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Object Detection Methodologies for Blind People

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Abstract—Vision is the most important sense. Image plays vital role in the human perception of the surrounding environment. However there are visually impaired people, industry has created a variety of computer vision products and services by developing new electronic technologies for the blind in order to overcome the difficulties. Digital image processing is the field which processes the digital image by using digital computer. An increasing interest in developing technologies attempts to help visually impaired people in their daily lives. It is shown that the object identification is the difficult task for visually impaired people . Although there are many applications that can be used for this task, there are still limitations that require more improving. For this reason, this paper provides the survey and an analysis of various evaluations for the technologies that used in the object identification task. For the visually impaired the idea of sensory substitution can be used.

Keywords—*Object recognition, visual substitution system, features extraction, SIFT, SURF.*

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I. INTRODUCTION

Since the 1970s, systems based on video camera have evolved considerably, making new tools for visual substitution [3]. One of the greatest difficulties blind people is the identification of their environment and its components. Identifying the objects with good efficiency is necessary so we are proposing the system which will give best results. The World Health Organization (WHO) estimated that in 2002, 2.6% of the world's total population was visually impaired [4]. Recently, several electronic applications have been developed visually impaired people. Different developing technologies that attempt to help visually impaired people in their daily lives are of more interest. However, it is shown that the object identification task is still the major difficulty for visually impaired people. Although there are many applications that can be used for this task, there are some limitations that require more improving. For this reason, this paper provides an analysis and evaluation for the technologies that used in the object identification task. A comparison between the applications that use human computation is provided in order to identify the best features that can be considered in designing efficient application to identify objects for visually impaired. For the visually impaired the idea of sensory substitution can be used. These systems are based on the conversion of own stimulus to a sense. Thus we are proposing the sensory substitution mechanism with the comparison based efficient system. We are interested in evaluating robust algorithms to recognize and locate objects in images with better. For getting the efficient system method to detect the object we propose comparing SIFT and SURF algorithm. The method which gives more matching, good processing speed and in variations with respect to illumination rotation and scale will be prove to be the effective algorithm to identify the object. The output of the efficient algorithm will be processed further for converting the information of the recognized object in to the speech form. Converting the detected object information in to speech makes it easier and friendly to identify object for the visually impaired person.

II. LITERATURE REVIEW

Juan and O. Gwon in paper entitled "A Comparison of SIFT, PCASIFT and SURF" summarized the feature detection methods as Scale Invariant Feature Transform (SIFT), Principal Component Analysis (PCA)–SIFT and Speeded Up Robust Features (SURF).In this paper author compares methods with the scale variation, accuracy in matches finding ,required storage space ,key point localization .They found that SIFT needs more memory space compared to other two methods and the matching speed for SIFT is less although it gives good match findings which improves the accuracy for object detection. Whereas PCA-SIFT show its advantages in rotation and illumination changes and gives less matches compared to SIFT [1].

Hanen Jabnoun, Faouzi Benzarti ,Hamid Amiri in their literature "Visual substitution system for blind people based on SIFT description" introduced the different video substitution methods vOICe , PSVA ,Vibe. They worked on the fast and robust algorithms to recognize and locate objects in images. They had implemented feature based extraction instead of using raw pixel values to make the faster processing and to reduce in-class variability to the raw input data [2].

Hanen Jabnoun, Faouzi Benzarti and Hamid Amiri, in paper "Object recognition for blind people based on features extraction" provided an overview of various visual substitution systems developed in the recent years. This method is based on video analysis , interpretation and feature extraction .They give the results of comparison of SIFT and SURF in which they concluded that SURF is faster than SIFT ,however SIFT is robust when the matches findings, scale variations are considered. They used video to Audio transformation to provide the object information [3].

TABLE I. PERCENTAGE OF MATCHING IN THE STEP OF OBJECT IDENTIFICATION AND TIME PROCESSING

Technique	Total matches	Correct matches	Incorrect matches
SURF	20%	18%	2%
SIFT	85%	82%	3%

Ricardo Chincha and YingLi Tian in paper entitled "Finding Objects for Blind People Based on SURF Features" has proposed an object recognition method to help blind people find missing items using Speeded-Up Robust Features (SURF). The Proposed recognition process begins by matching individual features of the user queried object to a database of features with different personal items which are saved in advance. From the experiments the total number of objects detected were 84 out of 100,this shows that their work needs better performance hence to enhance the object recognition SIFT can be used instead of SURF[4].

TABLE II : RECOGNITION ACCURACY FOR EACH REFERENCE OBJECT

Objects	No. of Images	Correct detected	False Positive	Accuracy
Keys	20	19	0	95%
Cell	20	12	0	60%
Wallet	20	17	0	85%
Sunglasses	20	17	0	85%
Total	100	84	0	84%

Hanen Jabnoun, Faouzi Benzarti and Hamid Amiri, in their paper "Object Detection and Identification for Blind People in Video Scene" has proposed system that restores a central function of the visual system which is the identification of surrounding objects. This method is based on the local features extraction concept. The simulation results using SIFT algorithm and key points matching showed good accuracy for detecting objects. They have worked for the key point detection in fast video using affine transformation in SIFT which is invariant to the changes in luminosity [5].

