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OBJECT RECOGNITION BY VISUALLY IMPAIRED USING MACHINE LEARNING: A STUDY

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ABSTRACT

Machine learning is an application of Artificial Intelligence. It provides the system the ability to learn automatically and improve from experience. Machine learning needs no explicit programming to implement. It aims in development of computer programs which can access data and use those data to learn on their own. Machine learning can be has got huge number of applications such as Image Recognition, Speech Recognition, Self-driving cars, Virtual Personal Assistant, etc. Machine Learning has a good set of algorithms which help in creating applications in it. Machine Learning tools are portable and aids in easy development of applications.

Object Recognition by Visually Impaired is one of the areas where Machine Learning can be used. Countless number of Object recognition technologies have emerged using which exhilarating applications are becoming possible for visual substitution. Industries have created a variety of computer vision products and services by developing new electronic equipment for the blind in order to overcome their disability. This paper is to review some of the object recognition methods available for visually impaired using machine learning.

Keywords : Convolutional Neural Network, SURF, SIFT, NAVI, Android based object recognition, Feature extraction

I. INTRODUCTION

A good vision is needed to carry out to carry out day to day activities for us. Many faces difficulties to do their day to day activities because of lack of good vision. Like people with good vision, visually impaired also has a number of interests. But many of the visually impaired are unemployed due to inadequate resources to aid them in learning. The schools and institutions for blind are not adequate to educate them. Surveys highlights that Braille, a special learning method for blind becomes difficult because of insufficient learning kits.

The blind people face many problems due to inaccessible environment and social challenges. The most challenging task of a visually impaired is navigating around the places. Finding good reading material in accessible form, getting a suitable job and earning on their own are also challenging for them. Most of the blind people depend on the objects' shape and texture, maintaining and arranging their clothes becomes a challenging task. Many methods are available for the visually impaired to overcome some of these difficulties.

Large number of researches were carried out to find a solution to aid the visually impaired in recognizing the environment and objects. Some of the researches have done to develop an audio system which can give audio feedback about the surrounding objects, a Navigation assistance system to assist blind people for autonomous navigation by converting image to sound, an Android-based application for object recognition to help the blind understand their environment better, a visual substitution system based on evaluating fast and robust algorithms to recognize and locate objects in images.

The existing systems has some common limitations such as accuracy, lighting requirements, multiple hardware setups for visually impaired and the environment, long processing time, complex outputs, poor performance, high cost, etc. The object is extracted to detect moving objects and the limitation of this method is the requirement of enough ground visibility. Methods that are based on occupancy maps gives more accurate results for still objects than dynamic objects. All the methods have some limitations over their good performance.

II.OBJECT DETECTION METHODS

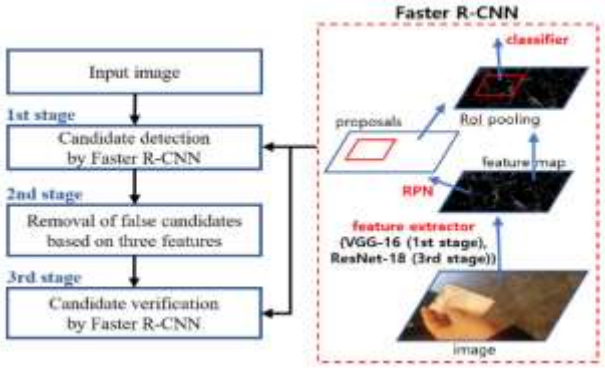
Deep Feature-Based Three-Stage Detection of Banknotes and Coins for Assisting Visually Impaired People

A new advancement using smartphone technology is detecting banknotes and coins to assist visually impaired persons using the cameras in the smartphones [9]. Previously, handcrafted feature-based methods, such as scale-invariant feature transform or speeded-up robust features (SURF) [10] [11] were used. Those methods were not able to produce robust detection results for banknotes or coins captured in various backgrounds and environments [12]. Using the advanced deep learning technology, studies have been activated on banknote and coin detection using Convolutional Neural Network (CNN). But the studies also showed degraded performance based on the changes in background and environment. To overcome the above problems, this paper introduces a three-stage detection technology for new banknotes and coins by applying quick region-based CNN, geometric constraints, and the residual network (ResNet). An experiment was performed using the open database of Jordanian dinar (JOD) and 6,400 images of eight types of Korean banknotes and coins obtained using our smartphones. The result exhibited a better detection performance.

