BME Design-Fall 2024 - Molly Wilhelmson
Complete Notebook

PDF Version generated by

Kate Briesemeister

on

Dec 11, 2024 @11:14 AM CST

Table of Contents

Team contact Information

Kate Briesemeister - Sep 26, 2024, 3:45 PM CDT

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Project description

Kate Briesemeister - Sep 26, 2024, 3:41 PM CDT

Course Number: BME 200/300

Project Name: Wearable light logger to facilitate full spectrum light dosing for mood disorders

Short Name: Wearable light logger

Project description/problem statement: Currently, there are no affordable wearable light-logging devices on the market. Full-spectrum light therapy has been proven to be successful in treating mood disorders, especially seasonal affective disorder, but patient response studies are lacking. A wearable allows for accurate representation of light intensities that reach the retina, the presumed site of action. A wearable light logger would provide convenient research into what correct dosages for optimal patient response look like for patients suffering from mood disorders.

About the client: Our client, Dr. Jean Riquelme, is a clinical professor in the Department of Family Medicine and Community Health at the University of Wisconsin School of Medicine and Public Health. She requests that our device is non-obstructive to users. Her idea includes a lightweight, non-metal based, and comfortable device. We have also been given flexibility over the target age range and aesthetic appeal.

9/13/2024 - First Client Meeting

Molly Wilhelmson - Sep 13, 2024, 2:06 PM CDT

Title: First Meeting

Date: 9/13/1014

Content by: Molly

Present: Ella, Kate, Neel

Goals: Learn client expectations and thoughts about the project

Content:

As a team we compiled a list of questions for Dr. Jean Raquelme, our client, which is attached as a pdf. We decided to meet weekly, with some skip dates while she is out of town. She provided a pickup spot for materials, and we ordered a Happy light to use for testing. She is wanting to focus on the sensor for clinical use, as all existing models are not for this use. The sensor should be wearable and not slide off the face. It should measure light intensity hitting between the eye area for research interpretations. We discussed a glasses design or a headband design. She wanted us to decide on a lot of factors, like size, weight, target age range, and design. One important measure she mentioned was to avoid using metal for the components that might contact skin since sensitivities could exist. She recommended using plastic instead.

Conclusions/action items:

We will meet with her next Friday to discuss our PDS draft and ensure it aligns with her needs.

Molly Wilhelmson - Dec 10, 2024, 4:11 PM CST

1. What is the allotted budget for the semester?
Reimbursement, $500

2. Will this device be used more as a research tool, or for commercial use?
Research

3. What are your main goals for us this semester? Is there a specific part of the project you want to focus on - electronic component, attaching to glasses, etc.
Up to us, wearable, headband or glasses. Non-metal based. Happy light to test. Light reaching the area between the eyes

4. Is this a new project? Ongoing? What resources can we access?
New, scattered research.

5. How durable should our model be?

6. Is appearance important to you?
No

7. Should the device be able to grow/adapt with the user?

8. How often would you like to meet with the group?
Monday and thursday, not friday or saturdays

9. What difference from the circuit would you like to see? HDSD?
Clinical Use, rather than wildlife/geological research. No method in US measuring light reaching the eye during SAD. Do clinical trials to get a dose response curve. Meant for concentration issues and how much light

10. What are the biggest concerns you have with the devices currently on the market?
Heavy, feel comfortable using

11. Is a glasses type of device ideal for you?
Yes, non-obtructive, lightweight, cheap. Headlamp

12. Are there any specific materials you have in mind for this project?
Plastic or something, not metal (comfort in contact with skin)
Elastic headband

We can decide if we want to focus on adults, or include kids as well

1902 South Park, easiest point for drop off

Download

Client_Questions.pdf (60.3 kB)

9/20/2024 - Second Client Meeting

Kate Briesemeister - Sep 20, 2024, 12:41 PM CDT

Title: Second Client Meeting

Date: 9/20/2024

Content by: Kate Briesemeister

Present: Molly, Ella, Kate

Goals:

- update client about last weeks advisor meeting

- get client input on 2 of our preliminary designs

- walk client through upcoming deadlines and schedule

Content:

- updated the client on last weeks advisor meeting and our initial thoughts to make a basic circuit

- updated the client on our two design ideas and got feedback

- client thinks that the glasses design might be more consistent between patients

- however, client seems to be more inclined to the headlamp because of the feasibility of tilting it up and down

- client recommends minimizing disposable parts because that would complicate the environmental concerns

Conclusions/action items:

- continue to update our client with weekly progress report

- send client important upcoming dates

- discuss whether we want to do poster session in March and update the client with our final decision

11/8/2024 - Client Meeting

Molly Wilhelmson - Nov 13, 2024, 1:17 PM CST

Title: Third Client Meeting

Date: 11/8/2024

Content by: Molly

Present: Light Loggers

Goals: Share out team's progress this far

Content:

Consider adding ventilation if components heat up too much. She likes the adjustable headlamp. Sustainability: Battery is rechargeable? We need an on/off switch

Cleanable with wipes-consider in the report to weigh materials. UV radiation. Antimicrobial medical fabric. Elastic bands may not be washable, include in future work.

Conclusions/action items:

We gained useful insight into what to consider for sustainability of our design and for cleaning.

9/13/2024 - First Advisor Meeting

Molly Wilhelmson - Dec 10, 2024, 4:14 PM CST

Title: First Advisor Meeting

Date: 9/13/24

Content by: Ella Eklund

Present: Team

Goals:

-to talk to our advisor about our first client

-to gain knowledge about bio instrumentation

Content:

-focus on the infrared lower wavelength

-intensity to have an effect/intensity and power

-LED is power-hungry

Research

1. Biophysics - what light we need to get to the patient, optic parameters

2. Instrumentation - start building out the circuit to get to the design, LED driving circuits, optical sensor design

Need a light sensor to measure the light intensity - ask him

Laser Safety Officer

Get glasses for testing wavelengths - you can't see infrared so you can burn your cornea :0

Try to assess to do an electrical property through the university - there's a process - an advisor can help facilitate

PDS - follow the rubric to the tea, if the section not applicable have a headline that shows why we don't include

Can send advisor PDS early to get comments and help - submitted by noon Friday we are good

Conclusions/action items:

We will begin writing our first draft of the PDS, and continue initial research about biophysics and instrumentation.

9/20/2024 - Second Advisor Meeting

Kate Briesemeister - Sep 20, 2024, 2:01 PM CDT

Title: Second Advisor Meeting

Date: 9/20/2024

Content by: Kate Briesemeister

Present: Whole Team

Goals:

- update advisor on past weeks work

Content:

- first presentation coming up, we should be starting designs
- design matrices are garbage!
- get coin cell batteries to slot in to the circuit (CR2450), wouldn't require a huge box (battery/wireless over a wired system)
- CR2450 battery holder from digikey
- #1 challenge is the circuitry, let's focus time on that
    - raspberry pi with wifi capabilities, small circuit board, could handle everything for us
    - to take light measurements, integrate light sensors with a front end --> then, what circuitry needs to be attached to read in the data
    - we need an analog to digital convertor, get a small breadboard
    - start working on the analog circuitry, order a light sensor

Conclusions/action items:

- look through protocols to make sure we can operate safely
- do the design matrix, don't spend a lot of time on it, spend more time on actually developing designs
- figure out whether client wants to measure intensity or wavelength (if intensity, intensity at what wavelength)
- purchase (digikey or makerspace): CR2450 battery, CR2450 battery holder, analog to digital convertor, regular breadboard, light sensor
- complete design matrix and progress report #3 for next week

2024/9/27- Third Advisor Meeting

Molly Wilhelmson - Dec 10, 2024, 4:15 PM CST

Title: Third Advisor Meeting

Date: 9/27/24

Content by: Ella Eklund

Present: Team

Goals:

-Meet with our advisor to get advice on where we are at in the project

Content:

-make a sensor design matrix - include it in the preliminary presentation if the group thinks it is best

-sci-hub - articles and journals for free

-has a colleague design he will share with us

-plan ordering for materials after the presentation

-Raspberry PI: microcomputer, that reads data from sensors and processes it, the brain of the whole operation

Arduino processes in real-time, raspberry doesn't but acts as a control

-connects similarly to an Arduino, wires

-test Molly's photoresistor she already has, you may need to find a different one that reaches 1000 lux

-AD8276: single version op amp

-look for sensors and then order circuit components

-Laser safety team

DAC

-bit depth - taking snapshots of voltage in time and assigning to a digital value

we dont need high speed - having a higher bit rate is never a bad thing

SPI

-Data interface: I2C

-2450 is 3V

-We should purchase MCP4726A0 - E/CH

TLO71 or 72 - general op amps

Conclusions/action items:

We will begin making our design matrix for the sensor/instrumentation. We need to research sensors which detect high values of lux (10000 lux).

2024/10/18 - Fourth Advisor Meeting

Kate Briesemeister - Oct 25, 2024, 1:28 PM CDT

Title: fourth Advisor Meeting

Date: 10/18/24

Content by: Kate Briesemeister

Present: Kate, Ella, Neel

Goals:

- Meet with our advisor to get advice on where we are at in the project

Content:

- discussing our prototyping and circuitry progress

- suggestion of sewing the wire inside a sleeve onto the headband

- when unstretched, the wire would be coiled up inside the sleeve, would reach full length when stretched

- for the tiny parts - look for the notch to find pin one, align them, solder it to the red board (if we cant/struggle doing this, we can ask brandon for help and he will walk us through doing it (go to wimmer)

- Brandon suggests a broadband visible light sensor and call that good

- discussed the show and tell: we dont need to prep anything, just will set up a station

Conclusions/action items:

order photoresistor, schedule a time to solder with Brandon, continue working on code and circuitry.

2024/10/25 - Fifth Advisor Meeting

Molly Wilhelmson - Dec 10, 2024, 4:16 PM CST

Title: Fifth Advisor Meeting

Date: 10/25/24

Content by: Kate Briesemeister

Present: Whole team

Goals:

- Meet with our advisor to get advice on where we are at in the project

Content:

- ribbon cable to connect the breadboard in the front and in the back

Refer to below PDF written by Molly for details of this meeting

Conclusions/action items:

- order light sensors

- once parts arrive, go to WIMR to solder

- prep for show and tell

Molly Wilhelmson - Nov 01, 2024, 11:49 AM CDT

What vcc+ - do we need for voltage followers

Vcc- ground, vcc+ to input voltage, we only wanted positive voltage

Can our new light sensor be added to our current circuit design?

Flexible circuit board for new sensor. I to C outputs digital signal, btween chips and can find code for raspberry pi. Most work happens on the chip. Would need to learn digital protocol would be great. Single wavelength only 550nm. What is the wavelength? Broad band might be better. Two sensors! Converter. Solder sensor onto converter

Intensity at what wavelength-JEAN

Photodiode pin - analog front end, a to d in raspberry pi- pre amplifying stage. Easier worry less about the trans. In place of photoresistor

What are the pin numbers for the difference amplifiers.

Circle on op amp square pad is pin 1
Red is positive when multimeter reads positive, black goes to ground.
Ribbon cable.

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Untitled_document_8_.pdf (28.2 kB) Here are some notes taken by Molly during the fifth advisor meeting

2024/11/8 - Sixth Advisor Meeting

Kate Briesemeister - Nov 13, 2024, 2:56 PM CST

Title: Fifth Advisor Meeting

Date: 11/8/24

Content by: Kate Briesemeister

Present: Whole team

Goals:

- Meet with our advisor to get advice on where we are at in the project

Content:

- For adding in an on off switch:

- We could get a toggle switch or a button switch, we want to make sure its non momentary
- Single pull, single throw switch on the powerline
- 3.3 volt regulator - will make it turn on and off gracefully
- Battery will connect to the switch, output of the switch goes to regulator, regulator goes to the rest of the circuit
- Next week, shortened 15 minute meeting at 1:45pm in regular room after Tong lecture (12-1pm)
- For final poster and report: Think about what quantifications we want to make
    - Figure out percent error, how far off our measurements are from the happy light output
    - Create a signal to noise ratio:
        - Noise: sensor in dark room with no ambient light, what is the fluctuation (calculate a mean value), then put the sensor in different amounts of lights, report the worst value

Signal-to-Noise ratio

- SNR: ratio between signal power and noise power
- Definition:

$$SNR = \frac{P_{signal}}{P_{noise}} = \left(\frac{A_{signal}}{A_{noise}}\right)^2$$

$$SNR(dB) = 10\,^{10}\log\left(\frac{P_{signal}}{P_{noise}}\right) = 20\,^{10}\log\left(\frac{A_{signal}}{A_{noise}}\right)$$

Conclusions/action items:

- continue prototyping
- begin thinking about our final deliverables

2024/11/15 - Seventh Advisor Meeting

Kate Briesemeister - Nov 15, 2024, 2:02 PM CST

Title: Seventh Advisor Meeting

Date: 11/15/24

Content by: Kate Briesemeister

Present: Whole Team

Goals: update advisor on current status and receive feedback

Content:

- negative pin from battery is ground, attach alligator clip to the ground rail, positive end would go into the power rail to power the raspberry pi pico and circuit

- our blue wire is already connecting ground to ground. good!

- for a permanent solution, add headers and solder wires to headers for stability in the wires, eventually solder it all to a flat breadboard

- for website: reach out to Makerspace for help

- sensor calibration: set it at known lux values, measure voltage, create a fit line to create our own equation (ideally should be linear)

- velcro works just fine to connect the box to the front plate

- figure out how to velcro on the back box

Conclusions/action items:

- finish protoyping

- begin calibration

- try to be done with testing by next week

- get poster printed earlier rather than later (fastcopy/fastprint out of the chemistry department)

11/1/2024-Show and Tell feedback

Molly Wilhelmson - Nov 13, 2024, 2:08 PM CST

Title: Show and tell feedback

Date: 11/13/2024

Content by: Molly

Present: n/a

Goals: Summarize our thoughts after sharing our design with our peers at show and tell.

Content:

The main problem we wanted to address in our design was the sensor's ability to detect light from inside of our black box which contains the circuit board. We asked our peers for potential solutions, as well as feedback on our testing plan and the rest of our design.

To address our main question, some responses included, having the sensor stick out of the bottom of the black box, so it was more accurately placed on the bridge of the nose, using a clear cover for the circuit, and to glue it to the front panel of the box so that the circuit will not move and the sensor stays aligned with the hole.

We decided the last was the best option since we do not want exposed components to prevent damage, and increase the safety of the design. The clear cover idea may diffract or scatter the light reaching the sensor and decrease its accuracy. The last choice is feasible and is a great solution to our question.

Other feedback included using a smaller board using Adafruit, which could be great next steps if our current circuit design works as intended.

Conclusions/action items:

We will focus on designing our light logger as planned, and attach the circuit board to the front panel using adhesive so that data is accurate and safe.

2024/12/10 - Final Expenses Table

ELLA EKLUND - Dec 10, 2024, 2:41 PM CST

Title: Final Expenses Table

Date: 12/10/24

Content by: Ella Eklund

Present: N/A

Goals:

to document the final expenses table for the project

Content:

Component 1

Happy Light	Light for testing sensor	Verilux	N/A	9/13/24	2	$49.99	$99.98	Link

Component 2

Battery	Battery for chip	PGSONIC	CR2045	9/19/24	1	$1.15	$1.15	Link

Component 3

Head Lamp	Light that attaches to head	Fire Supply Depot	FL8210-6SMD	9/26/24	1	$11.92	$11.92	Link

Component 4

Raspberry Pi	Chip for coding	Raspberry Pi	Raspberry Pi Pico W	10/4/24	1	$7.20	$7.20	Link

Component 5

Comparator	Building circuit	Texas Instruments	LM393PE4	10/4/24	2	$0.25	$0.50	Link

Component 6

Battery Holder	Holder for coin battery	Digikey	BS-2450	10/4/24	1	$3.84	$3.84	Link

Component 7

OPAMP	Building circuit	Digikey	AD8276ARZ	10/4/24	1	$7.37	$7.37	Link

Component 8

IC DAC 12BIT V-Out	Building circuit	Digikey	MCP4726A0T-E/CH	10/4/24	3	$2.16	$6.48	Link

Component 9

OPAMP	Building circuit	Texas Instruments	UA741CN	10/25/24	2	$0.25	$0.50 Link
Component 10							
Breadboard	Building circuit	Busboard Prototype Systems	BB400	10/25/24	1	$2.00	$2.00 Link
Component 11							
Sensor 550NM	Measure light values	Digikey	OPT3007YMFT	10/31/24	1	$2.79	$5.42 Link
Component 12							
Sensor Photodiode 900NM	Measure light values	Digikey	BPW34S-ND	10/31/24	1	$1.58	$4.21 Link
Component 13							
DFN to DIP SMT adapter	Allows for soldering components to breadboard	Digikey	IPC0083-ND	10/31/24	1	$4.79	$7.42 Link
Component 14							
Ribbon Cables	Flexible wire connection around head strap	Amazon	B08LPFX7QN	10/31/24	1	$10.39	$10.39 Link
Component 15							
Spandex	Flexible wire enclosure around head strap	Joann Fabrics	N/A	11/6/20241		$7.92	$7.92 N/A
Component 16							
Micro Usb Cable	Longer cord connection from device to computer	Amazon	N/A	11/24/24	1	$7.69	$8.11 Link
TOTAL:	**$184.41**						

Conclusions/action items:

After calculating our final expenses table, we can share this information with our client to guarantee reimbursement.

11/13/2024- Voltage to Light Intensity

Molly Wilhelmson - Nov 13, 2024, 3:52 PM CST

Title: Voltage to Light Intensity

Date: 11/13/2024

Content by: Molly

Present: Light Loggers

Goals: Plan out what our code will look like to calculate the light intensity.

Content:

Light sensor = 550 kHz bandwidth, 900nm, 430nm-1100nm

Wheatstone bridge Vout = Vb-Va

Vout = (R3R2-R1R4) / (R1+R2)(R2+R4)

For our circuit Vout = (Rsensor*10k - 10k*10k) / (20k)(Rsensor*10k)

Va = 3.3 V (10k/(10k+Rsensor))

Vb = 3.3V (10k/20k)

Vout for voltage follower = same as wheatstone bridge at each terminal

Vout = Vnoninverting-Vinverting

Conclusions/action items:

These will be useful in computing ideal voltage and current values to test our circuit using an digital multimeter

2024/12/10 - Final Prototype

ELLA EKLUND - Dec 10, 2024, 2:31 PM CST

Title: Final Prototype

Date: 12/10/24

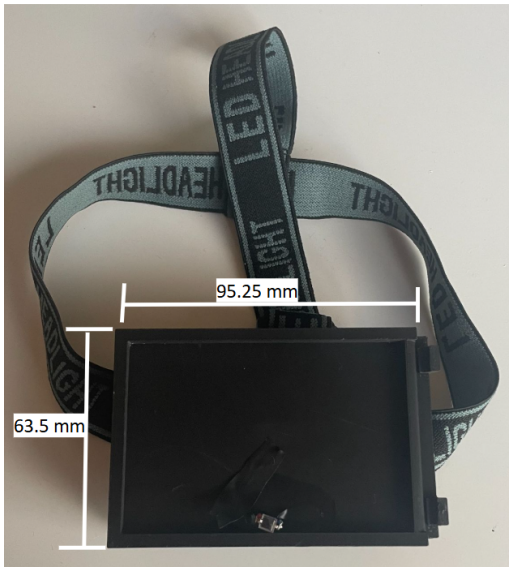
Content by: Ella Eklund

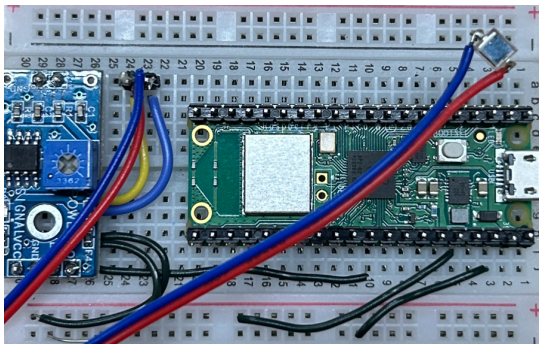
Present: N/A

Goals:

to show the final prototype

Content:





```
from machine import ADC, Pin
import time
import math

adc = ADC(Pin(26))

def read_voltage_u16():
    adc_value = adc.read_u16()
    adc_real = 65535 - adc_value
    voltage = (adc_real / 65535) * 3.3
    return voltage

def calculate_lux(voltage):
    if voltage <= 0:
        raise ValueError("0 lux")

    lux = (math.log(voltage / 0.0702)) / 0.000162
    return lux

while True:
    voltage = read_voltage_u16()
    try:
        lux = calculate_lux(voltage)
        print("Illuminance: {:.2f} lux".format(lux))
    except ValueError as e:
        print("Error computing lux:", e)
    time.sleep(0.5)
```

Final wearable device, circuitry, and code for the project

Conclusions/action items:

After completing the final wearable device, circuitry, and code, these images and descriptions can be added to the final report and shared with our client and advisor.

