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A SMART TACTILE FOR VISUALLY IMPAIRED PEOPLE

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ABSTRACT
Although contemporary world aims to make daily life of people easy and comfortable, the impaired still have many difficulties in society. One of the most significant difficulties is traveling for the visually impaired people because of inappropriate city designs. Moreover, these people are not able to travel without assistance to their desired destinations. Recent developments in technology have enabled several facilities, such as tactile paving surfaces, to improve their lives, but so far there is no comprehensive solution to the problems they face. This study proposes a new, cost efficient and simple system, which consists of two main elements: batons, and tagged paths to make traveling alone possible. Furthermore, the proposed system is available for IOS and Android mobile devices, and consists of two software applications, "InGuide" and "OutGuide", for indoor and outdoor environments respectively. Both of the applications use voice command interpreter algorithms to guide tactile users.
Keywords: Cane, Visually Impaired People, Guidance, Smart Devices

1. INTRODUCTION
Visually impaired people usually need assistance to reach their destinations in indoor and outdoor environments. However, their current tools, such as tactile paving surfaces and white canes are not adequate for their needs, because the main purpose of these tools are to provide visually impaired people safe routes on sidewalks, and avoiding obstacles on their routes, rather than allowing them to travel to destinations such as pharmacies, hospitals and shopping centers, and navigate inside these places. Therefore there is a need for a solution that can assist them throughout their lives to successfully navigate in indoor and outdoor environments.
In this paper, we proposed two approaches for routing the people with visual disorder: 1. For outdoor places such as sidewalks, passive RFID tags can be placed under the tactile paving surfaces, to allow modified white stick with a reader to inform the user when they reach their destination, as well when they pass places like markets, cafes, etc. on their way. Using GPS and RFID tags system can guide users to the closest desired outdoor destination located on tactile paving surfaces.
For indoor environments such as subway stations, theatres, concert halls, hospitals and shopping centers, the solution works on the same principle, but in a more complex way. The reader on the cane and the visually impaired person still needs tactile paving surface in order to complete the convergence and navigate successfully.
With the growing awareness of the challenges caused by visual impairment, governments started to build tactile paving surfaces on the sidewalks. While this solution helps visually impaired people to travel, it does not enable them to know when they reach their destination. Therefore this solution is of solution value. When the companies realized this problem, they developed mobile apps in order to notify users about their location, but GPS alone cannot provide precise data in real time [3]. For this reason, these applications are not accurate enough daily use, and frequently provide incorrect information. Other solutions that use ultrasonic sensors or laser range finder are more effective guiding visually impaired people and detecting obstacles, but are too expensive for widespread use [2, 4-7].

Research has been conducted how radio frequency identification can be used in robot-assisted indoor navigation for the visually impaired. The experiments illustrate that passive RFID tags deployed in the environment can act as reliable stimuli that trigger local navigation behaviors to achieve global navigation objectives [1]. A portable mid-range localization system using infrared LEDs is a versatile indoor/outdoor pedestrian guidance system for the visually impaired. Additionally, two systems are proposed, a fixed active beacon and a receiver using an ultrasound time-of-flight method, and a differential infrared intensity method, which can generate a uniform signal field that exceeds 30m [8]. There are a number of different applications about the guidance of visually impaired people in the literature, such as, guidance using rotational and directional vibration patterns, wearable Cognitive Aid System for Blind People (CASBliP), wearable obstacle detection system based on neuro fuzzy, ARGUS autonomous navigation system, Goren-Goz, a white stick named NaviBaston, and Sesli-Adimlar [9-15].

2. SMART TACTILE: THE PROPOSED TOOL

The proposed tool aims to guide visually impaired people in indoor and outdoor locations using RFID technology. The application, served by tool, guides users with voice commands using RFID reader and RFID tags located on tactile paving surfaces to identify location and the direction of the user. The indoor and outdoor guidance of users work in similar ways. For outdoor environments, GPS technology is used to determine user's initial location, and if user is on tactile paving surfaces, software directs user to their closest desired location using RFID reader and RFID tags placed on tactile paving surfaces to identify location.

In consultation with visually impaired people, an interactive cane was designed and an application was develop. Figure 1 shows the operational profile of the proposed system.

