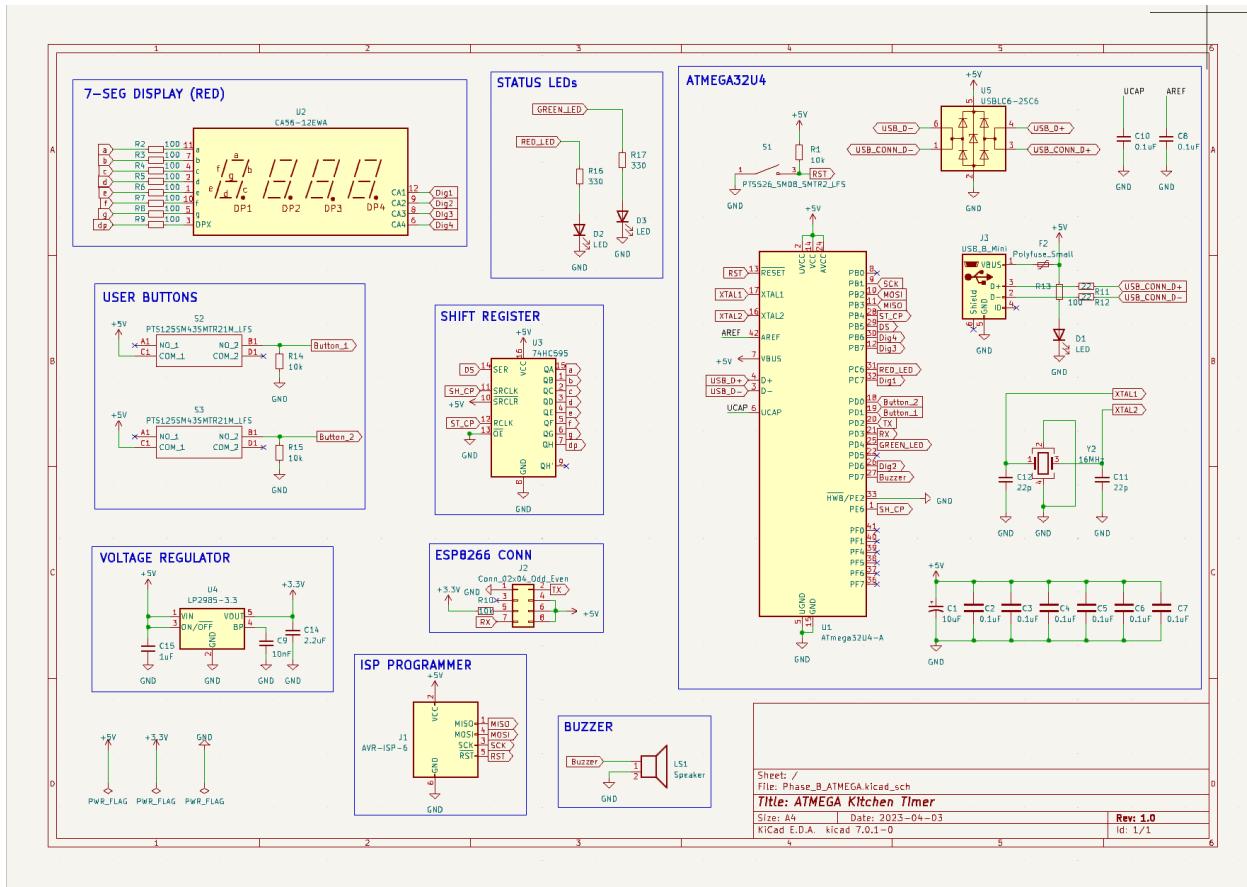


# **Embedded Systems Report**

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**ENCE 3231**

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## Project Requirements

Embedded Systems 2023 encompasses the different components that are involved with several embedded systems. From the basic manufacturing of a kitchen timer on a PCB design software all the way to coding the microprocessor to create a kitchen timer that will be built from scratch. The requirements of this project are all laid out on the four phases of the class Phase A-D.

