An Implementation of an Intelligent Assistance System for Visually Impaired/Blind People

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***Abstract*—In this paper, we propose an intelligent assistance system for visually impaired/blind people, which is composed of wearable smart glasses, an intelligent walking stick, mobile devices application, and on-line information platform. When visually impaired/blind people wear the proposed smart glasses and holding the proposed intelligent walking stick, thus the obstacles can be detected. If a visually impaired/blind person is fall down, then the related information (GPS, fall down, *etc.*) will be recorded and uploaded to the on-line information platform. Related information can also be viewed by the proposed mobile devices application.**

I. Introduction

According to the statistics of the World Health Organization (WHO) [1], as of the end of the 2016, there were about 7.338 billion people in the world, of which about 285 million people were visually impaired. Among these visually impaired people, there were 246 million amblyopia and 39 million blind people that account for 4.25% of the world's total population as shown in Fig. 1.

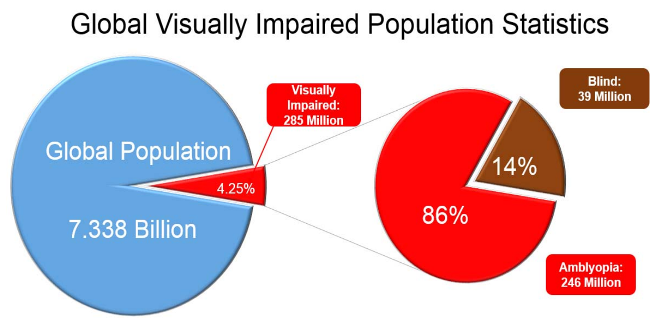

Fig. 1. The ratio of visually impaired people to the world's total population.

In recent years, many related works [2]-[6] were studied and developed for caring, helping, and protecting the visually impaired people. Elmannai and Elleithy [2] reviewed the current development status of the sensor-based assistive devices/aids and gave some possible future directions.

Khlaikhayai *et al.* [3] proposed an intelligent walking stick, which was applied for elderly and blind people to achieve a goal of safety and navigation. This work integrated wireless sensor with an ad hoc network. This intelligent walking stick can perform and realize the special events such as blind rally and disable people networks.

Bai *et al.* [4] developed smart guiding glasses as an electronic travel aids (ETA) for providing indoor travelling for the visually impaired group. Compared to other existing works, this work implemented a multi-sensor fusion-based obstacle avoidance method, which was integrated a depth sensor with an ultrasonic sensor to overcome the problems of detecting small obstacles. Bai *et al.* [5] also proposed a wearable smart glasses-based indoor navigation device, which a dynamic sub-goal selecting scheme was adopted to guide the blind people to the destination and to help them bypass obstacles, simultaneously.

Lee *et al.* [6] presented an indoor positioning system, which image and ultrasound sensors were mounted on a pair of wearable glasses. This system can real-time recognize certain color-coded markers and observe obstacles for detecting distance of 15 meters. However, most previous works [4]-[6] for the visually impaired people were based on wearable glasses and applied to the indoor environment. Moreover, we still lack a complete interoperated aids suite. Therefore, in this paper, we pair a wearable smart glasses and an intelligent walking stick to construct an intelligent assistance system for visually impaired and blind people to provide walking safety functions such as fall down/collision announcement and obstacles detection for visually impaired/blind people.

II. The Proposed System

The proposed intelligent assistance system consists of wearable smart glasses, an intelligent walking stick, mobile devices application, and on-line information platform.

Fig. 2 demonstrates an application scenario of the proposed intelligent assistance system. Firstly, visually impaired/blind people need to wear the proposed wearable smart glasses and holding the proposed intelligent walking stick, thus the front obstacles can be detected by wearable smart glasses and to remind visually impaired/blind people by intelligent walking stick. Furthermore, if a visually impaired/blind person is happened fall down or collision event, then the related information (GPS, fall down, *etc.*) will be recorded and uploaded to the on-line information platform. The related information will also be immediately announced related persons (for example, family members or caregivers) by the

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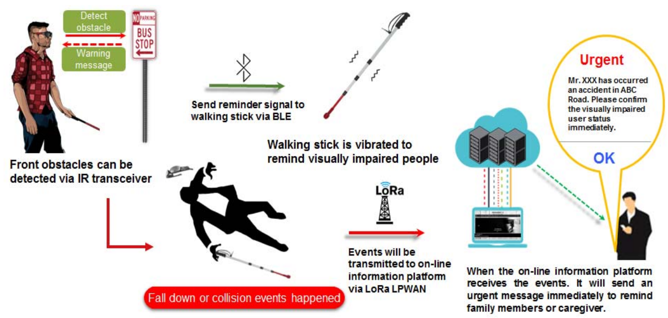

Fig. 2. An application scenario of the proposed intelligent assistance system.

proposed mobile devices application.

