Crash Proof Belt

Project write up

#1 Problem Finding

We identified 20 problems at the start of the year that were either affecting large groups of society or were more common in our daily lives. From there we narrowed down to three problems that seemed the most realistic and made use of a decision making matrix to select our eventual problem based on feasibility, size of target audience and capabilities of existing solutions.

#2 Define the Problem

The problem was that the blind or elderly have poor spatial awareness thus are susceptible to falling down and getting injured. Our original problem statement was; “how may we create a product that would alert the end user if there was an object in front of them, hence preventing them from falling and getting injured?”

Through our research, we found out that in 2010, 39 million people were blind and another 285 million people were living with visual impairments. This was a large group of people that were going about their daily lives with the great risk of falls and resulting injuries. In the study done, it was found that two of the five factors believed to be the cause of falls was the impact of sight impairments on getting around the home and the impact of sight impairments on negotiating the environment away from home. We also found that 60% of the blind travelled outside of their residence at least 5 times a week, and majority knocked their head at least once a month. It was also found that this significantly decreased their overall confidence when moving around. This shows that this problem needed to be solved.

The few existing solutions in the market were anti slip mats, table edge cushions, support beams and walking sticks. All of them costs below $40 except the support beams which costs around $2000 depending on the number of them installed in the house. Each of them had their pros and cons. Anti-slip mats prevent falls on slippery surfaces but does not stop the user from knocking into walls or furniture. Table edge cushions reduce the impact from knocking into tables but are limited to tables only. Support beams allow its end user to grip on firmly thus increasing stability and balance but are troublesome and costly to install and may take up too much space if installed onto every wall. Lastly, walking sticks are convenient and increase stability and balance but do not prevent the user from knocking into objects above waist level.

#3 The Big Idea

Our proposed solution was a belt that will notify the user when there is an object in front of them. It will comprise of a sensor attached to the front of a waist pouch to sense objects near the waist area, along with a power bank and motherboard that will be placed inside the waist pouch. The end user will be alerted if there is an object nearby through the use of a speaker. The purpose of our product is to completely prevent falls and injuries due to collisions with various objects. It could potentially benefit users greatly as our product would prevent the injuries rather than cure them.

It will be more cost efficient than existing solutions and our product will also be easily accessible and affordable for end users in Singapore. The only problem that we could foresee was that people may find using our product troublesome as they may already be accustomed to using a walking stick, a tool that most visually impaired people make use of.

At the proposal evaluation on 2 April, the teachers told us that our idea had potential, but we had to do more research regarding the target audience and the would-be capabilities of our product.

Some major milestones that we aimed to achieve through the course of our project:

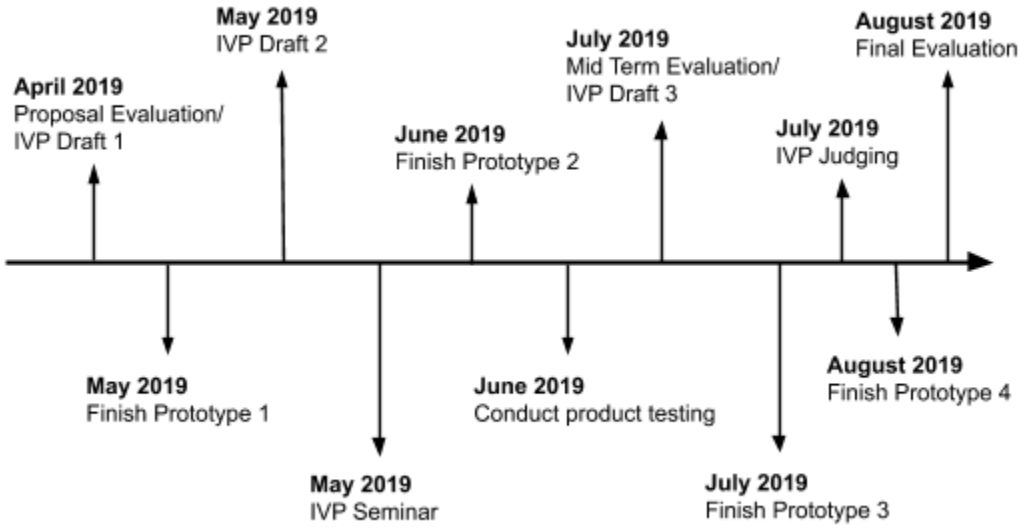


Figure 1

#4 Construction Process

We thought of some considerations before we dived into the prototype construction. The first is size, as if the prototype is too bulky, the user will find it difficult and troublesome to use. The second is cost,

as if the prototype is beyond the end users budget, they would not buy it. Thus we needed to keep it in a reasonable price range of the end user, roughly $150. Thirdly, user friendliness, as if the prototype cannot be easily used by the end user, it would be highly ineffective.

