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Blind Assistant

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Abstract:- Vision is essential for human being to sense the world. In case of survival it is indispensable. Unfortunately, there lot of people live with vision impairment throughout the world. They are facing lot of challenges daily to survive in the world. Project blind assistant is to provide some sort of support to blind people through computer technologies to overcome their challenges.

The project is about to provide a blind assistant mobile application build up with the combination of image processing and sound recognition technologies. Even though there is lot of blind assistant products in market, they have failed to reach visually impaired community. So, we have done series of literature reviews on already existing products to identify obstacle in build up a successful blind assistant product. Those analyses helped us to install the blind assistant product. Machine learning, Image processing, Sound recognition technologies assisted in the implementation of the product.

This product will help the blind people to identify roads, road signs, vehicle and other road side objects and guide the blind through voice output. The project focuses on challenges face by blind in road side scenario and provides solution to overcome those challenges. The product is a mobile application which could be handled by blind easily.

Keywords:- *Machine Learning; Image Processing, Sound Recognition, Vision Impairement.*

I. INTRODUCTION

Vision is related with sensing with eye. Continuously there are ongoing process such as organization, identification, and interpretation of sensory information to sense environment. Eyes are the principal organs of the visual field. They enable visual sensory data to be received and processed.

Sound is other important sense which will related with process of identification and interpretation of sound around environment. Ears are main organs in hearing. Ears have the ability of sensing sound waves. Identification and interpretation of sound waves happen with the aid of brain primarily in temporal lobe.

Sound and sight are interlinked with each other. One will ensure the reality of other one in case of blindly situations. Five senses are very much important perceiving the world reality. Out of them sound and sight take much part.

Our world revolves around the preciseness of the five senses. Loss of any one of the senses will create chaos in one's life. Out of five senses vision is far most important in survival as we deal with large scale of visual sensory information on daily basis. Visual impairment is a decreased ability to sense the light to a degree. Globally, around 1.3 billion individuals are estimated to be living with some type of vision loss. 36 million of them are blind [1]. Vision loss will create major impact of people's daily activities. They need to depend on others for their survival. There are lot of blind people who did great achievements by overcoming these struggles, but they are less in number when compare with millions of blind communities. So, it is our responsibility to assist blind people in whichever way we could. Evolution of braille letter, blind sticks, sensor technology, and medical science provide a lot of assistance to blind in perceiving the visual world.

Computer technology also evolved to assist blind through various object detection technologies and algorithms. The project also focuses on assisting the blind people with the help of image recognition and sound recognition technologies. Image processing is a procedure of extraction of image features suitable for computer processing where image acquisition will be carried out by an image capturing devices equivalent to eye in natural phenomena. Identification and interpretation of images will be done through series of enhancement, segmentation and extraction processes.

Sound recognition technology able to identify and interpret various sounds through data processing feature extraction and classification algorithms. Both sound recognition and image processing technologies will be combined to identify an object accurately. In some situations, we need to guess the object based on the sound. This idea is installed in our system to provide better perception.

This project focuses on road side scenario specially travelling through pavement, identification of road signs, vehicle detection and location identification. The application can provide instruction to end user through the voice output. The System main goal is to capture the image from the video stream using camera mounted in spectacle and surrounding audio with microphone and send it to mobile phone for further processing and instruct the blind via earphone. The system is dividing into four main components such as sign board identification, Assist along pavement, Vehicle identification and location identification.

II. RELATED WORK

Visually impaired people desperately need help with mobility because barriers can cause injury. There are already several techniques for offering visually impaired mobility assistance, ranging from human assistants to contemporary appliances.

In past years, several types of research have been taken on removing obstacle of visually impaired people. Throughout, the time computer technology influenced in research for assisting blind people. Image processing technology has been playing much role in object detection in such researches. Many research projects and technology proposals are continuously appearing in order to detect objects accurately.

Project researched by Gude, M.Osterby, S.Soltveit concentrated on individuals with blind and visual impairments and created a concept to help them navigate indoors and outdoors and identify items in an environment. This project used as a virtual eye (VE) streaming video device used to browse the workplace. Computer technology interprets the video stream to recognize the object and to calculate its distance. This can be done by tagging "Semacodes" items. Decoded data is sent to a device that can generate braille that must be held by the individual. This way, the braille device provides him with data that helps him interpret the world around him. [2].

