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Online Human Detection using HOG and RSCBFD Algorithm

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Abstract*— Human detection has many applications in many fields such as robotics, surveillance, user interface design, Human Activity Recognition etc. Many approaches are available for human detection. A new approach for human detection is introduced here, a combination of two algorithms like HOG and RSCBFD algorithm. The combined algorithm helps the system to be faster than previous systems and provides better accuracy also. Since it is fast, the method can use for real time systems. The performance of the system is compared and analyzed with some previous methods.

***Index Terms*—gradient, HOG, RSCBFD, cosine similarity.**

I. INTRODUCTION

The Human detection deals with the recognition of humans. It has many applications. In early days, the human detection was done by using sensors. The sensors like body heat sensor, motion sensors etc were used for human detection. But, human detection using video is even a difficult task than using a sensor. But human detection using videos have more applications than sensor based human detection. There are many approaches are used for human detection using videos. But most of them are not for real time detection.

The sensor based human detection has many applications in security section. In high security systems like bank locker system or in treasury, any human presence will detect using the heat sensor. The room will be air conditioned and if any human presence will increase the heat and this cause the detection of human or any other entity.

Consider an example; in the year 1911, the famous painting of Mona Lisa was stolen. The thief who stole the painting hides inside the museum for a night and waited till the dawn to take the painting out. Ultimately he succeeded to steal it. But such a scenario can be avoided using the human detection system. By using sensor based human detection, the heat sensor or motion sensor gets active when the museum closes. So any human entered/hides inside the museum will be notified to the authorities. Also, by using video based human detection system, the cameras must install all over the museum and detect humans online. If any hint of humans or motion at that time will give alert to the officials.

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II. RELATED WORKS

Currently many approaches are available for both human detection and activity detection. For Human Detection, Navneet Dalal and Bill Triggs[1] introduced Histograms of Oriented Gradients (HOG) which is for offline human detection. It is slow because it normalizes twice the given image before detection. Later another human detection technique called Linear Binary Pattern (LBP) was introduced by Amit Satpathy, Xudong Jiang and How-Lung Eng[2]. It is less complex than HOG. Also it is faster than HOG. Jianxin Wu, Christopher Geyer and James M. Rehg[3] proposed another human detection algorithm called CENTRIST (CENsus TRansform hISTogram). It has proved that it is faster than LBP. It is a human detection algorithm which can be applied in online human detection systems. It is already enhanced by online object detectors introduced by Kalal et al.[4].

In this paper, the Human Detection is based on the collaboration of algorithms like HOG and Robust Skin Colour Based Algorithm, a face detection algorithm used for human detection. The Proposed system tries to detect humans in real time. The proposed method is described in following sections.

III. PROPOSED SYSTEM

The proposed algorithm is for an online human detection which can be effectively useful in real time systems. It combines HOG and RSCBFD algorithm to get better outcome. Human Activity Recognition (HAR) using videos are often done in offline. But for an online system, it must be much faster than the conventional HAR systems. For an online HAR system, here some algorithms are merged and incorporated with each other. For human detection, algorithms like HOG and RSCBFD are merged and for activity detection, NTB algorithm is used. The system overview is shown in Fig 1.

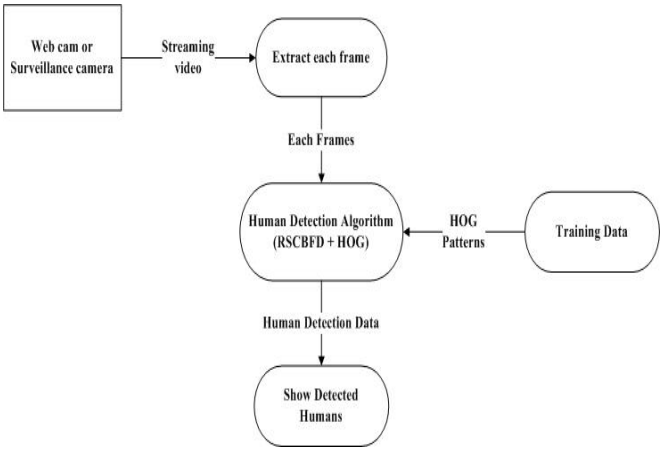

Fig 1: System Overview

The Web camera or CCTV camera will capture the live images. From these images, each frame is separated to individual image frames, so that it can process further. Now, these individual image frames are subjected to human detection algorithm. Before that, the consecutive frames are taken and compare each pixel to corresponding positions of both frames. If the pixels contain same values, then those pixels were skipped. The pixels with changed values get marked. Only that changed pixels get considered for further operations. So, the pixels refer to motion is considered because assuming that if there is no movement, illegal activities would not occur.