### **Phase A:**

Phase A introduced students to the process of making a component in companies based on schematics, flowcharts and criteria all the way to the end result of a prototype of the component tested and verified with the correct code.

### **Phase B:**

Phase B then gave students more freedom to create their own ideas for the same project now giving it their own flavor into the project. They created their own PCB design and designed it for the continuation of this project.

### **Phase C:**

Phase C incorporated the software side of the device initially as it transitioned into assembling the device. Students looked at configuring the new STM microprocessor and soldering the ordered PCB boards to start assembling the final version of the board.

### **Phase D:**

This phase was focused on our own personal projects that were able to be accomplished now that we have done phases A-D.

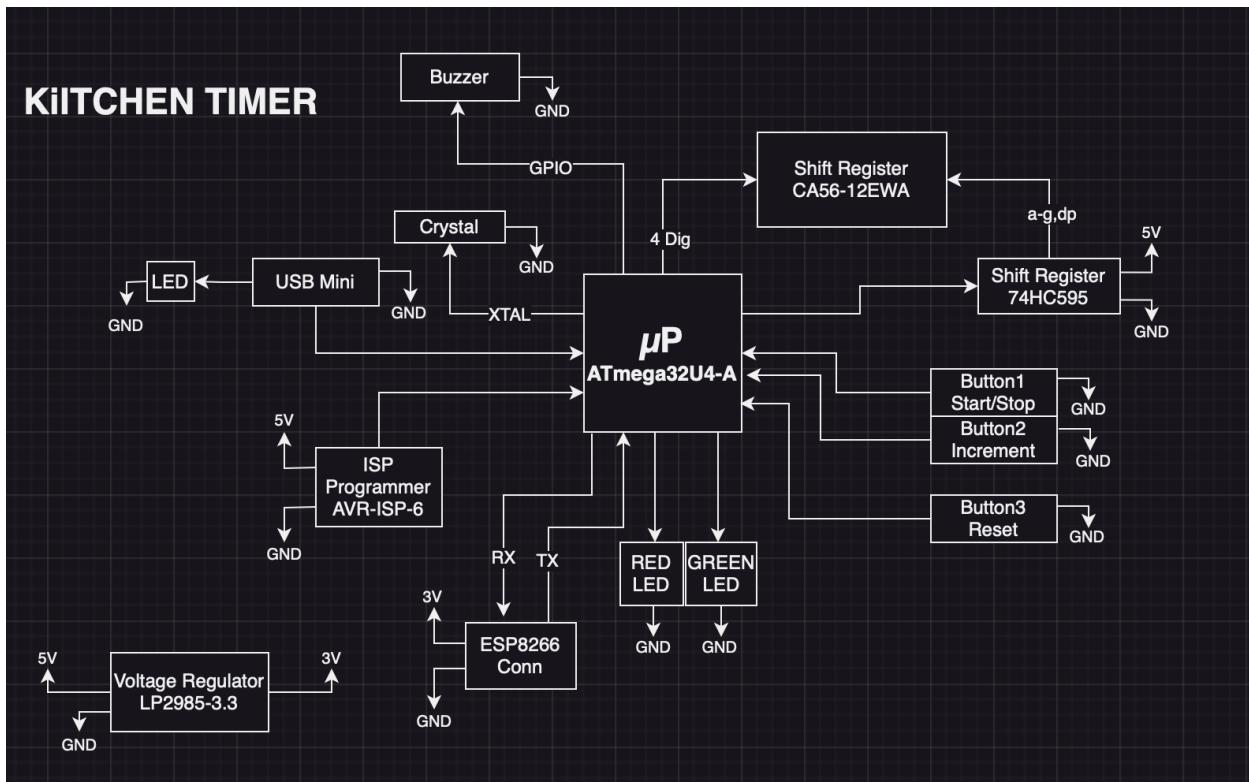
## System Design (Block Diagrams)

Link For FlowChart

Image Below

<https://app.code2flow.com/HEZqe5sGI6Bg>

Block Diagram:

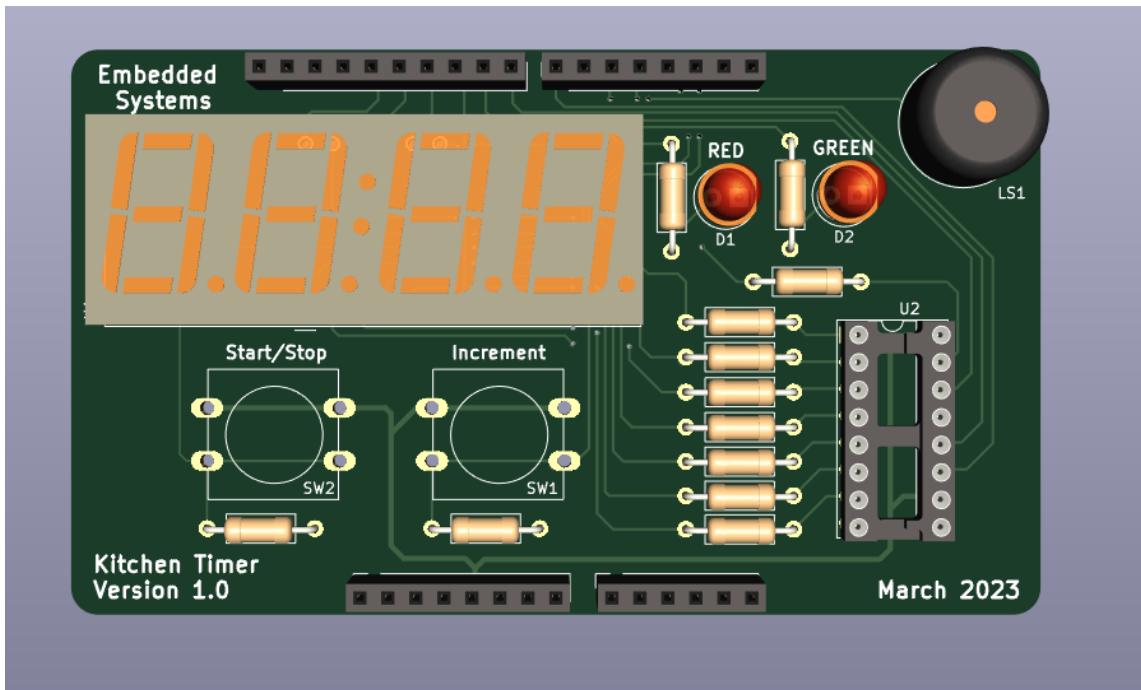


## Component Selection

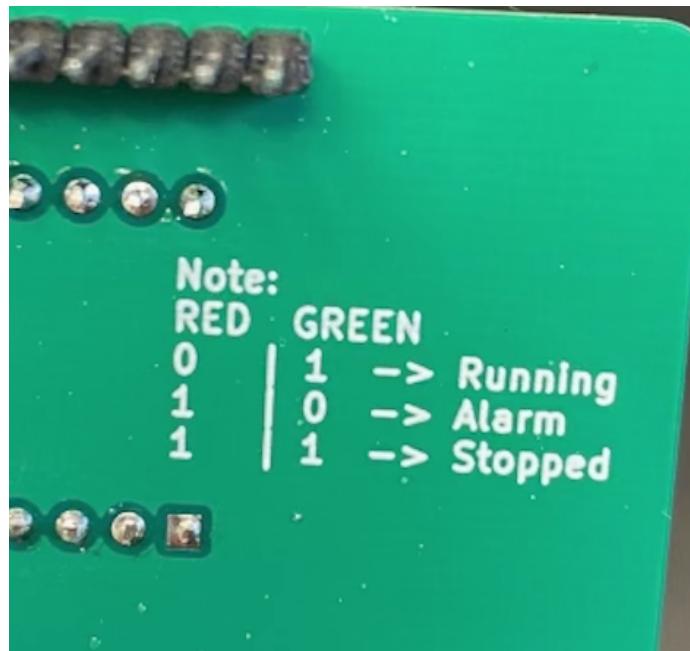
The components for the kitchen timer were selected prior to the lab by the professor including items that each accounted for the parts available at the university to the parts that best suited our applications needed for the most efficient timer the class can create.

