**SCHOOL OF COMPUTING**
**Faculty of Engineering**

# Assignment 3 (Group)

SECV2113 - HUMAN COMPUTER INTERACTION

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# Title: User Study of Navigational Aid System for the Visually Impaired

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## 1.0    Abstract

**Problem Statement**

Navigation is something that is a part of our daily lives as we navigate ourselves in the world to reach our destination. It can be a problem for normal individuals to navigate around unfamiliar places and unfamiliar roads so it is apparent that the problem will be much more severe for individuals that are visually impaired. One of the consequences of vision loss is being uncomfortable about safety while moving around or traveling independently.

Indoor navigation involves moving around in an enclosed space and it is easy for normal individuals to do without bumping into objects or people in an unfamiliar space but it will be a problem for those that are visually impaired to navigate themselves in the unfamiliar space.

Outdoor navigation involves navigating oneself by the means of public transportation or walking. Normal individuals are able to navigate by using public transportation thanks to the signs provided which they perceive by using their vision which cannot be done by those that are blind or severely impaired. Besides that, blind people have to walk using a walking cane to help them navigate through obstacles by contact when outdoors.

**Methodology**

In order to conduct our project, the method that we are going to use is internet survey. As we are unable to reach people with vision impairment difficulties during this pandemic, interviews cannot be conducted because we cannot contact blind individuals due to a lack of information. The best expected result is to be able to have an adequate amount of respondents for our online survey.

**Expected Outcome/ Contribution**

The best expected outcome would be a navigation system that is able to sense the real time and provide the best route or decision for the visually impaired individual. For example, spectacle or phone applications that are able to analyse the surroundings and provide information via audio cues.

## 2.0    Introduction

The approximated population in the year 2020 is an astonishing amount of 7.79 billion people and out of the 7.79 billion people, there is an estimated amount of 49.1 million that are blind which has increased by 14.7 million people since the year 1990 [1]. Vision plays an important role in our daily lives as we require vision to determine our own position and direction and also the relative location of obstacles and dangers in the surrounding and thus, a loss of vision brings about severe effects to our ability of completing these tasks [2].

The blind individuals in our community will have to face challenges when trying to navigate themselves in their daily lives such as navigating around in a building where they cannot obtain information on where to go and this discourages them from going out by themselves [3]. Various attempts have been made to help these individuals overcome their difficulties in navigating themselves such as navigation tools that are able to help them and also programs such as the orientation and mobility (O&M) program which allows the individuals to learn how to use the white cane and also sensory compensation [2,3].

Over the century, there have been various prototypes of electronic travel aids (ETA) which were worked on by the researchers caused by the rapid development of radar and sonar systems that apply the same concept during the Second World War [2]. The various ETA developed could not help the user to reach their destination by themselves and this leads to the development of navigation systems that have a built in GPS system and utilize inertial navigation [2]. In Malaysia, the St Nicholas Home has come up with a mobile application that is known as 'ViNV' and it is a Bluetooth beacon based navigation system that provides audio cues and visual guidance to the users as they enter a building that is equipped with a beacon and this initiative is supported by the Penang Island City Council as they are sensitive towards the different needs that are present within our society [4]. The mayor of the Penang Island City Council has said that all local government and Malaysian Authorities of Local Authorities are committed to provide equal rights and opportunities in all aspects of life for the people with disabilities and also prioritise the provision of better and more user friendly facilities that are in line with the government's goal of providing a better place of living for those with special needs [4].

Therefore, it can be seen that our government is supportive of these types of initiatives and it is aligned with their goal of providing a better living space, equal rights and opportunities for the whole community.

### 3.0      Materials and Methods

The study explores the problems that blind individuals face in terms of navigating themselves during their daily lives. The study was carried out by an online survey due to the pandemic and the survey consists of structured questions that allowed some freedom to describe their problems. These questions are able to identify the problems that they face in their daily lives.

