# Support Vector Machines for Human Face Detection: A Review

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***Abstract*—** The computer vision drawback of face detection has over the years become a standard high-requirements benchmark for machine learning ways. Within the last decade, extremely efficient face detection systems are developed that extensively use the character of the image domain to attain correct time period performance. However, the effectiveness of such systems wouldn't be potential while not the progress within the underlying machine learning and classification ways. Now the research area of face recognition technology is much advanced because the research in this area has been conducted for more than 30 years. The main reason for the popularity of face recognition is that it can be used in the different fields like identity authentication, access control and so on.

Support vector machine learning may be a comparatively recent methodology that gives a decent generalization performance. Like alternative ways, SVM learning has been applied to the task of face detection, wherever the drawbacks of the technique became evident. Analysis that specializes in accuracy found that competitive performance is feasible however training on adequately giant datasets is difficult. Others tackled the speed issue and whereas varied approximation ways created interactive response times potential, those usually came at a worth of reduced accuracy.

***Index Terms*—** *SVM, face detection, SVM classifiers.*

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## I. INTRODUCTION

One of the guarantees of AI is that the ability to build computer systems that might be ready to make selections supported generic sensory inputs by process them in an exceedingly similar fashion to humans. Computer vision is to the present day a extremely active field of analysis, driving additionally a major quantity of innovation within the closely related fields of image process and machine learning.

Face detection and recognition may be a specific instance of the object recognition problem that deals with finding and characteristic appearances of human faces in digital pictures or video frames. Traditionally, face detection and recognition has been the main target of the leading beholding analysis thanks to its wide pertinence. Biometric systems will like characteristic the user's face, security applications will find intruders, digital cameras will mechanically target the faces within the frame, interactive systems will be controlled by head movement, users will search their photography archives for all pictures of a selected person—all these use eventualities square measure already potential nowadays with the assistance of face detection and recognition algorithms.

That is to not say that face detection and recognition could be a 'solved' problem—while sensible performance has been achieved for several applications, a fine-print notice usually remains: 'depending on conditions, performance might vary'. Application specific fine-tuning so remains a serious focus once engineering systems that use face detection and recognition, whereas analysis work continues so as to boost the generic underlying ways and algorithms to form them quicker and a lot of correct.

At the center of each face detection system lies a machine learning algorithmic rule. So as to differentiate faces from background it's necessary to be able to classify a fraction of image information as a face, and it may be done victimization nearly each machine learning technique out there. Classifiers work as call functions that area unit supported rules or models that area unit fashioned throughout the method of learning. The foremost outstanding machine learning ways historically embrace neural networks, applied math modeling ways like principal elements analysis, and a lot of recently, support vector machines.

After its introduction within the early Nineteen Nineties, the support vector machine learning

technique was fast to achieve an oversized following. Offering a simple to grasp geometric interpretation of the educational method, in distinction to usually additional 'black-box' neural networks whose inner state is mostly arduous to interpret, for a short time SVMs were a favoured technique and got adopted in an exceedingly variety of research areas. It's the quality of huge and high-dimensional issues like face detection that creates them an honest stress-test for the sensible aspects of recent machine learning ways. The initial formulation of the support vector machine learning algorithmic rule needed O (N3) training time that created it unworkable to much use with massive sets of high-dimensional image information, whereas the ensuing classifiers that contained the handily explicable resolution were too slow for interactive applications.

In more recent years, important enhancements are created to deal with the problems of the support vector machine learning. The analysis given during this paper joins in to defend the position that the support vector machine learning technique is extended in ways in which build it an adequate approach for prime needs issues like face detection.

## II. LITERATURE REVIEW

The task of face detection is to search out all instances of human faces in a picture, within the general case while not assumptions regarding the quantity of faces, their sizes or positions. A wider survey of face detection approaches; this reviews the 2 most typical approaches—model-based and pattern-based detection [1].

Three-dimensional modeling of human faces is so normally restricted to the information acquisition and training stages of the face detection problem, and also the search within the 2D image area is sometimes performed victimization pattern classification ways. In distinction to the model-based approach, pattern classification ways typically solely contemplate 2D view-based representations of faces.

A method to expeditiously represent human faces victimization this idea: eigenvectors extracted from a covariance matrix of a given distribution of face pictures [2]. Illustration of faces to recommend a recognition system wherever a candidate image is projected onto the face area outlined by the chosen eigenfaces [3]. This 'distance-from-face-space' will be used for face/non-face classification. As an example that Independent Component Analysis (ICA), which may be thought of as a generalization of the PCA approach, outperforms the latter during a face recognition state of affairs [4]. Independent component analysis (ICA) is a method for finding underlying components from multidimensional statistical data. There is need to implement face recognition system using ICA for facial images having face orientations and different illumination conditions, What distinguishes ICA from other methods is that, it looks for component that are both statistically independent and non Gaussian. Linear Discriminate Analysis (LDA) may be a spatiality reduction technique just like PCA, however geared toward discrimination, face recognition and additional improved by [5, 6]. Common problems in PCA method is overcome by Linear Discriminate Analysis (LDA). Linear discriminant analysis (LDA) has been used as a dimensionality reduction technique to many classification problems, such as speech recognition, face recognition, and multimedia information retrieval. LDA is the most dominant algorithms for feature selection in appearance based methods ICA provided a more powerful data representation than PCA as its goal was that of providing independent rather than uncorrelated image decomposition and representation.

Neural networks can be considered as massively parallel computing systems which are consisting of large number of simple processors with number of interconnections. Neural networks uses some organizational principles (such as learning, adaptability, fault tolerance, generalization, and distributed representation, and computation) in a network of weighted directed graphs, where the nodes are artificial neurons and directed edges (with weights) are connections between neuron outputs and neuron inputs. One of the most important characteristics of neural networks are that they have the ability to learn complex nonlinear input-output relationships, use sequential training procedures, and adapt themselves to the data. Hopfield Neural Networks (HNN), Self-Organizing Map (SOM), Back-Propagation (BP) have been used for face recognition.

Neural networks are used in many pattern recognition problems, like character recognition, object recognition, and autonomous robot driving. The feasibility of training a system to capture the complex class of face patterns is the main advantage of the NN in the face recognition.

The NN is non linear in the network hence it is widely used. NN approaches encounter problems when the number of classes increases.

Neural Networks (NN) are wide applied for numerous pattern classification tasks, as well as face detection and recognition. The Multi-layer Perceptron (MLP) model was used for the primary applications, like the face detection systems [7]. A neural network classifier supported the Constrained Generative Model (CGM) Another learning design, referred to as SNoW (Sparse Network of Winnows) [8], came from the domain of natural language processing and was initial applied to face detection [9].

AdaBoost is an adaptive Boosting machine learning technique is taken into account one amongst the foremost successful object detection strategies in computer vision. AdaBoost is an improvement on the many previous boosting approaches. It is a meta-algorithm in a way that it uses some other weak classification algorithm to build a series of classifiers and combine them in a way to achieve 15strong classification. The series of weak classifiers is constructed in such a way that misclassified training examples are given more weight in the subsequent steps. Each classifier in the series also gets an importance weight based on how accurate it is. The final AdaBoost classifier is then an importance-weighted majority vote of the weak classifiers. AdaBoost has been successfully used to boost different classifiers, including perceptrons, PCA and LDA based classifiers, linear support vector machines and others.

Initial introduced support vector machines (SVM) quickly became a wide used machine learning technique [10]. It's the pioneering and arguably the foremost well-liked of the kernel strategies, the category of algorithms that map data points into terribly high-dimensional feature areas, [11, 12] initial to use the SVM technique to face detection. They used nineteen × nineteen pixel image patches containing faces and non-faces. A lot of recently SVMs saw more enhancements in tries to enhance their efficiency. Approximation methodology to create efficient SVM classifier cascades victimization 20×20 pixel pictures and also the Gaussian Radial Basis Function (RBF) kernel [13]. Within the lightweight of the terribly efficient AdaBoost face detection system to more improve the SVM cascaded classifier [14, 15].

State of the art face detection systems like the one developed to create variety of problem-specific novel approaches like classifier cascades, boosting, efficient rectangular Haar-like options and integral pictures, to be combined with the standard and universally applicable machine learning ways so as to attain smart performance in terms of each accuracy and speed [15].

## III. SUPPORT VECTOR MACHINES

Support Vector Machine could be a sensible learning technique supported applied math Learning Theory. An easy SVM may beat a complicated neural network with elaborate options in a very handwriting recognition task. SVM have the aim of crucial the situation of call boundaries that turn out the best separation of categories. Within the case of a two-class pattern recognition drawback during which the categories are linearly severable the SVM selects from among the infinite range of linear call boundaries the one that minimizes the generalization error. The greatest margin between the two classes, where margin is defined as the sum of the distances to the hyper plane from the closest points of the two classes [1]. This drawback of maximizing the margin is often solved victimization commonplace Quadratic Programming (QP) optimization techniques. The data points that are closest to the hyper plane are used to measure the margin; hence these data points are termed 'support vectors'.

SVM also can be extended to handle non-linear call surfaces. If the 2 categories don't seem to be linearly severable, the SVM tries to seek out the hyper plane that maximizes the margin whereas, at identical time, minimizing a amount proportional to the quantity of misclassification errors. The trade-off between margin and misclassification error is controlled by a user-defined constant. Away of protruding the computer file

onto a high-dimensional feature house victimization kernel functions and formulating a linear classification drawback in this feature house.

The support vector machine learning technique could be a comparatively new approach that pioneered the adoption of kernel-based ways and through the last twenty years caused a major impact within the analysis community. Praised for the universal applicability and wonderful generalization performance also as resistance to overtraining, SVMs were applied to just about each machine learning problem, together with that of face detection.

SVMs area unit capable of learning the complicated and correct classifiers needed for face detection also as applicable to the cascade ways required to attain quick detection speeds [13, 14]. However, the drawbacks of the technique became evident as well—learning from the massive amounts of information required for face detection was slow and sophisticated, requiring thorough time and memory resources, whereas the approximation ways accustomed construct the cascades were able to address the difficulty of visual attention and early background discarding solely to some extent. Support vector machine learning may be a comparatively recent methodology that gives a decent generalization performance. Like alternative ways, SVM learning has been applied to the task of face detection, wherever the drawbacks of the technique became evident. Analysis that specializes in accuracy found that competitive performance is feasible however training on adequately giant datasets is difficult. Others tackled the speed issue and whereas varied approximation ways created interactive response times potential, those usually came at a worth of reduced accuracy.

## IV. OBJECTIVES

The goal of present the paper is to make survey of face detection system and from which the support vector machine technique is viable technique for detecting human face from photographic images.

Face detection problem will be investigated, comparing the suggested techniques and algorithms to best known alternatives. The goal can be divided into the following objectives:

1. Detecting the Speed.
2. Training Time of Large Dataset.
3. Training Data Reinforcement.
4. A Competitive Face Detection Technique.

1. Detecting the speed –

The SVM is the classifier which is used for classification and performs the detection which is expensive to evaluate. As SVM is used to classify data in simple way, it classifies the data which is used in the detection of the human faces with the help of high dimensional images which is stored in the datasets. Approximating the SVM classifier with cascades of smaller classifier by which significant improvements in the evaluation cost from which measurable for accuracy.

2. Training time for large dataset –

SVM training algorithms have a time complexity of O (N2). As we are working with the images we need database for storage and hence there may be chances of large datasets. It require long training time as there is large datasets which are used for face detection and they are high dimensional.

3. Training data reinforcement –

Large number of training data used for human face detection and it is large for machine learning, it typically present small portion of all possible inputs which represents correct or valid human face. Augmentation is a common approach to the sparseness issue. The main objective to construct a dataset augmentation technique which reinforces the face/non-face decision boundary of training set which gives measurable enhancement in the classification accuracy without increment in the classifier complexity.

4. A competitive face detection technique –

There are number of techniques which are used for the face detection and each technique has its own strengths and weaknesses and it impacts on its performance and the accuracy.

As if we build face detection system for detecting the human face and also evaluate the

performance on known face detection benchmarks databases.

## V. STRENGTHS AND WEAKNESSES OF SVM CLASSFIERS

In the context of pattern recognition based face detection and recognition, support vector machines are an attractive classification technique:

### A. Non-linearity of the classifier.

The kernel approach of SVMs allows for arbitrary complex decision boundaries between face and non-face examples, resulting in high accuracy rates.

### B. Resistance to over-training.

The maximum-margin guarantee makes SVMs resistant to overstraining and critical forgetting, and to some extent deals with outlier problems.

### C. Human interpretative learning process.

The intuitive geometric interpretation of the SVM as a hyper-plane separating two classes of points helps to argue about the behavior of the classifiers, while the concept of support vectors gives insight into what examples in the training set are good representatives of the object class.

### D. Effective approximation methods.

The geometric nature of the SVM algorithm allows the development of effective approximation techniques that can be used to obtain very efficient classifiers.

## VI. CONCLUSION

This paper has attempted to review a significant number of papers to cover the recent development in the field of face recognition. Present study reveals that for enhanced face recognition. As now the research area of face recognition technology is much advanced. Face recognition is that it can be used in the different fields like identity authentication, access control and so on. Hence in this paper we has attempted to survey on human face detection using support vector machine. SVM is the more efficient technique compared to others for human face detection.

This summary holds the position that SVM learning are often extended in ways in which create it Associate in Nursing adequate approach to high-requirements issues like face detection. Associate in Nursing SVM-based face detection system is represented that uses the three main contributions of the research: a mixture of a unique dataset up market technique Associate in Nursing an improved giant training algorithmic program to get extremely correct SVM classifiers and a replacement strategy to supply extremely efficient classifier cascades.

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