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Smart Indicator for Blind People

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Abstract - **This paper presents a novel navigation system for the blind and visually impaired person. To carry on multi target recognition quickly and effectively, according to the characteristics of SIFT, PCASIFT and SURF algorithm, a method of multi target recognition based on SURF algorithm is studied. The method includes multi angles recognition and multi targets recognition. Firstly, feature points were extracted single target or multiple targets by SURF algorithm, then storing feature of target in the database, Secondly traversal targets database in the process of image registration to recognize the target, Finally, a series of tests are make to evaluate the method. Experimental results show that SURF algorithm has better robustness for characteristics of two-dimensional for rotation, scale changes and occlusion. And the three-dimensional rotation targets and multiple targets are identified quickly and effectively.**

Index Terms— **SURF; multiple targets recognition; multi angle recognition of single targets**

I. INTRODUCTION

Target recognition is a very active research direction in computer vision, image processing, pattern recognition and artificial intelligence. Target recognition has been the hot and difficult in field of computer vision. A lot of people, domestic and foreign research institutes have done a lot of research. SIFT algorithm is proposed by David Lowe in 1999, and conducted a more in-depth development and improvement in 2004, SIFT in feature description of image is deserved to be called the most popular, Because SIFT feature matching algorithm has strong ability to match two images, it can handle matching problems such as translation, rotation, affine transformation between two images [1]. SIFT has attracted the attention of many scholars since it was proposed, this method is widely used in target tracking and search based on 3D [2], target recognition [3],texture recognition, wide baseline image matching [4] and feature matching of image [5]. KE and Sukthankar didn't calculate gradient histogram directly, through PCA reducing the dimensionality, also achieved strong robustness [6], but computing speed of this method of extracting the stability feature is still relatively slow. Then Bay and Tuytelaar proposed SURF algorithm based on the SIFT algorithm. As the scale-invariant feature transform algorithm (SIFT algorithm) of accelerated version, SURF algorithm achieves real-time processing to match objects of two images in moderate conditions [7].

II. MOTIVATION

The rapid intensive use of technology now a day has led into a dramatic increase in the demand of its usage in our daily life and makes it more comfortable. There are large numbers of visually impaired people, which led us to develop such system in order to help them to avoid obstructions. Smart technology has helped blind people in many different life aspects, such as ascending stairs, reading e-mails and using computers and mobile phones. According to World Health Organization (WHO) official statistics in 2009, there are 314 million visually impaired persons in the world in which 45 million of them are blind and 87% of them are from developing countries. Aging is the main factor for blind people and 19% of the world's population, which are above 50 years old are more exposed to lose their vision. Therefore, several methods and devices have been developed and employed to serve blind people as guidance or in any other life aspects.

III. PROBLEM STATEMENT

Indoor and outdoor navigation is becoming a harder task in the increasingly complex urban world. Advances in technology are causing the blind to fall behind, sometimes even putting their lives at risk. Technology available for context-aware navigation of the blind is not sufficiently accessible; some devices rely heavily on infrastructural requirements. 314 million visually impaired people in the world today.[7]

- Now days….
  - 45 million blind
  - More than 82% of the visually impaired population is age 50 or older

- The old population forms a group with diverse range of abilities. The disabled are seldom seen using the street alone or public transportation.

IV. LITERATURE SURVEY

According to the statistics from the World Health Organization (WHO) [8], about 285 million people are visually impaired worldwide. Of these about 39 million are completely blind, and 246 million have low vision. Moreover, about 65% of these are aged 50 and older, while this age group comprises about 20 % of the world's population [9]. Therefore, with an increasing elderly population in many countries, more people will be at risk of age-related visual impairment.

V. THE PRINCIPLE OF SURF ALGORITHM

(A) Introduction of SURF algorithm

SURF algorithm is an improved algorithm that improved on SIFT algorithm. Mainly reflects on the efficiency of this algorithm, run faster than the SIFT algorithm. As the scale invariant feature transform algorithm (SIFT algorithm) of accelerated version, SURF algorithm achieves real-time processing to match objects of two images in moderate conditions. The only one principle of it is so fast is the integral image haar [8] derivation.

