Detecting and Extracting Features of Multiple Moving Objects for Surveillance System

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***Abstract*— Object detection and feature extraction are main initial steps in digital image processing for surveillance system. A single object can be easily detected in an image. Multiple object in an image can be detected by using different object detectors simultaneously. The object detection methods have a wide range of application in a variety of areas including robotics, medical image analysis, surveillance, military operation and security purpose. Feature extraction is the process of extracting useful information from the input image. Here, object is detected and then extract its features by using HOG i.e. Histogram Oriented Gradient algorithm. This paper explains an algorithm which takes the video as an input and starts extracting frames from these video. Through the feature extraction algorithm, we have detected and extracted its features. Further these detected objects were classified according to the shape based criteria.**

***Index Terms*— Object detection, Sliding Window Technique, Feature extraction, HOG, SVM.**

I. INTRODUCTION

Detection and extraction of moving object for surveillance system is an important research area of image processing. The essential work of surveillance system is to detect the moving object and extract its feature through the sequence of frames [9]. Object detection is to identify the object of interest in video sequence and to cluster pixels of these object. Feature extraction is the process of extracting useful information from an input or a query image [6]. Object detection can check existence of object in video frame and to detect that object. Then detected object can be classified in various categories such as humans, vehicles and other moving objects. In this paper, image acquisition is performed on an input video sequence.

The term image acquisition as we know it refers to the process of capturing real world images from the input digital camera and storing them into a computer or a laptop. Digital camera which capture images directly in digital form are more popular now a day. The films which are used in analog camera is not used in digital cameras. Instead they are used charge coupled device or CMOS devices, the image sensor that converts light into electrical charges. Image Resizing means to create new pixel locations and assigning gray-level values to these locations. Then we have to convert a resize image in RGB 2 GRAY scale. In gray scale each pixel having 8bits number. It can take values from 0-255. Each value corresponds to the shade between black and white color, i.e. 0 for black and 255 for white. The images can be scan at all scales and locations. Then the features will be extracted over the window. Then run the linear SVM classifier on all location of an image [6]. The multiple detection in 3-D position is fuse and scale space. Then object is detected by using bounding boxes. SVMs are a well-known technique suitable for binary classification tasks, which is related to and contains elements of non-parametric applied statistics, neural networks and machine learning.

Like classical techniques, SVM score value is a function of selected financial ratios and according to the score value SVMs also classify a company as solvent or insolvent. But this function is neither linear nor parametric. The formal basics of SVMs will be subsequently briefly explained. The case of a linear SVM, where the score function is still linear and parametric, will be firstly introduced, in order to clarify the concept of margin maximisation in a simplified context way. Afterwards the SVM will be made non-linear and non-parametric by introducing a kernel.

Human motion analysis is one of the most popular and recent research topics in digital image processing. In which the movement of human is the important part of human detection and motion analysis, the aim is to detect the motion of human from the background image. The background subtraction method is common approach which identifies the moving objects from the portion of video frames that differs significantly from the background model [18]. The main idea about moving object is to separate the moving foreground object and background pixels. The basic idea in background subtraction is to classify the pixels as background or foreground by thresholding the difference between background image and current image [16].

Video surveillance of human activity usually requires people to be detected and background subtraction is a powerful mechanism for identifying changes in the video sequence. Feature extraction is very clear process for reducing dimensionality so as to represent each parts the image with great efficiency. Feature represents a pattern or a distinct structure of an image [4].

Feature are extracted simply based on there appearance. Feature extraction is the process of generating featureswhich is capturing from camera which is used in the selection and classification task. One of the main goal of feature extraction is to obtain the compact set of feature called feature vector without redundancy [14][15]. Extracted features should increase the classification rate of an object. Surveillance system should be capable to monitor security sensitive areas such as banks storage department, highways, crowed public places and border areas etc.

