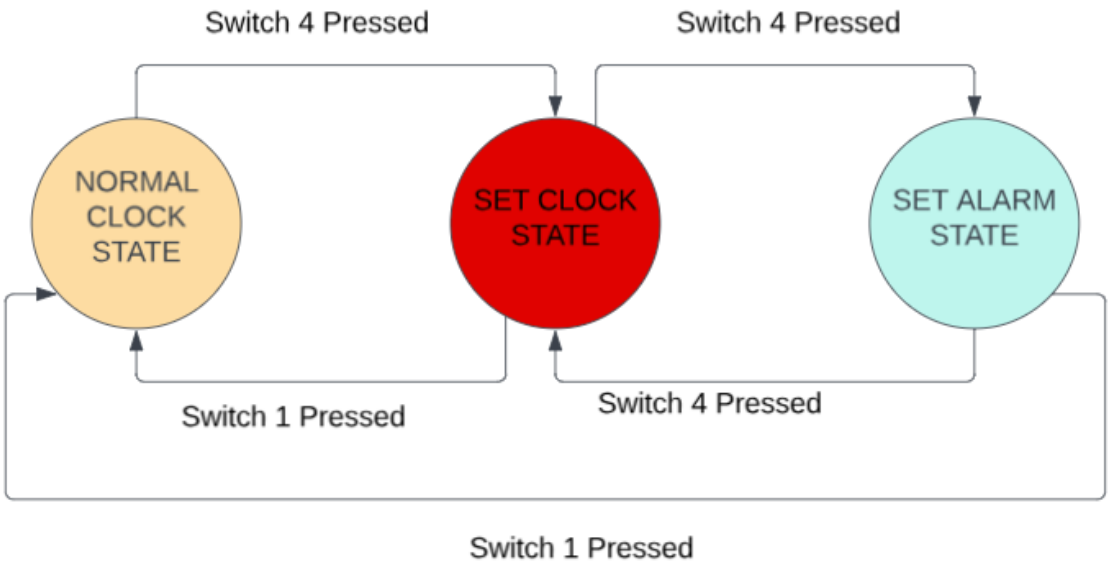


Figure 4. Power Supply and Backup Battery

Design Section-Software

This section encompasses the design specification for the digital clock using different software presentation diagrams.

