VIEW FOR THE BLIND

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Abstract

A Cure for blindness is one of the most sought and most necessary inventions in today's world. There are various technologies such as Surgery, Stem cell Therapy, Corrective lenses, and Technical Devices that are being used in providing a partial cure for blindness. Though a complete cure is not found yet. Therefore there is a need for a trusted and automatic classification technique that is essential for helping the blind with their everyday life. With the of high quality technologies available, a device can be designed to assist the Blind with their vision. Image processing and Sonar are some of the major technologies used for this cause. But the classification of objects and navigation becomes difficult in outdoor environments as the objects to be classified vary depending on the location. While navigating indoors can be achieved with the help of image processing. In this paper we present an affordable solution to help blind people navigate indoor environments. Our solution performs image classification on a Raspberry Pi and provides feedback to users using Audio Assistance. Images at n frames per second can be sent as the input to object classifier.

Keywords*:* Wearable sensors, Object Detection, Image Classification, Sensors, Cameras, Handicapped aids, Visually Impaired People

I. INTRODUCTION

The ability to navigate from place to place is a significant part of daily life. Human beings process the world around them mostly via the sense of sound and vision. It is a general belief that vision plays a critical role, but many would have great difficulty in identifying the visual information they use, or when they use it. We find it easy to navigate in extremely familiar places without the sense of vision. This is possible mostly due to muscle memory. This can be experienced in examples such as going to the bathroom from your bedroom in the middle of the night. But only a minority of people have experienced navigating large-scale, unfamiliar environments without the aid of their eyes. Consider trying to catch a train in Bandhra railway station blindfolded at peak hours. Yet, the visually challenged travel independently on a daily basis. To facilitate safe and efficient navigation, blind individuals must acquire travel skills and use sources of nonvisual environmental information that are rarely considered by their sighted peers. Their sense of smell and their hearing are very sharp, as they rely a lot upon these senses. They also take to feeling the environment around them. This is harmless in the confines of a home. The purpose of this Device is to provide some of the navigational technologies available to blind individuals to support independent travel. With advancement in technology a lot of navigation systems have come up to aid the visually impaired. However, they remain inaccessible to many. Often, they are simply too expensive. In this context, we propose a smart system which will help the blind navigate easily. The system is low cost and would be focusing on blind navigation in large-scale, unfamiliar environments. The technology discussed can also be used in well-known spaces and is also useful to those with low vision. Additionally, it can also be used by people with both low vision and low hearing ability.

II. RELATED WORKS

A falling detection system has been designed by Wang Rong [1] et al. has provided a solution to detect elder people's movement. Also, as a risk warning service, the falling detection system can be used to protect blind and visually impaired people and alarm their family when abnormal events happen. Kaiming He [2] created a method to detect objects in images which extends Fast R-CNN named Mask R-CNN . Girshiek R [3] also created a Fast R-CNN with Computer Vision and Image Processing closely resembling that of Kaiming He. The object detection technology can help a blind group to know what appears in front of their walking direction well.

Another system is called intelligent electronic eye for visually impaired people [4]. The visual data from the surroundings is collected by using image and obstacle sensors. It will be processed by an AVR micro controller and necessary voice information is provided. The electric power for this unit is availed through solar photo voltaic module, piezoelectric source and also from electricity generated from body temperature. An ultrasonic sensor based system is proposed in [5]. In this paper, an ATmega2560 based on Arduino Mega 2560 is used for the object detection and distance measurement. Objects/staircase detection and distance measurement is performed by this system.

In the paper Computer vision guidance system for indoor navigation of visually impaired people [6], it is mentioned that indoor navigation help can be provided to blind by using mobile application and the remote processing computer.

III. PROPOSED SYSTEM

One of the major disadvantages in providing navigation assistance to the blind is the variety of obstacles to be identified. Obstacles such as a table, a tree or some other stationary object needs the user to move in a different direction. Obstacles such as Stairs or a log on the path needs to be step over. To identify the various types of Obstacles, Object Classification is used. And a navigation assist is provided based on the object classified. This is achieved by using text to speech conversion on the obtained result. Another disadvantage in the existing systems is that they are not affordable to all the people in need. The existing systems are either too costly for a common person or not available nearby. This system deals with that disadvantage by being affordable by most with a design that works without accessing the internet.

