Obstacle Detection & Warning System for Visually Impaired People based on Smartphone

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Abstract— Proposed system provides detection of obstacle and classification system in a real-time, used to assist visually impaired people to introduce safely within indoor and outdoor environments, handling by the smartphone device. A blind person walking in an unfamiliar area they face so many problems. This issue may be of true obstacles or identifying potholes, bumps in his way. In the past few years, there are various ETA's have been developed for visually impaired people Out of all ETA's available, they are not affordable for blind persons and most of these ETA's focuses on only one problem i.e. Either potholes detections or obstacle in front of the user. And they do not provide information about the environment in which user is present. In proposed system, use of Ultrasonic sensor, camera, and smartphone for detection the difficulties in the path of visually impaired persons. The detection algorithm is based on the information collected from an ultrasonic sensor in the smartphone. The output gives to the user is in the form of vibration and audio. The intensity of the output depends on the distance of an object from the user.

Key words: Ultrasonic Sensor, ETA (Electronic Travel Aids), Smartphone, IR Sensor, Real-Time System

I. INTRODUCTION

According to W.H.O. (World Health Organization) there are 39 million peoples are blind and 246 million have low vision and in the world 90% visually impaired have low income [2]. There are many tools available in the market for these visually impaired people. But the problem is that these tools are not affordable as they have low income. For example, White cane and Guide Dogs.

White canes and Guide Dogs are mostly used by visually impaired people but they have some limitations. For example, Guide Dogs are not mostly applicable in some places [1]. White canes have fewer limitations than Guide Dogs but they have shorter sensing range and they are not suitable for detecting obstacles above the ground level such as tree branches, open windows etc. Improving mobility of blind or visually impaired people variety of the techniques are proposed such as technique developed on GPS (Global Positioning System) [3], [4], [5], RFID [6], [7] by using the cameras [8], [9] and depth sensor [10], [11]. Some limitations can be found in these studies i.e. GPS based systems are not suitable in indoor environment. RFID system suitable for indoor settings but it is impossible to recognize the moving object in dynamic or open environments.

Propose approach can gives solution to the problems detects in previous techniques by designing scalable and exact solution which helps to recognize the obstacles and objects which moves or change position frequently in user's environment. So the focus of this proposed system is the calculations of the distance of the obstacle from the user and providing the haptic and audio to the user. Apart from that using smartphone camera, the user can be made familiar to surrounding. Given system propose and validate a better technology designed to alert user by the presence of static/dynamic obstacles few meters around them and to provide guidance in urban environments, in both indoor and outdoor environment.

II. PROPOSED SYSTEM

The proposed system consists of the two ultrasonic sensors, Arduino nano, a Bluetooth module, IR Sensor, camera and smart phone application.

Two ultrasonic sensors are attached to one feet long stick in which one sensor is at the bottom of the stick and another sensor is attached to stick facing the front side of the user (fig.1).

In this system, the detection process consists of two working modes, first is above ground level mode and second is ground level detection mode. The first mode or the above ground level mode which stores the distance of ground from the stick during calibration process in database using ultrasonic sensor. If the obstacle is detect then the device is warn to the user in the form of audio or vibrating feedback.

In this mode, stored distance in the database is used for the compared with the current distance from the ultrasonic sensor at the same time. While using this device whenever the distance stored in the database is shorted than the value obtained by the sensor then the device warns the user that there is the bump on the ground. And if the distance stored in the database is longer than the stored distance, the device warns the user that a lower level (a hole) is detected.

In the second type of detection, system uses the second ultrasonic sensor to calculate the distance of obstacle in the front of the user. The camera is used to identify the object in the surrounding of the user using image processing technique.

III. SYSTEM ARCHITECTURE

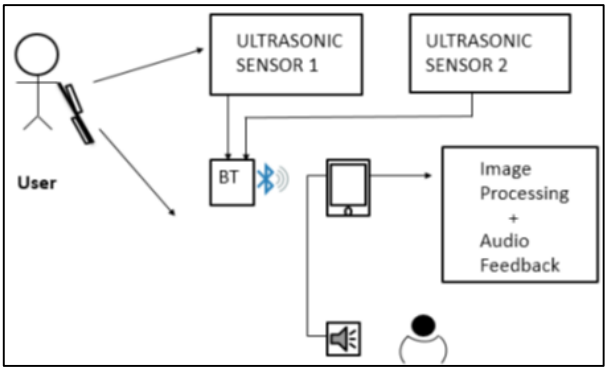

Fig. 1: System Architecture

In this system, the two ultrasonic sensors are placed on Arduino Nano board, in which Bluetooth module is also

present. The data which is collected by the two ultrasonic sensors is send to the smartphone through Bluetooth module. The application installed in the smartphone, process data which is send by Bluetooth module using the obstacle detection algorithm and provides vibration or audio feedback to the user as an output.

The user can take a picture of the environment by using the camera to know about the surroundings. Then the picture taken by the camera is processed to identify the object in the image using various image processing algorithms [12].

IV. WORKING

The detection process consisting of two working modes, the above ground level detection mode, and the ground level detection mode. During the calibration process, the user is moving his arm while carrying the stick from 0-45 degree and the distance of the ground from the stick at each angle can be stored in database of the mobile application. In this the stored distance in the database are used in comparison with the acquired distance at the same angle.

Now when the user use this stick, the ultrasonic sensor attached to the stick which is front side of the user will calculate the distance of an obstacle from the user and by using an audio signal, send the notification to the user about the distance. At the same time, second ultrasonic sensor activated will find the distance of the ground from the user and send it to the application through Bluetooth. This distance will be compared with the stored value in the database to decide whether it is bumps, potholes, or any other obstacles. After the detection of the any obstacle the output will be given to the user in the form of vibration or an audio signal.

In case of moving object, the camera will take a picture of the surrounding environment and the application will process that image to provide detailed information about his surroundings to the user [12].

V. CONCLUSION

Proposed system will overcome drawbacks of traditional mobility aids, which is only focuses on either potholes or on the detecting objects in front of the user. This system detects all obstacles presents in the user's environment.

Proposed system not only focuses on the affordability but also efficient and simple in many ways. The size of stick in this system is small so it may not affect mobility of the user and user can easily carry the stick with him.

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