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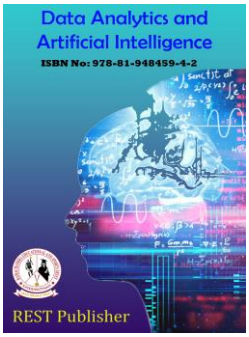

Assistance and Rehabilitation for Visually Impaired using Image Processing

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Abstract: *Visually impaired people find it difficult to identify unknown objects. Some objects may cause harm to them and in this pandemic situation it is not safe to touch each and every object even it is not harmful. The Project that we preferred is to find solution to overcome problems faced by visually-impaired people using object detection. Object detection is an image processing technology that helps us to retrieve data from an image and identify the object. This system can help to detect the objects with its characteristics with the use of image processing techniques. In this system some feature extraction algorithms like SURF are developed to extracting the important features of the object. After feature extraction the extracted values are compared and classified by the classifier algorithm like KNN. The overall concepts are developed and recognized by mat lab software.*
Keywords*: Visually impaired, image processing, feature extraction, classification.*

1. INTRODUCTION

In the fast-moving world with day-to-day growth in new technology a normal human being itself finds it bit difficult to survive in this challenging world and for a visually impaired person it is very difficult to act as a normal human being. They truly need the support of technology. The advancement of technology paves way to find solution for the real-life problems. Blind people put their lives into risk while navigating from one place to another. They may miss the lane while navigating in a new location. They need support from others in order to do their day-to-day work. Because of this they loss their individuality and privacy. There are people who are having complete blindness or low vision faces many difficulties during their navigation. According to the survey of WHO in 2019 India currently has around 12 million blind people against 39 million globally which makes India home to one-third of the world"s blind population. In this 29% of the people are educated. People with complete blindness or low vision find it difficult to identify the objects and people around them. Also, they struggle a lot to mingle with their environment and to understand the emotions around them. These may be big struggle in past decade but now many researchers have given modern solutions to these problems. The solutions are lightweight so that the visually impaired may not feel it difficult to carry it out. A digital image is a two-dimensional image that has been processed by a computer. It refers to the digital processing of any two-dimensional data in a wider sense. An array of real or complex numbers represented by a finite number of bits is referred to as a digital image. A picture on a transparency, slide, photograph, or X-ray must first be digitized and processed as a matrix of binary digits in computer memory. After that, the digitized image can be processed and/or viewed on a high-definition television monitor. The image is stored in a rapid-access buffer memory for display, and the monitor is refreshed at a rate of 25 frames per second to create a visually continuous display. The main aim of this project is to find multiple objects and assist blind people by using more accurate image processing techniques. Object recognition has a wide range of uses, including smart object identification for blind people. Through image processing techniques, this system can assist in the identification of obstacles.

2. RELATED WORK

Many researchers proposed ideas to assist blinds. But many works need heavy hardware support. In [1] Computer vision, machine learning and deep learning technology help the system to identify the objects and its characters clearly. The proposed method operates performs obstacle classification and feature extraction. The detected obstacles are marked as normal or danger based on its class. RGB color histogram, histograms of oriented gradients (HOG), HSV (Hue,