(B) Principle of SURF algorithm

1. Construction of Hessian matrix

The core of SURF algorithm is the Hessian matrix [8], in order to operation conveniently, if the function f (z, y), Hessian matrix is composed by function and the partial derivative.

$$H(f(x,y)) \qquad (1)$$

H matrix discriminate is:

$$\det(H) = \qquad (2)$$

In the SURF algorithm, image pixel L (x, y) instead of the function value f (x, y), we use the two order Gauss function as the filter, through specific convolution computation of two order partial derivative, three matrix elements so that we can get three elements of H matrix, H matrix as in (3).

$$H(x,t) = \begin{bmatrix} L_{xx}(x,\sigma \\ L_{xy}(x,\sigma \end{bmatrix} \qquad (3)$$

$$L(X \qquad (4)$$

L(X, £) is expressed in different resolution of an image, it can use the Gaussian kernel function G(£) and image function, (X) can be obtained by the convolution of point X(z, y), kernel function G(£) is as in (5), g(£) is Gaussian function, t is the Gauss variance, the value of H determinant of each pixel in the image can be calculated by this method, and use this value to determine the feature point, the discriminant of H matrix is as in (6).

$$(5)$$

$$\det(H_{approx}) = D_{xx}D_{yy} - \qquad (6)$$

2. Construction of Scale space

The scale space of image is expressed in different resolution of image. As in (4), we can know that J(X) of an image can be obtained by Gaussian kernel function G(£) which expressed in different resolution. The size of the image scale is generally used to be represented by the standard deviation of Gaussian. In the field of computer vision, scale space is described symbolically of an image pyramid. In order to improve the performance of this algorithm, SURF algorithm doesn't need double sampling of image. The size of image kernel is increased under SURF algorithm, so it allows multilayer images of scale space to be processed at the same time. Fig.1 is a pyramid structure is based on the traditional way. The size of image is mutative, and operation will be repeated using Gauss function to process the sub-layer smoothing. The SURF algorithm doesn't change the original image but change the size of filter, as in Fig. 2.

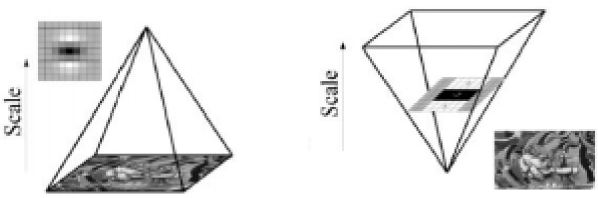

Fig 1 & 2: Traditional pyramid structure & Pyramid structure under SURF

3. Precise Positioning of Feature Points

we will use the scale layer of image resolution and the corresponding size of filter in the detection process, filter with 3 × 3 as an example, One of scale layer image of 9 pixels detecting the feature point and another 8 points, then compare with the 9 points of the scale which above and below. According to whether feature pixel values of X greater than the surrounding pixels, this point x (Fig. 3) must be the feature points of this region.

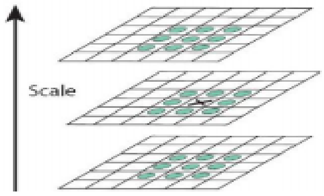

Fig 3: Non Maximal Suppression

4. To Determine the Main Direction

The calculation of radius 6×S (S is feature point scale value) within a neighborhood of the point haar[11] wavelet response in Z, Y direction, and give Gauss weight coefficient to value of these response, make the points that near feature points response greater, and the points that away from feature points response smaller, adding response in the range of 60 to form a new vector, then traversal the whole circular area, select the longest direction of the vector as the main direction of the feature point. As in Fig. 4.

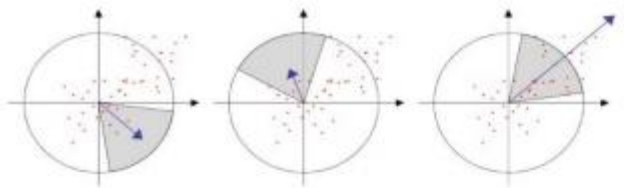

Fig 4: Orientation assignment

5. Generation of Feature Point Descriptor

To ensure the rotational invariance, firstly rotate axis in the direction of the key point. Secondly using the key point as the center to get 8×8 window. Left part of the central black point is the current position of the key points, each cell represents a pixel that small neighborhood of the key points in the scale space, using the equation to get the gradient magnitude and gradient direction of each pixel, Direction of the arrow represents the gradient direction of the pixel, Length of the arrow represents the gradient magnitude, Then weighted arithmetic by Gauss window, each pixel corresponds a vector, its length is Gauss weights of the pixel, Blue circle represents the range of the Gaussian-weighted as the direction as in Fig. 5. Gradient direction histogram in 8 directions is calculated for each of the 4×4 blocks. Draw the accumulated value of each gradient direction, then can form a seed point, as in right part of Fig. 5.

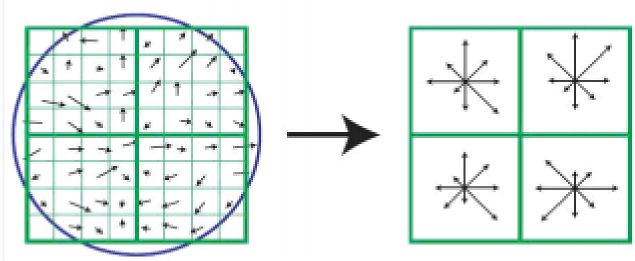

Fig 5: Image gradients (left) and keypoint descriptor(right)

A key point in this figure is composed of 2×2 seeds, Every seed point vector information in 8 directions, thinking combined with the neighborhood direction information increase algorithm against noise. At the same time feature matching that includes a positioning error also provides better fault tolerance.

VI. PROPOSED ALGORITHM

Although my aim for working on this project is to provide frequent path for blind person, Blind person will carry a web cam. During live camera if there is any object detected, this system will inform blind person to be aware of that object. For the testing of my developed algorithm, I have started this with a recorded video. I have recorded a video of Table. During playing of this video, as the table is detected, system will display the name of object i.e. TABLE. The required algorithms are shown below.

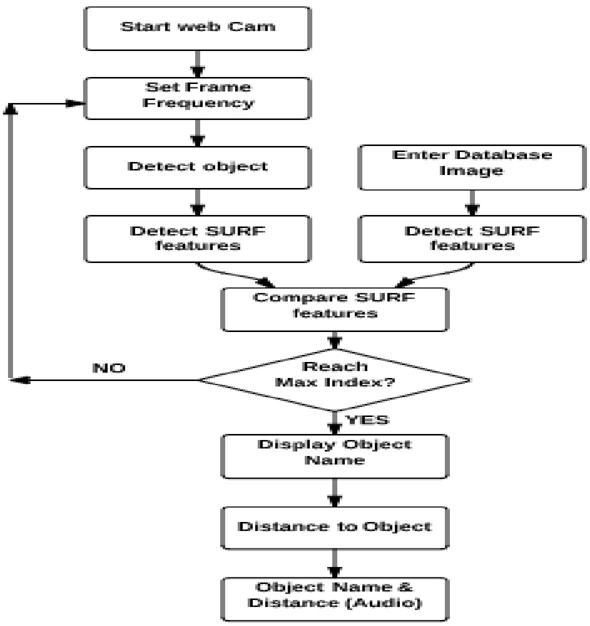

Fig 6: Proposed algorithm

The above algorithm is the proposed algorithm of this project. It shows the complete flow of getting the desired output. Firstly, it starts with the activation of web cam. As this system is designed for blind people, this camera will work as their eyes. I have used the software called MATLAB. The frequency of frames passed by a second will be set in matlab. Now web cam is already activated, as any object is detected in web cam, as per coding, SURF features of object will be detected. Now, I will enter the data base image of object. The SURF features of this data base image will also be detected.

Now I have two kind of different SURF features. At this stage, both features will be compared. I have set an index point in coding, that shows the max matched features between two images. As it reaches the max index, it will display the name of detected object.

Here, I have tried this algorithm on three objects (TV remote, cupboard and chair). Thus, it is clear that this algorithm alerts blind person by indicating the object.

This was the complete description about proposed algorithm. I have started following it. Till now, I have successfully applied SURF on two images. Instead of capturing image from web cam, I have entered sample image for simple execution. As it works successfully, I will apply by using web cam during next phase.

V. EXPERIMENTAL RESULTS AND ANALYSIS

A. Recognition of Single Target

The method of target recognition is divided into the following steps:

a) Extract SURF feature of one interest target from an image or a frame of video, and then establish feature database for every target.
b) Select a object which is needed to be identified from feature database, and the SURF feature are taken out.
c) Start recognition multi threads, an image of video is acquired and a new SURF feature are extracted.
d) The SURF features of two groups are compared to determine the target weather existing. The threshold [10] is set to 0.65, which is the optimal threshold value of our experiment.

Select a dustbin corresponding feature database, and then start the recognition threads. The dustbin's features detection process shown below as in Fig. 7(a) to 7(h).

B. Recognition of Multi Target

Recognition steps are like recognition of multi angle of single target. For showing the experimental results clearly, we need to put the objects being identified together, and then traverse the signature database to match feature. Experimental results as in Fig. 8(a) to Fig. 8(d). Objects in Fig. 8(b) are a chair, a cupboard and a travelling bag. For the target recognition whose color features are more obvious, use SURF algorithm to recognize, accurately and rapidly, as in Fig. 8(d).

Fig 7:Database Image of Dustbin

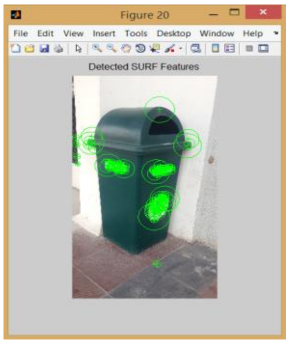

Fig 8: Detected SURF feature of Dustbin

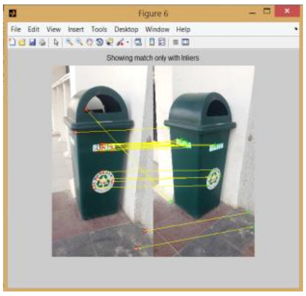

Fig 9: All matched SURF features of Dustbin

Fig 10: Detected Object

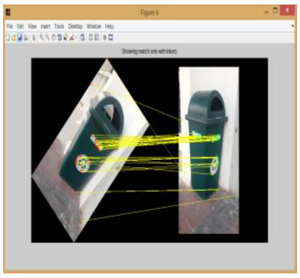

Fig 11:All matched SURF features of Dustbin (45° rotation)

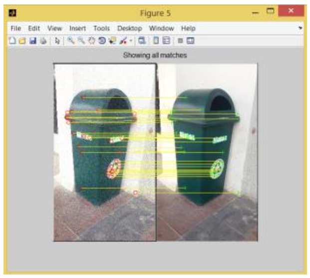

Fig 12:All matched SURF features of Dustbin (Blur Image)

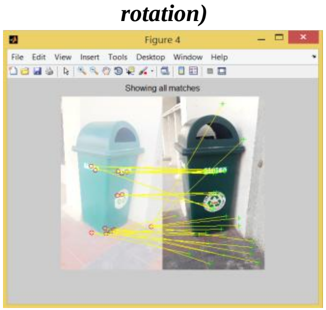

Fig 12:All matched SURF features of Dustbin (High Brightness Image)

Fig 13:Detected Distance between Camera and Object

C. Comparative Analysis

Table 1: Comparative analysis of SURF & SIFT

	Matched Features		**Time (sec)**	
Parameters	**SIFT**	**SURF**	**SIFT**	**SURF**
Original	356	234	124.46	4.12
Scaling	151	109	72.72	4.74
Rotation	1109	498	143.81	4.54
Blurring	227	195	32.58	3.11
Illumination	697	478	55.62	4.67
Affine Transform	215	174	90.67	3.56

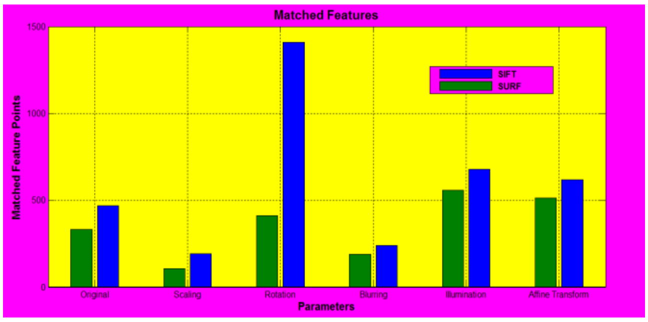

Fig 14: Graphical analysis of matched points detection of SURF & SIFT

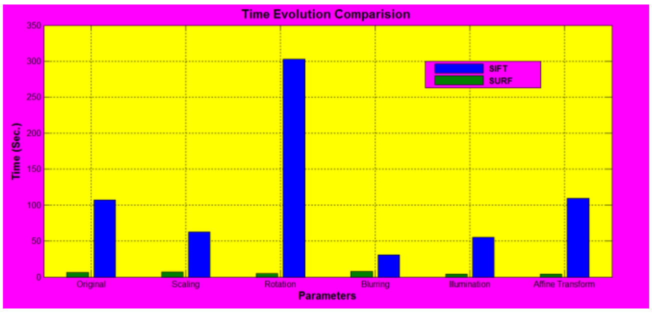

Fig 15: Graphical analysis of time consumed for detection of object in SURF & SIFT

VI.CONCLUSION

This report has presented a novel wearable indicator system for the blind and visually impaired in unknown dynamic environments. Firstly I have successfully applied SURF on image and have got desired object detection. Now I have use web cam instead of database image, so wonderful system has been designed which can not only estimate the camera motion itself but also reconstruct the motion of the moving object to avoid collisions. System extracts video frames through the camera. Fast robustness feature detection of SURF algorithm is used for each frame image, to find quickly multi target or different angles target, and draw an external circle representing recognition region. Experimental results show that this method has low complexity, real-time and good robustness characteristics. I proposed an object recognition system using SURF feature extraction is suitable for object detection and recognition from cameras. Furthermore this system is able to find the distance from object to camera. The output will be in form of audio, so that as the object comes in front of blind person he/she will be able to know the name of object and the distance from camera to that object. The system which we have developed using MATLAB, is remarkable in many ways. First of all it's able to detect all views of the object (front and side view) and recognize each of them very accurately. Then this method gives good result for an object for a very close as well as far away from the camera.

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