Deliverable D

20 Points

October 13, 2024

Abstract

This document features the different concepts we produced regarding the design of software for smart glasses to be used by the visually impaired to assist them with their daily tasks. We came to the conclusion that the most prospective concept was to integrate the smart glasses system with a smartphone app that can be used to control many of the glasses features.

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1 Introduction

As we continue the process of designing the software for smart glasses on behalf of Shabodi, our team has developed each of our own unique conceptual approaches. Each of these concepts tackle various aspects of the smart glasses varying from navigation systems to smartphone integration. These concepts showcase our team's diverse ideas, which allows for endless possibilities as to how we can improve the smart glasses. These concepts provide a solid foundation for creating an API that will satisfy, and hopefully exceed Shabodi's expectations.

2 Potential Concepts

2.1 Navigation

2.1.1 Smart GPS (Westley)

There were several conceptual ideas created for this deliverable. The first was a simple navigation software system. It would be similar to a smart GPS, where the user could request to go to a location, and then go home, find a friend etc. It also included a read text function that would have allowed the user to have the glasses read back to them whatever text was in front of them. Pros – This is a simple design, so making the application robust would not be very difficult. The App would be designed purely for the glasses, and the buttons would be high contrast and large. Cons – This application would not have had much in terms of scalability. There is only so much to be done with navigation and a read off function. There would be minimal use of the network.

2.1.2 Obstacle detector (Adeife)

Another concept that was shared was designed more so for those with partial vision impairment. I focused mainly on the navigation aspect of the smart glasses. I took heavy inspiration from the reversal haptic feedback of cars. In cars, when you are reversing, as you get closer and closer to the curb, you see the arrows on the screen of your car turn from green to yellow to red. Green indicates the user is far from the curb and red indicates the user is close to the curb and should use caution. I would like to integrate this into the smart glasses. Let's say, for instance, the user is about to walk into a wall or an object. The smart glasses will pop up a warning sign on the edge of the glasses, alerting the user of this impending obstacle. It will then give the user a route to avoid the obstacle. Pros – This design has been used before, as already stated. It should pose no issue adding this feature to the glasses. Cons – The sound feature would pose an issue as it may hurt the user. Moreover, there would be relatively no use of the network for this feature.

2.2 AI Assistant (Westley)

The concept of an AI assistant was also explored. The proposition was an AI assistant that could, in absence of vision, help as a virtual assistant. This could be something as simple as choosing clothing, and asking for help, or a virtual assistant which would stay with you as you walked and talked into your ear. Pros – This would use possibly complex APIs so that the AI

could connect to and utilize different databases. Scalable, there is always something that the AI could learn. The AI assistant, while many already exist, is a micro service and could be used for other programs. Cons – AI includes a fair bit of complexity that would take significant time to develop. It would be difficult to provide the AI with the sufficient network power to make decisions expediently.

2.3 Smartphone Integration (Westley)

Another concept was a smartphone integration system that would have the smart glasses working as an extension of the user's smartphone. This would allow the user to access all of the apps on the phone, as well as the networks. Furthermore, the smartphone base would give more power in terms of network speed and computing to the smart glasses. Pros – Uses many APIs. Uses already existing hardware. The user has a unique experience where they can access their phone in a way that perhaps was not possible before. Cons – There is work to be done to ensure that the application can be developed to accept all the options available on the phone. This could be reinventing the wheel in terms of user experience.

2.4 Hardware (Charla)

This conceptual design focussed heavily on the physical components of the smart glasses and the functionality of each of those components. One of the most notable features was the audio output positioned on the glasses frame by the ears to provide auditory guidance, warnings, and feedback to the user. Another feature was the sensors that would need to be strategically placed on the glasses to provide location information about the surroundings of the user. A final feature was the actual design of the "glass" portion of the glasses which was thought to be a digital screen relaying the visuals the user would typically see, except by having them on a digital screen, objects could be highlighted or shown in high contrast to further assist the user.

The auditory guidance system would be an integral part of this design, as the user would rely heavily on all available feedback aside from visual. Pros – Would make use of an effective form of input/output that works for the user. Cons – Focusses on hardware rather than software, does not rely on API capabilities and may become irritating to the user.