Flowchart of system:-

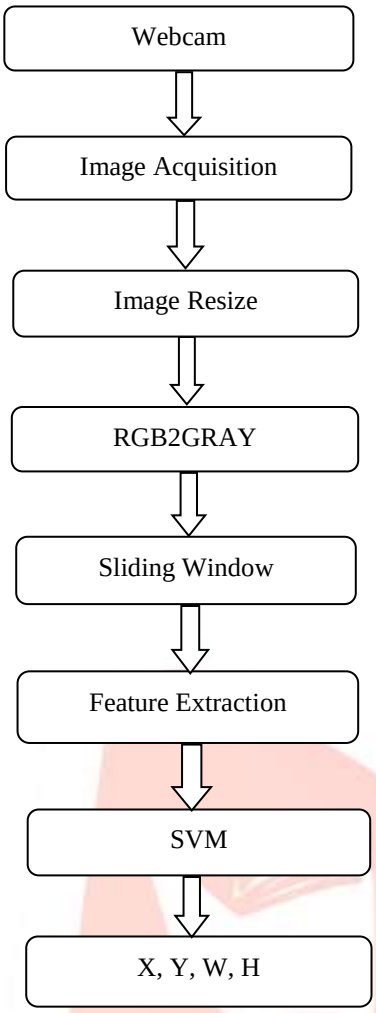

Fig: Flowchart of system

II. IMAGE ACQUISITION AND RESIZE

In digital image processing, in image acquisition usually a hardware-based source for processing is used and it is defined as the action of retrieving an image from some input source. It is very first step in the sequence of workflow because, without an input image, no processing is possible. The image that is acquired is completely unprocessed at the input side.

Now the incoming energy is transformed into a voltage by the combination of input electrical power and sensor material that is responsive to a particular type of energy being detected. The output voltage waveform is the response of the sensor and the digital quantity is obtained from each sensor by digitizing its response.

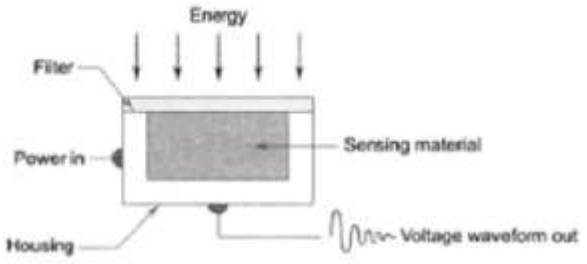

Fig: Single image sensor

Fig: Line sensor

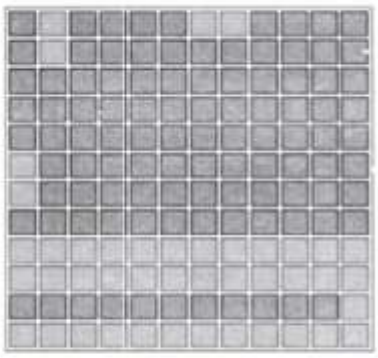

Fig: Array sensor

Image Acquisition using a single sensor:

Image acquisition by using a single sensor and example of a single sensor is nothing but a photodiode. Now to obtain 2-D image using a single sensor, the motion of an image should be in both x and y directions. The sensor rotation provide motion in one direction while linear motion provides motion in a 90 degree or perpendicular direction.

From image acquisition using a single sensor can obtain high-resolution images with high precision control. This is an inexpensive method. But the downside or a disadvantage of this method is that it is slow as compare to others.

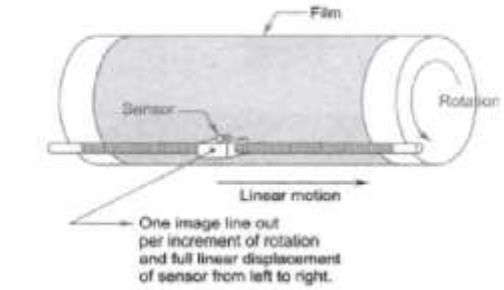

Fig: Combining a single sensor with motion to generate a 2D image

Image Acquisition using a line sensor (sensor strips):

Image acquisition using a line sensor that is sensor strips, it provides imaging in one direction. Again in this sensor strip motion perpendicular to the strip provides imaging in one direction.

