Evaluation on Improving Usability in Intelligent Assistive Navigating Device for the Blind

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Introduction

- ❑ Objective: The aim of this study is to compare the technology and systems for visually impaired users, then find the fundamental features that will enhance targeted users to increase the use of ATs.
  - ❑ Future research: Providing a comprehensive overview with a result of an analysis, which should identify effective future research areas in the field.
  - ❑ Visually impaired users can travel as self-control, autonomy, and confidence will obtain by using highly maintained ATs.
- ❑ Background: According to World Health Organization (WHO), Global Cooperation on Assistive Technology (GATE) has programmed to give the opportunity to the disables and aged individuals to afford qualified assistive technology (Boot *et al.*, 2017:1). According to the list of recommendations introduced by the program, most of the intelligent ATs designed for the visually impaired were not commercialized.
- ❑ Key Words: Assistive Technology (AT), Wireless, Radio-frequency Identification (RFID), Beacon, Usability, Accessibility, Depth of Information, Obstacle Detection.

Methodology

Three criteria for analysis: Accessibility, Depth of Information, Obstacle Detection. The analysis condition is conceived in combination with the conditions analysed by Tapu *et al.*, and principles of universal design (Tapu *et al.*, 2018:11; Mace, 1997).

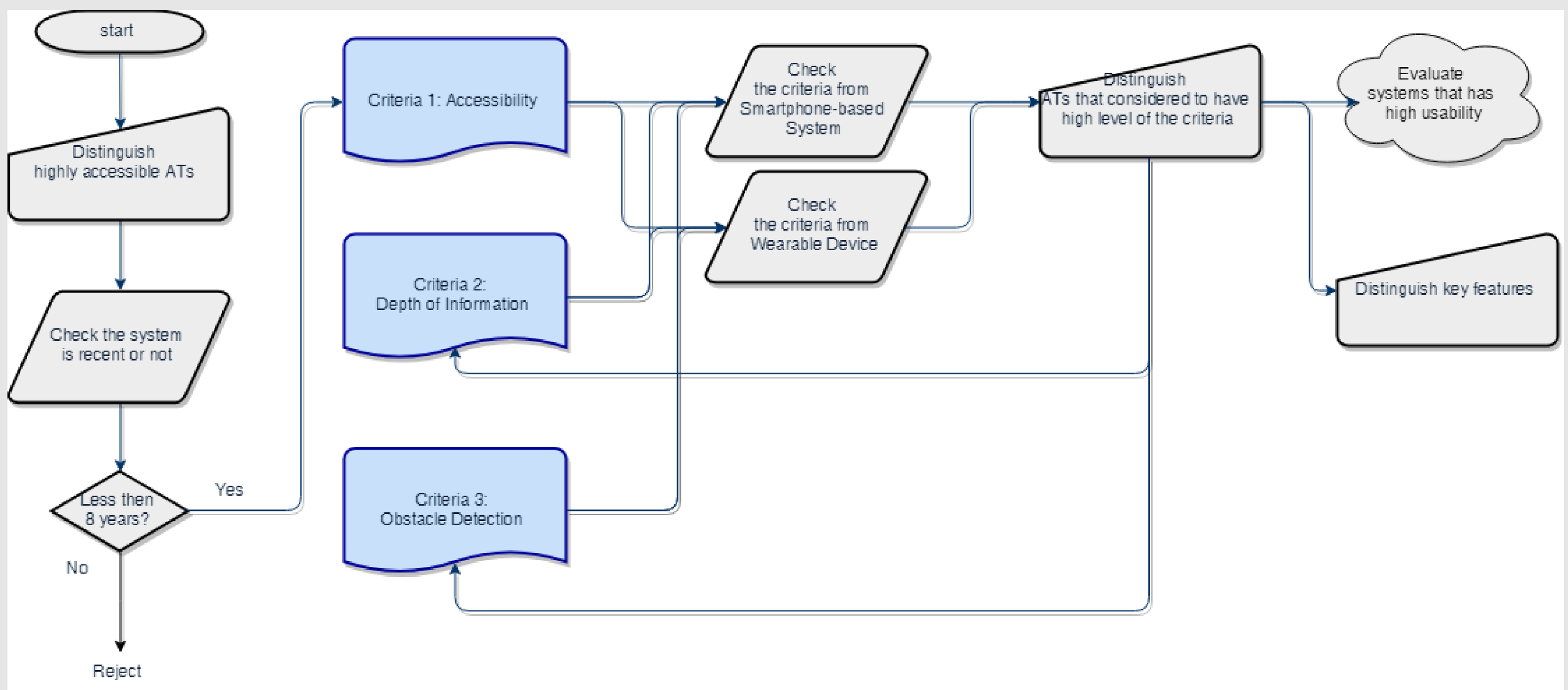

Figure 1: Overall Process Flowchart

Results

Table 1: Comparison of Intelligent Assistive Technologies that considered to consist High Accessibility, Depth of Information, and Obstacle Detection.

System name (Year of publication)	Wireless	Sense type	Usable area	Friendliness	Portability	Processing Speed	Coverage Distance	Robustness	Detective
