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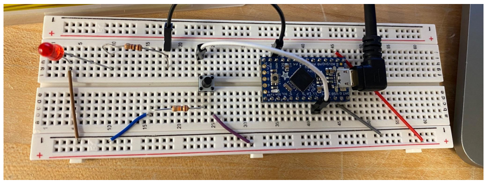
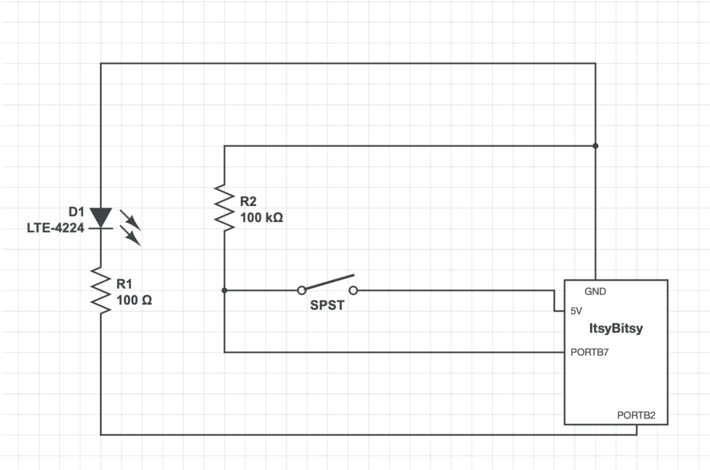
Collab with Kevin Paulose

MEAM 5100
LAB 2 -BEACON

2.1.1





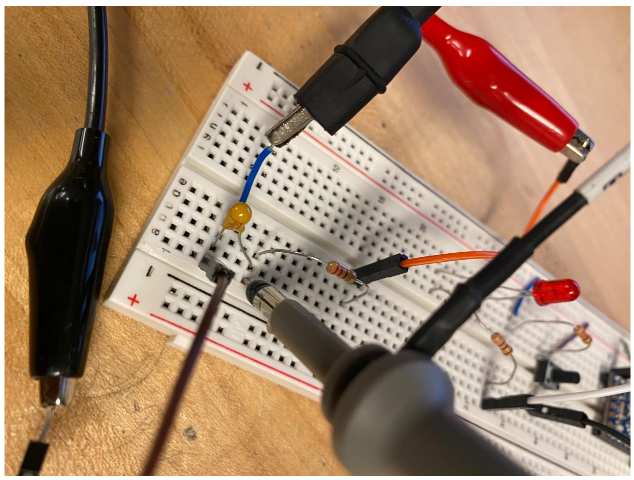
PORTB2 output for LED and PORTB7 reads the input from the switch. If pressed then high and LED turns ON.

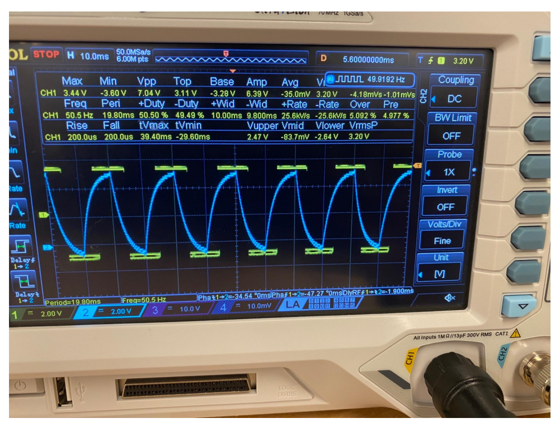
2.1.2

Setting Cutoff Frequency to be 72Hz so according to the RC calculation for LOW Pass Filter.

$$f_{cutoff} = \frac{1}{2\pi RC}$$

R=220 Ohm and C= 10uF . So this will attenuate the wave greater than 72Hz.



