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Portable Obstacle Detection System for the Visually Impaired

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Abstract- In today's world, where things are changing rapidly and at the pace at which the human race is evolving, it seems like a daunting thought to not really be able to witness our surrounding and the world in which we live. Though the number of visually-impaired people are comparatively less, one cannot imagine or understand what they must be going through, to simply survive in this world. Consequently, visually impaired people have trouble managing their lives and have a very tough time moving about even in small areas. In order to help overcome these difficulties, we propose a portable obstacle detection system which mainly focuses on image processing techniques to capture images and estimate the position of any obstacle lying in the path of the person. Initially, the frames are captured in real time using a stereo camera and are processed to generate a disparity map which then gives the proximity of objects ahead of the person, along with its azimuth i.e. left, centre or right. Based on the distance at which the obstacle lies from the camera and the location of the obstacle, audio signals in the form of beeps will be sent to the person through an audio device, which will act as a warning, so that he avoids going in that particular direction or taking that particular path.

Keywords- Image Processing, Stereo Vision, Visual Impairment, Disparity Map, Audio Feedback, StereoPi, OpenCV, Python, Raspbian OS

I. INTRODUCTION

Among the many things that are difficult for visually impaired people to do in their day-to-day life, one which comes across as possibly the most challenging, is moving around freely without being highly cautious of the things surrounding them. Due to this, the walking pace of the person is highly affected and the person tends to stay in a state of constant fear of what might come ahead of him next which basically makes them often depend on another person for help. This makes them prone to accidents and they could either cause harm to themselves or to the surrounding. The things around them can range from objects as small as an apple or as big as a table and so on.

To make it simpler for these visually impaired people, we focus on developing a system that would be easily portable and convenient enough for the person operating it and would accurately warn the person of any obstacle lying ahead of him.

Our system is based on image processing techniques along with the hardware implementation using raspberry pi micro-controller, audio driver and interfacing with Python.

It consists of three main phases:

Input Video Acquisition

Image Processing

Audio Feedback

The input from the stereo camera will be in the form of frames captured in real-time. These frames will be given to the image processing module. The image processing module is in-turn divided into three phases, namely, disparity map generation, object distance estimation and object position quantisation. The third part includes the audio feedback or the warning phase, where based on the distance and position of object, audio signals will be sent to the person.

II. EXISTING SYSTEMS

People with visual impairment face a lot of difficulties in their day-to-day lives and in order to assist them there have been many systems implemented so that they could at least move around without being dependent on others.

This section provides information about currently existing obstacle detection systems that help the visually challenged remain self-dependent.

A. *Assisting the Visually Impaired: Obstacle Detection and Warning System by Acoustic Feedback* [1]

The system computes a dense disparity map using images of a stereo camera. Using the dense disparity map, potential obstacles can be detected in indoor and outdoor scenarios. A ground plane estimation algorithm based on RANSAC plus filtering techniques are used, which allows detection of the ground in each frame. A polar grid representation is used to detect obstacles in the scene. Acoustic feedback is used to assist visually impaired users while approaching obstacles. The user is informed

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about the presence of obstacles by beep sounds with different frequencies and repetitions. Audio bone conducting technology is used to play these sounds without interrupting the visually impaired person from hearing other important sounds from its environment. Its limitation was that it is not very efficient in terms of its wearability.

B. Stereovision-Based Algorithm for Obstacle Avoidance [2]

The vision-based obstacle avoidance algorithm for autonomous mobile robots provides an efficient solution that uses a minimum of sensors and avoids computationally complex processes. Stereo camera is the only sensor required. The algorithm consists of two building blocks. The first one is a stereo algorithm which is able to provide depth maps of the scene in frame rates. These rates are suitable for a robot to move freely. The second block is a decision making algorithm that analyses the depth maps and gives the most appropriate direction for the robot to avoid any existing obstacles in that particular path.

This method has been tested on self-captured outdoor images and its results have been evaluated. Real time input is not tested by this method.