*Table 1*          *Survey Question*

| Questions | Type and Option |
|---|---|
| Do you have a smartphone and what do you use it for? | Text answer, so that the participant can describe |
| How do you move around in your environment | Text answer, so that the participant can describe |
| Is moving around easier in an open space or enclosed space | Multiple Choice Question. Option: Open Space / Narrow Space |
| Do you use any application that is able to help you navigate? | Multiple Choice Question. Option: Yes / No |
| If you use your hand to identify obstacles when you move, are you afraid of touching sharp objects or objects that can harm you? | Multiple Choice Question. Option: Yes / No |
| What are the general problems that you face? | Text answer, so that the participant can describe |
| If you went out, what mode of transportation would you take? | Multiple Choice Question. Option: Public transport, By foot, Motorcycle, Private vehicle |
| Are you familiar with the surroundings of your destination? | Multiple Choice Question. Option: Yes / No |

| | |
|---|---|
| Do you go out alone? | Multiple Choice Question. Option: Yes / No |
| After you have arrived at your destination, do you move according to your memory or is there someone to help you? | Multiple Choice Question. Option: Move according to memory / Someone is there to help |
| Can you move alone in an unfamiliar environment? | Multiple Choice Question. Option: Yes / No |
| What are the problems that you face when going out? | Text answer, so that the participant can describe |
| Do you constantly carry any other objects with you except for the white cane? | Multiple Choice Question. Option: Yes / No |
| How do you differentiate your personal belongings with those of your family members? | Text answer, so that the participant can describe |
| What are the problems that you face when staying indoors? | Text answer, so that the participant can describe |

We asked the Sarawak Society of the Blind (SSB) Kuching branch to help distribute the online survey to its members of the society as we were unable to visit due to the ongoing pandemic and the participants were informed of the purpose of the online survey. After we sent an email to SSB, the participants were then emailed by the SSB about the online survey.

## 4.0    Results

## 4.1    User Requirements Analysis

**General**

3. Is moving around easier in an open space or an enclosed space?(Adakah pergerakan lebih senang dalam tempat yang luas atau tempat yang lebih sempit?)
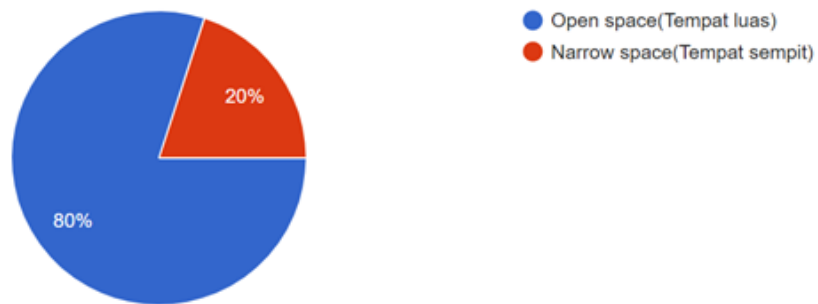
5 responses



*Figure 4.1.1    Preference of type of spaces*

Figure 4.1.1 shows that the preference of the type of spaces for the people who have visual impairment when moving around. By the observation of this figure. we can see that 4 out of 5 respondents felt that moving around the open space is easier than moving around in a narrow space.

4. Do you use any application that is able to help you navigate?(Adakah anda mengguna aplikasi yang dapat menolong anda? )
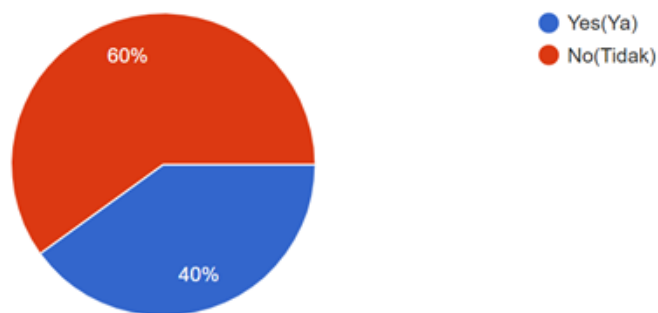
5 responses



*Figure 4.1.2    Use of Application to help Visually impaired to navigate*

According to Figure 4.1.2, the number of visually impaired who use an application to help them navigate is less than the number of visually impaired who don't use an application to help them navigate. Out of 5 respondents, there are 60% of respondents or 3 people answering 'No' for this question, even though nowadays technology has many inventions regarding the field of visual impairment.