## Build Prototype (Arduino Shield Description)

The prototype included a PCB design that allowed for integrating pins into the arduino code that we already had in our components list. The class builds upon ideas learned in mechatronics and engineering integration to create a concurrent code that essentially creates a kitchen timer that allows it to increment the time, to start and stop the timer, and to turn a green led and red led on and off depending on the state.



The following states is given but a binary 1 and 0 system that is engraved on the back of the PDB on this design and the final version of the PCB that uses its own microprocessors the states are listed below.

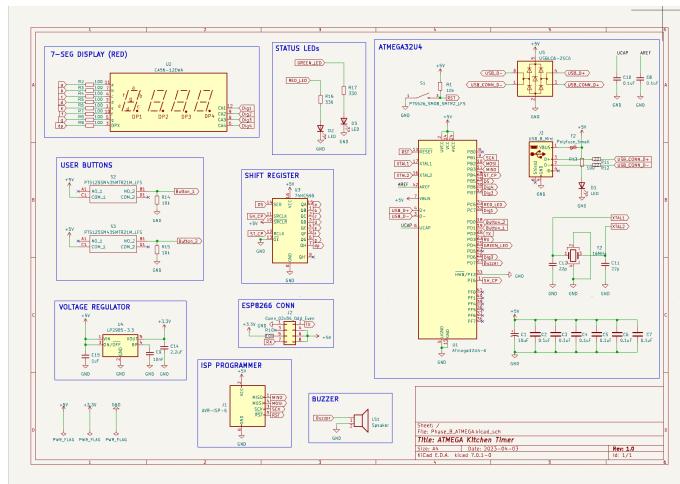


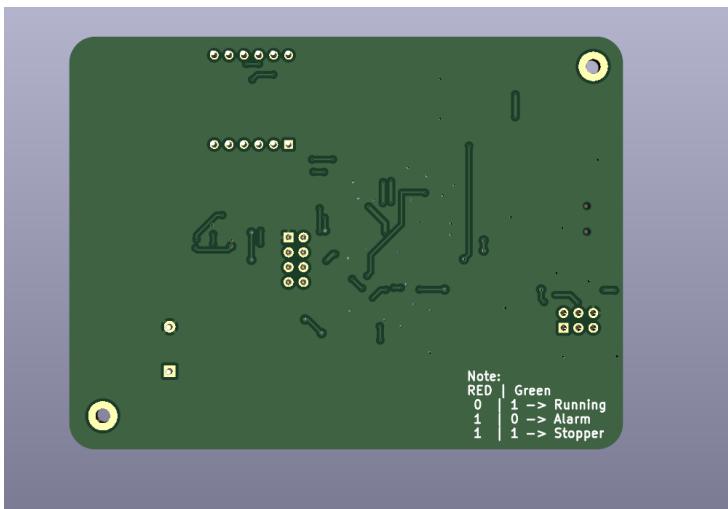
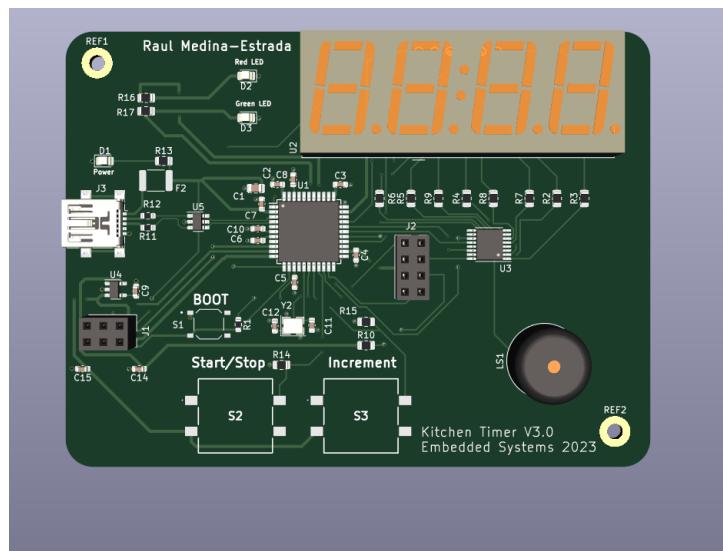
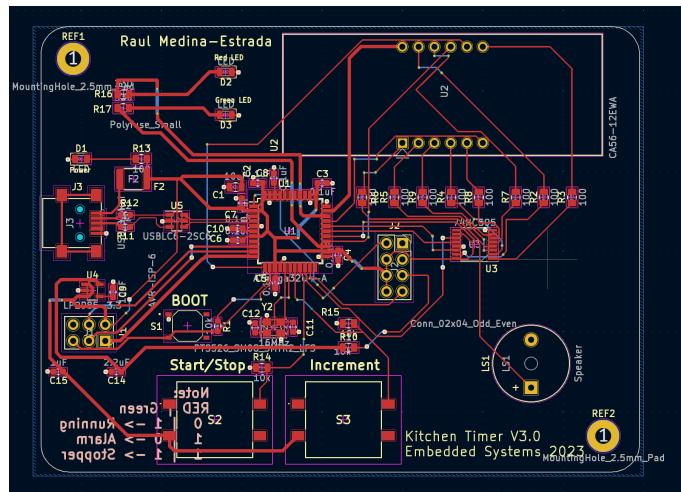
## COMPONENTS

