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SVM BASED HUMAN DETECTION BY VIDEO ANALYSIS

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ABSTRACT

Human detection is an important application where security is the main concern. This paper presents the machine vision approach for detection of human in video using support vector machine. To improve the efficiency of machine learning 3 statistical features are computed from haar wavelet transform which forms the training input to the SVM. This technique is demonstrated using real world video data and SVM classifier gives encouraging detection rate for these features.

***Keywords* - Haar wavelet, Human Detection, Machine vision, Support vector machine, Video surveillance.**

1.Introduction

Visual surveillance is emerging importance in areas of machine vision for the high security purpose. Simultaneous observation of multiple video screens with different units of structure has become complicated for human operator. With the aim to detect a moving human in video a Real-time system is developed to detect human through video analysis. Most of the early studies on human detection have been conducted. Recently Ahmed et al.[1]presented the algorithm using PCA method and wavelet decomposition. Ye et al. [2] proposed the feature extraction method using DWT with support vector machine Xinnan et al.[3] presented a grid and center radiating vector features with SVM classifier. Mostayed et al.[4] attempted classification of human using K-means clustering based on DFT and DWT features. Sudha et al.[5] segmented individual frames using background subtraction algorithm from which wavelet features are extracted and used with SVM. El-yacaubi et al.[6] Proposed a model-free approach and dynamics of human figure are modeled using Hidden Markov Models. P. Li [7] presented a novel gait recognition based on Haar wavelet and fused Hidden Markov Models.

In order to develop human detection system haar wavelet transform is used for feature extraction for obtaining three statistical features from red, green and blue layers of human and non-human images. Further the SVM classifier is used for two class classification purpose.

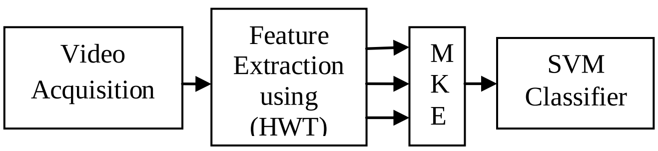

Fig 1 Overview of the proposed method

Fig 1 shows the overview of proposed method. For video acquisition of surveillance place web camera is used. As a system is real time the algorithm is developed to convert this run time video into image sequences. Feature extraction is done by applying haar wavelet transform on each obtained image and three statistical features are derived that is mean(M), kurtosis(K) and energy (E). These features are used to form training input to the SVM.

2. Feature Extraction using Haar Wavelets

Wavelet analysis is an advanced feature extraction algorithm which is based on windowing technique with variable sized regions. The window size can be kept wide for low frequencies and narrow for high frequencies which lead to an optimum time frequency resolution for complete frequency range. For the image decomposition and feature extraction the haar transform has been applied. It will decompose a image into four components LL, LH, HL, HH Where L denotes low frequency and H denotes high frequency. Out of four, LH, HL & HH represent the finest scale wavelet coefficient of details images and LL represents low frequency level coefficients of approximation image.

2.1 Statistical feature Extraction

The statistical features are obtained from two level decomposed sub-bands of image. Mean, kurtosis and energy these three statistical features are calculated by using equation (1), equation (2) and equation (3) respectively [8].

Mean:

$$Mk = \frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N} x(i,j) \qquad (1)$$

Kurtosis:

$$K_k = \left[\frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{E(x_k(i,j)-\mu_k(i,j)^4)}{\sigma(i,j)^4}\right] \qquad (2)$$

Energy:

$$E_k = \frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N}\left|x_k(i,j)\right| \qquad (3)$$

3. Support Vector Machine

A support vector machine (SVM) is based on a statistical learning theory showing various advantages over existing soft computing methods. As compared with the soft computing methods generally used for various applications, SVM gives better performance. Lanlan Wu et al [9] achieved classification accuracy ranging 92.31 to 100% for different feature selections using SVM. It is used in case of finite sample data. It aims at acquiring the worthy solutions on the ground of present data rather than the optimal value for infinite samples.

If the original problem is stated in a finite dimensional space and the sets required to separate out are not linearly separable in that space then it can be mapped into a higher dimensional space, so as to make separation between the sets more distinguishable. This peculiar quality of SVM shows its good potentiality of abstraction. As its ramification is independent of sample dimension, it solves the problem of dimension disaster. This method is successfully implemented in face recognition, machine fault detection and in handwritten digit recognition for tablets, PDA's and other electronic devices.

As shown in fig 2 the two sets of sample points are represented by green and red color, H is the hyper plane or separator, H1 and H2 are planes running parallel to the hyper plane and pass through the sample points closest to the hyper plane. As there are many such hyper planes which can show divergence between the two sample sets, a hyper plane which has maximum distance from both H1 and H2 is chosen. The distance between H1 and H2 is called as margin. The hyper plane with largest margin is called as maximum-margin hyper plane and the linear classifier it defines is addressed as maximum-margin classifier. The more margin a hyper plane has, less is the error in optimizing the separation between sample points.