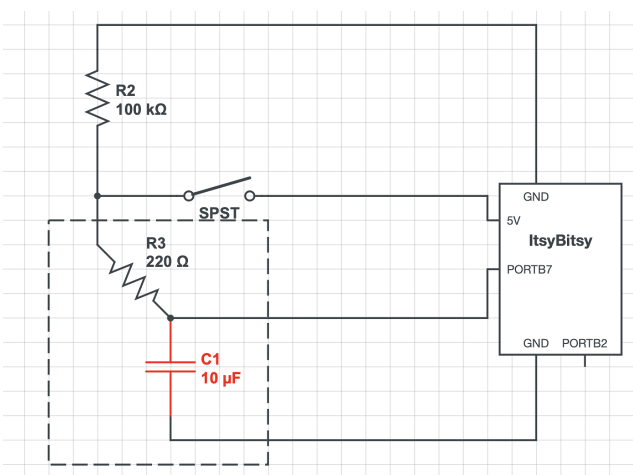


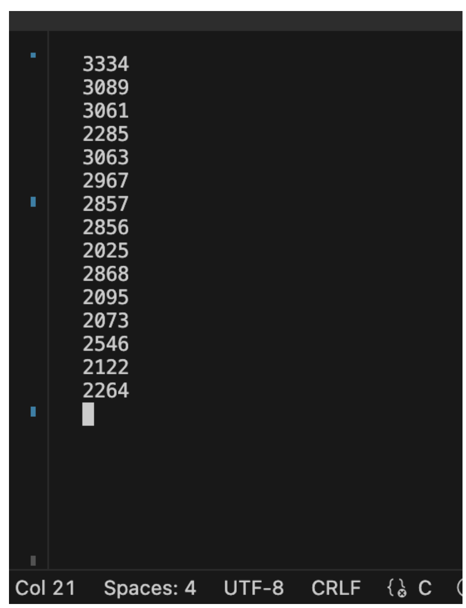
10HZ **50HZ**

100Hz **227 Hz**

Here the Yellow wave is the input square wave and Blue is the output of the Low Pass Filter. We can see the attenuation as the frequency increases. A square wave consists of multiple harmonics at higher frequencies. When passed through a low-pass RC filter, the filter attenuates these higher-frequency components, allowing only the lower-frequency components to pass through. This results in a rounded waveform with smoothed edges, as the filter's cutoff frequency determines the extent of attenuation of the square wave's harmonics.

2.1.3





Fastest Time (s) = 2025*(1024 / 16,000,000)*1 second **= 0.1296 seconds.**

2.2.1

Resistor	Output- Low light	Output- Bright light
4.7k Ohm	4.96V	4.84V
47k Ohm	4.47V	3.53V
470k Ohm	2.6V	0.09V

The finding is consistent as when more bright light- more current is generated by a phototransistor. So according to V=IR. More Voltage across Resistor and hence low voltage at Output. Similarly for greater resistor more voltage across resistor so less across output (Between ground and phototransistor.)

- Dealing with analog values on Itsybitsy (LVTTL logic levels)
  - Above 1.9V is gauranteed logic high $V_{IH} = 1.9V$
  - Below 0.9V is gauranteed logic low $V_{IL} = 0.9V$

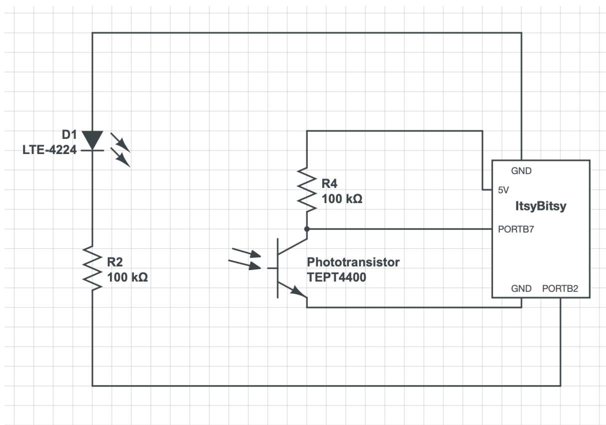
For 470k Ohm resistor the Voltage reached Valid Logic Low and High for ATmega32U4. As seen from table.

2.2.2

Video Link:
https://drive.google.com/file/d/1YeVx3fE5Q8vWosIv8y5eVJIZint714jS/view?usp=share_link

2.2.3

Video Link:
https://drive.google.com/file/d/1ma6EIidI6DMghvosKTryFF1kyZ9UPLgv/view?usp=share_link



Used a **100k Ohm** Resistor and it was sensitive enough for the experiment. And it is correctly related to values we found earlier.