State Diagram



Flow Charts

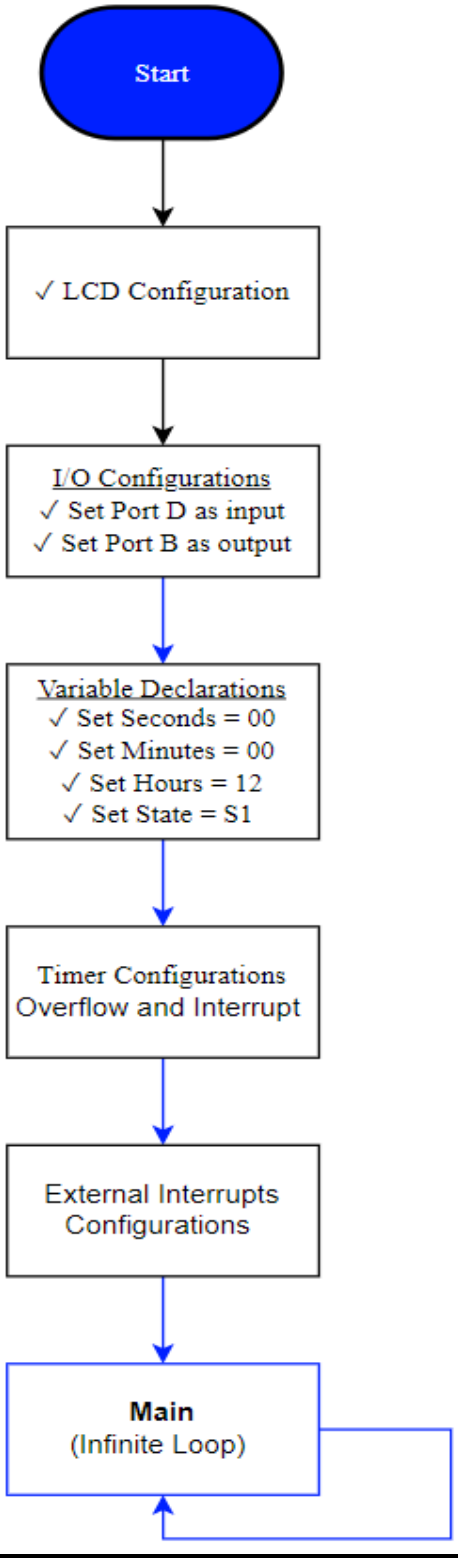