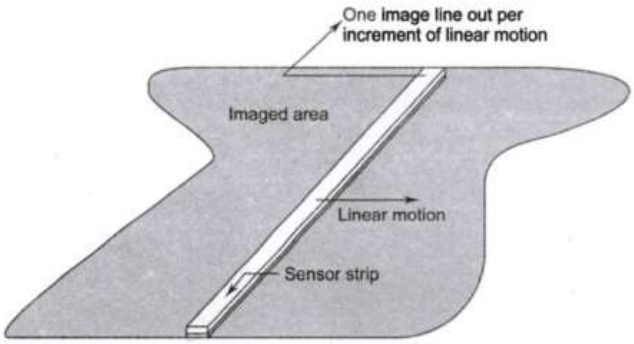

Fig: Linear sensor strip

Image Acquisition using an array sensor:

In image acquisition using an array sensor, the sensors which are individual are arranged in the form of a two-dimensional array. This type of arrangement is found in digital cameras. E.g. CCD array

In this, the response of each sensor is proportional to the integral of the light energy projected onto the surface of the sensor. Noise reduction is achieved by letting the sensor integrate the input light signal over minutes or ever hours.

The sensor array is coincident with the focal plane; it produces an output proportional to the integrate of light received at each sensor. Digital and analog circuitry sweep these outputs and convert them to a video signal which is then digitized by another section of the imaging system. The output so obtained is a digital image.

The advantage of an array sensor is, since sensor array is 2D, a complete image can be obtained by focusing the energy pattern onto the surface of the array.

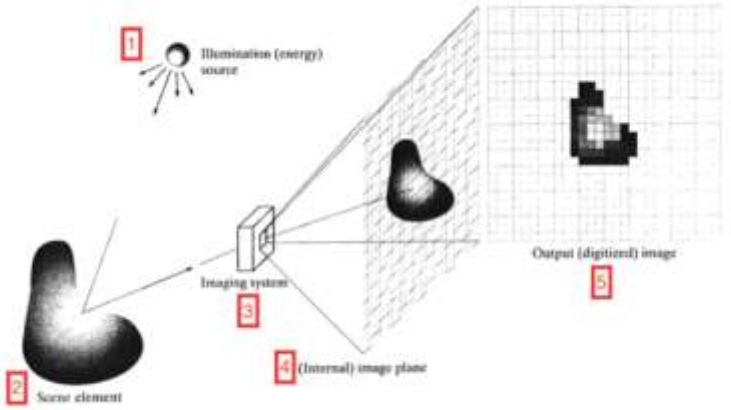

Fig: An example of digital image acquisition using array sensor

After the image acquisition process, the image resize is performed. We have to resize image at a particular value for the conversion of RGB 2 GRAY. Image formation using sensor denote the brightness or intensity I of the light of an image as two dimensional continuous function F(x, y) where (x, y) denotes the spatial coordinates when only the brightness of light is considered. Sometimes three-dimensional spatial coordinates are used. Image involving only intensity are called gray scale images. (Paper-RGB2GRAY2)

Each pixel in RGB is 8bit number and in gray scale it is also 8bit number. It can take values 0-255 that is 0 for black and 255 for white in gray scale and in RGB it can take values 0-255 for each color. In gray scale each value corresponds to shade between black and white and in RGB shade of corresponding color. Number of channels in gray scale is 1 and in RGB is 3. Number of channel defines the dimension of array, each pixel is. Both RGB and gray having depth 8bits. Depth defines the maximum bit size of the number which is stored in array.

III. Feature Extraction

Extracting feature is one of the important steps, for any algorithm. The input video sequence is provided and from that video sequence frames are extracted then by using sliding window technique object is detected. The feature is extracted by HOG algorithm which is nothing but histogram of oriented gradients. And finally object is classified. By using various methodology, feature extraction is based on appearance are carried out. The process of defining a set of feature, or image characteristics, feature extraction which will most efficiently or meaningfully represent the information that is important for analysis and classification. Histogram of oriented gradient feature extraction is performed by step by step. Compute centered horizontal and vertical gradients with no smoothing in that, then compute gradient orientation and magnitude of the input image. For color image, pick the color channel with the highest gradient magnitude for each pixel. For example, for a 64*128 image, divide the given image into 16*16 blocks of 50% overlap. Likewise, there are 7*15=105 blocks in total. Then quantize the gradient orientation into 9 bins. Then the vote is the gradient magnitude. The vote can also be weighted with Gaussian to down-weight the pixels near the edges of the block.

