



INTELLIGENT WHITE CANE TO AID VISUALLY IMPAIRED

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ABSTRACT--Visually impaired people need some aid to interact with their environment with more security. The traditional methods to help blind and partially sighted people to move around on foot are the white cane (or white stick) and the guide dog that is very expensive due to the training process and maintenance. The white cane is a long stick that operates as a contact tool. It is useful to detect obstacles, stairs and curbs in the walking path while the eco of the typical sound originated when contacting with the floor gives average volumetric information to the user and also alerts other people in their walking path. Recent advancements in embedded systems have opened up a vast area of research and development for affordable and portable assistive devices. Unfortunately the cost of these devices, their size, intrusiveness and higher learning curve prevents the visually impaired from taking advantage of available devices. This paper proposes the creation of smart white cane for increasing the independency of visually impaired people which is robust, low cost and user friendly. This smart white cane incorporates various purposes such as obstacle detection, item locator, alarm system, altitude sensing, and voice messenger and so on. This intelligent stick allows greater mobility and safety.

Keywords- visually impaired, assistive device, intelligent stick.

2.INTRODUCTION

According to World Health Organisation, 285 million people are visually impaired worldwide: 39 million are blind and 246 have low vision. About 90% of the world's visually impaired live in developing countries. Globally, uncorrected refractive errors are the main cause of visual impairment; cataracts remain the leading cause of blindness in middle- and low-income countries. Our environment is complex that has different types of obstacles at different locations. People who are visually impaired are often dependent on external assistance. Existing devices are able to detect and recognize objects that emerge on the floor, but a real risk is also coming from objects that are decreasing from the floor, as holes and pits. Using a traditional white cane is a universal solution, allowing a less risky journey for blind people. Such a tool is used to explore the environment by a frontal sweep, or contact with the ground to detect the presence of an obstacle. However, this cane does not allow sufficient exploration of objects that are at the top or which are getting too closer. To this end, the realization of an electronic cane automating the detection and recognition of fixed and mobile obstacles can offer more security and comfort to blind persons. This can be done through the integration of various specific sensors, which are designed to provide several types of information such as obstacles form, dimension, colour and distance from the user.

3.STATE OF ART THAT ALREADY EXISTS:



As an aid to autonomous outdoor and indoor mobility, different solutions based on various technologies and working principles are available, both as commercial products and at the research state. Each detection technology has its own advantages and issues. Some of them are

- Obstacle detectors using LASER technologies able to signal the user the presence of obstacles in front of him/her. Such devices, anyway, do not work in all situations, mainly due to the very different physical properties of obstacles.
- Other mobility aid systems exploit the GPS (Global Positioning System) signal transmitted by the GPS satellite constellation; As a consequence of GPS relatively poor accuracy and precision such systems are not completely suitable for blind pedestrians mobility in an urban scenario. Moreover, such systems cannot be used inside buildings, where the GPS positioning signal is lacking.
- Another proposed mobility aid is represented by a guidance system based on a path implemented by means of buried RFID tags, a cane mounting an RFID reader and a portable user terminal providing indications downloaded from an online map.
- Paths equipped with suitable guide tiles provide the user with a safe route inside buildings or outdoor; however, the user should have a preliminary knowledge of the route.
- Finally, dog guides may present some issues for the user, as he/her must establish a very strict, continuous and engaging relationship with the dog.

4. PROPOSED MOBILITY AID

The basic idea behind this paper is to realize a guidance system trying to overcome some issues presented by other mobility aid solutions, realizing a safe path that may be followed by the user thanks to a tactile vibration feedback provided by a Smart Cane handle while the user is on a predefined safe track. The intelligent Cane is a traditional white cane equipped with electronic devices, and can potentially also be used as a traditional white cane. In addition, during the route the user is provided with vocal information by means of a headphone about the obstacle present in front of him whose image detail is fed in by the image from a monocular camera connected to the Smart Cane and additional features like item locator, altitude sensor alarms. Thus the stick will work by following,

- If any obstacles are detected it will convey voice message with a distance at which it is placed.
- Item locator can be used to detect the lost house keys, specs, audio player remote, etc.
- If he/she is in emergency, they can give an alarm to the surrounding by pressing the alarm button.
- If any pit is there, it is possible to determine the altitude using altitude sensor.
- Efficient battery usage and using solar energy for charging.

5. SYSTEM ARCHITECTURE

A. SENSORS

Sensors allow perception of the environment in more or less reliable way compared to the human eye. The use of different sensors is required, in different fields, to help the user in making a decision. The reason behind using the Ultrasonic sensor over other available sources is, it is less affected by target materials or by colour, it is capable of detecting objects within a meter. These ultrasonic sensors are designed to resist external disturbances such as vibration, infrared radiation, ambient noise, and EMI radiation. Ultrasonic waves are emitted from the module and bounce back



when hits an objects and obstructions in the path of the user is determined. The output of the sensor provides change in voltage with respect to the distance of the obstacle. This system also provides details about the physical nature of the obstacle by using monocular camera. In this system various sensors such as item locator RF sensor, altitude sensors are used to provide user more convenient way of mobility.