C. Real time Depth Estimation and Obstacle Detection from Monocular Video [3]

The system which detects arbitrary static objects in traffic scenes from monocular video using structure from motion involves a camera in a moving vehicle which views the road ahead. The camera translation in depth is known. The depth of the scene is determined from the scaling of supervised image regions. Obstacle hypotheses are generated from these depth estimates in image space. Then testing is performed of these hypothesis by comparing with the counter hypothesis of a free driveway. This methodology can detect obstacles at distances of 50m and more with a standard focal length. This early detection allows the driver warning and safety precaution. Detecting moving obstacles in a monocular scenario is a challenge this system faces.

III. PROPOSED SYSTEM

The aim of the proposed system is to design and develop a system which will warn the visually impaired person if there is an obstacle ahead of him within a given range, by providing alerts in the form of audio signals which will help him navigate through his path safely.

A. Architecture of the Proposed System

1) Block Diagram:

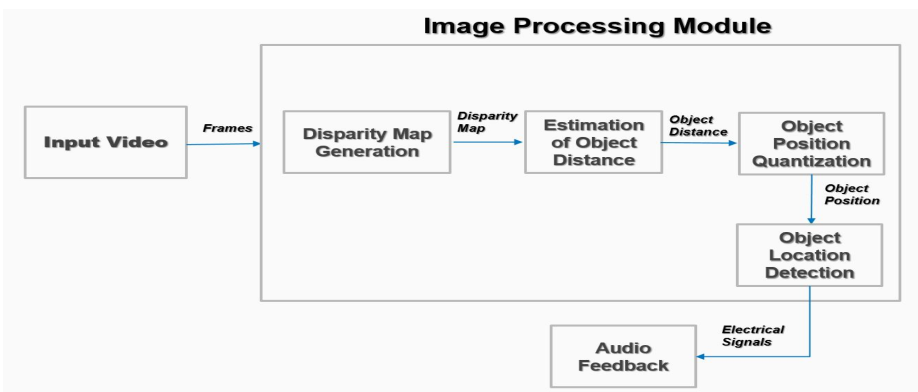

Fig 1: Block diagram of the entire system

The block diagram of the proposed system consists of three main phases:

a) *Input Video Acquisition:* In the first phase, stereo cameras attached to the raspberry pi micro-controller, will take input from the live video being captured as the person moves around. The input will be in the form of frames which will be sent to micro-controller. The images taken by the stereo cameras will be marginally different from each other in terms of the horizontal position. The camera captures two different views of the same scene i.e. a left view and a right view, both at the same time. These images are then sent to the micro-controller for further processing.

b) *Image Processing:* The image processing phase is in-turn divided into three sub-phases:

(i) *Disparity Map Generation:* The disparity map is a representation of the proximity of the objects or elements in an image from the camera. It is shown as a range of grayscale intensities from white to black. The shades of white i.e. higher intensities imply that the object is nearer to the camera while shades of black which are lower intensities, implies that the object is far from the camera.

(ii) *Estimation of Object Distance:* Based on the disparity map generated, we can estimate the approximate proximity of the objects in the image from the reference plane. The parts of the disparity map having higher intensity will have a shorter distance from the camera while the low intensity regions will have a larger distance from the camera. Thus the obstacle is categorised to be either far, near or at a moderate distance.

(iii) *Object Position Quantisation:* Once the distances are calculated, we find the region with the least distance and estimate the position of this particular region with respect to the reference plane. The image plane is divided into three broad regions i.e. left, right and centre along with far and near aspects. Based on the inclination of the smallest distance, we estimate the position or the region in which the obstacle lies. Now, along with the region, the distance estimated will be given as input to the audio feedback phase.

c) Audio Feedback: After calculating the object position, the person is given a warning through audio signals. If the obstacle lies in the centre, then the signal will be given to both sides of the hearing device. If it lies in the left region, the signal will be comparatively louder on the left side of the device and similarly if the obstacle is detected in the right region, the warning signal will be louder on the right side of the hearing device. Also, based on the proximity of the obstacle it will change the rate of the audio signals. If the object lies closer to the person, the rate of beeps will be high and will increase as he approaches it and if it is at a fair distance the rate of beeps will be low and will decrease as he moves away from the object. Thus, the audio output will help the person determine where the obstacle lies along with the approximate distance of the obstacle.

