Smart Glass for Visually Impaired

Kriti Dubey[1] Chandra Kiran Reddy[2] Manvitha Raju[3] Rishab Bhattacharyya[4] Dr. B. S. Shylaja[5]
[1,2,3,4,5]Department of Information Science and Engineering
[1,2,3,4,5]Dr. Ambedkar Institute of Technology, Bangalore, India

Abstract— Smart Glass is a device which is a wearable spectacle that adds more information to what the wearer sees. These glasses are computerized with heads up display which collects information from internal as well as external sources. Smart glasses have all the features of Smart Phones like they support Bluetooth, Wi-Fi, GPS – which has an inbuilt function of an activity tracker which tracks the distance walked or run, calories burned and heartbeat count. Blind and Visually impaired people find difficulties in walking the street, which makes it dangerous. In this paper, the proposed system is based on a Raspberry Pi Module 3B, which acts as processor, to capture images through Raspberry Pi Camera to detect faces. The system detects and sends a warning message via an earphone. The experimental result achieved using the LBPH classifier is 85% accurate in face detection. The smart glass is economically friendly and user-friendly.

Keywords: Vision Impaired, Facial Recognition, Face Detection, Open CV

I. INTRODUCTION

The World Health Organization (WHO) estimates that 80% of visual impairment is either preventable or curable with treatment. This includes cataracts, the infections river blindness and trachoma, glaucoma, diabetic retinopathy, uncorrected refractive errors, and some cases of childhood blindness.

Although the term smart glass is understood as a glass which is technical advanced to enhance what the wearer sees. The actual definition of Smart Glass for Vision Impaired is a Smart Glass acts as a "robot eye" for the visually impaired person so that he can do his daily chores easily without any help from anyone.

The objective is to help visually impaired person be independent and provide a decent quality of life along with a safe and sustainable environment and application of 'Smart' Glass. The purpose of the Smart Glass is to improve the quality of life for blind person and providing assistance to the family members by enabling features like tracking via GPS, alerting the wearer when known faces are noticed by the glass.

The proposed system uses raspberry pi board from which it takes inputs from raspberry pi camera. The input is in the form of real time images what the wearer sees. The images are processed and faces are detected. Once the face detection is done the wearer is voice assisted via a message sent through the earphones.

II. LITERATURE SURVEY

In the paper Smart Eye Implementation using Smart Glass and Bio Chip – it is told that today the technology has advanced so much that it has built a prototype of human organ especially for eye known as "bionic eye" which has its own limitation and can be overcome via Smart eye or Smart Glass. This smart eye would give assistance to visually impaired, by a combination of software and hardware. The Hardware includes camera, audio and a biochip which is embedded with face detection algorithm.[1]

In another paper by Esra Ali Hassan and Tong Boon Tang, it is told that even if there are new aids or technologies available, they would be either very expensive ($3000 or 209000 or above) or they would be affordable ($200 or 14,000) but these affordable glasses have one or limited function. The wearable devices are found to be useful because they are hands free or requires minimum use of hands. Most popular type in smart glass is head mounted device. They are famous because the device points normally at the viewing direction, thus doesn't require any other additional instruction like other devices.

This paper presents a new design of smart glasses that can provide assistance in multiple tasks while maintaining at a low building cost. The design uses the new raspberry pi 2 single board computer, a camera, and an earpiece to convey information to the user. Due to page limit, we only demonstrate reading task only. The experiment results and how additional tasks may be added are discussed.

Hassan and Tang uses Simulink for image processing and also have implemented text recognition mode. The smart glass built by them is used for text recognition to help the visually impaired person read easily by using the famous Smart glass type – head mounted device. They used Raspberry pi 2 and camera to easily process the image seen by the wearer and convey the message through the earphone. [2]

III. METHODOLOGY

The Smart Glass consists of Raspberry Pi Module 3B which process the images caught by the Raspberry Pi Camera and gives the designed output through earphone. The two main features focused here is Face Recognition, Face Detection. To detect faces it uses OpenCV and Classifiers. These classifiers are pre-trained set of data which is in XML.

OpenCV Face detection provides algorithms that are used to detect, recognize, and analyze human faces in images. The ability to process human face information is important in many different software scenarios. Example scenarios are security, natural user interface, image content analysis and management, mobile apps, and robotics.