null	Placed	References	Value	Footprint	Quantity
1		C1, C4, C5	0.1uF	C_0603_1€	8
2		C2, C3	22p	C_0603_1€	2
3		C9, C13	1uF	C_0603_1€	2
4		C8	10uF	C_0805_2C	1
5		C14	2.2uF	C_0603_1€	1
6		C15	10nF	C_0603_1€	1
7		R5, R6, R7	100	R_0805_2C	8
8		R1, R2	10k	R_0805_2C	2
9		R3, R4	330	R_0805_2C	2
10		R13, R17	10k	R_0603_1€	2
11		R14, R15		R_0603_1€	2
12		R16	1k	R_0603_1€	1
13		D1, D2, D3	LED	LED_0805_	3
14		U1	CA56-12EV/CA56-12EV		1
15		U2	74HC595	TSSOP-16	1
16		U3	ATmega32 TQFP-44	_1	1
17		U4	USBLIC6-2 SOT-23-6		1
18		U5	LP2985-3.3	SOT-23-5	1
19		Y1	16MHz	Crystal_SM	1
20		F1	PTCSMD	Fuse_1812	1
21		S1, S2	PTS125SM/PTS125_Si		2
22		LS1	Speaker	Buzzer_12	1
23		S3	PTS526_S/PTS526_Si		1
24		J1	AVR-ISP-6PinSocket		1
25		J2	USB_B_Mi USB_Mini-H		1
26		J3	ESP_ConnPinSocket		1

Components used come from the following template and accounted for the specific individual components located within the component. The use the new ESP wifi module and the ATmega microprocessor module within kiCad. The class will also be using more slick smaller components such as the LED's and resistors, along with two new buttons.

