An Approach for Shadow based Time Prediction in Video Sequence

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***Abstract*— Running days everything is being watched out by using cameras and it plays a vital role in the absence of paid watchmans. This camera provides the security at each and every moment of our lives. At current times high resolution cameras have ability to detect the objects very accurately. During low-light conditions, the video quality is poor. This may lead to insufficient information in video. Facial features are not visible properly and it will become difficult to identify a person. The time is the important evidence of proof. At the time of accidents the Forensic Identification Services (FIS) uses shadows to predict at what time the incident has happened.**

The proposed work "Naïve approach for Shadow based time prediction in Video Sequence" detects shadow and then extracts the shadow region from the video frames by using background subtraction method and morphological operations. Based on the length of the shadow and angle of inclination between object and shadow is used to predict the time.

Keywords—Background subtraction, Shadow extraction, Forensic Identification Services [FIS], Time prediction.

1. INTRODUCTION

With wide range of styles and features, in recent days the invention of camera changed the world by providing security in most industries. These applications can range from theft and vandalism deterrence to traffic and weather monitoring and more. This camera system can bring us peace of mind same time improve the management of organizations by providing security to the lives. In present days high resolution cameras have ability to detect the objects in accurate manner.

Both public and private sectors use video surveillance systems as a security tool for helping people and their property by reducing crimes. And they have significant implications in the defenses against criminality and also terrorist threats. Understanding of human activities from a video is an important stream of research within computer vision which has been achieved a lot of importance in the history of last few years. Growing interest in human motion analysis is indeed strong motivation to the recent improvements in computer vision.

Object detection in video sequence is a major problem in computer vision applications in several fields, such as target tracking, traffic monitoring and video surveillance. Among the entire background object's shadow in the image, the particular image has more influence on the accuracy of the image segmentation and also the measurement. Thus shadow identification and extraction is a preprocessing and inevitable task of some computer vision algorithms for applications such as image segmentations, object detection and tracking.

Shadows are the physical phenomena observed in most of the natural scenes. Not only the shadow, but shading in image also leads to undesirable problems in image analysis. Moreover, shadows imply a geometric relationship between the objects, its light source, and also the viewpoint. This indicates that real images associated shadows are used for image synthesis but only in a limited situation where the lighting conditions are consistent with that of the real images [1].

Shadows are defined as the parts of the scene and they are not directly illuminated by a light source due to an obstructing object(objects). And the shadow regions are always illuminated by the ambient light. Shadows can be divided into two major classes: self-shadows and cast shadows. A self-shadow occurs on the portion of an object that is not illuminated by direct light. A cast shadow is an area projected by the object in the direction of direct light. The cast shadow is usually further divided into two parts: umbra and penumbra. The umbra represents the shadow region where the primary light source is completely obscured, but the penumbra is the region around the edge of a shadow where the light source is partially obscured.

Shadows are classified into two types based on the intensity. They are hard shadows and soft shadows. The soft shadows always retain its texture of the background surface, whereas compared to soft shadows hard shadows appears too dark and they have little texture. Hence there is more complication in the detection of hard shadows. So many shadow detection techniques requires multiple images for camera calibration. There should be a best techniques that must be able to extract only the shadow region from a single frame.

The proposed method recognizes shadows as positive influence on sources of information and it provides useful information about objects. Shadow in an image plays a very important role in image processing applications. Finding the length of the shadow the object height and based on this information angle is measured.

Shadow is indentified as an object which is normally connected adjacent to the object. Shadows in an image can divulge information about the object's shape, orientation and even about the light source [3].

The two factors that affects patterns of shadow:

- Object's size
- Angle of light source.

During low-light conditions the video quality is very poor and the facial features are not visible properly. At the time of accidents, the time is important evidence of proof. In these situations Forensic Identification Services feels very difficulty in finding at what time the incident has happened.

To overcome these shortcomings the proposed system will find out the length of the object and shadow and measure the angle between the object and shadow to predict the time.

2. MOTIVATION

- The motivation carry out this work is primarily personal interest in undertaking and do a challenging project in an interesting area of research.
- In order to help Forensic Identification Services (FIS) in case of emergency conditions like accidents.

3. RELATED WORK

In this section related literature about shadow detection and shadow extraction is done by using various methods. But there is no base paper regarding time prediction and angle formation, only shadow detection and extraction methods are briefly described.

N.Muthamizh Selvi [1] proposed image processing technique for detection of shadow portion. The image is acquired using digital camera having high resolution. After getting the image, then the preprocessing technique to extract the noise of the source image. The object and the shadow are extracted using morphological operations.

Adesh Hardas, Dattatray Bade, Vibha wali [2] have proposed image processing technique background subtraction. Identify the objects in an image by using computer vision application background subtraction. The background subtraction separates the foreground from background. Cast shadow related with the object is get detected and is a great challenge in video surveillance.

Krishna Kaant Singh, Kirat Pal and M J Nigam [3] have proposed a method that works on Otsu's thresholding method to detect shadows. After shadow detection they are separated by the object using morphological operations.