Project researched by Chucai Yi Roberto W. Flores Ricardo Chincha YingLi Tian Is a camera-based system intended to help blind or visually impaired individuals discover their daily requirements. This suggested scheme will identify objects on a camera-based network and on corresponding-based recognition. Here data sets of daily necessities have been gathered, and Speed-Up Efficient Functions and Scale Invariant Feature Transform feature descriptors have been used to conduct object recognition. Multiple camera system is constructed by putting a camera at key places in the enclosed environment of a blind user's daily routines. The cameras supervise the situation around these set places and tell blind people of the places of their requested products. Matching-based image recognition is conducted throughout this phase to locate items. Then the program will submit the most comparable item, even if it matches the length, and advise the blind person to get near to its place. Later, the camera connected to the disabled person will conduct more identification to confirm the presence of the requested item.

Muhammad Sheikh Sadi, Saifuddin Mahmud, Md. Mostafa Kamal, Abu Ibne have proposed a solution for blind individuals to navigate securely by identifying the barrier and producing the associated warning signal as per the range of the barrier. The approach is given by the development of a moving assistant integrated in a spectacle glass between a barrier detection unit and also an alarm generator. There will only be one ultrasonic sensor in the barrier detection unit that can reach a range of 3 meters as well as an angle of 60 degrees to spot barriers. The barrier detection unit produces a large-frequency signal across an ultrasonic sensor and evaluates the signal return back by the sensor. Therefore, the length of the barrier is evaluated and so this data about the barrier is transmitted to the blind through the use of an alert generator that produces an alarm equivalent to the range.

Umer ,Kumar, and A. Shubham Melvin Felix. Veeramuthu has been researching a solution implemented via Android's mobile app that focuses on voice assistant, image recognition, currency recognition, e-book, chat bot, etc The app can help in recognizing objects in the environment by using a voice command, perform text assessment to acknowledge the text in the hard copy document It will be an effective way for blind individuals to communicate with the environment using technology as well as using the technology's equipment [5].

Md.Siddiqur Rahman Tanveer, M.M.A.Hashem and Md.Kowsar Hossain have proposed a project which could help the blind person by tracking his movement and helping to rescue him if he is lost. Blind person is navigated with spectacle mounted android application. Latitude and longitude collected using GPS sends to server. Another application could track the movement by getting response from server. In the system Obstacles are informed by using voice output to guide the blind. Ultra-sonic range

finder has been used to detect position of the obstacle and to measure the distance.

Prince Bose,Apurva Malpthak,Utkarsh Bansal,Ashish Harsola have proposed the system to assist blind in using internet or digital form of information with the help of voice assistant system instead of braille displays and keywords. Audio input will help to blind access e- mail, daily news, weather forecast and maintain notes.

Vincent Gaudissart, Silvio Ferreira, Céline Thillou, Bernard Gosselin have researched to provide textual information to blind or visually impaired people as voice output .An embedded device is used to read textual information in day to day activities such as banknotes, schedule of train books, postal letter .Here the image taken by the embedded camera is sent to image processing module and text to speech module and then synthesis the information to user [8].

In most of the existing projects augmented reality and sensor technology were used to detect obstacles in front of user. Some research has been done on image processing, but they are all about how to assist blind in indoor activities such as detecting daily utile, currency, reading book, house hold items and so on. Project researched for outdoor activities are commonly based on sensor technologies where obstacles and its distance will be detected but details about object were ignored and, they are in some way costly.

Earlier researches done based on image processing have limited accuracy in critical situations such as identifying far away vehicles, vehicles hidden from view by factors such as decorations and banners and vehicle being fake due to image illusion. So, this research views an object as a combination of sound and image where one will ensure the reality of other one. This project has been carried out with an idea of combining image processing and sound recognition technology in identifying some objects such as vehicles, people, and signs to improve the accuracy of blind assistant product.

