I Kain frassek declare I did not plagiarize to get any of this information in section 1.

Week 3

Q 1.1

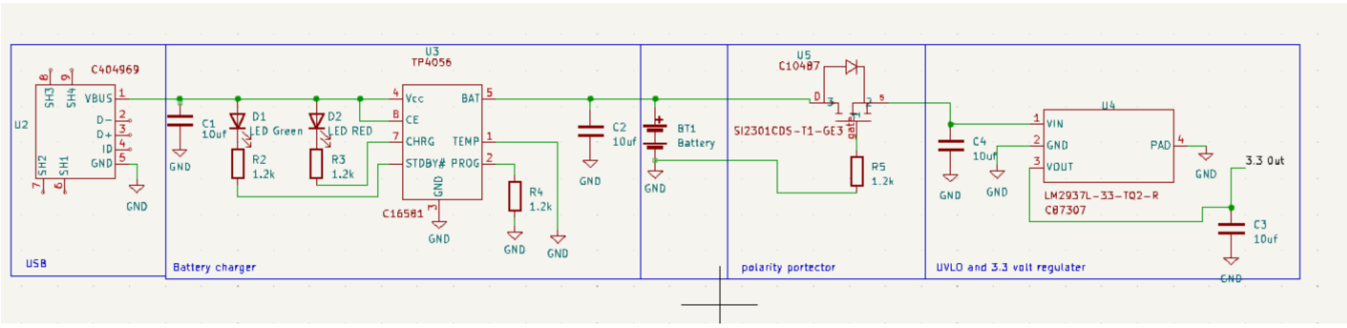
Specification

USB input	This must be a micro-USB input. It must be able to output between 4.5 and 5.5 volts which can then be used to charge the battery. It will need to be able to withstand high temperatures such as up to 80 degrees Celsius.
battery charger	The battery charger must be able to take the 5 Volt voltage source from the micro USB and charge the battery. It will indicate when the battery is fully charged using a green LED and when the battery is still charging using a red LED. It must also be able to withstand temperatures up to 80 degrees.
Undervoltage lockout	This must be connected to the lithium-ion battery. It must ensure that if the voltage provided by the battery goes below 3.3 volts no voltage is provided to the main circuit.
Battery	This must be a lithium ion battery that fits into the BH-18650-B1BA002 holder. It must be a 3.3 Volt battery. It must be able to withstand temperatures around 80 degrees Celsius.
Battery terminal pins	These need to be 2 pins that can be used to provide 3.3 volts to the main circuit in case the battery is not available or for testing purposes.
Reverse polarity protection circuits	This must be connected to the battery. It must be able to detect whether the batteries polarity has been swapped or if the polarity at which the battery is being charged is in the wrong direction. If the polarity in either case has been swapped it must prevent the main circuit and battery, from being powered or charged by this voltage.
3.3 Volt regulator	This circuit must be able to take the voltage from the battery which will be 3.3 volts or higher and regulate it so that a constant 3.3 volts is supplied. This can then be used to power our circuit reliably.

Q1.2

https://github.com/Carciax/EEE3088F-Project-CKR/tree/main/Budgeting/BOM.xlsx

	A	B	C	D	E	F	G	H	I	J	K
1	Reference	Value	Footprint	Datasheet	Qty	name on JCL	name	cost per unit	extend part	cost total	
2	BT1	Battery		~	1	n/A	n/A	0	0	0	
3	C1-C4	10uf		~	4	C19702	CL10A106KP8NNNC	0,0066	0	0,0264	
4	D1	LED Green		~	1	C2296	LED_0805	0,0119	0	0,0119	
5	D2	LED RED		~	1	C2286	LED_0603	0,0054	0	0,0054	
6	R2, R3	1.2k		~	2	C22765	0603WAF1201T5E	0,001	0	0,002	
7	R4	1.2k		~	1	C22765	0603WAF1201T5E	0,001	0	0,001	
8	R5	1.2k		~	1	C22765	0603WAF1201T5E	0,001	0	0,001	
9	U2	USB			1	C404969	MicroXNJ	0,0333	3	3,0333	
10	U3	batery charger			1	C16581	TP4056	0,2027	0	0,2027	
11	U4	pmosfet			1	C10487	S12301CDS-T1-GE3	0,0725	0	0,0725	
12	U5	UVLO/ LDO			1	C87307	TO-263-3	0,478	3	3,478	
13										6,8342	