4. METHODOLOGY

The proposed system framework contains the procedures to collect the sample shadow based videos and images using camera under one hour interval. (i.e. from morning 9.30AM to 6.30PM) image pre-processing, prediction of time based on the length of the object and its related shadow is done. The Architecture diagram of shadow based time prediction is as shown in figure 1.

The proposed system consists of 2 modules.

- Module – I: Knowledge Acquisition
- Module – II: Time prediction

Module –I: Sample images and videos are collected to record the record the features such as length of the object, shadow and the angle between them. These details are stored in Knowledge database for further processing.

Module –II: In this module, five steps such as object detection, shadow detection, shadow extraction, and feature extractions are employed to predict the time.

A. OBJECT DETECTION

The first step towards detecting objects is to discover the moving object in each successive frame of a video. Object detection is method of identifying the non-stationary movement of the objects in the video frame sequences. There are many various methods available to find the object in the video frames. Such methods are optical flow background subtraction, frame difference and double difference.

In computer vision moving object detection and tracking is a fundamental topic. Moving object detection is very important as it contains the shadow with the object. One of the most widely used methods to detect moving objects is the background subtraction method.

B. SHADOW DETECTION

Shadow detection is the main process for the final image analysis task. To detect shadows, the surrounding regions and appearance of the local regions are considered.

Shadowed boundary tends to be dark, with little texture, whereas some non-shadowed regions may have similar characteristics. Background subtraction is the most common method used to segment out the interested objects in a particular frame.

C. SHADOW EXTRACTION

The shadow identification and segmentation requires accurate selection of features that can be used to distinguish actual foreground objects and the related shadow. The proposed method employs various methods to separate shadows from foreground objects for time predication. Background subtraction results include foreground objects and shadows.

D. FEATURE EXTRACTION

In feature extraction phase the proposed method extracts two features like length and angle. The length of the object and its related shadow are determined. Based on the length of the length of the object and shadow angle formation is done to predict the time.

E. TIME PREDICTION

The final step is time prediction. The time prediction is done based on the length of the object and the shadow along with the angle of inclination between the object length and the shadow length. Finally the outcome of the proposed system is the display image with time.

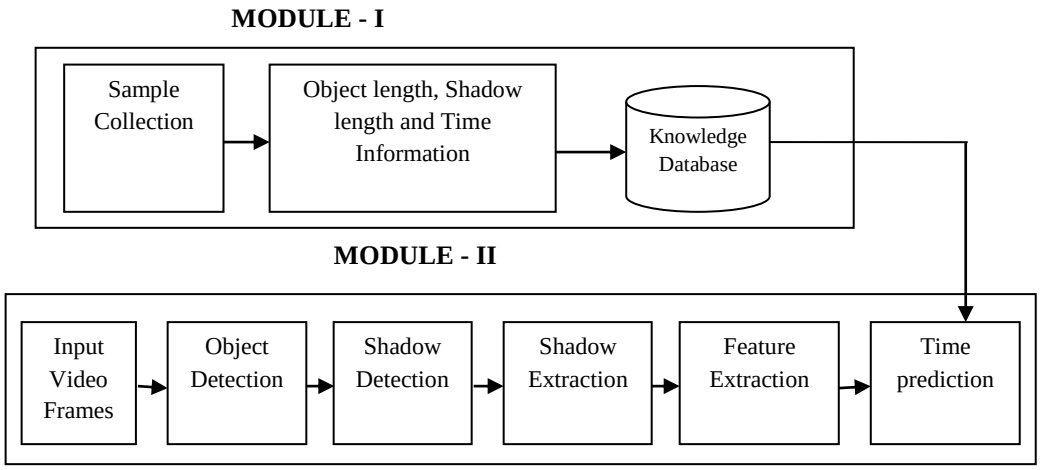

Figure 1: Architecture Diagram

In the proposed method first take the video as input then it is converted into number of frames. Background subtraction technique will identify the background objects as foreground object or background. The resultant frame contains only the foreground object and the adjacent shadow attached to the interested object. In order to extract the shadow region background subtraction method is applied. And to obtain different features like and length and angle, the threshold technique selects a threshold to separate the background shadow from the main foreground object.

Morphological operations are applied to segment the objects like man and the related shadow in frame and these object and shadow boundaries are extracted to calculate the length of the object and shadow in the form of pixels. Based on the length of the object and shadow angle is formed. The θ (theta) is the angle of interest, AB defines the length of the man denoted by as θ (*y*), BC defines the length of the hypotenuse denoted by (*z*), and AC defines the length of the shadow with respect to the object man adjacent to the angle θ (*x*) as illustrated in the triangle shown in figure2.

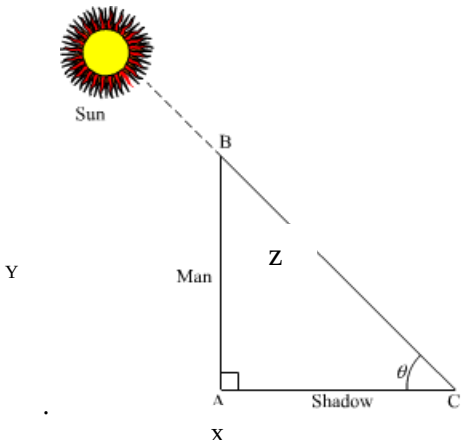

Figure 2: Angle between the Man and Shadow

A. Object Length

The object length is computed based on the size of the pixels of object that is man.