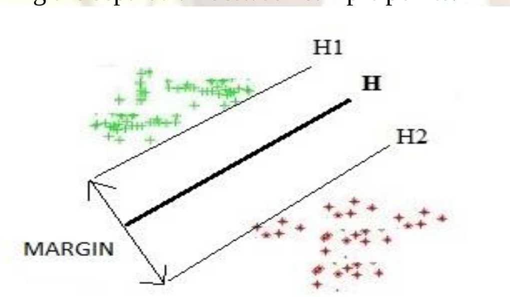

Fig 2 Distinguishing sample point using SVM

This case study uses the Gaussian Radial Basis Function Kernel for the classification. For the nonlinear case, we project the original space into a higher dimension space in which the SVM can construct an optimal separating hyper-plane as explained above. Let us consider a function □ □ x(), such that F □ □ {□ x(): x□ □X} is the feature point corresponding to the data item x. For SVM, the kernel function is represented as

K(x, z) □ □ (□x(), □ z()), □x, z□X

replacing the inner product (x, z).

3.1 SVM Based Human detection

The sample set should include human sample and non-human sample. The non-human sample includes all kinds of images including all kinds of animals and vehicles. The combination of human sample and part non-human sample forms the training input to SVM and an initial SVM classifier. The final sample set we obtained includes 1500 human samples and 1500 non-human samples.

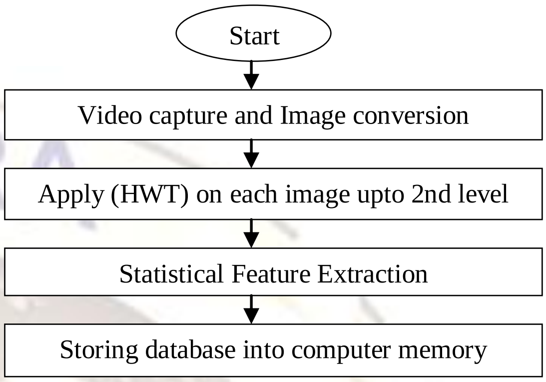

Fig 3 Process of developing Database

Fig 3 shows the process of developing database video capturing is done with web camera it captures 15 frames per second the size of each frame or image is 320 x 240. The application program does the feature extraction as the procedure mentioned above. At last this database is stored in computer memory.

We test our algorithm based on the mixed database we have taken video consist of human walk through surveillance region with different gestures simultaneously this video is converted in image sequences. The pixel of the image is 320x240.Application program does feature extraction at last, the trained SVM detector is used for decision making.

4. Results And Discussion

In the current study, the SVM is used for nonlinear classification of human and non-human image features. The performance of two features classifications is presented using haar wavelet statistical features.

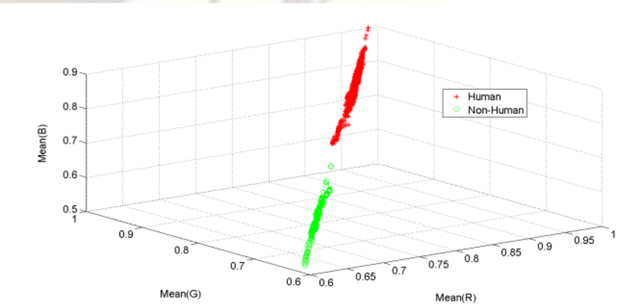

Fig 4 Plot for mean feature

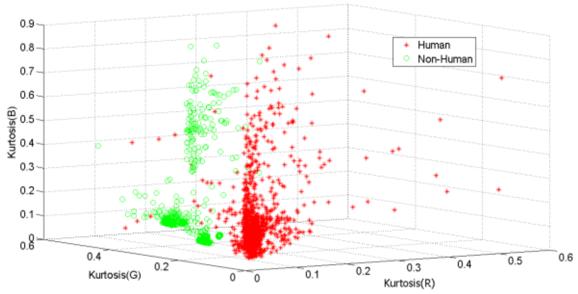

Fig 5 Plot for Kurtosis feature

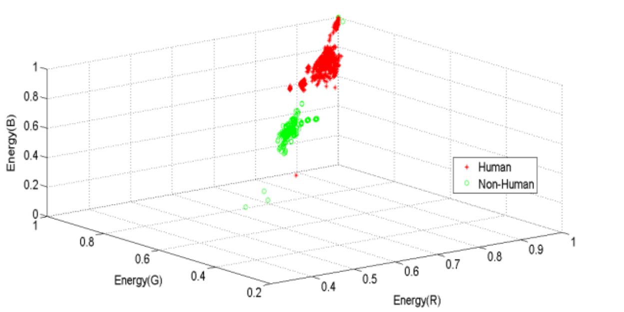

Fig 6 Plot for Energy feature

Fig 4, 5 and 6 shows plots of Mean, Kurtosis and Energy features obtained for three layers of images red, green and blue 320 X 240 pixel size images. From the plots it can be observed that the data for human and non-human for combination of three features is separable for the sample data considered for numerical analysis. These preliminary results give a confidence that the haar wavelet statistical features can be used for human detection.

Table 1 Experimental results of SVM

Features	Mean	Kurtosis	Energy
Total Samples	3000	3000	3000
Error samples	117	270	2
Detection Rate	96.19	91.01	99.65

The performance of the SVM classification is measured in terms of success rate which is the ratio of number correctly classified sample against the total number of samples used for classification.

In SVM, experiments were conducted; we found that classification performance of SVM depends on the selection of features the table 1 shows that SVM is tested for three set of features, the performance of SVM to energy feature is almost 99% and for mean the detection rate of SVM is upto 96%. For kurtosis the performance of SVM is comparatively lowest 91%.

5. CONCLUSION

High accuracy is required for human detection which required a fine algorithm for decision making. This paper implements the SVM based human detection and uses haar wavelet based statistical features. The experimental results shows that out of three statistical features energy feature greatly improves the detection rate of SVM.

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