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Assistive System for Visionless Earthlings using ML

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Abstract: This is a unique system that functions as a voice assistant for visually impaired persons. This system is used to assist the visually impaired in accessing the phone's most vital capabilities while also improving the system's quality through the use of bespoke layouts and text-to-speech. The object detection system employs tensor flow object detection techniques, in which an android application detects obstacles and guides the end-user via voice alert, providing information such as the distance between the object and the person, as well as the object's direction [left, right, or middle]. All in all, the System is a voice assistant for whatever action the user has taken with a custom app while using data from the default app.

Keywords: Visually challenged, object detection, distance of the object, direction of the object, voice output.

I. INTRODUCTION

Vision is one of the most important asset for every human being. Even though people have jobs, cars, money, home but without vision they would be still considered poor. Lack of vision is like hidden poverty. Visually impaired people use their own style for doing things so that they lead a normal life. They face many problems because the infrastructure will be not easily accessible and they face challenges in the society as well. Among many challenges the visually challenged people face a biggest challenge of Moving around places. Since they will be knowing the exact positions of every objects in their own home they can roam around their home easily. The visitors to their home and the ones living with them should make sure they do not move things without telling the Blind person.

With the help of touch sensitive tiles, the commercial places can be easily accessible for visually challenged person. But this can't be available in many places and it will be biggest problem for blind. Visually challenged people would face problems when they overly rely on other individuals even though they may get helped because of kindness from people around. For detection of objects the android application is developed in the system. The smartphone's camera is used to detect objects in front of the user. TensorFlow lite object detection techniques are used by the application to detect the objects. The application also provides an audio message to the user which includes the name and location of the object. Object distance and object direction with respect to user's position will be contained as location in formation. The speakers or earphones are used to give audio message to the visually challenged person. Since the smartphone is used there will be no need of any external camera to perform the mentioned processes.

The main objective of this paper is to showcase how computer vision technique like detection of objects can be used to assist visually challenged to travel without being dependent on others and also to give the models, functions and overview of the assistive android application for blind.

II. EXISTING APPROACHES

Several systems have been designed in such a way that almost all of the objects inside the house are attached with Radio frequency identification tags, or RFID tags, and all of the data related to the objects, as well as an audio clip, is stored in the computer's database, and the user is provided with an RFID reader, which scans the tags that are in close proximity to the user and plays the appropriate audio clip.

Another solution is devised with a camera attached to the cap, which they refer to as a smart cap. For processing the camera footage to detect objects, they employed Raspberry Pi as the underlying hardware. Using earphones, the user will be told about the things. The system's disadvantage is that it consumes too much power. It necessitates the use of additional power banks in order to function for an extended period of time, and it is also costly.

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A system in which a camera is attached to the stick. It is built in such a way that it recognises people's faces and their distance from the user. The disadvantage is that it is unable to detect items in its immediate vicinity.

Another system that increases the use of traditional white cane by the visionless individual for the purpose of roaming indoor areas. Front-end user depth data is obtained using a Microsoft Kinect sensor that is mapped to the pattern display map. The system uses the information with the help of neural network to remove related features from the scene, allowing for the identification of potential obstacles along the way. The pattern type presented as input is properly distinguished by the results of neural network.

Another system uses ultrasonic mixer sensors that work primarily in the goal of Ultrasonic sound production and warning method. The system however has two responses that are does it have an additional vibrating response mechanism. This enhances the overall response received by the blind user who gets the results made with the various properties of high, low, medium vibration and strong vibration. This Unit provides a complete limit of the proposed activity it was far away. With various devices to detect obstacles available and GPS emerges as the most popular technology in blind navigation kit, necessary to provide general assistance to the visually impaired environmental information to make roaming safer and you are safe. This unit is built to receive data from environment, data integration and the required information required by the blind is provided user. The user receives an alert vibrated by the unit in finding obstacles. The user then translates these vibration based on their location so they know your location obstacle