SmartCane (2011)	No	Tactile, Acoustic	Indoor/ Outdoor	High	High (Optional earphones)	-	Detect range: 1 m	Moderate Size-40 kHz frequency (Audible noises: less than 20 kHz, Industrial noises: use MHz units)	Object distance: detect until 4 feet Road conditions: water sensor (detect only the water is over 0.5cm)
Beacon SfM (2017)	Yes (Beacon)	-	Indoor/ Outdoor	High	High	Localize one image: Mean 1.41 s	Short-range passive communication: 0.30 m (error: 0.45 m)	-	A-KAZE system was used (High detection rate for: Bikes, Boat, UBC, Trees, Synthetic Rotation sequences (Alcantarilla and Bartoli, 2013:9))
Necklace sonar (2013)	No	Tactile	Indoor/ Outdoor	High	Moderate (Optional white cane)	Cannot detect the object at speeds larger than 1m/s (Convert: 3.6 km/h) (regular walking speed does not affect detecting)	Factory specification detection range: 6 m and an angle of 35 degrees Outdoor detection range: maximum 3 m (average 1.5 m)	High Tested: 25-43 obstacles (pedestrians, open umbrellas, carts, curbs, traffic signs, telephone booths, traffic lights)	Detection avoidance rate (%) Indoor: more than 80% Outdoor: more than 75%
Schwarze *et al.* (2015)	No	Acoustic	Outdoor	Moderate	Low (Equipment: Helmet and white cane)	15 fps Latency time: up to 50ms	10 m (Tested up to 20 m distance include re-detecting)	Moderate (environmental noise had not impact navigating)	Any size Any shape Static and Dynamic Any position
Mocanu *et al.* (2016)	No	Acoustic	Indoor/ Outdoor	High	Moderate (Equipment: Belt)	10 fps	5 m	High (motion, lighting intensity, trembled and cluttered images)	Any shape Any size Static and Dynamic Any position

Adapted from: Ishihara *et al.*, 2017; Mocanu *et al.*, 2016; Schwarze *et al.*, 2015; Villamizar *et al.*, 2013; Wahab *et al.*, 2011

