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Providing a Method for Object Detection Using a Combination Category

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Abstract. The object detection systems in an image, refers to systems that will find an object in an image completely mechanized and automated. These systems are often searching a particular object (which is known) in a raw image. These systems are often involved in two separate categories: (a) image processing, and (b) pattern recognition. The first issue involves the extraction of meaningful and valuable features. While the second issue involved finding a suitable learning model, so that it separates the object data from non-object data in a favorable and acceptable way. In this study, we have reviewed by three-step method of learning objects and using a multi-layered combination model for detection and using heuristic algorithms association rules for feature selection step and finally using a combination category method similar to the intensification of the final step there. And by reviewing various evaluation models, we measured the quality of our models. In this study, we showed that using a majority vote model is the best way to detect an object.

Keywords: object detection systems, classification, pattern recognition, learning object, heuristic algorithms association rules.

1. Introduction

One of the main issues in machine vision discussions is object detection. In recognition of objects in images, we can convert them to readable, understandable and processed data that it can be used in many applications, such as industrial, military and so on.

Object detection systems in an image, refers to systems, which find an object in an image in completely mechanized and automated way. These systems often search a particular object (which is known) in a raw image. These systems are often involved two separated categories: (a) image processing, and (b) pattern recognition. The first category involves the extraction of meaningful and valuable features. While the second category involved finding a suitable learning model in such a way that it separates the non-object data from object data in an acceptable and appropriate way.

These systems consist of two separate phases: a training phase and testing phase (ID). In the training phase, we provide at first an N series of object images (photos which content one object and it haven't got anything else) and an N series of non-object images. It should be noted that all the images are the same size. This series is called the training data set. In the next step, we convert the training images after pre-processing in to the training features vector. After this stage, we select some feature (remove some features) among the obtained characteristics in the previous step.

Then we perform a machine learning model on this data so that the model learns what will be the connection between selected features and an object / non-object image. In the experiment step, often a picture pyramid will be made (pyramid image will be for different image sizes) and each sub-image will be given as an object image candidate to the model to determine whether the candidate is an object or not.

Environmental issues, such as lighting conditions, image quality, and the background will cause severe hardships. For this reason, most of the time in the preprocessing step, we often use the integrated image. The challenge of identifying objects in images will be obtained from things diversity, their diversity in resolution, objects size diversity and objects rotating diversity.

Their diversity in resolution will be done with integrating image. Because of the existed rotating in objects, researchers have to use particular features that are independent of objects' rotation. Researchers have proven that histogram-based features are independent of objects rotating diversity.

As we aim to find the "face" object, we encounter by Face Detection. Face recognition is a key issue in most of computer-generated imagery and for face recognition; object recognition techniques will be used. Automatic face detection is as one of the main challenges in the authentication systems. The face of an object is non-rigid. The human face detection challenges of images are obtained from the human face diversity, such as race, resolution, facial expressions, face size, the head states and face tilt and darkness.

In this research, it will be tried to present a three stage learning object method (in this study, it means only “face” object or “machine” object "car" in the image). Educational stages consist of three parts. In the first part which is pre-process, we use a local binary pattern operator (LBP) to extract LBP for each training image that the obtained image will be called LBP.

In the second part, after obtaining a LBP image for each image, we consider LBP images which belong to the training object series as a training object series or positive class. Then, we obtain the maximum frequent patterns in this training object series with the MAFIA algorithm help. Among the obtaining maximum frequent patterns, a representative will be selected. This representative should have the most similarity to the rest. The introduced maximum frequent pattern as a representative is called the repeated positive class patterns or positive features patterns. In the same way, we obtain the patterns of negative features (or class of non-object). These obtaining patterns which are called the positive and negative features are being used for making a feature vector.