An in-depth measurement process was proposed that did not involve user intervention from a single image and was requested for its application to assist the visually impaired. Obstacles in this pre-user space are pre-divided without user intervention and depth is estimated for each of these constraints based on spatial assumptions that are determined by determining the position of the disappearance point. This method has revealed location details of the size associated with the location of the barriers from the user rather than just favouring the obstacles. Nor does it require previous user details or surrounding space like the height of the user by helping the visually impaired. The method does not use any natural learning process and thus is independent of the surrounding space. It can therefore be used in familiarity with unusual places. In addition, the proposed method is found to be compatible with real-time use as it does not use US sensors. Or a difference in depth details within the same barrier can be found, the proposed system may fail to capture the deep suspension between small adjacent sections in the same contact barrier. Therefore a graph-based subdivision can be requested to separate subdivisions into the same barrier

The another system includes the combination of the various modules and their functions and delivers visually challenged with a multi-purpose device. The device has a unique design that facilitates usability and portability. The device makes use of GPS to monitor continuously the current location of the user. The device also warns when any obstacles are encountered. Based on previously stored photographs it also identifies the people around. The device is easily carried in pockets thus helping the user getting rid of long metal rods. The clarity of the output is very high since it is provided over earphones as voice commands. There is no requirement of internet connections since all the data is entered into the system previously. So this can be handy when there is no availability of internet connection throughout the cities. This device is very easy and simple to use because it does not use touchscreens

Another system is focused on object detection. The system is portable. The system is placed on a chest of the person. The Camera connected to the Raspberry Pi captures video of the scenario and this is the case converted to standalone by the processor. The user provides speech commands when they need the item. Speech input is recognized and the user is lead to the object by the system with the help of voice output.

Another system consists of a smart and lightweight glass system for visually impaired people. We have shown how smart glass is designed, including hardware design and software development. And we used a lot of the best image processing, object recognition algorithms in a new smart glass system. This program can detect and detect objects in real time. Smart glass can be useful for visually impaired people in their city life. And soon, we will be implementing very useful programs in a clever glass system, such as talking to Wikipedia, Google, Voice Guidance and more.

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III. PROPOSED WORK

A. Architecture:

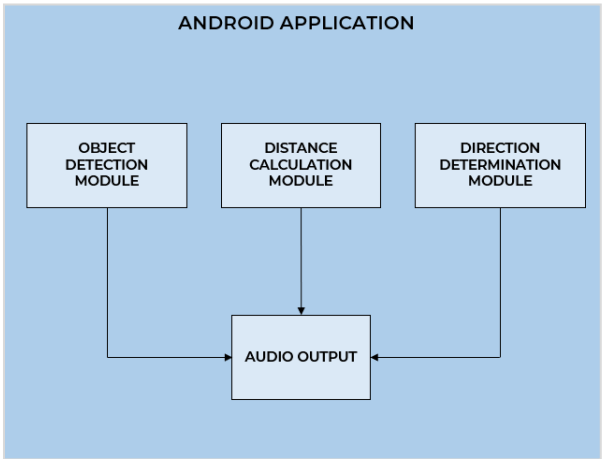

Fig. 1 System's Architecture

The block diagram depicts the various modules that are engaged in our project. Our project is an Android application made up of modules that attempt to detect objects, calculate distances, identify directions. All of the outputs from these modules are combined and produced as audio.

B. *Activity Diagram:*

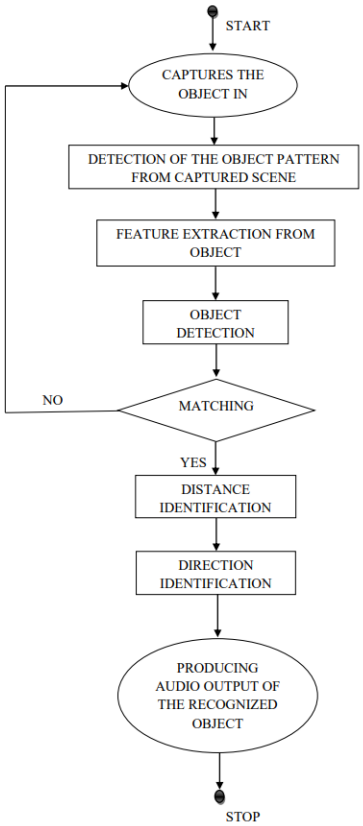

Fig. 2 Activity Diagram of the System

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C. Methodology:

i. Detection of objects

The main goal of the system is to detect objects. Classification of objects and localization of objects are included.