Saturation, and Value) histogram and uniform local binary patterns (LBP) features are extracted. The classifier isused to determine the type of the detected obstacle in the images based on the visual features that were extracted from these images. Machine learning technique is used for feature extraction and the result is given to deep neural network for object classification. This application also helps them to navigate from one location to another. This work has certain limitations Only 3 classes (person, vehicle and others) are used to train the model which is relatively very less for various objects identification. There is no option for re training of new objects in future. The false alarm rate is between 5% and 23%. The project in [2] aims to develop an assistive technology that uses deep learning, computer vision, and the Internet of Things to assist blind people in overcoming obstacles. The interface is capable of classifying and identifying various objects in the image, and also informing the user of the object class using audio responses. It is primarily focused on three main computer science techniques: Deep Learning, Computer Vision, and the Internet of Things. Deep learning enables neural networks to automatically search the wide dataset for similarities and fine relations. The trained similarities are used to perceive new knowledge after the model has been trained using the dataset. They used YOLO (you only look once) algorithm because it offers real-time object detection and produces more reliable results than other algorithms. The system's disadvantage is that the trust score is estimated to be about 40%, based on which shape features are predicted against the likelihood of C groups of objects. Predictions with a trust score that is invalid are not expected. In [3] they demonstrate a smart device that aids the visually impaired in reading paper-printed text effectively and efficiently. The proposed project is focused on the creation of a camera-based assistive system that helps people to read text documents. The framework is for deploying image capturing techniques in a Raspberry Pi-based embedded system. The method of processing scanned images of machine printed documents into a format that can be processed by a computer. Optical Character recognition is also useful for visually impaired people who cannot read Text document, but need to access the content of the Text documents. Skew Correction, Linearization, and Noise Reduction are the three phases in the pre- processing stage. The skewness of the captured image is verified. With either a left or right orientation, the picture has the potential to be distorted. The picture is brightened and binarized first. The system's disadvantages are that it needs several steps to translate into an audio device, such as converting an image file to text and then using a text converter to convert into an audio file using Raspberry Pi. It has a poor degree of precision, and scanned images do not yield reliable results. In [4] the device uses real-time object detection and recognition to assist the blind in navigating independently. The proposed framework consists of a Raspberry Pi-3 processor equipped with a Tensor Flow-based pre-trained Convolutional Neural Network model (CNN). A NoIR camera is attached to the processor. An AVR microcontroller will process it, and appropriate voice information will be given. This unit's electric power comes from a solar photovoltaic module, a piezoelectric source, and electricity produced by body temperature. For object detection and distance calculation, an ATmega2560 based Arduino Mega 2560 is used in this paper. Smart Cap is a text-to-speech synthesiser that uses TensorFlow. The system's operation begins with the Raspberry Pi processor being properly powered. A box representing a part of the image where a specific object was observed, a score representing the degree of trust for each of the objects, and a class mark are all included in the output. The disadvantages of this system are that, unlike other systems on the market, the subject just needs to wear the cap and should have skills to operate it. In [5] the proposed system would help the blind by using voice commands to detect objects using image processing and provide audio output to navigate and enter the desired object. The user interface for the device is speech commands. Speech feedback is recorded using a microphone. The Google API is used to recognise the obtained data. It also identifies objects and sign boards using image processing as its primary technique. The Pi camera captures video, from which the frames are removed. For better outcomes, the frames are pre- processed. These frames are subjected to image processing algorithms for object detection, and the object is marked. After the object has been found, the user receives audio messages from headsets reminding him or her of the object's location. Obstacle detection is achieved using ultrasonic sensors. The blind person is alerted to any obstacles in the path by a beep sound created by the buzzer. One of the system's flaws is that the Pi camera attached to the Raspberry Pi takes video of the scene, which is then transformed into frames by the processor. The user wants to provide speech commands when he/she is in need of the object.

3. PROPOSED SYSTEM

In this system using of image processing steps can identify and classify the objects. Then some feature extraction algorithms are developed to extracting the important featuresof the object. After feature extraction the extracted values are trained and classified by the classifier algorithm. The overall concepts are developed and recognized by mat lab software. The process involves the following stages:

- Input Image, Segmentation, Feature Extraction, Classification.

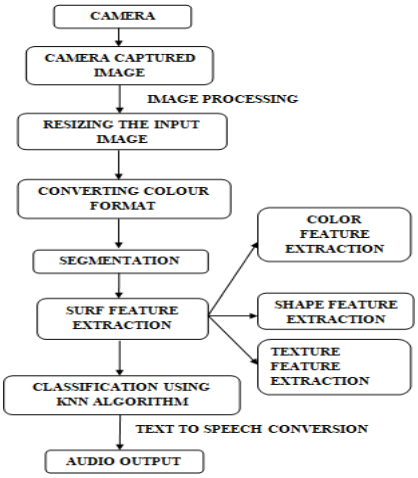

FIGURE 1. System Process

Input image: A depth camera is attached to the device. The system automatically captures the object in 5 seconds after the blind user starts the camera. The camera also has led flash lights, which aid in the capture of clear images in low light. The camera has a 58o field of view and a 30-fps frame rate. The image is then submitted to be processed further. The input image is given into the workspace, using the "imread" command in matlab.