A new technique was proposed in this study for banknote detection with banknote images captured in complex backgrounds and different environments using a smartphone camera [1]. To improve the detection performance in the VGG-16-based Faster R-CNN, post processing methods were applied in the first stage of detection. The second stage of detection was based on three features, the width-to-height ratio, detection box size, and detection score, to remove the FP candidates. The third stage of detection by the ResNet-18-based Faster R-CNN to detect the final banknote region for the candidates remaining ager the post processing. A self-collected DKB v1 and the developed models with algorithms were imparted for a proper evaluation by other researchers.

Flow chart of the proposed banknote detection method

When the experiments were conducted with the DKB v1 and

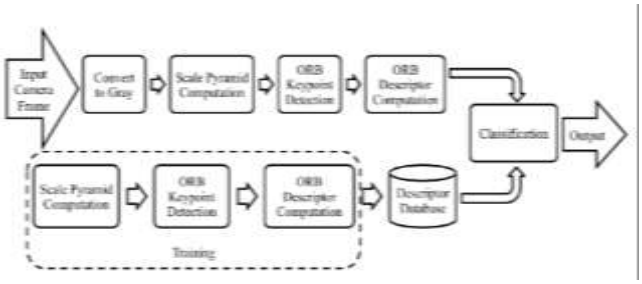


JOD open databases, high detection performance was obtained for bills, but FP detection errors were produced for coins.

Android-Based Object Recognition for the Visually Impaired

Another object recognition system is using a smartphone application for Android which uses the camera of the device [5]. This system is able to manage high accuracy and is fast, compatible and consumes less cost. A low complexity algorithm should be used and it uses least amount of power. It also achieves real-time performance and user friendliness. It should also handle differences in viewing conditions such as orientations, scales, 3D viewing point and illuminations.

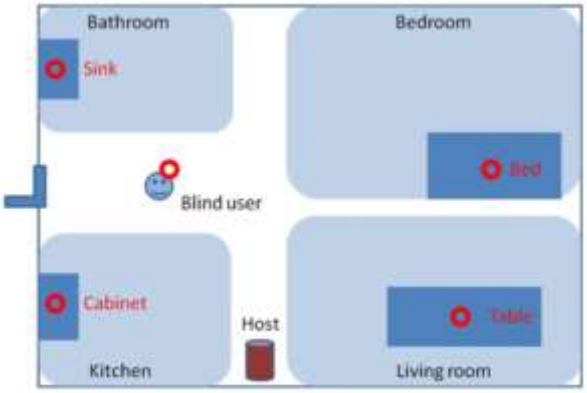
Object recognition applications using android phones [5] eliminate the need for additional equipment. However, limited processing power of mobile phone makes the applications rely on client server architecture. One of those applications is Google Goggles [6]. It requires an internet connection and it will not allow adding new images to the application database. In another related paper, a mobile application was proposed which can identify paper bills of various denominations to aid the blind user make cash transactions safely. More research has been done to make systems for visually impaired users that uses only local processing based on a mobile phone's computational resources. In this paper an Android application is developed that can do all the processing locally providing the final output as auditory feedback. This implementation uses SIFT [7] features.

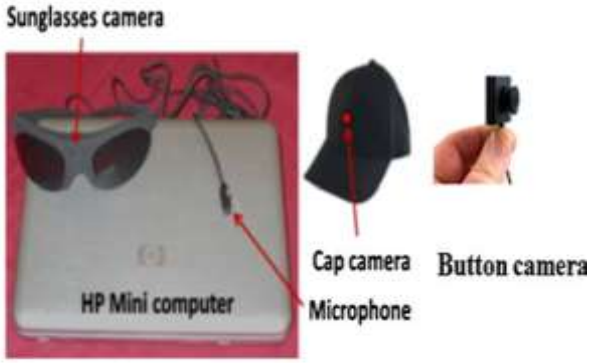


Object recognition applications also exist commercially for the blind. LookTel [8] has developed two applications especially for the visually impaired, the LookTel Recognizer and LookTel Money Reader [9]. These applications were developed for devices running iOS. These two applications need no internet connection and exhibit real-time performance. The LookTel Recognizer compares the name of the object with the pre-built database and speaks out the name of object when they are matched to a database object. The Money Reader can recognize 21 different currencies and can also identify the type and denomination of a paper bill.