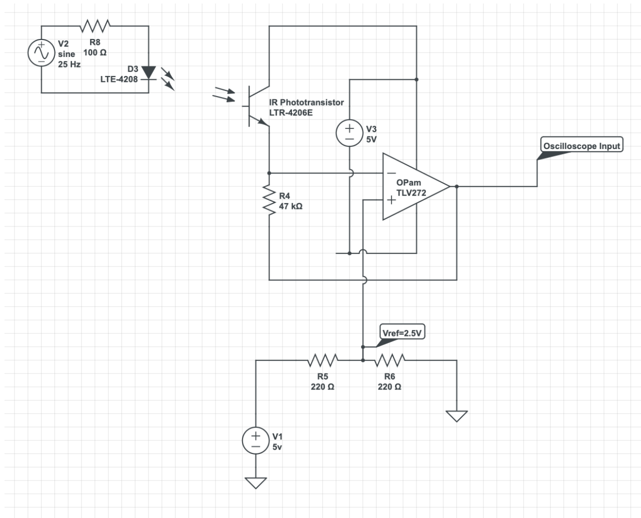
2.3.1

For IR Emitter LTE-4208 using the datasheet, I found that the Typical Vf = 1.2V and So calculating R= 5-1.2/0.03 = 126 Ohm and using the physical circuit I found that at about **100Ohm it was having 30mA current.**

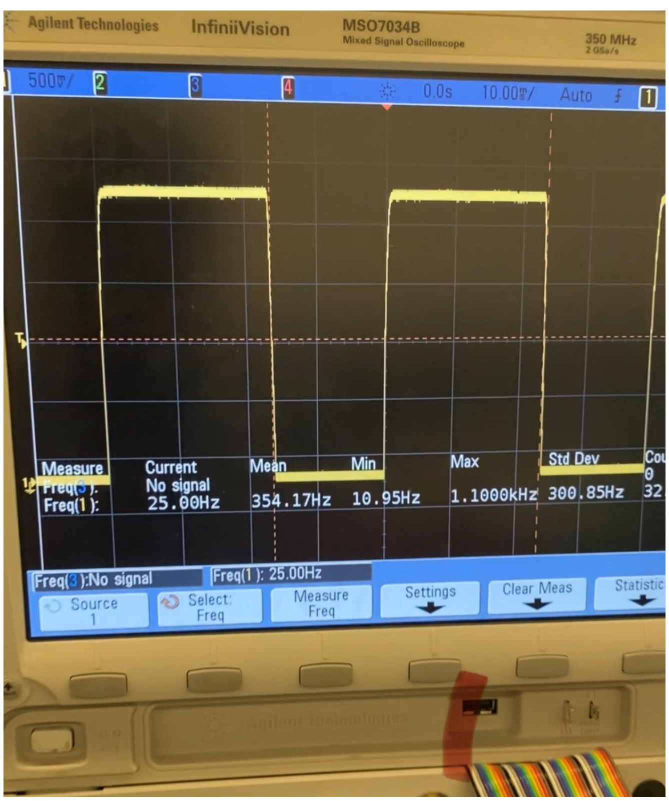
For an IR phototransistor measuring the current generated when it detects IR at a somewhat far distance was about 0.04mA. So for Valid Logic High for Atmega32U4 which is 1.9V I calculated Vout=-IR. R = **47k Ohm.**