### PCB Design (Kitchen Timer design, Schematics & PCB layout description)





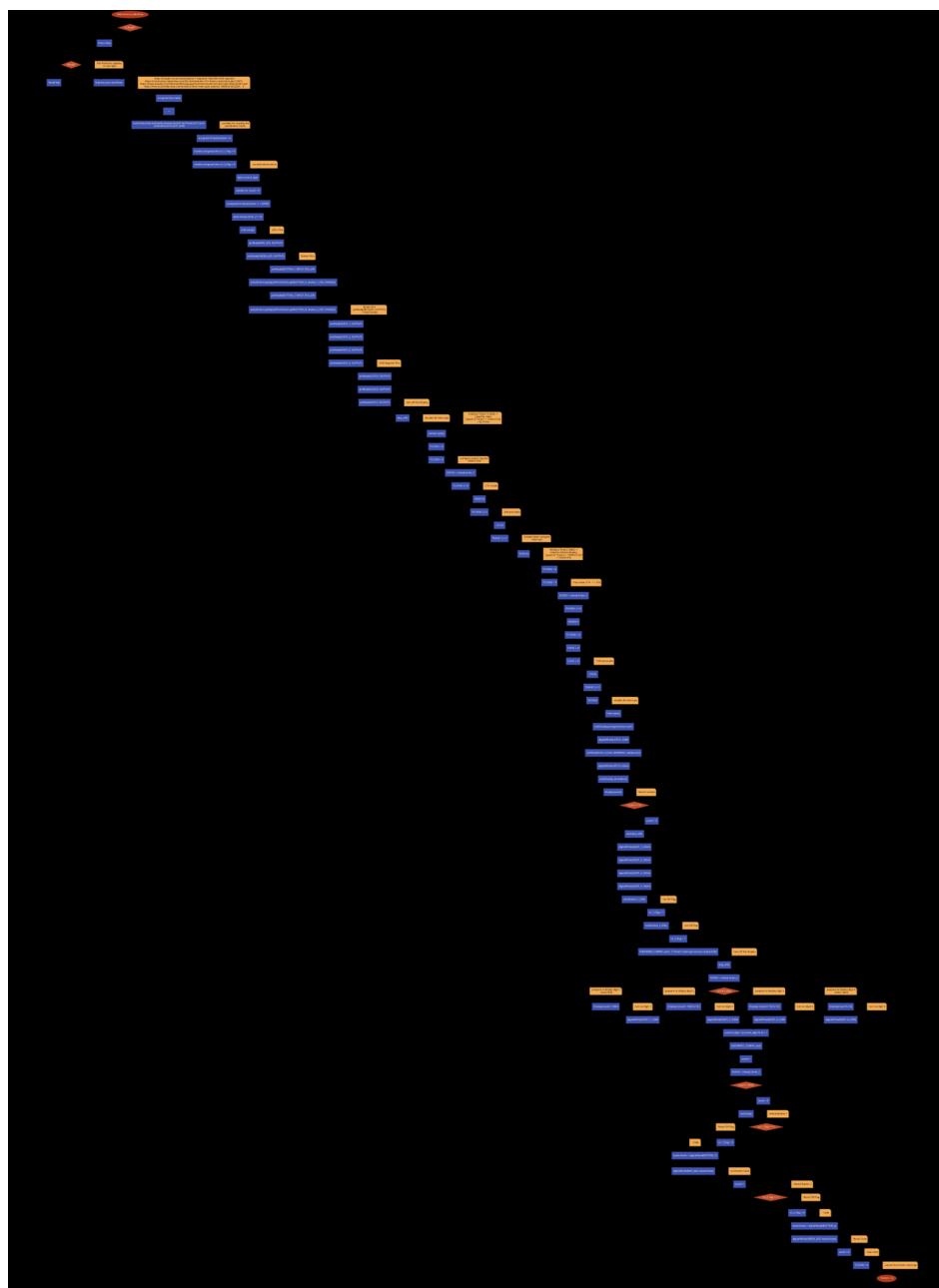
## **Assemble Stage** (Documentation of assemble process)

