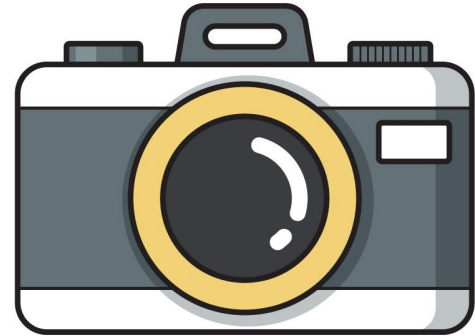# EEC136 Digital Camera

Week 3 Project Update

Waylon, Cassandra, Viktor, Alina, Angel

Overview

1. Began building prototype board and testing photodiodes.
2. Tested prototype with PSoC ADC pins.
3. Power consumption calculations and researched solutions.
4. Tested multiplexer implementation to circuit board.
5. Created OrCad design and PCB library for photodiode sensor.
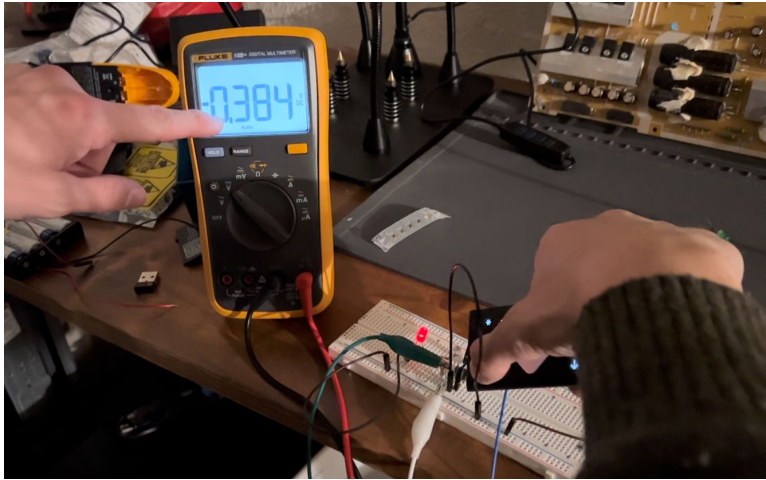
Waylon

1. Assisted in building design for reading a voltage proportional to the the current through the photodiode.
   a. Since the photocurrent is linearly related to the irradiance of the photodiode we had to change our design from directly measuring the voltage from a photodiode to measuring a voltage that is representative of the current generated by the photodiode.
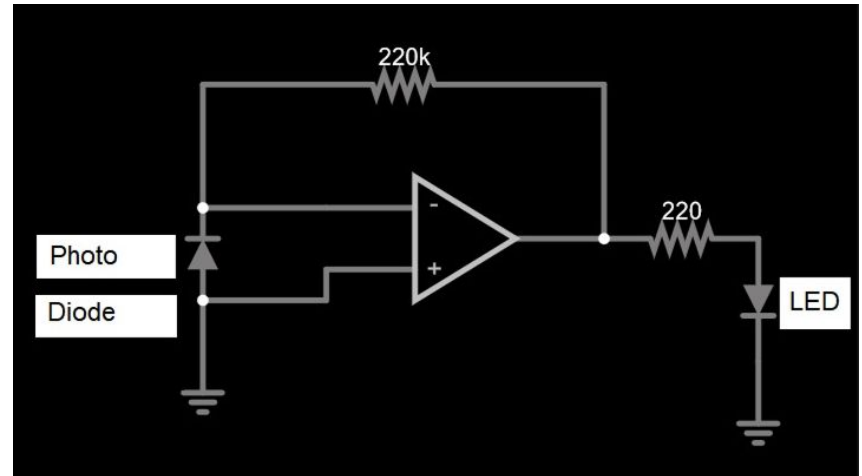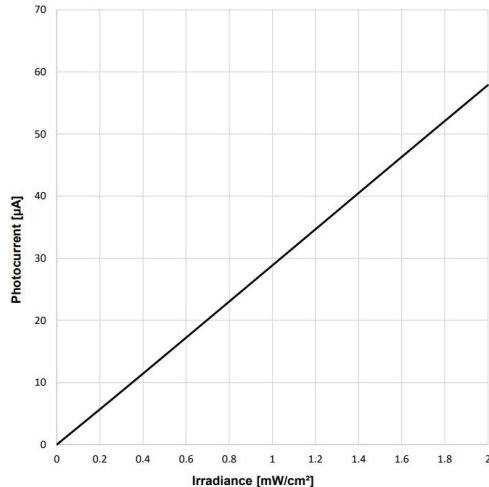
Waylon