The approach of classifying an object into previously established categories is known as object detection. Object categorization, in other terms, is the process of assigning a label to a whole image. The image's name is represented by that label. If we give a picture of chair to the computer, for example, it tends to recreate it. to classify it and save it as "Chair" We can easily accomplish this. Image of objects are identified; nevertheless, in the case of a computer, identify the things in the image. The process of classifying objects takes time.

The objects in the image are separated by creating rectangle shaped boxes around them with the help of the computer, commonly known as the Bounding Box, in object localization.

We try to combine classification and localization of objects to categorize them and separate some objects in an image as detection of object.

The output of this module provides us the coordinates of the bounding box along with the name of the object. The coordinates obtained is used in other modules for detecting the direction of the object and its distance from the user is also calculated.

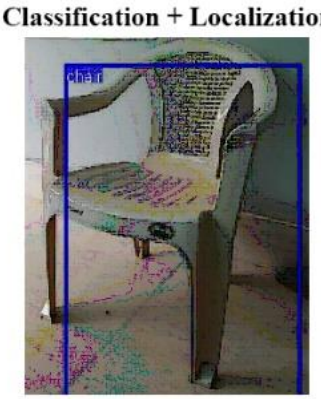
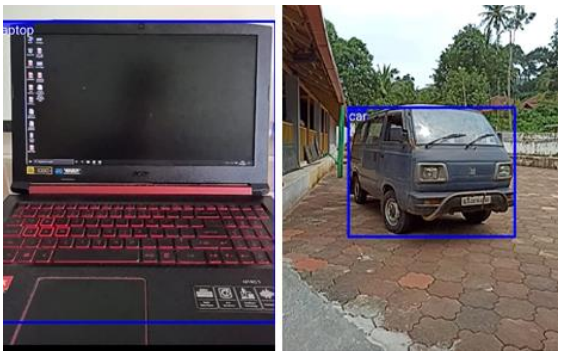


Fig. 3 Classification and Localization of the Object



Laptop, Car

Fig. 4 Detection of Objects

TensorFlow lite object detection API model, which can categorise 90 objects by default, will be used for object detection. The model can be retrained to classify more items. There is no need to capture the objects because it detects them in real time, with the ability to save any image.

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When frame contains many things the priorities are assigned to them by us. The notifications about all the present objects in the frame cannot be provided to the visually challenged people . Each image's final output will be determined by the objects with the highest priority. The highest priority will be given to anything that could be dangerous to a visually impaired person. A truck or a car, for example, will take precedence over a human being.

Furthermore, Measure of accuracy is contained in the Tensorflow object detection model, that indicates the degree of certainty with which the object was detected. It is expressed as a percentage figure. The accuracy of the system can be improved by retaining the confidence threshold value at 70%. The only objects that are told to the user are those which are detected with the confidence level higher than 70%.

ii. Calculation of distance

The distance of the object from the visually challenged user will be made known to him/her. For this project, we will make use of Open-Source Computer Vision Library.
To compute and figure out the distance will make use of triangular similarity law. Knowing the object's distance from the visually impaired user would be more advantageous than knowing the thing's name since it would provide the user a alert about the space around him and distance of the object from him.

To estimate the distance, the device's camera must first be calibrated, necessitating the use of the calibration module. The application must run calibration when launched at very first time. The main idea of calibrating is to identify and take the value of the lens focal length which is made use in the successive steps.

iii. Direction determination

The direction of the object is told to visually challenged user like this: "to the left," "to the right," and "at the centre." The output of this model is nothing but direction which is of useful to blind to accurately determine the object's location and also allows him to navigate much more efficiently.

The entire screen is divided in the ratio of 3:4:3 along its length to identify the direction.

The direction of the object is determined by the portion of the image where the object's centre is located. For example, if the object's centre is in the third section of the screen, the object's direction will be Right. The coordinates of the bounding boxes are be used to centre coordinates calculation. To find the x location of the centre, you only need the bounding box's x coordinates.

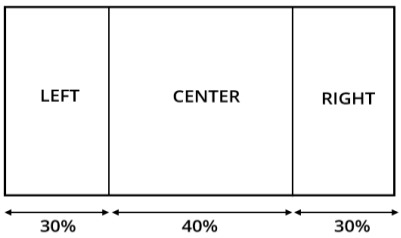

Fig. 5 Direction Determination Method

iv. Audio output

This is the last step. The features included in the audio output are listed below :

1) What is the object's name?
2) How far is the object distant with respect to the user?
3) The orientation of the object
For Instance, "Detected chair at 2 feet to the right", is an audio output message.

