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An Assistive Mobility Device for the Blind: White Guide

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ABSTRACT

Presently, for making human life easier with innovative articles various approaches are being used. Blindness is a characteristic, not a disability or defect. Navigating in an unknown environment poses a great difficulty for the visually challenged people. They are dependent for any type of movement. To overcome this smart product is proposed that can be attached to white cane. White cane will help the user with obstacle detection, real time location tracking of the blind, support intimation in case of emergencies and some voice control features. It consists of various sensors to perceive the environment and give haptic feedbacks. The product connects with an Android application via Bluetooth. The main aim is to provide a reliable, safe, affordable and easy to use navigating tool to ease the lives of visually impaired people.

Keywords: *White Guide; SoS Unit; Android.*

1.0 Introduction

About 285 million people in the world are visually impaired; 39 million of them are blind and not only that, about 90% of these impaired live in the developing countries itself. These figures are more than results to some large-scale studies; they are a clear indication to the degree of audacity this large proportion of specially-challenged population requires, in terms of research, technology support (as in assistive aids) and various other socio economic factors.

Even for the people which perfect eyesight, the congestion of obstacles is sometimes problematic, it is even worse for the visually challenged. People with visual disabilities are often dependent on external assistance which is generally provided by humans, trained dogs, or special electronic devices for decision making. But even the present day technical aids are neither so efficient nor so affordable. Most of them require the users (blind) to adapt to entirely new device and are too complex for them to use.

We therefore propose a considerably improved and a highly cost effective detachable device which would be compatible with the conventional white cane facilitating a better technical assistance to walk and would also help as a significant aid in any sort of emergencies.

The device we propose would be an assistive aid with integrated ultrasonic sensors and other peripherals such as a SoS button, call button etc. The device would not only cater features such as obstacle detection but would also help in case of emergencies and that would be fulfilled by the smart cane app. The real-time location of the user can also be mapped through the cane and its corresponding Smartphone application.

Ultrasonic sensors uses longitudinal mechanical waves which travel as a sequence of compressions and rarefactions along the direction of wave propagation through the medium. It evaluates the attributes of the target by interpreting the echoes from these waves. Sensors determine the time interval between sending the signal and receiving the echo to calculate the distance to an object, this distance is sent to our central microcontroller (Arduino Nano) which in turn produces organized vibration patterns according to the feed received.

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The real-time location tracking on the other hand uses the user's GPS system to give feeds to the support's mobile phone application. Real time location would be triggered in two cases, either when the user passes the Sos button on the cane or when the support tracks the user in the application itself.

Apart from SoS button, other peripherals such as Power Button and call button have their own functionalities. Power button switches the device On/Off. Call button on the other hand helps the user connect to the support in much less time and also helps the user connect or disconnect any incoming call.

A long-lasting battery would be installed in order to support all the embedded systems and their peripherals.

2.0 Existing System

This section is intended to describe some related works on the development of similar devices for the visually-challenged. Technology can help in reducing many barriers that people with disabilities face. Such class of technologies is referred to as assistive technology. Assistive Technology has been utilized in assisting such technologies for a long time now. However, developing an AT is expensive, complex to build and costly to maintain.

The Guide Cane is designed to help the visually impaired users to navigate safely and quickly among obstacles and other devices which are not safe. Guide Cane can be used in many ways but in our device user holds the Guide Cane in front of the user while walking. The Guide Cane is heavier to carry than the white cane, because it uses a servo motor and it is hard to keep because it cannot be folded. The wheels used in servo motor are equipped with encoders to determine the relative motion. The servo motor is controlled by the built-in computer, can steer the wheels left and right relative to the cane. To detect obstacles, the Guide Cane is equipped with ten ultrasonic sensors. A mini joystick is located at the handle which allows the user to specify a desired direction of motion [1].

Smart Cane device is an electronic travel aid which fits on the top fold of the white cane. It serves as an enhancement to white cane and overcomes its limitations by detecting knee above and hanging obstacles. For safe mobility, it is important that such obstacles are detected early. The cane has other uses as a spatial awareness device as it can detect presence/absence of objects in the surroundings. Further, as compared to the white cane, the detection distance is increased from 0.5 meters to 3 meters. It informs about the presence of objects before actually touching the object with the cane and thus helps in preventing unwanted contact. This avoids socially awkward situations like collision with people while walking or unsafe collisions with animals or into trash. SmartCane device uses ultrasonic ranging to detect objects in its path and generates tactile output in the form of different vibratory patterns [1-6]. These vibrations convey the distance information and thus enable the user to negotiate the obstacles from a safe distance. With simple orientation and training, any visually impaired person who is a regular user of the white cane for mobility can benefit from this device [7].

Smart Cane was developed by students and faculty of IIT Delhi. This device only provides obstacle detection and no other feature and was priced comparatively high for such a feature Mechatronic Stick for blind is another device that belongs to the same category of assistive aids; it uses ultrasonic sensors and sound vibrations. It is basically a guiding system, designed to facilitate the daily work of the visually-challenged, but this device too has portability issues due to its weight and cannot be folded. Therefore a device like that is not practically usable for day to day chores.

2.1 Software techniques:

Arduino IDE is software that is used to develop the source code of the Arduino Nano microcontroller. Arduino IDE is a Window based open-source IDE which makes it easier to write code and uploading it to the board.

Along with Arduino Ide, Android Studio for the mobile phone application development is needed. Android Studio provides the fastest tools for building apps on every type of Android device.

It is a world-class code editing, debugging, performance tooling, a flexibly build system, and an instant build/deploy system which allows to focus on building unique and high quality apps.

2.2 Hardware requirement

Ultrasonic sensors generate high frequency sound waves and then evaluate the echo which is received back by them.

Ultrasonic is similar to the infrared where it reflects on a surface in any shape. However, the ultrasonic has a better range detection compared to infrared. Comparing with other sensors, the ultrasonic is more accurate and efficient. The distance and angle measurements of ultrasonic sensors are highly reliable than others by proving that the relative errors and variances of the measurements are within a reasonably small range. The ultrasonic is therefore a very suitable choice for developing the White Guide.

Microcontroller - a single chip that contains the one or more CPU(Processor), non-volatile memory for the program , volatile memory for input and output , a clock and an I/O control unit and time. It is designed for a small set of specific function to control a particular system. For example, in wheelchair Microcontroller is used to control the motion using remote control. The reason of using microcontroller is because it is versatile in nature and has the ability to store and run unique programs [1] The microcontroller that would be most suitable for the White Guide is Arduino Nano. Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. Arduino can sense the environment by receiving input from a variety of sensors (ultrasonic sensor in our case) and can affect its surroundings by controlling the various actuators. The microcontroller on the board is programmed using the Arduino IDE.

3.0 Proposed System Architecture

The proposed system mainly consists of two units:

- Sensor unit
- SoS unit

3.1. Sensor unit:

The sensor unit comprises of Obstacle detection and Tactile feedback of the same.

The obstacle detection would be carried out through Ultrasonic sensors and taking the distance mapped as input into Arduino code. An action corresponding to the distance calculated is carried out, if the distance calculated is less than the threshold distance mentioned in the code, then a tactile feedback of the same in given through vibrator peripherals on the cne. Therefore, if there is an obstacle within the minimum distance range mentioned in the code, the user is intimated of the same by organized vibration patterns on the device (White Guide) itself.

3.2 SoS unit

SoS Unit primarily has two main components:

- In-Android App Tracking
- SoS button on device

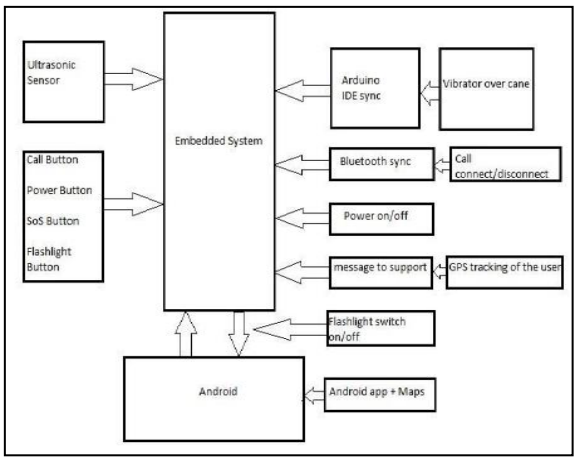
3.2.1 In-android app tracking

The Andoid App would have two logins, one for the user (blind) and other for the support. The user login redirects to the support details page wherein the details of the support such as Name, Phone Number and email id is entered. The support login redirects to the real-time tracking of the user. This support-side functionality of in-app real tracking of the corresponding user makes up half of the Sos module.

3.2.2 SoS button on device

The White Cane would have an integrated Sos push button. This SoS button, when pressed triggers an offline message notification from the user's cell phone to the support details retrieved from the corresponding support details entered in the user login. The Sos button works by linking to the Arduino microcontroller which in turn interacts with the cellphone via Bluetooth.

Fig 1: Proposed Block Diagram



4.0 Conclusions

With the proposed system, if constructed with at most accuracy, the blind people will able to commute with a considerable ease without others help. If such a system is developed efficiently, it

might provide a base for generation of more such devices. Also, as far as the localization is concerned, the real-time tracking feature will be real boon for the blind as well as their support.

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