DRAWBACKS OF GPS TECHNOLOGY FOR THE BLIND PEDESTRIAN NAVIGATION IN MALAYSIA

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ABSTRACT

Technology for the disabled has been on the rise for many decades now. Out of disabled people, the blinds are the highly affected group when it comes to independent navigation. This research has shown the reason behind the lack of acceptance when it comes to the usage of Global positioning system by the blind community in Malaysia. The research took place in the Malaysian foundation for the blind. The research was conducted following the ethnographic methodology. The experiments were observational and were done on a set of blind technology users in Malaysia. The results obtained from the observations have concluded and enforced the limitations of the existing GPS technology for the blinds. This research would be of great value in enhancing the technology for the blinds future use and help them to confidently navigate in unknown environments.

Keywords: Navigation, global positioning system, GPS, technology, Malaysia and blind.

INTRODUCTION

Blindness is a disability that affects people in every phase of life, with independent mobility being the largest of the setbacks. Several scales have to be developed to define the levels of blindness. However, total blindness is the lack of any form of visual light and is defined as no light perception (Salowi & P.P., 2012). The blinds have very less knowledge about the environment they are in, from perceiving colors, to shape of objects, they lack cognitive sense. Therefore, navigation poses the biggest threat. According to Enge & Misra, (2011), there have been a lot of advances in the GPS technology, Most of GPS receivers are now already built into mobile phones, with varying degrees of user accessibility and coverage. Even though the growth of usage of smartphones has rapidly increased in the blind communities as they have become more usable for the blind in terms of integration of functions needed as text to speech, gesture recognition and localization (Smith, 2012). The only form of any knowledge a blind person can receive is through verbal instructions. These verbal instructions are a specific set of phrases which are provided to the blinds especially while travelling. When technology like GPS is created, the geometric information is the basis for existing information and fundamental features such as semantics are neglected while constructing areas and end user profiles (Nikoloudakis et al., 2009). Which might add on to the fact that blind people can't use it fully because of the lack of given features and instructions most suitable for them.

During the late 90's, GPS was presented and there have been numerous endeavors to incorporate it into a navigation assistance system for the visually impaired and the blinds. There are many studies that have found out that the blind pedestrians frequently use GPS based services in order to obtain appropriate and timely data applicable to a specific destination (Justason et al., 2010). However, it is a possibility to assume that the blind would want more details than just textual information in most situations, the blind people would not formulate the trust based on GPS by just listening to a few instructions given and would suffer while navigating independently , thereby proving to not fully accept GPS technology while navigating.

There are 285 million visually impaired people in the world out of which 39 million are completely blind (Ladke & Prasad, 2015). The technology is on a rise to provide independent navigation systems for the blind, however, there are many reasons behind the issue of GPS not being used in the systems, the first being that GPS signals are not always accurate on the smartphones, therefore the difference between the two places can not be accurately navigated by a blind person, moreover, the smartphones don't receive signals underground or in the depths of large buildings (L.Winkless , 2017) .Several research based projects around the world have shown that the blind people face a lot of problems when it comes to mobility and navigation. Navigation may take place in ill-defined areas such as university campuses, therefore passing the information about the surrounding and direction would be needed in detailed elaboration for the comfort and understanding of the blind.

During the last few decades many efforts have been undertaken to invent technical solutions for blind peoples' navigation. However, there are difficulties linked to these technologies and makes it unsafe for the blind to use them in real life. GPS shows a 5 meters average accuracy, which is a big lag for the GPS success amongst the blind and the units are understood in different ways based on the comprehension of the user.

The scope of this research was to understand the usage of GPS based applications amongst the blind and the successful navigation while using a GPS. A comparison was made on the time needed, its difference and the errors made by the blinds while using the GPS, in contrast to not using the GPS and getting help from a human guide. This research could assist the blind in having a more independent life, which could become a means of livelihood for the blind people in the community.

