Assistant Systems for the Visually Impaired

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Abstract - *One of the main concerns of visually impaired people is the physical movement. People with complete blindness or low vision often have a difficult time in self-navigating unfamiliar environments. Travelling or simply walking down a crowded street may pose great difficulty. So, many people with low vision tend to bring a friend or family member for assistance. It also becomes difficult for them to keep track of their routine environments. In this way, blind people are always dependent on someone or the other. This system proposes integration of technologies to reduce the difficulty faced by blind people to a bearable extent. Hence, we are going to build an application where object recognition methods using computer vision, image processing, auditory assistance are all embedded in one that will help blind people to recognize obstacles in front of them without any external help.*

Key Words: Computer Vision, Visually Impaired, Assistance Systems, Obstacle Detection, Object Tracking

1. INTRODUCTION

Globally, it is estimated that at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion of them have a vision impairment that could have been prevented or has yet to be addressed. These 1 billion people include those with moderate or severe distance vision impairment or blindness due to unaddressed refractive error, cataract, glaucoma, corneal opacities, diabetic retinopathy, and trachoma, as well as near vision impairment caused by unaddressed presbyopia. Population growth and ageing will increase the risk that more people acquire vision impairment. Now a days everyone and even blind people are familiar with the technology and are using it on a daily basis. We can use this technology to help them in recognising obstacles and help in navigation.

Our project proposes a wearable system that uses an android phone and a camera that will generate instructions which, in the form of audio commands transmitted through headphones, will assist the user in taking appropriate actions.

2. LITERATURE SURVEY

[1] References surveys that tell us that our society has a significant number of physically challenged people and large proportion of them are visually impaired.

Vision impairment classifications:

(1) Mild impairment – presenting visual acuity worse than 6/12

(2) Moderate impairment– presenting visual acuity worse than 6/18

(3) Severe impairment– presenting visual acuity worse than 6/60

(4) Blindness – presenting visual acuity worse than 3/60

A person's experience of vision impairment varies depending upon many different factors. This includes for example, the availability of prevention and treatment interventions, access to vision rehabilitation (including assistive products such as glasses or white canes), and whether the person experiences problems with inaccessible buildings, transport and information. In terms of regional differences, the prevalence of distance vision impairment in low- and middle-income regions is estimated to be four times higher than in high-income regions. With regards to near vision, rates of unaddressed near vision impairment are estimated to be greater than 80% in western, eastern and central sub-Saharan Africa, while comparative rates in high-income regions of North America, Australasia, Western Europe, and of Asia-Pacific are reported to be lower than 10%.

According to [2], 285 million people are suffering from severe sight problems and 39 million are completely blind. Their financial status adds an extra adversity because most of the blind population falls under Low Income Group.

Among all the senses, ability to see through the eyes is one of the most important senses in human beings. And the loss of this ability severely affects all the possible movements an individual is likely to do in his/her life. Since such people are not expected to grow in their profession as much as an abled person, they often experience a violation of their rights and also discrimination on social platforms & at the workplace. Government and social groups are actively participating in making life of visually impaired more convenient and safer by organizing campaigns and providing education about the new tools and technology.

Therefore, the development of these tools is a great challenge. The use of mobile applications is growing in visually impaired as well. So, the idea is to make efficient use of this technology for the betterment of their daily activities. Using cameras and sensors we can detect the environment and the obstacles. And then tell the user to act accordingly with the help of audio files.

In [3], a method is proposed where the image is captured using the camera and the captured image is scanned from left to right for detection of the obstacle and then sound is generated. Sound is generated by analyzing the image where top image is altered into high frequency and the bottom portion into low frequency sound. And the loudness depends on the brightness of the image as well. The image is differentiated into foreground and background using image processing techniques. The foreground is assigned with high intensity value and background are assigned with low intensity values. Then this image is converted into stereo sound where the amplitude of the sound is directly proportional to intensity of image pixels, and the frequency of sound is inversely proportional to vertical orientation of pixels.

In [4], 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, is proposed. 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 should 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.

