Bilkent University

Department of Computer Engineering

Senior Design Project

OverSeer

Project Specifications Report

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1. Introduction

OverSeer is a mobile application that aims to remove barriers for the visually impaired people. OverSeer navigates people for the places they want to go and warns them towards obstacles they face on their paths. Next, OverSeer provides live support to help them for any problem. They can ask for price information at a supermarket or they can just want a volunteer to show the correct place of an object with the help of live support.

In this report, having described the problem, we talk about some constraints that need to be vanished to provide a reliable application together with their ethical and professional issues. Finally, we list all the functional requirements that need to be provided to make OverSeer available for everyone.

1.1 Description

Our main goal is providing safe travelling for the visually impaired people. There are some applications which share the same goal. For instance, "Be my eyes" is an app that connects visually impaired people with sighted volunteers [1]. Another example, "GetThere" is a navigation app which is useful for blind people [2]. The last example is "WeWalk". WeWalk provides a smart cane which detects near obstacles with its ultrasonic sensor [3]. These examples give different solutions to different parts of the main problem. Moreover, some of the applications are not free and may require smart devices other than mobile phones.

OverSeer combines these solutions without a requirement other than a smartphone. This allows OverSeer to have three main functionalities. Firstly, OverSeer has navigation which helps users to reach their destinations in the truest way. This navigation functionality finds the most relevant place according to the user's demand and directs the user to reach the destination. Also, it helps the user to use public transportation. Secondly, OverSeer has an obstacle detection functionality. The application warns the user if there is an obstacle in his or her way. Lastly, OverSeer has live support. The users can ask for help from volunteers and volunteers can access the users' camera in order to help them. While using all of these functionalities, users can use voice commands to navigate in the application.

1.2 Constraints

1.2.1 Fast Results For Obstacle Detection

In this project, obstacle detection will be performed based on instant frames captured by the user's phone camera. This means that the application should detect obstacles in a very short amount of time after receiving the frames to warn the user before facing any danger. In order to notify the user about the obstacle at the correct time, the application should perform this task fast enough to prevent accidents. Therefore, detections should be made under 1.5 second.

1.2.2 Accurate Performance For Obstacle Detection

In addition to prediction time, accuracy of the predictions is another crucial aspect of the application. In order to protect the user from any physical harm, application should detect obstacles with high accuracy. In the case of a tradeoff between precision and recall, higher recall will be preferred because detecting higher portions of the existing obstacles is important for our aim and to accomplish this we can make a compromise on the number of wrong detections for non-existing obstacles. Therefore, the recall score of the predictions should be at least 90% for a safe walk.

1.2.3 Accurate Navigation

While leading the user through the route that is determined by the application, instructions should be clear enough to make him or her follow the determined path. Our application, therefore, should make precise location detections to give accurate instructions and error for the location should be lower than 10 meters.

1.2.4 Robust Network

Live support through video streaming is an important aspect of the application and in some cases visually impaired people get help from some volunteers by using this feature. To provide the best support for the visually impaired person, volunteers could see the related scenes clearly. Besides, many people should be able to use this feature simultaneously. Finally, any connection problems should be handled by the server. Our network structure, therefore, should provide 720p video quality option to streaming while also providing stable connections to users simultaneously.

1.3 Professional and Ethical Issues

Our topic is about visually impaired people, so we have a lot of ethical and professional responsibilities. One of the biggest ethical responsibilities we have is making our target audience not feeling separated from the society. To fulfill this responsibility, we designate requirements accordingly but we also deal with significant professional and ethical issues.

Most importantly, the live support system can be abused by malicious people who do not intend to help the user, and we have several plans to deal with this issue such as authentication or verified supporters. As developers it is our responsibility to protect users' data and we also need to show that their data will not be used outside their permission or in any malicious way. Another professional issue we are dealing with is having a very accurate object detection system. Our system should make almost no mistake when guiding the user through their travel. Missing an obstacle on a sidewalk that has a potential to hurt the user or labeling a non-obstacle thing as an obstacle that would make the user make unnecessary movements would both be unethical and unprofessional. Similarly, in our navigation system we should calculate an absolutely correct path while making the path as efficient as possible.

In short, we aim our application to be the guiding eyes of our visually impaired users. This bears a lot of ethical and professional responsibility. They should feel secure when using the live support system, they should not be having to do any unnecessary actions while using the application and lastly, they should not feel like they have visual impairment while using our application.

2. Requirements

OverSeer must be capable of the following functionalities:

2.1 Navigation

Users must be able to tell OverSeer where they would like to travel. They should be able to save their places of interest and navigate to their point of interests. OverSeer must guide users by voice commands for navigation. OverSeer must warn users if they are off-path and guide users back to the correct path. Occasionally, OverSeer should tell the remaining distance to the point of arrival.

2.2 Obstacle Detection

While users are travelling, they must be notified if an obstacle is on their path so that they could avoid potential harm. OverSeer must alert the user if any obstacle is detected. Obstacles can be cars, poles, holes, fire hydrants etc. OverSeer must not warn users when these obstacles are not in the user path or within a certain distance to the user. Furthermore, traffic lights can be processed to guide the user for crossing the road.

2.3 Place Discovery

Users must be able to tell OverSeer which places they seek at their current location. OverSeer must find the most relevant places the user asks for and provide an option to navigate to these places. A place can be a pharmacy, restaurant, cafe, ATM.

2.4 Public Transportation Support

OverSeer should recognize public transportation points. This would allow users to be alerted if their bus stop is the next stop or if they are near the required bus stop.

2.5 Live Support

Users must be able to ask help with live support. The user will be able to live stream their environment using their device camera to a volunteer or their predefined friends, relatives.

2.6 Accessible Control

Users must navigate in the OverSeer by voice commands or triggering certain motions with their device.

3. References

[1] "Be My Eyes Main Page," *bemyeyes,* [Online]. Available: https://www.bemyeyes.com. [Accessed: 11.10.2020].

[2] L. Lesher, "GetThere GPS Nav. for Blind," *play.google,* [Online]. Available: https://play.google.com/store/apps/details?id=com.LewLasher.getthere&hl=en_US. [Accessed: 11.10.2020].

[3] "WeWalk Main Page," *wewalk,* [Online]. Available: https://wewalk.io/en/. [Accessed: 11.10.2020].