Conclusion

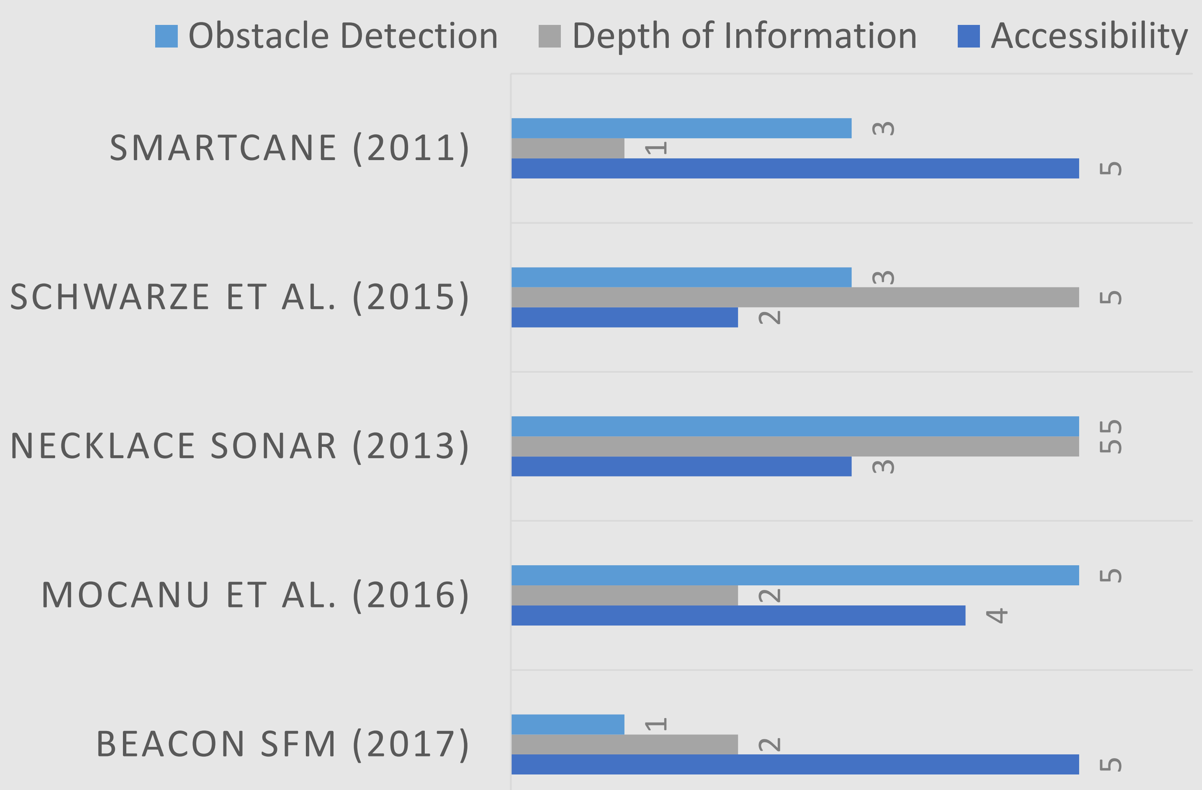

Figure 5. Comparison of Intelligent Assistive Technologies that considered to consist High Accessibility, Depth of Information, and Obstacle Detection.

The evaluation of the systems showed positive relationship between the three standards and enhancing usability, therefore successfully identified the essential features:

- ❑ System should be able to use in both indoor and outdoor area.
- ❑ System should use tactile or acoustic sense but also need an accurate supplement of the disturbing conditions.
- ❑ System should alert detailed information in real-time.

Necklace sonar (2013) presents high level on both Obstacle Detection and Depth of Information with moderate level on Accessibility, however it provides all three essential features.

Key Points: Based on this evaluation, it is recommended to have three conditions (Accessibility, Depth of Information, and Obstacle Detection) by providing: 1. indoor and outdoor area, 2. high friendliness, 3. high portability, 4. short processing speed, 5. large coverage distance, 6. high level of robustness, 7. large detection capacity for future intelligent ATs.

Limitations

- ❑ Sources were examined with the contents in the article of each system.
- ❑ "-" character was used when the article did not mention about the performance, which does not mean the system has low performance level on the function.
- ❑ The target of this research who use Intelligent ATs are broad.
  (Visually impaired Users > Lifelong Blind Users)

Reference

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