Inclusivity/Urban City

The Outliers

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Content Outline

Significance of problem

Many countries are trying to achieve social equity in all areas by removing barriers and providing access for disabled people as accessibility is increasingly recognized as a key element of a high quality, efficient and sustainable transport system. However, there are several important factors that need to be considered for a better understanding and experience of the whole journey of accessibility for disabled. Figure 1 below shows the journey cycle standard for disabled people. Research by Seyed Hassan, Mashita, Awang and Rostam (2011) supports that most of the commuter feels unsafe with current infrastructure, specifically on the journey to and from the terminal, boarding and alight from the chosen public transport.

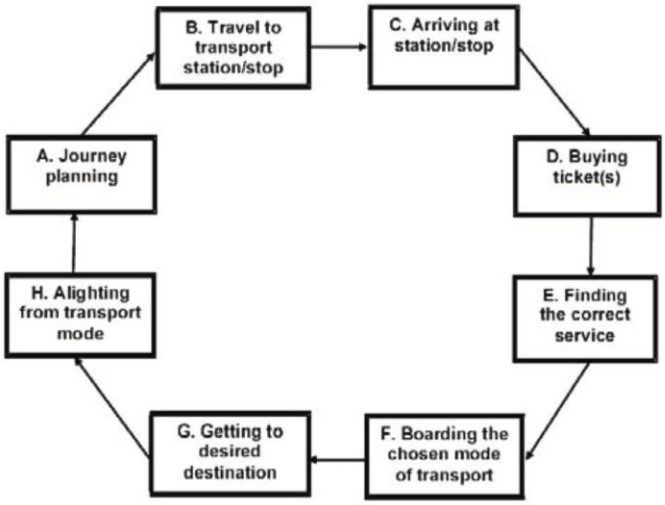
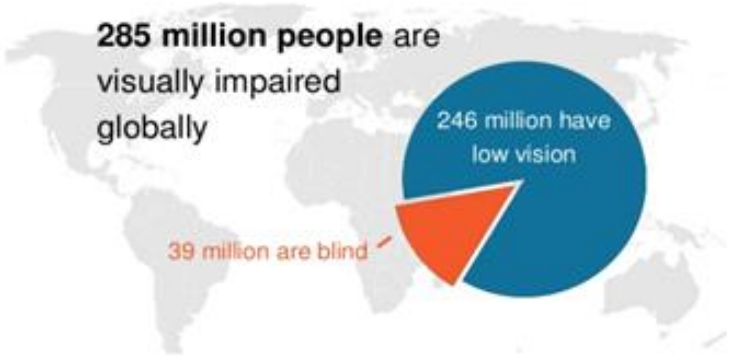


Fig. 1: The Journey Cycle. (Source: Assessment of Accessibility Standards for Disabled People in Land Based Public Transport Vehicles, Lafratta, 2008).

According to American Foundation for the Blind (AFB) (2013), locating bus stops is a significant access barrier for the visually impaired riders often due to information lack of details, bus stops are not clearly marked with non-visual indicators or are placed inconsistently off roadways. The challenge of locating a bus stop is exacerbated when traveling to an unfamiliar location where both bus stop placement and the position and type of surrounding landmarks are not known to the traveler a priori. As public transport systems reduce or stop service due to

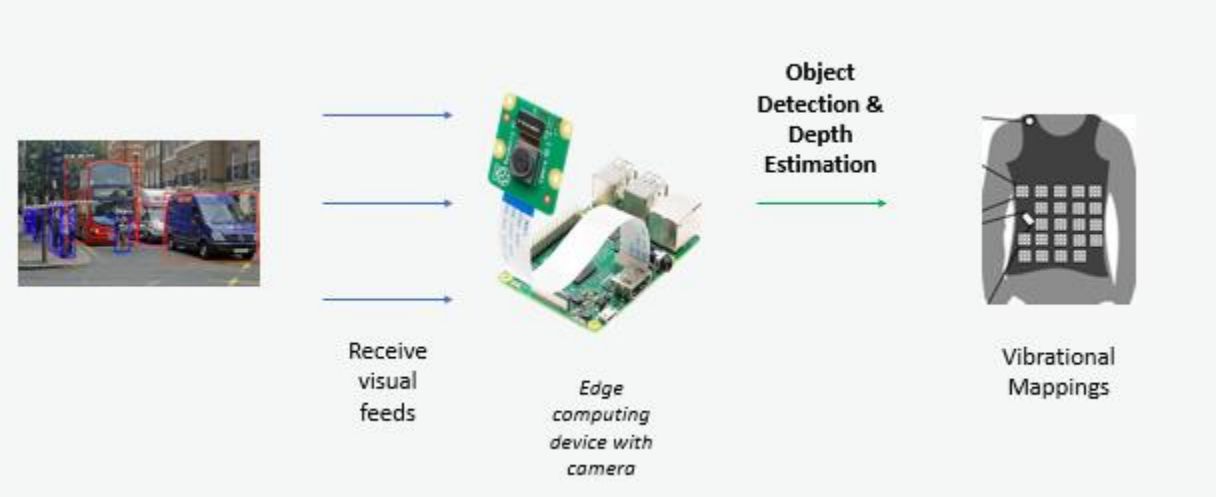
Covid-19, persons with disabilities who rely on these methods for accessible transport may not be able to travel, even for basic necessities or critical medical appointments. With statistics provided by WHO has shown that 295 million people are visually impaired worldwide and 39 million of them are blind, it is important to note how these people are uniquely impacted by the Covid-19 that continues to have wide-reaching impacts across the globe.



Solutions Introduction

The proposed solution is divided into two parts:

1) A general solution, which aims to translate visual information to vibration mappings, such as touch or pressure
2) A simple device to make our city smarter, using bluetooth beacons.



For the first solution, a navigation device is proposed to assist a disabled person (visually impaired) to navigate around cities. The features of this navigation device are as follows:

1) A sensory vest created by David Eagleman equipped with one frontal camera, worn by the disabled person to capture visual feeds of the surroundings.
2) A computer vision software to process the visual feeds to identify obstacles and its closeness to the disabled person.
3) Generation of vibration signals based on the processed information. This will assist the disabled person to navigate an area based on the instructions.

For the second solution, to assist a disabled person to understand the surrounding, bluetooth beacons are proposed to be used to encode and transmit important surrounding information. Bluetooth beacons have a better range and could encode more information than QR code. Using bluetooth beacons placed around cities' infrastructures, the visually impaired can receive information of the surrounding (such as nearby stairs, escalators, shops etc) via the wearable edge computing device. Distance of these objects can also be inferred using bluetooth signal strength.

Impact of Solution

Government is putting efforts to ensure all segments of society benefit from the development of the country. Government has come out with the National Transport Policy (NTP 2019-2030) to include the interests of disabled community.

After the announcement of NTP 2019-2030, Damai Disabled Person Association Malaysia president V. Murugeswaran said that "Public transport is a key factor for disabled people to go out and live independently. Accessibility should be available everywhere for disabled community." (NST, 2019) Hence there is a desperate need to enhance the accessibility of the public transport system for the benefits of the disabled community.

We came up with a solution to compliment the limitations of the traditional approach on public transport accessibilities. This solution is to ensure that visual impaired community too can enjoy equal opportunities to use public transport with ease.

Traditional approach vs Our solution

Attributes	Traditional Approach	Our Solution
Feature	Tactile Ground Surface Indicators and audio guides at selected platforms.	Navigation device with real time vibrational mappings for navigational guidance.
Safety	Medium, unable to detect the real time	High, able to detect the real time changes of surroundings.

	changes of the surroundings.	
Flexibility	Low, people affected by visual impairment tend to memorize the layout of the area. Therefore, not encouraged to change the layout of the area frequently.	High, the device is able to detect the real time surrounding changes and feedback to the user. Hence, no need to redesign the layout of the area on a large scale.
Implementation Time	Low, training centers are readily available.	Medium, needs time to educate and train the user to familiarize with the device.
Coverage	Major cities.	Worldwide.
Data Capture	No.	Yes, the captured data can be used to further enhance the accessibility of the public transport.

Cost	High, must redesign the current infrastructure to cater the needs of users with visual impairment.	Medium, need to invest in Bluetooth beacons technology. Hence, minor additions on current infrastructures are required.

Deep Dive into Solution

Through this solution, an edge computing device equipped with a camera and the sensory vest is proposed. A visually impaired person will wear the sensory vest around the body, and the computing device with camera around the head or neck area, and the device will capture visual feeds in front of the person. The service allows the edge devices to function using local data without reducing the ability to connect to the cloud for management, analytics and also durable storage. Even if the user's wearable is not connected to the internet, the service allows the device to operate in offline mode which is an advantage to the user as not all areas in Malaysia are fully covered with strong telecommunication signals. With AWS Lambda functionality, the ML interface/model is able to run in the edge device that helps the visually impaired in traveling. Then, this visual feeds will be processed to do object detection and depth estimation. The objective is to detect the distances of obstacles and people in front of the visually impaired and encode these distances to vibrational mappings. Then, based on these vibrational mappings, the visually impaired can know if any obstacle or person is in close proximity.

Architecture of Solution

AWS SageMaker will be used in training deep convolutional neural network models for object detection and depth estimation. Object detection and depth estimation inference module will be deployed on the edge computing device.

Going further

There are many ways to enhance the solution to benefit a larger group of disabled. 360° cameras can be used instead to improve the detection of surroundings changes and raise alert to the moving closer objects from blind spots.

Moreover, the solution can be refined with adding more features such as GPS/GSM tracker as position locator to provide a more accurate location to the user. Emergency features can be applied to the device by linking the video to the police, hospital, fire station when accidents such as fire, fall down, theft or robbery are detected. With these features incorporated, disabled persons facing critical accidents can be noticed immediately.

References

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