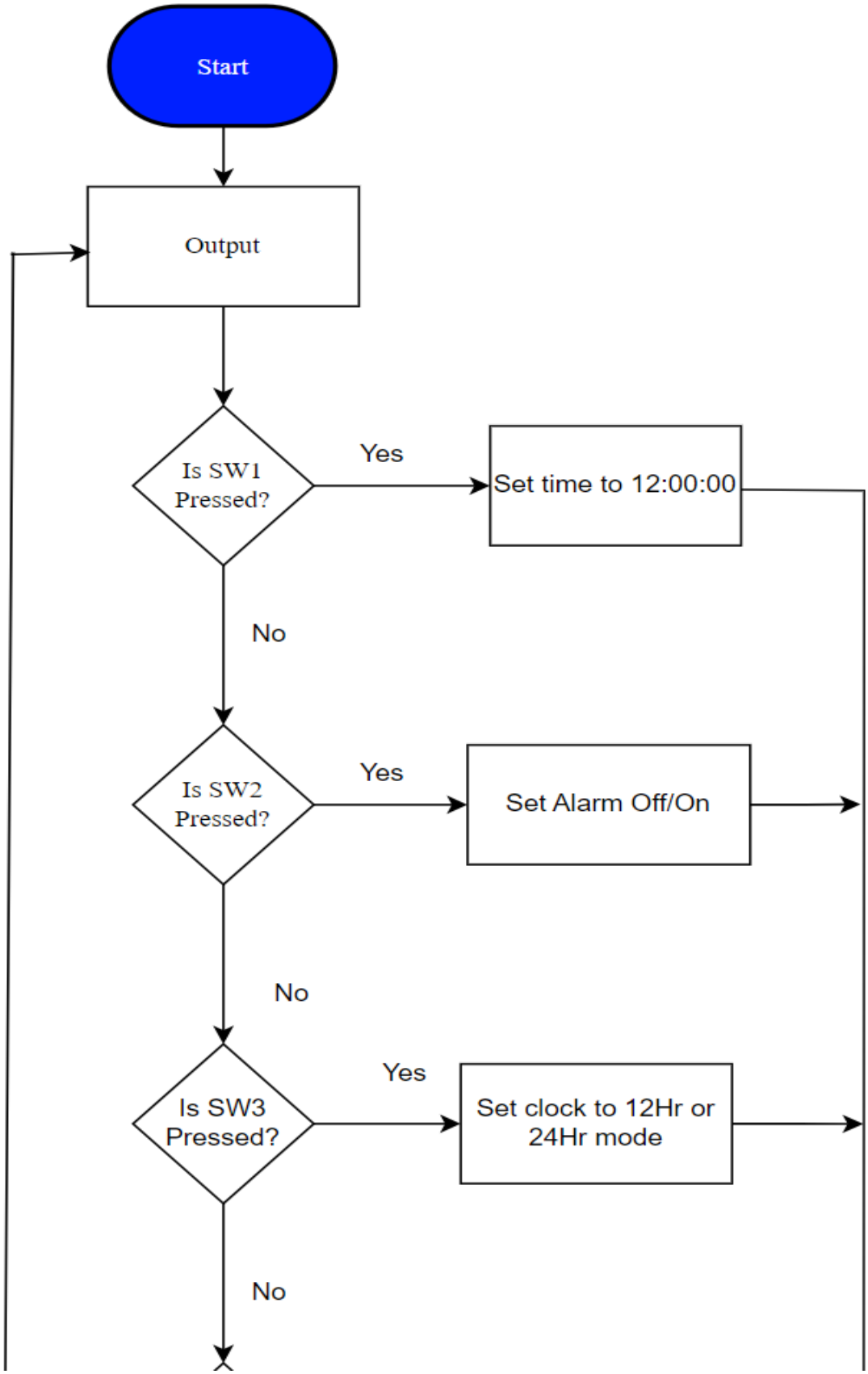