2014/12/10- Method for Fabrication

ELLA EKLUND - Dec 10, 2024, 2:38 PM CST

Title: Method for Fabrication

Date: 12/10/24

Content by: Ella Eklund

Present: N/A

Goals:

to describe the methods for fabrication

Content:

Method:

-The circuitry aspect of the design was constructed by attaching the potentiometer and Raspberry Pico to the breadboard.

-The photodiode sensor was soldered to two headers and then connected to the potentiometer and Raspberry Pico via wires.

-The potentiometer was turned to ensure maximum sensitivity of the sensor's readings.

-The sensor was soldered onto two longer wires so it could poke through the hole in the circuit box.

-The sensor was connected to the potentiometer with the correct polarity to ensure accurate readings.

-The box containing the circuitry was 3D printed and two holes were extruded from the box by drilling, chiseling, and filing.

-The circuitry was inserted inside the box with the sensor protruding out the hole on the lid of the box.

-The sensor was secured with tape to ensure no movement during testing.

-The headlamp originally purchased was altered by removing the light portion and filing down the remaining components for a flat surface on the front plate.

-Hook and loop connectors were attached to the back of the box and the front plate of the headlamp.

-The two connections were then secured and the Raspberry Pi was connected to the laptop via a micro USB cable.

-The code was created using a calibration curve to take the input voltage and convert it into illuminance in lux, then display it on the serial monitor.

-To create the calibration curve, average voltages were recorded at three known light intensities, then connected with an exponential line of fit in Excel.

Conclusions/action items:

After outlining the method for fabrication, the team can insert this into our final report and communicate it with our advisor and client.

2024/12/10 - Sensor Calibration Protocol

ELLA EKLUND - Dec 10, 2024, 1:43 PM CST

Title: Sensor Calibration

Date: 12/10/24

Content by: Ella Eklund

Present: N/A

Goals:

-to calibrate the sensor with the Happy Light and create protocol

Content:

Calibration Protocol:

1. Sensor was situated 30.5 cm in front of happy light

2. Sensor was connected to micro python code

3. Light was turned off to create pitch black environment and sensor recorded three set values of HappyLight (5000, 7500, 10000 lux)

4. Voltage values recorded from sensor at each different lux setting were calculated into an average

5. Calibration curve was made with set lux values and average voltage values recorded from microcontroller

6. Calibration equation was completed:

Calibration equation:

y = 0.0702e^1.62E-04x
y is voltage, x is light intensity (lux)

7. Calibration equation was inserted into the code and calibration is complete.

Conclusions/action items:

After concluding the calibration of the sensor, the team is ready to test the sensor in different conditions and determine if calibration was correct.

ELLA EKLUND - Dec 10, 2024, 1:44 PM CST

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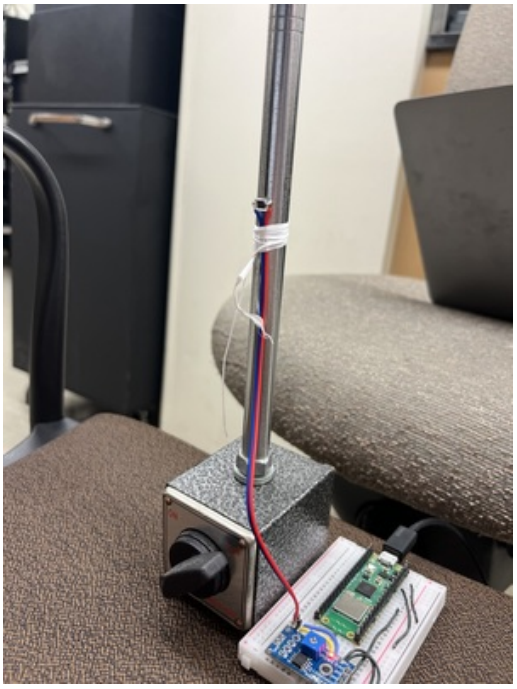
IMG_4562.jpg (4.11 MB)

ELLA EKLUND - Dec 10, 2024, 1:44 PM CST



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IMG_4563.jpg (3.6 MB)

2024/12/10 - Accuracy Testing Protocol

ELLA EKLUND - Dec 10, 2024, 1:56 PM CST

Title: Accuracy Testing Protocol

Date: 12/10/24

Content by: Ella Eklund

Present: N/A

Goals:

to create a protocol for accuracy testing of the sensor

Content:

1. The Wearable Light Logger was worn on the head with the sensor near the bridge of the nose

2. HappyLight was placed 30.5 cm in front of the user

3. The sensor was plugged into the code

4. In a dark room, three light settings of HappyLight were turned on (5000, 7500, and 10000 lux). The sensor recorded voltage values for each light setting.

5. Protocol was repeated, in a room with ambient lighting, and voltage values were recorded.

6. Voltage values from each light setting and dark and ambient lighting were calculated to an average

Conclusions/action items:

After completing the protocol, there are now set steps for accuracy testing of the sensor if it needs to be replicated in the future. The protocol can now be added into the final report.

2024/12/10 - Comfortability of Wearable Device Protocol

ELLA EKLUND - Dec 10, 2024, 2:05 PM CST

Title: Comfortability of Wearable Device Protocol

Date: 12/10/24

Content by: Ella Eklund

Present: N/A

Goals:

to complete the protocol for the comfortability of the wearable device

Content:

1. A survey was conducted on Google forms

2. Survey respondents would wear the Wearable Light Logger for several minutes

3. Survey respondents would respond to the following questions

- Is the device comfortable? (rated on a scale of 1-5)
- Does the device fit your head?
- Is the device's weight comfortable?
- Would you feel comfortable wearing this device for 2 hours?

4. After answering questions, the responses of each survey respondent were recorded.

Conclusions/action items:

After completing the protocol for the comfortability of the wearable device, the protocol can now be completed in the future if need be. The protocol can now be inserted into the final report.

2024/12/10 - Accuracy Testing Results

ELLA EKLUND - Dec 10, 2024, 2:14 PM CST

Title: Accuracy Testing Results

Date: 12/10/24

Content by: Ella Eklund

Present: N/A

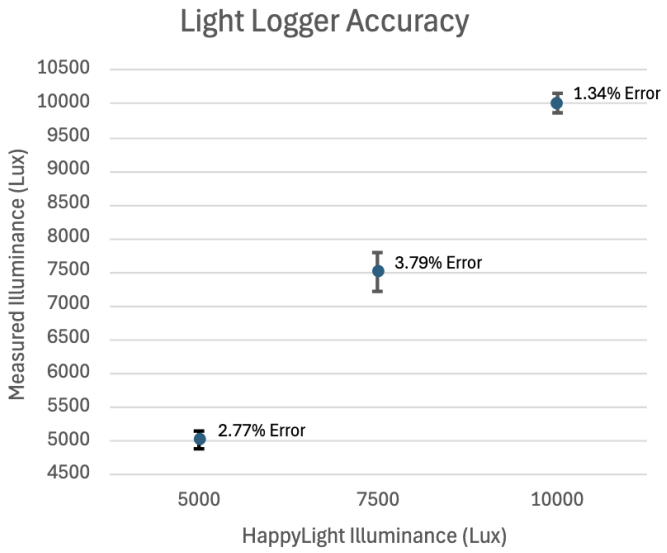
Goals:

to analyze results of accuracy testing of the sensor

Content:

After following the accuracy testing protocol, the results followed:

The results from the accuracy test yielded less than 5% error for both trials; dark light and ambient light. Results from the trial in a dark room show that at 5000 lux of incoming light emitted from the HappyLight, had a 2.77% error, at 7500 lux there was a 3.79% error, and at 10,000 lux there was a 1.34% error. In our discussion the team decided that using the device in a dark room would be best so those values were plotted.



After testing, the team feels confident that the sensor is accurate for the three values from the happy light. In the future, we would like to test the sensor with other light sources at other lux to see how those results yield.

Conclusions/action items:

After receiving the results from the accuracy of the sensor testing, this information can be inserted into our final report and communicated with our advisor and client.

2024/12/10 - Comfortability Results

ELLA EKLUND - Dec 10, 2024, 2:21 PM CST

Title: Comfortability of the Wearable Device Results

Date: 12/10/24

Content by: Ella Eklund

Present: N/A

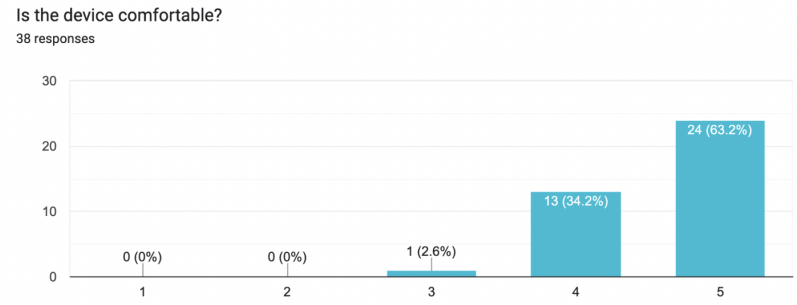
Goals:

to discuss the results from the Comfortability of the Wearable Device

Content:

After following the protocol of the comfortability of the wearable device, the survey respondents responded with the following data:

After having participants wear the device for several minutes, 38 survey responses were recorded, with generally favorable results. All responses (100%) indicated that the design was comfortable enough to be worn for two-hour intervals, the maximum time of use suggested by the client. Comfort ratings were also positive with 63.2% rating the device 5 out of 5 and 34.2% assigning a 4 out of 5. Additionally, 100% of participants stated that the device fits their head properly and that the weight of the device was comfortable.



1: Extremely uncomfortable 5: Extremely comfortable

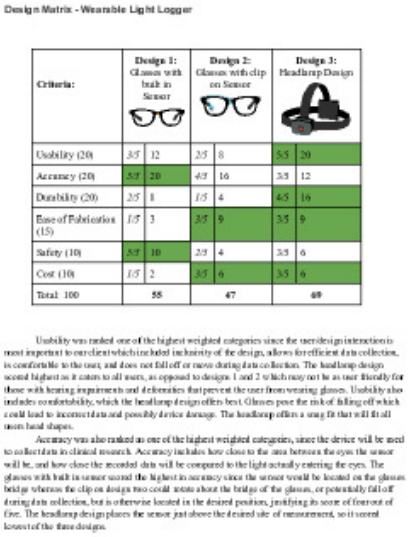
These results show that the design successfully met all of the client's criteria that were evaluated. The positive feedback suggests that the design will be successful in its intended use, in terms of wearability and comfortability.

Conclusions/action items:

After receiving the results from the comfortability of the wearable device testing, the team feels confident that the device is comfortable. The results can be inserted into our final report and shared with our client and advisor.

2024/9/27 - Design Matrix - Wearable

ELLA EKLUND - Sep 27, 2024, 1:48 PM CDT



Design Matrix - Wearable Light Logger

Criteria:	Design 1: Glasses with built in Sensor		Design 2: Glasses with clip on Sensor		Design 3: Headlamp Design	
Usability (20)	3/5	12	2/5	8	5/5	20
Accuracy (20)	5/5	20	4/5	16	3/5	12
Durability (20)	2/5	8	1/5	4	4/5	16
Ease of Fabrication (15)	1/5	3	3/5	9	3/5	9
Safety (10)	5/5	10	2/5	4	3/5	6
Cost (10)	1/5	2	3/5	6	3/5	6
Total 100	55		47		69	

Usability was ranked one of the highest weighted categories since the user/design interaction is most important to our client which included the brevity of the design, allows for efficient data collection, is comfortable to the user, and does not fall off or move during data collection. The headlamp design scored highest as it caters to all users, as opposed to designs 1 and 2 which may not be as user friendly for those with hearing impairments and deformities that prevent the user from wearing glasses. Usability also includes comfortability, which the headlamp design offers best. Glasses pose the risk of falling off which could lead to incorrect data and possibly device damage. The headlamp offers a snug fit that will fit all users head shapes.

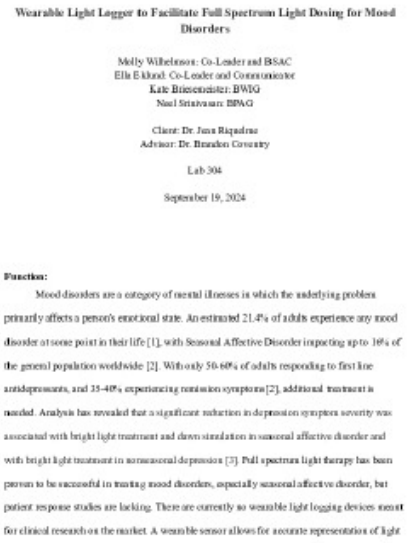
Accuracy was also ranked as one of the highest weighted categories, since the device will be used to collect data in clinical research. Accuracy includes how close to the area between the eyes the sensor will be, and how close the recorded data will be compared to the light actually entering the eyes. The glasses with built in sensor scored the highest in accuracy since the sensor would be located on the glasses bridge whereas the clip on design two could rotate about the bridge of the glasses, or potentially fall off during data collection, but is otherwise located in the desired position, justifying its score of four out of five. The headlamp design places the sensor just above the desired site of measurement, so it scored lowest of the three designs.

Download

Design_Matrix-Wearable_Light_Logger.pdf (258 kB)

10/8/2024-Product Design Specification

Molly Wilhelmson - Oct 08, 2024, 3:20 PM CDT



Wearable Light Logger to Facilitate Full Spectrum Light Dosing for Mood Disorders

Molly Wilhelmson: Co-Leader and BSAC
Ella Ekland: Co-Leader and Communicator
Kate Briesemeister: BWIG
Neel Srinivasan: BPAG

Client: Dr. Juan Riquelme
Advisor: Dr. Brandon Coventry

Lab 304

September 19, 2024

Function:

Mood disorders are a category of mental illnesses in which the underlying problem primarily affects a person's emotional state. An estimated 21.4% of adults experience any mood disorder at some point in their life [1], with Seasonal Affective Disorder impacting up to 10% of the general population worldwide [2]. With only 50-60% of adults responding to first line antidepressants, and 35-40% experiencing remission symptoms [2], additional treatment is needed. Analysis has revealed that a significant reduction in depression symptom severity was associated with bright light treatment and dawn simulation in seasonal affective disorder and with bright light treatment in nonseasonal depression [3]. Full spectrum light therapy has been proven to be successful in treating mood disorders, especially seasonal affective disorder, but patient response studies are lacking. There are currently no wearable light logging devices meant for clinical research on the market. A wearable sensor allows for accurate representation of light

Download

PDS_Draft.pdf (295 kB)

Molly Wilhelmson - Oct 11, 2024, 3:38 PM CDT

BME Design 200 and 300

Wearable Light Logger for the Treatment of Mood Disorders

BME Design 200 & 300: Product Design Specifications

Date: September 19, 2024

Project title: Wearable Light Logger to Facilitate Full Spectrum Light Dosing for Mood Disorders

Group members
Leader: Molly Wilhelmson and Ella Ekland
Communicator: Ella Ekland
BSAC: Molly Wilhelmson
BWIG: Kate Briesemeister
BPAG: Neel Srinivasan

Client: Dr. Juan Riquelme
Advisor: Dr. Brandon Coventry

Function

Mood disorders constitute a category of psychiatric conditions characterized by disturbances in an individual's emotional state. Research indicates that approximately 21.4% of adults will experience a mood disorder at some point during their lifetime [1], with Seasonal Affective Disorder (SAD) impacting up to 10% of the population worldwide [2]. The effectiveness of first-line antidepressants is questionable, with a response rate of just 50-60% in adults, while only 35-40% experience remission symptoms [2]. Additional treatment apart from medication is necessary to increase response rates and remission. Analysis has revealed that a significant reduction in depression symptom severity was associated with bright light treatment and dawn simulation in seasonal affective disorder and with bright light treatment in nonseasonal depression [3]. Full-spectrum light therapy has shown efficacy in treating mood disorders, especially seasonal affective disorder, however patient response studies are lacking. Patient response studies are crucial in determining the exact treatment of mood disorders, as factors like light intensity could be determined for the ideal remission of symptoms. Research is needed to study the exact conditions of light therapy needed to best treat disorders like SAD. With data regarding the light intensity that best reduces symptoms of SAD, more concise prescriptions can be made for patients with SAD or similar mood disorders. Thus, a measurement device is warranted to characterize which conditions result in the most remission of symptoms of mood disorders. A wearable light logger would provide convenient research into what correct dosages for optimal patient response look like for patients suffering from mood disorders. A wearable sensor allows for an accurate representation of light intensities that reach the retina, the presumed site of action.

Client requirements

- Functional wearable device that can record the amount of illuminance in lux near the retina

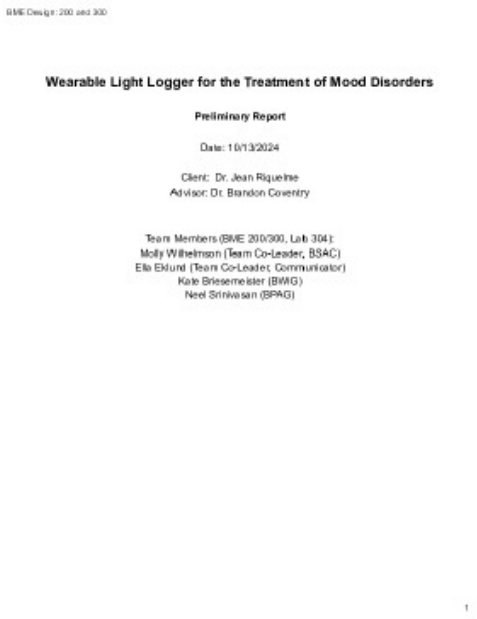
1

Download

Wearable_Light_Logger_-_Product_Design_Specification.pdf (82.4 kB) Updated PDS according to advisor's suggestions

2024/11/13 - Preliminary Report

ELLA EKLUND - Nov 13, 2024, 2:08 PM CST



BME Design: 200 and 300

Wearable Light Logger for the Treatment of Mood Disorders

Preliminary Report

Date: 10/13/2024

Client: Dr. Jean Riquelme
Advisor: Dr. Brandon Coventry

Team Members (BME 200/300, Lab 304):
Molly Wilhelmson (Team Co-Leader, BSAC)
Ella Eklund (Team Co-Leader, Communicator)
Kate Briesemeister (BWG)
Neel Srinivasan (BPAG)

1

Download

Wearable_Light_Logger_-_Preliminary_Report_1_.pdf (1.9 MB)

2024/12/8 - Final Poster

Kate Briesemeister - Dec 08, 2024, 3:40 PM CST

Download

Final_Poster_1_.pdf (1.8 MB)

2024/9/12- Light Therapy in Treatment of Mood Disorders

ELLA EKLUND - Sep 12, 2024, 1:53 PM CDT

Title: Light Therapy in Treatment of Mood Disorders Research

Date: 9/12/24

Content by: Ella Eklund

Present: N/A

Goals:

-to learn about how light therapy is used to treat mood disorders

-to understand light therapy in general

Content:

Name: "The efficacy of light therapy in the treatment of mood disorders: a review and meta-analysis of the evidence"

Source: PubMed

Link: https://pubmed.ncbi.nlm.nih.gov/15800134/

Citation:

R. N. Golden *et al.*, "The Efficacy of Light Therapy in the Treatment of Mood Disorders: A Review and Meta-Analysis of the Evidence," *American Journal of Psychiatry*, vol. 162, no. 4, pp. 656–662, Apr. 2005, doi: https://doi.org/10.1176/appi.ajp.162.4.656.