Fig. 3 shows a prototype of the proposed wearable smart glasses. An infrared (IR) transceiver sensor module (see Fig. 3 (a)), a 6-axis (Gyro + accelerometer) micro-electromechanical (MEM) sensor module (see Fig. 3 (d)), a microcontroller unit (MCU) (see Fig. 3 (c)), a Bluetooth low energy (BLE) wireless communication module (see Fig. 3 (d)), and a battery charging module (see Fig. 3(b)) are mounted on the wearable glasses. Fig. 4 shows a prototype of the proposed intelligent walking stick. A vibration motor, a GPS module, a MPU, a BLE wireless communication module, a LoRa-based LPWAN wireless communication module, and a 6-axis (Gyro + accelerometer) micro-electromechanical (MEM) sensor module are mounted on a walking stick. Fig. 5 shows an execution screen of the proposed on-line information platform. Fig. 6 demonstrates operating screens of the proposed mobile devices application.

III. Conclusion

In this paper, we have proposed intelligent assistance system, which is paired a wearable smart glasses and an intelligent walking stick for visually impaired/blind people. For the further works, we will try to integrate deep learning techniques for recognizing front images (such as traffic signs) and to develop intelligent walking guiding related functions.

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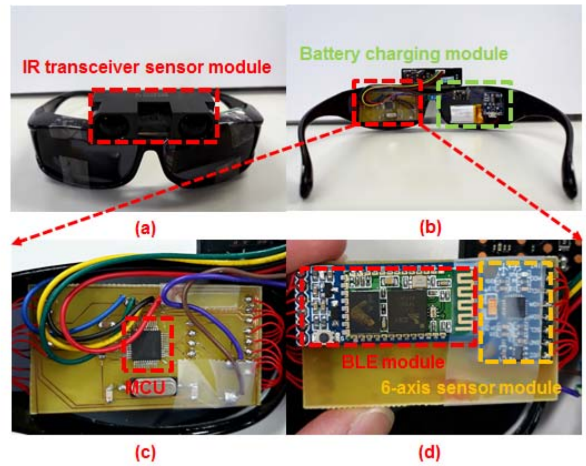

Fig. 3. Prototype of the proposed wearable smart glasses.

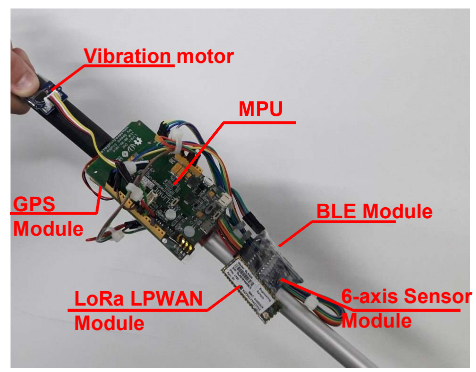

Fig. 4. Prototype of the proposed intelligent walking stick.

Fig. 5. On-line information platform.

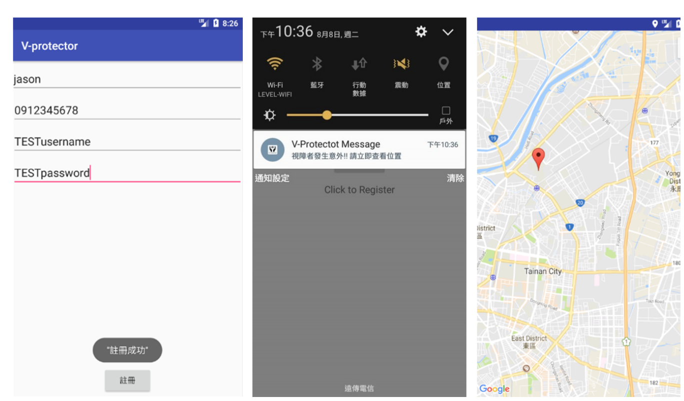

Fig. 6. Operating screens of the proposed mobile devices application.