We purchased a power bank as a power source, a motherboard as a processing unit, a waist pouch to store the power source and motherboard, ultrasonic sensors to detect objects and a speaker to notify the end user through audio cues if there is an object in front of them. From there we managed to successfully program it to transmit an audio cue via the speaker if it sensed any object within 70 cm in front of the sensors. We dubbed it prototype 1.0.

(The core of our first prototype)

Figure 2

We then fit the core into a waist pouch, such that it is now wearable. We also received feedback from our project mentors that the sensors do not cover enough area as in the upright position, with the sensing angle of the x and y axis being a flat plane and 20 degrees respectively. Thus, we mounted 2 sensors, with a wedge in between at 30 degrees, and thus covered a much larger area in front. It would be prototype 1.1.

(Prototype 1.1)

Figure 3

At the IVP Seminar on 24 May, the judges informed us that the speaker was a bit loud and annoying, and they also highlighted that a walking stick could interfere with the sensor on the waist. They advised us to test the prototype with an end user for first-hand feedback. Thus, we mounted the sensors on a lanyard so a walking stick would not interfere with it and we also added a vibrating motor so that the speaker could be removed if the user did not want the audio cues. These changes made up prototype 2.

Furthermore, after making the changes, we modified our original problem statement. The refined problem statement was; “how may we create a product that will give the end user a sense of

confidence and security when moving around their familiar environment?" The purpose of the product was also changed to only detect objects above waist level.

On the Field Testing

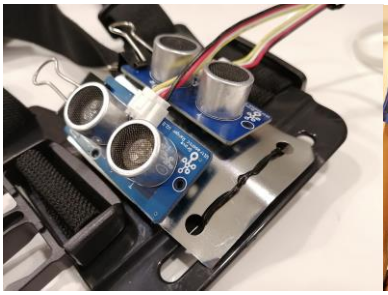
From there, we conducted a test with an end user, a visually handicapped client of Guide Dogs Singapore on 6 June. The feedback that he gave was that there was some lag time, the sensing distance was too short, that it was a bit bulky, and that the vibration was too faint for him to feel. He also added that the prototype was not visually pleasing. He also added that he would pay roughly $100 for the product. We continued modifying a bit and increased the sensing distance to 1 meter, decreased the lag time and added an additional vibrating motor. Hence, we came up with prototype 2.1.

(Prototype 2.1)

(Group photo taken)

Figure 4 *Figure 5*

During the Mid-Term Evaluation on 4 July, we received positive feedback that our product had potential to be marketed but needed to be made less flimsy. This was also confirmed when the mentors at the next draft session said that it was not sturdy enough. Therefore, we proceeded to make some major improvements such as fixing it on a proper chest mount instead of a lanyard, and included a metal wedge for a new and improved rugged look. We named it prototype 3.0.



(Prototype 3.0)

Figure 6 *Figure 7*

We first displayed prototype 3 at the IVP judging on 26 July, where the judges said that it was a good effort but wanted us to make it much more compact and make it more user friendly.

From there, we created Prototype 4, the final product. Its key features are a stable adjustable chest mount, double ultrasonic sensors angled at 30 degrees with a metal wedge, an adjustable waist pouch

with 2 vibrating motors, a speaker to transmit audio cues and a far more compact and superior motherboard and power bank neatly tucked away in the waist pouch.

(prototype 4.0/Final product)

Figure 8

#5 Modification and Evaluation

For the final check, we formulated our product test criteria and checked against it. Our product had to be compact, cost efficient and user friendly.

Our final product fits most of the criteria for success. At $105, it is below the budget that we set which was $150, and at 265g, it is also below the weight limit that we set which was 500 grams. However, we do admit that the prototype has room for improvement, mainly in the area of ease of use. Currently, it is a two part contraption that the user can wear but we hope that our future prototypes can be just single part contraption so that the end-users can put it on with ease.

With that, we believe that our product would be able to serve its purpose as a practical, affordable and easily accessible real-world solution to a problem that is affecting a large group of people in society. We plan to develop our product even further, recognizing the potential in the next phase of development. We look forward to the final evaluation.

#6 References

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