Lensy

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CSE 440: Introduction to HCI

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Overview

Problem

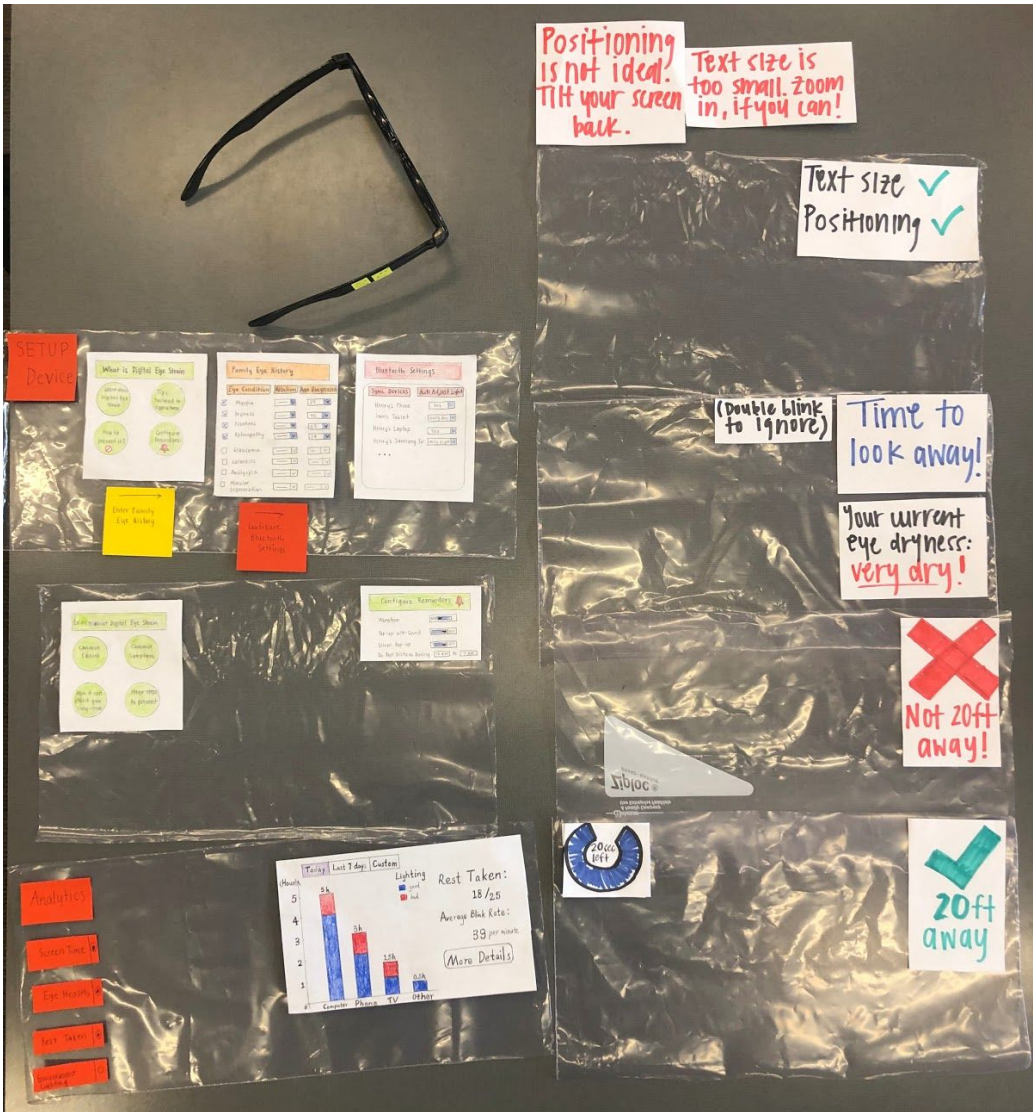
Digital eye strain is an issue that many individuals who spend extended periods of time in front of device screens face. The syndrome shows itself via a number of symptoms ranging from dry eyes, blurred vision, fatigue, headaches, difficulty in concentrating, and so on. Unfortunately, many individuals are heavily tied to various device screens for work, school, or other important reasons and do not have the option to detach from these screens in order to reduce symptoms. Furthermore, many individuals are not even aware that their symptoms are caused by a combination of their environment (lighting, font size, etc.) and device screens, thus do not even know where to begin in alleviating their symptoms. Over time, these symptoms may worsen and put an individual's eyes at serious health risk as well as make it nearly impossible to work at a screen for prolonged periods of time.

Solution

Our solution, Lensy, is a wearable pair of glasses combined with AR technology. The glasses contain several key functionalities in order to help reduce digital eye strain symptoms. They block blue HEV light that projects off of screens and adjusts the lenses to the perfect shading in order to reduce symptoms depending on an individual's environment. As an individual works at various devices throughout the day, the glasses remind the individual to take breaks by looking away via customizable vibrating or pop-up reminders and ensure they are looking at something that is at least 20 feet away and for 20 seconds. The glasses are highly customizable and can be configured to not disturb during certain hours of the day, allowing them to work with a variety of schedules. The glasses also detect, via a small camera, what devices an individual looks at, for how long, the lighting of the environment, angle and distance to the devices, and text sizes. Combined with sensors that detect certain symptoms like dry eyes and fatigue, individuals can monitor their progress over time via the analytics button on the side of the glasses. Resultantly, individuals can work at various device screens for long periods of time without experiencing symptoms, and assure that their eye health is in good hands.

Initial Paper Prototype

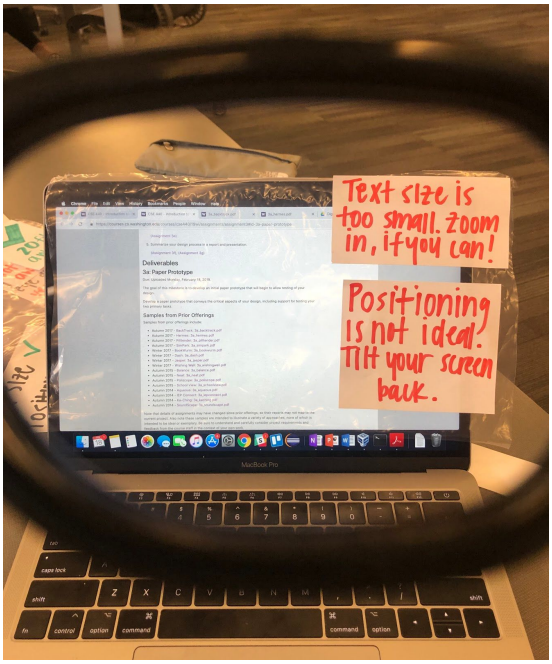
Overview

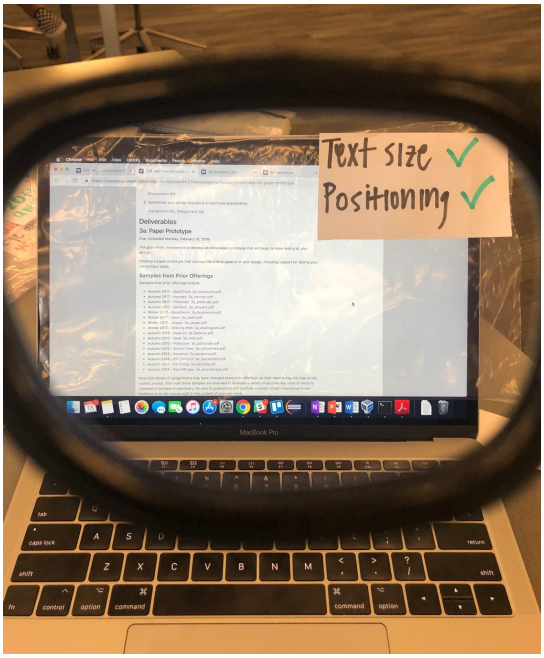


Our prototype includes a pair of glasses frames that will be used to simulate the AR glasses, as well as the various “digital elements” individuals will see while wearing the glasses. We use transparent zip lock bags to simulate the AR technology.