Lamya, Hessah, Abahussain, Lama, Masheal, Reem in the paper "Toward designing efficient application to identify objects for visually impaired" has provided a survey for the assistive technologies that can be used to help blind people in identifying objects. They presented advantages and disadvantages of the different technologies and made an evaluation in order to find out the best assistive technology that can be used for designing an efficient identification application. Furthermore, they made a comparison between the mobile applications that use human powered technology to find out which are the limitations that require more improving and research [6].

Chen Alan L. Yuille, in the paper "A Time-Efficient Cascade for Real-Time Object Detection: With applications for the visually impaired" has proposed time-efficient cascades, that can speed up object detection. For Solving the Decision Problem they used Greedy Algorithm. The text detector was tested in two systems to help blind and visually impaired people navigate on streets. One system is called the "Smart Telescope". The other similar system called "Signfinder" is designed for blind people. Instead of having a micro screen for output, the Signfinder system has an extra module to recognize the text in the marked regions, and read it aloud using a speech synthesizer [7].

Abhinaba, Indrani, Ankana, Debasish in the paper "A Novel Probabilistic approach of Colored Object detection and design of a Gesture based Real-time Mouse Tracking along with Virtual Teaching intended for Color-Blind people." has presented a conceptual approach of controlling mouse movements, writing texts and sketching colored images by simply making real time gestures in air with colored objects. They have introduced Virtual Teaching by Real-time color detection and tracking [8].

Fig.1 .Screenshot of GUI Paint session consisting of all detected

Chucai Yi, Member, IEEE, Yingli Tian, Senior Member, IEEE, and Aries Arditi in their paper "Portable Camera-Based Assistive Text and Product Label Reading From Hand-Held Objects for Blind Persons" has proposed a camera-based assistive text reading framework to help blind persons read text labels and product packaging from hand-held objects in

their daily lives. They proposed an efficient and effective motion based method to define a region of interest in the video. The performance of the proposed text localization algorithm is quantitatively evaluated. Then they employed the Microsoft Speech Software Development Kit display the audio output of text information [9].

Lukas T, Hendrik, Andrea Finke and Helge Ritter, the paper entitled "Gaze-contingent audio-visual substitution for the blind and visually impaired" has proposed a system for gaze contingent auditory substitution of spatial vision. It is intended to be a mobile helper in everyday life of the visually impaired. The prototype they have developed combines eye tracking with depth measuring and Sonification techniques. Eye movements support mental imagery regardless of the presence of visual stimuli. They have developed the Auditory Night Sight as a gaze-contingent system, meaning that the user's gaze immediately determines the direction of perception. In more than nine out of ten trials localization was successful. Size detection seems to be the much more difficult task [10].

Payal Panchal, Gaurav Prajapati, Savan Patel, Hinal Shah and Jitendra, the paper "A Review on Object Detection and Tracking Methods" has given the brief idea about various object detection methods. They have also given the comparison of these methods. They concluded that the problem occurs during identification of object if the position of camera is not proper and object in image is not captured properly then it cannot be identified. To solve these problems and get some accuracy they suggested combining multiple methods and making use of it together according to the application [11].

TABLE III. OVERALL ANALYSIS OF THE RELATED WORK

Ref. No.	Purpose	Problem Identification	Motivation
1	Comparison of SIFT, PCA-SIFT, SURF	To have good matches findings & Robustness ,good speed	SIFT can be used to solve the match finding as well robustness problem
2	Comparison of SURF and SIFT	To resolve invariant changes in view point of object	SIFT is found to be best solution. Use of real time application may help to increase the object detection.
3	Object recognition based on feature extraction	Real time processing	Real time performance will give better results
4	Finding Objects Based on SURF Features	Matches found are less	Prefer SIFT instead of SURF
5	Object detection in video	To detect detecting everything that belongs to a given place or location	Key point detection in fast video using SIFT
6	Designing efficient application to detect object	Application should give accurate results and database that contains image information should not be affected	Image processing gives faster and accurate result
7	To make a time-efficient Cascade for Real-Time Object Detection application with higher speed	To develop a time efficient system	Greedy Algorithm for solving decision problem
8	Colored Object detection and design of a Gesture based Real-time Mouse Tracking.	A form of machine learning is required to make the system smart enough for self-analysis of texts and patterns	Real-time color detection, intelligent text detection and Analyzing
9	A camera-based assistive text reading framework to help blind persons read text labels and product	To distinguish the object of interest from background or other objects in the camera view	Microsoft Speech Software Development Kit for the audio output of text information
10	To develop the Auditory Night Sight as a gaze-contingent system	Data from the current experiment are not suited for gamma band analysis.	Sensory substitution is good way to make system easy to blind person
11	A Review on Object Detection and Tracking Methods	Shape Based methods are unable to moderate accuracy	Computational Time requirement is low

12	Digital Image Processing Second Edition	There are various object detection methods depending on different techniques of identification.	SIFT and SURF is preferable for our application,

III. PROBLEM IDENTIFICATION

As per the survey of different methods and their applications identified that there should be a robust, invariant method to detect the objects with maximum matches. Existing approaches toward object detection needs some improvements .Work need to be done for comparing both SURF and SIFT to get the superior results in our application for object detection. The object information should be reached to the blind person in friendly way.