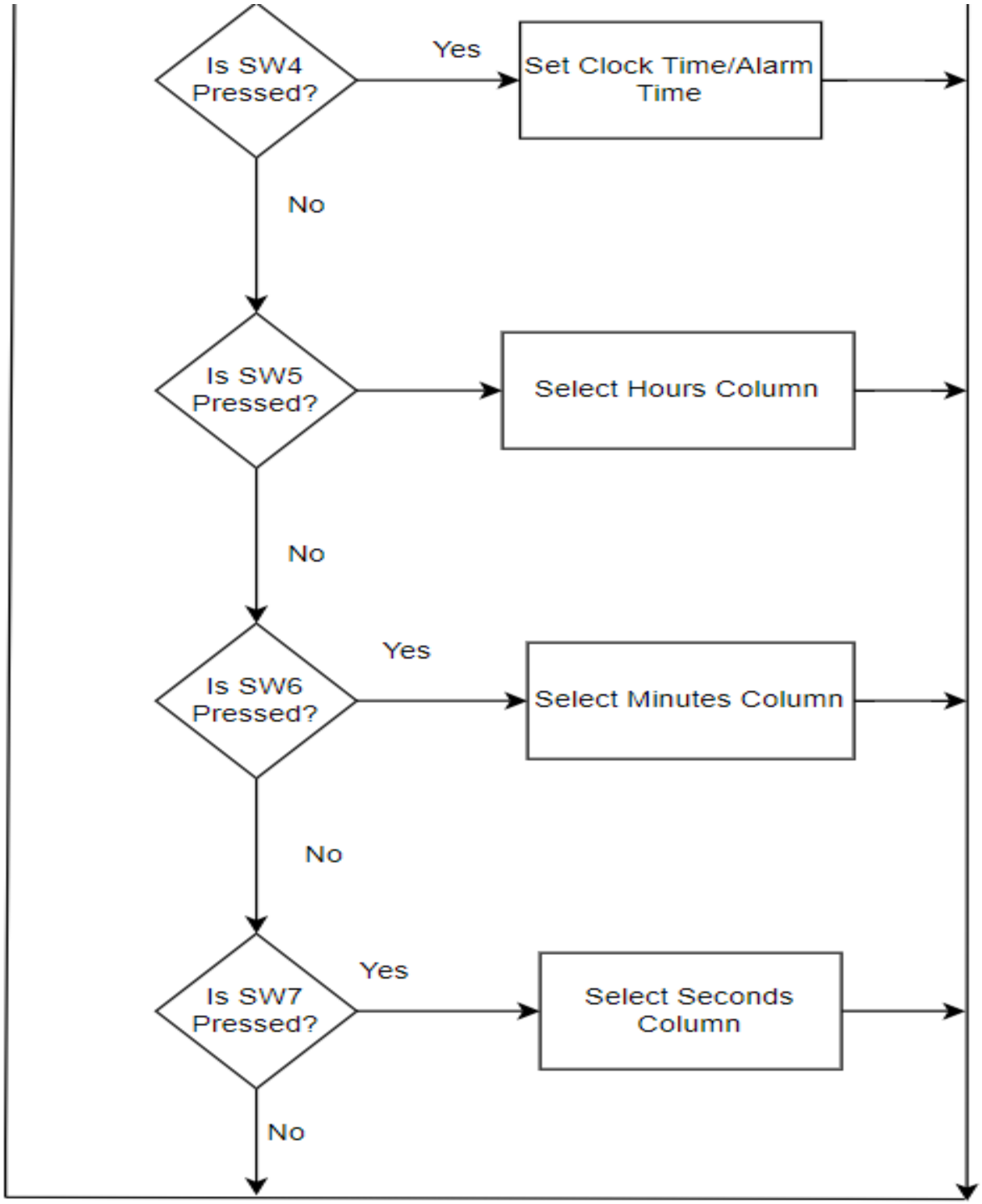
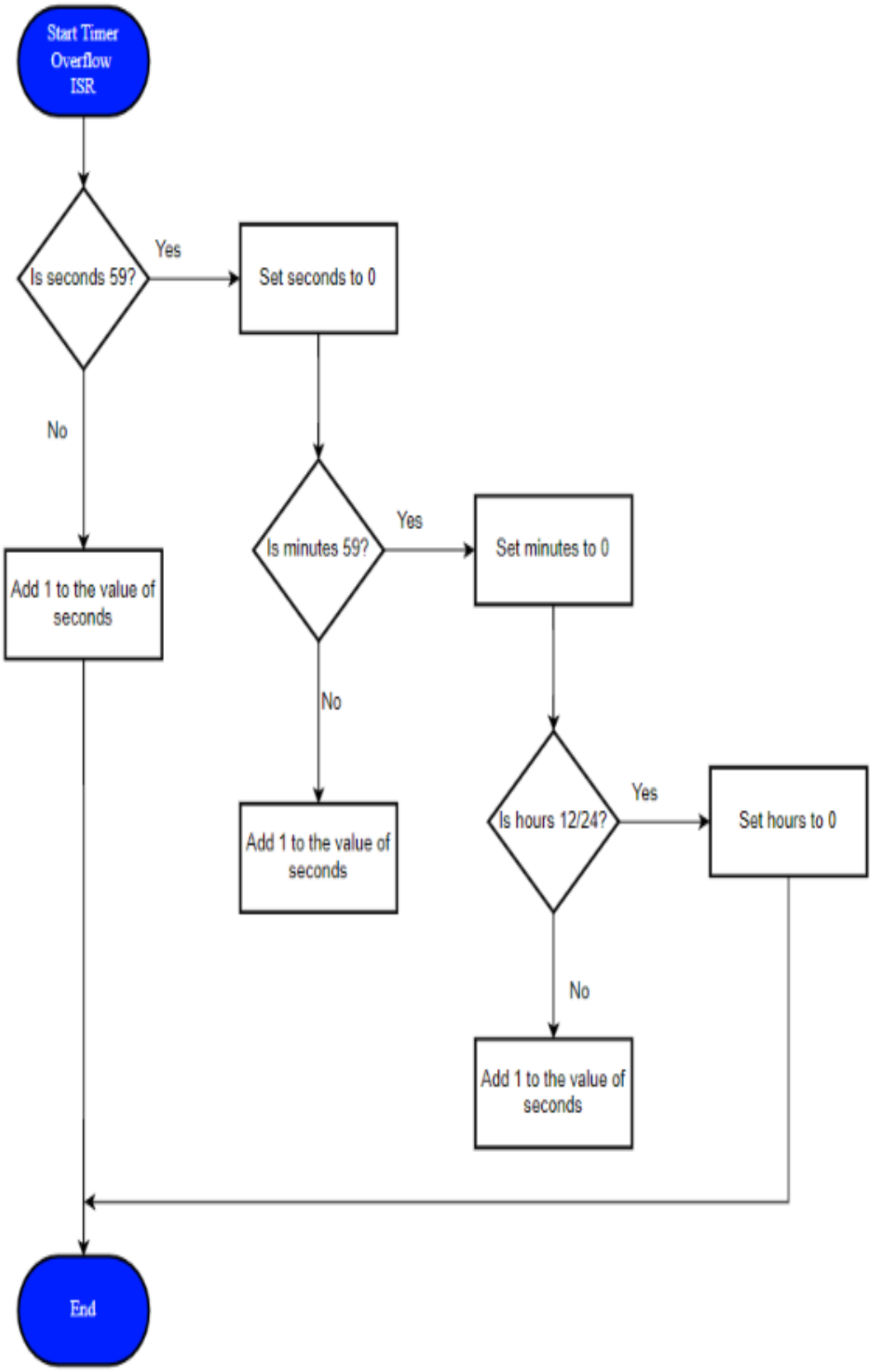