### **Software Replacement** (Code needs to be formatted; Mutex)

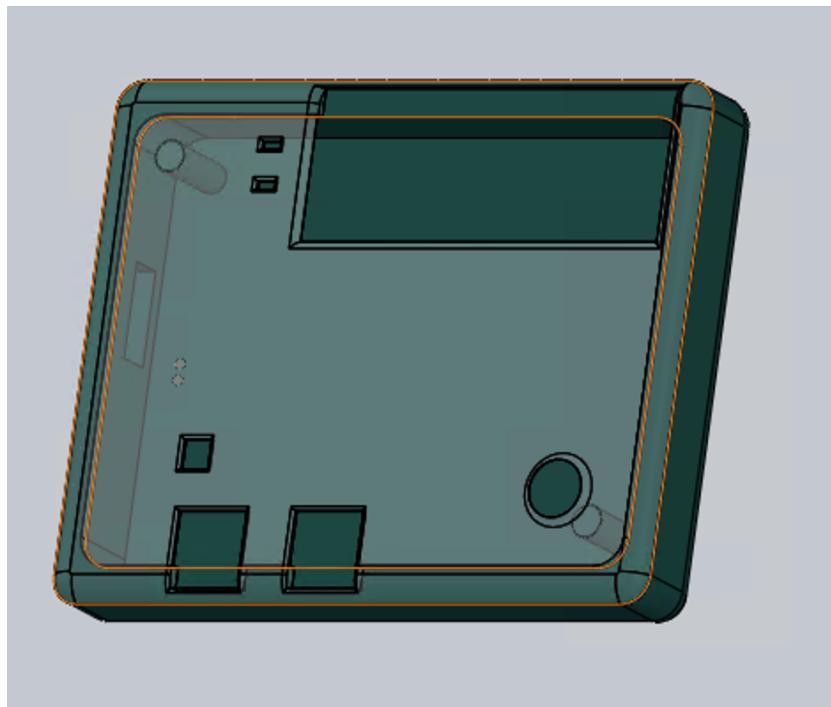
- The following code follows the initial prototype stage used for the arduino PCB design from the previous phase. It uses ISR flags and if statements to manipulate the seven segment display attached to the PCB board.

Link For FlowChart

Image Below



## Enclosure Design (CAD Designs, 3D printed Model)



Enclosure Design includes a clear top side with openings for the Start/Stop button, the Increment button, and the newly added reset button. It also includes two LED holes for the smaller new LEDs and the opening for the original seven segment display and buzzer. There are also two included mounting holes on the actual PCB design. The button allows for the pins on the bottom of the PCB and the USB port on the side included.

Once I printed the case, I realized that the top side had miscalculations. I had measured starting from the edge of the case and not from the start of where the IC would be which led to the buttons and buzzer holes to be lower and further in than intended. From here I wanted to pivot. I originally wanted the top side to be seen through so I could see my custom IC board but the colors selection did not offer a clear option. Therefore, instead of reprinting the case, I wanted to get creative with it. I will be doing this with epoxy. There are multiple projects that use epoxy for electronics as they do a really good job with preserving the component. I will do this by first using a hot glue gun to cover the parts that I don't want the epoxy to ruin in the kitchen timer. This includes the port, buttons and buzzer. From here I will add the epoxy up until the buttons are still reachable with fingers. The final product leaves the actual IC board still visible in order to be able to see my first IC board project while still having a kitchen timer that is functional and efficient.

With the time this document needs to be submitted my case will not be complete due to wanting to add the ESP8266 which was not offered during the class. I ordered it and is arriving after the due date. I need to solder the device before applying the resin that is meant to be on the component indefinitely.



### Conclusion:

This course was perfectly structured to teach students how to be able to start from an idea and manifest the actual component from it. It starts with an idea on paper and putting together components and a schematic that will be able to be put together on a breadboard. In our case the professor was able to get the bread board prototype out of the way to make sure it was working. From this idea we worked with the professor to be able to create a working pcb design on KiCad. From there the boards were ordered and soldered. A kitchen timer enclosure was then created for it. The original kitchen timer used an Arduino interface so we spent Phase C developing knowledge on an STM development software since it uses the same microprocessor software as the ATMega microprocessor used in the kitchen timer. Once everything was put together the students have finally finished their own kitchen timer made from the brilliant mind of the professor. These type of classes include the type of projects that is necessary in order for students to be able to show something for their future prospects in jobs and research opportunities.