5.If you use your hand to identify obstacles when you move, are you afraid of touching sharp objects or objects that can harm you?(Jika anda ada menggunakan tangan untuk mengenali hadapan semasa menjalan, adakah anda takut menyentuh benda yang tajam atau benda yang boleh mencederakan anda?)
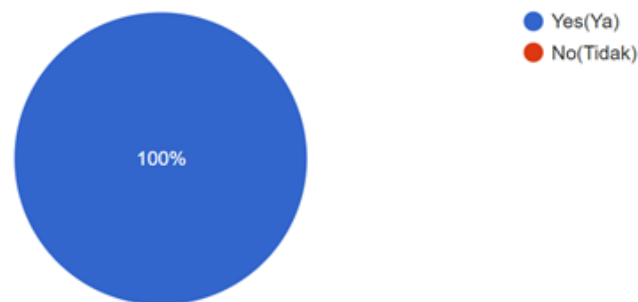
5 responses



*Figure 4.1.3 Fear of touching objects that can harm visually impaired when they use hand to identify obstacles*

By referring to figure 4.1.4, all of the respondents agree that they are afraid of touching objects that can bring harm to them when trying to identify obstacles with their hands.

**Outdoor**

1.If you went out, what mode of transportation do you take?(Jika anda keluar, apakah jenis pengangkutan yand digunakan oleh anda?)
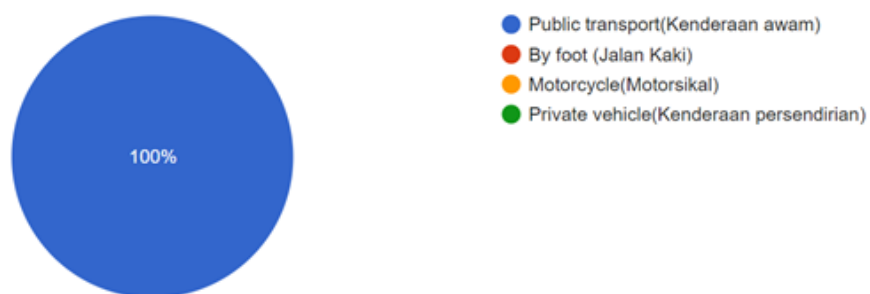
5 responses



*Figure 4.1.4 Transportation of Visually Impaired normally use*

From figure 4.1.4, we can observe that all of the respondents say that they are using public transport in their daily life.

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2.Are you familiar with the surroundings of your destination?(Adakah anda memahami persekitaran destinasi anda?)

5 responses
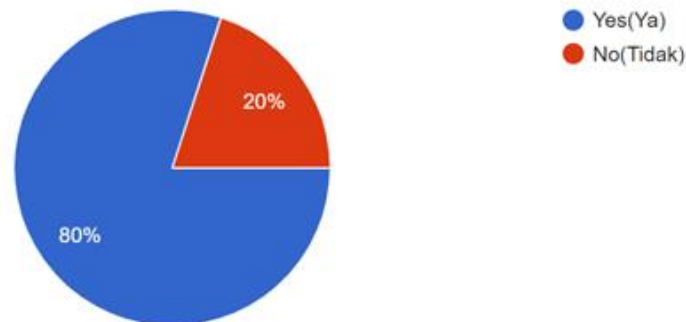


*Figure 4.1.5   Familiarity with the surrounding of destination*

Figure 4.1.5 shows us that 4 out of 5 respondents agree that they are familiar with the surroundings of their destination. Only 1 of the respondents are not agreed with this statement.