Task #1

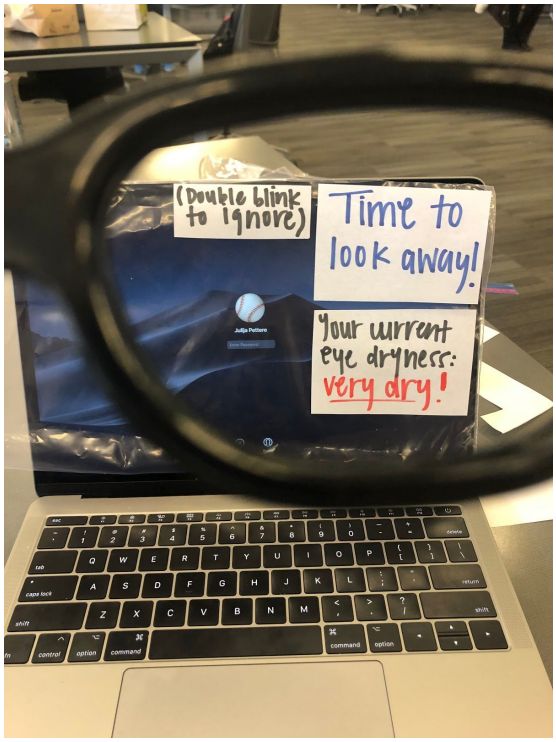
Task overview: Working on a task in a shared space or home for long durations without experiencing digital eye strain. This includes working at about 1-2 devices and variable lighting + environment

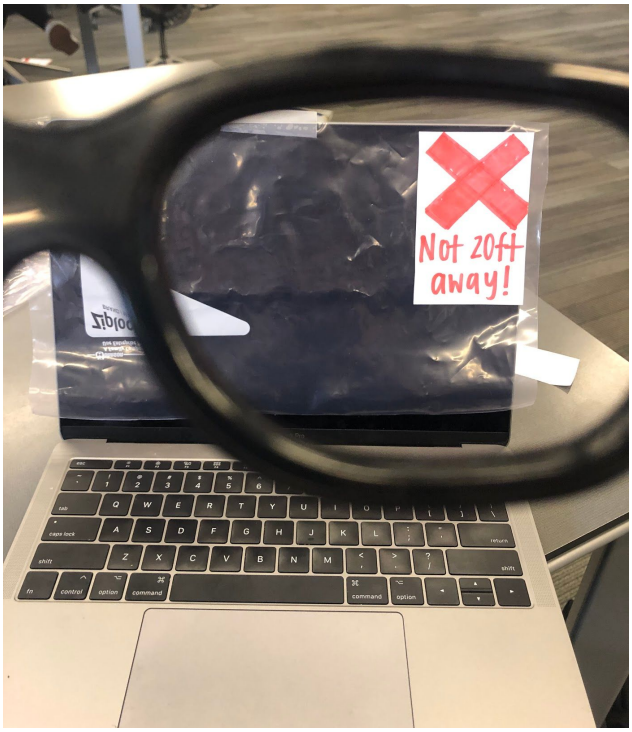




When an individual initially puts the glasses on, the glasses scan the device screen in front of them and let the individual know (via AR technology) if the text size is too small. Similarly, the glasses check if the individual has the ideal positioning relative to the device they are sitting in front of. If both checks are passed, the AR technology displays a pop-up letting the individual know that the text size and positioning are best in terms of reducing digital eye strain symptoms.

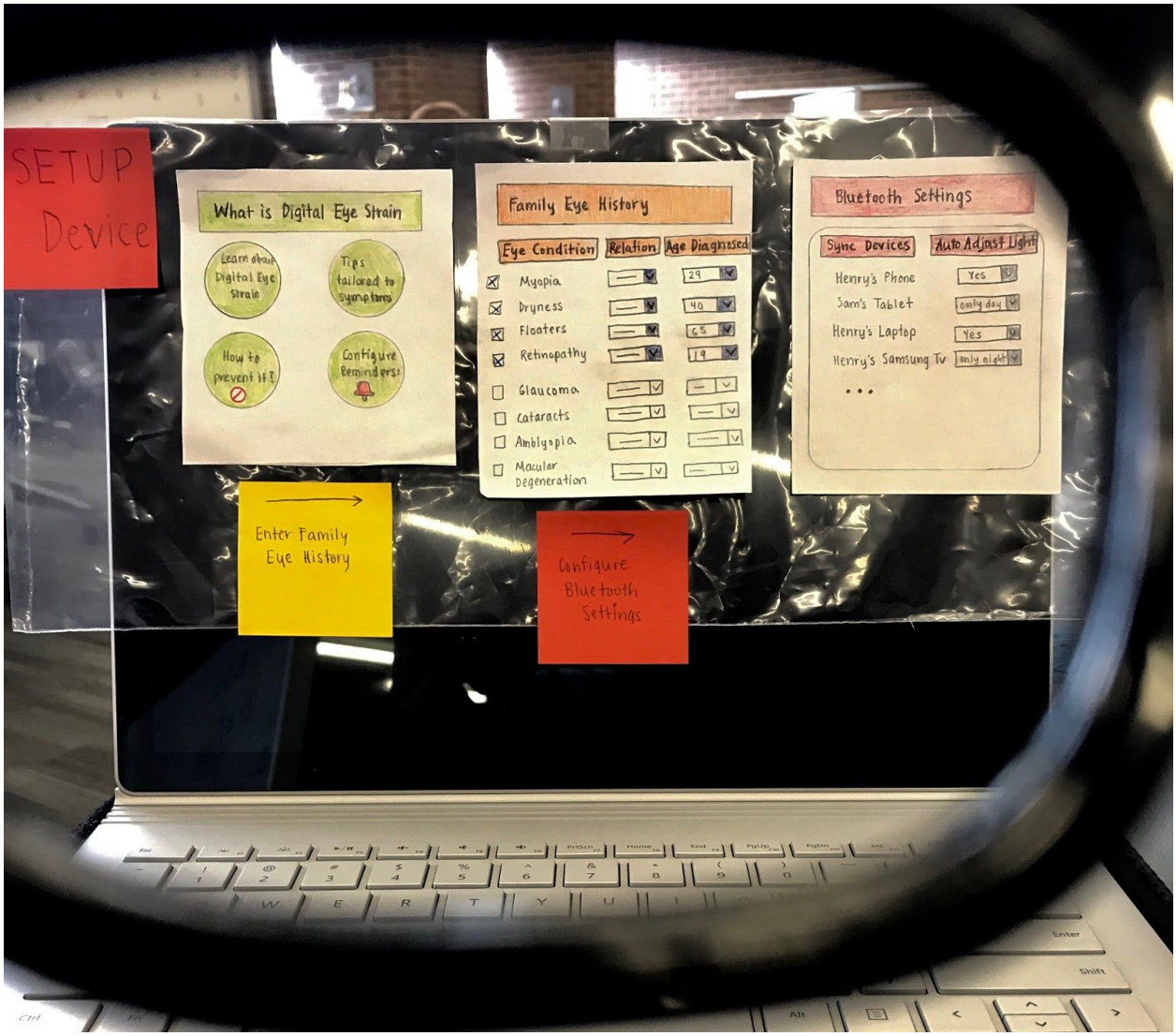
While an individual is working the glasses will remind them every once in a while to take a break and look away from their device screen. To do so the AR technology will display a pop-up reminder letting the user know to look away, and alongside a statistic about some aspect of their current digital eye strain symptoms in order to motivate them to take the action. As the individual looks away, the glasses will notify them if they are looking at something that is at least 20 feet away. Once the individual is looking at something that is at least 20 feet away, a timer will start at 20 seconds and count down to 0. Afterward, the individual can look away and resume their work.



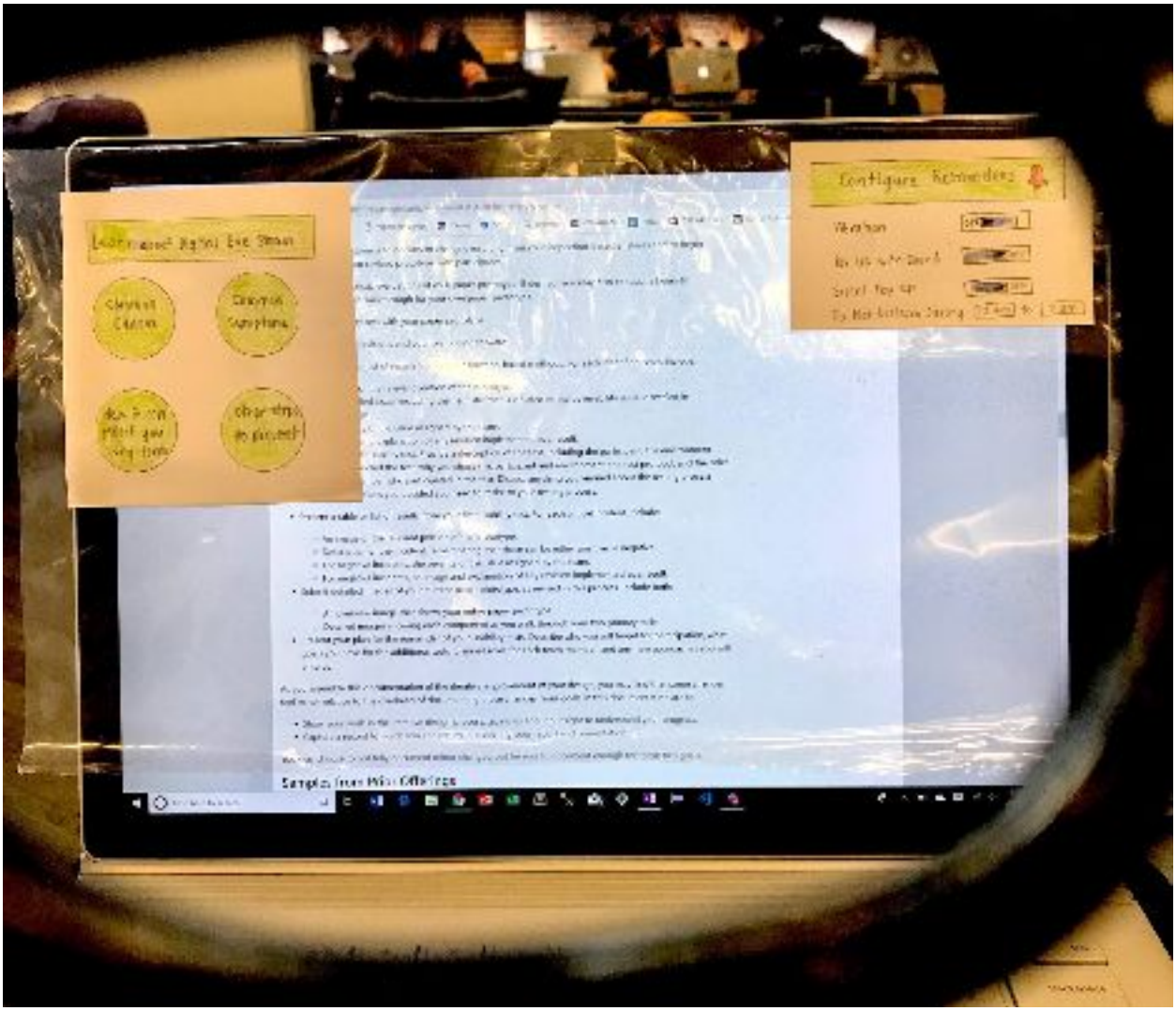


Task #2

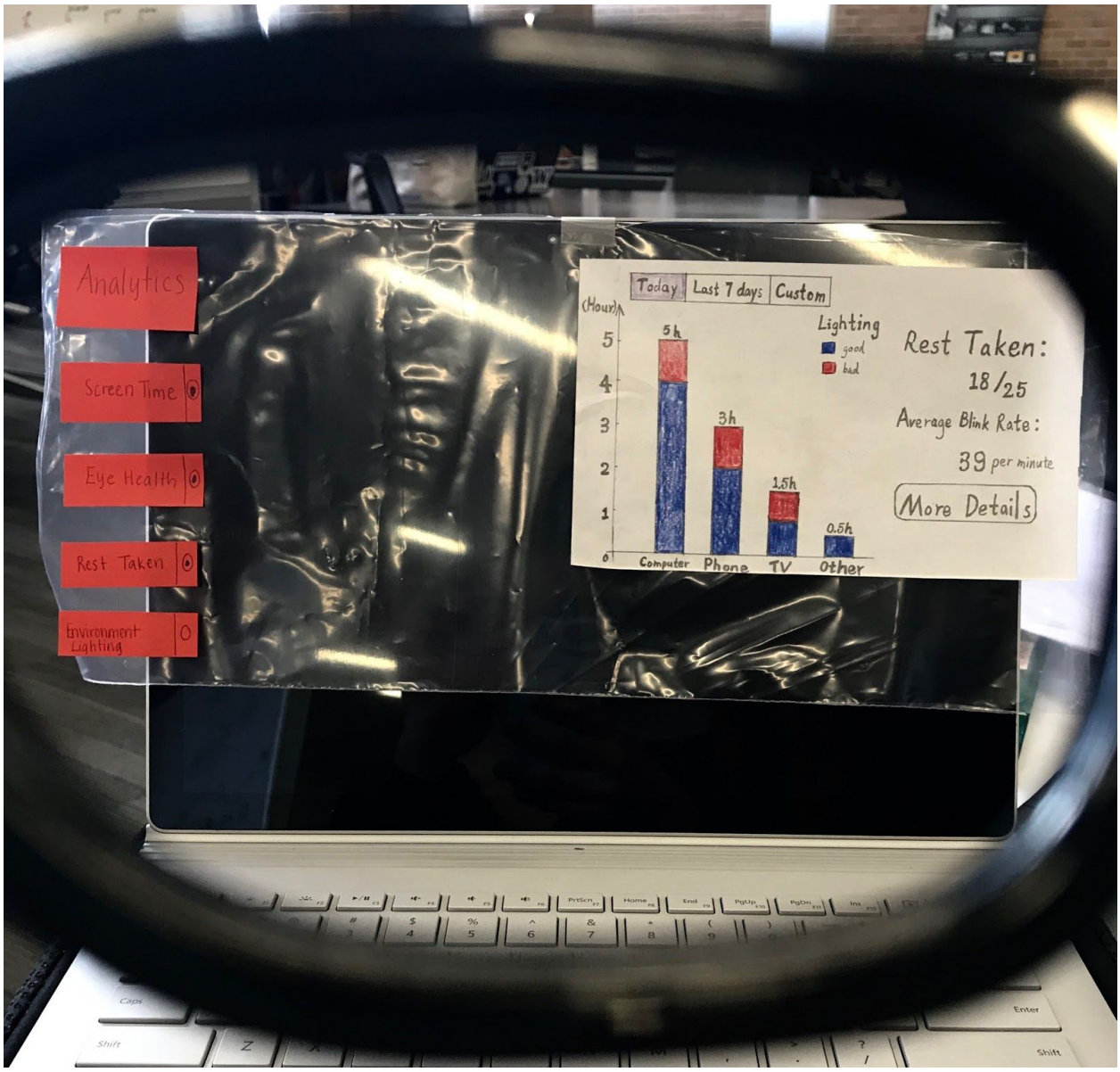
Task overview: Educate self about digital eye strain, and understand personal digital eye strain symptoms + see the progress of these symptoms over time.



The device will first lead to a setup screen in which different panes can be swiped through to complete setup of things like 'Personal and Family Eye History', 'Bluetooth Settings', and 'Learning about Digital Eye Strains'. As seen the different options can be selected with the touch of a drop-down menu. In addition, the "What is Digital Eye Strain" pane has a series of buttons to select which will clear the screen and present a new pane with more details about that topic. For example, if the individual wants to "Learn about Digital Eye Strain", it will lead them to the following view below.



Here the individual can select buttons to learn more about common causes, common symptoms, how it can affect you in the long-term, and other steps to prevent digital eye strain besides using this product. These panes will also be more tailored towards the symptoms you are currently experiencing and risk factors you may be exposed to as predicted from your family eye history. The pane on the right shows an example of how you may configure your reminder settings. This includes knowledge about why it is important to follow the 20-min break reminders as it related to your personal eye health goals, and how you would like to receive your reminders including the options of vibration, pop-up with or without sound, and do-not-disturb settings.



The individual can also see analytics by swiping on the red ‘Analytics’ button or clicking the ‘Analytics’ button on the glasses which will present a customized analytics pane depending on the measures you are interested in including ‘Screen Time’, ‘Eye Health’, ‘Rest Taken’, and ‘Environment Lighting’. As seen the individual can see the data for the ‘current day’, ‘last 7 days’, or a customized amount of time, and see charts such as the usage across different devices in good or bad lighting and personal eye health metrics such as blink rate and dryness relating to symptoms of digital eye strain you are developing.

Testing Process

Heuristic Evaluations

To begin our testing process we conducted three rounds of heuristic evaluations with individuals from other groups in our class. The individuals walked through two tasks using our paper prototype and evaluated the prototype's usability using Nielsen's heuristic principles. Any issues were noted along with a severity rating. This allowed us to prioritize changes going forward and assured we were handling the issues in our prototype that was most concerning or potentially detrimental to usability testing.

Evaluation #1

- Team members who facilitated: Amy Shah, Max Ding
- Classmates who conducted: 2 members from the clothing tracking group

Evaluation #2

- Team members who facilitated: Amy Shah, Julija Pettere
- Classmates who conducted: The team working on staying connected with family

Evaluation #3

- Team members who facilitated: Max Ding
- Classmates who conducted: The team working on travel adjustment

Usability Testing

To further evaluate our prototype idea we conducted three usability tests. For these tests, our team rotated who facilitated the participant interactions during the tasks, and who took notes. The following is the protocol we followed for all of our usability tests:

1. **Introduce the problem** we are tackling and provide a brief overview of the AR glasses. Address any participant concerns.
2. **Task #1:** set up the glasses for the first time; this includes walking through settings and instructions.
    a. Introduce task goals & allow them time to accomplish this goal.
3. **Task #2:** read an article on their laptop and rest their eyes via the AR reminder.
    a. Introduce task goal & allow them time to accomplish this goal
4. **Task #3 (extension of the first task):** walk through analytics and understand their symptoms
    a. Introduce task goal & allow them time to accomplish this goal
5. **Conclude** by asking some follow up questions about their experience using the glasses, anything they found hard to understand or unintuitive, and any suggestions they have for improving the design.

The following are descriptions of the three usability test participants (We conducted all usability tests in an open workspace on campus, at a table, with the participant's laptop in front of them - simulating their typical work environment):

- **Participant #1:** University student in CSE department
    - We chose this participant for this study as they experience digital eye strain daily and are looking for a way to actively combat the symptoms while still being able to go about their daily work and tasks.
- **Participant #2:** University student in non-tech affiliated major
    - We chose this participant because we wanted to test our prototype on someone who suffers from digital eye strain (because they work at a laptop all day), but is not as tech-savvy, thus they may be able to identify some assumptions we all made while creating our prototype as our entire team is computer science majors.
- **Participant #3:** University Student in CSE department & AR experiences
    - We chose this participant because we wanted to test our prototype on someone who isn't aware of digital eye strain but constantly uses devices all day from mobile devices, laptops, and TV. This participant is also more aware of AR and VR as someone who owns a VR Oculus rift device and has experience using AR apps. With this knowledge, this participant is able to identify if our design is consistent with other AR based devices and apps, and our design is intuitive.

Refinements made throughout the process

- **Including individuals with varying tech experience**
    - After conducting our first usability test with a CSE major we wanted to make sure to we tested our prototype on individuals with varying tech savviness so we specifically picked our next two participants to be - an individual who knows very little about tech, and an individual who has specifically worked with AR for a long time.
- **Making task ordering more intuitive**
    - We realized our first task does not make sense to perform all at once initially as it includes setting up the glasses as well as looking at analytics (which only makes sense to do after performing other tasks). So we split up our second task into setup and viewing analytics and made it sandwich our first task.
- **Simulating natural workflows**
    - Initially, for our second task we went straight into having the participant be reminded to look away, but quickly realized this does not properly simulate getting distracted from a task at hand. Thus we added having the participant read an article for a couple of minutes prior to being alerted of the reminder.

Testing Results

Heuristic Evaluation (Issues Found and Addressed)

- **Recognition rather than recall (severity 3):** One group thought it was super unclear how to use AR portion of the glasses prototype (what gestures are possible). Given that this group consists of CSE majors and they had trouble with this, other individuals would definitely struggle as well. As a result, individuals might be hesitant to use/explore AR glasses.
    - **Changes made:** Considering that AR technology is still very new, a part of our solution for this issue is explaining to users how to navigate the AR. (i.e. how to tap buttons, swipe, etc.) The second revision is adding a 'day one' experience that is essentially a tutorial that walks a user through the various possible gestures. This includes an overlay on the faded out digital elements that teach gestures.
- **Consistency and standards (severity 2):** Button and display size should be consistent and on the larger end, in combination with showing less text per single view of digital elements. Otherwise, some of the presented views are too overwhelming for the user and nearly impossible to read without lots of strain.
    - **Changes made:** In order to address this issue, we reduced the amount of text presented to a user on one screen. We did so by splitting up the various views that were on one screen and spread them across many, thus a user could swipe to see the full range of views. We also increased the text size across all our various prototype views.

Usability Tests (Issues Found and Addressed)

Usability Test #1

- **Unclear on/off status (severity 3):** When waiting for a reminder to take a break to be shown, the participant had no way of knowing the current power state of the glasses while having them on.
    - **Changes made:** In order for users to know the on/off state of the glasses while wearing them, we added a little power signal (green for on) as well as a battery immediately next to it.

Usability Test #2

- **Unclear navigation (severity 3):** When reading the "How to Navigate" pane the user was unable to understand that the user can select buttons on the screen, and instead was trying to use the buttons on the wearable device. Also, the user didn't understand that the image themselves weren't clickable and were just demos of the motions that can be done.
    - **Changes made:** We added a dialogue box next to the How to Navigate pane that will disappear after 10 seconds giving enough time for people to read it, and later

can be viewed again through pressing the info button. (verbal explanation for navigation)

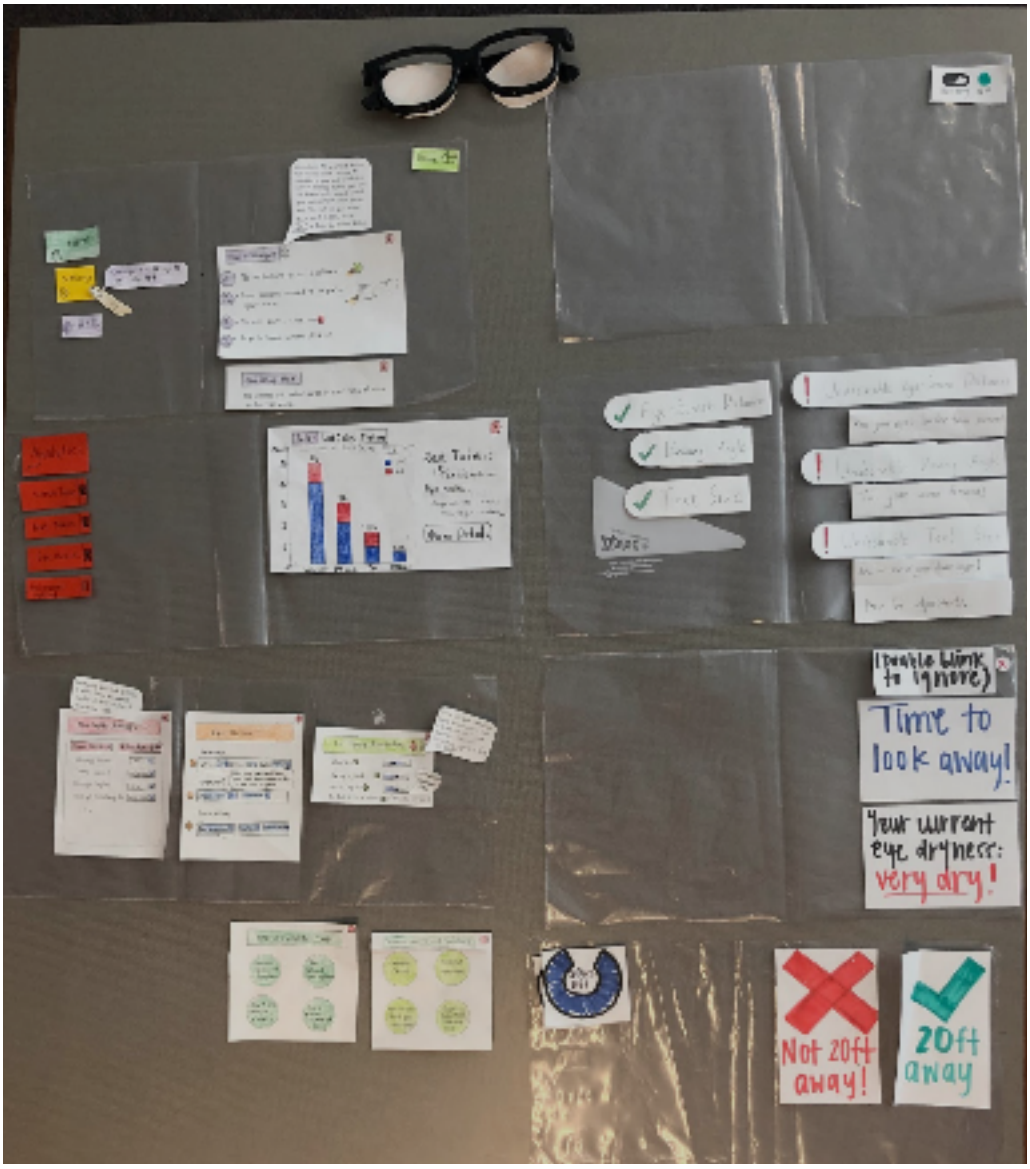
- **No help instructions (severity 3):** User didn't understand elements on the settings like what the Bluetooth connection would be used for, or what the reminders were to be made for.
    - **Changes made:** We added a dialogue box next to the Bluetooth Settings and Configure Reminders pane that disappears after 10 seconds giving enough time for people to read it, and later can be viewed again through pressing the info button. (also prompts them to go to the learn tab so that users can learn more)
- **Inconsistent labeling (severity 2):** The participant tested the Analytics pane and understood that they could select different options on the left to view the graphs on the right, however, they were confused by the inconsistent naming on the graph and analytics view and the options on the left. They also weren't sure what the chart was showing and what the rest taken was referring to.
    - **Changes made:** We added a title to the graph describing exactly what this graph is showing, we also made the legend more clear and descriptive. We readjusted the titles on the right to be consistent with the left and added units on all the numbers shown to make it more clear to the user what these numbers mean.

Usability Test #3

- **Cluttered Views (severity 3):** The setup screen was too cluttered and there was too much information which she would rather see in a separate app than through the AR.
    - **Changes made:** We can present one pane at a time in the setup, and also remove the "What is Digital Eye Strain" pane in order to declutter the setup. Also, on startup of the device instead of directly coming to the setup screen, we could provide a walkthrough of the device, which ends with the user being pointed to the setup screen to configure their settings, entering the eye health information and connect their devices.
- **Confusing home page (severity 2):** The user was unsure of what the homepage was and how to get there.
    - **Changes made:** We added a home button to the top right corner of each view which leads to a simple and clean "home view" with four buttons for all the options, Analytics, Settings, Learn, and Help. The Learn button leads to a view to learn more about digital eye strain which was removed from the setup page it was initially on, and the help button provides an overview of Lensy, can answer questions, and give instruction on what motions can be used with the AR. These four buttons are also on the glasses itself now if the user wishes to click physical buttons instead.

Final Paper Prototype

Overview:



Our final paper prototype includes examples of different panes that will be shown through the device including Settings which allow the user to configure their Eye History, Bluetooth Settings, and Configuration of Reminders, Analytics to see a customized analytics pane depending on the measures you are interested in including Screen Time, Eye Health, Rest Taken, and Environment Lighting, a Learn section to learn more about the causes and symptoms of digital eye strain and a Help section to understand how to navigate and use Lensy. All these sections are color coded in the menu and with buttons on the glasses itself. We also provide examples of how 20-20-20 rule notifications pop-up and how Lensy analyzes the environment upon sitting down to work.

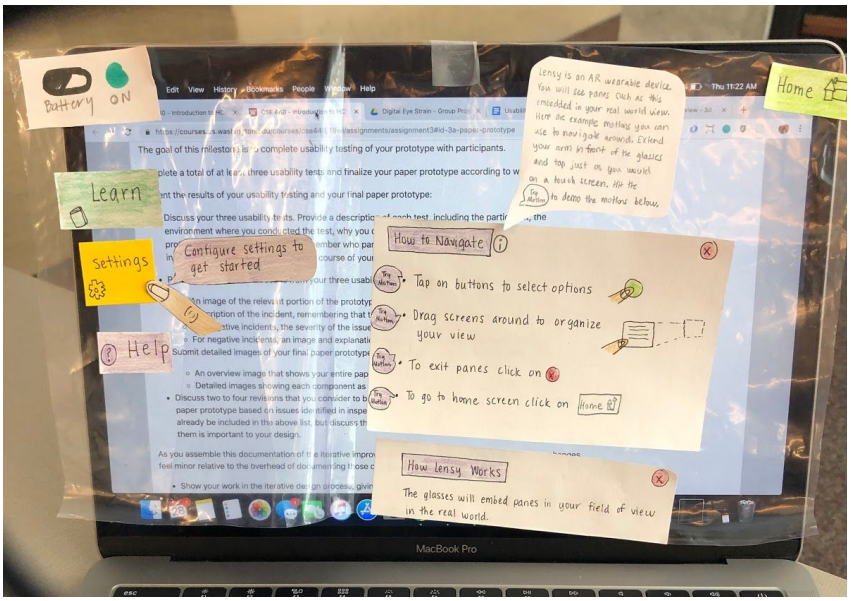
Task #1

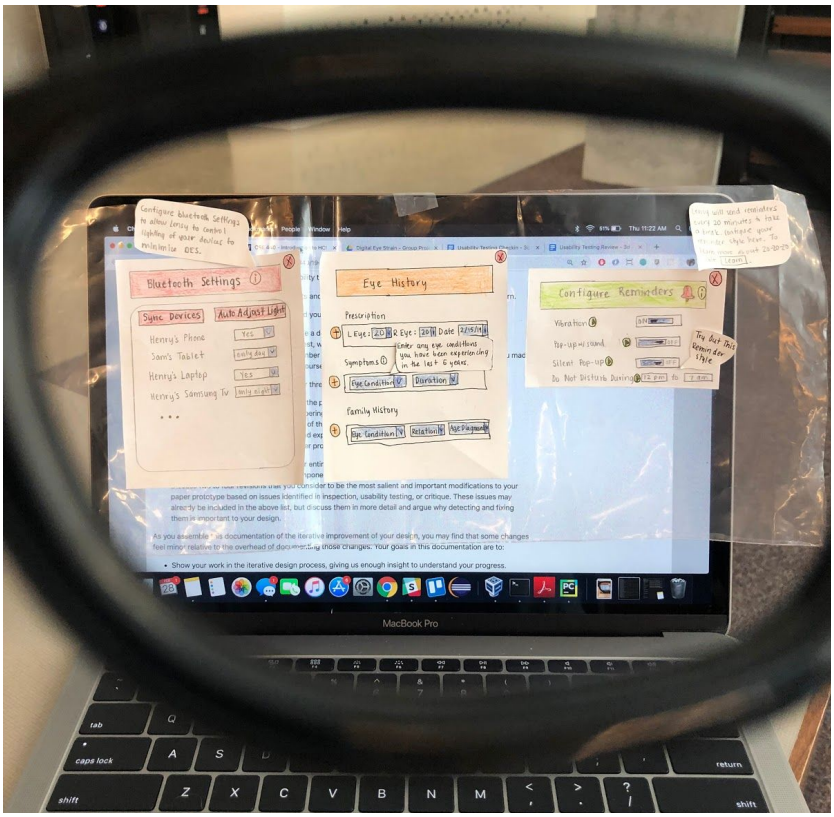
In order to educate oneself about digital eye strain, and understand personal digital eye strain symptoms + see the progress of these symptoms over time we provide a series of panes in the Analytics and Learn sections.

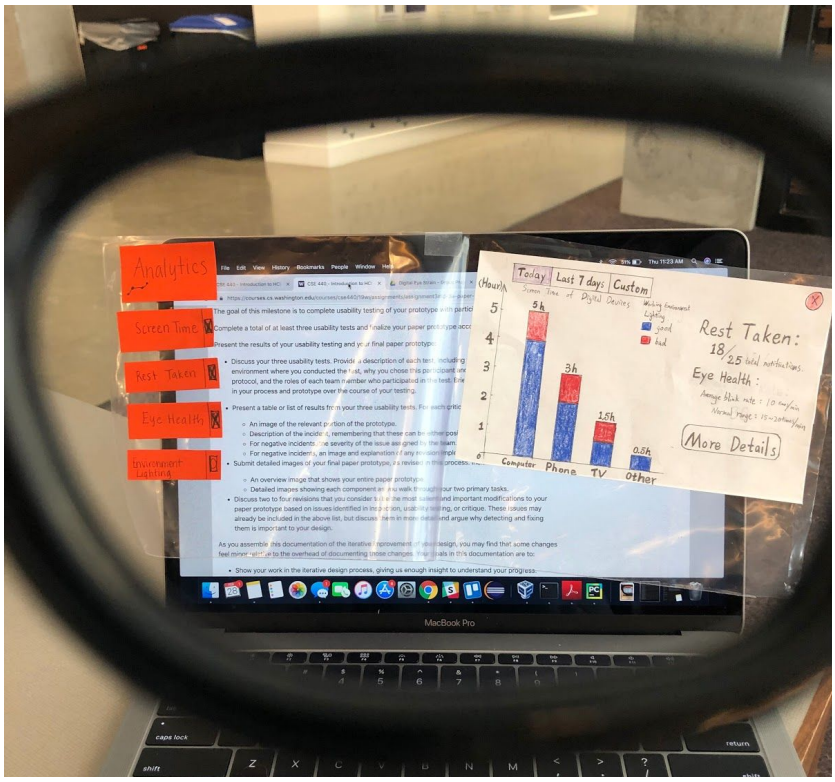
On startup of the device instead of directly coming to the setup screen, we provide an introduction and walkthrough of the device, which ends with the user being pointed to the Settings button to configure their settings, entering the eye health information and connect their devices.

The settings screen includes different panes which can be swiped through to complete setup of things like Eye History, Bluetooth Settings, and Configuration of Reminders. As seen the different options can be selected with the touch of a drop-down menu. Dialogue boxes next to the How to Navigate, Bluetooth Settings and Configure Reminders panes disappear after 10 seconds giving enough time for people to read it, and later can be viewed again through pressing the info button. This verbally explains key parts of Lensy and how to use it. This also motivates the user to learn more about digital eye strain. For example, the dialogue on the reminder box explains what the reminders are being used for, the 20-20-20 rule and also prompts the user to go to the Learn tab so that users can learn more about digital eye strain and which is something that they may otherwise skip over.

The individual can also see Analytics by clicking on the orange Analytics button or clicking the analytics button on the glasses which will present a customized analytics pane depending on the measures you are interested in including Screen Time, Eye Health, Rest Taken, and Environment Lighting. As seen the individual can see the data for the current day, last 7 days, or a custom amount of time, and see charts such as the usage across different devices in good or bad lighting and personal eye health metrics such as blink rate and dryness relating to symptoms of digital eye strain you are developing.

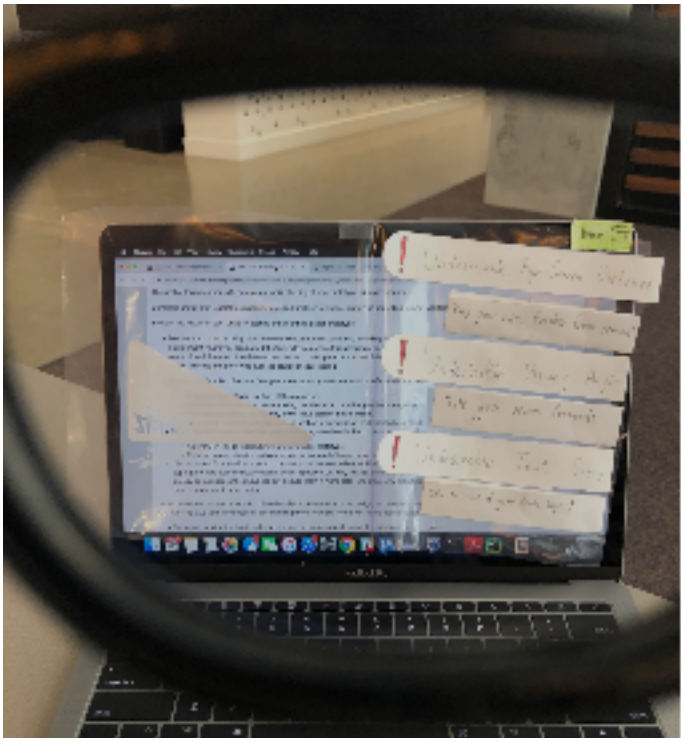


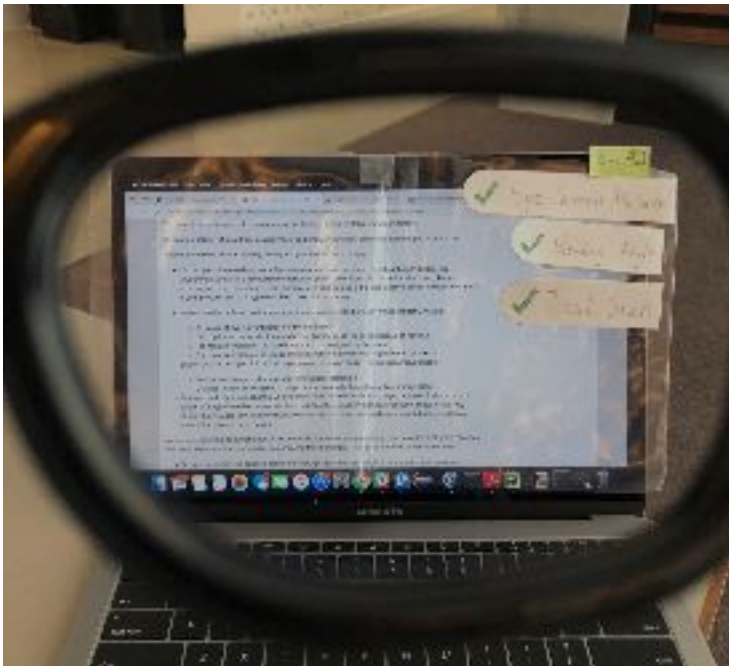

Bluetooth Settings
Sync Devices
Auto Adjust Light
Henry's Phone
Sam's Tablet
Henry's Laptop
Henry's Samsung Tv
Eye History
Prescription
Family History
Configure Reminders
Vibration
Pop-up reminder
Silent Pop-up
Do Not Disturb During
MacBook Pro


Analytics
Screen Time
Rest Taken
Eye Health
Environment Lighting
Today
Last 7 days
Custom
Rest Taken:
18/25
Eye Health :
More Details
Computer
Phone
TV
Other
MacBook Pro

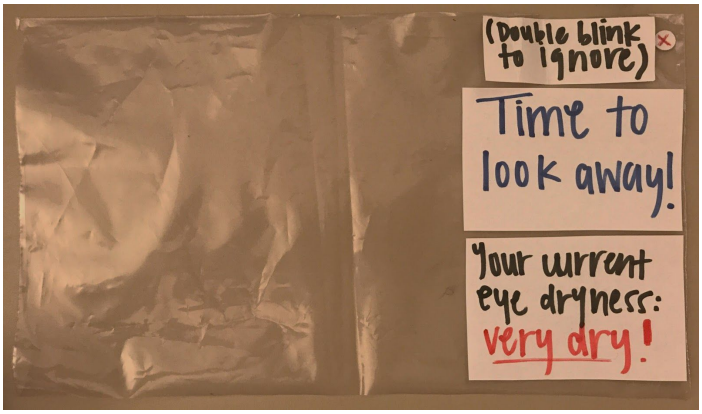
Task #2

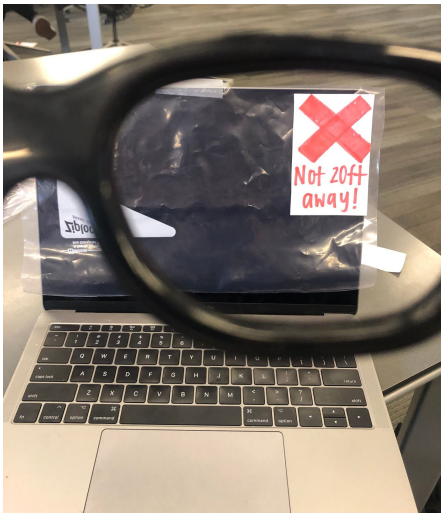
Environment Scan: Upon sitting down to work (having already gone through tutorials if this is an experienced user), the glasses scan the environment of the user including the position to the device screen, the text size on the screen, and the distance they are away from the screen. If any of these are not ideal, the user is presented with a small warning notification, otherwise, the user sees a green checkmark next to all passed environment checks. The image below on the left depicts the warnings one may see if one of these checks does not pass, and the image on the right shows what one would see if all the checks pass

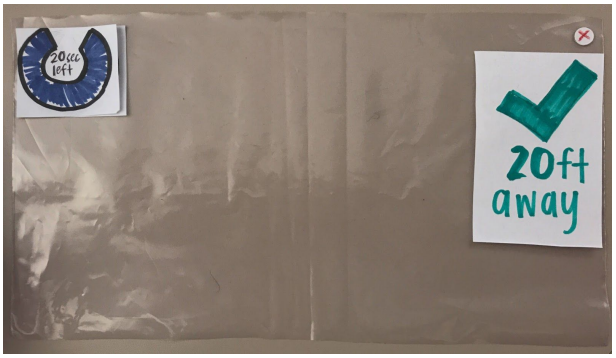




Reminders: Periodically, while the user is working, the glasses will notify the user that it is time to rest their eyes by looking away. This comes with a little stat about the user's current eye health in order to motivate them to take the action. Once the user looks away, the glasses notify them if they are looking at something that is at least 20 feet away. Once they are looking at something that is at least 20 feet away, a timer starts and counts down from 20 seconds. Afterward, the user can return to their work.







Digital Mockup

Home

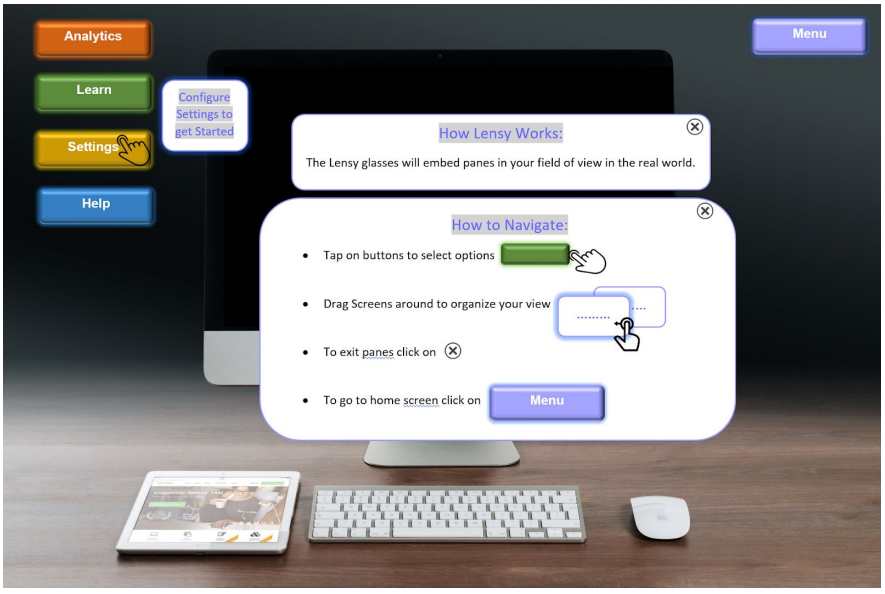
This is the home screen that users will see through the AR glasses. In the right upper corner they will see a menu button and battery level and on the left, they will see buttons to navigate the experience including Analytics, Learn, Settings, and Help. We kept this view minimal to ensure that digital elements are not too distracting or obtrusive of their real-world view.

Task #1

Overview: Educate self about digital eye strain, and understand personal digital eye strain symptoms + see the progress of these symptoms over time

On startup of the device instead of directly coming to the setup screen, we provide an introduction and walkthrough of the device, which ends with the user being pointed to the Settings button to configure their settings, entering the eye health information and connect their devices.

The tooltip disappears after 10 seconds to avoid cluttering the user's view.



The individual can also see Analytics by clicking on the orange Analytics button or clicking the analytics button on the glasses which will present a customized analytics pane depending on the measures you are interested in including Screen Time, Eye Health, Rest Taken, and Environment Lighting. As seen the individual can see the data for the current day, last 7 days, or a custom amount of time, and see charts such as the usage across different devices in good or bad lighting and personal eye health metrics such as blink rate and dryness relating to symptoms of digital eye strain you are developing.

Task #2

Overview: Working on a task in a shared space or home for long durations without experiencing digital eye strain. This includes working at about 1-2 devices and variable lighting + environment.

When the user puts on the glasses, they automatically detect the user's environment, measuring eye-screen distance, viewing angle and the screen text size. If those measurements are undesirable, an AR alert will pop up from the upper-right corner, indicating which measurements are undesirable.

The user can tap the alert for more details of how to adjust his/her posture and the drop-down text box gives precise approaches to fix the issue in order to minimize digital eye strain symptoms.

Also, as the user gets familiar with the most ideal environment for them to work in, they can selectively choose to no longer view these various environment alerts via customization options in settings.

Once the user's environment is desirable, the glasses show that all the criteria are at a good level and significantly less harmful for their digital eye strain symptoms.

After working for 20 minutes (default, customizable in settings), a reminder pops up at the upper-right corner, telling user his/her current eye dryness and informing the user that he/she needs to take a rest and look away from the screen. Considering that the user might not want to be interrupted by the rest, the user can optionally ignore this reminder by either double blinking or tapping the closeout button.

If the user decides to take a break, the glasses automatically measure whether the user is looking at an object 20 feet away to release his/her digital eye strain. If the user is not looking at objects 20 feet away, a warning saying that the user is not looking at objects 20 feet away pop-ups.

Once the user looks at something that is at least 20 feet away a timer appears at the upper-left corner and counts down for 20 seconds. After 20 seconds, the user can return back to their work and the inner reminder timer will reset.

Discussion

1. **Learnings from the process of iterative design:**
    - The process allowed us to catch unexpected issues at every design step of the way so we never got too far without incorporating feedback. Essentially it ensured we could not dig ourselves too deep into a bad design hole. While each step took more time considering we were incorporating feedback, in the long run, it likely saved us a lot of work/time.
    - The individuals we are designing for are everything. It was important that we always come back to them and their needs and this process helped us do that by making sure we were testing their ability to complete tasks rather than just how usable we thought our ideas/prototypes are.

2. **How the process shaped our final design:**
    - From the early stages, the process allowed us to develop the 'right' focus (not too broad/specific). This allowed our design to specifically help individuals who are suffering from digital eye strain, and cannot relieve their symptoms because their schooling/work is heavily tied to their device usage
    - In the later stages of evaluations and testing, the process assured our design was the most usable for the individuals we were trying to design by allowing issues like trouble with navigation, inconsistency, too much clutter, etc. to be discovered and fixed. Ultimately the process ensured our AR glasses were helpful but simple to use despite the fact that AR technology is relatively new.

3. **How usability test results changed our tasks:**

Our tasks initially had a lot of overlap and were varying in vagueness/specificity. By performing usability tests we were able to clarify the end to end goal and remove overlap with other tasks. Our first task of setup and analytics also had to be broken up and surround our second task so that the ordering made sense when conducting usability tests, but ultimately was best for encapsulating the end to end goal of relieving and understanding digital eye strain symptoms.

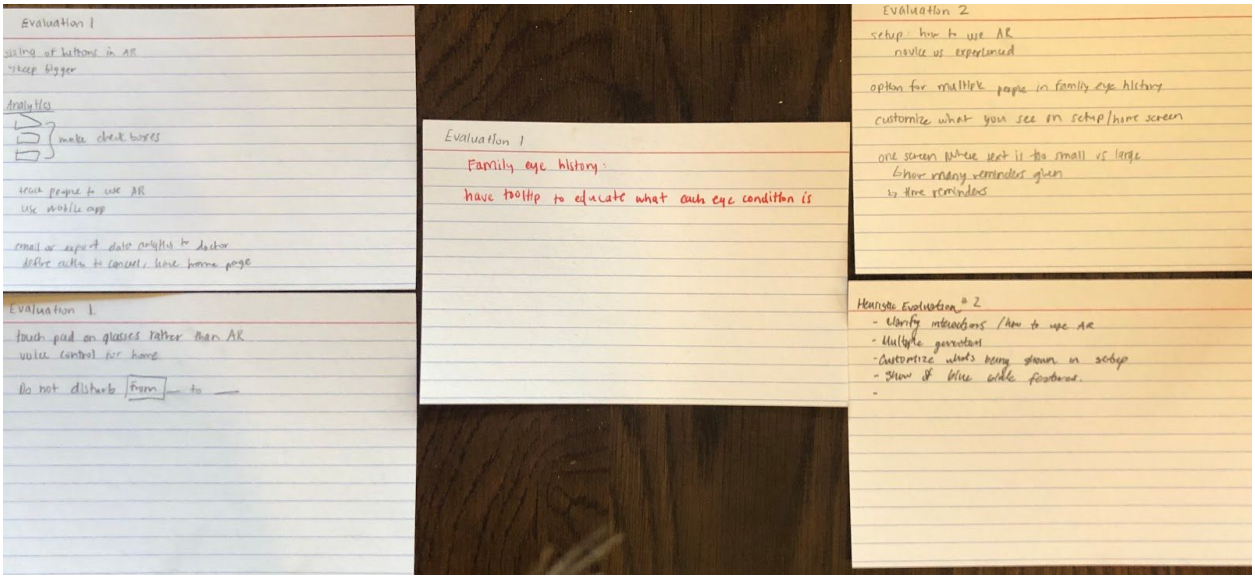
4. **Thoughts on more/ iterations:**

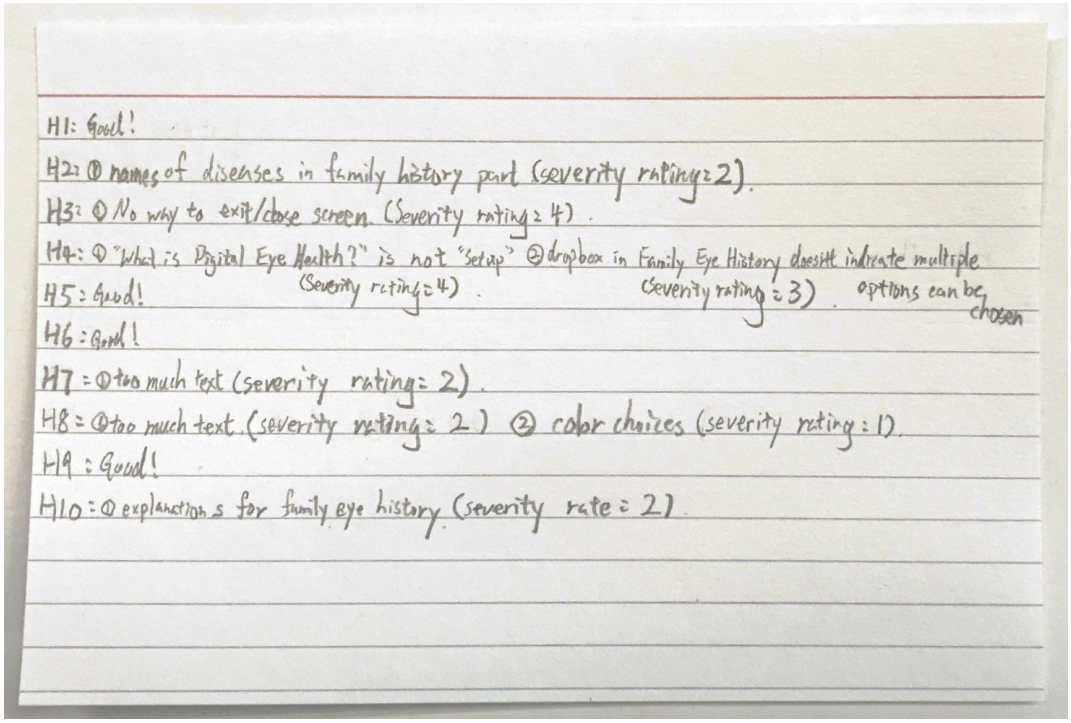
In each iteration of our design, we were able to get further feedback starting form focusing on feedback related to our goals and task and then further refining our actual design during the later iterations. In the last usability study, we found participants gave really crucial feedback about simple things such as how to undo and navigate around. Then more iterations would be able to help us refine our design and make sure it is intuitive and user-friendly while it is easy to overlook details when we are focused on the tasks and constantly seeing the design. A fresh pair of eyes always bring new perspectives on the design and surface potentially overlooked features that are crucial to the design. Currently having another iteration with our digital mockup would be

very helpful especially since it clearly shows what the user may see with the AR which is harder to convey in papers, and can help us understand how users react to this design in a medium, AR, that is new to many.

Appendix

(I) Heuristic Evaluation Cards:

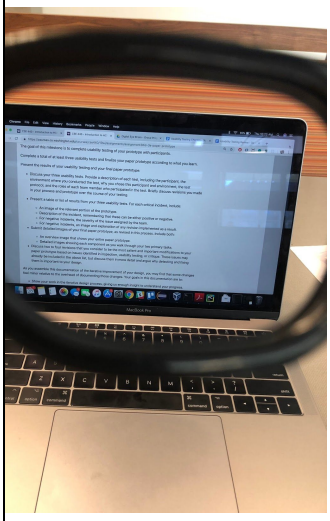
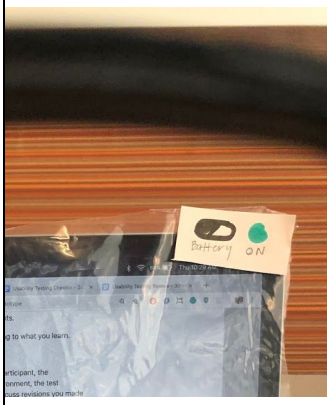
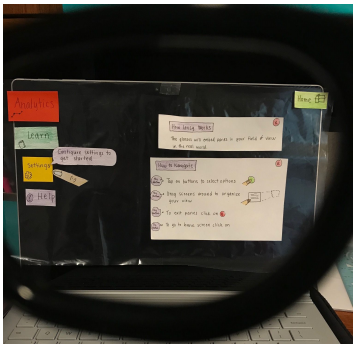
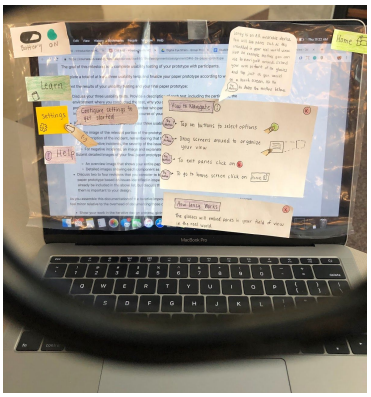


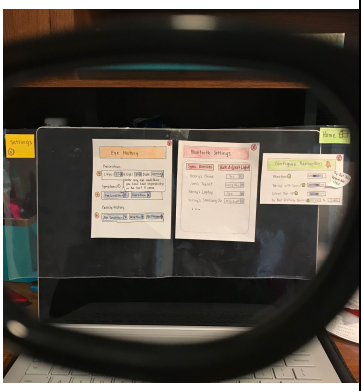
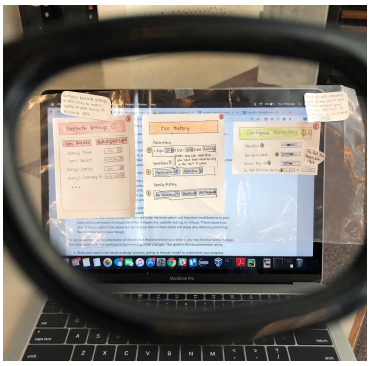
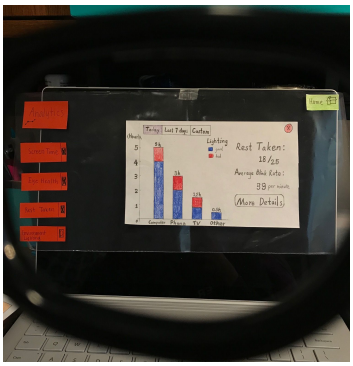
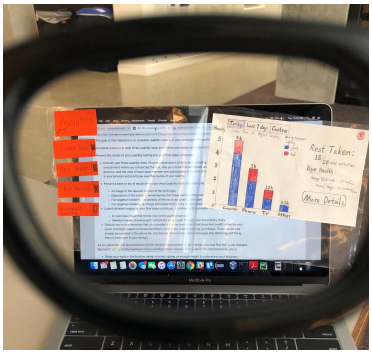
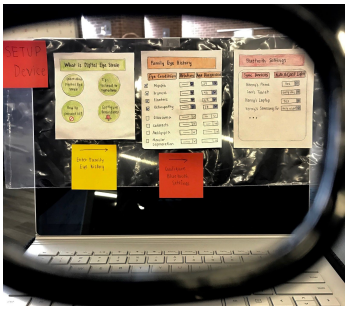
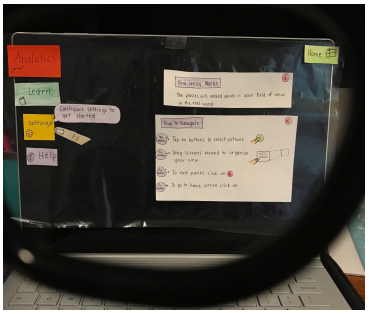


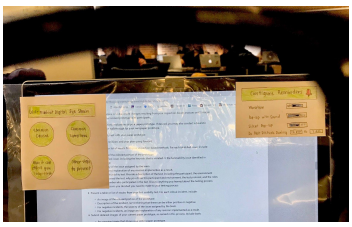
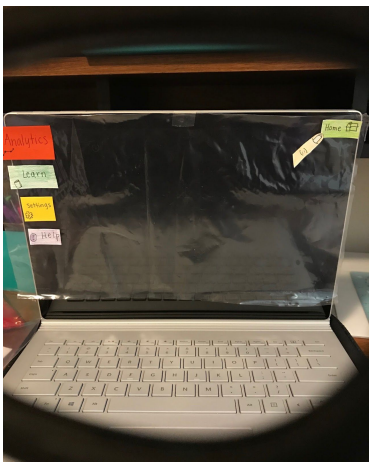
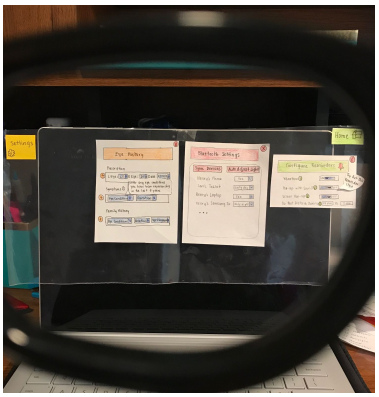
(II) Task Descriptions

- Task 1: Working on a task in a shared space or home for long durations without experiencing digital eye strain. This includes working at about 1-2 devices and variable lighting + environment
- Task 2: Educate self about digital eye strain, and understand personal digital eye strain symptoms + see the progress of these symptoms over time

(III) Identified Critical Incidents From Usability Testing:

Incident Severity	Before	After	Feedback from Eval
3 (Major usability problem)			When starting the second task we asked the participant to take a minute to work at their laptop as they usually might (but with the glasses on). After about a minute we showed the reminder view that lets them know it is time to take a break. Right before showing this screen, the participant asked how should they know that the glasses are even on when they are just working with them on. Essentially they had no way of knowing the current power state of the glasses while having them on.
3 (Major usability problem)			After introducing the device to the participant we presented the setup pane above to show a demo of how to navigate the AR. I purposely didn't mention how to do this during the introduction of the device and simply said its an AR device. This was to make sure if the user was able to understand and follow the design. When reading the "How to Navigate" pane the user was unable to

			understand that the user can select buttons on the screen, and instead was trying to use the buttons on the wearable device. Also, the user didn't understand that the image themselves weren't clickable and were just demos of the motions that can be done.
3 (Major usability problem)			Following the setup, the user proceeded to the settings/configuration panes. Since the participant has no knowledge of digital eye strain and what Lensy would be doing to help the user combat digital eye strain the user didn't understand elements on the settings like what the Bluetooth connection would be used for, or what the reminders were to be made for.
2			The participant tested the Analytics pane and understood that they could select different options on the left to view the graphs on the right, however, they were confused by the inconsistent naming on the graph and analytics view and the options on the left. They also weren't sure what the chart was showing and what the rest taken was referring to.
4			The user was unsure how to navigate and remove panes from her field of view after completing the setup.

3			The user was unsure of what the homepage was and how to get there.
3			The setup screen was too cluttered and there was too much information which she would rather see in a separate app than through the AR.

Contribution Statement

Amy Shah: 35% Wrote the overview and task one description for the digital mockup and paper prototype, part of the discussion questions, and the made the appendix.

Julija Pettere: 60%; Wrote out majority of sections 1-8 and a part of the discussion questions

Max Ding: 5% Proofread the whole report and made some minor changes.