Figure 5.


Start
Output
Is SW1 Pressed?
Yes
Set time to 12:00:00
No
Is SW2 Pressed?
Yes
Set Alarm Off/On
No
Is SW3 Pressed?
Yes
Set clock to 12Hr or 24Hr mode
No


Is SW4 Pressed?
Yes
Set Clock Time/Alarm Time
No
Is SW5 Pressed?
Select Hours Column
No
Is SW6 Pressed?
Yes
Select Minutes Column
No
Is SW7 Pressed?
Yes
Select Seconds Column
No


Start Timer Overflow ISR
Is seconds 59?
Yes
Set seconds to 0
No
Add 1 to the value of seconds
Is minutes 59?
Yes
Set minutes to 0
No
Add 1 to the value of seconds
Is hours 12/24?
Yes
Set hours to 0
No
Add 1 to the value of seconds
End

Components and Equipment

Below is a list of the components and equipment used to design and develop the digital clock.

Components:	**1**	ATtiny4313 Microcontroller
	2	0.33 uF Capacitor
	1	330 Ohm Resistor
	1	10K Ohm Resistor
	1	3 Pin Switch
	2	Jumper Connector
	1	Male-Female Jumper Wire
	1	8 MHz Crystal Oscillator
	1	LED
	8	Pin Pushbutton
	3ft	Soldering Wire
	1	Buzzer
	1	2N3904 Transistor
	4	2 Pin Male (Header)
	1	16x2 Character Alphanumeric Display
	2	1N4001 Diode
	1	20 pin Dip Socket
	1	Clock Board
	1	Voltage Regulator

	2	2 Pin Male (Header)
	1	16 Pin Female (Header)
	1	10k Ohm Potentiometer
Equipment:	**1**	9V Battery Supply
	1	Pololu USB AVR Programmer v2.1
	1	12V DC Power Supply
	1	Soldering Iron
	1	Computer with Atmel Studio 7 and KiCad

These components were used to develop the clock. The microcontroller was the computer or brain of the entire clock. Instructions were written in C code in Atmel Studio 7 and uploaded to the microcontroller using the Pololu USB AVR programmer. The regulator and diodes were used to protect the microcontroller and LCD from damage that may be caused by voltages higher than 5.5V. The crystal was used to help ensure accurate and precise timing. The potentiometer was used to adjust the LCD contrast, the buzzer provided sound whenever the alarm was triggered. The other components such as the transistor was used to switch the buzzer off once the alarm time had elapsed.