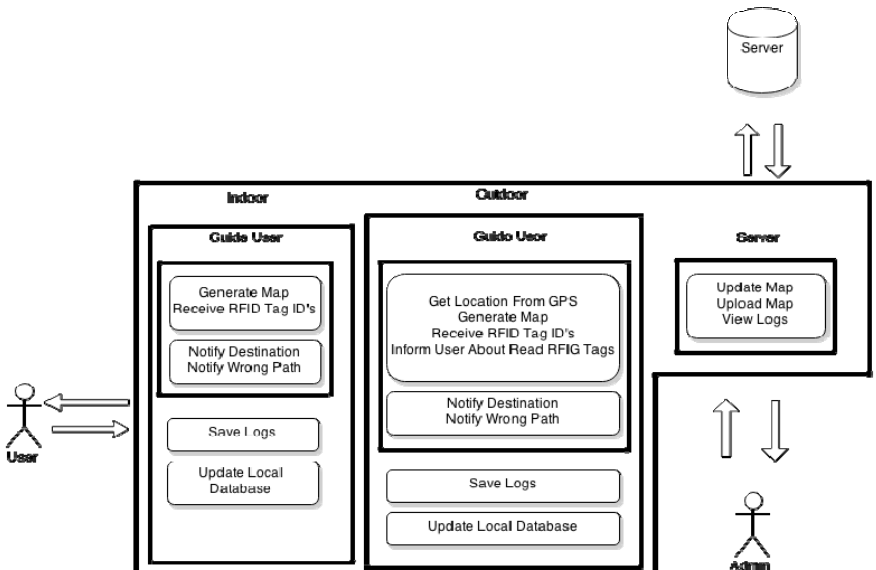

Figure 1. High level design of the Smart Tactile system

The proposed tool has been developed using current tools for the visually impaired, i.e. the white sticks and tactile paving surfaces. As shown in the Figure 1, there are three important packages in the project. The first is the indoor package, which holds the instructions for guidance in indoor environments. The second package is slightly different, and it holds the instructions using GPS. The third is the server part that provides the administrator with upload and update capabilities.

Besides these packages, our application has a single graphical user interface that will accept direction commands as a voice input, as shown in figure 2. When the software is executed, the application starts immediately to download a map of the current indoor location, and waits for the voice command from the user. The microphone, shown in the figure 2, is for development purposes and indicates that the application is running and ready to convert user input to string, supported by the use of Google speech libraries.

People may have different accents; therefore our application may not be able to interpret every voice commands. In order to increase precision, libraries provided by Google and Apple have been incorporated into the proposed tool. Another possible problem is that our software is highly dependent on databases, and any outdated database can misguide our users. For this reason, the application should refresh the maps each time a particular indoor location is visited.

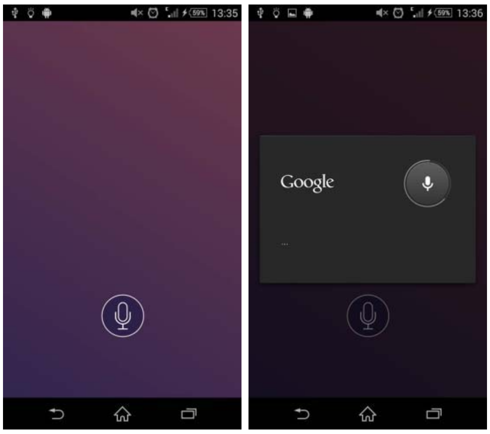

Figure 2. Basic user interfaces of the Smart Tactile

The indoor part of this project depends on the presence of tactile paving surfaces and RFID tags. When visually impaired people travel on the tactile paving surfaces, previously placed RFID tags are read by an Android or IOS-equipped white stick. Through the RFID tags, direction of the user is recognized, then the user adjusts the direction as desired using android or IOS devices. According to the RFID tags that are read, the software uses a voice to guide the users. The system is illustrated in the figure 3. In order to accomplish guidance, the features of the indoor environments possible routes are determined. When the interactive cane reads the RFID tags, the software identifies the location of the user, whose direction is determined by comparing current and previously read RFID tags. When the user moves away from the tactile paving surface, it is envisaged that the software will warn the user with a verbal message.

Similar to indoor places, uniquely identified RFID tags are placed under tactile paving surfaces in order to allow an interactive cane to read the tags and send the data to an Android or iOS device. The device utilizes the RFID data and, use GPS to determine exact direction of the user. After the determination, an automated voice file from the mobile device informs the user when passes facilities such as markets and pharmacies.

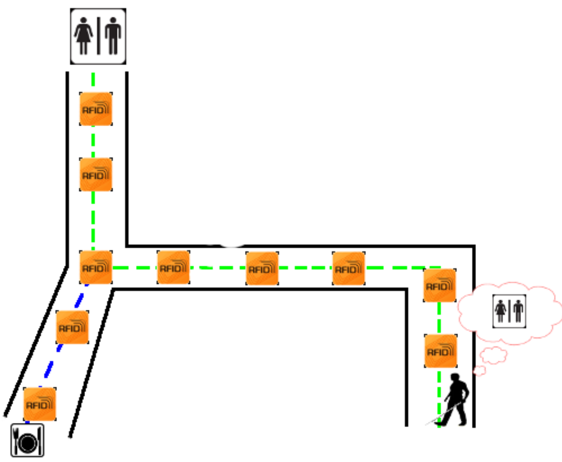

Figure 3 Illustration of the proposed system.