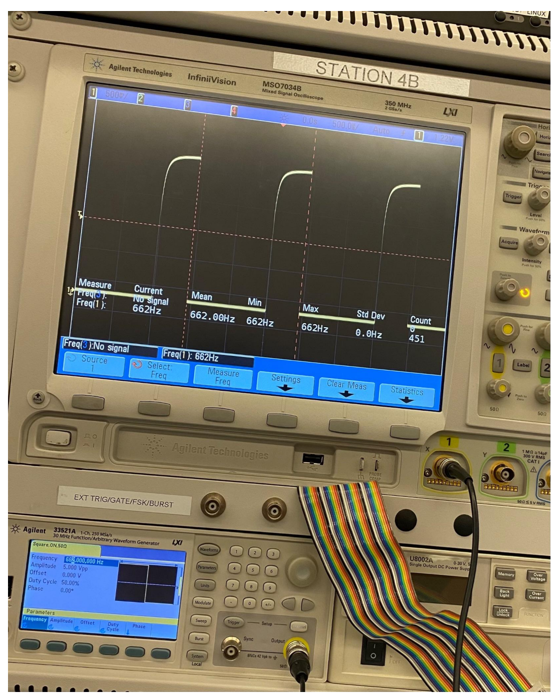
Video of Output=
https://drive.google.com/file/d/106sQkrThouYfVaGB-uisDXXUi6Gszwyq/view?usp=sharing

Using Inverting feedback Opam configuration.



