An Inspection of Object Classification for Tracking Fast-Moving Object

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ABSTRACT
Vision is important in life; in earlier years many systems fail because of poor classification. Objects can be classified as living or man-made movable objects such as a human, vehicles, animals, floating clouds, and swaying trees in the field of computer vision. Many algorithms have been proposed for classification from the image of a video stream. For robust and accurate tracking, it also depends on a good classification algorithm that segments foregrounds from a background in a video stream. The goal of object classification is to extract useful information from images pinpointing between static and moving objects. In this paper, different types of classification algorithms are discussed, and tracking techniques are proposed in the field of computer vision. The goal of tracking is not achieved without the classification of objects.

Keywords
Object Classification, Segmentation, Object Tracking, and Video Surveillance.

1. INTRODUCTION
In the area of computer vision, research has been conducted on object tracking for monitoring the movements of objects from one point to another using static or networked cameras. Countless surveillance systems have been installed around but not all of them perform monitoring continuously [1]. Crimes and other unlawful acts do not happen at a certain place because surveillance systems such as Closed-Circuit Television (CCTV) have been deployed to monitor the movement of events even if the systems are not functioning. The security system transmits a signal to a specific place on a limited set of monitors for monitoring. Areas such as banks, casinos, airports, military installations, convenience shops, stadiums, and any crowded area need to be monitored to ensure safety. Intelligent systems have been developed for accurate and efficient object classification and tracking in the form of humans, animals, and vehicles. The primary aim of this paper is to critically discuss the various techniques for object classification methods for tracking fast-moving objects.

Usually, images from a video stream are grouped into two sets of pixels. Foreground and background pixels [2]. Normally, foreground objects are moving objects like humans, cars, birds, and bikes and the rest of the image is the background [3]. The approaches to classifying objects are motion-based classification, shape-based classification, color-based classification, and texture-based classification.

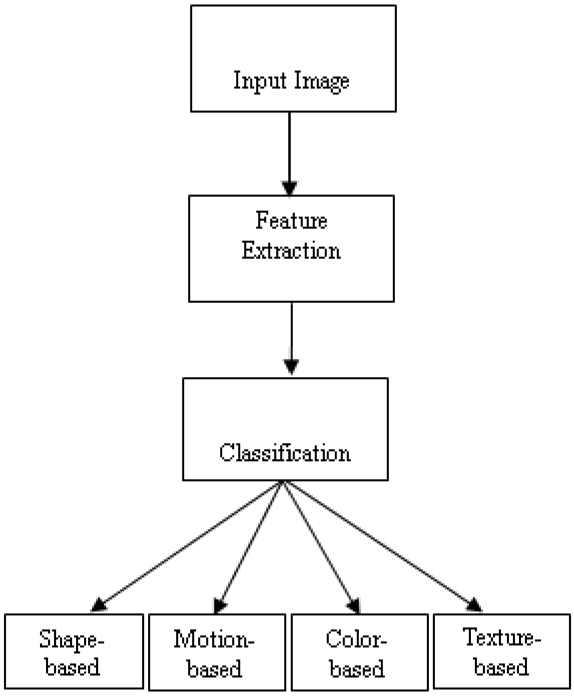

Fig 1: shows a block diagram of the different classifications

In video surveillance, objects are first detected as they appear in a frame with feature extraction followed by classification depending on the algorithm of the system such as shape-based, color-based, motion, or texture-based. Object detection also can be broken into sections such as Frame Differencing, Optical Flow, and Background Subtraction.

1.1 Frame Differencing
In frame differencing, systems first analyze the images in motion, being captured by the camera, for detection of any moving object. When moving objects appears in a frame, the difference between the two uninterrupted images is computed [4]. The frame differencing algorithm gives an accurate output of the position of the moving object in the frame.

1.2 Optical Flow
This approach involves the computation of the image visual flow field of the object. The optical flow approach gives more accurate moving information about the object and it is very meaningful for detecting a moving object from its background. This approach is very sensitive to noise and has poor anti-noise performance including large quantity computation as its demerits that does not allow it to well use in real-time detection and tracking.

1.3 Background Subtraction
This approach is used for automatic video exploration, particularly in the field of video surveillance [5]. It predicts a moving position by subtracting the current image pixel by pixel from a reference background image [6]. Many methodologies have been proposed for background subtraction in terms of foreground detection. In the paper [7] where a simple version of this approach is well explained.

2. LITERATURE REVIEW
Object classification, as indicated by its properties can be classified into four groups Shape-based, Motion-based, Color-based, and Texture-based classification. These four classifications, to some degree, can discover normal application regions. Their features will be compressed into the following segments, where algorithmic achievement and highlights are quickly presented. To start with, Shape-based classification is presented.

2.1 Shape-based Classification
As discussed in [8] objects can be classified under different descriptions of shape figures of motion regions such as depictions of points, boxes, and blobs are presented for classifying moving objects. Features inputted into a system for classification are a mixture of image-based and scene-based object parameters, for example, image blob area, the apparent aspect ratio of the blob bounding box, and camera zoom.

2.2 Motion-based Classification
Non-flat uttered object motion demonstrates an occasional property, so this has been utilized as a solid signal for moving object classification. Optical flow is likewise exceptionally helpful for object classification. Residual flow [9] is utilized to examine the inflexibility and periodicity of moving elements. Normally, unbending objects would show minimal residual flow whereas a non-inflexible moving object, for example, humans had higher normal residual flow and even showed an occasional segment. When an object is in motion, specific features can be extracted from the object for classification [10].

2.3 Color-based classification
Unlike image options (e.g., shape and size) color is comparatively constant under vantage point changes and it is easy to be attained. Color is most certainly not always suitable as the means of recognizing for tracking objects, but it also plays the basic feature of recognizing objects when it appears in the scene, and it provides a low computational cost of the algorithm as suggested by many researchers as an advantageous feature. It is important to deploy color histogram-based techniques when tracking moving objects such as a vehicle in real-time.

2.4 Texture-based classification
In object classification for recognition and tracking, object texture can be utilized to count the rates of gradient direction in localized portions of an image. Its computations are established on a dense grid of reliably spaced cells and use overlapping local difference normalization for enhancing accuracy. According to paper [2], table 1 defines a relative study of classification techniques using accuracy and computational time. Merit and drawbacks of various techniques are also defined in the table.

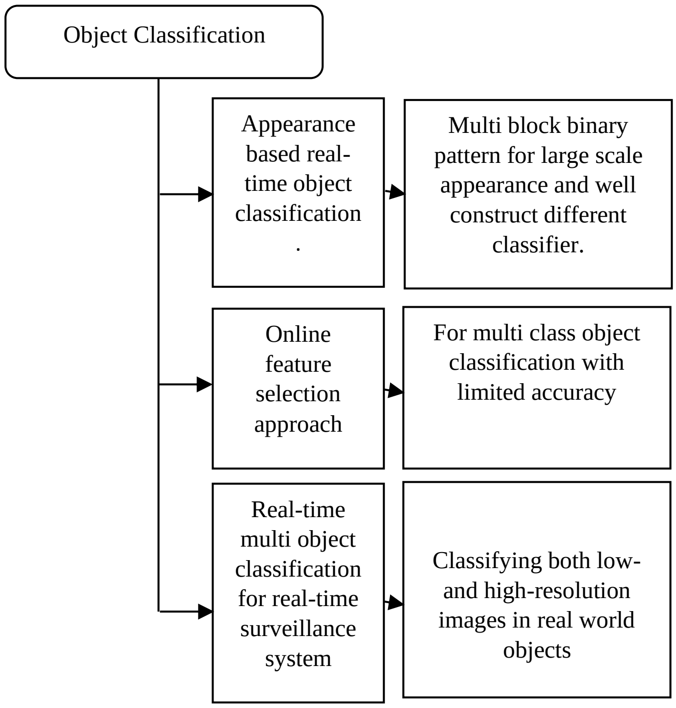

Fig 2: Shows the General overview of Object Classification [10]

To address classification problems, many researchers have proposed to learn object classifiers from dimly categorized Internet images, such as images retrieved by keyword-based image search engines. Object classification in terms of object detection, feature extraction, dimensionality reduction, and classification are some of the proposed techniques. Feature extraction is the most useful technique used to extract features from objects in motion and dimensionality reduction is used for accuracy improvement [10].

Table 1. Relative Study of Classification Techniques

Methods	Accuracy	Computational Time	Comments
Shape-based	Satisfactory	Low	The simple pattern-matching approach can be utilized with appropriate templates. It does not function admirably in dynamic states and is incapable to regulate internal movements well.
Motion-based	Satisfactory	High	It does not require predefined pattern templates but finds it difficult to recognize a non-moving human.
Texture-based	High	High	It provides improved quality at the expense of additional computation time.

Color-based	High	High	It makes a Gaussian Mixture Model to depict the color dissemination inside the arrangement of images and to segment the image into background and objects

In the paper [11], the author suggested that utilizing a single feature alone on an image or object may not be enough to produce a result for classification rather a combination of image features such as shape, texture, and color can be used. The paper continued to show that for better performance in object classification one of the renowned technique to use is Kernel Learning Algorithm where the feature combination problem becomes a Kernel combination problem where the Support Vector Machine (SVM) may utilize a single kernel function as;

$$k\left(x, x^{'}\right), \quad x, x^{'} \in X, \qquad [1]$$

A linear arrangement of different kernels as;

$$k\left(x, x^{'}\right) = \sum_{m=1}^{M} \beta_m k_m \left(x, x^{'}\right), \ \beta_m \in R_+ \qquad [2]$$

Otherwise, a product of kernels is computed as;

$$k\left(x, x^{'}\right) = \prod_{m=1}^{M} k_m \left(x, x^{'}\right) \qquad [3]$$

In place of a single vector machine, a single kernel k can be computed as;

$$f\left(x\right) = \sum_{i=1}^{N} \alpha_i k\left(x, x_i\right) \qquad [4]$$

And a Multiple Kernel Learning, group of kernels $\{k_1, \ldots, k_m\}$, the learning classifier and arrangement weight β can be cast as a convex optimization problem from the equation [4] is computed as;

$$f\left(x\right) = \sum_{m=1}^{M} \beta_m \sum_{i=1}^{N} \alpha_i k_m \left(x, x_i\right), \ \sum_{m=1}^{M} \beta_m = 1 \qquad [5]$$

3. CONCLUSIONS

In this paper, various approaches to classifying objects. Numerous algorithms have been proposed for object classification from the image of a video stream. This paper presents the study of object classification methods and adds a quick review of the connected topic bestowed. The trailing perspective is classed into three classes, visual perception, object categorization, and object follow-up. The number of ways and techniques used during this study associated with object detection and trailing has been delineated.

4. ACKNOWLEDGMENTS

Sincerest gratitude to the Almighty God for making it possible through this COVID-19 epidemic and to express gratitude to our families and loved ones.

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