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Review of Canny Edge Detection Algorithm and HOG Feature Extraction in Facial Expression Recognition

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Abstract: The Facial Expression Recognition system has many applications in the field of machine learning and computer vision. The canny edge detection algorithm has proved to be a very successful one in many image processing applications. It uses intensity gradients of an image for successful edge identification. For feature extraction in (FER) systems many methods are there for still images and videos. HOG (Histogram of Oriented Gradients) is the feature extraction method using image gradients that is applied in many FER systems. The first step of calculation in many FER systems is image pre-processing. This step is for removing noise and ensuring normalized color and gamma values. This step can be left out when we do feature extraction using HOG descriptor computation, as the HOG descriptor normalization produces the same result. Both the algorithms use image gradients for their computation. In our paper we shall provide a review of these two successful algorithms and analyze them for effective Facial expression recognition with less computational time and memory.

Keyword: - image gradients, HOG, hysteresis thresholding,

I. INTRODUCTION

Facial expression recognition is one of the hot topics in the field of image processing, computer vision and machine learning. In the first step face have to be detected in the image using an edge detection algorithm and then the features of face is extracted using a feature description algorithm. Then the expressions of face like sad, happy, astonished, etc have to be recognized using the classification algorithm. Edge detection is the most common preprocessing step in many image processing algorithms such as image segmentation, image enhancement, tracking and image/video coding [3]. In digital image processing, the term edge is a collection of the pixels it refers to the part where the brightness of the image local area changes significantly in digital image processing [2]. The general methods of edge detection are first order Derivative-gradient method, Second-Order Derivative and Optimal Edge Detection to detect the edges proposed by digital image processing [1]. A lot of edge detection algorithms, such as, Robert detector, Kirsch detector, Gauss-Laplace detector, Prewitt detector and Canny detector have been proposed [1]. Among the existing edge detection algorithms, the Canny edge detector has remained a standard for many years and has best performance [4]. This paper also reviews the application of histogram of oriented gradients descriptor (HOG) in the FER problem. HOG is a shape descriptor that counts occurrences of gradient orientations in localized portions of an image and that is mainly used for the purpose of object detection but that is also intuitively useful to model the shape of the facial muscles by means of an edge analysis.

II. LITERATURE REVIEW

The literature shown in the references was used to study the two algorithms. Reference[1] explains Canny edge detection algorithm and its complex steps easier to understand. HOG was reviewed using references[5], [9] and [10]. Other references were also useful for better understanding of facial expression recognition.

III CANNY EDGE DETECTION ALGORITHM

There are many edge detection algorithms like Roberts, Prewitt, Sobels and Canny. Among these algorithms the Canny Edge detection algorithm which was released in 1986 was the most successful one. It has been used by many researchers for separating objects of interest from the image. It is used for counting number of vehicles in a road scene, number of persons in an image, separating affected cells from an MRI scan etc. Canny edge detection algorithm is a search based method. The Process of Canny edge detection algorithm can be broken down to 5 different steps:

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1. Apply Gaussian filter to smooth the image in order to remove the noise
2. Find the intensity gradients of the image
3. Apply non-maximum suppression to get rid of spurious response to edge detection
4. Apply double threshold to determine potential edges
5. Track edge by hysteresis thresholding: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

The success of the algorithm is based on the fact that it uses hysteresis thresholding instead of standard thresholding. The hysteresis mode uses a hysteresis loop to provide a more connected result. Any pixel above the upper threshold is turned white. The surround pixels are then searched recursively. If the values are greater than the lower threshold they are also turned white. The result is that there are many fewer specks of white in the resulting image.

IV HOG

There are many feature extraction methods like LBP, LGC, LDP and HOG. HOG is the one which uses image gradients. HOG is dense feature extraction method for single image. It extracts all regions of interests from image through gradients. This technique is pretty fast. The essential thought behind the histogram of oriented gradients descriptor is that local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. The image is divided into small connected regions called cells, and for the pixels within each cell, a histogram of gradient directions is compiled. The descriptor is the concatenation of these histograms. For improved accuracy, the local histograms can be contrast-normalized by calculating a measure of the intensity across a larger region of the image, called a block, and then using this value to normalize all cells within the block. This normalization results in better invariance to changes in illumination and shadowing. The following are the steps involved in implementing HOG

1. Gradient Computation
2. Orientation Binning
3. Descriptor Blocks
4. Block Normalization
5. Object Recognition

The first step of calculation in many feature detectors in image pre-processing is to ensure normalized color and gamma values. However, this step can be omitted in HOG descriptor computation, as the ensuing descriptor normalization essentially achieves the same result. Image pre-processing thus provides little impact on performance. Instead, the first step of calculation is the computation of the gradient values. The most common method is to apply the 1-D centered, point discrete derivative mask in one or both of the horizontal and vertical directions. Specifically, this method requires filtering the color or intensity data of the image with filter kernels. Gaussian filters was also tried by some researchers.