The steps in feature extraction:

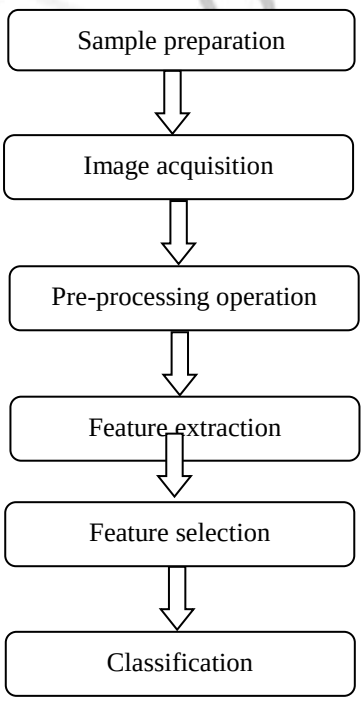

Fig: Feature extraction steps

Now the algorithm overview, when input image is given, divide image into small sub-images called as “cells”. These cells can be rectangular or circular. Then a histogram of edge orientation is accumulating within that cell. For describing the object, the combined histogram entries are used as the feature vector. To provide better illumination invariance for eg. Lighting, shadows etc. normalize the cells across larger regions incorporating multiple cells known as “blocks”.

IV. SVM (SUPPORT VECTOR MACHINE)

For classification of objects, support vector machine (SVM) is generally used as classifier. The image can be used as fixed dimension vector when features are extracted from the frames and then classifier used as classify the images. The support vector machine (SVM) gives the good performance in image classification tasks. By studying characteristics, can be in high dimensional feature space to improve the characteristics of the linear separation using linear support vector machine (SVM) had the best classification results, greatly reduce the consumption of time and space for the trained classifier [svm1].

The SVM approaches to find out the hyperplane which are optimally separating between classes by focusing on the training cases that are placed at the edge of the class descriptors. These training cases are called support vectors [svm3].

A support vector machine (SVM) is a classifier defined by a separating the two hyperplane. In 2-D plane or a space this hyperplane is nothing but a line dividing plane in two parts. The two parts where in each class of hyperplane lay in either side. Suppose we are given plot of two label classes on graph as shown in figure and we have to draw a separating line for the classes.

Fig: Draw a line that separates black circles and blue squares.

The following figure shows the separating two points or classes. The line draws such that left of line having black circle class and on right side having blue square class. The hyperplanes drawn in multidimensional space that separate outs classes.

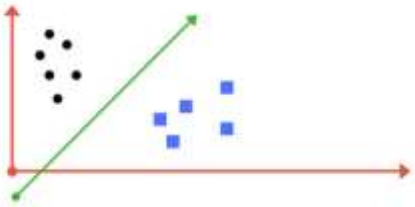

Fig: Sample cut to divide into two classes.

Support vectors are nothing but the data points which is nearest to the hyperplane, the points of a data set that, if removed, would alter the position of the dividing hyperplane. Because of support vectors, they can be considered the critical elements of a data set [21].

SVM is used for text classification tasks such as category assignment, detecting spam and sentiment analysis [21]. It is also commonly used for image recognition challenges, classification of feature vector, and also performing particularly well in aspect-based recognition and color-based classification. SVM also plays a vital role in many areas of handwritten digit recognition, such as postal automation services. Classification of images can also be performed using SVMs. Hand-written characters can also be recognized using SVM.

The important advantages of SVM are: the aim of SVM is at limited samples and also the goal of support vector machine, by using limited information the optimal solution should be get.

V. RESULTS AND DISCUSSION

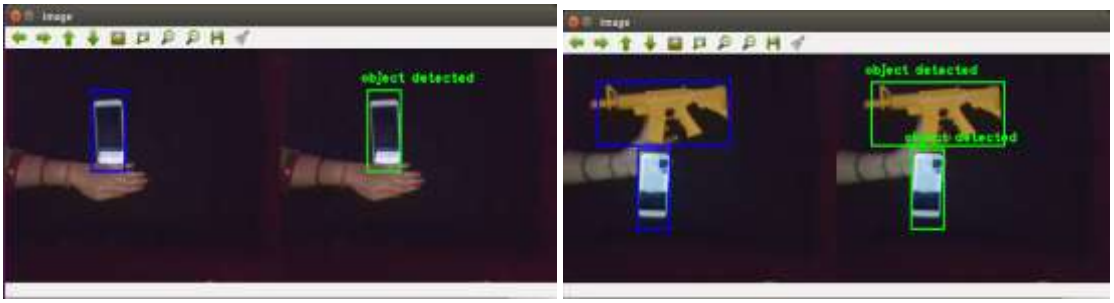

Fig: In above figure mobile and gun is detected as a object.