The Proposed System works by Capturing an image using Rasp PI Camera Module, Preprocessing it to fit the classifier, and Processing the image to classify the object and Provide navigation result based on the object. This result is the converted into speech using TTS, and is sent to the speaker attached which will provide the audio assistance to the user.

The Image Capturing is done at a rate of n frames per second and each frame is processed to provide assistance. The captured image is stored in external memory card attached to the Raspberry PI controller temporarily in JPEG format. The image is verified for the size accuracy to match a BitMap. Then this image is sent for preprocessing to the controller where the image undergoes noise reduction and elimination. After the noise removal operation, the image is converted to a BitMap equivalent. This Bitmap image is used in all further operations.

The processing stage involves detecting an object, classifying the type of object, and Providing navigation based on the type of the object. To categorize objects into different types accurately, the classifier model has to be trained with the objects of all category. The model is created and trained using tensor flow library. The training data is gathered from different environments allowing the model to be accurate in its detection and classification. The classification of object using the probabilistic values is done in the softmax layer by applying activation function. The several layers of convolution plus RELU and the pooling layer finds a way to learn the features by filtering along with loss function. The proposed system classifies the objects into movable and immovable Objects. In an immovable condition a assistive navigation is provided to the TTS. Once the model is trained it learns about all the types of Objects and has the capability to classify the input image. In the testing phase, the model is tested with the test data, the model learns the features and classifies its type. The end result is that the given image is classified as movable or immovable and if it is immovable the system provides an assistive navigation to the user to move in the direction free of obstacles.

In the case of Immovable objects, the navigation is generated by requesting the user to look for a direction without obstacleand once found the navigation is provided.

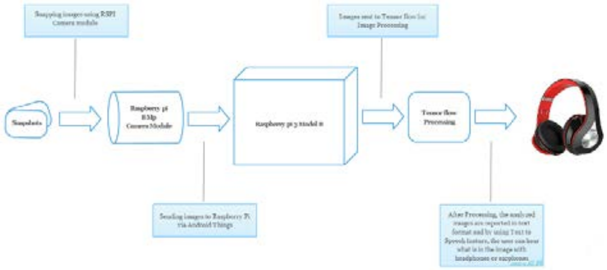

Fig 3.1 Block Diagram

This navigation is sent to the TTS module. The TTS converts the incoming string into utterances and stores them in order in an indexed map. This map is used to convert individual utterances into audio and these audios are sent in the same order to a queue of assistive navigation to be provided to the user. This queue is accessed by the speaker which is constantly looking for input. Hence the assistance is provided in the order of generation i.e., the second navigation assistance is added to the queue only after the first assistive utterance is added.

Additionally, a helper file is added to load the set of objects lazily that can be classified by the device. The file fetches the type of the object from the trained model from the external card only when the object is not detected before. This enables the classifier to react efficiently. Further efficiency can be achieved by using a GPU unit with the controller and tuning the model to use it instead of the controller processor.

Algorithm overview

Step1: Provide the input image (from Camera module) into the convolution layer.

Step2: The parameters are chosen to apply filters accordingly and perform convolution.

Step3: Apply the RELU activation function.

Step4: Pooling is performed to reduce the dimension.

Step5: The steps 2 to 4 are repeated until satisfied.

Step 6: The output of the previous steps is fed into the fully connected layer.

Step 7: Softmax activation function is applied to the result of the fully connected layer and output the class after classification.

Step 8: Based on the output the navigation is generated and fed to the TTS speaker

Step 9: The navigation is converted into audio and it is provided to the user

IV. RESULT AND DISCUSSION

The performance of the generated model is analysed using graphs of accuracy and loss metrics with both training and validation datasets and the performance of the model is improved accordingly. The final rate of accuracy is noted. The improved model is used to classify the images and the result of the classifier is fed to the speaker to provide assistance to the wearer. The user is also provided with navigation with respect to the result of the classifier.

V. CONCLUSION

The main aim of this paper is to provide an affordable yet accurate solution to the navigation problems faced by the visually challenged. Conventionally Object Detection and classification was tested using internet images, OV7670 camera module for arduino, and JavaCV. The computational time and accuracy of classifying objects was less than expected. Therefore to increase the accuracy and to reduce computational time, Convolution neural network was used for classification using tensor flow. In this method the results are classification of the objects and the respective navigation techniques. The feature were extracted using CNN.

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