Many devices implemented using Image Processing or some other technologies like sensors for the visually impaired people. But these devices don't have traffic sign detection features. The goal of this part (Traffic sign detection) is helping the visually impaired people who are mostly struggling while crossing the road. In normal situations they can act independently with the help of their White Cane. Only in situations like crossing the road, finding a bus stop they depend on a third person and they must ask whether there is a zebra cross or bus stop. So, this device has the feature of detecting the traffic signs and alerts the user.

Detecting the obstacles is not only enough for a blind to avoid injuries due to obstacles as they don't know where this obstacle is in. So, the system is using ultra sonic sensor to calculate the distance of obstacle from the blind. Ultra-sonic sensor sends signals from its transmitter and receives back the signal after it collides with an obstacle. Distance can be calculated using the signal travelling time.

The image taken from the camera may not be a clear image. It may be a distorted, blurry, noisy image, dark or in any form that cannot be used for identification of obstacle. Using unclear image may cause wrong assistive to blind. So, this system has better pre -processing mechanism to enhance the quality of image and obstacles should be identified based on ML model. Therefore, effective and efficient machine learning algorithms has been used to predict obstacle accurately.

There have been researches done on vehicle detection based on sound, but they are not incorporated with devices related to assisting blinds. This research has proposed the idea of combining image processing and sound recognition in the vehicle detection process to increase accuracy. In real time humans are detecting an object with the help of five senses. In subtle level these five senses are interlinked to perceive the object accurately. Out of five senses sight and sound are playing major roles in object detection. Based on above process the idea of combining image processing and sound recognition technologies to detect vehicles has been proposed.

Vehicle sounds are complex and can be influenced by various variables such as the type of car, gear, amount of cylinders, selection of mufflers, maintenance status, operating velocity, distance from the microphone, tires and the highway the car is traveling on. Vehicle sound noises have been removed to enhance car detection effectiveness.

Vehicle sound has many attributes, loudness, energy of sound, pitch and wave length. These attributes need to be analyzed to detect vehicles. Effective and efficient machine learning algorithms have been used to predict vehicle accurately. Datasets have been created by capturing vehicle sounds from environment. After removing noises from audio features of audio has been extracted and stored.

Microphone has been installed to receive environmental sound. Vehicle detection will be done in real time. In real time, input audio data will be processed and compared with trained models. Output result will be combined with image-based vehicle detection output and result should be delivered to user as voice output.

III. ARCHITECTURE OF THE SYSTEM

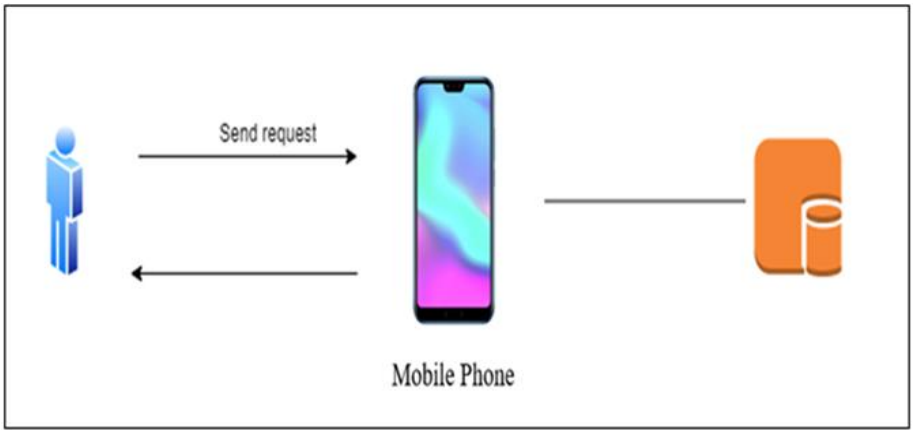

Fig 1:- High level Architecture

IV. METHODOLOGY

First requirements were collected by having conversation with the blind people. After that several research papers were read and related project ideas, technology stacks and nonfunctional requirements are perceived and analyzed with the blind people's requirements. After that new system was proposed which can satisfy blind's basic requirement and more efficient in every aspect.

