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FEATURE EXTRACTION BASED ON THE KANADE-TOMASI ALGORITHM FOR TEXTURE-BASED VIDEO CODING

Ramyashree (1RE14LSP09)
M. Tech SP, Department of E&C
REVA ITM, Bangaluru-64

Vidyasagar K N
Asst., Professor, School of E&C
REVA University, Bangaluru-64

Bharathi S H
Professor, School of E&C
REVA University, Bangaluru-64

Abstract–In this paper, we mainly focus on the extraction of features based on Kanade-Tomasi method for application of video compression in texture-based coding. This is also familiar as Shi- Tomasi algorithm which mainly contributes on direct computation of the eigenavalues of an input image. The first step is to detect the corners which are the interested feature parameters. The corners are detected by computing the minimum eigenvalues. The experimental results reveal that there is improvement in obtaining the video with a high quality in texture coding in the reconstruction stage. The obtained features are used to regain the lost data by considering only the relevant bits by estimating the vectors of motion between the video frames. The proposed algorithm is compared and tested with the Moravec algorithm and Harris-Stephens method and the results obtained are better improved than the previous two methods as specified above.

Keywords – Definition of Feature, Corner Detection, Feature Extraction Techniques

I. INTRODUCTION

The features are used to represent the information present in an image. The representation of the data can be in various forms as continuous, discrete, binary and categorical. The feature can be considered as an input attribute or the variable. There are techniques such as feature construction which is based on automatic method for converting the raw data into useful feature variables. The integration of the modeling process with the feature construction is practiced as to obtain the features. The key step in the process of the data analysis is the Feature construction, the satisfying the machine learning and the statistics endeavor. In stage of construction of the feature, it is necessary as not to lose the data interpretation. The raw features are used by adding them to the preprocessed data by comparing the functionality with the data represented.

The final task is to take an object in system of processing an image and then it is classified by recognition. The collection of the classes is generated as to consider an image and determine as in which area the class belongs to. The mechanism which determines this is known as the classifier. The extraction of the mathematical features is done as to perform classification. These measurements of features act as the input to the classifier. The two main categories which help in extraction of the features by classifying the parameters are Shape and Texture of the data. The texture describes the interior grayscale values and the geometric specifications of the interior and the boundary is given by the shape of the feature. If there are maximum features present, then the functionality of the classifier becomes tedious. The good condition as to separate the classes adequately is the requirement of minimum features. The feature vector is used to store the classified feature that is selected for the classifier mechanism.

The features which helps to extract the classes by using the tool Matlab is explained briefly:

1. TEXTURE

In order to obtain the pixels of the non-zero values in the gray-scale object the technique of the masking is carried out. The masking technique helps to obtain the statistical measurements that are useful in the classification of the object. The texture statistics can be computed using the m-file command ‘statxture’. The functionality of this command ‘statxture’ gives the output that is stored in a vector T.

2. SHAPE

There are three main commands used as to extract the features based on the shape of the data interpretation. The regionprops, Fourier coefficients and the features at the Medial Axis are the commands used in Matlab to obtain the features.

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II. FEATURE SELECTION

The obtained features from the previous mentioned techniques thus can be added in order to obtain the relevant data. The summation of all the features is reasonable but results in the cost of high price. There is a rapid increase in the pattern dimensionality and results in features with high ratio of redundancy and generates the noisy, irrelevant data from an input data which is relevant at the initial stage. Thus the 'feature selection' plays a crucial role in distinguishing whether the feature is informative and relevant to specified data or it is irrelevant. This feature selection helps in representing the data using the relevant bits with results in high-quality video based on texture-coding.

III. FEATURE EXTRACTION

The technique of feature extraction is carried out by extracting the measured data of relevant information and by creating the features by considering only the desired values based on various parameters. The main conditions that are a must in order to extract the features are the data must be non-redundant and the human interpretations should match to the desired output of features and have a smaller dimensions. The transformation is done by reducing the set of vectors when the input values are redundant and are represented by the large amount of bits known as feature extraction.

The advantages of the feature extraction are representation of the image can be done using relevant data. This is achieved by the reduction of the repetitive bits that are present in the redundant complex data. Thus the accuracy, computation power and the memory storage are improved by Feature extraction.

The two main issues of the feature extraction are decomposed into two steps, to mention they are the feature construction and the selection of feature. The feature selection is carried first as to extract the informative and the relevant features.

The advantages of these two steps include:

- *The data is reduced as the storage capacity is limited.*
- *The predictive accuracy and the speed of the algorithm are drastically increased.*
- *The resources are saved as they can be used for further processes which help in reduction of the feature sets.*

Filters are used to select the features without optimization the predictor during the performance. The technique of utilization of "black box" as to obtain the features is performed known as the Wrappers. The third method is using the embedded methods which are based on the training as how to select the features to the specific learning machine.

IV.PROPOSED METHODOLOGY

The computer vision supports the determination of the interest points for further processing known as Interest point detection. The corner parameters help to obtain stable, well-defined and a robust image features the detectors are sensitive with respect to its local region. The characteristic of the localization properties in the corner detector is much better and the localization error is less than the blob detectors. When the object models are related to temporal imagery, the blob detectors are preferred. The techniques of feature extraction can be worked by using the mathematical programming environments like NumPy, the R language, the MATLAB and the SciLab based on its respective built-in commands.

A. CORNER DETECTION

Corner detection helps in extraction of certain kind of interest points known as features where corner is a major parameter detected first shown in Figure1. The technique of the corner detection can be used in image registration, image mosaicing, 3D modeling, object recognition, motion detection and in the video tracking etc.

The definition of a corner specifies the intersection of the two edges or different directions of the two dominant edges. The real corners are detected by performing the local analysis of previously estimated interest points and estimate the corner with the same properties in multiple images.

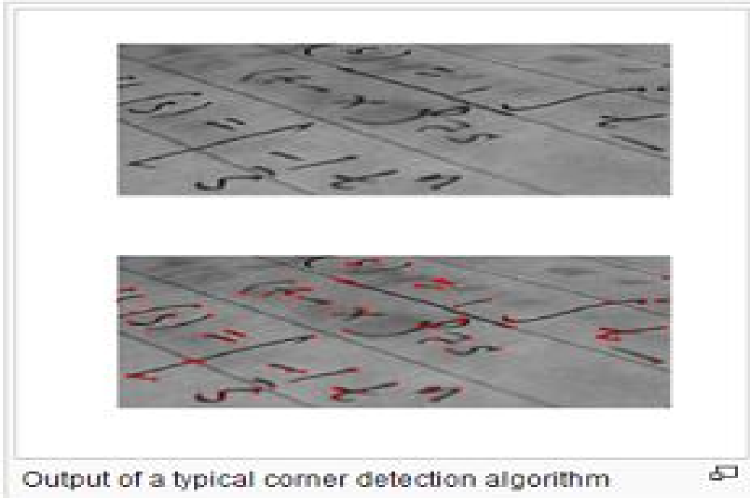

Figure 1: Algorithm of the corner detection.

B. CORNER DETECTION ALGORITHMS

The correlation is the main methodology used to detect a corner in images. The algorithms used for corner detection results in suboptimal and are very expensive regarding the computation process. The Moravec algorithm is the basic algorithm designed to detect the corners. Further technology has designed the improved algorithms as to overcome the limitations faced in the Moravec algorithm. The Harris and Stephens method is proposed and it is frequently preferred as to perform the corner detection which is improved than the previous algorithm.

In the proposed algorithm of Harris and Stephens, the differential is computed by taking the corner score as its inputs by directly pointing to its direction. The 2-dimensional grayscale image is considered as input image$I$. The image patch is considered at the area denoted by (u, v) and then this area is shifted by the displacement of(x, y), then total weight of squared differences computed as to obtain the SSD. Therefore result of the weighted SSD is given by a variable$S$:

$$S(x,y) = \sum_u \sum_v w(u,v) sqrt(I(u+x, v+y) - I(u,v))^2, \quad (1)$$

The approximation of $I(u+x, v+y)$, is done by using the Taylor expansion. The variables I_x and I_y are considered as the partial derivatives of the original image$I$. The resultant of approximation is given as:

$$S(x,y) \approx \sum_u \sum_v w(u,v) \left(I_x(u,v)x + I_y(u,v)y\right)^2, \quad (2)$$