2. Used opamp TL72IP from Texas Instruments with a +9 and -9 VCC.
   a. This created a high enough voltage to turn on the output LED to show operation in lieu of PSOC code.
   b. https://www.youtube.com/watch?v=1SukKrbIzVw

High intensity light (bright LED and higher voltage
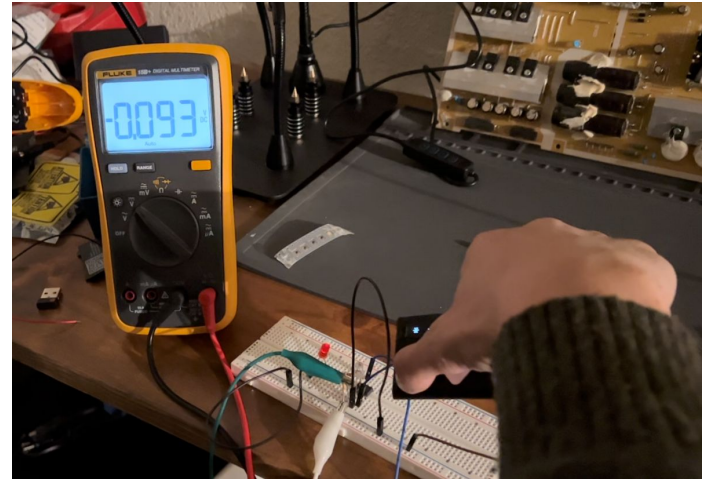
Lower intensity light (dim LED and lower voltage)

Waylon

Next Steps

The next steps to complete the Alpha Prototype are to iterate this design for a grid of photodiodes and use the voltage from the feedback resistor to determine the mix of white and black colors to create a pixel of appropriate grayscale based on luminosity.

Alina

- Worked with Angel on the PCB for the PSOC, checking all the connections.
- Completed altium library for all the components that will be needed for the future use
- Worked on the orCad block diagram with Viktor to simulate and understand the design of the future prototype
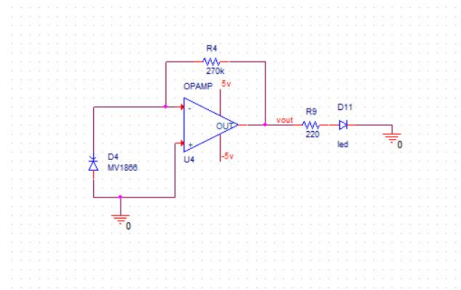
For next week:
- Order the PSoC
- Work on the prototype with the group, by including four photodiodes on the board
- Research and decide how the final product will work (op amp for an each amplifier/ or user of multiplexers)

Viktor

This week:

- Software- Finish coding the ADC Psoc voltage reading as well as implementing the code for the usage of multiplexer cd74hc4067 with Psoc environment.
- Hardware - Implemented a multiplexer test circuit that demonstrate the compatibility of the hardware with the software . Assisted Alina with the OrCad design. Implemented the ADC test circuit the demonstrate the reading of voltage through the Psoc analog pins. (**See reference images in slide 11**)

Plans for next week:

- Software- Assist the team with design decision on how to generate a grayscale matrix due to a voltage reading from the prototype.
- Hardware - Assist the team with the implementation of the full alpha version.

Angel

This week:

- **PCB Design** - Worked with Alina to produce a double check on PSoC PCB and also begin component research for pad sizes and documentation.
- **Hardware** - Assisted with first prototype bring-up with Waylon & Cassandra of a transimpedance amplifier. With this we were able to measure Vout and light up an LED when flashing photodiode. (**See reference images in slide 10**)
  - Assisted Cassandra in calculating power draw consumption and figuring out what our limitations may be when adding more photodiodes in circuit.

Plans for next week:

- **PCB Design** - Make sketch of new PCB board for sensor layout and begin footprint
- **Hardware** - Figure out power consumption and max voltage inputs. For both the sensor and the Psoc GPIO pins we will be using.