- The purpose of this study was to assess the evidence base for the efficacy of light therapy in treating mood disorders

-analyses revealed that a significant reduction in depression symptom severity was associated with bright light treatment and dawn simulation in seasonal affective disorder and with bright light treatment in nonseasonal depression.

-eight studies, having an effect size of 0.84 and 95% confidence interval [CI] of 0.60 to 1.08| five studies; effect size=0.73, 95% CI=0.37 to 1.08| three studies; effect size=0.53, 95% CI=0.18 to 0.89 (data for each study set)

-Adopting standard approaches to light therapy's specific issues and incorporating rigorous designs are necessary to evaluate light therapy for mood disorders.

-This analysis of randomized, controlled trials suggests that bright light treatment and dawn simulation for seasonal affective disorder and shining light for nonseasonal depression are efficacious, with effect sizes equivalent to those in most antidepressant pharmacotherapy trials.

Conclusions/action items:

After reading this article on light therapy for mood disorders, I have gained an understanding that light treatment is efficient for treating mood disorders in some aspects. It was effective regarding seasonal affective disorder and nonseasonal depression. The study regarded light therapy as equivalent to antidepressant pharmacotherapy. After doing this research, I must share what I learned with my teammates.

ELLA EKLUND - Sep 12, 2024, 1:55 PM CDT

Reviews and Overviews

The Efficacy of Light Therapy in the Treatment of Mood Disorders: A Review and Meta-Analysis of the Evidence

Robert N. Golden, M.D.
Bradley N. Gaynes, M.D., M.P.H.
R. David Ekstrom, M.A., M.P.H.
Robert M. Hamer, Ph.D.
Frederick M. Jacobsen, M.D., M.P.H.
Trisha Suppes, M.D., Ph.D.
Katherine L. Wisner, M.D.
Charles B. Nemeroff, M.D., Ph.D.

Am J Psychiatry 2005; 162:656–662

The development of light therapy in psychiatry is closely intertwined with the original description of the syndrome of seasonal affective disorder. Two decades ago, Rosenthal and colleagues (1) described a series of patients with histories of recurrent depressions that developed in the fall or winter and spontaneously remitted during the following spring or summer. Their initial report also included preliminary findings indicating that bright artificial light, administered in a manner that would in essence extend the photoperiod, was more effective than dim light in treating seasonal affective disorder. The article presented an underlying hypothesis about the pathophysiology of the syndrome (i.e., depressogenic effects of melatonin), which in turn shaped the selection of treatment parameters; the interval, duration, and timing of bright light exposure were designed to suppress the release of melatonin and lengthen the photoperiod.

Both seasonal affective disorder and bright light therapy quickly captured considerable attention, both in the scientific community and with the general public. Several research groups launched clinical trial programs, and soon this experimental treatment was extended to other conditions, including nonseasonal mood disorders, Alzheimer's disease, circadian-related sleep disorders and jet lag, eating disorders, and other behavioral syndromes (2,

3). An international organization (the Society for Light Treatment and Biological Rhythms) was created, and several journals that emphasized phototherapy and biological rhythms emerged. Despite the growth in clinical and research programs, there remained an absence of recognition and support for light therapy within many segments of the psychiatric treatment community. Most insurers do not offer reimbursement for this treatment, most residency training programs do not provide clinical training in phototherapy, and there is unease that "the biological psychiatry establishment has regarded light therapy with a certain disdain and relegated it to the edge of the paradigm" (4).

The American Psychiatric Association (APA) Council on Research requested that the APA Committee on Research on Psychiatric Treatments use the principles of evidence-based medicine to examine the efficacy of light therapy (J. Greden, personal communication). A work group was formed from members of the committee as well as outside consultants with expertise and experience in relevant disciplines. The work group completed a comprehensive literature review and meta-analysis. This report contains our findings about the efficacy of light therapy in the treatment of mood disorders in adult patients.

656 http://ajp.psychiatryonline.org Am J Psychiatry 162:4 April 2005

Download

golden-et-al-2005-the-efficacy-of-light-therapy-in-the-treatment-of-mood-disorders-a-review-and-meta-analysis-of-the.pdf (146 kB)

2024/9/12- Treatment for Seasonal Depression

ELLA EKLUND - Sep 12, 2024, 7:44 PM CDT

Title: Treatment Measures for Seasonal Affective Disorder Research

Date: 9/12/24

Content by: Ella Eklund

Present: N/A

Goals:

-to focus on seasonal affective disorder and its treatment measures

-to gain more knowledge on how light treatment specifically treats seasonal affective disorder

Content:

Name: "Treatment measures for seasonal affective disorder: A network meta-analysis"

Source: PubMed

Link: https://pubmed.ncbi.nlm.nih.gov/38220102/

Citation:

Z.-W. Chen, X.-F. Zhang, and Z.-M. Tu, "Treatment measures for seasonal affective disorder: A network meta-analysis," *Journal of Affective Disorders*, vol. 350, pp. 531–536, Apr. 2024, doi: https://doi.org/10.1016/j.jad.2024.01.028.

- The purpose of this study was to assess the potential effectiveness of several mainstream therapies, including phototherapy, antidepressants, cognitive-behavioral therapy, and negative ion generators, in the treatment of Seasonal Affective Disorder (SAD).

-A total of 21 randomized controlled trials, involving 1037 participants, were included.

-The standardized mean difference of depression scores and corresponding 95 % confidence intervals were calculated to assess the efficacy of phototherapy for Seasonal Affective Disorder.

-Phototherapy exhibited statistically significant mild to moderate therapeutic effects in alleviating depressive symptoms and can be considered as a clinical therapy for treating Seasonal Affective Disorder

-However, the quality of evidence remains low, and further well-designed, larger sample sizes, and high-quality studies are needed to confirm the efficacy of phototherapy in treating Seasonal Affective Disorder.

Conclusions/action items:

After this review article, I have gained even more knowledge about the results of how light therapy has helped seasonal depression. The effects were moderately helpful in alleviating depressive symptoms and can be considered as therapy. Looking forward I need to share this information with my team to share the results.

2024/10/12 - Light Reaching Retina

ELLA EKLUND - Oct 12, 2024, 5:23 PM CDT

Title: Light Reaching Retina Research

Date: 10/12/24

Content by: Ella Eklund

Present: N/A

Goals:

-to gain a better understanding on what occurs when light reaches the retina and what occurs in the brain

Content:

Title: "How light reaches the eye and its components"

Source: PubMed

Citation: D. H. Sliney, “How light reaches the eye and its components,” *International Journal of Toxicology*, vol. 21, no. 6, pp. 501–509, Nov. 2002, doi: https://doi.org/10.1080/10915810290169927.

- The human eye is exquisitely sensitive to light (i.e., visible radiant energy), and when dark-adapted, the retina can detect a few photons of blue-green light.

-ocular tissues are also more vulnerable to ultraviolet (UV) and light damage than the skin.

-humans have evolved with certain anatomical, physiological, and behavioral traits that protect this critical organ from the UV damage that would otherwise be certain from the intense bath of overhead solar ultraviolet radiation (UVR) when we are outdoors during daylight.

-There are three critical ocular structures that could be affected by UV exposure: the cornea, the lens, and the retina.

- The cornea transmits radiant energy only at 295 nm and above.

-The crystalline lens absorbs almost all incident energy to wavelengths of nearly 400 nm.

-Thus there are intraocular filters that effectively filter different parts of the UV spectrum and allow only of the order of 1% or less to actually reach the retina.

Conclusions/action items:

After researching about how light reaches the eye, I have gained more knowledge on what parts of the eye are affected. After learning this information, I need to share with my teammates to write our relevant physiology of the project.

2024/10/12- Eye Basics Research

ELLA EKLUND - Oct 12, 2024, 5:58 PM CDT

Title: Basics of the Eye Research

Date: 10/12/24

Content by: Ella Eklund

Present: N/A

Goals:

-to understand the very basics of the eye

-to understand how light transforms once it reaches the eye to the brain

Content:

Title: How the Eyes Work

Source: National Eye Institute

Citation: National Eye Institute, “How the Eyes Work | National Eye Institute,” Nih.gov, Apr. 20, 2022. https://www.nei.nih.gov/learn-about-eye-health/healthy-vision/how-eyes-work

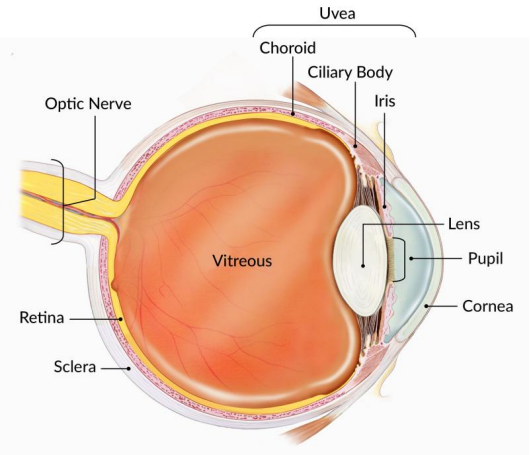
-First, light passes through the cornea (the clear front layer of the eye). The cornea is shaped like a dome and bends light to help the eye focus.

-Some of this light enters the eye through an opening called the pupil (PYOO-pul). The iris (the colored part of the eye) controls how much light the pupil lets in.

-Next, light passes through the lens (a clear inner part of the eye). The lens works together with the cornea to focus light correctly on the retina.

-When light hits the retina (a light-sensitive layer of tissue at the back of the eye), special cells called photoreceptors turn the light into electrical signals.

-These electrical signals travel from the retina through the optic nerve to the brain. Then the brain turns the signals into the images you see.



Conclusions/action items:

After this source, I feel that I have gained a lot more knowledge about how light actually ends up reaching the retina. I now understand that once light reaches the retina, photoreceptors turn the light into electric signals for the brain. I now need to share this information with my team.

2024/10/12- Light Improving Mood

ELLA EKLUND - Oct 12, 2024, 6:26 PM CDT

Title: Light Therapy and Serotonin Testing

Date: 10/12/24

Content by: Ella Eklund

Present: N/A

Goals:

-To understand how light therapy improves mood and how serotonin is boosted

Content:

Title: Light therapy and serotonin transporter binding in the anterior cingulate and prefrontal cortex

Source: PubMed

Citation:

S. J. Harrison et al., “Light therapy and serotonin transporter binding in the anterior cingulate and prefrontal cortex,” Acta Psychiatrica Scandinavica, vol. 132, no. 5, pp. 379–388, Apr. 2015, doi: https://doi.org/10.1111/acps.12424.

Testing Objective:

To investigate the effects of light therapy on serotonin transporter binding (5-HTT BPND), an index of 5-HTT levels, in the anterior cingulate and prefrontal cortices (ACC and PFC) of healthy individuals during the fall and winter. Twenty-five per cent of healthy individuals experience seasonal mood changes that affect functioning. 5-HTT BPND has been found to be higher across multiple brain regions in the fall and winter relative to spring and summer, and elevated 5-HTT BPND may lead to extracellular serotonin loss and low mood. We hypothesized that, during the fall and winter, light therapy would reduce 5-HTT BPND in the ACC and PFC, which sample brain regions involved in mood regulation.

Results of Testing:

In winter, light therapy significantly decreased 5-HTT BPND by 12% in the ACC relative to placebo ($F_{1,9} = 18.04$, $P = 0.002$). In the fall, no significant change in 5-HTT BPND was found in any region across conditions.

Significant Outcomes:

-Serotonin transporter binding was significantly reduced in the anterior cingulate cortex (ACC) of healthy individuals following light therapy relative to placebo during the winter months.

-First evidence of the involvement of the serotonin transporter in the ACC, a brain region with a known role in antidepressant response, in the therapeutic effects of light therapy.

-Identification of a central biomarker that could be applied in the future to assess the effect of modifications of light therapy (i.e., modifications that lead to greater effect on the biomarker could be selected for further investigation).

Conclusions/action items:

After reading this test, I now have some concrete evidence that light therapy can boost serotonin in the brain during the winter months which helps alleviate the symptoms of SAD. After this research, I need to share this information with my team.

2024/10/12 - Safety of Light Therapy

ELLA EKLUND - Oct 12, 2024, 6:36 PM CDT

Title: Safety of Light Therapy

Date: 10/12/24

Content by: Ella Eklund

Present: N/A

Goals:

-to determine if light therapy is safe and if there are any cases where light therapy can be harmful

Content:

Title: Light Therapy: is it safe for the eyes?

Source: PubMed

Citation:

A. Brouwer et al., “Light therapy: is it safe for the eyes?,” Acta Psychiatrica Scandinavica, vol. 136, no. 6, pp. 534–548, Sep. 2017, doi: https://doi.org/10.1111/acps.12785.

-This source did a testing of all sources on PubMed at that time that mentioned discomforts with light therapy treatment

- Ocular complaints, including ocular discomfort and vision problems, were reported in about 0% to 45% of the participants of studies involving light therapy. Based on individual studies, no evident relationship between the occurrence of complaints and light therapy dose was found. There was no evidence for ocular damage due to light therapy, with the exception of one case report that documented the development of a maculopathy in a person treated with the photosensitizing antidepressant clomipramine.

- Results suggest that light therapy is safe for the eyes in physically healthy, unmedicated persons. The ocular safety of light therapy in persons with preexisting ocular abnormalities or increased photosensitivity warrants further study. However, theoretical considerations do not substantiate stringent ocular safety-related contraindications for light therapy.

Conclusions/action items:

After reading this article, I have learned that light therapy can lead to some ocular discomfort but very rarely are their serious injuries or diagnoses. After learning this information I need to share it with my team.

2024/10/12 - SAD Light treatment

ELLA EKLUND - Oct 13, 2024, 3:36 PM CDT

Title: SAD Light Treatment

Date: 10/12/24

Content by:

Present:

Goals:

Content:

Title**: Bright Light Therapy: Seasonal Affective Disorder and Beyond**

Source**:** PubMed

Citation**:**

P. D. Campbell, A. M. Miller, and M. E. Woesner, “Bright Light Therapy: Seasonal Affective Disorder and Beyond,” The Einstein journal of biology and medicine : EJBM, vol. 32, pp. E13–E25, 2017, Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6746555/

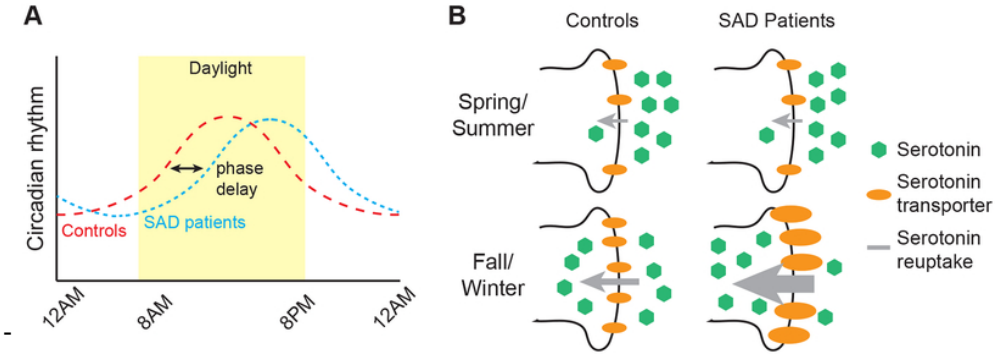
Abstract:

Since the first description of Seasonal Affective Disorder (SAD) by Rosenthal et al. in the 1980s, treatment with daily administration of light, or Bright Light Therapy (BLT), has been proven effective and is now recognized as a first-line therapeutic modality. More recently, studies aimed at understanding the pathophysiology of SAD and the mechanism of action of BLT have implicated shifts in the circadian rhythm and alterations in serotonin reuptake. BLT has also been increasingly used as an experimental treatment in non-seasonal unipolar and bipolar depression and other psychiatric disorders with known or suspected alterations in the circadian system. This review will discuss the history of SAD and BLT, the proposed pathophysiology of SAD and mechanisms of action of BLT in the treatment of SAD, and evidence supporting the efficacy of BLT in the treatment of non-seasonal unipolar major depression, bipolar depression, eating disorders, and ADHD.

Important facts:

-Once these electric signals reach the brain, the light signals the brain to produce serotonin, a neurotransmitter that can improve mood, energy, and focus. It has been hypothesized that bright light therapy may function by either correcting the winter circadian rhythm phase delay or by increasing synaptic serotonin, possibly in the serotonin-rich midbrain.

-Several studies have also proposed that serotonin is implicated in the pathophysiology of SAD, as selective serotonin reuptake inhibitors (SSRIs) appear to be effective in the treatment of SAD



Conclusions/action items:

After learning about light therapy regarding circadian rhythm, I feel that I have a much better understanding about hwat is exactly happening in the brain when light therapy reaches the photoreceptors. Now I need to update my team about this information.

2024/10/13- Timing of Light Exposure

ELLA EKLUND - Oct 13, 2024, 3:56 PM CDT

Title: Timing of Light Exposure Research

Date: 10/13/24

Content by: Ella Eklund

Present: N/A

Goals:

to gain a better understanding of how light exposure affects the body's natural rhythms.

Content:

Title: **Timing of light exposure affects mood and brain circuits**

Source: PubMed

Citation: T. A. Bedrosian and R. J. Nelson, “Timing of light exposure affects mood and brain circuits,” Translational Psychiatry, vol. 7, no. 1, pp. e1017–e1017, Jan. 2017, doi: https://doi.org/10.1038/tp.2016.262.

Light Detection and Circadian Function

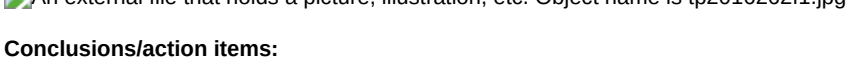
In mammals, the retina detects light using specialized photoreceptor cells. The classical photoreceptors, rods and cones are primarily responsible for image-forming vision. The third class of photoreceptors, called intrinsically photosensitive retinal ganglion cells (ipRGCs), perform non-image-forming functions, including circadian phototransduction. ipRGCs represent a small fraction of the larger class of retinal ganglion cells, but their expression of the photopigment melanopsin makes them uniquely photosensitive

Aberrant Light Exposure and Mood

Given the sensitivity of the molecular clock to the timing, intensity and spectra of illumination, artificial light at night can cause serious circadian and physiological disruption. Exposure to light at night is prevalent throughout life, beginning in early childhood and extending into old age. This chronic level of nighttime light exposure is unprecedented in human history. A growing body of research shows that one consequence of nighttime lighting is disrupted mood regulation and that humans are sensitive across the lifespan.