METHODOLOGY

Ten participants were recruited with the criteria of being over the age of 21, who were experiencing blindness, use at least one navigation aid (white cane or a guide dog), because traditionally white cane is the most common and the simplest tool used by the blinds while navigating to scan obstacles on the ground such as holes , steps , walls , uneven surfaces etc.The participants have tried GPS technology in the past or are using a GPS based navigational application; they have experience in using technology and have basic orientation and mobility training (Ladke& Prasad, 2015). The methodology used was an ethnographic study design (Naomi et al., 2005) and was carried out first as a pilot study to test the hypothesis and then as a multiple participant study with each participant, in order to gather clear understanding of their experience while navigating using the GPS technology to have a holistic understanding of the usage of the GPS amongst the blind, researchers were observing and recording the participants actions throughout the navigation. The steps involved were as follows: An observation trip on an unfamiliar route using a white cane and without any physical assistance by the guide, an observation trip on an unfamiliar route using GPS technology and a follow up interview.

The GPS navigation technology was first tested within a single-participant pilot study. The main purpose of this study was to determine if the test would be feasible. The participant was required to perform 3 sets of navigation. . In each set, there were two runs, one run was performed with the help of a guide's directions, and the other run was performed with the help of GPS instructions, however, the participant was carrying a white cane in both cases for his own comfort. The total numbers of runs were 6, done in a set of 3. In each set, the first run was taken using the verbal directions of the guide and the second run while returning from the same location was taken using the GPS navigation.

After completing the single-participant pilot study, a similar study involving 10 participants with a visual impairment was conducted. The participants were recruited by the blind foundation of Malaysia. The data was clarified and confirmed with participants through a follow up interview. After that, the data was used to analyze and identify the benefits and limitations of navigation using a GPS application. The major stress was laid on the information lacking for the blind while navigating and the difficulties faced when using the GPS as well as the challenges faced by the participants while using GPS. All the results were recorded to later interview the participants and question them about the usage and comfort level.

FINDINGS

Considering the use of technology, the feasibility and effectiveness of that technology measures the success of its usage. The feasibility of technology can be described as its practicality and workability. While being workable, it must be complemented by the factor of its effectiveness. Effectiveness can be defined as the level of success a technology may provide. Therefore, the hypothesis that the blind could navigate well with the help of a human guide compared to a GPS technology proved to be right based on the results of the number of errors made by the participants during the observations. These errors were counted as the number of deviations from the path while navigating due to various factors such as lost signal of GPS, misunderstanding of the instruction , wrong turns and obstacles on the road. The other errors that were recorded in the form of qualitative data such as obstacles on the road and steps on the roads , parked vehicles , poles , trees and stalls. The numbers of deviations while walking are shown in Figure 1.

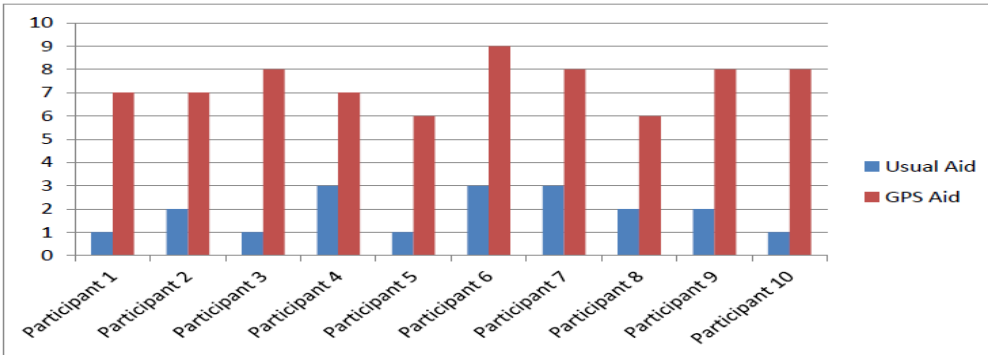

Figure 1: Average number of deviations

DISCUSSION

The finding was supported by the feedback of the blind participants that the verbal directions given by the GPS applications while navigating in an unknown environment were insufficient for them to navigate with the confidence of safety and security. This point has also been emphasized by previous researches in which the blind demand more explanation to create a visual understanding of the routes and environment (Vladimir et al., 2010). The blinds made many errors while using the GPS and felt a lot of discomfort on the road as compared to when navigating with the help of a usual aid. The obstacles were not identified by the GPS, leading to the participants always being under the threat of hurting themselves while navigating in an unknown outdoor environment. The same concern was stated in the research done earlier which mentioned that GPS fails to give obstacle detection and warning alerts (Lakde & Prasad, 2015).The common point mentioned by all participants was that the GPS technology is used only for outdoors as the signal indoors doesn't allow GPS to work well indoors.Therefore, validating the points made by Salah and Fezari (2010) that outdoors, commercially the GPS can provide the information of the position within 20 meters accuracy.

GPS is used on unfamiliar routes to give the blind an idea of their location and help them to create a mental map of the place. As stated in a previous research by Justason et al. (2010). However, while navigating there was an average error of 15 to 25 meter range moreover, the GPS was getting affected by tall buildings, leading to the participants' deviation from the path. This is because for a blind person, an error of 15 to 25 meters is very huge and can create a lot of trouble while navigating, thereby making it difficult for them to trust the GPS. The blinds felt more information should have been provided to them by the GPS while navigating around. To solve this issue, The GPS instructions could have been timelier and more detailed, thereby making the participants believe that it would guide them properly to their destination.

CONCLUSION

Numerous research projects have outlined assistive navigation gadgets for the visually-impaired and blind. Additional projects have composed assistive navigation gadgets for the overall public that could be adjusted to use by individuals with visual weaknesses too. Unfortunately, just a few of these have made the progress from research-oriented projects to business items. In the business field, just a couple of items in view of GPS have had any quantifiabl eaccomplishment in the market as electronic travel aid for the visually impaired, however and still, after all, that the adoption and use rate stays low among the targeted audience.

This research was able to find out a few reasons behind the less usage of GPS amongst the blind navigators. The comfort level of the users is low because of the lack of information the GPS provides, no obstacle detection and a lack of a timely response as well as the distance error made during the navigation time. However, the barriers of the GPS could be overcome if the users can be provided with better roads without any indiscriment parking, stalls, holes on the ground and unpredictable changes on the way, which could help them navigate using GPS alone. This could further incorporate in assessing the best unit of measure to be used while the process of navigation is taking place.

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REFERENCES

A. Smith. (2012)Nearly half of American adults are smartphone owners," Pew Research Center's Internet & American Life Project".

Bousbia-Salah, M., Larbi, A. & Bedda, M. (2003). An approach for the measurementof distance travelled by blind and visually impaired people. 10th *IEEE International Conference on Electronics, Circuits and Systems*, 1312-1315.

Bousbia-Salah, M., Larbi, A. & Bedda, M. (2004). An interface card for measuringdistance travelled by blind pedestrians. *Automatic control and computersciences*, vol. 38, pp. 68-74.

Bousbia-Salah, M. & Bedda, M. (2003). An alternative method of distance measurement walked by the blind. Advanced Modeling and Optimization, *Electronic International Journal*, Vol. 5,pp. 39-50.

Chaitali, K., Lakde, P., & Prasad, S. (2015). Review Paper on Navigation System for Visually Impaired People. *IJSRSET*, Volume 2 .2, pp. 2394-4099, 2016.

Dunai, L., Lengua, I., Peris, G., & Defez, B. (2013). Object Detection andRepresentation Procuedure for a Navigation Device for Blind People, (Cc),1515–1522.

Enge, P., & Misra, P. (2011). Global Positioning System: Signals, Measurements, and Performance - Revised Second Edition (2011).

Justason, N., J. Treviranus, L. McArthur and J. Silva. (2010). GPS-based navigation inthe everyday life of blind users, Department of Occupational Science & Occupational Therapy, University of Toronto.

Laurie Winkless .(2017). Using Technology To Help Visually-Impaired People Navigate Cities.

Nicholson, J. (2010). Generation and Analysis of Verbal Route Directions for Blind Navigation, Utah State University.

Salowi, M. A., & PP, G. (2012). Report of the National Eye Database.

Vladimir, K., J.Nicolson and J.Martson. (2010). The Blind Leading the Blind: Toward Collaborative Online Route Information Management by Individuals with Visual Impairments, Paris, France.

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