Face recognition based on the geometric features of a face is probably the most intuitive approach to face recognition. In this paper we have considered LBPH (Local Binary Pattern Histogram). The basic idea of Local Binary Patterns is to summarize the local structure in an image by comparing each pixel with its neighborhood. Take a pixel as center and threshold its neighbors against it. If the intensity of the center pixel is greater than or equal to its neighbor, then denote it with 1 and 0 if not the classifier will end up with a binary number for each pixel, just like 11001111. So, with 8 surrounding pixels the classifier will end up with 2^8 possible combinations, called Local Binary Patterns or sometimes referred to as LBP codes. [8]

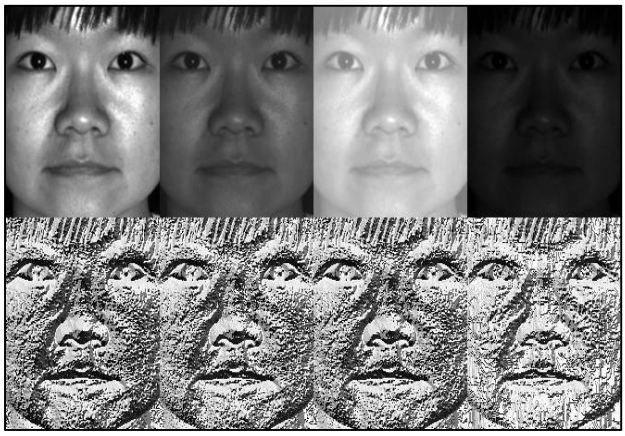

Fig. 3.1: Histograms of LBPH

In the Fig. 3.1 it depicts the Face Recognition using OpenCV with Local Binary Patterns Histogram (LBPH) classifier. LBPH face recognition is light and fast. The program runs the face detection algorithm. Program is trained with many face images. The images are first converted into grayscale and then trains the data and saves as a file which can later be used to recognize faces.

IV. Design and System Architecture

System architecture is a conceptual model that defines the structure, behaviour, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviours of the system. System architecture can comprise system components that will work together to implement the overall system. There have been efforts to formalize languages to describe system architecture collectively these are called architecture description languages.

The proposed system uses raspberry pi board from which it takes inputs from raspberry pi camera. The input is the real time images what the wearer sees. The images are processed and faces are detected. Once the face detection is done the wearer is assisted via a message sent through the earphones.

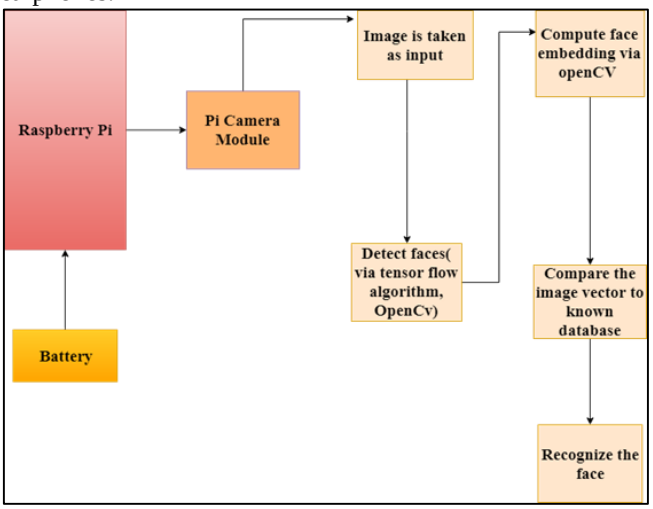

Fig. 4.1: System Architecture

The face detection process works as described below:

1) The RGB image is converted to YUV image and the Y (luminance) channel is extracted.
2) After the process we obtain the grayscale image.
3) Image is then moved to histogram equalization produces a normalized grayscale image.
4) The core of the detection is the Face Detection block, which is the processed by normalized grayscale image and performs actual face detection.
5) The image is then processed into OpenCV-PVL face detection user node to create output array containing detected faces rectangles array.
6) OpenCV is used to visualize face detection result.

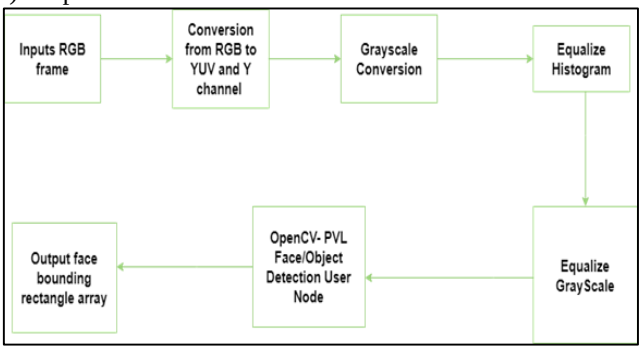

Fig. 4.2: Flow Chart on how face detection works

V. Result and Analysis

A. *Running the Program through the Software:*

In the fig 5.1.A the face which is detected have the region of interest which is used to compare with the recognizer model if the face is matched, the face label is voiced out.