Cassandra

This week:

- **Hardware** - breadboarded and tested new photodiode circuit design with Waylon and Angel
  - Performed power calculations/measurements and refined operating characteristics
  - Dropped op-amp power supply voltages from ±9V to ±5V
  - Final power assessment: ~20mW/pixel, ~1.25W for an 8x8 pixel array

Plans for next week:

- **Design (Hardware)** - research expected power draw and operation characteristics for the original pixel design in comparison with the new design
- **Hardware** - continue building up breadboard prototype to verify design works as intended (ex. test photodiodes with multiplexer)
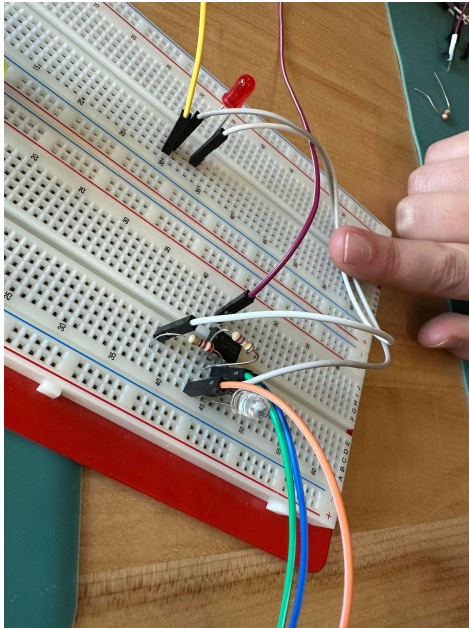
Reference Images

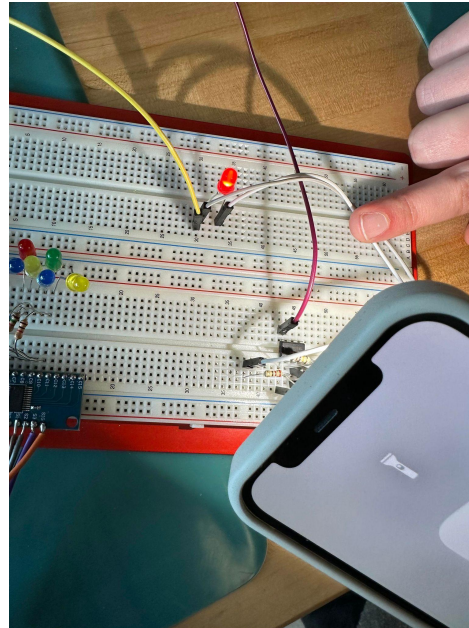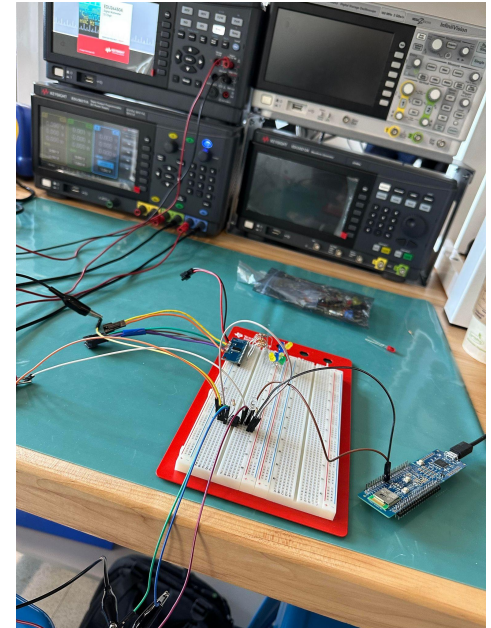**Fig 1.1 Photodiode w/o Flash**

Fig 1.2 Photodiode w/ Flash

Fig 1.3 Reading Values w/Psoc

Reference Images

Fig 1.4 Multiplexer test circuit
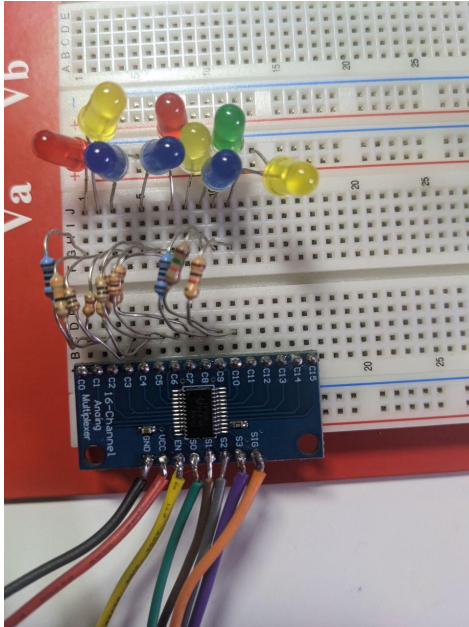
Fig 1.5 ADC value for photodiode w/o flashlight