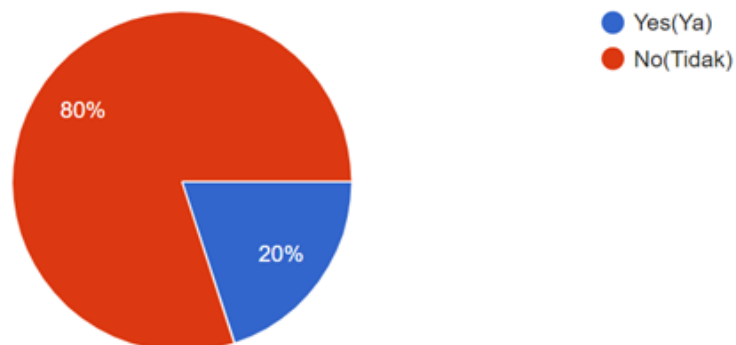3.Do you go out alone?(Adakah anda keluar secara bersendirian?)

5 responses



*Figure 4.1.6   Alone, go out or not?*

Based on figure 4.1.6, it shows that 4 out of 5 respondents normally will not go out alone.

4.After you have arrived at your destination, do you move according to your memory or is there someone to help you?(Selepas sampai destinasi, adakah anda bergerak berikuti peringatan anda atau ada orang yang menolong anda?)

5 responses
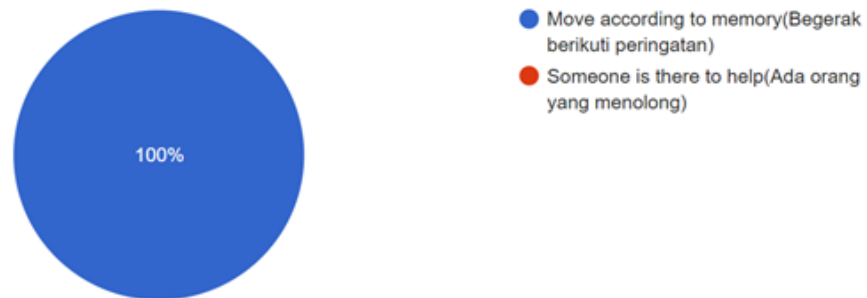


*Figure 4.1.7    How do visually impaired move around their destination?*

By referring to figure 4.1.7, all of the respondents agree that they move around their destination according to their memory and no one is there to help them.

5.Can you move alone in an unfamiliar environment?(Bolehkah anda bergerak secara bersendirian dalam persekitaran yang tidak dikenali oleh anda?)

5 responses
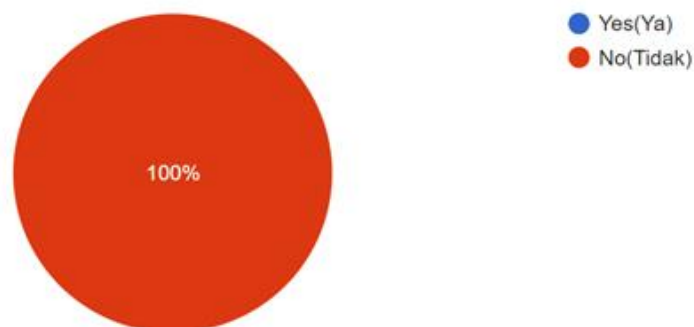


*Figure 4.1.8   Ability move around the destination in an unfamiliar environment*

Based on the observation of figure 4.1.8, all of the respondents have answered that they cannot move alone in an unfamiliar environment.

**Indoor**

1.Do you constantly carry any other objects with you except for the white cane?(Adakah anda sentiasa bawa barang yang lain kecuali tongkat putih?)

5 responses
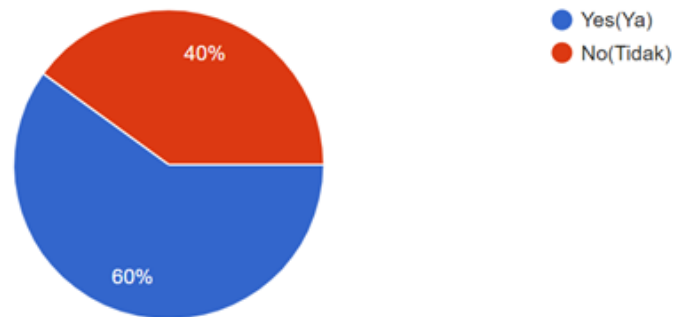


*Figure 4.1.9 Carry any other objects except white cane*

According to Figure 4.1.9, 60% of respondents are constantly carrying other objects with them except for the white cane.