Finding objects for assisting blind people

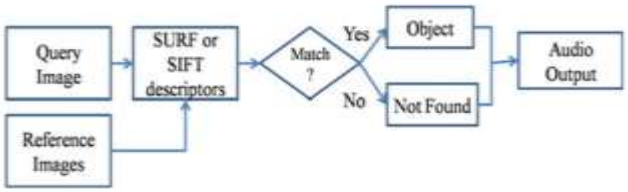
In this system [13], camera is fixes at the main indoor locations of visually impaired person's daily life environment by forming a multiple-camera network. The important locations are the locations where the visually impaired will move around like tables, wash basins and kitchen cabinets. The cameras provide locations of the objects the user needs by scene monitoring around these important locations. To find out the object matching-based recognition is carried out.





The visually impaired user is provided with a wearable camera connected (wire or wireless) to a computer (PDA, or laptop). The user can send speech command for searching an item. Then the user wears the camera system and look for the item he requested. When the item requested by the user is found by the system, an audio signal is produced. A dataset is created with the list of personal items as reference samples. The dataset consists of multiple images for each item that are captured from different camera views, scales and lighting effects. Multiple cameras are fixed in the locations where the visually impaired places their items. When the system receives a request of finding an object from the user, all the fixed cameras starts object recognition by searching the captured object in the reference objects of the dataset. Then the system reports the very close matching object to the user.

Another android application [14] to aid visually impaired people to see through handy device like mobile phone. It combines different techniques to create a rich android application that will recognize objects around visually impaired people in real time and also give an audio output to guide them as fast as possible. This application uses SSD (Single Shot Detector) [15] for object recognition and detection. The application uses a mobile phone camera [16]



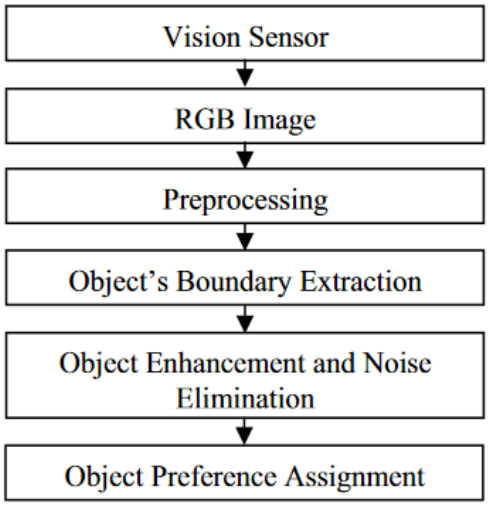
to scan the environment in real time and takes frames from the ongoing video. The frames are sent to the succeeding module where the SSD algorithm creates boundary boxes around the objects in the frame and group them into different categories. Finally, the application produces an audio output of the object detected with maximum confidence score among the other present in the frame. The frames are selected with specific interval to avoid the collision in the audio output.

AN IMPROVED OBJECT IDENTIFICATION FOR NAVI

Navigation Assistance for Visually Impaired (NAVI) is one of the types of vision substitute system which employs the concept of 'image to sound' [3]. NAVI can be applicable in a closed environment.