Opamp Output on Scope

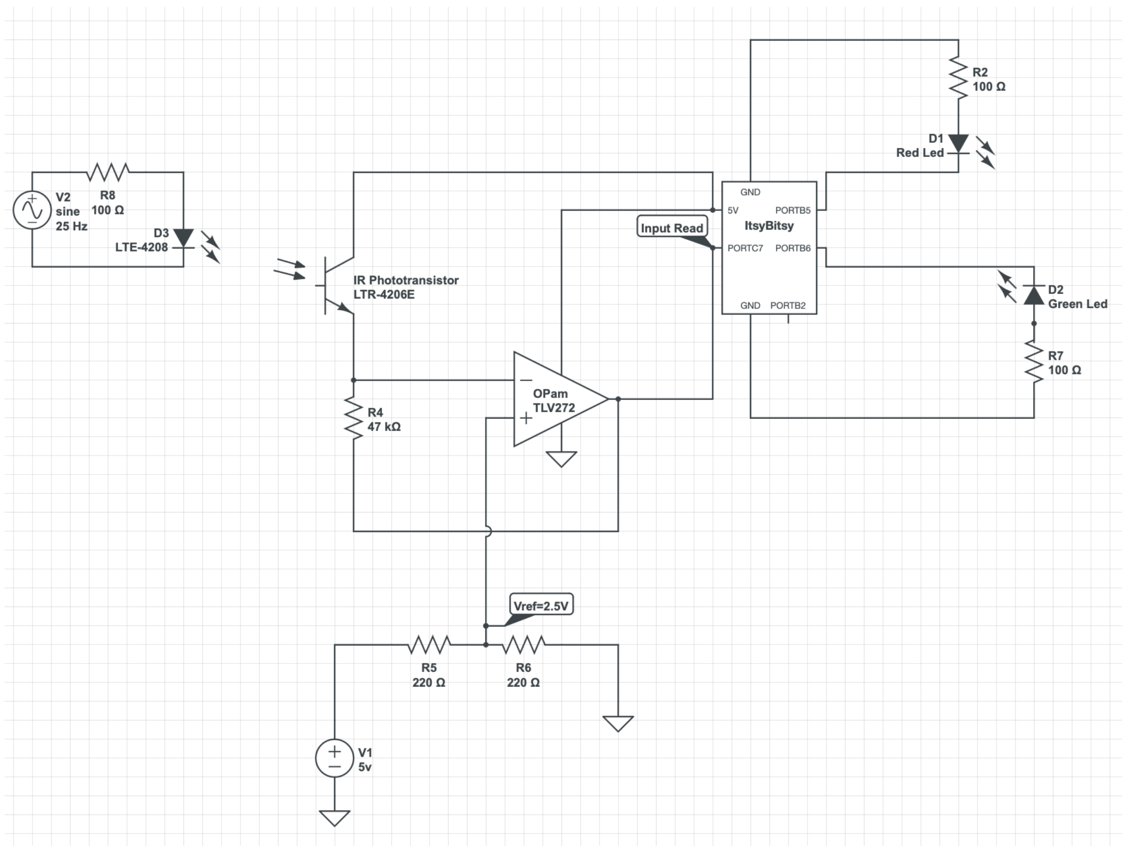




25Hz **662 Hz**

2.3.2

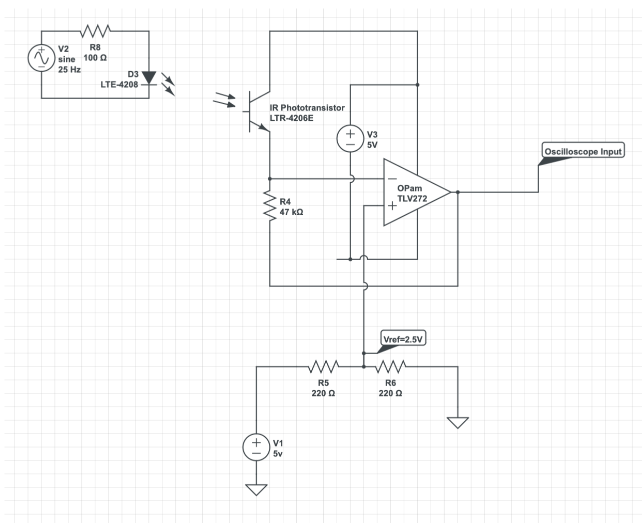
Using the same circuit with the same resistance and connecting the input to Itsybitsy, I was able to detect the Hz of input and turn on the Red and Green Led at 25 Hz and 662 Hz accordingly.



Video of Output=https://drive.google.com/file/d/1K4tPbQko0N6sMwpyk0E33RH7jncHPvZm/view?usp=sharing

2.4.1

For me the same circuit which was in 2.3.1 worked at 1.5m as well for both frequencies. I also checked with adding flash light from the phone but still there was not much noise to add a filter either hardware or software. I believe because the Opamp and resistor combination was sensitive enough to detect the signal but not noise. I did have to accurately aim the IR Emitter perfectly to detect it but it worked at 1.5m and also at 2m which I got checkoff with TA at 200 Hz for extra credit.



