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Shadow Detection and Removal from Moving Object Using Neuro- Fuzzy

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Abstract: Detection and tracking of moving objects is at the core of many applications dealing with image sequences. One of the main challenges in these applications is identifying shadows which objects cast and which move along with them in the scene. Shadows cause serious problems while segmenting and extracting moving objects due to the misclassification of shadow points as foreground. Shadows can cause object merging, object shape distortion, and even object losses (due to the shadow cast over another object). The difficulties associated with shadow detection arise since shadows and objects share two important visual features. First, shadow points are detectable as foreground points since they typically differ significantly from the background. Second, shadows have the same motion as the objects casting them. For this reason, the shadow identification is critical both for still images and for image sequences (video) and has become an active research area, especially in the recent past. It should be noted that, while the main concepts utilized for shadow analysis in still and video images are similar, typically, the purpose behind shadow extraction is somewhat different.

Our goal is to build a reliable shadow detector for moving objects of outdoor scenes. While detecting all shadows is expected to remain hard, we explicitly focus on the shadows cast by objects onto the ground plane. The types of materials constituting the ground in typical outdoor scenes are (relatively) limited, most commonly including concrete, asphalt, grass, mud, stone, brick, etc. With this observation, our hypothesis is that the appearances of shadows on the ground are not as widely varying as the shadows everywhere in the scene and can be learned from a set of labeled images of real world scenes. This restriction by no means makes the problem trivial: the ground shadow detector still needs to contend with myriad other non-shadow visual manifestations such as markings and potholes on the roads, pavement/road boundaries, grass patterns on lawns, etc. Further, since many objects (pedestrians, vehicles, traffic signs, etc) of interest to vision applications, are attached to the ground and cast shadows onto the ground, we believe such a ground shadow detector will find wide applicability.

Keyword: Neuro Fuzzy, recognition, Shadow detection, tracking object, stereo.

I. INTRODUCTION

Shadows are a frequently occurring natural phenomenon, whose detection and manipulation are important in many computer vision (e.g., visual scene understanding) and computer graphics applications. Shadows have been used for tasks related to object shape, size, movement, number of light sources and illumination conditions [1]. Shadows have a particular practical importance in augmented reality applications, where the illumination conditions in a scene can be used to seamlessly render virtual objects and their casted shadows. Contrary to the above mentioned assistive roles, shadows can also cause complications in many fundamental computer vision tasks. For instance, they can degrade the performance of object recognition, stereo, shape reconstruction, image segmentation and scene analysis. On the one hand, it can reduce the successful rate of edge extraction, object recognition, image matching, change detection and other processing for the corresponding ground objects in the shadow. On the other hand, it can produce a great deal of useful information about shape, relative position, surface character and other characters of the object generating shadow. It is a necessary step to eliminate shadow and restore the scenes in the shadow area before performing object recognition and image matching tasks for the shadow area. Thus, shadow detection and elimination has become very important in image processing. In digital photography, information about shadows and their removal can help to improve the visual quality of photographs. Shadows are also a

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serious concern for aerial imaging and object tracking in video sequences.

II. LITERATURE SURVEY

I. Sato, Y. Sato, and K. Ikeuchi, “Illumination from shadows,” TPAMI, presented that the image brightness of a three-dimensional object is the function of the distribution of light sources, the shape of a real object; and the reflectance of that real object surface[1].

A. Prati, I. Mikic et al., “Detecting moving shadows: Algorithms and evaluation,” TPAMI, presented difficulties associated with shadow detection arise since shadows and objects share two important visual features[2]. First, shadow points are detectable as foreground points since they typically differ significantly from the background. Second, shadows have the same motion as the objects casting them[3].

G. D. Finlayson, S. D. Hordley, C. Lu, and M. S. Drew, “On the removal of shadows from images[4],” TPAMI, discussed three different shadow-free image representations in this paper: a 1-d invariant derived from first principles based on simple constraints on lighting and cameras[5], a 2-d chromaticity representation which is equivalent to the 1-d representation but with some colour information retained and, finally, a 3-d full colour image[6,7].

R. Panagopoulos, C. Wang, and D. Samaras, “Estimating shadows with the bright channel cue,” in CRICV, introduced a simple but efficient cue for the extraction of shadows from a single color image, the bright channel cue[8,9,10]. They discussed its limitations and offer two methods to refine the bright channel: by computing confidence values for the cast shadows, based on a shadow-dependent feature, such as hue[16]; and by combining the bright channel with illumination invariant representations of the original image in a flexible way using an MRF model[11,12].

Remya K. Sasi,V.K. Govindan, “Fuzzy split and merge for shadow detection”, proposed a method to detect the shadow from single image using fuzzy split and merge approach, a classical algorithm used in image segmentation[13,14,15].

III. SYSTEM ARCHITECTURE

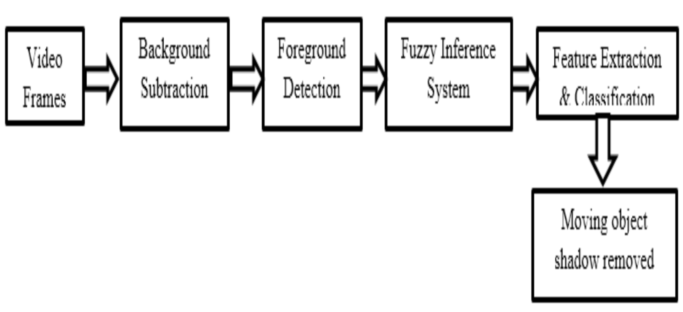

Fig. 1 Block Daigram

The block diagram consists of the following main components:

1) Video Frames

It takes the input in the form of videos for processing.

