

7 Closing Material

7.1 DISCUSSION

Our project aims to assist visually impaired individuals in navigation through the development of a wearable device. The Kinect used in our prototype did not meet our requirement of tracking objects up to 7 meters away, however, the D435i stereoscopic camera will meet this requirement. The prototype proved that haptic motors were viable, but did not meet the vibration displacement requirement of 16 zones. The frequency of data input and output (refresh rate of 15 Hz) has been met in our prototype and must be maintained throughout further development.

Power limitations have not been met, as no prototype has operated off a battery for extended periods of time. Data transfer has been within bounds of use as the image data is purely used for object detection in our prototypes. The design's comfort and climate requirements have only been partially met as a fully wearable device has not yet been constructed. The first prototype's cost of production did not exceed \$1000.

7.2 CONCLUSION

Our work has focused on developing a system to assist visually impaired individuals in navigating. The product comprises three main components: a stereoscopic camera, a haptic feedback array, and a bridge for computing. Our goals involve enhancing navigation and safety for visually impaired users through a wearable device. We intend to meet all of our listed requirements and complete an obstacle course to show the effectiveness of the device. Our plan of action involves purchasing the D435i camera and increasing the number of motors implemented to the complete 4x4 grid.

Moving forward, it is essential to test every portion of the device. When building our prototypes, we found it essential to solder correctly and ensure the connectivity of our wires. The prototype using a Kinect and two haptic feedback motors provided a testing bench, offering a proof of concept. However, there were slight challenges with identifying running motors. To achieve our goals effectively, future iterations should focus on reliable connections and address challenges in haptic feedback transmission. Continuous testing and refinement are crucial to ensure a seamless user experience.

7.3 REFERENCES

1. Manuel Zahn, Armaghan Ahmad Khan, Obstacle avoidance for blind people using a 3D camera and a haptic feedback sleeve. arXiv:2201.04453v1 [cs.HC]
2. Haptic Feedback testing adequacy for relaying 3D information:
<https://arxiv.org/pdf/2303.16805.pdf>
3. The vOIce: <https://www.nvaccess.org/audioScreen/>

7.4 APPENDICES

7.4.1 Team Contract

Team Procedures

1. Regular team meetings are scheduled to take place every Friday at 11:00 am. The location will be Parks Library unless otherwise relocated due to conflict or required activity. Additional meeting times may take place with the team or sub-teams as work ramps up.
2. For hour by hour communication, a mobile messaging app will be used to communicate quick update. For day by day communication, a discord server will be established to maintain long-term communication and an events calander. Logs and documentation will be kept in a shared Google Drive folder. Development tasks and issues will be tracked using GitLabs bultin issues board.
3. Ideally, a consensus amongst the team will be attempted; but if unable to achieve in a reasonable amount of time, a majority vote will be held. Within individual sub-teams, a consensus must be reached.
4. At each regular event, a minutes recorder will be chosen to log details for record keeping. The minutes will be added to a Google doc and updated after each team meeting.

Participation Expectations

1. Every member is expected to attended each scheduled meeting unless otherwise communicated before hand. Arrival to each meeting should happen 5 minutes prior to the designated start time. Participation is expected from each member respective to their role.
2. All assignments and preparation must be completed by the designated deadline. All group members should keep a timeline and make steady progress on their work, while maintaining communication on progress through the proper communication methods.
3. Expected level of communication will be relative to the conversation is question, but is expected to be handled in a timely manner and in good standing, i.e. respectfully and detailed. Delays in responses to team communication must not be exceed 24 hours with the exception of unforeseen emergencies.
4. Each member should abide by the group's decisions, and perform their tasks to the best of their ability. Completing assigned tasks to given specifications is required. It must be communicated to the team if a member is unable to do so.

Leadership

1. Leadership roles for each team member:
 - **Sami Bensallam** - Project lead, will be supervising both teams and assisting both teams, along with communication with advisor.
 - **Alexander Black** - Hardware lead, component assembly, minute taking.

- **Jacob Burns** - General software development, git repository manager, website maintainer.
 - **Yogesh Chander** - Software/Hardware integration, making sure both these elements work together smoothly and quickly.
 - **Jacob Lyons** - Component and system design, ensuring each piece of hardware works well on its own and as part of the greater system.
 - **Sergio Perez-Valentin** - Software lead, component testing, project management and revisioning.
2. During team meetings, the team will check on the progress of each team member. If a team member is struggling, another member of the team will be assigned to assist the struggling member. If problems still persist, a TA or outside consulting will be called upon.
 3. Gitlab issues and commits will be used to monitor the contributions of all team members.

Collaboration and Inclusion

1. Skills, expertise, and unique perspectives each team member brings to the team:
 - **Sami Bensellan** - Experience with both hardware and software, with a stronger focus in software engineering.
 - **Alexander Black** - Experience with hardware from undergraduate research brings a hardware focus to the team as a Computer Engineering major.
 - **Jacob Burns** - Experience with software and understanding of hardware. Familiar with numerous programming languages and databases.
 - **Yogesh Chander** - Experience with circuitry, embedded systems, and algorithms from major related courses. Further experience in web development.
 - **Jacob Lyons** - Experience with leadership from residential councils and being a TA, hardware design from CprE classes, experience with file systems and wireless communications from research internships.
 - **Sergio Perez-Valentin** - Experience with software workflows and high level conceptualization of program systems. Experience with Artificial Intelligence and machine learning algorithms. Extensive experience with unit testing and failure prevention.
2. The team will ensure each member is given a channel to voice their ideas during meetings. All ideas will be respected and discussed.
3. If a team member experiences collaboration or inclusion issues, it should be brought to the attention of the other members within the group. A solution that ensures the team member can work effectively will be attempted to be found. If a team member is not comfortable voicing their concerns, they should consult with the TA.

Goal-Setting, Planning, and Execution

1. Team goals for this semester:
 - (a) Implement a stereo-vision setup using two cameras.

- (b) Determine the distance an object is from the cameras using depth perception and sensors.
 - (c) For each team member to expand their skill sets as they complete their tasks.
2. Individual assignments will be given to respective team member that is determined best suited for said assignment. However, proper distribution of work load will be accounted for. Any task requiring more than one member will be grouped into a sub-team task.
 3. Meetings must stay project-related. Dedicated channels, such as the Discord server, are reserved specifically for the project. Any non project-related subjects must be held outside the scope of the project.

Consequences for Not Adhering to Team Contract

1. If a team members does not adhere to the stated contract, a meeting will be held to discuss the behavior.
2. If issues persist, it will be notified to the TA and a plan will be worked out. Regarding work, the other team members will redistribute the members work to ensure the project stays on time.

- a *I participated in formulating the standards, roles, and procedures as stated in this contract.*
- b *I understand that I am obligated to abide by these terms and conditions.*
- c *I understand that if I do not abide by these terms and conditions, I will suffer the consequences as stated in this contract.*

Sami Bensellam	DATE 9/8/2023
Alexander Black	DATE 9/8/2023
Jacob Burns	DATE 9/8/2023
Yogi Chander	DATE 9/8/2023
Jacob Lyons	DATE 9/8/2023
Sergio Perez-Valentin	DATE 9/8/2023