Video of Output=
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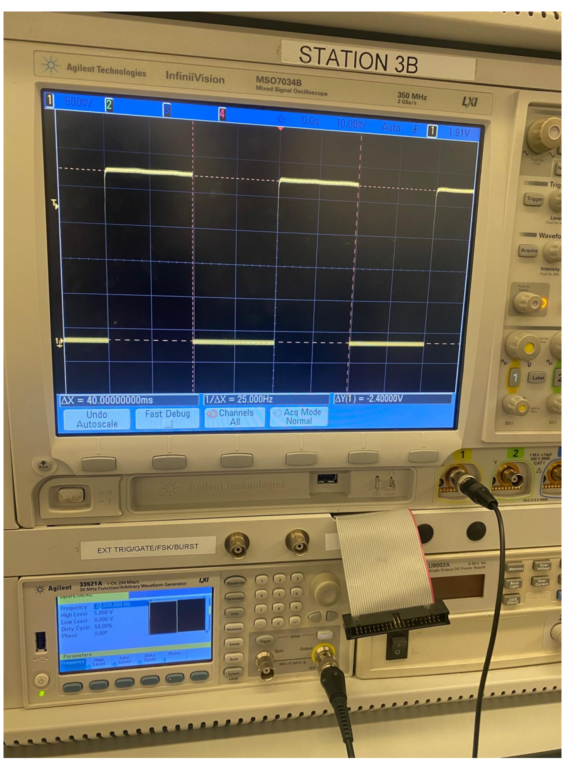
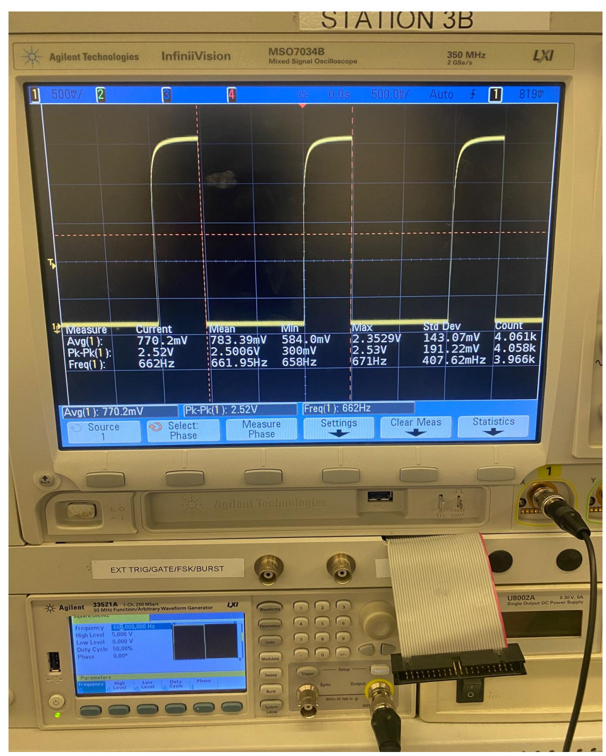
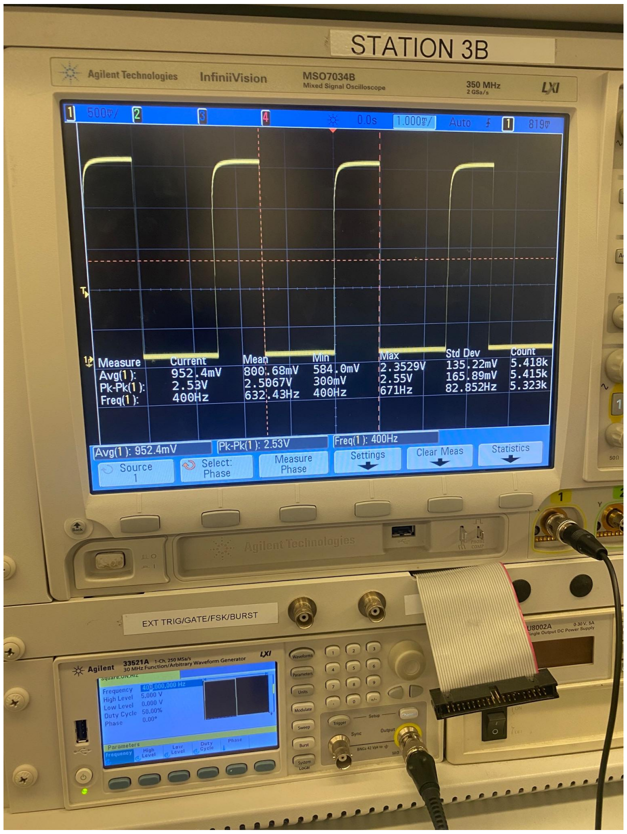




25 Hz **662Hz**



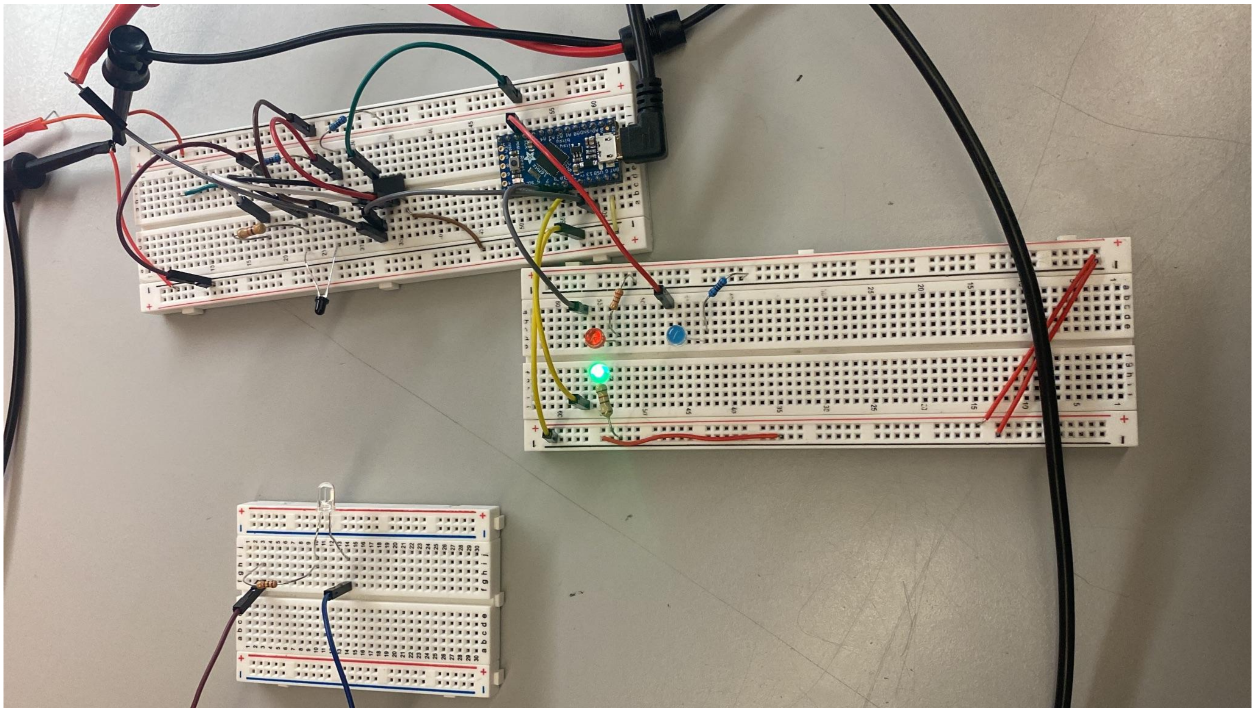
400 Hz.