## 4.2    Empathy Map

### Situation

Navigation in outdoor and indoor environment.

### Says

"Difficult to navigate without cane."

"Unfamiliar environment, public transport usually park far away from the designated entrance."

"Hard to buy things without help since I don't know where the items are"

"I face problem finding things around me."

### Thinks

It would be wonderful to be able to travel without relying on the cane.
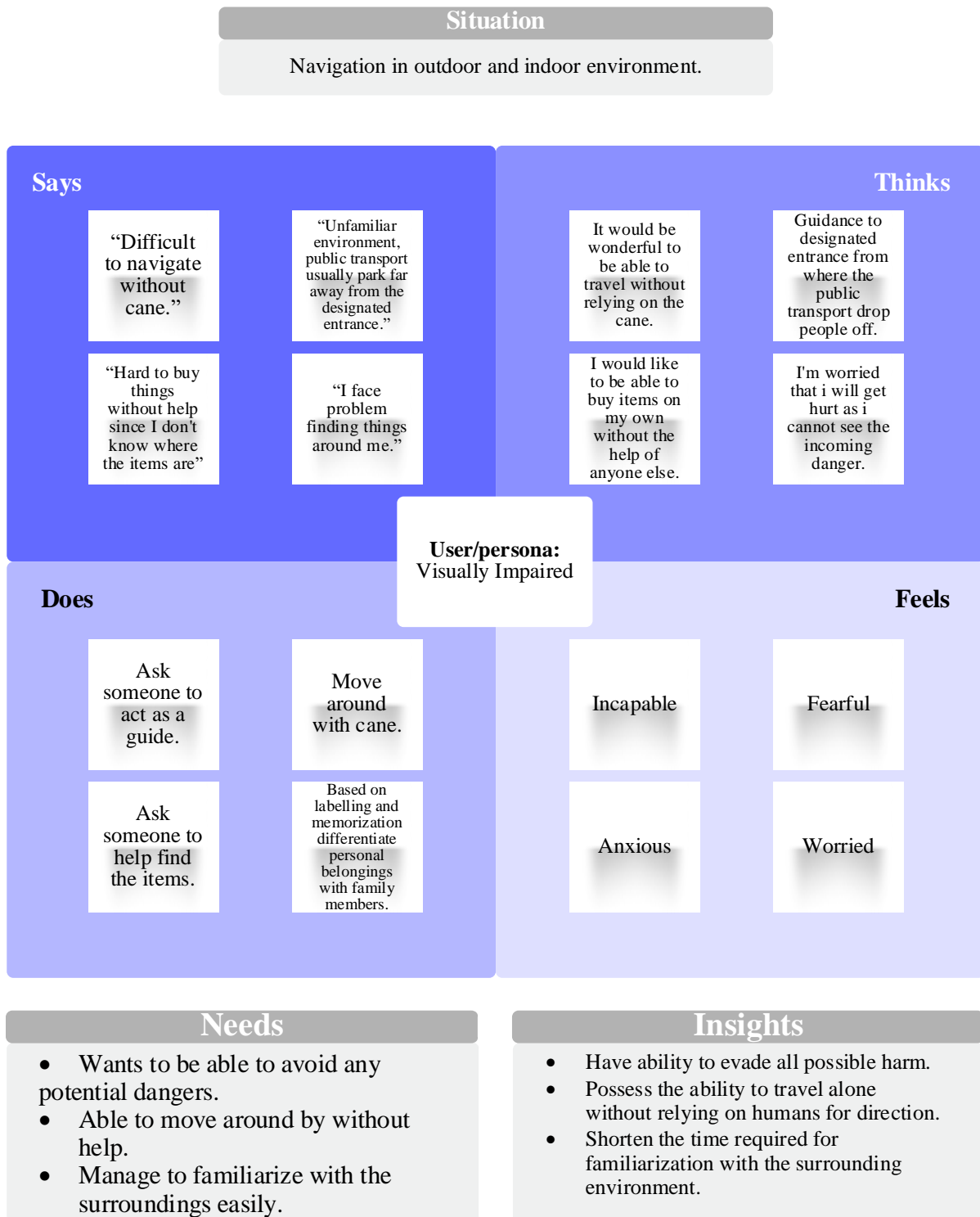
Guidance to designated entrance from where the public transport drop people off.