Algorithm 1: Training

Input image: 256*256 input image
// To read the image from the file specified by filename
1: A = imread(filename,fmt)
// To return image B that is scale times the size of A.
2: B= imresize(A,[numrows numcols])
// To convert the image I to double precision
3: I2 = im2double(I)
// To return a SURF Points object, points, containing information about SURF features detected in the 2-D grayscale input image I.
4: points = detectSURFFeatures(I)
// To return extracted feature vectors
5: [features,validPoints]=extractFeatur es(I,points)

Segmentation: Pre-processing is used to improve image data by suppressing unwanted distortions or enhancing those image features that are necessary for further processing. The major redundancy of images is exploited by image pre-processing methods. In real images, adjacent pixels corresponding to the same object have exactly the same or identical brightness values. As a result, a distorted pixel will frequently be restored as the average value of nearby pixels.

$$\sum_{i=0}^{n} \min_{\mu_j \in C} (||x_i - \mu_j||^2)$$

All the input images are resized into same dimensions. The output image will be blurred if the specified size does not generate the same aspect ratio as the input image. One justification for converting RGB image to GRAYSCALE formats in image is the color information is useless in many image processing applications. Finally, the images subdivided into many segments. The main reason for carrying out segmentation process is to enhance the image before extracting the features from it. Feature Extraction: Speeded Up Robust Features is a quick and effective algorithm for representing and comparing images in a local, similarity invariant manner. The key attraction of the SURF approach is its ability to compute operators quickly using box filters, allowing real-time applications like detection and object identification. The feature vectors must be descriptive of the object in nature, carrying essential and distinct characteristics. The key starting point for feature extraction is the SurfDetect.m function. The input to this function can be either an 8-bit RGB or an 8-bit grayscale image. An array of extracted interest points is returned as the output. This function is made up of the following function calls, each of which includes computations that can be parallelized on a GPU. An 8-bit RGB image is converted to an 8- bit grayscale image using the Convert32bitFPGray.m feature. The 8-bit grayscale image is then converted to a 32- bit floating-point representation, allowing for faster GPU computations. The integral image is calculated using the My IntegralImage.m function. The integral image can be used to quickly calculate the number of pixels contained within any rectangular region of an image. Calculating the sum of pixels aids in speeding up the convolutions in the following process. The FastHessian.m function stores the computed responses after convolution of the image with box filters of various sizes. Classification: After feature extraction, we use the K- Nearest Neighbor algorithm to identify the objects as harmful or non-harmful. KNN is a Supervised Learning-based Machine Learning algorithm that is one of the most basic. It algorithm can be used for both regression and classification, but it is most widely used for classification problems. Classification KNN is used to implement KNN algorithm in matlab.

Algorithm 2: Easy Life Application Input image:

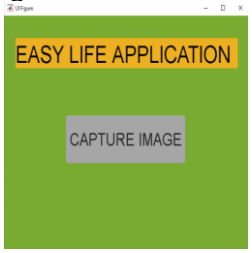

FIGURE 2. Easy Life Application

256*256 input image
// To read the image from the file specified by filename
1: A = imread(filename,fmt)
// To return image B that is scale times the size of A.
2:B= imresize(A,[numrows numcols])
// To convert the image I to double precision
3: I2 = im2double(I)
// To return a SURF Points object, points, containing information about SURF features detected in the 2-D grayscale input image I
4: points = detectSURFFeatures(I)
// To return extracted feature vectors 5:[features,validPoints]=extractFeatur es(I,points)
// To return a vector of predicted class labels for the predictor data in the table or matrix X
6: label = predict(mdl,X)
Output: audio output speak(text).

4. MATERIAL AND METHODS

The whole software is developed using matlab. The system is fitted with a depth camera. After the blind user starts the camera, the device automatically captures the object in 5 seconds. In addition, the camera has led flash lights, which help to capture accurate images in low light. The camera has a 58º field of view and a frame rate of 30 frames per second. The processor we used is Intel Pentium 4. We here use Google open-source image dataset. At first stage we trained with 100 images and the testing dataset with 10 images given 63.7% false positive rate. Second stage we tested with 3 classes with training data of 500 image and testing data of 25 images. The false positive rate obtained was 86.4%. The third stage of testing is done with 750 images where we obtained an accuracy of 93%. Hence, we noted that as the training image increases the accuracy also increases.