3. CONCLUSIONS

Before this solution, outdoor tactile paving surfaces were only used for guiding visually impaired people along pavements, and had no capacity to notify users of the presence of potentially useful facilities such as pharmacies and markets. For indoor places, the situation is more difficult. There is almost no sign of tactile paving surfaces, except for the subway stations. To overcome these problems, this project offers a permanent solution taking into account the daily habits of the visually impaired. Through its device and its software, the visually impaired are able to find their ways in the city with minmal difficulty. The system aims to provide direction finding for massive and complex places, such as conference halls, theaters and appropriate environments. Moreover, the tool is designed to be as cost effective and as simple as possible. For this system, all that is needed is a wtihe stick and an Android or IOS device which can be connected via Bluetooth technology.

4. REFERENCES

[1] Kulyukin, V.; Gharpure, C. ; Nicholson, J. ; Pavithran, S. : RFID in robot-assisted indoor navigation for the visually impaired - IEEE/RSJ International Conference on Intelligent Robots and Systems, Sendai, Japan, Volume: 2, Pages: 1979-1984, 2004.

[2] Ulrich, I.; Borenstein, J.: The GuideCane-applying mobile robot technologies to assist the visually impaired - Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on, Volume:31 , Issue: 2 , Pages: 131-136, 2001.

[3] Ran, L. ; Helal, S. ; Moore, S. : Drishti, an integrated indoor/outdoor blind navigation system and service. Pervasive Computing and Communications, PerCom 2004. Proceedings of the Second IEEE Annual Conference Pages: 23-30, 2004.

[4] Shoval, S. ; Borenstein, J. ; Koren, Y. : Auditory guidance with the Navbelt-a computerized travel aid for the blind. Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on, Volume:28 , Issue: 3, Pages: 459-467 , 1998.

[5] MacNamara, S.; Lacey G.: A Smart Walker for the Frail Visually Impaired, IEEE International Conference on Robotics and Automation, 2000, California, Pages: 1354-1360, 2000.

[6] Kulyukin, V. ; Gharpure, C. ; Nicholson, J. : RoboCart, toward robot-assisted navigation of grocery stores by the visually impaired. Intelligent Robots and Systems (IROS 2005). IEEE/RSJ International Conference, Pages: 2845-2850, 2005.

[7] Kulyukin, V.; Gharpure, C.; Nicholson, J.; Osborne, G:Robot-assisted wayfinding for the visually impaired in structured indoor environments , Autonomous Robots, Volume: 21, Issue: 1, Page: 29-41, 2006.

[8] Suhyeon P., In-Mook C., Sang-Soo K., Sung-Mok K.: A portable mid-range localization system using infrared LEDs for visually impaired people. Infrared Physics and Technology, Volume: 67, Pages: 583-589, 2014.

[9] Cosgun, A.; Sisbot, E.A.; Christensen, H.I.: Evaluation of rotational and directional vibration patterns on a tactile belt for guiding visually impaired people. Haptics Symposium (HAPTICS), Pages: 367-370, 2014.

[10] Dunai, L.; Lengua, L.I. ; Tortajada, I.; Brusola S.F.: Obstacle detectors for visually impaired people. Optimization of Electrical and Electronic Equipment (OPTIM), 2014 International Conference on, Pages: 809-816, 2014.

[11] Bahadir, S.K.; Koncara, V.; Kalaoglu, F.:Wearable obstacle detection system fully integrated to textile structures for visually impaired people. SENSORS AND ACTUATORS A-PHYSICAL, Volume: 179, Pages: 297-311, 2012.

[12] Carrasco, E.; Loyo, E.; Otaegui, O.; Fösleitner, C.; Dubielzig, M.; Olmedo, R.; Wasserburger, W.; Spiller J.: ARGUS Autonomous Navigation System for People with Visual Impairments. 14th International Conference on Computers Helping People with Special Needs, LNCS Volume: 8548, Pages: 100-107, 2014.

[13] Türkiye Ulaştırma Baklanlığı: Gören Göz. [Retrived from http://www.haberekspres.com.tr/gorme-engelliler-icin-goren-goz-projesi-h26680.html]; last accessed: September in 2014

[14] Cyclops: Navibaston. [Retrieved from http://www.sabah.com.tr/ekonomi/2013/05/07/navibaston]; last accessed: October, 2014.

[15] Avea: Sesli Adımlar 2014. [Retrieved from http://www.hurriyet.com.tr/ekonomi/27174411.asp], last accessed: October, 2014.