Rhythmic Expression of Clock Genes

Clock gene disruption is another core contributor to the effects of light at night. Exposure to light at night alters expression of clock genes and interacts with existing circadian gene variants that may predispose to mood disorders. Mice and hamsters exposed to dim light at night consistently show blunted amplitude of clock gene expression in the brain. Circadian genes appear to have critical roles in mood regulation, as mutations in a number of them have been linked to various behavioral impairments related to mood.


An external file that holds a picture, illustration, etc. Object name is tp2016262f1.jpg

Conclusions/action items:

After learning even more advanced research about the body's timings in regard to light exposure, I now understand how people with SAD body functions can improve with light therapy. After learning this knowledge, I must share this information with my team.

2024/9/12- Light Therapy Lamp

Title: Light Therapy Lamp

Date: 9/12/24

Content by: Ella Eklund

Present: N/A

Goals:

-to find a current light therapy lamp on the market

Content:

Name: Carex Day-Light Classic Plus Light Therapy Lamp

Link: https://carex.com/products/carex-day-light-classic-plus-light-therapy-sun-lamp?variant=30226595151977&currency=USD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&gac
4RXToxhQ7NxG1XC8fqRR1ne1BNe0EX2MFcjhUpcjbAY7sBhoC7sgQAvD_BwE

-Cost: $134.99

-delivers 10,000 LUX of glare-free light from a comfortable sitting distance

-Safety to use, blocks 100% of UV

-Projects light downward to mimic sunlight as recommended by experts

Conclusions/action items:

After looking at an on-market light therapy I realize its issues in accordance to our project. Our project needs to be wearable lightweight and affordable. Go think of this "competing design."

2024/9/11- BME Career Prep

ELLA EKLUND - Sep 11, 2024, 2:09 PM CDT

Title: BME Career Fair

Date: 9/11/2024

Content by: Ella Eklund

Present: BME 300 Lecture

Goals:

-to prep for the career fair

-to learn tips and tricks and guidance for the career fair and future career in general

Content:

-keep track of what you do - ECS tracking sheet

- connect BEFORE you are a candidate

-Applying is step 1 - follow-up is required

-Think beyond the title - focus on skills, industry, exposure

-Don't let perfect be the enemy of good

Resume Tips

-create balance - show a full picture of your experience

-MS Word!

-Don't use cover letters at the career fair

Career Fair

Looking beyond the obvious - overlap with other disciplines

Research the employer - feedback from our partners

Develop your "value-added" statement - why you?

Fall Career Fair

Sept 16-19

11 am - 5 pm

EH lobby, ME lobby and ECB lobby

Different employers on each day

Conclusions/action items:

Overall, I am feeling much better about the career fair and feel a lot of my questions have been answered.

2024/9/18- Leadership Style

ELLA EKLUND - Sep 18, 2024, 1:58 PM CDT

Title: Exploring your Leadership Style

Date: 9/18/24

Content by: Ella Eklund

Present: N/A

Goals:

-to explore leadership styles and what applies to me

Content:

-do I see myself as a leader?

-what are the important qualities of a leader?

Confidence, communication, understanding, organized, humility

-Anatomy of a good leader

Self-awareness: understand weaknesses and strengths

Vision: having a direction

Transparent: clear communication

Communication

Decision Making

Empathy

Leadership Styles

1. Power Model

"Someone has to take control here, and it should be me" - being in control is the most important thing

2. Servant

"It's not about me and my needs, the needs of my followers are most important" - Sharing power, listening, and understanding

3. Authentic

"By being my genuine self, I will gain and build trust" - Building self-esteem and self-awareness, emotional intelligence

4.People-Oriented Leader

5.Process-Oriented Leader

6.Thought-Oriented Leader

Leading others starts with leading yourself!

Self-assess, observe & reflect, seek out feedback

Goal Setting

I would like to work on decision-making and relying more on myself to take more action and be more assertive in situations where I am not comfortable

Conclusions/action items:

After the lecture today I feel much more aware of my leadership style and what changes I can make in the future to become an even better leader.

2024/9/25- BME Advising and Post Graduate Planning

ELLA EKLUND - Sep 25, 2024, 2:03 PM CDT

Title: BME Advising and Fall Planning

Date: 9/25/2024

Content by: Ella Eklund

Present: N/A

Goals:

-to learn about post-graduation options for BMEs

Content:

-Think about letter writers or references early

-What programs have the opportunities you are looking for?

Thesis Statement

-start with what you want to do

-personal statement: show a reasonable idea

-Defend your plan with your life experiences

-CV to some extent in paragraph form

Grad School Options

-Masters: industry-focused, generally one year, rewrite your story, will make you more desirable, more experiences, fill gaps in your resume, higher level of skills, higher starting salary (1200 a credit), another opportunity for summer for internships, can co-op during the MS as well, time to find the dream job

Research: for those continuing for a PhD

Accelerated Program: coursework only, independent study/research is allowed, Funding (TA only) stipend only (no tuition remission $1200/credit)

Biomedical innovation, design, and entrepreneurship: project-based - project required (BME Design project continuity), partnership with business school, Funding (TA only) stipend only (no tuition remission $1200/credit)

Application

-Applying next fall, statement of purpose, why you want to pursue further education, don't need letters of reccomendation for accelerated

You can also take your master's elsewhere at other schools

Conclusions/action items:

ELLA EKLUND - Sep 25, 2024, 4:23 PM CDT

Forgot to add conclusion:

After a very helpful lecture about the options I have after graduating I feel much better about my options. I think I am leaning more into the accelerated masters program, so I will have to debate if that is a choice I want for my future.

2024/10/02 - Near Peer Mentoring

ELLA EKLUND - Oct 02, 2024, 2:09 PM CDT

Title: Near Peer Mentoring

Date: 10/2/24

Content by: Ella Eklund

Present: N/A

Goals:

to get some more tips and tricks about peer mentoring

Content:

Why Mentor?

-Additional instructional and emotional support for students

-Peer mentors are more approachable, mentees are more willing to ask questions

-Share experiences

-Increases belonging

-Mutual benefits

Transferrable Skills

Leadership, communication, active listening, study practices

General Benefits of Mentoring

-Increased self-esteem/confidence

-Increased patience

-Build positive habits

-Foster personal growth

-Help identify gaps in your knowledge

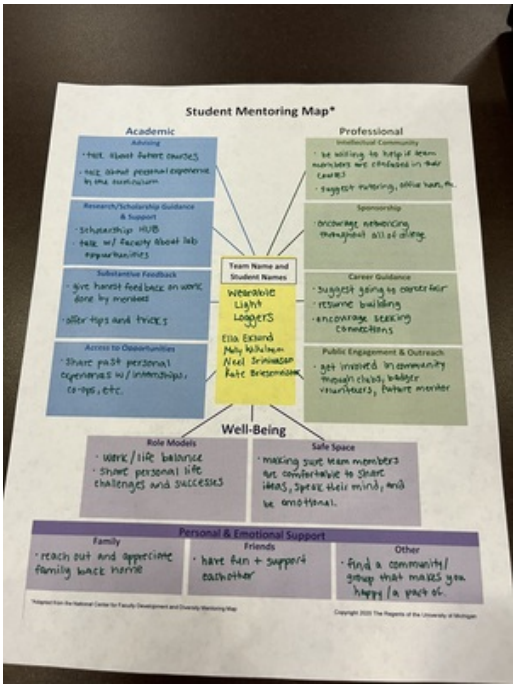
-Sense of accomplishment

What do I wish I knew in BME 200?

internships, more Solidworks knowledge, report skills, helping decide a track, advice for junior year, lab archives

Conclusions/action items:

ELLA EKLUND - Oct 02, 2024, 2:04 PM CDT



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2024/10/09- Sustainable Engineering

ELLA EKLUND - Oct 09, 2024, 1:58 PM CDT

Title: Sustainable Engineering

Date: 10/9/24

Content by: Ella Eklund

Present: N/A

Goals:

-to learn more about sustainable engineering

Content:

-The healthcare sector is approximately 5% of global emissions

-Circular economy: keeping things out of landfills

-Eutrophication: too many nutrients in a waterway

-Life Cycle Assessment: how you get a carbon footprint

How does sustainability fit into your project?

*Disposal of resistors and op amps and sensors - recycle those or find an environmental way to replace those components

Conclusions/action items:

After this invigorating lecture, we have learned much about sustainability and how we can apply this to our project. In the future we must share this information with our sophmores.

2024/10/16 - WARF

ELLA EKLUND - Oct 16, 2024, 2:02 PM CDT

Title: Introduction to WARF, IP, Disclosing & Licensing

Date: 10/16/24

Content by: Ella Eklund

Present: N/A

Goals:

to learn more about the WARF program and patenting

Content:

WARF - supports the university through patenting and licensing

-Technology Transfer: Moving research results from campus out into the market. WARF works at this interface to facilitate securing IP rights and commercial licenses

-Intellectual Property Overview

The four common types of IP:

1. Patents

2. Copyrights

3. Trademarks

4. Trade Secrets

5. Others: Biomaterials, technique and know-how, data

Overview of Non-Patent IP

Copyrights: protection for creative works that are expressed in a tangible medium, a wide range of subject matter, including software code

Trademarks: Protection for names, marks, logos, dress, etc, requires use in commerce, source-identifying function

Trade secrets: can be used to protect anything of value, protection is good so long as the concept is not generally known

Patent: property right, granted by a governmental agency

-patent holder has right to exclude others from making, using, selling, or importing the claimed invention

Three different types of US patents

1. Design (15-year term, limited to ornamental features)

2.Plant (new variety, 20-year term, asexually reproducing, non-tuber)

3.Utitlity

-Issued for the invention of a new and useful process, machine, manufacture, or composition of matter

-A quid pro quo with the USPTO and the public

-Often takes 2-5 years to issue after filing (patent examination)

-Costs, on average, $30k

Requirements for patenting

-eligible

-novel

-non-obvious

-enabled and described

patent examiners are scientists hired and trained by USPTO to review patent applications for these requirements

Disclosing an innovation to WARF

-Disclosing: describe the advantages, identify its advantages & potential applications, name contributors, provide funding and public disclosures

Assesing University Inventions

WARF bases its decision on accepting an innovation into our portfolio on:

IP Considerations:

-Type of IP protection

-Potential breadth and strength of IP Protection

-Public disclosure (past and planned)

-Stage of development

Marketing and Licensing

-Market Analysis

-License negotiation

-Ongoing

Value of Licensing

Benefits to the Company: reduced R&D costs, improved time to market, oppurtunity to enter new markets and expand your company quickly, new features or products provide additional revenue oppurtunities

Conclusions/action items:

After a very eye opening lecture, I feel that I have gained a much better understanding on the patenting process at UW Madison and how WARF helps student patenting. After going through this process slightly freshamn year, this presentation really soldified my knowledge.

2024/10/23 - IRB

ELLA EKLUND - Oct 23, 2024, 2:03 PM CDT

Title: IRB Lecture

Date: 10/23/24

Content by: Ella Eklund

Present: N/A

Goals:

-learn what an IRB is and how it works

Content:

IRB = Institutional Review Board

-committee that conducts ethical and regulatory reviews or research involving human participants

-IRBS were in response to unethical research - ethical principles - human research regulations

Several infamous studies were completed which led to regulations for the protection of human "subjects"

-1947 Nuremberg Code

-Tuskegee Syphilis Study

-Milgram shock experiments at Yale

UW Madison IRBs

-Minimal Risk Research IRB (Biomedical, education, and social/behavioral sciences research)

-Health Sciences IRB (Biomedical, interventional, any risk level)

-Serve UW Madison, UW Health affiliates, Madison VA Hospital

-May "cede" oversight to other institutions or independent IRBs

Questions to guide:

Is it research under the Common Rule?

-Research means a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge

Does it involve human subjects (Common Rule)?

-Human subject means a living individual about whom an investigator conducting research:

-obtains info or biospecimens through intervention or interaction and uses studies or analyzes the information or biospecimens

Is it human research under FDA device regs?

-Device

-Research/clinical investigation

-Subject

Preparing for IRB Review

-Researcher Responsibilities

--complete required training for researchers through CITI

--complete annual Outside Activities Reports

Conclusions/action items:

After a refreshing lecture about IRBs, I have gained a lot more knowledge on how IRBs work and the process of conducting IRBs for human subjects.

2024/10/30 - Navigating FDA Device Requirements

ELLA EKLUND - Oct 30, 2024, 2:09 PM CDT

Title: Navigating FDA Device Requirements

Date: 10/30/24

Content by: Ella Eklund

Present: N/A

Goals:

to learn about the FDA regulations and clinical trials

Content:

Medical Device: anything that is intended to improve help but not through chemical or biological action

Traditional Medical Devices: MRI, syringes, bandages, ECG

Non-Traditional: Apple watch, oral health mouthwash

Device Classification Overview

Classes of Marketed Medical Devices: Device classes, risk, marketing, examples

Regulatory Controls Key Elements: General controls (registration and listing), Special controls (performance standards), pre-market approval (data to show safety and effectiveness)

Class I Devices - low-risk level, mostly exempt from the premarket notification and quality system requirements, self-registration and listing with the FDA

Class II Devices - moderate risk, must follow general and special controls which can include performance standards, submission of a 510(k) application to show substantial equivalence

Class III Devices - high risk, must follow general controls and additional stringent requirements, such as clinical trials to demonstrate safety and efficacy

Market Submission Types:

-510k exempt - registration and listing only

-510k - Premarket Notification - substantial equivalence

-PMA premarket approval - full safety and effectiveness submission, manufacturing details

-De Novo Classification - Novel medical devices, no legally marketed predicate

How to Classify a Medical Device

-Product Code

-Search Regulation Number

-Quality Management Systems

Conclusions/action items:

After this FDA lecture, I learned a lot about how the FDA administers its regulations and how it applies to certain medical devices based on their risk and complexness. After this lecture, I could share this information with the sophomores in my group to let them know.

2024/11/06 - Regulatory Strategy

ELLA EKLUND - Nov 06, 2024, 2:03 PM CST

Title: Regulatory Strategy: The Framework Guiding Advanced Therapeutic Product Development

Date: 11/6/2024

Content by: Ella Eklund

Present: N/A

Goals:

To learn about what guides therapeutic product development

Content:

FDA Structure and Advanced Therapeutics

-Genome editing, gene delivery, cell therapy

-Device (CDRH), Drug (CDER), Biologic (CBER)

FDA Framework: Developing CGT Products for Hemophilia

-US laws (made by congress)--- Regulations (CFR Title 21)(are made by FDA based on laws)--- FDA Guidance(are made by FDA with help from the public to help industry and the public interpret regulations)

Dramatic Implications: 351 vs. 361

-Human cells, tissues, and cellular and tissue-based products (HCT/Ps)

-Minimally manipulated yes or no

Yes: Homologous use? (Same function) No: 351

351 and 361 are markedly different in terms of the time, effort, and expense required to bring a product. 351 products are regulated as drugs and or biologics, while 361 products, comparatively, are largely unregulated

A Target Product Profile (TPP) is your Product Vision

-When to use it, why to use it, how to use it

-Patient identification: Indication

-Patient benefits: Efficacy profile

-Patient risks: Safety Profile

-Is it medically and commericially compelling?

Considerations when Developing a 351-Regulated CGT

-Time = $

-Nonclinical, quality, clinical, regulatory

Conclusions/action items:

ELLA EKLUND - Nov 06, 2024, 7:14 PM CST

After an invigorating lecture, I learned so much about the FDA framework on therapeutics. After this lecture I need to tell my team about what I learned and how it can apply to our project.

2024/11/13 - Medical Device Innovation

ELLA EKLUND - Nov 13, 2024, 2:02 PM CST

Title: Medical Device Innovation From Prototype to Commercial Clinical Use

Date: 11/13/24

Content by: Ella Eklund

Present: N/A

Goals:

-to learn more the process of medical device innovation

Content:

Medical Device FDA pathways

Class I Device - 501k exempt

Class II Device - Premarket Notification 510(k), de novo, Humanitarian Device Exemption (HDE)

Class III Device - Premarket approval (PMA)

Regulatory Timelines

Breakthrough Devices Program

-Elon Musk Neuralink device Blindsight has submitted to be a part of the program but needs to go through all of the processes until commercially available

New Medical Technology Ecosystem

GPO, IDN (Integrated Delivery Network), HER, IT, JIT

Workflow: Patient Care Pathway as a Starting Point

-Diagnosis -- Procedure -- Support -- CPT, billing, Insurance

Stakeholders

-Patient

-National/Regional Groups

-Standards organizations

-National and Regional Payment/ Reimbursement

-National Clinical Oversight

-Administrative

Who Buys, Pays and gets Reimbursed (It depends!)

If device adds cost but saves in length of say, it can affect savings

Existence of codes do not equal financially favorable

Conclusions/action items:

After an inviting lecture, I feel that I have learned alot more about what to consider in the process of creating medical devices and trying to reach the market. I think this information will be very useful in the future if I gain a career in the medical device industry.

2024/11/15 - Tong Lecture

ELLA EKLUND - Nov 15, 2024, 12:54 PM CST

Title: Tong Lecture

Date: 11/15/24

Content by: Ella Eklund

Present: All BMEs

Goals:

to understand Tasso and gain advice and knowledge from its founders

Content:

-Tasso offers at home blood drawing services

-No one likes the blood drawing process

-Get scrappy with funding oppurtunities

-Evolution of the technology

---make a better product, kill your product when needed

-Finding a key customer

-Quality is key!

FDA

-Read the labels - easy to overanalyze what regulators say they "want" to do

Conclusions/action items:

2024/11/20 - New Product Development in Medical Device Industry

ELLA EKLUND - Nov 20, 2024, 2:07 PM CST

Title: How New Product Development Works in the Medical Device Industry

Date: 11/20/24

Content by: Ella Eklund

Present: N/A

Goals:

-to understand how new product development works in the medical device industry

Content:

-NPD in the medical device industry

-Highly regulated: FDA and other regulatory bodies have a significant impact

-Expensive: Requirement for verification and validation is a cost multiplier

-Resoucre intensive: Involves sizeable teams to execute projects

Strategy

-corporate business strategy -- product portfolio review -- project review -- budgeting and resource allocation

Types of NPD Projects

-Line extensions: Addition of additonal sizes and configurations

Highly interdisciplinal team involved in project development

Stages

Stage 0: Ideation

Stage 1: Exploration -- Define the problem to be solved

Stage 2: Concept development -- 1 leading concept

Stage 3: Design development -- begin formal design control documentation

Stage 4: Design confirmation -- conduct extensive verification and validation testing

Stage 5: Design Transfer and Commercialization -- complete any remaining testing and make final design changes

Post Market Surveillance

-regulatory agencies expect that companies are monitoring and documenting customer complaints and field issues post launch

-project teams report out to stakeholders

Case Study

ORwell Fluid Management Study

Conclusions/action items:

After the end of the lecture, I have learned that medical device development is expensive, complex, and a highly collaborative effort. This is the field I would like to advance my career in so I am grateful to have gained some knowledge today from the speaker.

