Suspect Person localization Using SVM of Thermal Vision Image

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***Abstract*— This article presents a study of the localization of suspect person, by infra-red thermography in a complicated zone or there are several different obstacles of different temperature, which gives difficulties to make a precise diagnostic of natures of the mobile things, for that the mathematical methods of classification and localization are, apply of the infra-red images. The results of detection obtained by these mathematical methods are presented and discussed.**

***Keywords*—localization, thermal image, SVM.**

I. INTRODUCTION

In the last years the non destructive testing (NDT) became important research domain in the industrial field, especially for the localization of the objects, Among the nondestructive testing methods there are ultrasonic technique [1], magnetic particle technique [2], eddy current technique [3], ray technique [4] and infrared thermography who the more used in NDT domain, however it is limited in certain cases [5].

When there are very small variations in the temperature, it is necessary to make special treatments of the infra-red images, because the infra-red camera does not make the classification and precise localization of the images. In this paper support vector machine (SVM) and neural networks are applied for classification and localization of person.

Neural networks ensure a simulation of how to organize information as a human brain. They are already used in various fields, as well as, pattern reorganization, data mining, target detection, and fault diagnosis [6], [7]. The network model consists of three layers: the input layer, the hidden layer, and the output layer.

Support vector machine (SVM) has been widely used in several domains, especially for detection and localization of objects; it's a binary supervised method.

This paper will investigate the application of infrared thermography technique as a detect method for suspected person in defense and protection domain and apply two different post-processing techniques, namely neural network and Support Vector Machine (SVM). This two techniques gives more detailed for infrared images.

II. DEFECT CLASSIFICATION METHOD

A. Neural Networks

Neural networks are structures based on the human brain, the research began in this domain of the connection started with presentation in 1943 by W. MCCulloch and W. Pitts of a simple model of biological neuron commonly called formal neuron, the representation of this neuron is shown by the following figure:

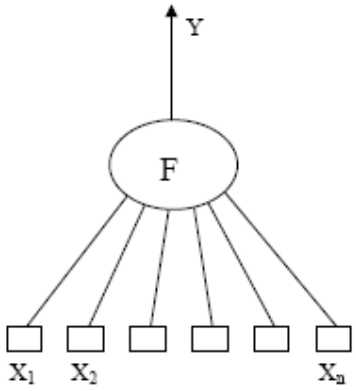


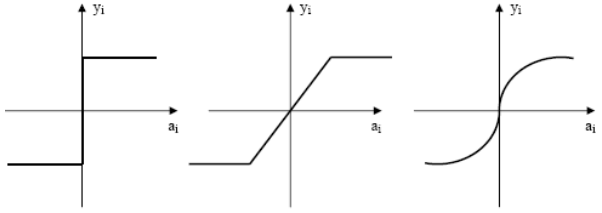
Fig. 1. Artificial neuron.

The neuron then carries out three operations on its inputs:

- Weighting: multiplication of each input by a parameter called connection weight,
- Summation: summation of the balanced inputs is carried out.
- Activation: passage of this sum in a function, called activation function.

Each neuron receives a variable number of inputs from upstream neurons. Each of these inputs is associated with a weight w which represents the strength of the connection. Each elementary processor has an output, which then branches out to feed a variable number of downstream neurons. Each connection is associated with a weight.

The calculated value is the output of the neuron which is transmitted to the following neurons.



Threshold function Linear function by parts Sigmoid function

Fig.2. Different types of transfer function for the artificial neuron.

The function F is called activation function (figure 1.2).It can be a function with threshold, a linear or not linear function.

The sigmoid function is presented as a continuously derivable approximation of the linear function of activation by parts or of the threshold function. It has the advantage of being regular, monotonous, continuously derivable, and limited between 0 and 1:

$$f(x) = \frac{1}{1+\exp(-x)} \quad (1)$$

The most used of neural networks are the networks which contain three types of layers:

Input layer: the neurons of this layer receive the values of input of the network and transmit them to the hidden neurons.

Hidden layers: each neuron of this layer receives the information from several preceding layers, carries out the summation balanced by the weights, then transforms it according to its activation function which is in general a sigmoid function. Thereafter, it sends this response to the neurons of the following layer.

Output layer: it does the same role as the hidden layers, the only difference between these two types of layers is that the output of neurons of the output layer is not related to any other neuron.