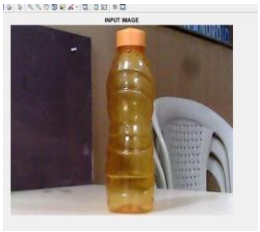

FIGURE 3. Input Image

Figure 4. Resized Image

FIGURE 5. Gray Scaled Image

TABLE 1. Statistics for ECDF

Data Statistics - 1

Statistics for ecdf

Check to plot statistics on figure:

	X		Y	
min	1		0	
max	6		1	
mean	3.143		0.4706	
median	3		0.4706	
mode	1		0	
std	1.952		0.3345	
range	5		1	

Save to workspace... Help Close

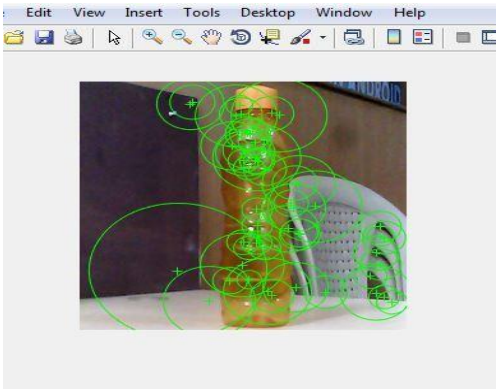

FIGURE 6. Feature Extracted Image

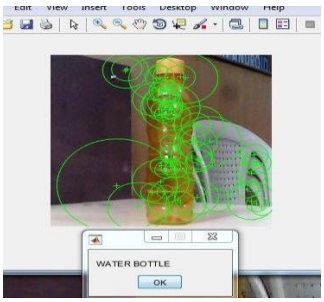

FIGURE 7. Output Image

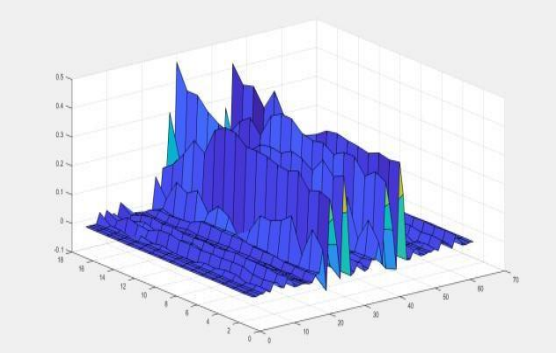

FIGURE 8. Surface Plot of data points

We compared the algorithm repeatability score with other algorithms like fast hessian and SIFT. We found that surf performs better than other algorithms. The system acquires good knowledge at faster rate because we enhance the image before the feature extraction. The accuracy can beimproved by using high configurationsystems and by training more image dataset. This system can support in multiple platforms.

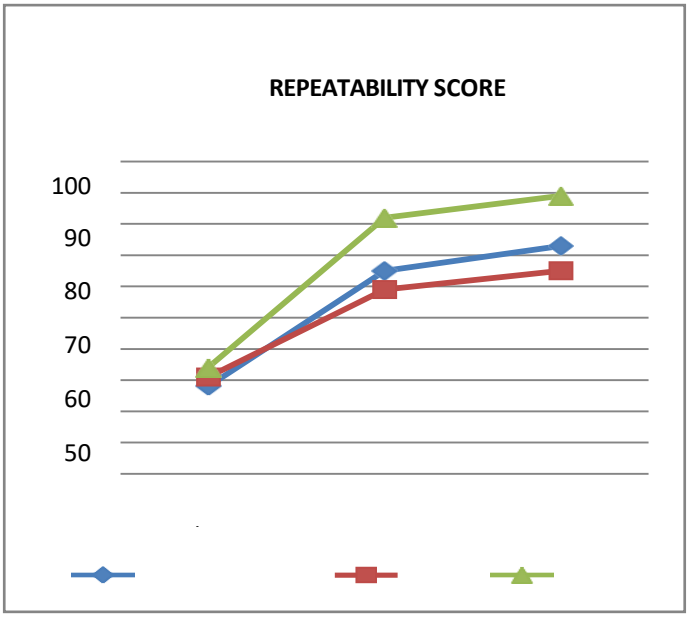

FIGURE 9. Repeatability Score Graph

5. CONCLUSION

This system helps visually impaired people to do their day-to-day task without the help of others. This helps them to maintain their individuality and security. The design of this system is the major part of research in the area of Image-Recognition and machine learning. Web cam is one of the basic hardware of this model. This research basically relied on images of different image data set to recognize high accurate object and labeled it. The system is designed to label the object in the correct region or set of regions in the image. Segmentation and the Object- Recognition are closely related to each other. We have included another technique which is useful, that is whenever a harmful object is given as input it gives us the pop- up message with a warning. Machine learning techniques helps us to recognize the object with the best accuracy as the objects are trained more and more the object is recognized with high accuracy. Web cam is one of the basic hardware of this system. In future the system is well trained with the images that are retrieved from the public repository and can be made more reliable.

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