In [5], the proposed model taps into the acoustic abilities of a Visually Impaired Person (VIP). An RFID based system is used to help the VIP identify any particular object of his need. In addition of RFID module, an Ultrasonic sensor is used to avoid obstacles and to provide various feedback for pinpointing the object. A series of acoustic actuators are used to trigger the required navigation for the VIP. The model uses two- way localization, one using acoustic stimuli and the other using RFID. The proposed model provides an affordable solution to the existing problem of lack of sophisticated technological assistance to the VIPs. Two types of systems are proposed to address blind assistance: with sensors mounted on a cane and with sensors mounted on a head module or glasses. This type mostly makes use of cameras and Artificial Intelligence technology. One such proposed systems makes use of a single image and processes the spatial depth of the objects around the user. Another report, proposes a system which converts virtual reality into audio reality using image processing. VIPs are particularly good at Sound Localization and this ability has been utilized in different research areas for VIPs.

[6] Is a survey of many implementations up till 2010. The category that are focused in this work are the "vision substitution." Following are the subcategories:

a) Electronic travel aid (ETA): devices that transform information about the environment that would normally be relayed through vision into a form that can be conveyed through another sensory modality.

b) Electronic orientation aid (EOA): devices that provide orientation prior to, or during the travel. They can be external to the user and/or can be carried by the user (e.g. infrared light transmitters and handheld receivers).

c) Position locator devices (PLD): which include technologies like GPS, etc. We are mostly interested in ETAs and more specifically in obstacle detection systems, not emphasizing in GPS features.

3. PROPOSED SYSTEM

Proposed methodology of object/obstacle detection works in a way that it involves several processes from extracting frames to the recognized output in the binary image.

3.1 Video Frame Extraction

The system will take real world visual data through the video camera. The camera will convert it into a digital format so that our system can pre-process it for further phases of implementation. The exact format and resolution of the video is undecided. These factors will depend on the limitations posed on us by the mobile phone that will be used for testing the implementation of the system.

3.2 Pre-processing

The initial task of pre-processing is to drop frames from the video data. A modern camera can record videos that have at least 20 – 30 frames per second. Since the person is not moving at a high pace, we can drop frames from the video to minimize the processing. To further reduce superfluous processing, we will convert the images/frames into a grayscale format. An image consists of pixels and every pixel holds its RGB colour values. By reducing the number of values stored by our pixels, we can minimize our processing by a large margin. Grayscale conversion carried out by retrieving the RGB contents from the image taking average of it and assign to the new pixel. After converting it to grayscale, thresholding of the image is performed. The threshold depends upon the environment in which the system will be used. An optimal threshold is needed for proper edge detection. If a pixel exceeds certain thresholds, it is classified as an edge. We will get a barebones and skeletal representation of the environment through these methods.

3.3 Object Classification

After the data is primed and processed, we will implement our object detection algorithms on it. We will be using the inherent library functions of OpenCV that offer object detection capabilities. The object will be classified as an obstacle after being judged upon its proximity to the user, and its other characteristics namely, whether it is static or moving, if it is large or small etc. The database will store the conditions in which respective instructions shall be generated.

3.4 Generating Instructions

We will be generating instructions according to the nature of the objects in the frame. These instructions will be sent to the text to speech API and then communicated to the user using audio output.

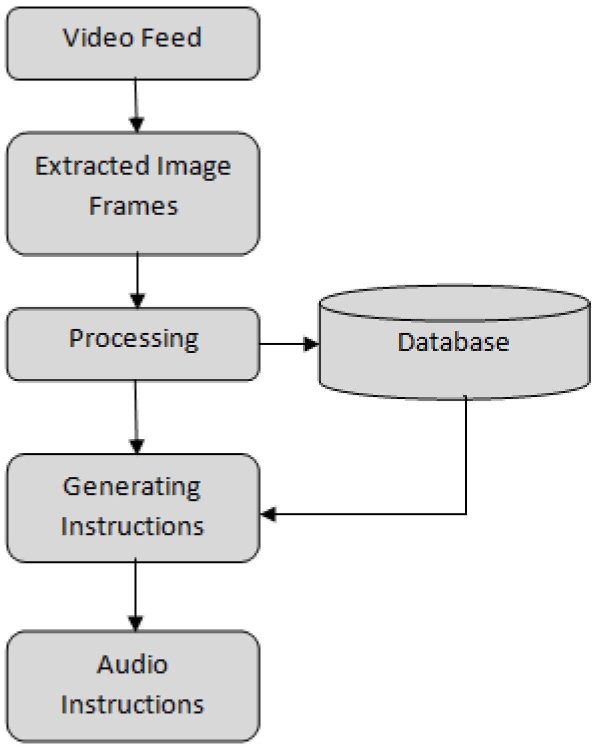

Fig -1: System Architecture

4. CONCLUSION

An extensive study on existing implementations is done and hence concluded that out proposed system is thereby feasible.

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