This in return is represented in the matrix form as:

$$S(x,y) \approx (x,y)A\begin{pmatrix} x \\ y \end{pmatrix}, \quad (3)$$

The variable A is termed as a structure tensor and is defined as:

$$A = \sum_u \sum_v w(u,v) \begin{bmatrix} {I_x}^2 & I_x I_y \\ I_x I_y & {I_y}^2 \end{bmatrix} = \begin{bmatrix} \langle {I_x}^2 \rangle & \langle I_x I_y \rangle \\ \langle I_x I_y \rangle & \langle {I_y}^2 \rangle \end{bmatrix} \quad (4)$$

The large variation in directions of (x, y) vector leads to generation of an edge or a corner. The structure tensor A must have two maximum eigenvalues as to extract a interest or the feature points. The magnitude of eigenvalues is considered to infer the presence of a corner in a considered image based on following arguments:

a) *The image pixel* (x, y) *results with zero feature points of interest if the values are* $\lambda_1 \approx 0, \lambda_2 \approx 0$.
b) *An edge is detected, if* $\lambda_1 \approx 0$ *and* λ_2 *has non-zero positive large value.*
c) *The corner will be detected if both the variables* λ_1, λ_2 *have positive maximum values.*

As the computation of the values of λ_1, λ_2 eigenvalues includes computing the square root, it becomes expensive. Therefore the Harris proposed method suggests that to determine the corner metric matrixM_c, which include the sensitivity parameter 'k' that is tunable,

$$M_c = \lambda_1\lambda_2 -k(\lambda_1+\lambda_2)^2 = \det(A) - k\, trace^2(A) \quad (5)$$

This method can improve the computational efficiency by evaluating the determinant of A and computing the trace of parameter. The value of sensitivity parameter is specified to be in range $k \leq .25$.

The next proposed algorithm Shi–Tomasi mainly concentrates on computing the corners directly rather than computing the trace and the determinant of image. As the corners satisfy the stability property, the tracking can be achieved much well than the mentioned previous two methods. The Shi- Tomasi method works on the principle of measuring by the Noble's corner detection which results in eigenvalues based on the functionality of harmonic mean:

$$M_c' = 2\frac{\det(A)}{trace(A)+\epsilon'} \quad (6)$$

Therefore, these proposed methods can be used for simulation, using the in-built functions of the programming tools such as Matlab.

V. EXPERIMENTAL RESULTS

The analysis of corner detection is done by implementing the Shi-Tomasi algorithm using Matlab. By considering the example of "salesman.png" as input frame, we will achieve in detecting the corner points. The in-built functions are used based on the mathematical concept of this algorithm. These detected corners points are used to estimate the interested feature detection. Thus obtained feature points are further used in many applications such as in tracking an object in a traffic subway, estimating the vectors with the similar features, and it is also used as the input vertices for generation of structured and unstructured meshes in an image in this paper. These interested feature points will be useful for motion estimation of images and can be used further for reconstruction that is compensating the predicted image. The experimental output images are shown below in a sequential manner:

Figure2: An original input image frame

Figure3: Corner points detected of frame

Figure4: Feature points of frame

Figure5: Application of Feature extraction in Generation of mesh

Therefore the results obtained using the improved method of Shi- Tomasi is shown in detail. These points of interested features can be further used for many applications as shown in Figure5 where, the feature points acts as the input values of vertices to form a triangular mesh using the Delaunay Triangulation Algorithm.

VI.CONCLUSION

In this paper we mainly concentrate on the proposed and improved methodology of Shi - Tomasi which aims at detecting the feature points. The feature extraction is achieved by using corner as a featured parameter. We study the two methods of corner detection Moravec algorithm and the Harris- Stephens algorithm. These algorithms also help to detect the corner and feature points but they results with expensive and slow with respect to the computation. The squaring of the computed eigenvalues results in a complex and time consuming methods. Therefore, the Shi – Tomasi algorithm (Kanade-Tomasi) is used which directly works on computing the eigenvalues and it considers the minimum values only of the resultant eigenvalues. Hence this algorithm reduces the computational time, thereby lessening the cost and hence memory capacity is improved. Thus the obtained features can be used to generate the triangular meshes. The length of these created meshes can be used to estimate the motion vectors and further can be used for motion compensation.

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