Q.1.3

Submodule interface

LED is used to indicate the charging of the battery.	one green LED and one red LED. Both in series with 1.2 KΩ resistors to reduce current.
STM32F051C6Tx	This is the main microprocessor board which will need to be supplied with 3.3 volts. current used to power itself is between 3 and 4.5 milliamps.
Potentiometer analog sensor	This will be supplied with 3.3 volts and will act as a voltage divider. It will draw 33 milli amps of power.
digital light sensor	this will be supplied 3.3 volts. And will draw a very low current.
Outputs via LED	There will be an LED powered by the 3.3 volts which can be used to flash at different rates and help give outputs about what has been sensed. These LED's will be put in series with large resistors to help reduce current.
Debug (SIL 1x10 Male)	This will need a 5 Volt power supply and therefore it will need to be supplied straight from the USB port.
Analogue sensor 2 thermistor	This will need 3.3 V power supply and should draw les that 1 mw of power.
USB connector	Will supply 5V to the main power circuit. An external USB cable will be connected to provide this power and for data transmission

I, Cameron Clark, declare I did not plagiarize to get any of this information in section 2.

Q2.1

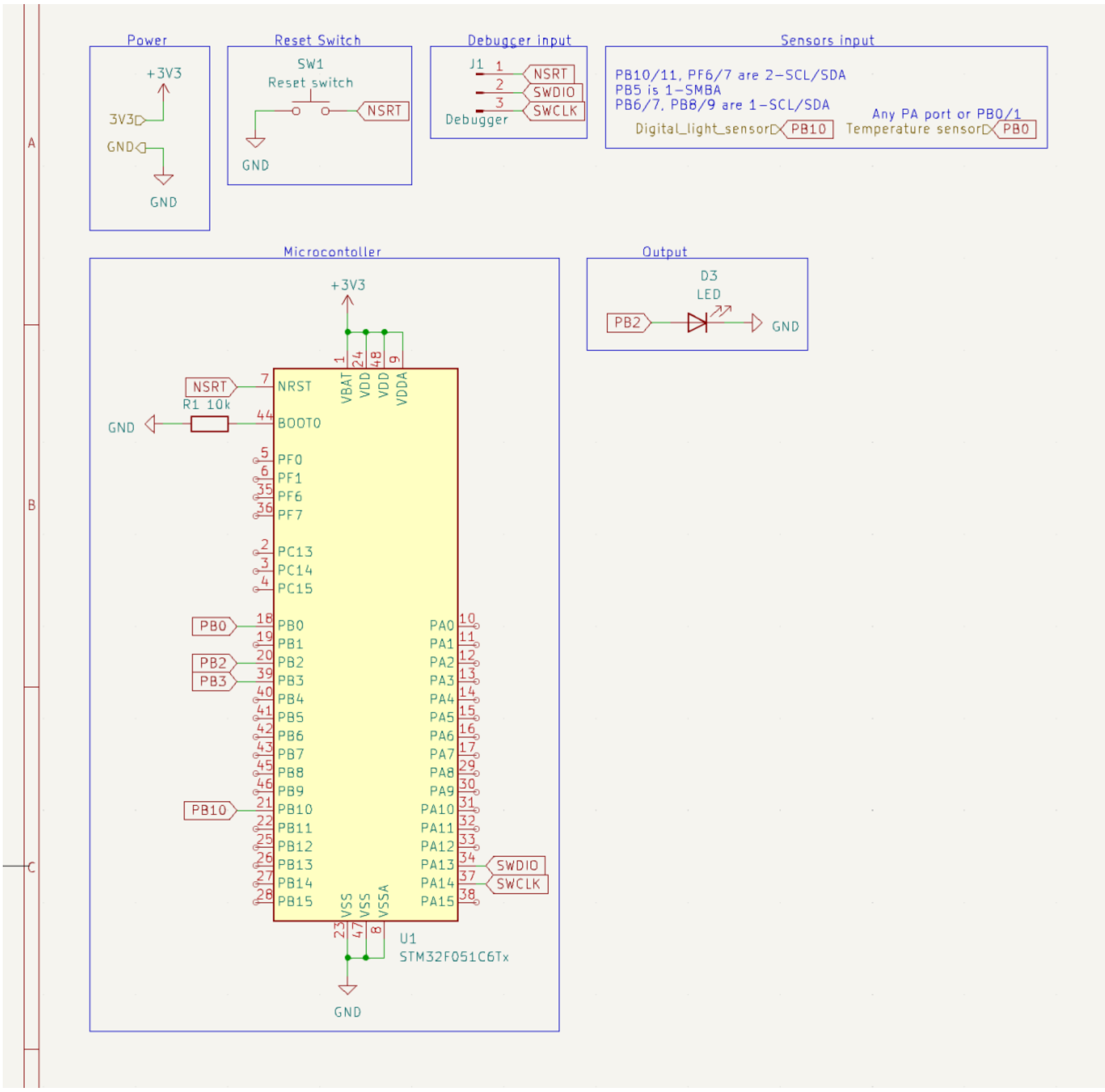
Microcontroller specifications. It must be able to:

- Receive 3v3 of voltage into pins 1, 9, 24, 28.
- Connect to ground on pins 8, 23, 47.
- Not exceed an input voltage of 4V
- Not exceed an input or output current of 25mA.
- Receive an input into pin 7 (NSRT) to reset and run the loaded program.
- Receive inputs into pins 7, 34, 37 (NSRT, PA13, PA14) for programming the chip using the debugger.
- Receive a grounded input into pin 44 (BOOT0) to configure the boot mode of the chip.
- Output 3V3 to a GPIO pin
- Receive a read using an ADC a variable voltage.
- Receive data through an IC1/2 enabled pin.

Q2.2
BOM
https://github.com/Carciax/EEE3088F-Project-CKR/tree/main/Budgeting/BOM.xlsx
Components for the microcontroller are indexed 6, 7, 8, 12 and 13 which are an LED, 01x03 male connector, 10k resistor, a button, and the 2 01x24 female headers.

Reference	Value	Footprint	DNP	Qty	JLC Part #	MFR Part #	Unit Cost	Extended Part Cost	Total cost (5 Boards)	
D3	LED			1			0,0054		0,027	
J1	01x03 pin header		X	1			0,0317	3	3,1585	
R1	10k R			1			0,0015		0,0075	
R6	1.2k R			1			0,001		0,005	
SW1	Push button			4			0,0425	3	3,2125	
U6	01x24 female header		X	2			0,5282	3	5,641	
								Total Cost	3,252	

Total cost estimated as $3.25.



Q2.3

Inputs

A push button will be used as a reset switch receive by the NRST pin 7. This will have a pulldown resistor internally configured. It will be used to start the program in the machine. It should receive a 3V3 volts from the power module and a max current of 4.5mA

Sensors

This module will receive a voltage from a thermistor in the range of 0 – 3V3. It will use an GPIOA pin or GPIOB pin 0/1 to input the voltage as these can be ADC enabled.
It will also receive data from a digital light detector sensor which will be receive by GPOIB5-11 or GPIOF6/7.

Outputs

This will output to a singular debug LED outputting 3V3 from any GPIOA/B pin. This will help the user debug the board and set it up.

I, Robert Dugmore, declare that I did not plagiarise anything in my authored section (Q3)

Digital sensor specifications:

I2C Ambient Light sensor

Specification	Detail
Input Voltage	3V3
Operating Temperature	-10°C to 70°C
Power Consumption	≤ 1mW
Output resolution	16 bit
I2C Slave address bit depth	7 bit
I2C mode	Fast mode (up to 400 kBits/s)
Light input range	0.01 lux to 64000 lux
Minimum pull-up resistor value	1 kΩ
Maximum pull-up resistor value	10 kΩ
Recommended pull-up resistor value	8.2 kΩ

The sensor module must take 3V3 power from the main 3V3 rail. It must take a clock input from the microcontroller and output serial data using I2C. It must connect to a level interrupt pin on the microcontroller. It must measure ambient light and output the light level in 16 bit resolution over the I2C connection. The I2C connection must use 7 bit slave addresses and operate in fast mode

Analogue sensor 1 specifications:

Potentiometer
Note: Justin Pead has told us that using a potentiometer as an analogue sensor is acceptable. Nevertheless we have also added a 2^{nd} analogue sensor (see below), which we believe we can still do within the specified budget.

Specification	Detail
Input Voltage	3V3
Operating Temperature	-10°C to 70°C
Power Consumption	≤ 1mW
Resistance	≥ 10 kΩ
Resistance tolerance	≤ ± 20%
Operating life	≥ 5000 cycles
Rotation Torque	≤ 10 mN.m
Maximum rotation angle	≥ 270°
Mounting type	Vertical

The sensor module must take in 3V3 power from the main 3V3 rail. It must output an analogue voltage based on the degree to which the potentiometer has been turned. It must draw less than 1 mW of power. It must be able to survive up to 5000 cycles.

Analogue sensor 2 specifications:

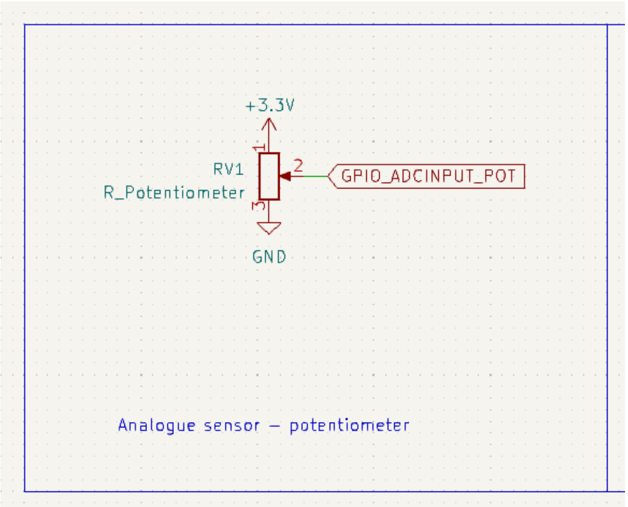
NTC thermister

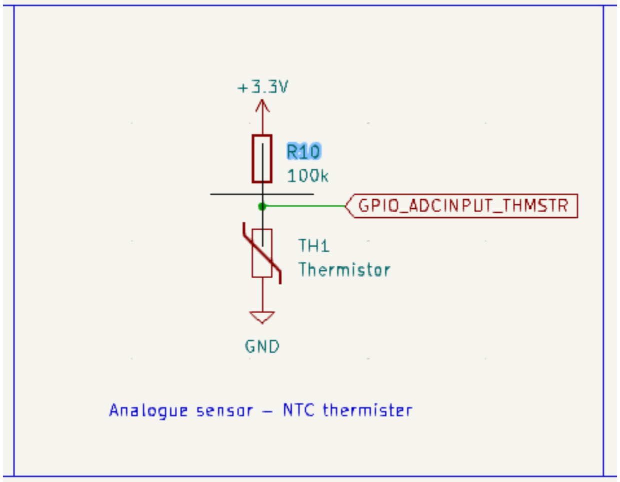
Specification	Detail
Input Voltage	3V3
Power consumption	≤ 1 mW
Resistance at 25°C	≥ 10 kΩ
Resistance tolerance	≤ ± 1%
Measurement temperatures	≤ -10°C to ≥ 70°C
Nominal B-constant	≥ 4000
Voltage divider voltage at 25°C	0.5 x 3V3

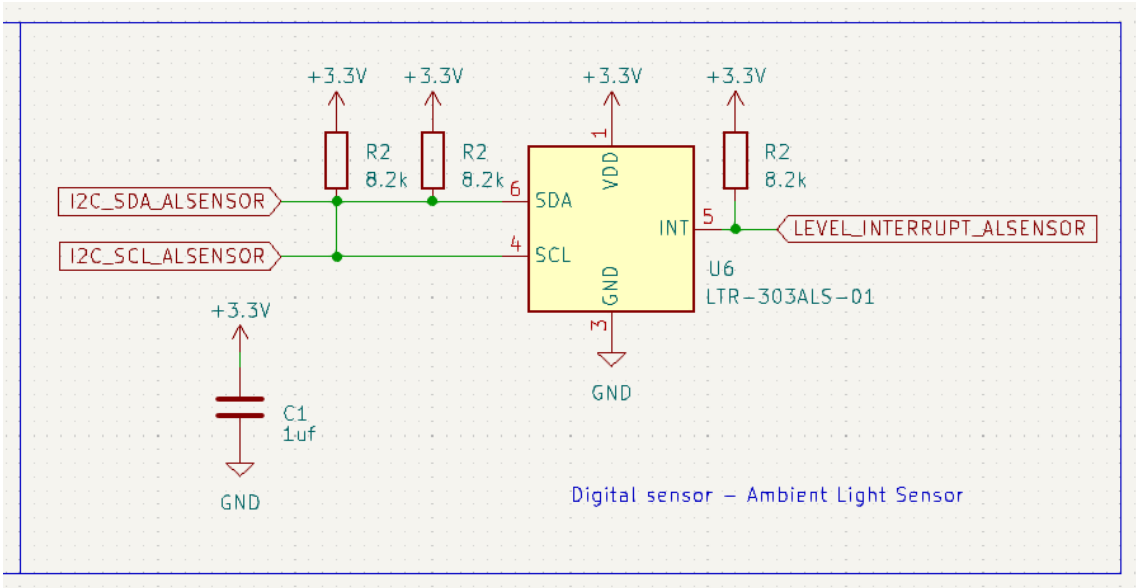
The sensor module must take 3V3 power from the main 3V3 rail. The sensor will be placed in series with a 100 kΩ resistor to form a voltage divider. The sensor must be able to read temperatures between -10°C and 70°C.

Draft schematic and BOM:

Schematic:







BOM:

https://github.com/Carciax/EEE3088F-Project-CKR/tree/main/Budgeting/BOM.xlsx
See sheet 3 (sensors)

The estimated total cost for this module is $14.0170.

Digital sensor interface:

Ambient light sensor

Electrical (pinout):

Pin	Description	Connections
1	Supply voltage	3V3 Capacitor +
2	No connection	NC

3	Ground	GND Capacitor -
4	I2C serial clock (SCL)	SCL pin on microcontroller I2C bus Pull-up resistor to 3V3
5	Level interrupt	INT pin on microcontroller Pull-up resistor to 3V3
6	I2C serial data (SDA)	SDA pin on microcontroller I2C bus Pull-up resistor to 3V3

The module will send digital data to the microcontroller via an I2C bus on the microcontroller. All pins will have 0Ω resistors in series with the “main” pin connections so that the sensor can be disconnected in the event that it doesn’t work properly.
All pins will have 0Ω resistors in series with the “main” pin connections so that the sensor can be disconnected in the event that it doesn’t work properly.

Electromagnetic (light):

The module will receive ambient light, which the sensor will internally convert to a digital signal (to be sent out of the module as an electrical signal over I2C)

Sensor dimensions:

Width: 2 mm
Length: 2 mm
Height: 0.7 mm

Analogue sensor 1 interface:

Potentiometer

Electrical (pinout):

Pin	Description	Connection
1	Supply voltage	3V3
2	Output	GPIO pin, configured for ADC input
3	Ground	GND

The module will send an analogue voltage to a GPIO pin configured for ADC input on the microcontroller.
All pins will have 0Ω resistors in series with the “main” pin connections so that the sensor can be disconnected in the event that it doesn’t work properly.

Tactile input:

The twist-knob of the potentiometer can be turned by hand to change the output voltage. This can be used during the configuration stage to fine tune the settings of the device. Additionally it could be used to sense “human data”, where the readings in the device

Mechanical input:

The twist knob of the potentiometer could also be connected to a small mechanical system that turns the knob. For example, the mechanical input could come from a small wind vane, or from a window where the researcher wants to measure when the window is opened and how wide it is opened.

Sensor dimensions:

Width: 9.8 mm
Length: 12 mm
Height: 15 mm
Knob diameter: 6 mm

Analogue sensor 2 interface:

NTC thermister

Electrical (pinout):

Pin	Description	Connection
1	Connection to 100 kΩ resistor of voltage divider and ADC input	GPIO pin, configured for ADC input 100 kΩ resister pulled up to 3V3
2	Ground	GND

The sensor module will send an analogue voltage to a GPIO pin configured for ADC input on the microcontroller.
All pins will have 0Ω resistors in series with the “main” pin connections so that the sensor can be disconnected in the event that it doesn’t work properly.

Temperature input:

The thermister reacts to changes in temperature. It is a negative temperature coefficient thermister, which means that its resistance decreases as the temperature increases. This resistance change will be read by placing the thermister in series with a static 100 kΩ resistor to form a voltage divider.
The thermister’s change in resistance with temperature is non-linear. This will be compensated for in software of the microcontroller so that accurate temperature readings can be obtained.

Sensor dimensions:

Width: 0,5 mm
Length: 1 mm