2) Background Subtraction

Background subtraction is a technique wherein an image's foreground is extracted for further processing like object recognition etc. In general an image's regions of interest are objects (humans, cars, text etc.) in its foreground. Background subtraction is a widely used approach for detecting moving objects in videos from static cameras.

3) Foreground Detection

In the next frames, a comparison is processed between the current frame and the background model. This subtraction leads to the computation of the foreground of the scene. The most insignificant method to perform foreground detection is by taking the difference between two images. Location of changes correspond to large values in the difference map which can be computed as the absolute values of the difference between corresponding pixels in the two images, relative or normalized difference also can be used.

4) Fuzzy Inference System

The Adaptive Neuro-Fuzzy Inference System (ANFIS) classifier is adopted to eliminate the limitations in the individual implementation of neural network or fuzzy. The learning capability of ANN was fully manipulated for automatic IF-THEN rules generation and parameter optimization of fuzzy system. ANFIS architecture is an adaptive network that uses supervised learning on learning algorithm, which has a function similar to the model of Takagi–Sugeno fuzzy inference system.

5) Feature Extraction and Classification

In machine learning, pattern recognition, and image processing, feature extraction starts from an initial set of measured data and builds derived values intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps. Feature extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems arises from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computational power.

6) Shadow Removed

With the application of classifier, the features of the shadow can be studied using spatial features, transform features, edge and boundary features, color features, shape features , texture features and the shadow gets removed.

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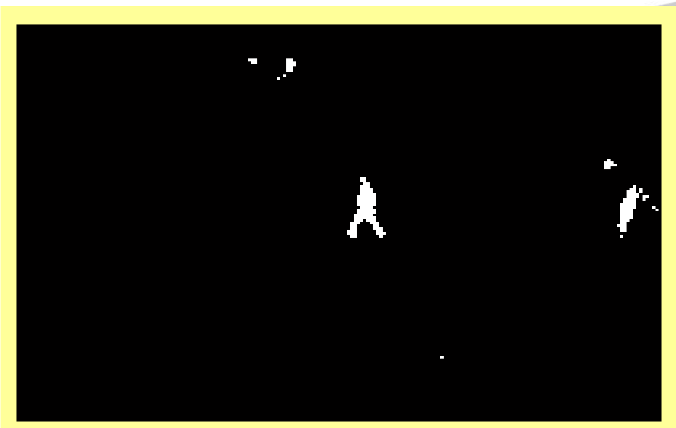
IV. RESULTANALYSIS

Pic 1: Input Video

The input video shows a sequence of 70 frames. For this, the height, weight and number of frames are calculated.

Pic 2: Detected foreground



The video shows a person moving wherein his shadow has to be removed from the scenario. The part that has to be worked upon (foreground) must be differentiated from the background. This difference is done by creating black and white portion for both the parts. Hence the white part is the detected foreground and the black part is the background part.

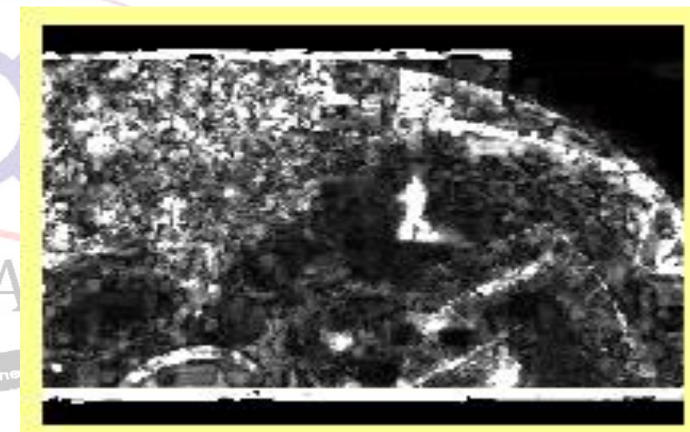
Pic 3: Brightness Difference

Brightness difference improves quality of image by increasing the luminance difference between the black and white parts. This creates the object distinguishable from other objects and the background. In visual perception, brightness is determined by the difference in the color and the brightness of the object with other objects.

Pic 4: Color Difference

The picture depicts the difference of two frames. The image is a color image and the difference of two frames is taken.

Pic 5: Enhanced Color Difference



This difference is then amplified with the help of scaling factor to perceive better view of the image.

Pic 6: Shadow Detected

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The applied properties of enhancement and brightness formed the area with more prominent shadows and the shadow is detected.

Pic 7: Shadow removed

This image is processed by the Adaptive Neural Fuzzy Inference System to eliminate the shadow from the object which is based on first-order Takagi-Sugeno-Kang (TSK) method.

V. CONCLUSION

In this paper, we have described a novel approach to detect and remove shadow from moving objects in real time video sequences. For the detection method, we are using background subtraction technique incorporating detection of the moving objects from the difference between the existing frame and the reference frame. It performs with stability in dynamic scenes, and less impacted by illumination changes. This method adopts pixel-based difference to find the moving object. After successful performance of background subtraction the foreground image is extracted whose features are enhanced by color enhancement method. For feature extraction, discrete wavelet transform is applied on the image using Haar wavelet. An ANFIS was developed, in which a system is specifically used for output class. The network input is a feature vector that composed of two major elements; two spatial features, and one temporal feature. The ANFIS training was done on the selected portion and a clear removal of shadow was observed. The experiment shows that the method has good performance and efficiency.

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