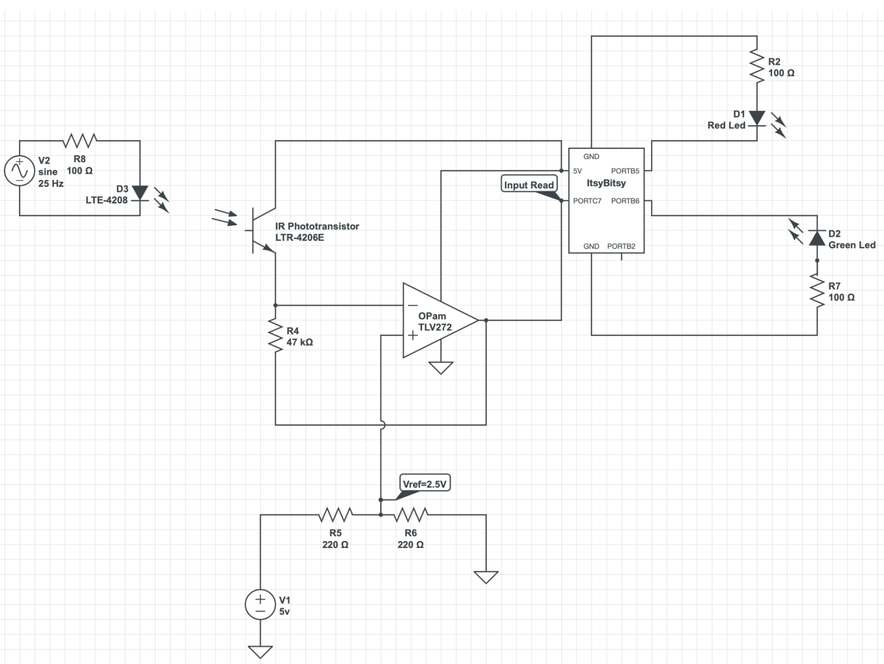
2.4.2

For me the same circuit which was in 2.3.2 worked at 1.5m as well for both frequencies. I also checked with adding flash light from the phone but still there was not much noise to add a filter either hardware or software. I believe because the Opamp and resistor was sensitive enough to detect the signal but not noise. I did have to accurately aim the IR Emitter perfectly to detect it but it worked at 1.5m and also at 2m which I got checkoff with TA at 200 Hz for extra credit.

I added an extra blue led seen below which detected 200Hz at 2m. So Below is the circuit with 3 leds detecting 25, 200, 662 Hz frequencies.

Video of Output at 1.5m for 662Hz =
https://drive.google.com/file/d/1VK5BQVIgJppGL7GoQJ4RKG1sD12yiTMj/view?usp=share_link





Same as 2.3.2 just added one extra LED at PORTB2.

Extra Credit Question of 200Hz at 2m also Done.

2.5

2.1 - 1 hrs
2.2 1 hrs
2.3-2.4 20hrs