IV. OBJECTIVES

The objectives of the proposed work are

- To prove the superior technique between SURF and SIFT by comparing the result analysis.
- To detect the object using feature extraction method for blind people using the most robust technique.
- To make the information available to the person using auditory translation system.

V. METHODS FOR DETECTING OBJECT

a) SIFT-Scale Invariant Feature Detection Technique

SIFT is an algorithm in computer vision to detect and describe local features in images. The algorithm was published by David Low in 1999. [12]

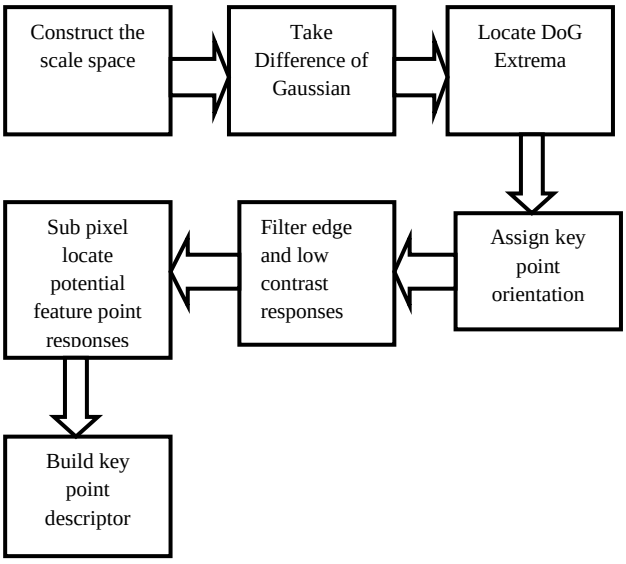

Fig. 2. Design flow for SIFT Algorithm

b) SURF-Speeded Up Robust Features

SURF is local feature detector used for object detection. SURF uses integer approximation of the determinant of Hessian blob detector.[13]

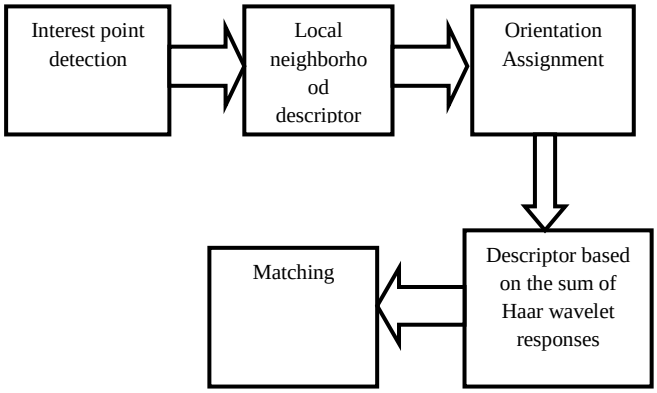

Fig. 3. Design flow for SURF Algorithm

VI. PROPOSED METHODOLOGY

The following diagram shows the proposed work flow

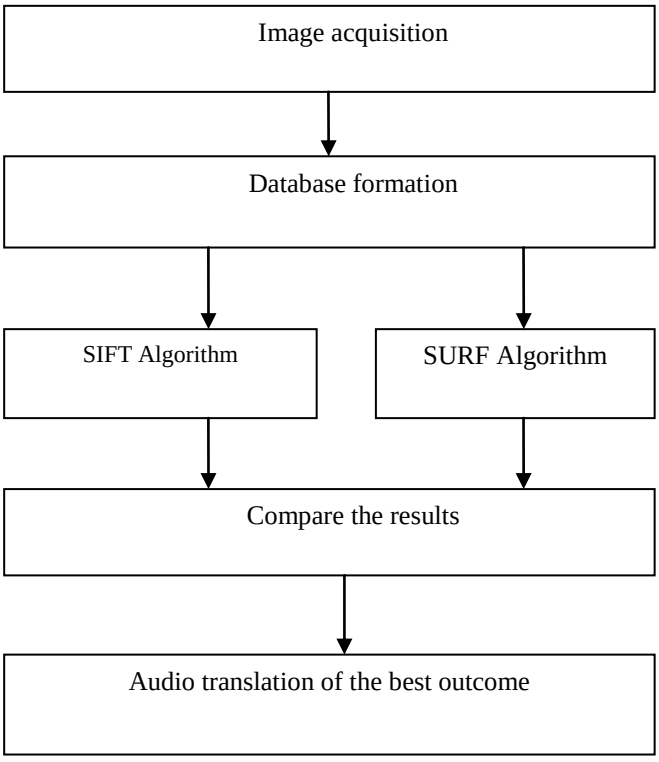

Fig.4. Proposed Methodology

VII. CONCLUSION

The survey of various work on object detection reveals that SIFT may give favorable results considering the robustness, scale invariance, luminance invariance and noise factor. Hence our main aim will be try to prove the best method for detecting object. The best outcome will be available to the user as detected object information in the form of speech.

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