If the face which is detected for a consecutive 4 frames, it checks if the frame is increasing or decreasing according to which voice assistance tells the person that the face detected of a person is approaching or moving away.

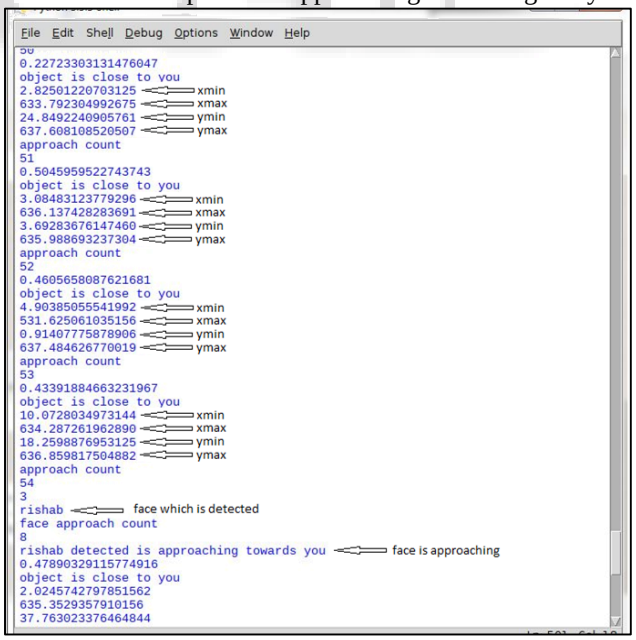

Fig. 5.1: A. Snippet from initiating software

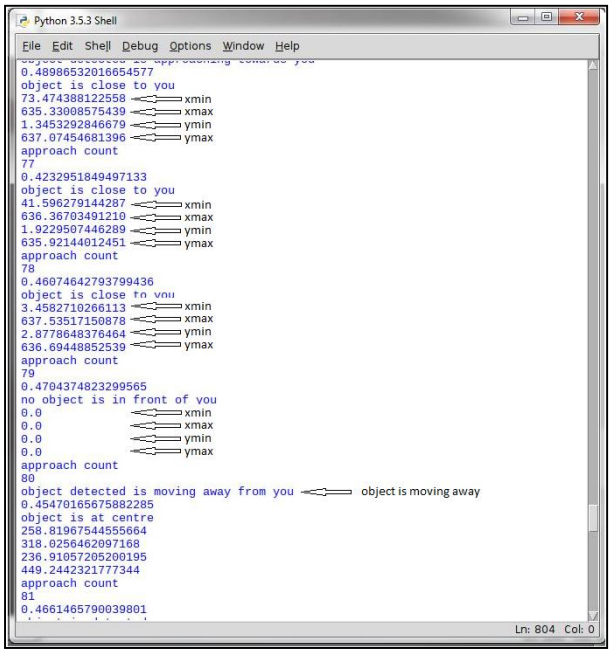

Fig. 5.1: B Snippet from initiating software

In the fig 5.1.B, the face which is detected have the region of interest i.e. x_{min}, x_{max}, y_{min}, y_{max} which is used to compare with the TensorFlow model. If the face is matched, the face detected is voiced out.

If the face which is detected is detected for a consecutive 4 frames, it checks if the frame is increasing or decreasing according to which voice assistance tells the person that the face is moving away.