2) Schematic Diagram: The schematic diagram consists of the position of the various components of the obstacle detection system along with the interfacing of the individual parts.

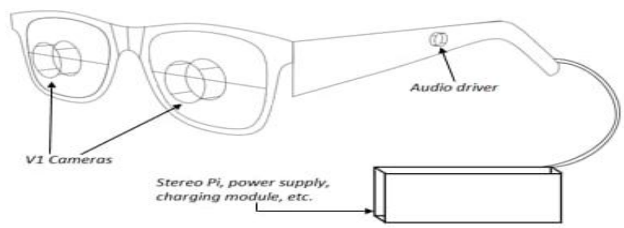

Fig 2: Schematic Diagram

B. Flow of Control

The flow diagram depicts how the system will function in various scenarios. It is a representation of the different conditions and their possible outcomes, from the time the system is switched on till it is switched off. It highlights the major phases involved for obstacle detection by showing the transition between the various phases. It also includes the starting and stopping condition along with the looping condition which tells us at what point the calculations will be carried out.

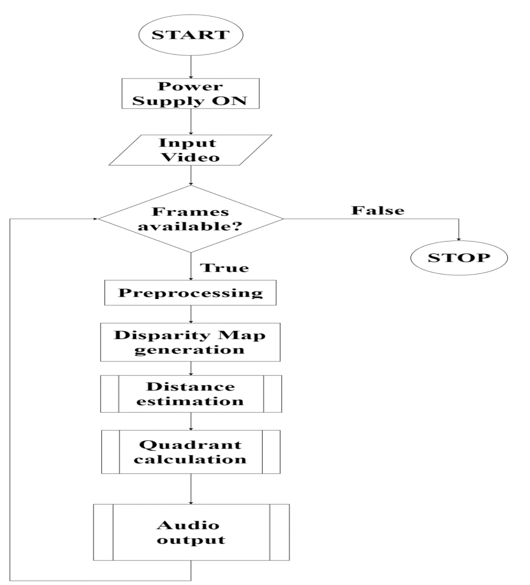

Fig 3. General Flow of Control

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IV. CONCLUSION

With the proposed design of the Obstacle Detection System, we intend to build a system which will help the visually impaired to move around safely indoors without relying on other individuals. Our target is to develop a prototype that is portable and user-friendly. While conducting research on the existing obstacle detection systems and learning about their processes, functionalities and drawbacks, we were able to select the approaches relevant to the system we have envisioned to build.

REFERENCES

[1] Alberto Rodriguez, J. Javier Yebes , Pablo F. Alcantarilla , Luis M. Bergasa , Javier Almazan and Andres Cela, “Assisting the Visually Impaired: Obstacle Detection and Warning System by Acoustic Feedback”, Sensors (Basel). 2012 Dec; 12(12): 17476–17496.

[2] Lazaros Nalpantidis, Ioannis Kostavelis, and Antonios Gasteratos, “Stereovision-Based Algorithm for Obstacle Avoidance”.

[3] Andreas Wedel, Uwe Franke, Jens Klappstein, Thomas Brox, and Daniel Cremers, “Real time Depth Estimation and Obstacle Detection from Monocular Video”. https://www.researchgate.net/publication/221113910_Realtime_Depth_Estimation_and_ Obstacle_Detection_from_Monocular_Video