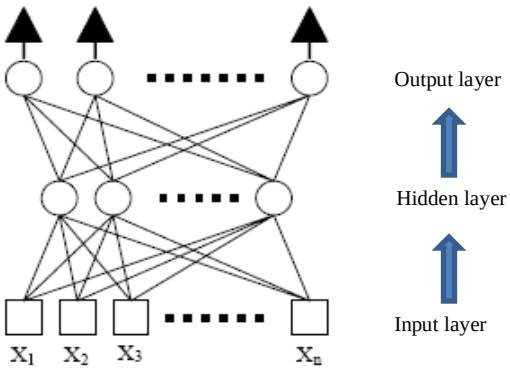


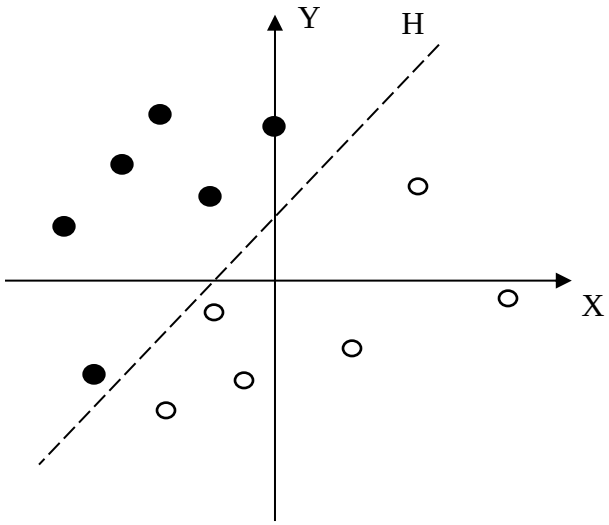
Fig.3. Neural networks with n inputs, one layer with N_c hidden neurons and N_0 output neurons.

B. Support Vector Machine (SVM)

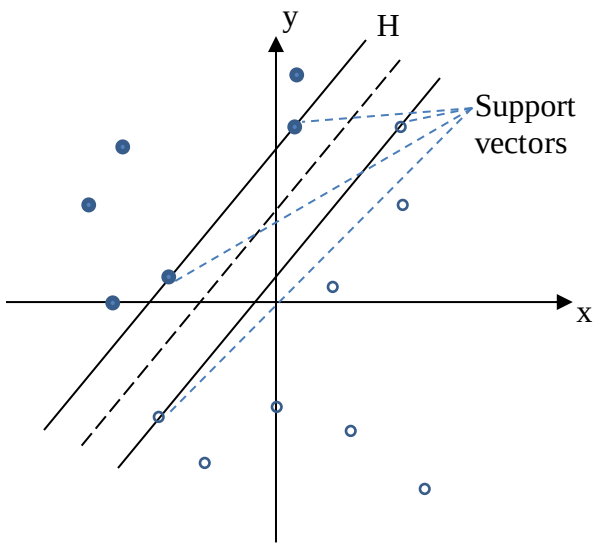
Among the cores methods, based on statistical theory of training of Vladimir Vapnik, SVM constitute the most known form. SVM is a method of binary classification by supervised training; it was introduced by Vapnik in 1995. This method is a recent alternative for classification. It based on the existence of a linear classifier in a suitable space. Since it is a problem of classification with two classes, this method calls to a data file of training to learn the parameters from the model. It is based on the use of function known as core (kernel) which allows an optimal separation of the data, it are based on a solid mathematical theory contrary to the neural networks method. It was developed with the opposite direction of the development of the neural networks.

For two given classes of examples, the objective of SVM is to find a classifier that will separate the data and maximize the distance between these two classes. With SVM, this classifier is a linear classifier called a hyperplane.

In the following diagram, we determine a hyperplane that separates the two sets of points.



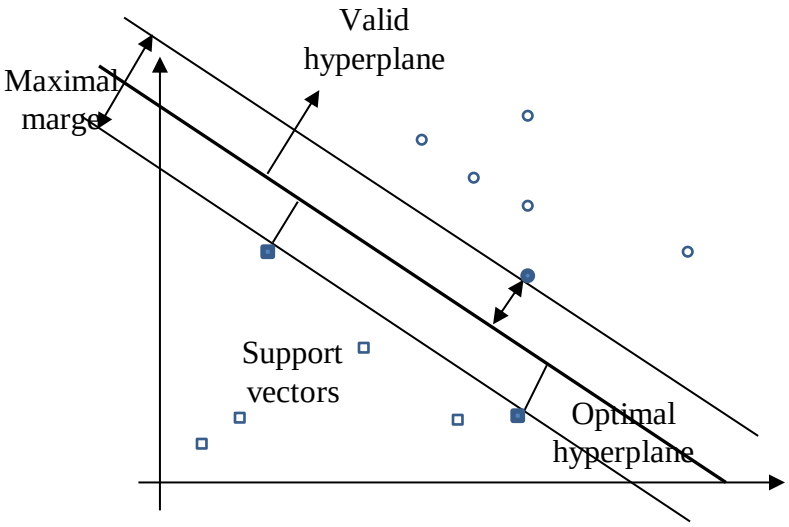
The closest points, which are the only used for the determination of the hyperplane, are called support vectors.