B. Face Detection through the Glass:

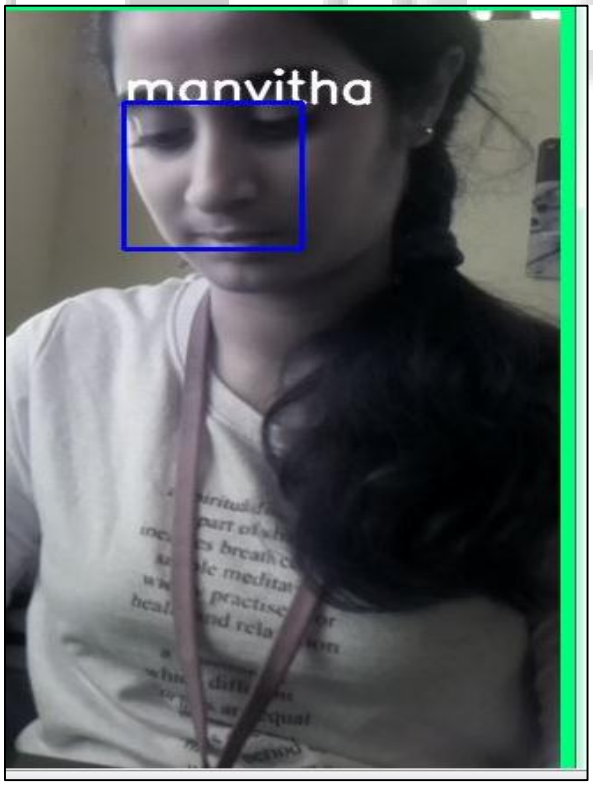

Fig. 5.2: Face Detection and Face Recognition of a known person

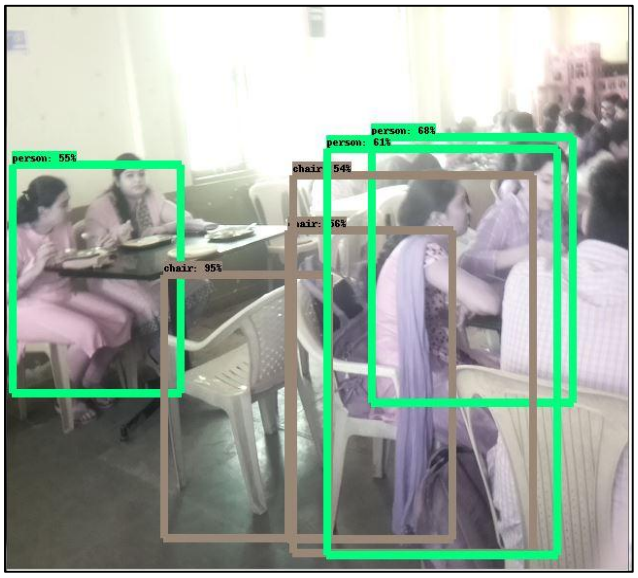

Fig. 5.3: Face detection of unknown face is done by the camera.

VI. CONCLUSION AND FUTURE SCOPE

The System presented a new combination of a low-cost Raspberry Pi based speech warning message via voice feedback system that allows the users to explain surroundings by detecting faces in real-time. It could be used to identify the presence of obstacles in the visual scope of the user for safe navigation in a crowded environment. The proposed system achieved both high accuracy and fast response. Experimental results show that our approach achieves high accuracy on face detection tasks for real-time testing with the visually impaired. Also, the system provides navigation and GPS tracking which makes it convenient for visually impaired person to walk. In addition to being of reasonable cost, light weight and fast software processor.

The project can be implemented and extended further by enhancing the design and make it lighter and easier for the wearer, that is the user to wear it easily without any difficulty. The software will be upgraded by implementing the latest technology to ensure the safety of the wearer. The project would be made friendlier for the wearer to ensure one can easily work without any difficulty. The voice assistant would be upgraded and simultaneously other features would be added to the device. A new processor would be built to enhance the speed of the processor. The application would be updated to ensure the guardian could track their wearer easily.

REFERENCES

[1] Smart Eye Implementation using Smart Glass and Bio Chip Akshay Vartak, Saurabh Ranjane, Dr. Suhasini Vijaykumar MCA Department, BVIMIT, India, MCA Department, BVIMIT, India, MCA Department, BVIMIT, India, IOSR Journal of Computer Engineering (IOSR-JCE)

[2] Esra Ali Hassan and Tong Boon Tang, "Smart Glasses for the Visually Impaired People", https://www.researchgate.net/publication/304802688_Smart_Glasses_for_the_Visually_Impaired_People, Published July 2016 [Accessed 10-10-2018]

[3] "Project Prakash", https://nei.nih.gov/news/scienceadvances/discovery/project_prakash.
[4] Rohit Sheth, Surabhi Rajandekar, Shalaka Laddha and Rahul Chaudhari (2014). American Journal of Engineering. [Online]. 03(10), pp-84-89. Available: http://www.ajer.org/papers/v3(10)/L031084089.pdf
[5] G. Gayathri, M. Vishnupriya, R. Nandhini, Ms.M. Banupriya (2014, March). International Journal of Engineering and Computer Science. [Online]. 03(03), pp-4057-4061. Available: http://ijecs.in/issue/v3-i3/8%20ijecs.pdf
[6] Sarah Griffiths and Fiona Macrae. (2014, June). Smart glasses for the BLIND: Display turns the world into outlines to help people with poor vision 'see' obstacles and faces. [Online]. Available: http://www.dailymail.co.uk/sciencetech/article-2659993/Smartglasses-BLIND-Device-transforms-world-outlines-shapes-help-partially-sightednavigate.html
[7] Steve (2010, Dec). HALO-Haptic Feedback System for Blind/Visually-Impaired. [Online]. Available: http://www.polymythic.com/2010/12/teaser-haptic-feedback-for-visuallyimpaired
[8] OpenCV Face Recognition Documentation, https://docs.opencv.org/3.4/da/d60/tutorial_face_main.html