9/15/2024 - The efficacy of light therapy in the treatment of mood disorders: a review and meta-analysis of the evidence

Kate Briesemeister - Nov 14, 2024, 7:46 PM CST

Title: The efficacy of light therapy in the treatment of mood disorders: a review and meta-analysis of the evidence

Date: 9/15/2024

Content by: Kate Briesemeister

Present: N/A

Goals:

- Begin understanding how light exposure affects mood disorders

- Understand potential side effects / negative effects of light exposure

- Investigate why there doesn't exist a lot of literature surrounding light exposure therapy

Content:

- There remains an absence of support for light therapy within the psychiatric community
- Most insurance companies do not reimburse this kind of treatment
- “the biological psychiatry establishment has regarded light therapy with a certain disdain and relegated it to the edge of the paradigm”
- One issue with creating a significant clinical trial is it is hard to find a placebo for light therapy
- The study showed light therapy being beneficial in seasonal affective disorder and nonseasonal depression
- There are side effects to light therapy: headache, eye strain, nausea, agitation
- This study excluded kids and seniors, focusing only on adults aged 18-65

Citation: R. N. Golden et al., “The Efficacy of Light Therapy in the Treatment of Mood Disorders: A Review and Meta-Analysis of the Evidence,” American Journal of Psychiatry, vol. 162, no. 4, pp. 656–662, Apr. 2005, doi: https://doi.org/10.1176/appi.ajp.162.4.656

Conclusions/action items: This article gave a lot of valuable information surrounding what light therapy is, how it affects the brain, and provided evidence of the positive affects it has. The article was a great basis of knowledge and a good place to start in terms of research.

9/15/2024 - What is the optimal implementation of bright light therapy for seasonal affective disorder (SAD)?

Kate Briesemeister - Sep 15, 2024, 2:29 PM CDT

Title: What is the optimal implementation of bright light therapy for seasonal affective disorder (SAD)?

Date: 9/15/2024

Content by: Kate Briesemeister

Present: N/A

Goals:

- Understand more about SAD and what it entails

- Learn about the correlation between light therapy and SAD

- Understand more specifics of how exactly light therapy works, the process of using light therapy

Content:

- Patients most likely to benefit from light therapy are ones with SAD (seasonal affective disorder), that completely goes away in the spring and summer months
- The most beneficial dose of light is 5000 lux hours per day
    - This could mean 30 min of 10,000 lux
    - (lux is the unit of luminance, one lumen per square meter)
- Studies indicate that treatment before 8am is ideal
- The light is usually angled towards the face, 16 inches away
- Common side effects: headache, nausea, agitation
    - Temporarily stopping or moving farther from the light can fix these issues

Citation:

R. D. Levitan, “What is the optimal implementation of bright light therapy for seasonal affective disorder (SAD)?,” Journal of Psychiatry and Neuroscience, vol. 30, no. 1, p. 72, Jan. 2005, Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC543845/

Conclusions/action items: This article gave good information surrounding how light therapy is used and set up for a patient. The article is encouraging me to look more into loght wavelengths, luminance, and other details surrounding how light affects the brain specifically.

9/15/2024 - Bright Light as a Personalized Precision Treatment of Mood Disorders

Kate Briesemeister - Sep 15, 2024, 2:41 PM CDT

Title: Bright Light as a Personalized Precision Treatment of Mood Disorders

Date: 9/15/2024

Content by: Kate Briesemeister

Present: N/A

Goals:

- Understand how bright light therapy affects specific parts of the brain and it's functions

- Understand the difference between the affects on seasonal vs non seasonal mood disorders

Content:

- Bright-light Therapy (BLT) can resynchronize the bodies circadian rhythm, enhance alertness, and effect neurotransmitter pathways
- BLT effects can depend on light intensity, wavelength, duration, and time of day
- Side effects are generally mild and can include nausea, diarrhea, headache, and eye irritation
- BLT can be used to counteract winter darkness
- This review explores unipolar and bipolar disorders, along with seasonal and non-seasonal characteristics
- There were 4 sections, BLT in BD depression, BLT in non-seasonal depression, BLT in SAD, and BLT for sleep abnormalities associated with mood disorders

Citation:

J. Maruani and P. A. Geoffroy, “Bright light as a personalized precision treatment of mood disorders,” *Frontiers in Psychiatry*, vol. 10, no. 85, Mar. 2019, doi: https://doi.org/10.3389/fpsyt.2019.00085

Conclusions/action items: This article provided a lot of valuable information and key details on what types of mood disorders are best helped by bright light therapy.

10/13/2024 - Seasonal Affective Disorder

Kate Briesemeister - Oct 13, 2024, 2:38 PM CDT

Title: Seasonal Affective Disorder

Date: 10/13/2024

Content by: Kate Briesemeister

Present: N/A

Content:

- SAD: depression symptoms coinciding with seasonal patterns, typically occurs in fall and winter

- in the US, about 2% of people have SAD

- "In a given year, about 5 percent of the U.S. population experiences SAD, with symptoms lasting approximately 40 percent of the year."

- SAD is more predominate in women

- circadian phase delay / circadian rhythm disruptions

- SAD is said to be a complicated mix of a lot of factors

- symptoms typically look similar to general depression but further investigation can identify a correlation with the seasons

- an evaluation using clinical tools is required to make a diagnosis

Citation:

S. L. Kurlansik and A. D. Ibay, “Seasonal Affective Disorder,” *American Family Physician*, vol. 86, no. 11, pp. 1037–1041, Dec. 2012, Available: https://www.aafp.org/pubs/afp/issues/2012/1201/p1037.html

10/13/2024 - Mood Disorders

Kate Briesemeister - Nov 14, 2024, 7:47 PM CST

Title: Mood Disorders

Date: 10/13/2024

Content by: Kate Briesemeister

Present: N/A

Content:

- Mood disorders (also called affective disorders) are divided into two categories: depressive and bipolar

- mood disorders can be best described as prevalent occurrences of emotional disturbances. These disturbances impact negatively an individuals quality of life and increase the risk of suicide

- depressive disorders are characterized by feelings of depression like a down mood, irritability, and a feeling of sadness or emptiness

- bipolar disorders are characterized by alternating mood episodes of depression and mania

- diagnosis of a mood disorder comes from a clinical evaluation by a psychiatrist who will look at past mood episodes, general medical history and family medical history

- to treat depressive disorders, typically SSRIs and SNRIs are the first recommendation

- depending on the evaluation of the patient, other types of medication can also be an option.

- psychotherapy (CBT, interpersonal therapy, and behavioral activation) can also be used in combination with medication

- bipolar disorders have a wide range of potential treatment options.

- wide variety of medications some including: lithium, divalproex sodium, and antipsychotics.

- other treatment method such as CBT, several forms of therapy, and peer programs can be used in combination with medication

Citation:

S. Datta, U. Suryadevara, and J. Cheong, “Mood Disorders,” *CONTINUUM: Lifelong Learning in Neurology*, vol. 27, no. 6, pp. 1712–1737, Dec. 2021, doi: https://doi.org/10.1212/con.0000000000001051

2024/11/15 - Tasso Lecture

Kate Briesemeister - Nov 15, 2024, 12:58 PM CST

Title: Tasso Lecture

Date: 11/15/25

Content by: Kate Briesemeister

Goals: Learn about entrepreneurs Erwin Berthier, PhD and Benjamin Casavant, PhD, founders of Tasso.

Content:

- Tasso: painless at home blood collection kit, meant to simplify the process

- a blood draw can be the difference between receiving the care you need, or not

- Tasso was an idea that came out of the research lab, the idea that the future of healthcare is in the home

- during prototyping, leaning on support and resources within Madison, just scraping by with what they could (money and materials)

- as grad students, writing A LOT of grants, trying to do whatever they could, getting scrappy

- were able to get a $150k grant with a $25 prototype, proved that their idea was feasible

- discovered that there was a lack of knowledge about capillary anatomy, found a professor doing research, were able to revamp their idea according to this new info to become a leader in the space

- **sometimes you have to kill products to get to a better product**, people will be unhappy but it's ok if you are doing it for the right reasons

- identifying a key costumer: someone in the pharma industry that had a failing clinical trial due to having to use a lancet for blood draw (painful and awful). from there, they were able to convert the whole pharma industry to Tasso

- then, they were drowning in a sea of possibility, grassroots effort, **focusing in on solving individual customer problems was what led to their success,** putting one foot in frot of the other

- baseball players requested a tamper proof box so players could do their anti-doping blood draws and send them in securely

- Tasso now does the anti-doping testing for most of the sports in the US (MLB, UFC), now they can use this fun fact in any sales conversation ever!

- business growth came during COVID, at home testing was a HUGE need, they were super backlogged, they very quickly switched to a larger warehouse

- when you scale up, remember that quality is key, one bad customer can kill the concept

- regulatory strategy:

  - read the labels, easy to over analyze, **find ways to simplify the product by using off the shelf or labeled components,** can you use what already exists advantageously?
  - you need someone who is aggressive enough in the regulatory space, not playing it too safe

- if you have an idea and you believe in it, go for it, you will figure it out along the way

- when you hit roadblocks, focus on innovation, creativity, and collaboration to get through them

- Tasso: Italian for badger ROLL BADGE!

- how did they realize they were good partners? they had fun together, half fun half work, finding someone who will go for the idea, no ego with each other, trust in each others character and ethic, **there is always going to be disagreements but as long as you trust their conscience you can take a step back**

Conclusions/action items:

main takeaways:

10/25/24 - Light Sensor Options

Kate Briesemeister - Nov 13, 2024, 3:16 PM C

Title: Light Sensor Options

Date: 10/25/24

Content by: Kate Briesemeister

Goals: Compare and contrast 2 light sensor options

Content:

Cut Tape:

-

Pin Diode:

- pin photodiode

- $2.67

- wavelength: 900nm

- spectral range: 430nm - 1100nm

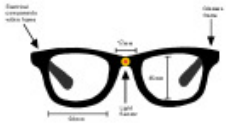
Conclusions/action items:

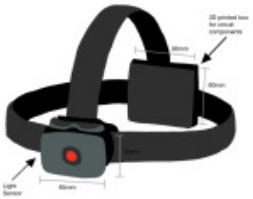
Cut tape: https://www.digikey.com/en/products/detail/texas-instruments/OPT3007YMFT/7896945

Pin diode: https://www.digikey.com/en/products/detail/vishay-semiconductor-opto-division/BPW34S/4071244?utm_adgroup=&utm_source=google&utm_medium=cpc&utm_campaign=PMax%20Supplier_Focus%20Supplier&utm_term=&utm_content=&utm_id=go_cr20243063242_adg-_ad-__dev-c_ext-_prd-4071244_sig-CjwKCAjwjsi4BhB5EiwAFAL0YK7VUusBmORoYFRx8tJlGwGwa1zuc9vNcfMLjvUiuETn-vz1kpTynxoCs_QQAvD_BwE&gad_source=1&gclid=CjwKCAjwjsi4BhB5EiwAFAL0YK7VUusBmORoYFRx8tJlGwGwa1zuc9vNcfMLjvUiuETn-vz1kpTynxoCs_QQAvD_BwE

9/26/2024 - Design Sketches

Kate Briesemeister - Nov 14, 2024, 7:31 PM CST





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Note_Sep_26_2024.pdf (1.7 MB)

Kate Briesemeister - Nov 14, 2024, 7:33 PM CST

Title: Design Sketches

Date: 11/14/24

Content by: Kate Briesemeister

Present: N/A

Goals: Sketches for Design Matrix

Content:

- attachment below

Conclusions/action items:

11/14/24 - CAD Files for Box

Kate Briesemeister - Nov 14, 2024, 7:41 PM CST

Title: CAD File Options

Date: 11/14/24

Content by: Kate Briesemeister

Present: N/A

Goals:

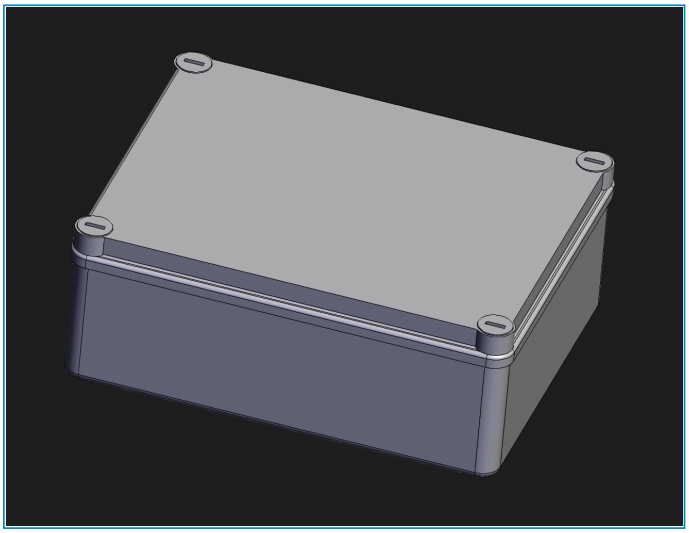
- find a box design to use for enclosing circuit components

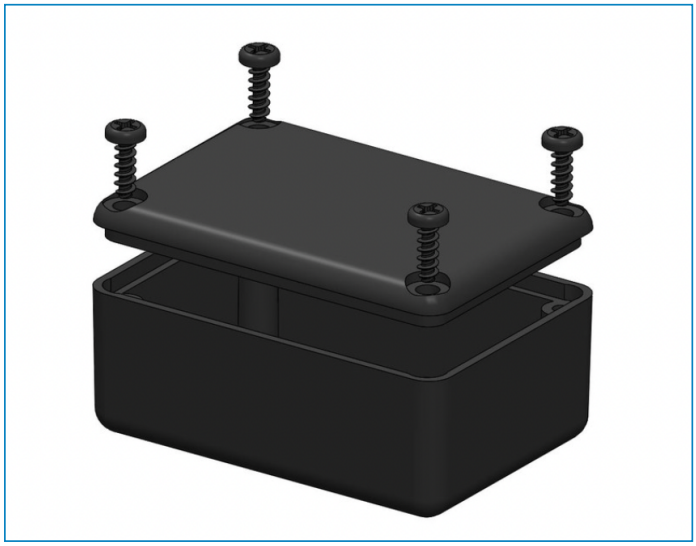
Content:

2 design options:

- https://grabcad.com/library/luca-00856-abb-box-1

- https://grabcad.com/library/camdenboss-abs-encapsulation-box-with-lid-40-x-28-x-18-1





Conclusions/action items:

2024/11/15 - Measurements for Boxes

Kate Briesemeister - Nov 19, 2024, 8:34 PM CST

Title: Dimensions for 3D printed boxes

Date: 11/15/24

Content by: Kate Briesemeister

Present: N/A

Goals: take measurements with calipers for 3D printed boxes.

Content:

- front box internal measurements: W 53.7 mm, L 81.8mm, H 14mm

- back box internal measurements: W 53.7 mm, L 81.8mm, H 20.5mm

- 4mm total leeway, 2mm on each side

- material: Ultimaker, PLA, Black, $0.05/gram

Conclusions/action items:

2024/12/8 - Final CAD Files

Kate Briesemeister - Dec 08, 2024, 3:22 PM CST

Title: Final CAD Files

Date: 12/8/24

Content by: Kate Briesemeister

Kate Briesemeister - Dec 08, 2024, 3:23 PM CST

Download

final-top-box.STL (1.48 kB)

Kate Briesemeister - Dec 08, 2024, 3:23 PM CST

Download

Back_box_bottom_lamp.STL (5.28 kB)

9/10/2024-Light Therapy

Molly Wilhelmson - Sep 10, 2024, 8:57 PM CDT

Molly Wilhelmson - Sep 10, 2024, 9:27 PM CDT

Title: "The efficacy of light therapy in the treatment of mood disorders: a review and meta-analysis of the evidence"

Date: 9/10/2024

Content by: Molly

Goals: Learn how well light therapy treats mood disorders and which disorders it is able to treat.

Content:

https://pubmed.ncbi.nlm.nih.gov/15800134/

The study evaluated the efficacy of light therapy in treating mood disorders. The researchers searched PubMed for trials of light therapy for treatment of mood disorders that met certain criteria. Significant reduction in depression severity was associated with bright light therapy and dawn simulation in seasonal affective disorder, as well as bright light therapy in non-seasonal depression. These trials are concluded to need more rigorous procedures to prove efficacy in treating mood disorders.

Conclusions/action items:

I would like to further investigate what light intensities are proven to treat mood disorders, in order to ensure the sensor will accurately function to identify the correct information needed for further research and trials regarding light therapy and mood disorders.

Molly Wilhelmson - Sep 11, 2024, 12:02 PM CDT

Title: 'What is the optimal implementation of bright light therapy for seasonal affective disorder (SAD)?'

Date: 9/11/2024

Content by: Molly

Goals: Learn more about seasonal affective disorder and the effect that light therapy has in treating it.

Content:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC543845/

The type of seasonal affective disorder(SAD) is characterized by worsening of mood in the fall or winter and complete remission in the spring and summer months and is the most likely mood disorder to respond to light. Patients with this variation of SAD should use light sources commercially available whose purpose is to treat SAD since other sources may not have the correct brightness or UV filtration to ensure safety. The most beneficial light dose is 5000 lux hours per day, or 10000 lux for 30 minutes a day. Many studies point out that morning exposure before 8am is optimal. Theraputical effects of light is mediated through the eye. Recommended treatment involves the patient sitting 16 inches(41 cm) from the light source while completing other tasks like reading or eating, and should be done daily.

Light therapy has more rapid effects than antidepressants, usually in the first couple of days. Light therapy is implemented as symtoms emerge rather than a preventive measure. This means the treatment should be used in the fall and winter months and cease in the spring and summer with complete remission of symptoms.

Conclusions/action items:

SAD is commonly treated with light therapy when symptoms resolve in the summer and spring months. Light therapy is not effective in treating SAD that does not exhibit full remission, or other varieties of depression. It is interesting that light therapy effects are visible more rapidly than medications. I would like to know how the light helps treat the symptoms in more detail, like what is happening internally in the eye and brain.

Molly Wilhelmson - Sep 11, 2024, 12:02 PM CDT

Title: 'Bright Light as a Personalized Precision Treatment of Mood Disorders'

Date: 9/10/2024

Content by: Molly

Goals: Learn more about seasonal affective disorder and the effect that light therapy has in treating it.

Content:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6405415/

SAD referrs to the seasonal pattern of recurring depressive episodes during the same time each year, mainly in the fall or winter, and remission perisod in the spring or summer. Its prevalence is between 0.4 and 16% in the general population depending on latitude, age, sex, and methods of measurement. It may affect paitents with unipolar and bipolar disorders. BLT is used to treat SAD because of its low risk rate and high response rate of abut 67% mild SAD patients and 40% in severe patients. BLT may begin at 10000 lux for 30 minutes. Lower intensities may be effective but need more exposure time- 2500 lux for 2 hr/day, 5000 lux for 1 hr/day. Effects significant at 2-3 weeks of therapy. Low intensity blue enriched light has effects comparable to BLT.