Fig 1.6 ADC value for photodiode w/ flashlight.


```
COM5 - PuTTY
volts = 0.145021v
ADC VALUE = 89.000000
volts = 0.143410v
ADC VALUE = 93.000000
volts = 0.149855v
ADC VALUE = 94.000000
volts = 0.151466v
ADC VALUE = 93.000000
volts = 0.149855v
ADC VALUE = 88.000000
volts = 0.141798v
ADC VALUE = 91.000000
volts = 0.146632v
ADC VALUE = 90.000000
volts = 0.145021v
ADC VALUE = 95.000000
volts = 0.153078v
ADC VALUE = 93.000000
volts = 0.149855v
ADC VALUE = 94.000000
volts = 0.151466v
ADC VALUE = 89.000000
volts = 0.143410v
tup_psoc6_01_cm0plus.S
```



```
COM5 - PuTTY
volts = 3.135675v
ADC VALUE = 1962.000000
volts = 3.161457v
ADC VALUE = 2028.000000
volts = 3.267805v
ADC VALUE = 2047.000000
volts = 3.298421v
ADC VALUE = 2047.000000
volts = 3.298421v
ADC VALUE = 1940.000000
volts = 3.126007v
ADC VALUE = 1911.000000
volts = 3.079278v
ADC VALUE = 1992.000000
volts = 3.209797v
ADC VALUE = 2036.000000
volts = 3.280696v
ADC VALUE = 2003.000000
volts = 3.227522v
ADC VALUE = 1896.000000
volts = 3.055108v
ADC VALUE = 1893.000000
volts = 3.050274v
tup_psoc6_01_cm0plus.S
```

GANTT CHART

PROJECT TITLE	Digital Camera	COMPANY NAME	EEC136B
PROJECT MANAGER	Waylon	DATE	1/13/23

								PHASE ONE															
								WEEK 1 - Jan 9-13					WEEK 2 - Jan 16-20					WEEK 3 - Jan 23-27					
WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE		M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	
1	Project Conception																						
1.1	Concept Design	Casandra	1/9/23	1/27/23	18	75%																	
1.1.1	Bill of Materials	Vic/Way	12/1/22	1/13/23	42	100%																	
2	Circuit Design																						
2.1	PSOC Programming Board	Angel	1/9/23	1/27/23	18	100%																	
2.2	Photo Diode Board	Alina	1/13/23	2/10/23	27	75%																	
2.3	OLED Display Board	Alina	1/13/23	2/10/23	27	0%																	
3	Software/Coding																						
3.1	Reading charge on pixels	Cassandra	1/21/22	2/18/22	27	100%																	
3.2	Processing Data	Cassandra	1/21/22	2/18/22	27	0%																	
3.3	Saving Files	Angel	2/4/22	2/25/22	21	0%																	
3.4	Displaying Files	Angel	2/4/22	2/25/22	21	0%																	
4	PCB Assembly																						
4.1	Parts Order Placed	Waylon	1/13/23	2/3/23	20	75%																	
4.2	PCB Boards Order Placed	Angel	1/13/23	2/3/23	20	25%																	
4.3	Soldering	Waylon	2/11/22	2/18/22	7	0%																	
4.4	Continuity Testing	Waylon	2/25/22	3/4/22	9	0%																	
5	Enclosure Design																						
5.1	3D Model	Victor	1/14/22	2/11/22	27	5%																	
5.2	3D Print	Victor	1/28	2/11/22	13	5%																	
5.3	Assembly		2/11/22	2/18/22	7	0%																	
5.4																							

Gantt Chart Google Slides Link

Bill of Materials Page 1 of 2

Item	Part No.	QTY	Cost	Received
Photodiode (final board)	VBPW34S	100	$54.00	
Photodiode (breadboard)	1540051EA3590	10	$7.29	X
MOSFET (n-type)	SQ1922AEEH-T1_GE3	200	$60.20	X
Button	In lab	5	$5.25	
Header Pins	In lab	10	$4.95	
PSOC	In lab	2	TBD	
Crystal Oscillator	In lab	1	TBD	
Battery	LIPO Battery (3.7V)	1	$10.95	
OLED Display	LCD-13003	2	$35.76	
Tri-LED	In lab	5	TBD	
Multiplexer	BOB-13906	2	$5.90	

Item	Part No.	QTY	Cost
10KΩ	TBD	4	TBD
0Ω Resistor	TBD	10	TBD
1KΩ Resistor	TBD	2	TBD
10uF Capacitor	TBD	1	TBD
22pF Capacitor	TBD	2	TBD
4.7KΩ Resistor	TBD	2	TBD
330Ω Resistor	TBD	1	TBD
470Ω	TBD	1	TBD