Electronic Eye for Visually Impaired Persons

S. Nithya¹, A. S. L Shrawan²

¹M.TECH (E.S.), ²Asst. Professor, Dept of E.C.E, Aurora’s Technological & Research Institute

Abstract— This paper presents an electronic travel aid for blind people to navigate safely and quickly, an obstacle detection system using UVC camera based visual navigation has been considered. The proposed system detects the obstacles up to 300 cm via sonar and sends feedback in form of beep sound to inform the person about its location. In addition to this, an UVC webcam is connected to 32 bit ARM micro controller which supports and algorithms for designing of blind people guidance stick. This supports image processing which are used to processes images and give voice response after detection, which is used for finding the properties of the obstacle in particular, in the context of this work, Identification of human presence is based on face detection and object detection. The algorithms are implemented in open CV ,which runs on LINUX environment.

Keywords— Electronic Travel Aid; Face Detection; Mobility; Navigation Aid; Visual Impairment

I. INTRODUCTION

Mobility is one of the main problems encountered by visually impaired persons in their daily life. Over decades, these peoples were using navigational aids like white cane, guide dogs etc. Long white cane is a traditional mobility tool used to detect obstacles in the path of the blind person. The length of the white cane depends upon height of the user and extends from the ground to the user’s sternum. On the other hand, guide dogs are assistance dogs, trained to lead visually impaired around obstacles. Due to the development of modern technology, many different types of navigational aids are now available to assist the blinds. They are commonly known as Electronic Travel Aids.

WALKING safely and confidently without any human assistance in urban or unknown environments is a difficult task for blind people. Visually impaired people generally use either the typical white cane or the guide dog to travel independently. Although the white stick gives a warning about 1 m before the obstacle, for a normal walking speed of 1.2 m/s, the time to react is very short (only 1 s). The stick scans the floor and consequently cannot detect certain obstacles (rears of trucks, low branches, etc.). Safety and confidence could be increased using devices that give a signal to find the direction of an obstacle-free path in unfamiliar or changing environments.

But the main disadvantage of this system is detection of obstacle is done shortest distance only and also it does not gives details about thing are in front of him.To overcome above disadvantage we replace sensors or GPS trackers with a camera. This camera acts as a eye to blind person. The camera with controller is placed to stick this camera monitor’s environment in front of person. The monitored conditions are send to controller continuously if it finds any obstacle in front of camera it alerts person giving signal through voice like “obstacle”.

The main advantage of our system is it shows differentiate between each and everything it detects. Suppose if it detects person coming in front him it gives voice message as “Person is in front of you” etc.

II. AN OVERVIEW OF THE ELECTRONIC TRAVEL AID

The system is based on an embedded system eBox is a small (4.5”x4.5”) low-cost X86 processor based embedded computer system. The ultrasonic sensors are connected with sensor circuit. It feeds the distance data to eBox 2300™ through a RS-232 serial cable. A USB webcam is connected with eBox 2300™ for capturing the field of view of the person, which is used for locating a human being. A headphone is connected with eBox 2300™ to get the audio feedback (beep sound) of the obstacle distance and presence of human being. The eBox 2300™ is powered by 5V, 3A DC adapter and sensor circuit is powered by two 9V alkaline batteries. The algorithms are implemented in C++ using Visual Studio 5.0 IDE, which runs on WinCE environment.

Figure1. depicts the proposed system for ETA. For better field of view, USB webcam is mounted on a helmet and ultrasonic sensors are placed on the user’s belt. Three easy control switches are provided to control the ultrasound based distance measurement system, human detection system and motion detection system respectively. The eBox 2300™ and sensor circuit are kept in the bag which will be held on the waist of the user. The user has to operate the system manually and he/she will get the auditory feedback till the switches are pressed.
Detection of Human Presence

The detection of human presence is carried out by detecting the human face. However, there are situations, when the face is not present in the field of view of the camera in spite of the presence of a human in front of the visually impaired person. Such type of presence of human being may be asserted by detecting cloth and human skin. To detect the presence of human, if cloth is found in the vicinity of human skin, and face is not detected (if Side faces), then it will be considered as human.

B. Object Detection

Object detection is a computer technology related to computer vision and image processing that deals with detecting instances of semantic objects of a certain class (such as humans, buildings, or cars) in digital images and videos.

III. EXTENSIBLE MARKUP LANGUAGE (XML)

It is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. It is defined in the XML 1.0 Specification produced by the W3C, and several other related specifications all gratis open standards.

The design goals of XML emphasize simplicity, generality, and usability over the Internet. It is a textual data format with strong support via Unicode for the languages of the world. Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures, for example in web services.

Many application programming interfaces (APIs) have been developed to aid software developers with processing XML data, and several schema systems exist to aid in the definition of XML-based languages.

The steps for training a haar classifier and detecting an object can be divided into:

- Creating the description file of positive samples
- Creating the description file of negative samples
- Packing the positive samples into a vec file
- Training the classifier
- Converting the trained cascade into a xml file

Using the xml file to detect the object.

IV. RESULTS AND DISCUSSION

In order to test the ELECTRONIC EYE device on the blind folded persons, a system prototype is developed as shown in Figure where UVC webcam is mounted on a helmet, human detection system and object detection system respectively.
To evaluate the performance of the Electronic Travel Aid device, it is tested on trained and novice peoples in the laboratory environment. Three easy control switches are provided to manually operate the device. First switch is to find the obstacles in the path of the blind person and second one is used to find the human presence in field of view of the camera and the last switch is used to detect any movement in front of the person. The device provides auditory feedback to the user in response to the switch pressed. For example, if user presses the first button to find the obstacles on his/her path, device will produce the beep sound whose loudness will increase or decrease with respect to the obstacle distance. To easily operate the device and to understand the auditory feedback, a proper training is required.

![Figure 5. Prototype of ETA device.](image)

A total of eight tests have been carried out in laboratory environment and outside on three blind folded persons in which two are trained subjects and one subject is novice. After blindfolding the person, he/she is asked to walk through the corridor where different type of obstacles has been placed within 10 meter range.

Object Detection

V. CONCLUSION

An electronic eye is to navigate visually impaired persons has been proposed here. The aid has been tested on blind folded volunteers in laboratory environment. Using this ETA device blind user can pass through the unknown environment independently. The major issues for the users to accept these aids are that they should be unobtrusive, easy to carry and for the convenience of the blind user, device should be small and light weight. The proposed system is designed considering all these factors. User needs to wear helmet in which camera and headphone are mounted.

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REFERENCES