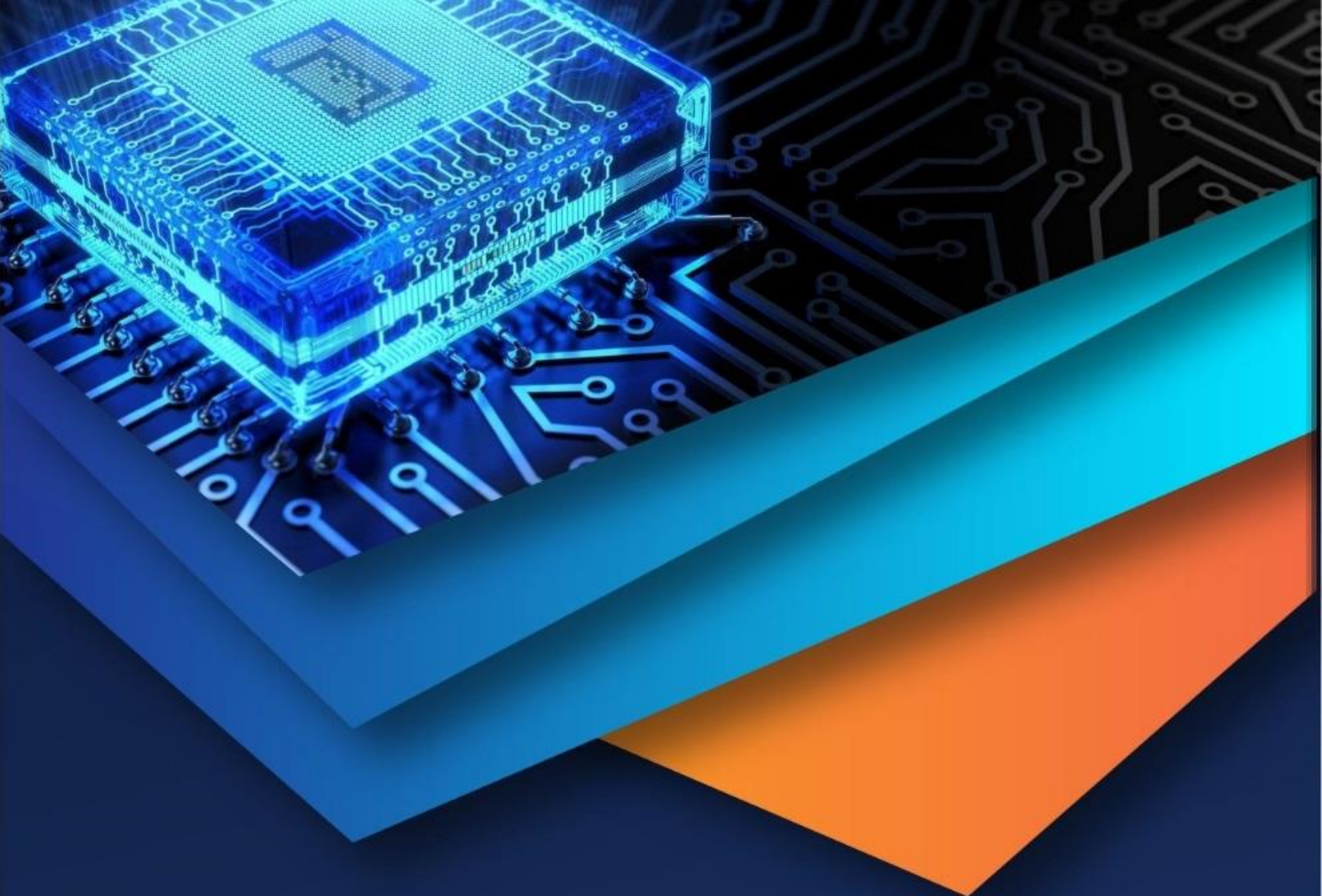
[4] "Visual impairment and blindness Fact Sheet N°282". August 2014. Archived from the original on 12 May 2015. Retrieved 23 May 2015.

[5] Rostam Affendi Hamzah and Haidi Ibrahim, “Literature Survey on Stereo Vision Disparity Map Algorithms”, Hindawi Publishing Corporation Journal of Sensors Volume 2016, Article ID 8742920.

[6] Anggi Gustiningsih Hapsani, Dahnial Syauqy, Fitri Utaminingrum, Putra Pandu Adikara, Sigit Adinugroho, “Onward Movement Detection and Distance Estimation of Object Using Disparity Map on Stereo Vision”, 5th International Symposium on Computational and Business Intelligence.

[7] Rostam Affendi Hamzah, Rosman Abd Rahim, Zarina Mohd Noh, “Sum of Absolute Differences Algorithm in Stereo Correspondence Problem for Stereo Matching in Computer Vision Application”

[8] http://mccormickml.com/2014/01/10/stereo-vision-tutorial-part-i



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