The individual frame must be in the form of RGB. Then this image is subjected to dilation and erosion. After those operations, the skin regions will obtain as white colour and rest as black. The algorithm in [5] is applied as it is. This gives the face of the person. After that, the HOG is applied. The steps like normalization, orientation binning etc are skipped. Here, the R-HOG is used. At first, the gradients at both x and y directions are find out.

Gradient in x direction,

$$\varrho_x(x,y) = P(x,y) - P(x+1,y) \quad (1)$$

Gradient in y direction,

$$\varrho_y(x,y) = P(x,y) - P(x,y+1), \quad (2)$$

where P(x,y) is the pixel gray value at a simple pixel location (x,y).

$$\text{GradientDirection}, \theta(x,y) = \begin{cases} if\ \tan^{-1}\left(\frac{\varrho_x(x,y)}{\varrho_y(x,y)}\right) \geq 0, then\ \tan^{-1}\left(\frac{\varrho_x(x,y)}{\varrho_y(x,y)}\right) \\ if\ \tan^{-1}\left(\frac{\varrho_x(x,y)}{\varrho_y(x,y)}\right) < 0, then\ \tan^{-1}\left(\frac{\varrho_x(x,y)}{\varrho_y(x,y)}\right) + \pi \end{cases} \quad (3)$$

(a) **(b)**

Fig. 2: (a) An Input Image (b) HOG patterns for the given input image

After obtaining the HOG pattern, its cosine similarity is found. This cosine similarity value helps for further human detection.

Cosine similarity,

$$\cos\theta = \frac{P_1Q_1 + P_2Q_2 + P_3Q_3 + \cdots + P_nQ_n}{\sqrt{P_1^2 + P_2^2 + P_3^2 + \cdots + P_n^2}\sqrt{Q_1^2 + Q_2^2 + Q_3^2 + \cdots + Q_n^2}} \quad (4)$$

Using cosine similarity, a value between zero and one is obtained for identify as human, and a range is fixed after a training process. So, whatever moving matters come at this range is identified as human.

IV. Results and Discussion

A comparison between different human detection algorithms is conducted and the results are plotted as a bar chart in fig. 3. Since RSCBFD is a face detection algorithm, it cannot detect humans in some situations. So it has very low detection rate in terms of human detection. But actually the algorithm has a better detection rate for face detection.

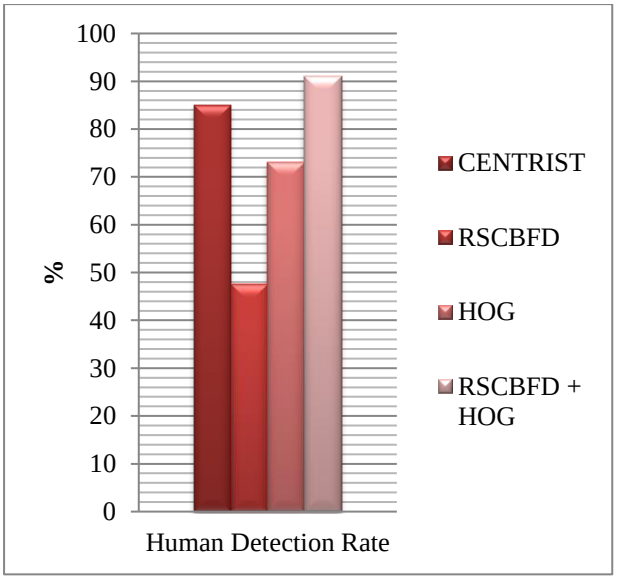

Fig. 3: Analysis for Human Detection Algorithms

Comparing some Human detection techniques like CENTRIST, HOG and the combination of RSCBFD and HOG; RSCBFD+HOG has a better performance.

The accuracy is calculated by,

$$\%\ Accuracy = \frac{Total\ number\ of\ samples\ correctly\ predicted}{Total\ number\ of\ samples} \quad (5)$$

V. Conclusion

An Efficient recognition of humans leads to improvement in many fields. In the field of surveillance, humans can be identified and it is subjected to human activity recognition. If the activity detection system has high accuracy, it is beneficial to fields like robotics, human-computer interaction, user interface design etc. In human detection system, the combined algorithm of RSCBFD and HOG has better performance than CENTRIST approach. So using both RSCBFD and HOG can increase the performance as a whole system.

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