Major depression effects 350 million people, and was projected to become second global leading cause of disability by 2020 (Murray CJ, Lopez AD. Evidence-based health policy–lessons from the global burden of disease study. *Science*. (1996) 274:740–3. 10.1126/science.274.5288.740 [PubMed] [CrossRef] [Google Scholar] [Ref list]). Only 50-60% of patients respond to first line antidepressants, and 35-40% experience remission of symptoms. These medications take at least 4 weeks to work properly. more sensitive to light intensities 2500-10000 lux

Bipolar disorder affects 1-4% of the population worldwide and is associated with manic and depressive episodes with limited treatment. Research has shown patients with BD respond to BLT, especially when combines with other therapuetic techniques. more sensitive to light intensities below 10000 lux

Light acts as mood stabilizer by stabilizing sleep alterations (insomnia or longer sleep duration), and circadian rhythms. SAD involves a misalignment of circadian system and needs a modification of nocturnal melatonin secretion. Light effects alertness, influencing mood. Synchronizes circadian and homeostatic drives and surpresses meletonin to increase alertness. Support BLT as treatment for SAD by resynchronizing biological clock (ciradian rhythm), increasing alertness, and increasing sleep pressure (homeostatic pressure) acting on mood.

Conclusions/action items:

This article provides specific details that I can use in the project motivation about mood disorders and how many people they impact. This also reinforces the light intensity that should be used to treat these disorders, which we can ensure our sensor will acurately detect.

Eye Anatomy

Molly Wilhelmson - Sep 22, 2024, 8:01 PM CDT

Title: How light reaches the Eye

Date: 9/19/2024

Content by: Molly

Present: n/a

Goals: Learn how the eye perceives light, so I can understand how light sensors can accurately detect the amount of light entering the eye.

Content:

1.
Sliney DH. How Light Reaches the Eye and Its Components. International Journal of Toxicology. 2002;21(6):501-509. doi:10.1080/10915810290169927

The cornea transmits radiant energy at 295 nm and above, the crystalline lens absorbs almost all incident energy up t 400nm, the retina becomes more absorbing with age and intraocular filters only allow 1% or less of the UV spectrum to actually reach the retina. The cells in the cornea and lens are meant to minimize the scatter of light, while other components do the opposite. UVR is largely absorbed in anterior portions of the eye, but barely any of it reaches the retina, near-infrared wavelengths(infrared A band or IR-A) also reach the retina.

Because the ground mostly reflects very low amounts of UV rays, and the eyelid and brow bone shield the cornea from direct overhead UV, the amount of UV that actually reaches the cornea is very different than what reaches the nose or forehead.

retinal irradiance is directly related to brightness of light, and is not related to corneal irradiance. "Equation [2] gives the general relation, where Er is the retinal irradiance (W *cm^-2), Ls is the source radiance, W *sr^-1 * cm^-2), f is the effective focal length of the eye (cm),de is the pupil diameter (cm), and tau is the transmittance of theocular media: Er = pi*Ls*tau*de^2 / 4f^2 [2].

Typical retinal irradiance for outdoor settings is between 10 and 100 microW*cm^-22.

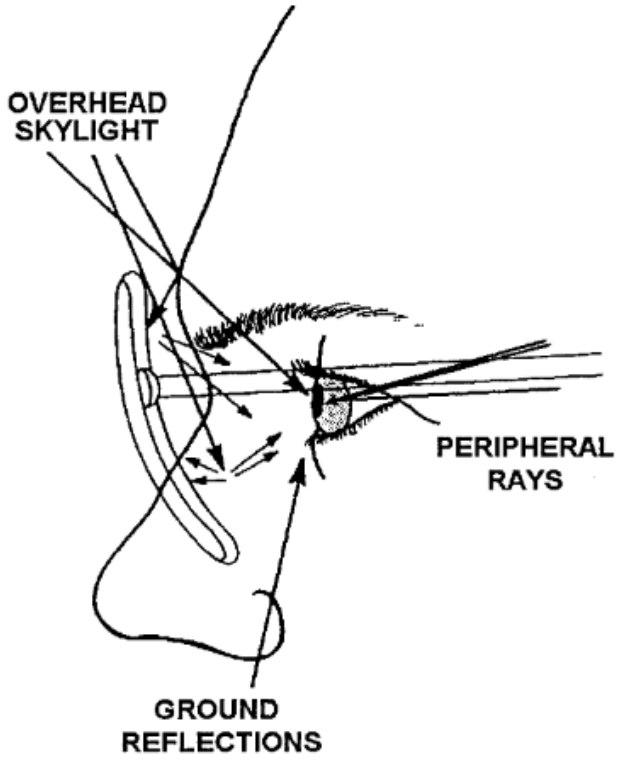


FIGURE 6

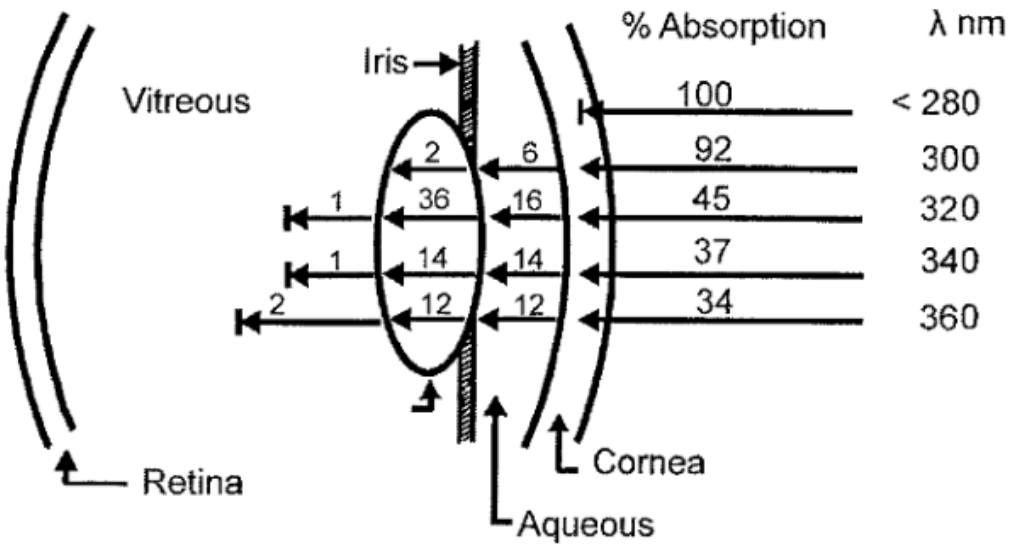


FIGURE 1
Relative absorption of visible and UV radiation within ocular structures.

Conclusions/action items:

This article focuses on UV damage that can be done to the eye, but includes valuable information of how much light reaches the retina, the presumed goal sight for light therapy. It includes retinal irradiance, and useful figures which illustrate how light reaches the eye which we can use in the background section of our reports.

Molly Wilhelmson - Oct 11, 2024, 3:14 PM CDT

Title: Light intensities in a day

Date: 10/11/2024

Content by: Molly

Present: n/a

Goals: Learn how the eye perceives light, so I can understand how light sensors can accurately detect the amount of light entering the eye.

Content:

Lanca C, Teo A, Vivagandan A, Htoon HM, Najjar RP, Spiegel DP, Pu SH, Saw SM. The Effects of Different Outdoor Environments, Sunglasses and Hats on Light Levels: Implications for Myopia Prevention. Transl Vis Sci Technol. 2019 Jul 18;8(4):7. doi: 10.1167/tvst.8.4.7. PMID: 31360613; PMCID: PMC6656201.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6656201/#:~:text=12%20The%20translatability%20of%20these,in%20lux)%20to%20prevent%20myopia.

Light intensities indoors range from 100 to 200 lux, and outdoor light levels range from 15,000 to 130,000 lux.

Conclusions: These intensity levels will be used to guide the testing of the light sensor, and also the choice of sensor we decide to use in our final design. We know or client would like us to test the sensor using the happy light which emits 10,000 lux. This should be a minimun requirement for our device.

9/10/24-Clouclip

Molly Wilhelmson - Sep 10, 2024, 8:57 PM CDT

Title: Clouclip Website

Date: 9/10/2024

Content by: Molly

Goals: Learn about existing light logger models, specifically the Clouclip and its limitations

Content:

https://www.clouclip.com/webCarbon/pc.html

The Clouclip is meant as a research tool for "myopia related behavioral factors" and is sold in two models, one meant for large research projects (M2) and another for individual customers(P2). It is works by having children wear the device for two to seven days, then the risk for myopia will be available to parents. The prediction of future myopia development can be made.

The Clouclip P2 is for children and parents and measures reading distances, angles, and durations, and illuminance and outdoor sunshine duration.

Conclusions/action items:

The Clouclip's functions were made clear here. I would still like to look more into how internal components function, and cost of the device.

9/10/2024-HOBO Pendant

Molly Wilhelmson - Sep 10, 2024, 8:50 PM CDT

Title: HOBO Pendant Datasheet

Date: 9/10/2024

Content by: Molly

Goals: Learn more about the HOBO light logger and how it functions.

Content:

https://www.onsetcomp.com/sites/default/files/2023-05/21536-P%20MX2201%20and%20MX2202%20Manual.pdf

The HOBO measures light/temperature indoors and outdoors, and is waterproof. The logger features bluetooth compatibility with phones, computers, and tablets where data can be downloaded onto and analyzed. The logger can calculate statistics, alarm past certain thresholds, and adjust sensor speeds above and below certain thresholds which would be useful for this project. The sensor operates 0 to 167,731 lux (15,582 lum/ft^2) with +- 10 percent in direct sunlight within the range of -4 to 158 degrees F. The logging rate is 1 to 18 seconds. The battery life is 1 to 2 years with a sampling rate of one minute and may decrease with use of other functions and has a memory of 96,000 measurements. It is 3.35x5.64x1.8cm and weighs 12.75 g. The logger features mounts at the top and bottom and responds to very similar wavelengths as the human eye does.

The logger does not measure at the exact angle of incidence, which should be proportional to the cosine of the angle of incidence of light. The rest of the article details how to set up the device and its functions but does not go into how the internal component work.

Conclusions/action items:

I would like to study how the electronics work inside the light sensor to replicate the sensing technology, and how to improve the existing sensor to more accurately represent the angle of incidence of the eye. I will need to research the systems of the eye and see how important the angle of incidence is to light being transmitted to the retina and how this affects mood disorders.

9/19/2024-Light Sensor Patent

Molly Wilhelmson - Sep 19, 2024, 4:42 PM CDT

Title: US6737629B2- **Light sensor**

Date: 9/19/2024

Content by: Molly

Present: n/a

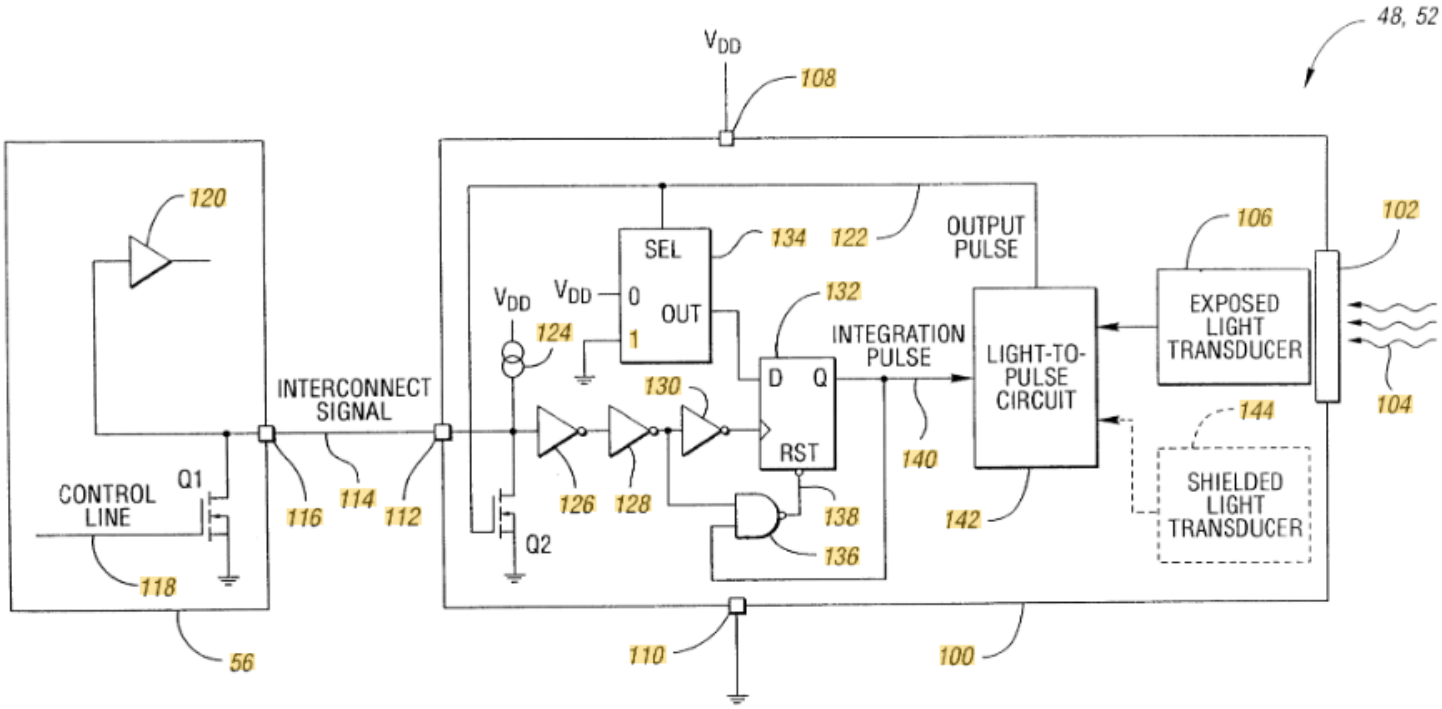
Goals: find a patent or standard related to our project, to guide us in our design ideas.

Content:

https://patents.google.com/patent/US6737629B2/en

[1] S. Jon and H. Bechtel, 2004. Accessed: Sep. 19, 2024. [Online]. Available: https://patentimages.storage.googleapis.com/05/0f/96/8cc94d8b41487b/US6737629.pdf

The invention is a light sensor which consists of a transducer exposed to light which allows it to accumulate charge in proportion to light incident over a certain period and a sensor logic which communicates with the light transducer in order to reset the charge in the transducer at the start of the periods, measure the accumulated charge, and determine a pulse with a width based on the charge. The sensor has a comparator with one input connected to the light transducer, and the other to a switched capacitor circuit. The switch is closed during the period, and opened after the time period, creating the pulse. A second comparator connects to a fixed voltage, and to the switched capacitor circuit. This stops the pulse if the ramp voltage is less than the fixed voltage. This sensor may be used in car's rearview mirrors to dim the mirror when bright light hits it.



Conclusions/action items:

This patent contains useful information about the circuit design within a light sensor and some of the components my team may consider when designing our prototype.

10/8/2024- Safety Requirements

Molly Wilhelmson - Oct 08, 2024, 2:26 PM CDT

Title: Designing Medical Electrical Equipment to Meet Safety Certification and Regulatory Requirements

Date: 10/8/2024

Content by: Molly

Present: n/a

Goals: learn about safety specifications related to our design

Content:

Designing Medical Electrical Equipment to Meet Safety Certification and Regulatory Requirements Brian R. Biersach Michael L. Marcus

https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=c4dc1f88b7e5a85e7ba8a258d28963b0cc1b53bf

Medical device safety is crucial for engineers to learn about before the design process begins to reduce production costs and ensure the safety of the patient. The article explores safety standard in the US and internationally.

This standard UL 2601-1 requires two levels of protection against excessive unintentional or leakage current flowing through the user. The equipment must pass 15 A of current or at least 1.5 times the highest current for 5 seconds from the 'protectively earthed part to the earthed connection.' with less or equal to .1 Ohms of resistance. The open circuit voltage should not exceed 6V. Factors which may fail to consider when designing a medical device include reverse polarity of supply mains, failure of insulation, interuption of protective earth, interuption of one supply conductor, mains voltage on applied parts and communication ports, failure of either mechanical or electrical parts one at a time, short circuiting, locking of moving parts, or failure of cooling systems. These risks should be analyzed and mitigated through the design of the device.

Conclusions/action items:

The article gave useful testing which could be used to test our circuitry, and also links other standard relating to electronics in medical devices.

9/25/2024-Light sensor circuit design

Molly Wilhelmson - Sep 27, 2024, 1:41 PM CDT

Title: CdS Photoconductive cells

Date: 9/25/2024

Content by: Molly

Present: n/a

Goals: Learn about potential circuit components to implement into our design

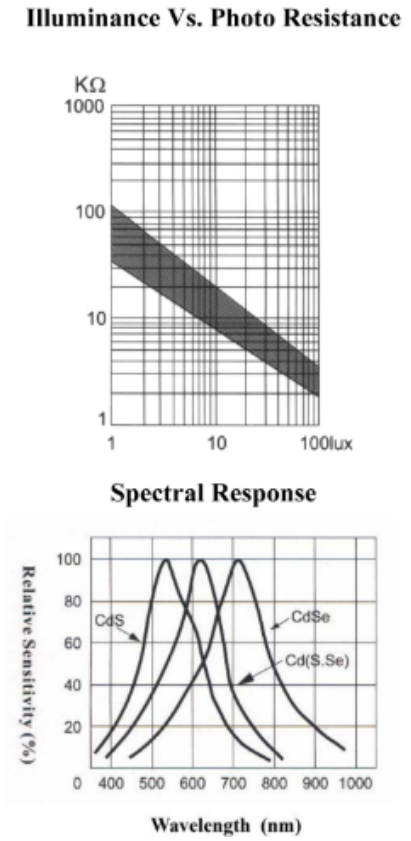
Content:

The CdS photoresistor has ~8-20 kohms at 10 lux (25 C)

at 0 lux, it has 1 Mohm minimum

The spectral response peak is at 540nm.

https://cdn.sparkfun.com/datasheets/Sensors/LightImaging/SEN-09088.pdf



The above are graphs used to calculate sensitivity of the sensor or resistance versus lux.

Conclusions/action items:

This sensor is highly sensitive and may be used as a component to measure light intensity, which we could calculate based on the resulting resistance of the photoresistor.

Molly Wilhelmson - Sep 25, 2024, 2:55 PM CDT

Title: CdS based novel photo-impedance light sensor

Content by: Molly

Present: n/a

Goals: Learn about potential circuit components to implement into our design

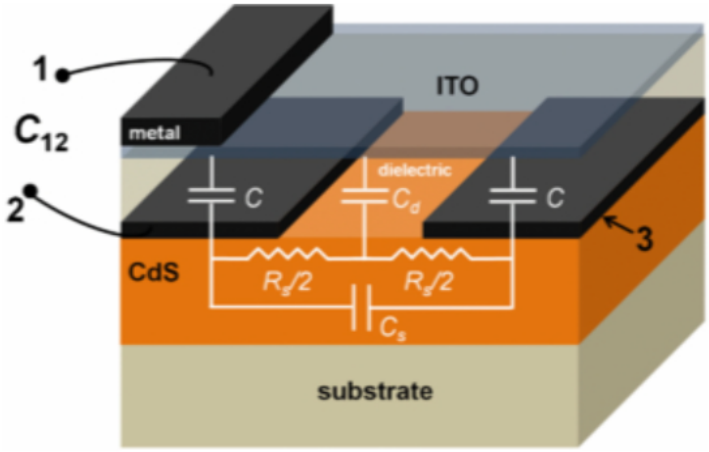
Content:

T Saxena *et al* 2014 *Semicond. Sci. Technol.* **29** 025002 **DOI** 10.1088/0268-1242/29/2/025002

https://iopscience.iop.org/article/10.1088/0268-1242/29/2/025002/meta?casa_token=FlJSBT_6uUUAAAAA:pA3cOGAe_r-Va6pitB4Fi3Jmxmo8gtt2fXXUDWWH2805PjH-zA8lGqfmZzMXynjMM9fZxZDG667Ye9gberRoNOIRL00

Conventional photoresistive sensors have limited tunability. Photocapacitive sensors adjust their capacitance upon illumination and can generate a wireless frequency-modulated signal in response to intensity modulation of incident light. They use ac frequency as a parameter changing sensitivity and dynamic range, advantage over photoresistive sensors in the sense of noise.