B. Shadow Length

The shadow boundary is extracted to find the length based on the size of the pixels of the shadow region.

C. Angle Formation

Based on the length of the object and shadow the angle is formed by using the trigonometric identity.

$$\tan(\theta) = AB(y)/AC(x) \quad (1)$$

$$\tan(\theta) = Man/Shadow$$

Where:

θ an angle of a right triangle

x shadow adjacent to the angle

y man opposite to the angle

z hypotenuse of a triangle

D. Time Prediction

The final step is time prediction. The time prediction is done based on the length of the object and the shadow along with the angle of inclination between the object length and the shadow length. Finally the outcome of the proposed system is the display image with time.

5. RESULTS

INPUT FRAME:

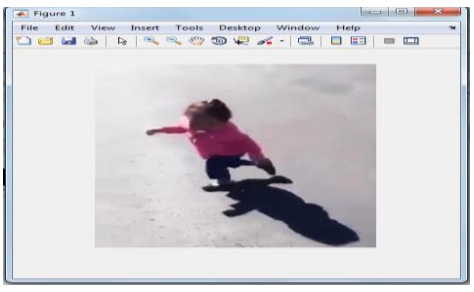

Figure 3: Input Frame

In the proposed method the input video is converted into number of frames. The input frame which contains two objects. The first object is the baby and the second one is related shadow of that baby.

OBJECT DETECTION:

Objects along with shadow region are detected using background subtraction method is shown in Figure 4. And the noise is eliminated using median filter.

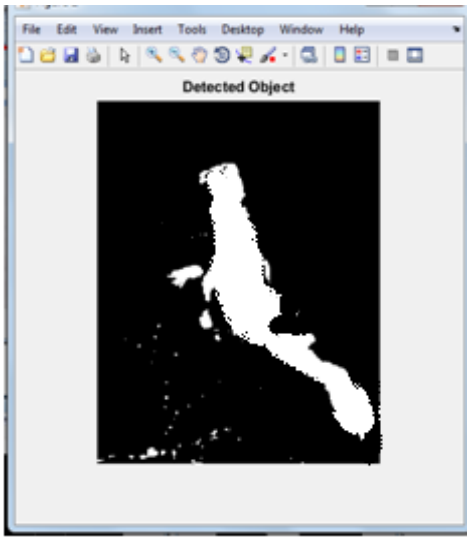

Figure 4: Background Subtraction

SHADOW EXTRACTION:

Figure 5. shows the objects and shadow regions are separation by using Otsu's thresholding. Only the object and the shadow boundary are extracted to find the size of them.

Figure 6. shows the boundary extracted object and shadow regions are filled using the morphological operations.

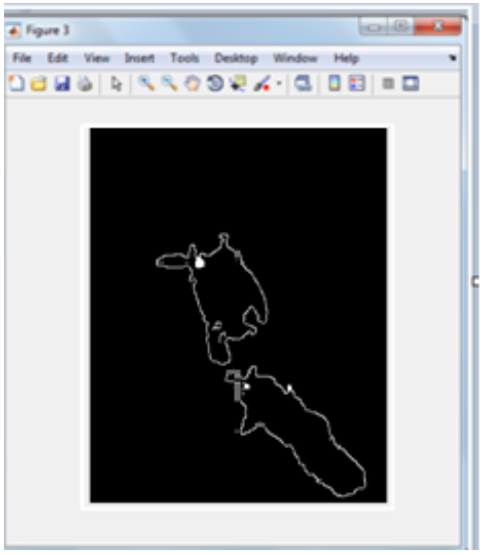

Figure 5: Object-Shadow Extraction

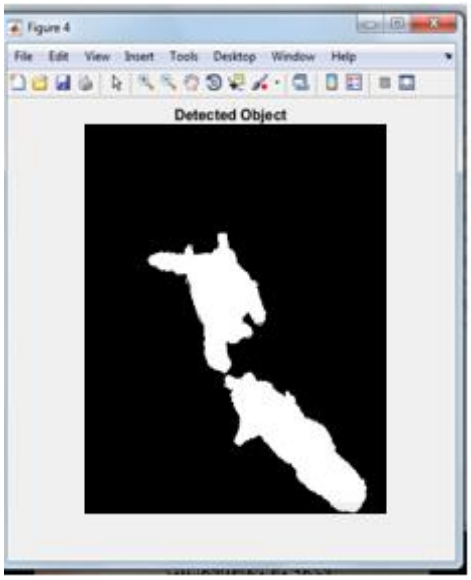

Figure 6: Region filling

6. CONCLUSION AND FUTURE ENHANCEMENT

In the proposed method the results shows object detection using the background subtraction method. The method works on Otsu's thresholding method to segment the shadows region and the regions are filled by morphological operations.

Further work can be carried out as the extension of the outlined work in the paper. Time prediction can be done based on the length of the object and the shadow and the angle formation.

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