The sensor placement and design would also be crucial to this design as it recognizes the surroundings of the user and provides that information to the system so that it can then be communicated whether that is auditorily, visually, or tactilely. Pros – may use location API, recognizes distance and relative size, provides the user with useful information. Cons – may have "blind spots," restricted field of view, could have inaccurate recognition of objects.

Finally, the digital screen design of the glasses would not be crucial to the functionality of the smart glasses but may provide an opportunity for another form of feedback to the user. Pros – better contrast between objects allows the user to "see" and identify objects more independently, enhances visual feedback. Cons – assumes the user is only partially visually

impaired (useless otherwise), does not rely on API capabilities, must have impeccable relay and timing of displaying visuals.

2.5 Voice-Based Interaction (Cadence)

This is a concept for the UI wherein almost all interactions between the user and the glasses happens through voice commands. The glasses would come with a guide-dog mascot which the user gets to name. This name is then how the user would address the glasses to initiate a command. For example, if a person had named their glasses Rover and wanted to use the glasses to zoom in on something, the user would say "Hey Rover, Magnify." This way, the glasses would not mistakenly pick up instructions and interrupt the user's day. Any warnings would also be audio based. This would make sure that the user's limited sight would not be relied on or further taken up by any visual warnings.

3 Chosen Concept / Conclusion

In summary, smartphone integration will be the global concept upon which the group will be focusing their energy. The proposition of navigation was considered however some questions arose concerning the liability attached to these glasses. For example, if someone was crossing the street and was hit, how does this affect the user and the reputation of the glasses / software. Even if the software was perfect, it cannot account for human error in drivers, or in a user that chose not to listen to the suggestions from the smart glasses. Furthermore, if the glasses were connected to a smartphone, they could access pre-established navigation software so the group would not have to reinvent the wheel. The smart read concept was also considered, though there were some problems with scalability. The group was not sure how to improve what was already on the market. This meant that perhaps it could be included in the software, but that it would not be a development focus. The smartphone integration would give the user the flexibility and use of a smartphone but give it further utility since those that are visually impaired may struggle with smartphones. As a group, each member will be starting to develop some app prototypes, and this will include the layout of the applications, as well as some functionality options. Together, the group has not decided on how the glasses themselves will connect with the user, so this will also be among things to accomplish in the future.

3.1 How Does This Idea Relate to the Design Criteria?

Design Criteria	Fulfillment*
Use APIs (Minimum 2) Efficiency (response time, resource utilization) Compatible with all APIs	3- Since the glasses rely on a smart phone, they would be compatible with and have access to all the same APIs as the phone. This is excellent, since phones are some of the most versatile, well-developed technology an individual has access to.
Easy to use Clear signals to user	3- The user can interact with the glasses through their smart phone, which are devices already very accessible to visually impaired people. This means the smart glasses UI can be very

Clear inputs from the user	simple and clear since most interactions can be done through the phone.
Easy to use Simple logic (Maintainability index) Fail safe measures Minimal network demands	2- The app would make the glasses a lot easier to navigate, since the UI within the glasses could then be fairly bare bones. However, it means the glasses would need to continuously be compatible with the standard smartphone.
Connects to 5G network Needs to have a two-way connection with the internet.	2- The smart glasses would send and receive much of their information through the phone. While this does constitute two-way connection, it does limit the ways the glasses can interact with the network.
Simple logic Accessible code / information Opportunities for improvement	2- The interaction between the glasses and the phone opens up a lot of freedom and possibilities for the software. Furthermore, the app would have very accessible code since apps are already an established technology. However, the dependency relations that would exist between the glasses and the phone might make these hard to edit in conjunction with each other.
Function on local network Smooth transition between networks.	3- Since the glasses would connect to the phone, the functionality and smooth transitions would then be determined by the capabilities of the phone, which are usually very high.
Adequate response time(s) Strong communication	2- Information that has to be routed through the phone would likely take longer than information which does not.
Professional graphics if there are Clear application use Simple	2- The UI in the glasses would be very simple and leave the more complicated functions to be dealt with by the phone, as the phone is already an established, fairly accessible technology. However, as the number of functions increases with development, the app would get more graphically confusing.
Use proper safety warning systems	2- While the smartphone integration does allow for a lot more information and processing power to be available to the glasses, it does not solve issues such as a speeding car, which cannot really be predicted.