It is obvious that there is a multitude of valid hyperplanes but the remarkable property of SVM is that this hyperplane must be optimal. We will therefore search among the valid hyperplanes, the one that passes "in the middle" of the points of the two classes of examples. Automatically, this is like looking for the "safest" hyperplane. Indeed, suppose that an example has not been described exactly, a small variation will

not modify its classification if its distance to the hyperplane is large. Formally, this amounts to looking for a hyperplane whose minimal distance to the training examples is maximal.

We call this distance "margin" between the hyperplane and the examples. The optimal separating hyperplane is the one that maximizes the margin. As we try to maximize this margin, it called separators with a large margin.



III. RESULTS AND DISCUSSION

Fig.4. Infrared image of suspect person.

Fig.5. Classification of image by neural networks method.

Fig.6. Localization or contour detection
of suspect person by neural networks method.

Fig.7. Classification of image by SVM method.

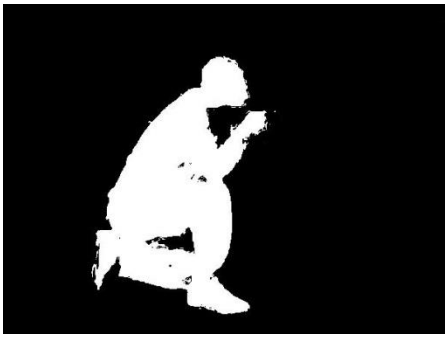


Fig.8. Localization or contour detection
of suspect person by SVM method.

Fig.9. Infrared image of two suspect persons.

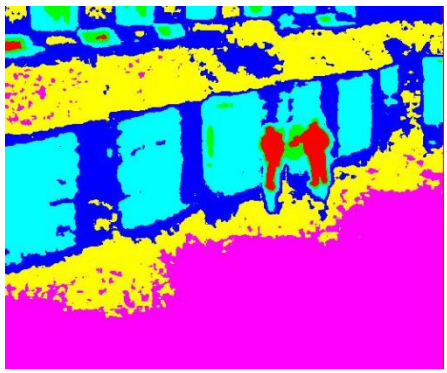


Fig.10. Classification of image by neural networks method.

Fig.11. Localization or contour detection of two suspect persons by neural networks method.

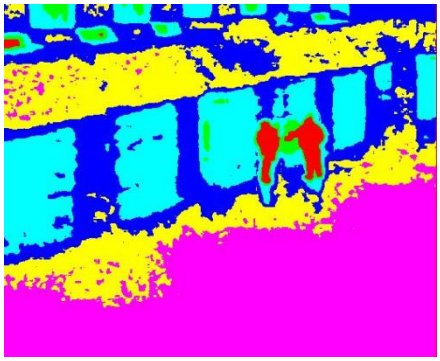


Fig.12. Classification of image by SVM method.

Using an infrared camera and a special software we analyse thermal images for detecting anomalies areas, in this study we will present the results obtained using some classification methods, and we choose a method for localization persons.

After applying the tow supervised methods, it can be seen in figures 5, 7, 10, 12, that there is a good classification, because there are a precise classification in all figures.

Fig.13. Localization or contour detection of two suspect persons by SVM method.

IV. Conclusion

Localization suspects persons (figures 6, 8, 11, 13) by its thermal image is a difficult task, this is due to characteristics of thermal images. In this paper we have presented two techniques for classification thermal images, neural networks and SVM methods. The results have shown that the two techniques are gives a best classification in infrared images.

The SVM approach proposed in this study allows localization of suspect persons before any dangerous of these persons, gives global information of the number, nature and situation of these persons.

From these results we can conclude that the SVM method gives a good result in classification and localization like the neural networks method. The two proposed methods in this paper, allows the control or survey procedure easy and safe, gives more details of image nature.

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