Fig: Object is classified as a gun and an animal.

Fig: In this figure object is classified as a mobile, animal and a gun.

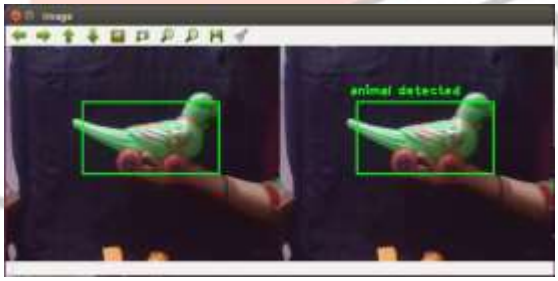

Fig: In this also object classified as mobile and an animal.

Fig: Object is classified as a Coin, mouse and mobile.

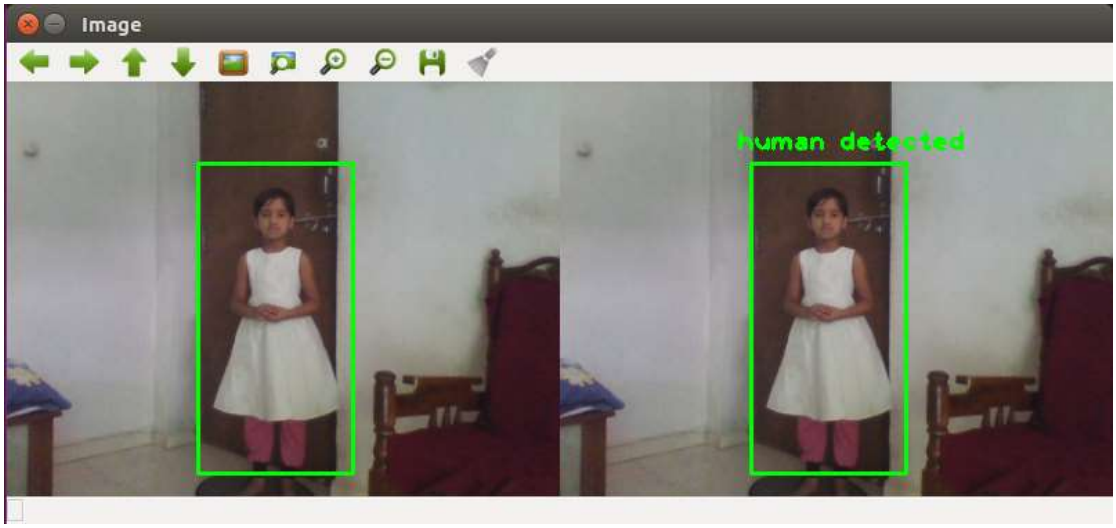
Image
human detected


human detected
human detected


human detected
human detected

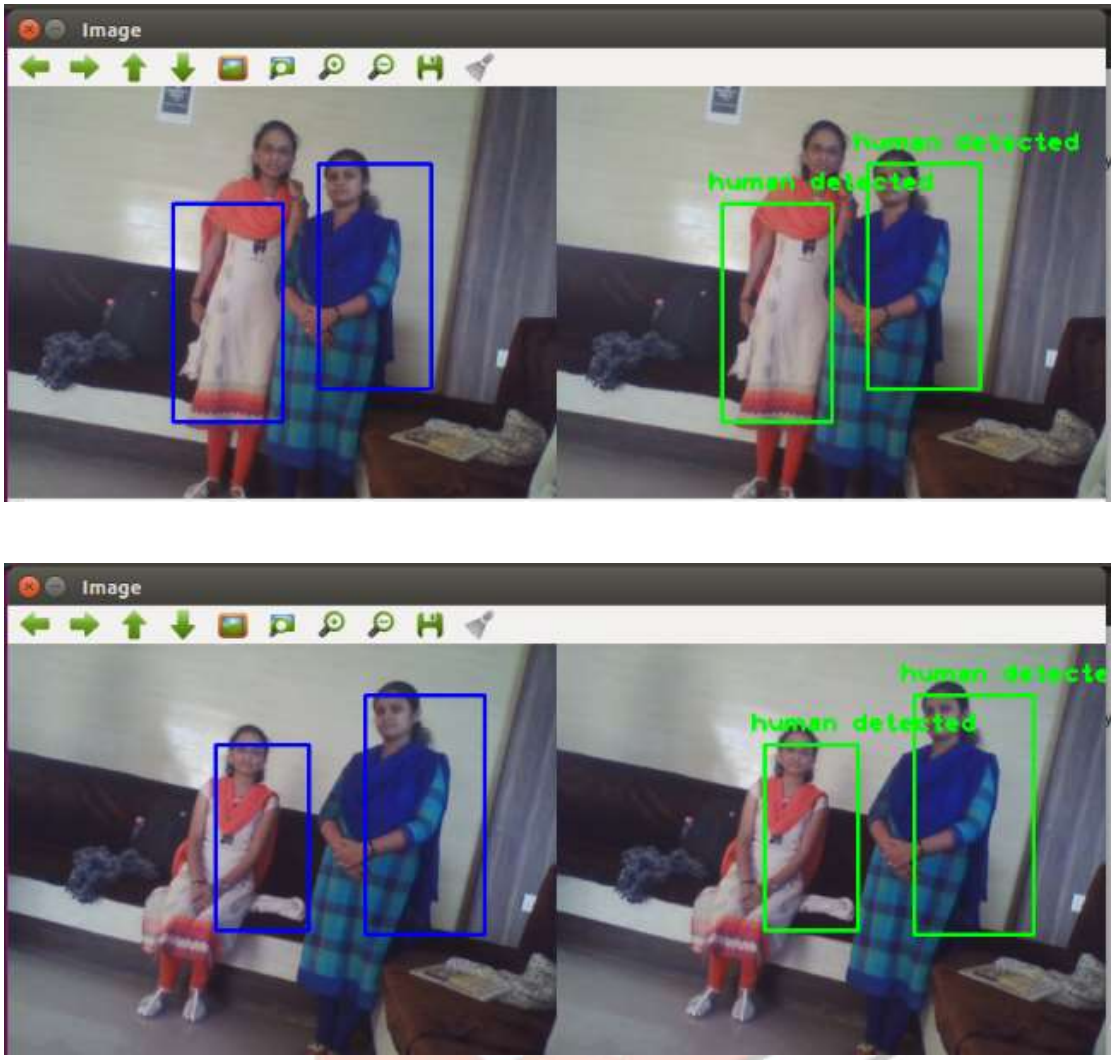

Fig: In this figure object is detected and classified as a human.

VI. CONCLUSION

The proposed system is used to detect and extract the features of multiple moving objects holding it using various algorithms. Moving object detection and extracting its feature has widely been adopted by the industry and organization because of its broad applicability in real life.

This system is invariant to lighting condition, background scenario and view point. Once the objects (human, gun, animal, mobile in this case) are detected using this system, then by using the histogram of orientate gradients (HOG) the feature can be extracted and classify them as a particular object. The algorithms used in the designed system are Sliding Window Techniques for object detection, Histogram of Oriented Gradients (HOG) for feature extraction and Support Vector Machine (SVM) for classification.

SVMs are a new technique suitable for binary classification tasks. As the proposed system dealing with the real time, here, the system is based on the OpenCV. The sliding window techniques should be continuously slide each and every part of an image for detecting the objects. The histogram of oriented gradients (HOG) is nothing but the feature descriptor which is mainly used for identifying human and other objects also identified by HOG. SVMs are a new technique suitable for binary classification tasks, which is related to and contains elements of non-parametric applied statistics, neural networks and machine learning.

VII. FUTURE SCOPE

Here in this project we have dealt with object detection, sliding window technique, feature extraction, Histogram of Oriented Gradient (HOG) and Support Vector Machine (SVM). Each and every topic has a very wide scope. After working onto these concepts there is more that can be done further likewise, after detection of a particular object if that footage is being accessed from a remote location and want to have an exact location of that object, there is a scope of getting exact location.

Also if the particular or an unexpected object is detected the entire system could be such automated so as to shut down the power of that particular area or to take some necessary actions. Also if any object that is detected an algorithm can be developed so as to read the characters written on the object for further processing. Also a system which is human free can be designed for a wild forest region to track the particular number of animals.

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