*How well a criterion is fulfilled is quantified on a scale of 1-3, 3 being very well, and 1 being not at all

4 References

1. *Be My Eyes – See the world together*. (2024). Bemyeyes.com. https://www.bemyeyes.com/

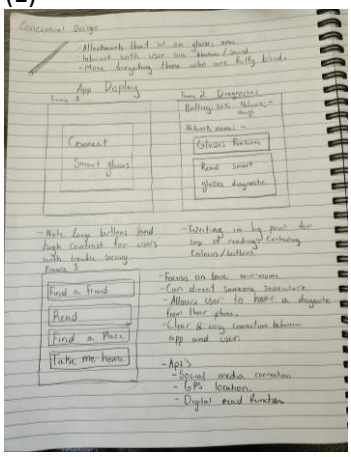
2. “What to Know About Phones for People Who Are Visually Impaired.” *WebMD*. https://www.webmd.com/eye-health/what-to-know-about-phones-for-people-who-are-visually-impaired

5 Appendix A

Shabodi Smart Glasses Concept Designs

Concept Designs (Westley)

(1)



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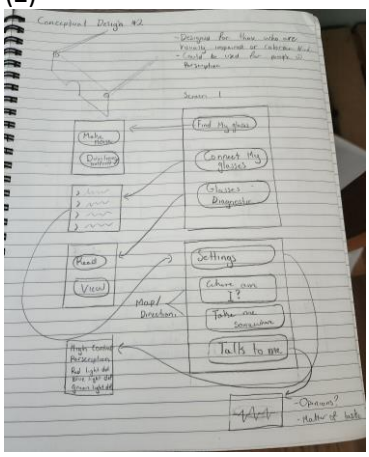

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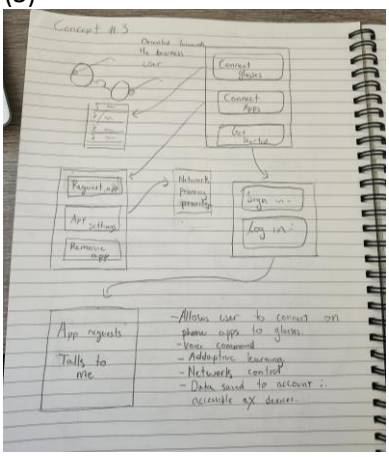

Concept Designs (Charla)

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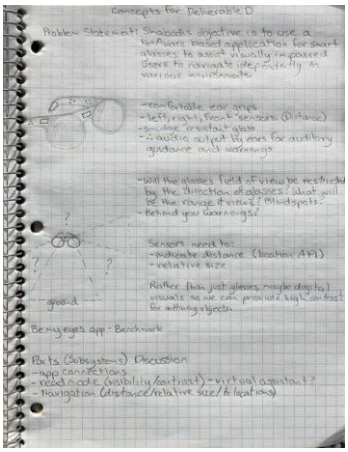

For details on subsection “Concept Designs” see section 2 Potential Concepts. Information pictured here is supplementary to the information provided in section 2.

Alternative navigation system (Cadence)

- Location APIs are used to locate user and guide them toward their destination. User can give a verbal command to the smart glasses with the address of their destination, and the smart glasses will guide the user with verbal commands, e.g., “turn left at the upcoming

intersection" ahead of time, and when reaching the intersection, "turn left." We would like the experience to fit the user's needs well, so it should be very customizable. So, if the user only wants information on upcoming directions, they can turn off the immediate directions, and vice versa.

- Magnification tools can be used so that the user can zoom in on intersection information (walk signal, hand signal with timer, red light, etc.) so that the user can rely on these tools to safely cross roads, rather than API information which may not be as reliable.
- When something is magnified, the smart glasses will audibly say how far away that item is. E.g., a user zooms in on an upcoming bicycle, and the glasses will say "6m away", so that the user can gage themselves whether or not it is safe to cross the bike lane. (alternatively, the user can magnify and say "distance" to which the glasses will respond)
- If there is an obstacle <2m in front of the user, then the glasses will automatically say "obstacle coming up in x metres" (note this can also be disabled by the user; helpful if they use a long cane as well as glasses)