The details provide to the visually challenged user through audio message will help him to identify the items along with the barriers of the environment. The user can hear it with the help of phone speakers or earphones.

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We'll use the Text to Speech library provided Google to create audio output. The audio output can also be delivered in other local languages to the user. This android application are divided into various modules and the output of all these modules are not continuous and they are discrete. For an instance the object detection module just provides name of the object as output. The calculation of distance is done in another separate module. And the output of all these individual modules are combined in the form of a simple sentence. The care should be taken so that the audio output is not delivered many times for the same detected object. By doing this it is made sure that the blind person knows completely about all the objects in the environment.

IV. RESULT

This system would make visually impaired people virtually visible, and it will use text-to-speech technology to deliver audio descriptions of their surroundings, allowing them to travel confidently. The proposed system is portable, dependable, and effective. It also creates a virtual world, and the system provides reassurance by voicing the name of the recognised object. With an accuracy of 87.3%, the system can recognise items around the user. The system will need to be retrained with a larger dataset in order to detect additional objects.

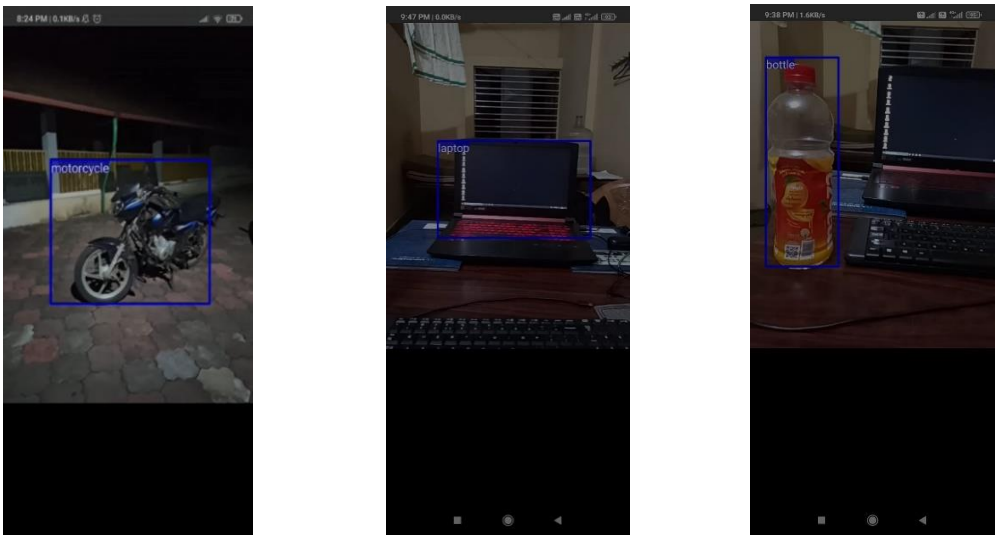

Fig. 5 Output of the Screen

The object detection system's android output screen is shown in the image above. The programme is able to correctly tell the user about the surroundings using an audio output, you can hear what's going on around you.

V. FUTURE SCOPE

The project's long-term goal is to improve object recognition rates by leveraging the TensorFlow framework, as well as offer precise distance measurements between humans and objects. However, if you're making an application with a lot of fast-moving objects, you should look into speedier hardware. In addition, we can combine face and text recognition in the same system. As a result, the system as a whole is compatible.

VI. CONCLUSION

Some solutions have been developed in recent years to assist blind or visually impaired people in detecting items in their environment, however they are ineffective. Our goal is to provide a reliable and comfortable method enabling blind people to recognise their surroundings. Our innovative system captures real-time photographs in front of the users using a smartphone camera sensor. Mobilenet SSD is a machine learning and feature extraction technique that was applied in this case. The SSD framework uses object detection to forecast bounding box coordinates and class probabilities for these boxes by selecting the entire image in a single instance and splitting it into grids. The most significant benefit of using SSD is its incredible speed; it is lightning fast, and it understands generalised object representation. This system would make visually impaired people virtually visible, and it will use text-to-speech technology to deliver audio descriptions of the detected object.

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