In the final part, we will finish the task by making an object detection. In making object detection, we use the obtaining positive and negative features patterns in the second part to identify the object. Making object detection includes the construction of several successive detectors with resonant mechanism and form a consensus. To strengthen this consensus for forecasting, we use object detection model with the help of color in another layer (second layer). For example, if the target object will be the face, object detection model with color help will use face authentic colors to detect the face. Also, in another layer we use positive characteristics to identify the matching amount with positive category and we use negative features for matching with the negative category. It means, we check the maximum frequent patterns in the positive category for the LBP image of a face potential image that few of them are available in this image, we also check the maximum frequent patterns in the negative category for the LBP image of a face potential image that few of them are not in this image.

These two values as double features can be used to detect the first layer of the face. The last layer, we use a consensus of learning model resemble to an artificial neural network (third layer).

Since, the most object detection models use one layer learning model patterns, one of the innovations of this research is the use of heuristic algorithms association rules for feature selecting step. Another innovative aspect of this research is the use of updated combination classification methods similar to intensifying in the final step. The most important innovation of the research is to provide a proposed framework for object detection (the object you want). Also, it will be tried that this proposed framework will be checked on at least two objects to verify this matter.

2. A review of the research background

Many Face Detection methods have been proposed [1] that these methods can be divided into three categories:

1 - Fixed and cognitive features methods

2 - Pattern matching method

3 –Learning based methods

Fixed and cognitive features methods are determined the facial features such as eye and nose and mouth and even the skin color and by considering the geometric relations, they form a group. Bhuiyan and colleagues [2] offered a method for converting pixels to color image by RGB method to YIQ method so by this method they can find the skin colors and categorized them into the skin region. Xiang and colleagues [3] provided a model to convert pixels from the RGB model to a R-G level to find the lip and skin color in images. When the skin region was set in an image, the components of the face or features such as eye, eyebrows, nose and mouth can be detected in these skin regions. The skin regions have been reported in appropriate face components as the face items. Lee and colleagues [4] used the conductive pattern and maps to determine the main features of the face such as two eyes and a mouth. Usually the review processes, including geometric relations of facial components, are necessary to reduce the number of false positives items. One of the main issues of fixed and cognitive features methods is that the changes in human knowledge to define rules are hard. If the rules will be very strict, it will be destroyed in identifying human faces. In other words, if the rules will be too general, it may be caused many false positive cases.

Usually the standard patterns will be pre-defined and will be built by functions. Face existence based on the similarities and the relation between input images and standard face patterns like eye and nose and mouth and face shape will be determined. Silhots was used as templates to find the potential places of the face [5]. Bhuiyan [2] form a pattern of facial images.

Jesorsky and colleagues [6], used the face pattern to find the general potential places of the face. Then, the eye pattern is used to determine the facial components. One of the disadvantages of the pattern matching method is that obtaining the right pattern of training face images is not an easy task. Another disadvantage is that the pattern considering in different moods are difficult. In contrast of pattern matching method, learning based methods will consider patterns as learning samples and will be benefitting from experts' labels for learning. So learning based methods are time-consuming in the training course. Although the speed of detection in these methods is very fast and sometimes is suitable for real-time systems, these types of methods include statistical methods, neural networks and support vector machines.

Shih and Liu [7] proposed DFA-SVM method which analyzing the discriminant features coherent the modeling of the face based on the distribution and SVM. Heisele [8] has made 5 levels of hierarchy from SVM categories with fewer levels of categories; with this analysis, which the higher classification level of more detection category will be done, has removed the most part of the background. Then the principal components analysis (PCA) was used for higher-level class sections so that to choose relevant image features. By combining hierarchies SVM categories and reducing features technique, the detection process compared with similar classification methods will be faster.

Viola and Jones [9] proposed object recognition program that is fast enough for real-time applications and can effectively be used for face recognition and by integration of new images which called combination images will be done and learning algorithm is based on the intensive algorithm (AdaBoost). Roth and colleagues [10] have suggested a method called snow to face detection with different features and different moods under various conditions. Nilsson and colleagues [11] have suggested an extended version of snow classification by splitting process. One of there verse stretches of this method is that they need a lot of faces and non-faces changes. Cristinacce and Cootes [12] have used the texture and link shape of visual model to create a set of region pattern indicators that a face image will be detected by collecting responses from these detectors.

One of the problems in learning based methods is that it needs a large number of positive and negative learning samples and the learning process is very time consuming. Another issue is that the interpretation of the results is very difficult. So it is difficult to adjust to different applications. Among the three methods listed above, the disadvantages of these methods include the following three points:

1- The difficulty and hardship in defining the knowledge and features relations.

2- The learning process is time-consuming in learning based methods.

3 - Obtaining suitable patterns in matching pattern method is very difficult.

Many ways have been proposed to recover the objects in the images being mixed with background (noise). In most ways, the object retrieval problem has been fixed in a framework of statistical learning solutions. At first the visual samples are provided by a set of attributes, and then learning techniques are used to detect objects related to favorite category. Generally, these methods can be classified into two groups: overall methods based on the appearance and methods based on components.

Overall methods based on the appearance will consider an object as a single unit and classified on the basis of extracting characteristics of the whole object. Many statistical learning mechanisms have been found to characterize and detect object patterns. Rowely and others (1) and Carcia and delakis (2) are using the natural network methods as classification methodsin face retrieval. Based on the properties of the shock wave, Osuna and others (3) and Papagepgiou and Poggio (4) are using support vector machines to locate human faces and cars. Schneiderman and Kanade (5) are using Naïve Bayes principle for face and non-face classification. Recently the helping algorithms are used to restore the old faces by viola and jones (6). And then to retrieve the text, are extended by Chen and Yuille (8). Other comprehensive methods used to retrieve the objects include the probability distribution (9, 10), principal components analysis (11) and linear composition semi spaces (12).

3. General overview of tracking objects proposed method

A proposed method is designed to track multiple object samples in different sizes at different positions in an input image. According to the trace, for example, the overall architecture of retrieving object method is shown in Figure 1. A key component of the proposed method is objects tracker, which uses the space histogram feature as showing the objects. We call object tracker as a spatial histogram based on an attribute (that from now on we will refer to object tracker based on SHF). In our method, object tracker will be formed based on SHF as a hierarchical classification which is combined the cascade histogram matching and support vector machine.

Regarding objects retrieval process, we have used a comprehensive searching window strategy for finding numerous samples of objects in an input image. Objects recovery process consists of three phases: construction of the image pyramid (Step 1), retrieving objects at different scales (step 2), and the combination of tracking results (step 3).

First, an image pyramid of the original image is created in step 1. Tracker is applied at any available position on the image for sample objects tracking in each location of the input image. For objects tracking larger than a fixed size, the input image size is reduced and the tracker is used at any scale. As it is shown in Figure 1, the image pyramid is built by subsample with a 102 factor. As a result, the proposed method can detect objects at different scales. In particular, a fixed-size sub-window pyramid will be scanning the image pyramid in different scales and each sub-image will be confirmed in terms of sample content. In step 2, all sub-images in the object tracker of SHF, are passed. First, the spatial histogram features will be created of the image segments. Secondly, cascade histogram matching will be applied on all the sub-window images for macro classification. This matter will remove a lot of sub-images as non-objects in the background, and almost will provide all the images samples sub-windows into fine recovery (fine). Finally, support vector machine classification will be applied to any remaining window to determine whether it contains a sample of objects or not. If a sub-image will be shown as a sample object by object tracker, it will be written on the scale image which is matched with it in the pyramid.

Step 3 is a stage for combining the tracking results (recovery), where objects overlapped samples in different scales are combined with the final tracking results. Since the object tracker is not sensitive to small changes of transfer and scale, numerous trace around each object sample will happen in pyramid images. We use a grouping method to combine matching recovery with the final tracking results. As it is shown in Figure 1, all tracking in different scales will be written at first on the original image, which consists of areas of the object candidate and the background. A grouping algorithm will be used to attach (direction) the tracking map on non-connected areas. In addition, some very small areas will be removed, because very small areas are usually associated with the wrong tracking. Each area will result a single final tracking. Location and size of the final track are an average position and all tracking sizes in that area. As a result, a number of object samples and position and its scale in the output image will be reported. An object tracker based on SHF can be built through a roughness on fine strategy. For each input image piece with fixed size, object tracker based on the SHF, at first will produce spatial histogram features of the image path, and then will perform the hierarchical classification with cascade histogram matching method and support vector machine. As a result, an object detector based on the SHF, will produce an output which shows if the input image component is an object sample or not.

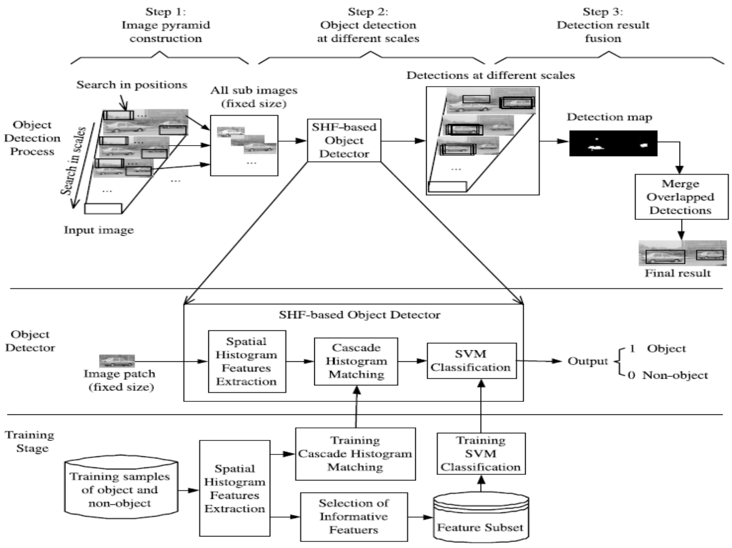


Fig1.the architecture of the proposed method of tracking objects

In the tracking of an object process, the cascade histogram matching method and support vector machines play different roles. Cascade histogram matching will position the object candidate samples and the support vector machine will confirm the object candidate samples. During the training phase, many objects and non-object samples will be used in order to select informative spatial histogram features, and also to train the object tracker based on SHF.

2 - The basic concepts and defining issues

Before describing the proposed method, we define some of the concepts used.

Window: Window is a fixed-sized area in the image.

Item: Item is also the pixel in the window, the item with (x, y) coordinates is shown that the item is located in x column and y row and the number of columns and rows have started from zero.

Template: Template is an image containing a set of items which includes all the items' coordinates, Bryce template examples which is shown in figure 1 can be shown as {(1, 1), (0, 2), (0, 0)} .

Excellent pattern: If any item in x pattern can be found in y pattern, it can be said that y is an excellent pattern of x and x is the sub-pattern of (under) y.

g_1	g_2	g_3
g_4	g_0	g_5
g_6	g_7	g_8

Fig2.The adjacent to calculate basic LBP

Support: pattern support is defined as an image percentage which contained pattern in the database.

Frequent patterns (fp): is a frequent pattern as long as its support is not less than minimum user-specified support threshold.

Maximum frequent pattern (mfp): x frequency pattern is maximum or peak as long as none of its x excellent pattern will be frequent.

4. An educational process

An educational process includes the following three parts:

1 –Pre-processing, where we use the horizontal and vertical edge detection operator for each training image that is called image edge.

2 - The results of the positive and negative characteristics in which we have used a Mafia algorithm to obtain the maximum frequent patterns from the obtaining edge images from the first stage. Among the obtained maximum frequent patterns, we choose a pattern with facial features and the chosen pattern will be called the positive features pattern. In addition, we use Mafia algorithms to obtain the maximum frequent

patterns from non-edge images that any of them are complementary the edge images. So this way we can achieve the negative features pattern.

3 - By making a face detector, it uses the obtained positive and negative features patterns in the second stages.

At this point of our pre-process, we derive the key components of a human face.

Then we apply 3 × 3 operators to extract horizontal and vertical edge images for input images, because the components of the face are a combination of horizontal lines. Then we use the equation 1 for filtering the noise pixels. The resulting images from applying this relation of the two previous images are shown in the following figure.

$$F(i) = \begin{cases} 255 & i > (\mu + c\sigma) \\ 0 & oth \end{cases}$$

Where is the input pixel color intensity and μ is the moderate intensity of image pixel color and σ is the standard deviation of image pixel color.

In the final stage, we combine the two image operator related to horizontal and vertical edges with logic "OR" operator.

Image of the horizontal and vertical edge combination

5. Results of the positive and negative features patterns

Then we use Mafia algorithm to obtain the maximum frequent patterns of the obtained edge images from the previous process. The mafia algorithm can effectively obtain the maximum frequency patterns from the database. The results which were for several pixel features will occur at the same time in human faces and will shape the maximum frequent patterns. That is why we need the maximum frequent patterns for face detection and select one of the facial features.

Selected maximum frequent patterns are called positive features patterns. Then, we use the Mafia algorithm on the face edge negative images that each of them is the complement of the edge image. Similarly, we can obtain the negative pattern features. Mafia algorithm will be used for finding maximum frequent patterns among all the edge images. Below we will show how the proposed method works. The below figure shows examples of training database, which consists of three edge image with 3 ×3 sizes.

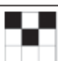
Image ID	Image	Patterns
I1		{(0,0), (2,0), (1,1), (1,2)}
I2		{(0,0), (2,0), (1,1)}
I3		{(2,0), (1,1), (1,2)}

Fig3. Three sample images

Assume that the minimum support threshold is 66%. In general, there are 4 distinct {(0, 0), (0, 2), (1, 1), (2, 1)}. Network for four cases is shown in the below figure that only non-animated edges should change by Mafia algorithm.

Mafia algorithm will move the network in a deep check method. When it moves a node, the support will check nodes and will remove the nodes with unfrequented patterns or the ones which can’t be the maximum frequent patterns. We start from node 0, node 1 and node 5 and node 11 and stop at nod15; because the node 15 is the deepest node in the left branch. In the {(1, 2) and (1, 1) and (2, 0) and (0, 0)} pattern, the node 15 is not a frequent pattern; because its support is 0.33. So we return to node 11. We calculate the support of node 11. Therefore {(1, 1) and (2, 0) and (0, 0)} is frequent because of its0.66 support. Therefore, because the node 11pattern is frequent, nodes 5, 6, 8, 1, 2, 3 and 0 can be pruned. We will continue this work to reach the nodes 12, 13 and 7, because the support of node 12, node 13 and node 7 is 0.33, so they are not frequent.

Then we reach the node 14 with 0.66supports. So it's frequent. As a result, nodes 9, 10 and 4 will be pruned because their node patterns are below node 14 pattern.

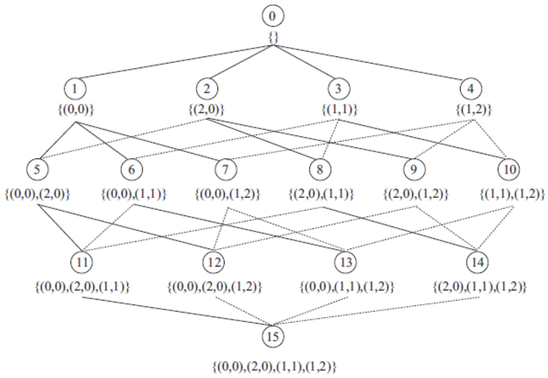


Fig4. Figure 7 grid patterns

Finally, we will gain two maximum frequent patterns which are node 11 and node 14 and is shown in the figure below.

Maximal frequent pattern 1		{(0,0), (2,0), (1,1)} [0.66]
Maximal frequent pattern 2		{(2,0), (1,1), (1,2)} [0.66]

Fig5. Two maximum frequent pattern of figure 7

6. Construction of face detection

The final classification wills use the negative and positive evaluated patterns as the facial features. After selecting useful features (corresponding to the negative and positive frequent patterns) to reduce the sizes we use the PCA technique to reduce the sizes. Then at the end, the classification model will be used:

1-SVDD single class
2-SVDD two classes
3-Parzen_DD two classes
4-knn_DD two classes with k equals to a neighbor
5-A combination of four categories 1 up to 4 by maximum integrating method
6-A combination of four categories 1 up to 4 by an average integrating method
7-A combination of four categories 1 up to 4 by multiplication integrating method
8-A combination of six classifier {parzenc, fisherc, qdc, svdd, knndd, rbnc}by maximum integrating method
9-A combination of six classifier {parzenc, fisherc, qdc, svdd ,knndd, rbnc} by an average integrating method
10-A combinationof six classifier {parzenc, fisherc, qdc, svdd, knndd, rbnc} by multiplication integrating method
11-A combination of six classifiers {parzenc, fisherc, qdc, svdd, knndd, rbnc} by selecting the optimal classifier
12-An intensive combination of 21 fisherc classifier
13-An intensive combination of 21 qdc classifier
14-An intensive combination of 21 simple BIZ classifiers
15-A combination of 21 qdc classifier bag
16-MLP
17-NuSVM
18-SVM
19-A combination of six classifiers {parzenc, fisherc, qdc, svdd, knndd, rbnc} by the majority vote method

7. The detection stage

We use the animated window method for each checking in testing image on the detection stage. For each animated, we derive areas of 100 $\times$ 40 sizes from any location in the input pyramid images by showing that. Then we process the window in the educational step with the use of the previous mentioned process. Then, we derive the mentioned features by Mafia algorithm and write the data in this space. In the next step, we apply the PCA and the data will be stored in a new space. Finally, by applying machine learning techniques, we perform the classification action.

8. Validation of results method

The experimental results of the proposed method and other methods will be reported with valid global criteria. Both accuracy and the area under the ROC curve criteria will be used during this chapter.

The first method to validate an output is accuracy. In this case, we know the actual label, and we will calculate the rate of considering the data quantity that is properly equal with actual labels as accuracy. Another criterion which is considered for evaluating an output of classification in this thesis is the area under the ROC curve, which is also known as the AUC. The final criterion used in the assessments is the height of the optimal point in the ROC curve which is called the AUR.

It is noteworthy that all the presented results in this thesis, in order the tests results to be more generalized have been achieved by averaging from 30 separate components.

9. Total testing data collection

Experimental tests have done on a data set that combines a series of actual faces images, which also some handmade non-facial images have been added to it. The series of actual face images is given from the website [13] facial image site].The used collection consisted of 420 face images. Also this database contains 382 non-facial images that are mainly taken by digital cameras. All images are first mapping in the size of 100×40.

10.The experimental results

Shih In the following table the accuracy results of 30 times performing each method is presented in detail. Each column in this table represents one of the techniques presented in Chapter 3. For example, column j represents the j-th presented methods in Chapter 3.

The average accuracy of 30 times performing each experiment for mentioning various methods, on the used data set is presented in the figure below. Note that after 30 performing, we averaged the30 earned accuracy and are considered as the ultimate accuracy. In each performing, we have considered 35 percent of the total data as educational and 65 percent of the data as experimental. In fact, this figure is the average accuracy results of the 30 times performing the previous methods.

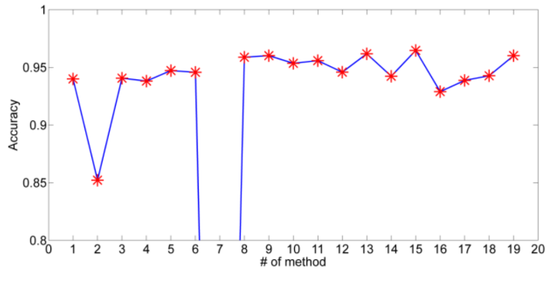


Figure6. The accuracy average results for different methods

In this figure, the horizontal axis has the method index number and the vertical column is an average accuracy. As you can see, the method 15 was performed much better of all the other methods and the average accuracy of this method is better than others. Also method 7 was performed worse than other methods and average accuracy of this method is worse than others. These methods are arranged based on performance on the following table.

Table 1 .Methods arrangements based on average performance

15	13	9	19	8	11	10	5	12	6	18	14	3	1	17	4	16	2	7

Now the question is whether this is the optimal arrangement or not. By conducting the t-test on these data and comparing them by means of accuracy difference meaningfulness the above chart data, method arrangement will be obtained in the following table.

Table 4.Methods arrangement in terms of better performance plurality

Amount	Arrangement
-18	7
-16	2
-13	16
-7	4
-6	17
-5	3
-4	14
-4	18
-3	1
-3	6
-2	12
-1	5
6	10
7	11
12	8
13	9
13	13
13	19
18	15

Compared with AUR criterion (in percentage terms) for a variety of mentioned different ways it is presented in the figure below. Note that, in fact this figure is the summary of the previous reviewed data. It should be noted that in this figure also you should multiply the AUR average of 30 times performing with a hundred and present it in percentage terms.

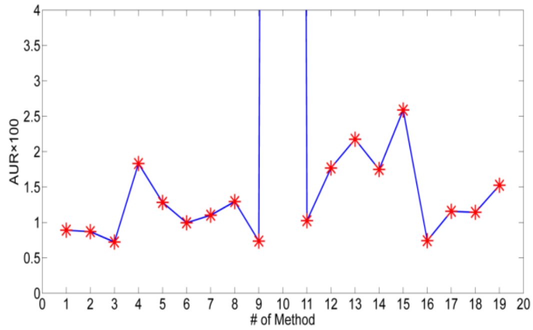


Figure 2 .The average AUR results (in percentage terms) for different methods

In this figure, the horizontal axis has the method index number and the vertical column is the average AUR (in percent). As you see, the method 10 and then the method 15 have performed worse than all other methods and the average AUR of being worse than others. Also, method 3 and then methods 9 and 16 have performed far better than all other methods and the average AUR of this method is better than others. Now, the question is that whether this is the optimal arrangement or not. By conducting the t test on these data, we understand the varying methods in accordance with the AUR difference meaningfulness.

Because, as the optimal point height will be lower in the ROC curve, it means less error, resulting in better accuracy. If i and j element in data related to the above graph will be -1, it means the performance of these two classifiers statistically has a significant difference and i classifier is better than j classifier. If i and j element in the previous table will be 0, it means the performance of these two classifiers statistically has not a significant difference and none of i and j classification is not better than another. By obtaining the sum of each row, a criterion can be achieved that tells us each method is better than how many ones and what is its position. By doing this test on the above chart data, an arrangement of methods is obtained in the following table. After obtaining the arrangement of methods in terms of better performance plurality according to AUR from these two graphs, we can conclude that the method 9is the best method because it is good with both criteria. In the following figure, we have shown the ROC curve of these methods.

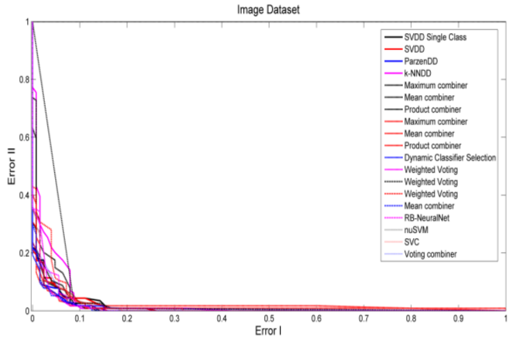


Figure 3. ROC curve for various presented methods on data collection of Face Detection

In many sources, the area under the ROC curve will be used as an important criterion for measuring the quality of a model. Also in this study, these amounts are brought based on AUC criteria in terms of percent for a variety of different methods after 30 times calculation and averaging.

The average AUC results for various methods have been presented, have been used for data set and have been presented in the figure below. Note that in fact this figure is a summary of the previous data. It should be noted that this figure also will multiply the average AUC on 30 times performing with a hundred and will present it in terms of percentage.

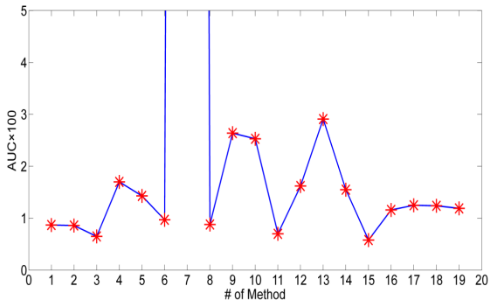


Figure 4. The average AUC results (in percentage terms) for different methods

In this figure, the horizontal axis has the method index number (which was presented in Chapter 3) and the vertical column is the average AUC (in percent). As you can see, method 15 and then methods 3and 11were performed better than all other methods and the average AUC of this method is better than others. Moreover, the method 7 was performed worse than other methods and the average AUC of this method is worse than others. Now the question is that whether this arrangement is optimal or not. By conducting the t test on these data and statistical comparisons of different methods based on the AUC difference meaningfulness, we will understand that if i and j element will be 1 in previous data table, which means the performance of these two classifiers in terms of statistical t test has a meaningful difference and i classifier is better than j classifier. If the i and j element in previous table will be 0 which means in the terms of the t test, the performance of these two classifiers has not a meaningful difference and none of the i and j classifiers are better than another. By obtaining the sum of each row, it can be achieved a criterion that tells us each method is better than how many methods and what is its position. By conducting this test on the above data, the methods arrangements were obtained in the following table.

11. The method arrangements in terms of better performance plurality according to AUR

Arrangement	Amount
15	-18
3	-15
11	-15
1	-10
2	-10
8	-9
6	-6
16	-2
19	0
17	1
18	1
5	3
14	5
12	7
4	8
9	14
10	14
13	14
7	18

According to this table, the best methods are respectively method 15, then methods 3 and 11, and then methods 1 and 2. This table is largely confirmed by the results presented in Table 4. From these two tables, it can be concluded that the method 15, is the best method. In general, also from all the results, this method can be chosen as the best method. In the following figurethe curve chart of most classifiers on this data set is shown.

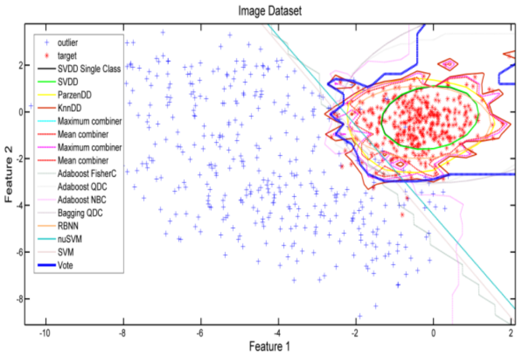


Figure 4. The curve chart of Chapter 3 classifiers on the face detection data sets

11.Conclusion

In this thesis, a method for extracting a feature in order to detect an object and more specifically face detection has been presented. In this method, we used various models to build a face detection system. We use a variety of evaluation models to measure the quality of our models. Finally, we have shown that the majority vote model is the best method.

12.References

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