The second step orientation binning is creating the cell histograms. A bin in a histogram is the block that you use to combine values before getting the frequency. Here each cell is a bin. Each pixel within the cell casts a weighted vote for an orientation-based histogram channel based on the values found in the gradient computation. The cells themselves can either be rectangular or radial in shape, and the histogram channels are evenly spread over 0 to 180 degrees or 0 to 360 degrees, depending on whether the gradient is “unsigned” or “signed”. In reference [10] Dalal and Triggs found that unsigned gradients used in conjunction with 9 histogram channels performed best in their human detection experiments. As for the vote weight, pixel contribution can either be the gradient magnitude itself, or some function of the magnitude. In tests, the gradient magnitude itself generally produces the best results. Other options for the vote weight could include the square root or square of the gradient magnitude, or some clipped version of the magnitude.[5]

To account for changes in illumination and contrast, the gradient strengths must be locally normalized, which requires grouping the cells together into larger, spatially connected blocks. The HOG descriptor is then the concatenated vector of the components of the normalized cell histograms from all of the block regions. These blocks typically overlap, meaning that each cell contributes more than once to the final descriptor. Two main block geometries exist: rectangular R-HOG blocks and circular C-HOG blocks. R-HOG blocks are generally square grids, represented by three parameters: the number of cells per block, the number of pixels per cell, and the number of channels per cell histogram. In the Dalal and Triggs human detection experiment, the optimal parameters were found to be four 8x8 pixels cells per block (16x16 pixels per block) with 9 histogram channels. Moreover, they found that some minor improvement in performance could be gained by applying a Gaussian spatial window within each block before tabulating histogram votes in order to weight pixels around the edge of the blocks less. The R-HOG blocks appear quite similar to the scale-invariant feature transform (SIFT) descriptors; however, despite their similar formation, R-HOG blocks are computed in dense grids at some single scale without orientation alignment, whereas SIFT descriptors are usually computed at sparse, scale-invariant key image points and are rotated to align orientation. In addition, the R-HOG blocks are used in conjunction to encode spatial form information, while SIFT descriptors are used singly.

Circular HOG blocks (C-HOG) can be found in two variants: those with a single, central cell and those with an angularly divided central cell. In addition, these C-HOG blocks can be described with four parameters: the number of angular and radial bins, the radius of the center bin, and the expansion factor for the radius of additional radial bins. Dalal and Triggs found that the two main variants provided equal performance, and that two radial bins with four angular bins, a center radius of 4 pixels, and an expansion factor of 2 provided the best performance in their experimentation(to achieve a good performance, at last use this configure). Also, Gaussian weighting provided no benefit when used in conjunction with the C-HOG blocks. C-HOG blocks appear similar to shape context descriptors, but differ strongly in that C-HOG blocks contain cells with several orientation channels, while shape contexts only make use of a single edge presence count in their formulation[10].

In the fourth step block normalization is carried out. Four different methods for block normalization was proposed in [10]. All the four methods showed very significant improvement over the non-normalized data.

The final step is object recognition. HOG descriptors may be used for object recognition by providing them as features to a machine learning algorithm. HOG descriptors were used as features in a support vector machine (SVM) in [10]. However, HOG descriptors are not tied to a specific machine learning algorithm.

The HOG descriptor has a few key advantages over other descriptors. Since it operates on local cells, it is invariant to geometric and photometric transformations, except for object orientation. Such changes would only appear in larger spatial regions. Moreover, as discussed in [10], coarse spatial sampling, fine orientation sampling, and strong local photometric normalization permits the individual body movement of pedestrians to be ignored so long as they maintain a roughly upright position. The HOG descriptor is thus particularly suited for facial expression recognition in images [9].

V CONCLUSION

Canny edge detection algorithm is superior to other edge detection algorithms, but increases latency time. HOG is also proved to be very successful. Both these algorithms have the initial steps in common like filtering and calculating image gradients. When they are combined some computation time can be reduced. So both the algorithms can be combined for effective facial expression recognition.

REFERENCES

[1] Ms. Anjum Sheikh, PG Scholar – VLSI, BDCE Sevagram, Wardha, India and Prof. R. N Mandavgane, Professor, BDCE Sevagram, Wardha, India and Prof. D. M. Khatri, Associate Professor, BDCE Sevagram, Wardha, India "REVIEW ON CANNY EDGE DETECTION" IJAICT Volume 1, Issue 9, January 2015

[2] M.Rathod PG Student, ME Communication System, L.J. Institute of Engineering and Technology. "Edge Detection in VHDL"IEEE2014

[3] Qian Xu, Srenivas Varadarajan, Chaitali Chakrabarti, Fellow, IEEE, and Lina Karam, Fellow, IEEE "A Distributed Canny Edge Detector: Algorithm and FPGA Implementation" IEEE Transactions On Image Processing, VOL. 23, NO. 7, JULY 2014

[4] W. He and K. Yuan, "An improved canny edge detector and its realization on FPGA," in Proc. IEEE 7th WCICA, Jun. 2008, pp. 6561–6564.IEEE Industrial Electronics, IECON 2006 - 32nd Annual Conference , pp 3328- 3331, November 2006

[5] Pierluigi Carcagnì, Marco Del Coco, Marco Leo and Cosimo Distante, "Facial expression recognition and histograms of oriented gradients: a comprehensive study", SpringerPlus (2015) 4:645 [6] Sajid Ali Khan, Sohaib

[6] Shabbir, Rabia Akram, Nouman Altaf 2, M. Owais Ghafoor , Muhammad Shaheen " Brief review of facial expression recognition techniques" International Journal of Advanced and Applied Sciences, 4(4) 2017, Pages: 27-32

[7] A. D. Chitra, Dr. P. Ponmuthuramalingam,"An Approach for Canny Edge Detection Algorithm on Face Recognition" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064

[8] Ranjana Sikarwar, Pradeep Yadav, " An Approach to Face Detection and Feature Extraction using Canny Method", International Journal of Computer Applications (0975 – 8887) Volume 163 – No 4, April 2017

[9] Manar M. F. Donia,Aliaa A. A. Youssif, & Atallah Hashad, "Spontaneous Facial Expression Recognition Based on Histogram of Oriented Gradients Descriptor"

[10] Navneet Dalal and Bill Triggs, "Histograms of Oriented Gradients for Human Detection", INRIA Rhone-Alps, 655 avenue de l'Europe, Montbonnot 38334, France