B.ITEM LOCATOR USING RF SENSOR

Item locator includes one transmitter, two key ring receivers and two thin receivers. Double sided adhesive tape is included for attaching thin receivers to other items. It works with keys, glasses cases, wallets etc. It has frequency of 433MHZ and transmitter range of 60 feet.

C.VIBRATOR WITH VOICE CONTROL

The system comprise of one vibrator and a headphone. Vibrators are placed over a sweat band. Vibratory patterns are produced by manipulating the duration while the vibrator is running and the interval between successive vibration pulses. Thus, by recognizing the vibratory pattern the user can infer the obstacle distance. When the obstacle is in zone then vibratory pattern is experienced. Vibrator frequency is inversely proportional to Obstacle distance. When the vibrator works along with the left or the right speaker, it indicates that there is a body in front and left or right according to speaker working.

D.BATTERY SYSTEM:

Choice of the power system for different units in smart cane is very crucial. Lithium ion batteries (LIB) as the power source for the RF locator and control unit. They have best energy-to-weight ratios, no memory effect, and a slow loss of charge when not in use. LIB can be recharged easily which will help in minimizing the required maintenance. When the LIB is near depletion, low battery alarm will be given to the user.

E. CHARGING CIRCUIT

A battery charger is a device used to put energy into asecondary cell or rechargeable battery by forcing an electric current through it. The charging protocol depends on the size and type of the battery being charged. A battery charger can be a AC adapter.

F.ALARM SYSTEM

The alarm system ensures the safety of the person when he is in danger.The device assists in particular that the visually impaired person has entered a potentially dangerous area. It may be the edge of railway platform for an example.It also alerts the person if any fire has broke out or any gas leakage has occurred.

G.CONTROL UNIT

The control sub-system consists of an Arduino Board having an ATMEGA328P microcontroller merged in it. Arduino is an open-source single board microcontroller, heir of the open-source Wiring platform, thus helping in designing electronics projects easily. The hardware consists of a simple open hardware design for the Arduino board with an Atmel AVR processor and



on-board input/output support. The software consists of a standard programming language compiler and the boot loader that runs on the board. The sensor output is provided to an Arduino which calculates the distance based on the program. The obtained value is compared with the fixed value and a vibratory pattern is generated according to the zone.

6. PROPOSED SYSTEM ARCHITECTURE

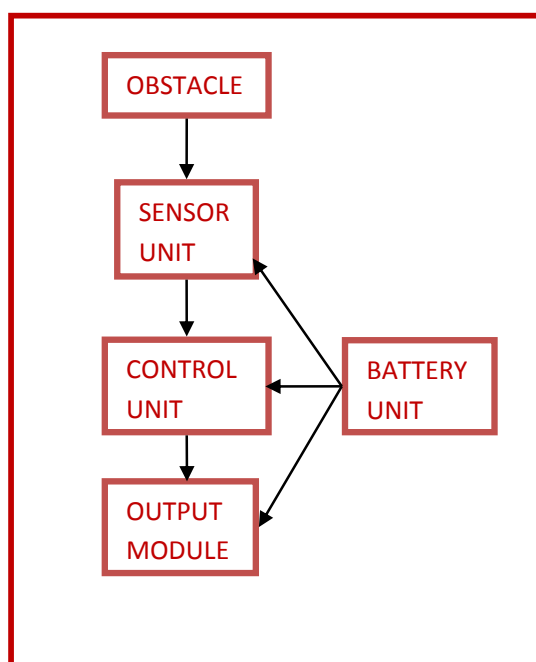


Fig.1 Block diagram of proposed system

The functioning of the intelligent stick with the above specified components will be explained as follows.

Ultrasonic sensor sends the signal to detect the presence of obstacle. The signal provided by the sensor is processed in a signal processing unit. Here it is processed to give depth information of the scene scanned according to given direction. When a wave is reflected the nature of obstacle and its distance could be sensed depending upon the amount of wavelength reflected from obstacle. The monocular camera which is installed in the cane captures image of the obstacle. The data obtained by the sensor and the monocular camera is sent to the microcontroller. Signal conversion takes place in the microcontroller and the converted data is sent to SD card and Bluetooth card. The data from microcontroller is stored in SD card. The code of the obstacle from the microcontroller is sent to Bluetooth card. The message is transmitted from SD card to headset using Bluetooth module. Similarly the different items like keys, specs can also be located accurately by RF sensor. The altitude sensor used in this system gives the altitude of the path the person is travelling. If any pits are found, it alerts the person similarly in the manner as other sensors. In case of dangerous situations the intelligent stick can be used as an alarming device by pressing onto a suitable button. Thus the stick acts as a life saver to the visually impaired person.

7. CONCLUSION



Blind and visually impaired people need some aid to interact with their environment with more security. Accordingly a multi-sensor system has been proposed.

In this paper, we have presented an intelligent cane which incorporates one ultrasonic sensor and monocular camera in order to assist visually impaired. It also includes item locator, altitude sensor and an alarm device in order to alert them in emergency situation.

8. REFERENCES

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