Before start to implement the coding phase, requirements were checked with the possibility regard with time, cost and scope and high-level architectural diagram was drawn to give the direction to finish the project successfully. Then research parts were studied well by the team and technology stacks and tools were identified which are as follows:

1) Adroid Studio
2) Colab
3) Tensorflow
4) Ultrosonic sensor

According to our proposed system main functionalities are as follows.

1) Detect the obstacles and vehicles.
2) Vehicle Detection based on Vehicle sound
3) Measure the distance between object and person.

1) Detect the obstacles and vehicles.

To detect the vehicles and obstacles, datasets are preprocessed and trained in COLAB using RCNN. As normal laptops didn't have enough GPU, Google COLAB had been chosen as it is a cloud-based data science workspace. After that trained models were converted to tensor flow lite model as it is designed specific for mobile devices.

2) Vehicle Detection based on Vehicle sound

a) *Extraction of Features of Audio and Audio Dataset Creation*

Audio Dataset has been created by obtaining sounds from environment. Noise of the input sound has been cleared and features of audio such as amplitude, decibel value have been extracted and stored in csv file. In such a way audio dataset has been created.

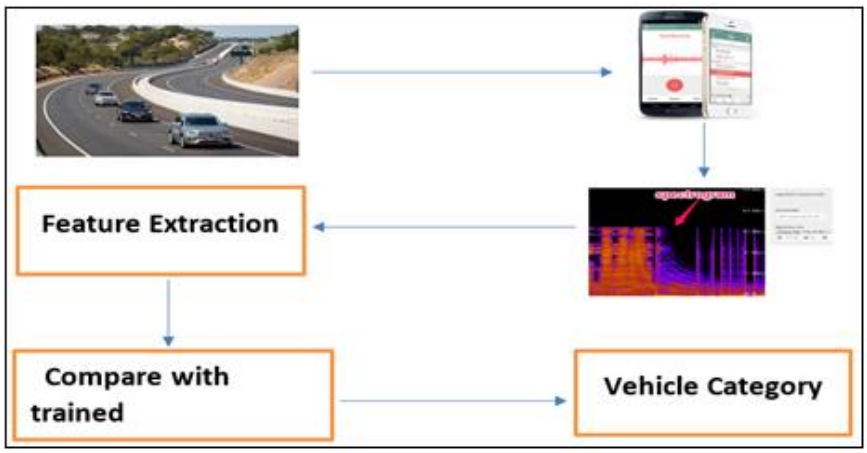

Fig 2:- Detection of Vehicle based on Vehicle Sound

In Real-time audio will be obtained through mobile microphone. Thereafter features of audio such as amplitude, decibel value will be extracted and stored.

When an audio is received by the system sampling frequency and sound object will be read from it and stored. Then the audio file data type will be read out. As, the system recognize only stereo type audio file. So, if it received mono channel audio file, then it will be converted in to stereo channel audio file. Amplitude will be extracted from the sound object and stored in csv file.

Researchers suggest amplitude and decibel values are useful in sound recognition [9]. STFT (Short Term Fourier Transform) will be used to produce frequency array from sound input. From frequency array the decibel value can be found using logarithmic equation.

$$dB_p = 10 * \log\left(\frac{I_{sig}}{I_{ref}}\right)$$

Many amplitude and power of the sound will be generated each second. So, mean of the amplitude and power needed to be found to analyze vehicle sound.

