

1. List two to four **Desired Needs** of your project that led to your final design objectives.

Answer in two to four bullet points or concepts within a sentence or two.

- Create a cheap, safe, and effective device to help visually impaired people navigate their environment
- Provide an alternative to healthcare professionals to treat individuals with visual impairments to improve their quality of life

2. List the major **Constraints** on your design/project

Safety: The device must not interfere with cues that visually impaired people already use, the device must be safe to wear over a long period of time, and the device must be robust enough to generalize to as many environments as possible

Risks: Errors in the detection of objects to avoid, errors in pathfinding that lead the user to collide with obstacles, unintuitive haptic feedback resulting in the user not following the intended path

Global Impact: Device must be easy to access in any area, regardless of internet access

Manufacturability: The device must be simple and cheap to manufacture, without the use of major industrial processes

Marketability: Device should be beneficial to visually impaired individuals and they should want to use this device in conjunction with their existing aids.

3. List the major **Engineering Standards** on your design/project

IEC 60601: Safety and essential performance of medical electrical equipment

IEC 62304: Life cycle process for developing and maintaining medical device software

ISO 9241-920:2024: Ergonomics of human-system interaction (Haptic interactions)

ISO 14971:2019: Comprehensive process for risk management of medical devices

3. Explain **Ethical, Environmental, or Societal concerns** for practical applications of your project.

Ethical: The device might be inaccurate, particularly given that it is impossible to test every single scenario a person might encounter wearing the device, which could lead to inaccurate paths, leading to potential harm to the user

Environmental: This device relies on lithium batteries, which degrade over time, and may not be disposed of properly. Manufacturing this device also required the use of 3D printing, which is not always successful, resulting in plastic waste which may not be properly handled

Societal: Wearing a device like this might attract unwanted attention to a user which may cause social issues due to the social stigma around less-abled individuals

5. Describe **Active Teamwork** and **Leadership** in your design group

Our team had regular meetings and made sure to incorporate everyone's opinions and thoughts into group decisions. No major decisions were taken without the approval of all members. We also sought the advice of our graduate student mentor and our PI whenever we needed such advice. Every member was assigned leadership roles over one specific subproject, and they were responsible for the completion of that project. Every member contributed, to the best of their ability and expertise, to every subproject. We established concrete goals and deadlines based on the project completion date, as well as whether each of us had extremely busy schedules in some circumstances. We made sure to provide constructive feedback when work was not up to the standards we expected of each other, and made sure to explain we expected of each other.

6. What were the most significant motivating factors that led you to

The most significant motivational factor was that the knowledge I would acquire and learn would help me in my career pursuits. I self-initiated many experiments in the background before reporting back to my team in my expertise which is mobile development, and ensured I made it understandable to my teammates who might not be as invested in that niche. Knowing the massive problem that we were aiming to tackle and the amount of benefit it would provide to our target audience helped me persist through challenges and setbacks.

7. What are your most **innovative and/or entrepreneurial ideas** for this project

My most innovative and entrepreneurial idea essentially boiled down to not reinventing the wheel. We were looking for a device to do the computations for our algorithm and an algorithm to understand the environment, and we realized that there already existed many models and APIs, trained using significantly more resources than we had access to, and was free to use as a part of the Apple ARKit library, which we decided to use to simplify our SLAM algorithm using models already trained using the resources of a trillion dollar company. This allowed us to use a very accurate model without the computing costs associated with creating it.