The impedance between C1 and C2 is changed due to illumination, see an increase in intrinsic photocapacitance of Cd , effective capacitance under illumination increases bc a lower resistive connection between the C1 and C2 each having the same capacitance C exists. This allows for increased circuit design flexibility.



Semiconductor resistance Rs was calculated after exposing the sensor to ac frequencies from 100 kHz to 2 MHz and measuring impedance differences. Many calculations are included to relate capacitance, Intensity of light, and inductance to come to the conclusion that a photo-impedance sensor could be used as an accurate wireless sensor.

Conclusion:

A photo-inductive sensor may be useful in our circuit design, to provide wireless results, which would increase the usability rating of our device. How the circuit is set up will need to be researched in order to see if this is a possible design component to consider.

Molly Wilhelmson - Sep 25, 2024, 3:24 PM CDT

Title: Optimizing Precision Photodiode Sensor Circuit Design

Date: 9/25/2024

Content by: Molly

Present: n/a

Goals: Learn about potential circuit components to implement into our design

Content:

Orozco, L. (2014). Optimizing precision photodiode sensor circuit design. *Application note MS-2624*, 1-5.

Photodiodes ae popular for light measurement sensors, commonly used for emission and absorption spectroscopy. The op amp keeps the voltage across the photodiode at 0V, and the voltage vs current curve shifts up or down as the light level changes. Current flows from cathode to anode

when light strikes it. Ideally all the photodiode's current flows through a feedback resistor across the negative input to the output of the op amp. This generates an output voltage = to the photodiode's current*feedback resistor.

Some considerations to get the best performance:

Make sure dc specs match application's requirements, small dc input offset voltage to reduce error and increased dark current. Op amps input leakage which goes directly into the positive terminal of the op amp rather than across the feedback resistor may cause errors. Decreasing external leakages within the circuit board by increasing resistance between the trace carrying the photodiode and the other traces.

Adding capacitance on the input of the op am and across the feedback resistor can ensure adequate ac function, we are concerned about the signal bandwidth and the noise bandwidth. Limiting the op amps used will reduce noise. Using a lowpass filter may be useful.

Op Amps recommended were the AD8615 and AD549, their data sheets are provided below.

https://www.analog.com/en/products/ad8615.html#part-details

https://www.analog.com/en/products/ad549.html

Conclusion:

It is likely we will need an op amp in our circuit to reduce noise and amplify our desired signals.

Molly Wilhelmson - Sep 25, 2024, 10:03 PM CDT

Title: BME 310 Resources

Date: 9/25/2024

Content by: Molly

Present: n/a

Goals: Learn about potential circuit components to implement into our design

Content:

https://docs.google.com/document/d/1OZbimvNg5YdNJVotGcB06gD1MIv3d_HNBHcSWaqQjow/edit#heading=h.jhps604pgx82

Voltage follower vo=R2/R1(v2-v1)

We can use the photoresistor circuit design to sense light.

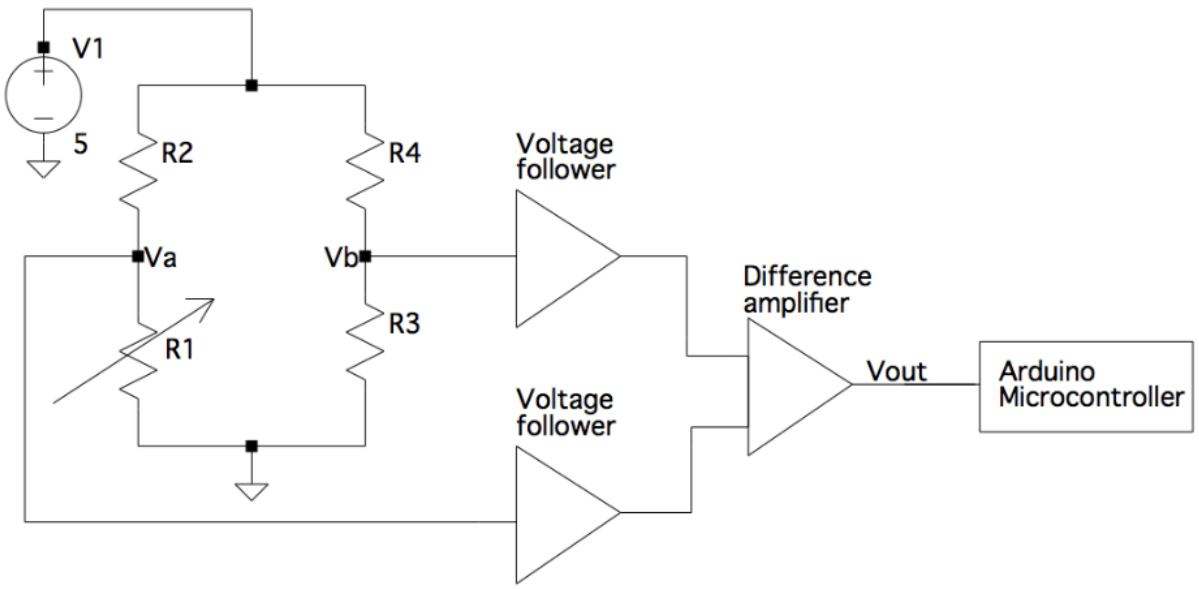


Figure 5: LTSpice circuit schematic of a photoresistor instrumentation (R2=R3=R4=1.57 kOhm).

Photometric power may be of use to us in calculating the light intensity - lux = (.096*Po[W]*683)/(pi*r^2) where Po is continuous wave out put power in Watts, and r is the radius of the laser or light source.

Conclusion:

This circuit design will be evaluated in the design matrix and is affordable to fabricate, since I have most of the components in my sparkfun kit. I would need to find out which comparators to use based on how much gain we need, resistor values and input voltage.

10/8/2024-Electrical components

Molly Wilhelmson - Oct 08, 2024, 2:54 PM CDT

Title: LM393 Comparator

Date: 10/8/2024

Content by: Molly

Present: n/a

Goals: understand the datasheet for the comparators we will be using in our circuit

Content:

https://www.ti.com/lit/ds/symlink/lm393.pdf?ts=1728340449226&ref_url=https%253A%252F%252Fwww.mouser.co.uk%252F

The comparator has supply voltage from 2-30V, temperature range from 0-70 C, offset voltage +-9 / +-4 mV, and response time of 1.3 microseconds.

Pin one is output, 2 is inverting terminal, 3 is non inverting terminal, 4 is ground, 5 is a second non inverting, 6 is a second inverting terminal, 7 is second output, and 8 is Vcc+. Below are the electrical characteristics for the comparator.

The design allows for high gain, little input bias current, and fast response.

6.10 Electrical Characteristics for LM193, LM293, and LM393 (without A suffix)

at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A [1]	LM193			LM293 LM393			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{CC} = 5 V to 30 V, V_{IC} = V_{ICR} min, V_O = 1.4 V		25°C		2	5		2	5	mV
				Full range			9			9	
I_{IO}	Input offset current	V_O = 1.4 V		25°C		3	25		5	50	nA
				Full range			100			250	
I_{IB}	Input bias current	V_O = 1.4 V		25°C		–25	–100		–25	–250	nA
				Full range			–300			–400	
V_{ICR}	Common-mode input-voltage range[2]			25°C	0 to V_{CC} – 1.5			0 to V_{CC} – 1.5			V
				Full range	0 to V_{CC} – 2			0 to V_{CC} – 2			
A_{VD}	Large-signal differential-voltage amplification	V_{CC} = 15 V, V_O = 1.4 V to 11.4 V, R_L ≥ 15 kΩ to V_{CC}		25°C	50	200		50	200		V/mV
I_{OH}	High-level output current	V_{OH} = 5 V	V_{ID} = 1 V	25°C		0.1			0.1	50	nA
		V_{OH} = 30 V	V_{ID} = 1 V	Full range			1			1	µA
V_{OL}	Low-level output voltage	I_{OL} = 4 mA,	V_{ID} = –1 V	25°C		150	400		130	400	mV
				Full range			700			700	
I_{OL}	Low-level output current	V_{OL} = 1.5 V,	V_{ID} = –1 V	25°C	6			6			mA
I_{CC}	Supply current	R_L = ∞	V_{CC} = 5 V	25°C		0.8	1		0.45	1	mA
			V_{CC} = 30 V	Full range			2.5		0.55	2.5	

(1) Full range (minimum or maximum) for LM193 is –55°C to 125°C, for LM293 is –25°C to 85°C, and for LM393 is 0°C to 70°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

(2) The voltage at either input should not be allowed to go negative by more than 0.3 V otherwise output may be incorrect and excessive input current can flow. The upper end of the common-mode voltage range is limited by V_{CC} – 2V. However only one input needs to be in the valid common mode range, the other input can go up the maximum V_{CC} level and the comparator provides a proper output state. Either or both inputs can go to maximum V_{CC} level without damage.

Here are the typical behaviors of the comparator

T_A= 25°C, V_S= 5V, R_{PULLUP}=5.1k, C_L = 15 pF, V_{CM}=0V unless otherwise noted.

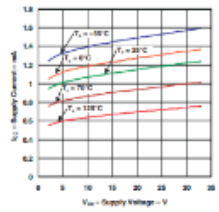


Figure 6-1. Supply Current vs Supply Voltage

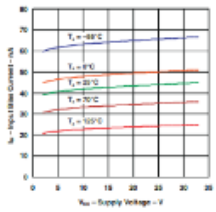


Figure 6-2. Input Bias Current vs Supply Voltage

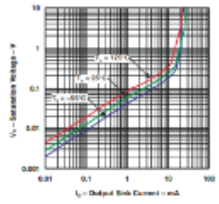


Figure 6-3. Output Saturation Voltage

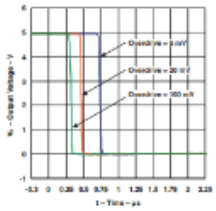


Figure 6-4. Response Time for Various Overdrives Negative Transition

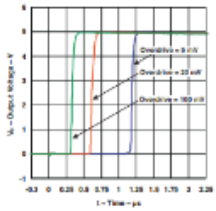


Figure 6-5. Response Time for Various Overdrives Positive Transition

Conclusions/action items:

This comparator is a dual comparator, which we may not need but could implement into our design after checking with our advisor.

10/16/2024-Team Meeting

Molly Wilhelmson - Oct 16, 2024, 8:03 PM CDT

Title: Circuit design ideas

Date: 10/16/2024

Content by: Molly

Present: Ella, Kate, Neel

Goals: Decide on how to begin fabrication of a prototype

Content:

We are wondering if we should attach the sensor circuit to the front of the headlamp, and the raspberry pi breadboard in the back of the headlamp. We need to discus how to attach the two breadboards. We also need two basic op amps rather than our analog to digital converters since the raspberry pi does this already.

Conclusions/action items:

We will visit the makerspace to get two op amps and then begin prototyping and testing our circuitry.

10/25/2024-Team meeting

Molly Wilhelmson - Oct 25, 2024, 1:20 PM CDT

Title: Initial Circuit fabrication

Date: 10/25/2024

Content by: Molly

Present: Light loggers

Goals: Begin fabrication after our componets are soldered and ready to use.

Content:

We purchased two UA741 op amps to use for our voltage followers, and began fabrication. We made the wheatstone bridge using 10 kohm resistors to begin, and a CdS photoresistor. The terminals connect to the voltage followers at the non-inverting terminal, and the inverting terminal connects to the output pin on both op amps. We are unsure what to use for our vcc + and -, and will ask our advisor later today. We also need to know the pin numbers for the differential amplifier so we can connect our full circuit.

The code for the raspberry pi is beginning to take shape, and can sense the light as a percentage, and displays the percentage on the computer. We need to find an equation to convert voltage into light intensity depending on the sensor we use.

Conclusions/action items:

We need to discuss with Brandon our circuit design and components, also we need to discuss a new sensor and how it would be incorporated into our circuit, and if we need to redesign to match the actual sensor we will use.

11/20/2024-Testing plans

Molly Wilhelmson - Nov 20, 2024, 5:35 PM CST

Title: Testing plans

Date: 11/20/2024

Content by: Molly

Present: Light loggers

Goals: create a testing protocol for our circuit

Content:

We will test the circuit using a multimeter using the equations I documented in the ... entry.

Ideally we will want a value of _ for va and _ for vb on the wheatstone bridge.

We want the same values at the output of the voltage followers.

The output voltage should be the difference between the two terminals.

To calculate lux, we need Current values as well. We can measure the output current value, and compare it to the current value which the sensor outputs to determine what current value correlates to different light intensities using the happy light. This may be more complicated than the next proposed idea, which we will actually use to gain an equation for the code.

To make the equation for the code we need to test the sensor output voltage at each known light intensity, then plotting these points, we can generate a linear regression line which will provide the equation we need to convert voltage to light intensity.

Conclusions/action items:

9/11/2024- BME Career Prep

Molly Wilhelmson - Sep 11, 2024, 1:51 PM CDT

Title: BME Career Prep

Date: 9/11/2024

Content by: Molly

Present: BME 300 lecture

Goals: Learn how to prepare for the career fair and how to successfully search for jobs

Content:

A co-op is an 8 month internship program you can do while still being enrolled as a full time student.

Create an ECS tracking sheet to keep track of what jobs have been applied to. at ecs.wisc.edu/resources.

It is helpful to connect with a candidate before applying for a job. The career fair is a great way to make connections with 324 different companies!

Some resume tips include: Use Microsoft Word with no charts, columns, or colors, tailor your resume based on the job posting, show balance of your experience, include design projects without years and semesters, include technical skills and coursework.

Cover letters add value to an application, but are not necessary at the career fair.

Have a purpose-more than an internship, discuss your classes which have prepared you for the position.

The career fair is 9/16-9/19 11-5 with different employers each day. look for bme, me, and ee

Conclusions/action items:

This presentation was very helpful in preparation for the career fair and my job search this year. I will work actively to prepare for the fair so I can be successful in gaining useful experience.

9/18/2024- Leadership Style

Molly Wilhelmson - Sep 18, 2024, 1:57 PM CDT

Title: Exploring Your Leadership Style

Date: 9/18/2024

Content by: Molly

Present: BME 300 lecture

Goals: Learn more about different leadership styles and which resonates with me best.

Content:

We spoke about if we see ourselves as leaders, I said yes because I think I am responsible, proactive and have a positive attitude. I think important qualities for a leader are being focused, positive, inclusive, open-mined, and organized. Some other good qualities are self-awareness, having direction and setting goal, clear communication, being transparent, decision making, and empathy.

Some style include the power model, servant, authentic styles.

Power model- someone needs to take control and its me, being in control is the most important thing, hierarchy, authority and command.

Servant leadership- the needs of my followers are more important, being of service to others, sharing power, listening and understanding, empathetic, empowering, shared decision making.

Authentic style- by being genuine I will gain and build trust, building self esteem and self awareness, transparency, genuineness, and honesty.

Some other styles are people, process, thought and impact oriented leadership.

People- getting to know each team member and builds trust and an inclusive environment.

Process- sets pace for team creating systems to get work done efficiently

Thought - sees the big picture, open to new ideas and approaches

Impact - set bar high for your team

Self assessments, observing and reflecting what makes you feel accomplished, and seeking feedback all help explore the way I lead.

A team goal: Everyone participates in design process by contributing thoughts and opinions. We may break things into parts, but everyone should take interest in the project as a whole and be able to engage in all parts

Self goal: I would like to practice my organization skills and be able to manage my time effectively, making time to work on my project and give it my full energy/attention despite having a busy schedule.

Conclusions/action items:

9/25/2024-Fall Post Graduate Planning

Molly Wilhelmson - Sep 25, 2024, 1:52 PM CDT

Title: Post Graduate planning

Date: 9/25/2024

Content by: Molly

Present: BME 300

Goals: learn about post graduate options and reflect which is best for me

Content:

Some general pointers are to use my undergraduate experience to build a story by gaining experience while in school and tie experiences together. Research is important for all paths. Thinking about what my ideal career looks like and finding programs have the opportunities I am looking for. I should have three references or people to write me letters of recommendations.

Cover letters- avoid chronological regurgitation of what you have done, instead start with what you want to do-thesis statement. Show reasonable idea of what you want to do after university. Name faculty who work in your fields of interest, defend plan with life experiences- most recent first. CV in paragraph form.

MS is a stepping stone for further education. higher level of skills, rewrite story, fills in gaps in your resume. masters programs in BME- research(1.5-2yrs, thesis requirement), accelerated program(1yr, coursework only, independent study is allowed, funding(TA) stipend), Biomedical Innovation, Design, and Entrepreneurship (1 yr, project based - BME design project continuity, partnership with business school, same funding as previous). Deadline to apply is near 12/15 with priority given to BME students with 3.0 at time of graduation.

Conclusions/action items:

I learned more about the masters programs which might be a good fit for me if I do not have a job secured after graduation.

10/2/2024- Near Peer Mentoring

Molly Wilhelmson - Oct 02, 2024, 2:09 PM CDT

Title: Near peer mentoring

Date: 10/2/2024

Content by: Molly, Tracy Puccinelli

Present: bme 300 lecture

Goals: learn about mentoring techniques

Content:

Why mentor 200's?: We know what they are feeling/ we have been in their shoes before. Getting them more comfortable with the course structure. Reinforces what you know. We are close to their experience levels, so we can best help them and relate to each other. Provide emotional and structural support for 200's.

Transferrable skills include leadership, communication, active listening, study practice, and interpersonal skills. Mentorship increases you own self-esteem and confidence, patience, builds positive habits, and fosters personal growth.

To be a good mentor, be welcoming, honest, proactive, builds trust, be reliable, available.

To listen effectively get rid of distractions, stop talking, act interested, ask questions.

In 200 I wish I knew more technical skills like solidworks, writing structure, internship advice.

Conclusions/action items:

We discussed techniques to be great mentors, and made an action plan in class.

10/9/2024-Sustainable Engineering

Molly Wilhelmson - Oct 09, 2024, 1:47 PM CDT

Title: Sustainable Engineering

Date: 10/9/2024

Content by: Molly

Present: Bme 300 lecture

Goals: learn about sustainable engineering

Content:

Healthcare sector is responsible for about 5% of global emissions and 8.5% of emissions at the national level in the US. Circular economy deals with keeping things out of landfills. We can use life cycle assessments to look at environmental impacts of components during its use. Allows us to think of our design's impact. Sustainibiliy is also about resiliency of the product and supply line rather than just environmental.

For our project we may dispose of resistors and op amps, possibly the sensor. Finding ways to dispose of them properly when they wear out is important. We may also consider using higher quality electronics to reduce the amount of time we need to replace components.

Conclusions/action items:

We will consider designing our prototype with sustainability in mind, as carry on this theme through my career

10/16/2024-Warf, IP, Disclosing and licensing

Molly Wilhelmson - Oct 16, 2024, 2:04 PM CDT

Title: Warf IP Disclosing and Licensing

Date: 10/16/2024

Content by: Molly

Present: bme 300 lecture

Goals: learn about these topics at UW-Madison

Content:

Warf's mission is to support the university through patenting and licensing. The technology transfer moves research results from campus into the market. Invention leads to invention disclosure, assessment, protection, marketing, licensing and then to financial return to the university to continue research producing more inventions. ex intellectual property licenses, industry sponsored research, consulting arrangements, or fees for services.