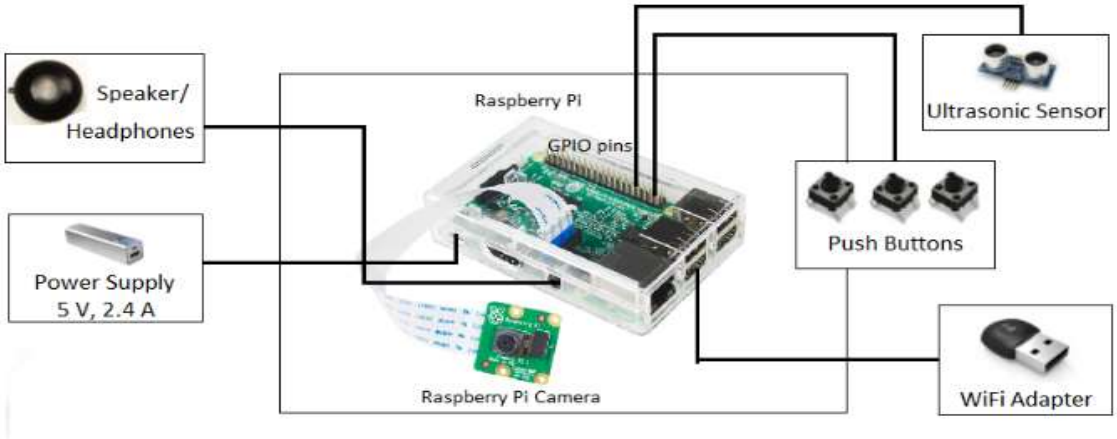
Figure 1. NAVI Hardware

The basic idea of NAVI is to identify the object and highlight it in the scene in front of a blind person and convert this information to audio form. NAVI system's function [2] can be divided into two sub modules, the vision module and sonification module. The vision module will process the image of scene in front of a blind person to observe the objects and background. The captured image is resized and quantized into four grey levels. Objects are identified with their grey value. The identified objects are sharpened and the background is suppressed using a clustering algorithm. Then the processed image is mapped with stereo sound patterns. Importance is given to the objects in the environment in the sound production. The sound produced gives the shape, size and orientation information about the object. This helps the blind person to identify the obstacles easier.



Assistive Technology for the Visually Impaired Using Computer Vision

A system that can assist the visually impaired in reading is the text to audio conversion. The objective is to design an inexpensive wearable device which uses computer vision to read any form of text in various alignments and lighting conditions. This system makes use of a Raspberry Pi with a compatible camera get the text around the visually blind person or a visually impaired person and reads it out to them in a regional language. A sensor is incorporated for the blind or visually impaired to know the distance of the nearest object at his eye level and the device lists various objects in its sight. The system is based on the combination of image processing, machine learning and speech synthesis techniques.



The proposed system [4] uses a wearable device which reads the text in front of the user, recognizes and lists different objects around the user and also tells the distance to the nearest object at the eye-level of the user in order to assist mobility and prevent collision into obstacles. Once the product is developed, it requires little maintenance and can be used for several years. The product can be used in the developing countries to aid the visually impaired in their daily work. The proposed system is multi-functional and effective. One more advantage is that most visually impaired people may not know the English language. Since this device is incorporated with language translation, the output can be received in multiple regional languages.

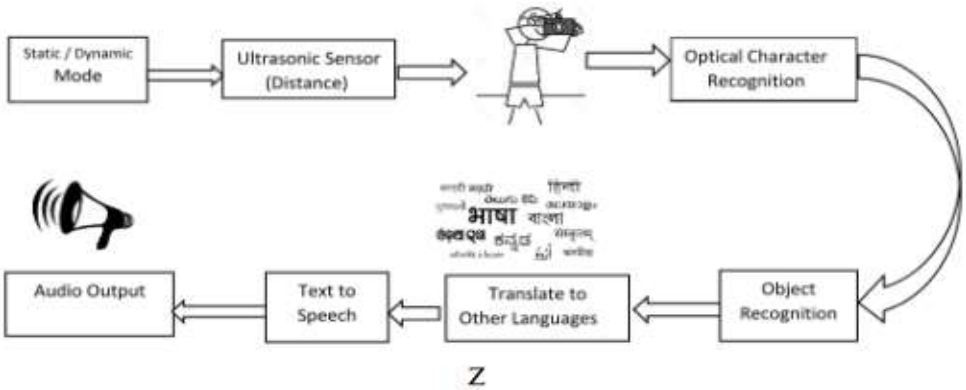


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Fig. 2 - Block Diagram of the proposed system

III.LITERATURE SURVEY

Rahul Kumar, Sukadev Meher has developed a system [17] with two modules. The first module identifies the objects e door, chair, stairs, mobile phone etc. and generate an audio feedback to the user. Convolution neural network is applied followed by softmax classifier to do this. The second module is for color recognition which identifies the color in front of the camera.

Aniqua Nusrat Zereen and Sonia Corray proposed novel approach of Object Moving Direction Identification using Depth Image for Blind [18] is a simple, affordable and realistic blind navigation support system. This system does not require any complex algorithm or mathematical calculation.

Nada N. Saeed, Mohammed A.M. Salem, Alaa Khamis describes an Android-based application for object recognition [5] developed to help the blind understand their environment better. This application is based on extracting local features of the object of interest, which are then matched to the corresponding features of objects saved in a knowledge base previously created. The local features are tested against more than one classification method and the results are analyzed. Deploying the application to a Samsung Galaxy Tab, the system is evaluated using a dataset especially developed for this purpose.

Megha P Arakeri, Keerthana N S, Madhura M, Anusha Sankar, Tazeen Munnavaro proposed a design [4] of an inexpensive wearable device that uses computer vision to read out any form of text around the user in various alignments and lighting conditions. The system makes use of a Raspberry Pi with a compatible camera to capture the content around the visually impaired or blind person and reads it out to them in a regional language. A sensor is also incorporated to notify the user of the distance to the nearest object at his eye level and the device enumerates various objects in its sight. The system is based on the combination of image processing, machine learning and speech synthesis techniques.

Chanhum Park, Se Woon Cho, Na Rae Baek , Jiho Choi , and Kang Ryoung Park proposed a study [1] with deep learning-based approach to detect and recognize bills and coins with images captured by smartphone cameras in complicated background and various experimental conditions for assisting visually impaired people.

Vikky Mohane, Prof. Chetan Gode developed a method to separate a object from un-necessary background, movement based technique is used to spot object of concern from the video by instructing person to shake the object that gives moving object area by K-means clustering background separation technique. After detection of moving area feature extraction SIFT technique is used to take out key points of that product and that key-point is matched with the data base images if it matches efficiently then it identify a product and produce name of that product to blind persons in speech. Instead of OCR we used SIFT because in OCR orientation of camera must be towards label of product and for blind person it is very tough to locate label efficiently whereas in SIFT product orientation is not a big deal as key-points can be matched from any position.

Bing Li, J. Pablo Munoz, Xuejian Rong, Qingtian Chen, Jizhong Xiao proposed a real-time holistic mobile solution called ISANA for blind navigation and wayfinding. The CCNY indoor map editor is used to parse geometric information from architectural CAD models and extract the semantic map with a global 2D traversable grid map layer and context-aware layers which enabled the global path planning to desired destinations.

IV.COMPARISON OF DIFFERENT METHODS IN LITERATURE SURVEY

S.No.	Author	Year	Method	Advantages	Accuracy
1	CHANHUM PARK, SE WOON CHO, NA RAE BAEK , JIHO CHOI , AND KANG RYOUNG PARK	2020	Faster region-based convolutional neural network	Helps visually impaired to detect bank notes and coins	95%
2	Nada N. Saeed, Mohammed A.M. Salem, Alaa Khamis	2013	SIFT feature extraction method	Mobile based object recognition for visually impaired	95.36%
3	Chucai Yi, Roberto W. Flores, Ricardo Chincha, YingLi Tian	2013	SURF and SIFT interest point detector	Helps blind to find their personal items	69%
4	R. Nagarajan, G. Sainarayanan, Sazali Yacoob, and Rosalyn R Porle	2004	Neural Network Approach	Assists blind people for autonomous navigation using NAVI hardware	
5	Megha P Arakeri, Keerthana N S, Madhura M, Anusha Sankar, Tazeen Munnavar	2018	OCR and Object Recognition	captures the readable material in front of the user, identifies the text in the image and reads it out	93.%
6	Hanen Jabnoun, Faouzi Benzarti,and Hamid Amiri	2014	SURF and SIFT algorithms	Assists blind people for object recognition and navigation	82%
7	Vikky Mohane, Prof. Chetan Gode	2016	SIFT technique	Helps blind people to recognize object	
8	Aniqua Nusrat Zereen ; Sonia Corraya,	2016	Object Moving Direction Identification using Depth Image for Blind	Helps to detect moving object in indoor environment	90%

V.CONCLUSION

In this study, the different methods used for object recognition for visually impaired people were studied and their advantages and accuracy levels were compared. So many methods are available for object recognition for blind using android applications and cameral like devices. On the basis of this study, a different algorithm can be used for object recognition for visually impaired. The new system can perform object recognition more efficiently with higher accuracy level.

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