I would like to be able to buy items on my own without the help of anyone else.

I'm worried that i will get hurt as i cannot see the incoming danger.

**User/persona:**
Visually Impaired

### Does

Ask someone to act as a guide.

Move around with cane.

Ask someone to help find the items.

Based on labelling and memorization differentiate personal belongings with family members.

### Feels

Incapable

Fearful

Anxious

Worried

### Needs

- Wants to be able to avoid any potential dangers.
- Able to move around by without help.
- Manage to familiarize with the surroundings easily.

### Insights

- Have ability to evade all possible harm.
- Possess the ability to travel alone without relying on humans for direction.
- Shorten the time required for familiarization with the surrounding environment.

## 4.3    Functional Requirement

The functional requirements of our proposed system will be according to the user requirement analysis that has been done. The user requirement analysis is able to tell us the requirements that the user desires and hence, we are able to come up with the functions that our proposed system will have to solve their requirements.

*Table 2          Requirement and Functionality*

| Requirement | Function |
|---|---|
| Identify sudden dangers in an environment | Allow identification of sudden dangerous variables |
| Help to navigate around | Able to inform the user of the directions to take to arrive at their destination. |
| Assist familiarizing with surrounding environment | Allow users to familiar surroundings in short time |

## 5.0    Discussions

Based on the observation, we can see that all of the respondents with vision impairment use smartphones in their daily lives. Thus, we can propose a solution that involves the usage of smartphones as a majority of the users have it. The respondents mostly use a white cane and prefer to move in an open space, this statistic can be interpreted as the white canes require an open space to maximise the efficiency. A narrow space might restrict the cane movement. There is also a question that asks respondents whether they are afraid of touching sharp objects or harmful objects when navigating and without no surprise, all of them answered "yes". This answer might correlate with the reason why they like open space more than narrow space. Although open space makes it harder to determine the direction of where they are facing, however, it is still better than having to use hands to navigate in a narrow space.

For the outdoor section, the respondents respond that they usually use public transport to go to their destination. They also stated that the majority of the respondents were accompanied by someone when going outdoors and usually go to the same place as they are familiar with their destination. With that in mind, most vision impairment people need someone to assist them as they are not able to move to a certain location on their own. In the survey, they stated that unfamiliar environments are a problem for them as they did not know where they were and are unable to adapt to their environment.

Moving on, people with vision impairment also have problems indoors. The most obvious problem is a sudden change of environment. It might be a table, a chair, or small items such as their toothbrush. The sudden change of environment might pose as an inconvenience or a threat to them too as they might trip and fall when something is below them. Besides, a change of environment makes it hard to find their belongings.

Hence, it can be seen that the user requirements obtained from this survey are categorized into 3 categories which are identification of sudden dangers in the environment, help to navigate around and also assist familiarizing with the surrounding environment.

## 6.0    Conclusion and Future Work

In conclusion, the user's requirements that our proposed system will solve will be based on the problems that we ask in the online survey. The problems that are faced by the participants are generalized and categorized into 3 requirements which are identifying sudden dangers in an environment, helping to navigate and assist the familiarization process with the surrounding environment and hence, our proposed product will be able to satisfy all 3 of these requirements. In terms of identification of sudden dangers in an environment, the proposed navigation system will have a danger identification feature that will be able to recognize objects that bring potential harm to the user. To help the user navigate around, the proposed product will be able to guide the user to their destinations through auditory cues by using a modern Global Positioning System (GPS) that determines the shortest route available. The proposed product will be able to assist the user in familiarizing with the surroundings by stating the layout of the building and excluding the objects that are easily moved around because these objects bring potential harm to the user which will be identified by the danger identification feature.

## 7.0    References

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