Intellectual property types are patents, copyrights, trademarks, trade secrets. Patents are almost 90% or IP here. Copyrights provide protection for creative works that are expressed in tangible medium including software code last 75 years. Trademarks provide protection for names, marks, logos, dress, requires use in commerce and is a source identifier. Trade secrets can be used to protect anything of value, protection as long as the concept is not generally known.

Patents are rights written by a government agency, US only noy global patents. Right to exclude others from making, using, selling, or importing the claimed invention. Three types of US, design 15 years, plant 20 years, and utility 1 year for provisional for additional research, 20 years for non-provisional this is used at warf. Issued for new and useful process, machine, manufacture, or comparison of matter. Takes 2-5 years to get a patent and costs about 30000 dollars mostly in attorney's fees. Requirements include being Eligible-cannot be a product of nature, abstract idea, or natural phenomenon, Novel-it must be new, Non-obvious- cannot be a simple modification or combination of existing concepts, Enabled and Described- must provide enough detail to teach others how to make or use the invention.

Warf receives 400 invention disclosures a year. Disclosing means describing the innovation and applications. Meeting with warf discusses the design in more detail and discuss next steps. Makes the patenting process simple. They consider types of IP that apply for each application and licensing considerations like applications, likelihood of identifying a commercial partner, and likelihood to return from licensing. Licensing includes market analysis, license negotiation and ongoing development, enforcement, amendment or termination. Licensing allows companies to reduce R&D costs, improved time to market, and additional revenue opportunities. Value is determined by technology application, key selling points features and benefits, technology trends, market size trend and competition.

AI cannot invent, and works devopled need to be works of human authorship to qualify for copyrights.

Conclusions/action items:

I have a good understanding of how warf works and things to consider when thinking about submitting an application for IP

10/23/2024- IRB

Molly Wilhelmson - Oct 23, 2024, 1:50 PM CDT

Title: Do I need and IRB?

Date: 10/23/2024

Content by: Molly

Present: BME 300 lecture

Goals: learn what constitutes the need for an IRB

Content:

Institutional Review Board (IRB) is a committee that conducts ethical and regulatory review of research involving participants. Ensures research is conducted in an ethical way. Unethical research using testing on human subjects, like Nazi prisoner experiments and a syphilis study, and others brought acts to ensure ethical studies. Lack of consent, deception, psychological impacts, and lack of information to make an informed decision are factors that these studies all included, which are now seen as unethical. The Belmont principles included beneficence minimizes harm, justice as equitation and ensuring potential harms by research was not exploited on population with no protection, and equal access to participation. Regulations for protection of human subjects by the Department of health and human services- common rule, and the FDA. Boards would review research studies to meet ethical and regulatory standard. They need a scientist, non-scientist, and wide range of experience in people included.

UW Madison has minimal risk research IRB and health science IRB.

Needing IRB's:

Under the common rule, research is a systematic investigation including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge. Involving human subjects: a living individual about whim an investigator conducting research, obtaining information or biospecimen through intervention or interaction, or uses identifiable private information or identifiable biospecimens. Is it under FDA device regulations?: device- use in diagnostics, treatment, or prevention of disease or that affects structure or function of the body, research/clinical investigation- involves one or more subjects to determine device safety or effectiveness. Subject- individual on whom or on whose specimen an device is used.

Conclusions/action items:

This lecture is useful in knowing whether our project requires an IRB, for testing, which I believe it may if the prototype goes on to the market, otherwise it may not.

10/30/2024-Navigating FDA Device Requirements

Molly Wilhelmson - Oct 30, 2024, 1:58 PM CDT

Title: Navigating FDA Device Requirements

Date: 10/30/2024

Content by: Molly

Present: bme 300 lecture

Goals: learn about fda requirements for medical devices, and how to comply with them during the design process

Content:

A medical device is defined as an instrument intended to improve health and affect the body that is not though chemicals, drugs or biologics. The definition is meant to be broad. Some software functions are excluded. Laboratory tests are now considered medical devices. Software is the largest new medical device development area. Software in a medical device is part of a medical device, as a medical device is controlled by different regulations. FDA regulations allow some devices to be covered by insurance, increasing access.

regulations 21 part 50, 56, 801, 803, 812, 814, and 820 are common regulations to consider in development.

Device classifications-need to fulfill different requirements:

Class one is low risk and are exempt from premarket approval, class two is moderate risk and has a 510k showing substantial equivalence, a class three device is high risk and requires premarket approval. Classes vary by country.

De novo classification are for new devices that are not like any other device.

Regulatory controls: General: registration and listing, adverse event reporting, general labeling, and good manufacturing practices, Special controls: performance standards, special labeling, post-market surveillance, and potential data requirements, Premarket approval: data to show safety and effectiveness.

Conclusions/action items:

The presentation walked through the process of FDA approval and how to classify a device. This gives insight into how companies market their devices, and can gain more money of a device is a medical device.

11/6/2024-Regulatory Strategy

Molly Wilhelmson - Nov 06, 2024, 2:02 PM CST

Title: The Framework Guiding Advanced Therapeutic Product Development

Date: 11/6/2024

Content by: Molly

Present: BME 300

Goals: Learn about regulatory sciences

Content:

Therapies include: genome editing, cell therapy, and gene delivery.

Subcategories of the FDA include: devices (CDRH) - premarket approval-safe and effective, 510k, and IDE (investigational device exemption) for clinical studies, drugs (CDER) - NDA(new drug investigation), IND (Investigational new drug), and biologic (CBER) - BLA (biologics lisence agreement), IND. Drugs are synthetic produced in a chemical reaction, and biologics are living things or produced by a living thing.

Laws influencing regulations: Federal food, drug and cosmetic act, Public health service act: biologics, CURES act of 2016: speeds up process, CARES 2020 act: managing disruptions in production.

Regulations are how the FDA interprets laws, make guidance frameworks with the help of the public to help industry and the public interpret the regulations.

Human cells, tissues and cellular and tissue-based products.

361: minimally manipulated products: blood transfusion, transferring from one to another, considered safe, used for the same purpose, largely unregulated, faster path into clinical use

351: bone sample, isolate cell type, deliver a new gene into the cell, then reinject, manipulating the product. High barrier, traditional biologic, more to show to prove safety and effectiveness.

Minimally manipulated, homologous use (same function), combined with another article, systemic effect or dependent on metabolic activity of the cells? If yes to all, 361.

Distinguish between good research projects, and on the critical path when thinking about the product development life cycle. To determine if it is critical path, develop a target product profile (TTP): when where and why to use a product. patient identification, patient benefits, patient risks: Indication, efficacy profile, safety profile. Is it medically and commercially compelling?

Nonclinical considerations for 351 regulated CGT: non-good laboratory practices nonclinical studies and pilot tax studies--> GLP (expensive) In quality: CMC (chemistry and manufacturing controls) development-->manufacturing consistency--> Phase 1 and 2 and 3 trials, launch prep-->Post marketing studies and RWE

Regulatory: TPP, interact meeting (not binding)--> pre IND, IND submission(definitive proposal to FDA), EOP1/2 meeting or special protocol agreement--> pre BLA and BLA meeting--> US sBLA approval of biologic.

Quality: system documents policies, procedures, processes, internal rules and other records to ensure consistent quality.

Conclusions/action items:

This gives a more in depth explanation about FDA regulatory systems.

11/13/2024-Medical Device Innovation from Prototype to Commercial Clinical Use

Molly Wilhelmson - Nov 13, 2024, 1:54 PM CST

Title: Medical Device Innovation from Prototype to Commercial Clinical Use

Date: 11/13/2024

Content by: Molly

Present: BME 300 Lecture

Goals: Learn about the next steps of getting a new medical device to the market, following IRB and FDA approval.

Content:

Every time the FDA needs clarification, the clock restarts when approving and classifying a new product. The breakthrough devices program allows for quicker approval. Still need to go through approval once in the program. After the FDA and IRB processes, reimbursement or financial incentive and sales.

Sales cycle begins with CPT codes- may reimburse money may not, then CMS national insurance decisions-Medicare, standards of practices, national regional buying groups, regional/local IDNs and hospitals, Hospital IDN value analytics groups, product evaluations, regional/just in time distribution, and finally product implementation.

Think about how activity id done today without the device, and where the patient comes into play: patient experience, physician experience. Begin at patient care pathway. Think about stakeholders for the medical device: patient, national/regional groups, standards organizations, national and regional payment/reimbursement, clinical oversight, and administrative items like materials, billing IT and value analytics. Standardization of hospital procedures is a goal currently.

Value based healthcare balances clinical economic and patient concerns.

Conclusions/action items:

Thinking about who the device will impact will result in a more marketable device. Figuring out codes, costs, and benefits of your device quantitatively will help you device be accepted.

11/15/2024-Tong Lecture

Molly Wilhelmson - Nov 15, 2024, 12:55 PM CST

Title: Tasso Tong Lecture

Date: 11/15/2024

Content by: Molly

Present: BME-everyone.

Goals: Learn how biomedical engineering plays a role in entrepreneurship

Content:

Tasso is a blood drawing device for at home use. Nobody love the blood drawing process, and there are over a billion blood draws a year but they are the difference between getting the care someone needs. They thought of the future of healthcare as being in the home. Began prototyping and asked around the university for help making a company. The law and entrepreneurship clinic helped the begin their company. Their first model cost $25 and allowed then to get a 150000 grant. Resorted to the university for help mapping capillary locations, improving their designs. Customers were unhappy with the changes, so to improve products you may have to kill them, but in a careful way not to lose customers. Finding a key customer is crucial for success. Focusing on the people with the problem, and catering to their needs to be successful.

When scaling up, quality is key. regulatory specialists can make your design possible by finding ways around a class two device.

Conclusions/action items:

This company is a great example of how the design process can bring new technology.

11/20/24-How New Product Development Works in the Medical Device Industry

Molly Wilhelmson - Nov 20, 2024, 2:07 PM CST

Title: How New Product Development Works in the Medical Device Industry

Date: 11/20/24

Content by: Molly

Present: bme 300 lecture

Goals: learn about this process

Content:

NPD in medical devices are highly regulated, expensive, resource intensive, and competitive. Medical device companies need to select their projects carefully. Understanding the business sustaining for the next 3-5 years, then defining which product categories they want to develop, sustain, and eliminate. Then companies select and prioritize projects they will support for the next year to three years, and finalizing allocating a budget and resources.

Line extensions are additions of product sizes and configurations, there are also product improvements, new to company, and new to world projects.

After concept development, formal business reviews determine if the design is a go or no-go, after design confirmation the design freezes, then it is launched and post market surveillance begins. The process is similar to the design process I am familiar with.

Stage 0 is an idea, Stage 1 is exploration where the problem is defined, and concepts are created for 8-10 ideas, a high-level business case is developed, and preliminary technical scouting and intellectual property.

Stage 2 is concept definition based on customer interviews to get down to one leading concept, robust business cases including market opportunity and expenses, as well as comprehensive IP examinations. The next gate review is "go/no-go" decision.

Stage 3 is design development which moves to a functional prototype and begins design control documentation. This is mandatory of class 2 and 3 devices and includes documentation of customer needs, design requirements, design inputs/outputs, testing, and design reviews. This is tightly aligned with risk management.

Stage 4 is design confirmation and includes verification and validation testing, finalizing product and component drawings/models, accelerates manufacturing process development along with quality control plans, "freeze" at the end of this stage, submits regulatory documentation like a 510k to the FDA.

Stage 5 is design transfer and commercialization to complete remaining testing, make final design changes, create instructions for use, service plans and resources, and finalize go-to-market strategy and start limited release.

Post market surveillance monitor customer experience, complaints, sales, and improvement opportunities.

Conclusions/action items:

Medical device development is expensive and complex, and having limited resources causes companies to have to make processes to reduce risk and increase success. Our experience using the design process is valuable and similar to the process in industry.

Light Wave Absorption Research (IR, UV, RGB)

NEEL SRINIVASAN - Nov 15, 2024, 3:41 PM CST

Title: Research on light wave absorption for wearable light logger

Date: 9/15/2024

Content by: Neel Srinivasan

Present: Neel Srinivasan

Goals: To summarize my research on various light wave absorption

Content: Light is taken in by the retina's of the eyes. Ideally, we will need a sensor that can measure across the wave spectrum. This sensor must be placed as close to the space between your eyes as possible to ensure comparable data measurment as if the sensor were a retina.

Conclusions/action items:

2014/11/03-Template - Copy

NEEL SRINIVASAN - Dec 10, 2024, 2:22 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

Raspberry Pi Pico Selection

NEEL SRINIVASAN - Nov 15, 2024, 11:01 AM CST

Title: Chip Selection for Design

Date: 10/4/24

Content by: Neel

Present: Whole team

Goals: The team met to decide what type of chip/circuitry we want to feature in the device.

Content: Because of its easy access to the internet and ability to run on lower amounts of power, the team decided a raspberry pi pico W would be our best option. We plan to write code that will connect the raspberry pi chip to the internet, convert voltage values taken in by a sensor into lux, and export them to a website. The raspberry pi pico W offers an onboard analog to digital converter(ADC), which will be essential for converting our measured voltage values into lux.

Conclusions/action items:

Purchase Raspberry Pi Pico W at Makerspace

Solder headers onto chip

Begin preliminarily code

Coding outline plan

NEEL SRINIVASAN - Nov 15, 2024, 6:15 PM CST

Title: Plan/Layout for code

Date: 10/6/24

Content by: Neel

Present: Neel

Goals: To create a rough outline of the necessary code components for the Wearable Light Logger project.

Content: The device should be able to measure light intensity values that are taken in by retinas, and then export those values to a website such that users will be able to read and understand the data. To do this, the code will first have the chip connect to wifi. This will include a loop function such that if the wifi connection fails, the code will loop back and continue to attempt a connection until successful. The code will then have specific data equations for the ADC pin to convert the voltage values to lux. Then the chip will use the wifi connection to export the data to a website(through the whole code line, if the wifi fails we will try to include a loop to refresh and ensure connection prior to data export).

```
import network
import utime
import machine

# Wi-Fi credentials
SSID = "your_wifi_ssid"
PASSWORD = "your_wifi_password"

def connect_to_wifi():
    wlan = network.WLAN(network.STA_IF)
    wlan.active(True)
    wlan.connect(SSID, PASSWORD)

    while not wlan.isconnected():
        print("Connecting to Wi-Fi...")
        utime.sleep(1)

    print("Connected to Wi-Fi:", wlan.ifconfig())
    return wlan.ifconfig()[0]  # Return the IP address

ip = connect_to_wifi()

# Set up ADC pin for LDR (GP26/ADC0)
ldr = machine.ADC(26)

def read_ldr():
    # Read analog value from LDR (0-65535)
    ldr_value = ldr.read_u16()
    # Convert to voltage (0 to 3.3V)
    voltage = (ldr_value / 65535) * 3.3
```

```
    return voltage
import urequests

# Define the URL to send data to (your server's URL or API endpoint)
URL = "http://your-server.com/ldr-data"  # Replace with your actual URL

def send_data_to_server(lux_value):
    # Create a payload with the LDR value
    data = {
        "lux": lux_value
    }

    # Send data as a POST request
    try:
        response = urequests.post(URL, json=data)
        print("Data sent! Response:", response.text)
        response.close()
    except Exception as e:
        print("Failed to send data:", e)

while True:
    # Read the LDR value
    voltage = read_ldr()

    # Convert to lux (use your previous function here if needed)
    lux_value = voltage * 100  # Simplified for example; replace with actual lux conversion

    # Send the LDR data to the server
    send_data_to_server(lux_value)

    # Wait for a bit before sending again
    utime.sleep(5)

from flask import Flask, request, jsonify

app = Flask(__name__)

@app.route('/ldr-data', methods=['POST'])
def ldr_data():
    data = request.get_json()
    print("Received LDR data:", data)
    return jsonify({"status": "success"}), 200

if __name__ == "__main__":
    app.run(host='0.0.0.0', port=5000)
```

Conclusions/action items:

Find necessary code requirements(what types of functions)

Develop code outline in Thonny

NEEL SRINIVASAN - Nov 15, 2024, 6:12 PM CST

Download

Coding_Requirements.docx (14 kB)

Design Factors

NEEL SRINIVASAN - Nov 15, 2024, 4:34 PM CST

Title: Design Discussion

Date: 10/2/24

Content by: Whole team

Present: Whole team

Goals: To outline our designs and describe the rationale behind our choice.

Content: We had three designs in our preliminary design stage: the glasses with built in sensor, glasses with clip on sensor, and headlamp. The Glasses with the Built-In Sensor design feature a photoresistor sensor attached in the middle of the bridge of the glasses frame. The electronic components of the design would be integrated into the frame of the glasses by cutting out a small subsection of the frame and implementing the circuitry. The electronic components would require an integrated circuit to fit within the frame and would be completely enclosed by the glasses frame for a cohesive design. The photoresistor attached to the center of the bridge of the glasses would be able to accurately sense the light reaching the retina.

The Glasses with the Clip-On Sensor design feature a clip-on photoresistor sensor that would attach to the middle of the bridge of the glasses and clip-on electrical components attached to the frame of the glasses. The photoresistor clipped onto the glasses would be able to replicate the light reaching the retina. This design would be able to attach to any standard pair of glasses and could be removed and reattached. The electronic components attached to the frame of the glasses would feature an integrated circuit covered in a 3D-printed box that can clip onto the side of the frame of the glasses.

The Headlamp design features several different components. The light from the original headlamp would be removed and the photoresistor sensor would be attached to the tilting plate of the headlamp. The electronic components would be attached to the anterior of the headlamp by being positioned into a 3D-printed box that would be attached to the back strap. The electronic components would feature a breadboard circuit, Raspberry Pi, and a battery to power the circuit. The tilting aspect of the headlamp with the sensor would be able to accurately replicate the light reaching the retina.

When weighing out the designs as part of creating our design matrix, usability refers to the ease of data collection for the clinician, the comfort level of the patient during data collection, and the inclusivity of the design. Usability was ranked highly due to the client’s emphasis on these components of the design. The headlamp design scored the highest due to its inclusive design, which allows the device to adjust to any patient’s head size, and its comfortable design which easily fits over one's head. The two glasses designs require the patient to be able to wear glasses despite potential deformities a patient may have, and are not adjustable making the two designs less comfortable and inclusive than the headlamp design. Additionally, the glasses with clip-on sensor design place the electronics on one side of the glasses frames, which could tilt the glasses to one side or cause the glasses to fall off of the face during data collection.

Conclusions/action items:

Begin evaluating and prototyping headlamp design

First Client Meeting 9/13/2024

NEEL SRINIVASAN - Sep 15, 2024, 10:56 PM CDT

Title: First Meeting with Client 9/13/2024

Date: 9/13/2024

Content by: Neel Srinivasan

Present: Whole Team & Client Dr. Jean Riquelme

Goals: To describe our team's first meeting with our client for the wearable light logger project

Content: In our first meeting we met with our client Dr. Jean Riquelme. We asked her questions about the project, specifically, what her expectations are for this group and certain boundaries/limitations/hopes that she has for us. We also got the opportunity to schedule our future meetings at a time that works for everyone. Dr. Riquelme also conveyed the idea that we should conduct our work with flexibility and independence, as she wants to take a rather hands off approach to her directions.

Conclusions/action items:

Prepare for next meeting with Progress Report #2

Continue to update lab archives with further research

Brainstorm possible designs for light logger

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity. subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items: