

Finding Objects for Blind People Based on SURF Features

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Abstract – Nowadays computer vision technology is helping the visually impaired by recognizing objects in their surroundings. Unlike research of navigation and wayfinding, there are no camera-based systems available in the market to find personal items for the blind. This paper proposes an object recognition method to help blind people find missing items using Speeded-Up Robust Features (SURF). SURF features can extract distinctive invariant features that can be utilized to perform reliable matching between different images in multiple scenarios. These features are invariant to image scale, translation, rotation, illumination, and partial occlusion. 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. Experiment results demonstrate the effectiveness and efficiency of the proposed method.

1. Introduction

The World Health Organization (WHO) estimated that in 2002, 2.6% of the world's total population was visually impaired. Also, the American Foundation for the Blind (AFB) approximates that there are more than 25 million people in the United States living with vision loss. Visually impaired people face many challenges when interacting with their surrounding environments. One challenge is finding dropped or misplaced personal items (i.e., keys, wallets, etc.). While many literatures and systems have been focusing on navigation [1], wayfinding [8], text reading [3], bar code reading, banknote recognition [7], etc, there are no camera-based systems available in the market to find personal items for the blind. The goal of this paper is to develop an effective algorithm to help people with visually impairments to find personal items such as keys, wallets, sunglasses, cell phones, and other objects.

In this paper, we develop a method to help blind people finding missing items based on Speeded Up Robust Features (SURF) [4, 6]. A blind user is equipped with a wearable camera which is connected

(wire or wireless) to a computer (PDA, or laptop). A database of the personal items for the user is created in advance. In the database, multiple images for each item are captured from different camera views, scales, lighting changes, and occlusions. The user can send requests of finding an item by speech command and then wear the camera system to look for the item. When the system finds the requested item, an audio signal will be produced. In our method, based on the blind user's request, features from camera captured images are first extracted by SURF. Then, these features are compared to pre-calculated SURF features from reference images of the request object in the database. If matches are found, the algorithm will output an audio signal to indicate that the object has been found according to the pre-established thresholds for each object.

2. SURF Detector and Descriptor

Robust distinctive features extraction is important for developing effectiveness and accuracy of the object recognition algorithms. Interest point detectors and descriptors [4, 5] enable the extraction of sufficient distinctive features from reference images which allow their precise matching with other images in the presence of clutter. Recent developments in object detection and recognition involve the use of Scale Invariant Feature Transform (SIFT) [5], and Speeded Up Robust Features (SURF) [4, 6]. SIFT is a method to extract features invariant to image rotation and scaling, as well as partially invariant to image viewpoint and illumination changes. SURF is a detector-descriptor algorithm that accelerates the keypoint localization process maintaining the image properties.

3. Detecting Objects by SURF-based Feature Matching

The object recognition is conducted by matching the reference and query images. We collect a database

which contains personal items that are essential to visually-impaired individuals such as keys, cell phones, wallets, sunglasses, and sneakers. The database includes 100 test images, containing 20 images for each of the object class mentioned above. In addition, 20 negative images with none of these objects are captured to evaluate false positives. This database covers a variety of conditions such as image scale, translation, rotation, change in viewpoint, and partial occlusion.

4. Experimental Results

As shown in Table 1, our algorithm achieves an average accuracy of 84% for 5 types of objects. Figure 1 demonstrates sample result images for different objects the conditions of scaling change, translation, rotation, change in viewpoint and partial occlusion.



Figure 1: Matching between reference and test images in the presence of cluttered background under various conditions, keys (image scale), cell phone (partial occlusion), sunglasses (translation), sneaker (rotation), and wallet (change in viewpoint).

5. Conclusion and Future Work

This paper has presented a new approach for object recognition using SURF features to help blind people find missing items in their daily life. Our future

work will focus on enhancing the object recognition system so that it can better detect and identify objects under extreme and challenging conditions. We will also address the human interface issues for image capture and auditory display of the object recognition on computers and cell phones.

TABLE 1: 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%
Sneaker	20	19	0	95%
Total	100	84	0	84%

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