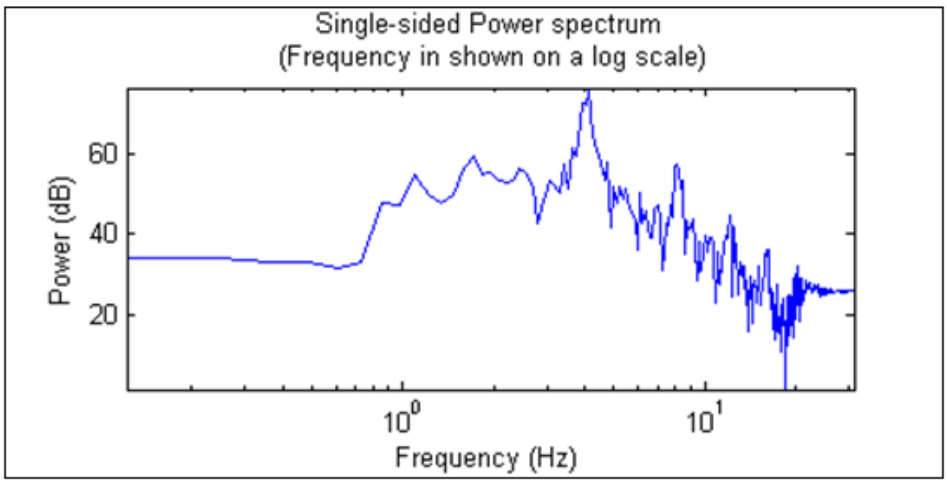

Fig 3:- Decibel vs Frequency graph

b) Audio dataset training and object detection

After creation of audio dataset, system has been trained with those datasets by using machine learning algorithms. By using random forest algorithm, system has been trained with datasets obtained as samples. The features extracted from new audio input will be compared with the trained model. Output result will be sent to main system for further processing where output result will be used to detect vehicle by combining image processing-based vehicle detection techniques.

3) Measure the Distance between Object and Person.

Using ultra-sonic sensors, the gap between the individual and barriers is recognized by evaluating the time taken to move from the senor by ultra-sonic waves and returning to the sensor after striking the barriers.

Finally, all the components were integrated within android studio and using Google's voice API outputs are generated as an audio respect to the mobile camera streaming.

V. RESULTS & DISCUSSION

In Main goal of the system is assisting blind in roadside scenarios like walking in pavement, waiting to board a bus or three- wheeler, get information about current location. The System contains four main components such as sign board identification, Assist along pavement, Vehicle identification and location identification. A blind person could access the different features of the system through voice command. Response from the device is delivered to blind person as a voice. The device is a mobile application.

The system captured and detected the Traffic Signs, Pavement obstacles and Vehicles (bus and three-wheelers). These raw data are analyzed by image processing and extracted. Extracted data are compared with the ML models for detecting the object and result is converted to audio output.

If blind person needs to detect a bus or three-wheeler, he could access the feature of vehicle detection through voice command. The device is using image processing and sound recognition techniques in detecting vehicles. Therefore, vehicle could be detected from video received through camera and the sound of the engine received through microphone. Results from both detection techniques are combined to give accurate prediction about the vehicle. Detected vehicle details are delivered to user as voice output.

Vehicles are detected from engine sound through series of sound recognition techniques. System is trained with created datasets through machine learning algorithms. Features extracted from vehicle sound which is gathered in real time are compared with trained data sets and vehicle is predicted. Output result is sent to main system for further processing where output result is used to detect object by combining other object detection techniques.

Vehicle detection accuracy is increased by combining image processing and sound recognition technology. System detects the category of vehicle whether it is bus or three-wheeler based on vehicle sound. Meanwhile, vehicle is identified from video input receive from surrounding environment. In such situation, both identifications is combined to provide final result which is more accurate. Even though result predicted only from video input or audio input in separate instances is less accurate, Vehicle detection from sound acted as supplement to the vehicle detection from video and vice versa in case any of the detection method was failed.

VI. FUTURE WORK

In future System will be enhanced to reduce response time and identify obstacles and other objects more accurately. And, system will be upgraded with night vision. Furthermore, system will be developed as a device using suitable hardware specifications (wide angle camera, stabilizer, mic) etc. Backend will be deployed on a server as it could facilitate the user to give assistance to more objects and to make user to easily upgrade new features without troubling. As for now, Bus and Three-wheeler are concentrated on vehicle identification process. In future project could be expanded to all sorts of transport vehicles.

VII. CONCLUSION

Project goal is assisting blind in road side scenarios like walking in pavement and boarding a transport vehicle. System provides features like sign board identification, assist along pavement, Vehicle identification and location identification to achieve the status of perfect blind assistant product. User could access the above features through voice command which provides ease of communication between user and device. Vehicle detection accuracy has been increased by combining image processing and sound recognition technology. System could detect the category of vehicle whether it is bus or three-wheeler based on vehicle sound. Meanwhile, vehicle could be identified from video input receive from surrounding environment. In such situation, both identifications will be combined to provide result which is more accurate. In all instance's user will be instructed through voice output.

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