DIGITAL CLOCK

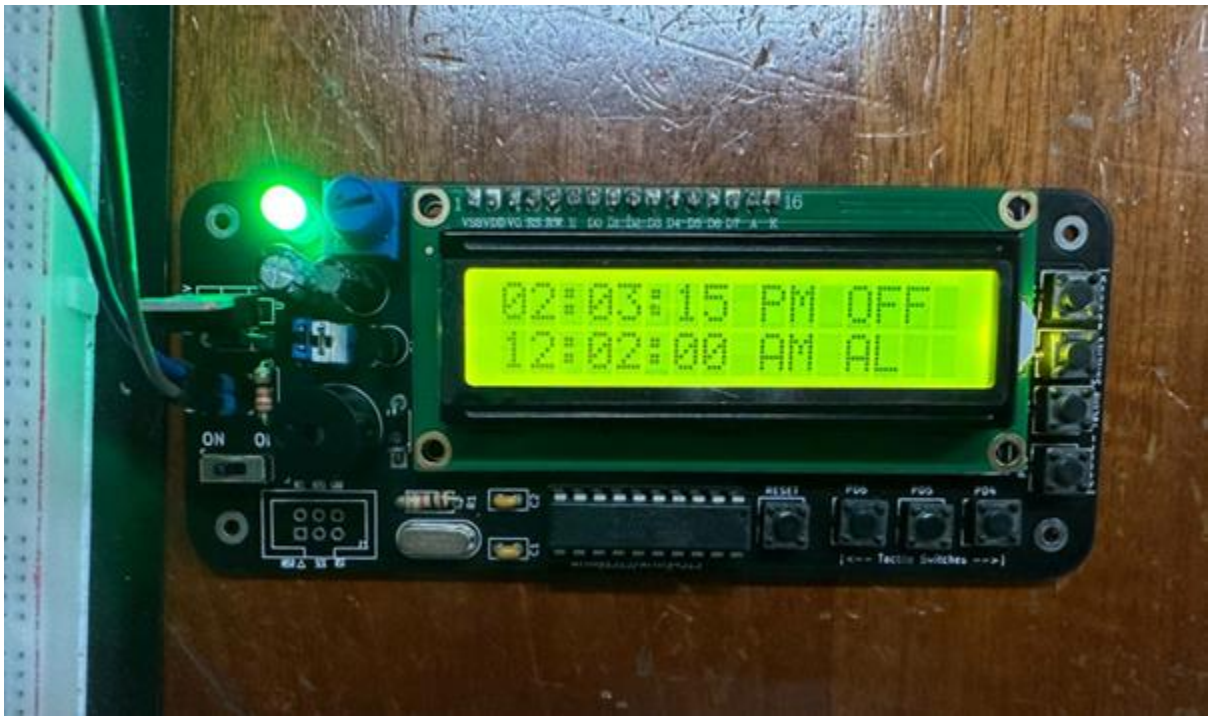


Fig. I Image of clock displaying time in 12 hour mode.

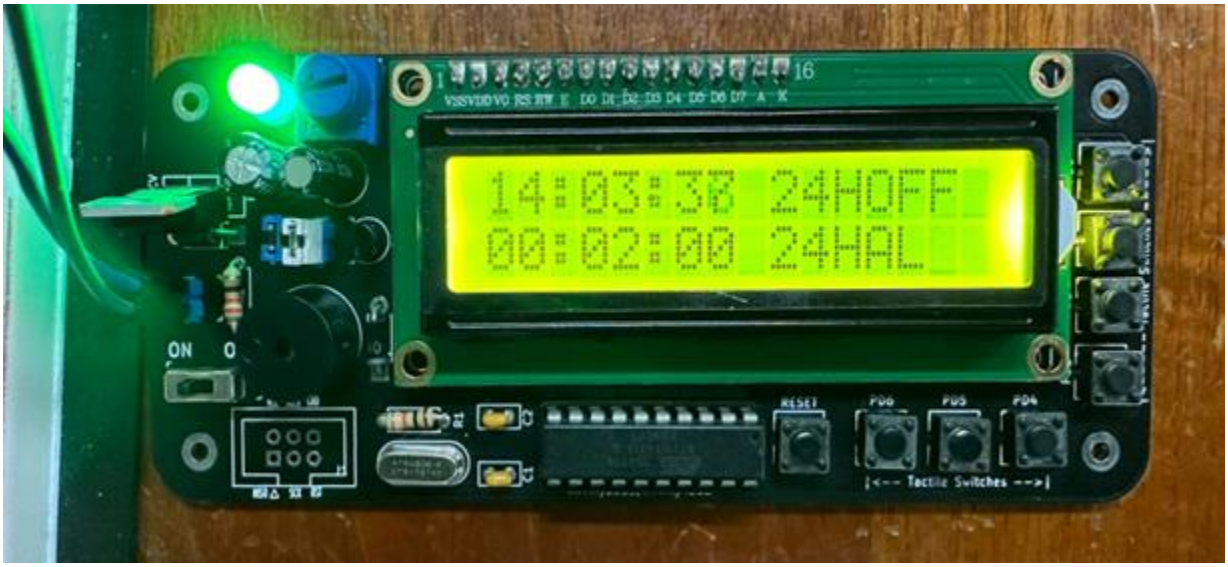


Fig. II Image of clock displaying time in 24 hour mode.

Fig. III Image of alarm time set to 2:05:00 PM.

Conclusion

This project has been instrumental in the development of my technical abilities, specifically those related to designing and developing solutions. It is through this assignment that I have learned how versatile the ATtiny 4313 microcontroller is, being able to be programmed to work in multiple different configurations to carry out different tasks. Many challenges were encountered during this experiment, such as having to resolder different components, replacing defective components, and generally having to understand how to code and configure for the ATtiny 4313, which, although challenging, was nevertheless seen as an experience that I have deep and resounding admiration for what it has done for the growth of my technical abilities.

The digital clock constructed, however, was able to meet the requirements outlined. However, it should be noted that improvements could have been made in the overall system design, such as having an eloquent-looking enclosure for the backup battery as well as the connectors supplying power from the JPS main.

References

M.A. Mazidi, Sarmad and Sepehr Naimi, The AVR Microcontroller & Embedded System Using Assembly and C, Pearson: Prentice Hall, 2011.