A Simulation Model for Corner Detection in Fruits Foveated Images

K. L. Neela, P. Mercy Nesa Rani, T. Rajesh

Abstract— Corner detection is a challenging and important research area in computer vision and object recognition systems. However, they have some problems such as sensitive to noise, poor localization. The corner detector -Feature Accelerated Segment Test (FAST) which will be a good locator of corners in foveated images similar to Human Visual Fixations. The feature detector considers pixels in a circular region. This technique creates uniformity over the image area considering the brightness and darkness for estimation that constitutes as corner. The resulting detector will detect very stable features in foveated images. This paper deals with foveation filtering and corner detection to establish foveal location in natural images. The proposed approach is implemented with the help of VC++ language and will provide fine location for all real world applications.

Index Terms: Foveation Filtering, Corner Detection, Foveated images, FAST algorithm, Fruit Images

I. INTRODUCTION

A corner can be defined as the intersection of two edges. A corner can also be defined as points for which there are two dominant and different edge directions in a local neighborhood of the point. An interest point is a point in an image which has a well-defined position and can be robustly detected.

This means that an interest point can be a corner but it can also be, for example, an isolated point of local intensity maximum or minimum, line endings, or a point on a curve where the curvature is locally maximal or the more general terminology interest point detection is an approach used within computer. In practice, most so-called corner detection methods detect interest points in general rather than corners in particular. Corner detection vision systems to extract certain kinds of features and infer the contents of a fruit images.

Fruits contain a significant amount of water, sugar, minerals and vitamins. Fruits act as an important protective food because of their high nutritional value which plays a pivotal role in human nutrition. India is the world's largest producer of fresh fruits [1] and a great diversity of fruit crops is grown in various regions of India.

Importance of fruits in human diet is well recognized. Man cannot live depending on cereals alone. Fruits and vegetables are essential for balance diet and good health. Nutrionists advocate 60- 85 gm of fruits and 360 g vegetable per capita per day in addition to cereals, pulse, egg etc. Fruits are good source of vitamins and minerals without which human body cannot maintain proper health and develop resistance to disease.

Manuscript received on May, 2013.

K. L. Neela, Department of Computer Science, University College of Engineering, Thirukkuvalai, Tamil Nadu, India.

P. Mercy Nesa Rani, School of Social Sciences, College of Post Graduate Studies(Central Agricultural University), Meghalaya.

T. Rajesh, School of Crop Protection, College of Post Graduate Studies(Central Agricultural University), Meghalaya.

They also contain pectin, cellulose which stimulates intestinal activities and energy giving substances like oils, fats and proteins. Many fruits have medical purpose. Carbohydrate and fats derived from fruits provide energy. Proteins from fruits are useful for building body tissues. Carbohydrates in fruits are mainly sugar, which break down easily and make a quick source of energy. Fruits are made up of 90 percent 95 percent water. Water is an important nutrient. It is responsible for transporting nutrients around the body, regulating body temperature, keeping joints moist and getting rid of waste products in the body.

Custard apple (600 mg/100 g), guava (299 mg/100 g) and Citrus (63-68 mg/100 g) are the richest source of Vitamin C in case of fruits. Fruits like banana (150 mg / 100 g), Apple (120 mg/100 g) and Cashew nut (630 mg/100 g), Almond (240 mg/100 g) are the good source of Vitamin B1. Papaya (200 mg/ 100 g), Bael (191 mg/100 g), Pomegranate (100 mg/100 g), pineapple (120 mg/100 g) are the major suppliers of Vitamin B2. Mango (4800 mg/100 g), Papaya (2020 mg/100 g) and Jack fruit (540 mg/ 100 g) are the richest source of vitamin A.

Fruits like litchi, wood apple, dried grapes, oranges and straw berry are the good source of Calcium. Almonds, cashewnut and litchi are the more suppliers of the Phosphorus. Dates, ber and cashewnut are the major suppliers of iron. Fruits are rich in fiber, which is essential for the smooth movement of food in the body's digestive system. Fruits help in maintaining easy bowel action and eating fruits every day will prevent constipation. Diets rich in potassium may help to maintain healthy blood pressure. Fruit sources of potassium include bananas, prunes and prune juice, dried peaches and apricots, cantaloupe, honeydew melon and orange juice.

Fruits contain many vitamins and nutrients that may reduce risk for many illnesses including stroke, heart disease and other heart-related illnesses, diabetics, certain cancers, such as mouth, stomach and colon-rectum cancer, kidney stones and bone loss. The fruits like anola, pomegranate, jamun, bael fruit etc. have great medicinal value. Fruits are loaded with most of the essential antioxidants (Vitamins A, C, E and Lycopene) and human body cannot produce on its own. Antioxidant nutrients help human body to prevent disease, fight illness and stave off the signs of aging.

A successful corner detector should find all the true corners with high location accuracy. Furthermore, it should eliminate or minimize all the false (spurious) corners and be robust to noise and invariant to resolution, scale and orientation [2]. Being applicable to any arbitrary image type and computational efficiency are also important factors. Corners have long been recognized as rich bearers of visual information, and numerous algorithms have been proposed for detecting corners and using them as features in basic visual tasks such as object recognition, stereo matching, shape analysis

*Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication*

and optical flow computation [3].

II. RELATED WORK

A. Moravec Algorithm

This is one of the earliest corner detection algorithms and defines a corner to be a point with low self similarity [4]. The input of Moravec algorithm is gray-level image and the output is an image in which values are proportional to the likelihood that the pixels are corners. The algorithm tests each pixel in the image to see if a corner is present, by considering how similar a patch centered on the pixel is to nearby, largely overlapping patches. The similarity is measured by taking the sum of squared differences (SSD) between the two patches. A lower number indicates more similarity. The drawbacks are

- ✓ It is difficult to find corners in diagonal edges.
- ✓ It is not isotropic
- ✓ If an edge is present that is not in the direction of the neighbours, then it will not be detected as an interest point.

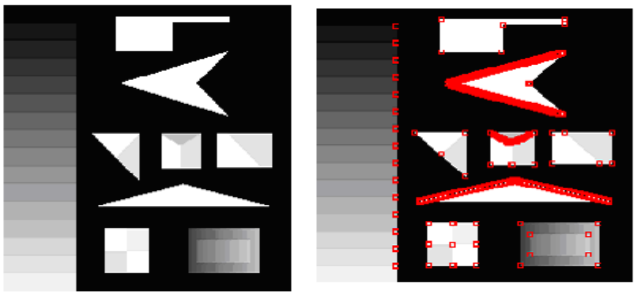

Fig1. Example for Moravec detector

B. HARRIS/PLESSEY OPERATOR

Harris and Stephens developed this combined corner and edge detector by addressing the limitations of the Moravec operator. The result is a far more desirable detector in terms of detection and repeatability rate at the cost of requiring significantly more computation time. Despite the high computational demand, this algorithm is widely used in practice. The Plessey operator differs from the Moravec operator in how the measurement of local autocorrelation is estimated. This measurement allows the variation of the autocorrelation over all different orientations to be obtained [5]. The rational for the Plessey operator follows from addressing the limitation of the Moravec operator. The input for Plessy detector is gray-level image and the output is the position of each detected corner [6]. The drawbacks are

- ✓ Local estimation of derivatives is very sensitive to noise
- ✓ When smoothing is applied, the corner localization precision is reduced.
- ✓ The computational complexity of the smoothing operation, derivative estimation and corner strength computation can be quite high.
- ✓ The Plessey operator suffers from poor localization and is computationally expensive.

The advantages are

- ✓ It has the best detection rate of other operators
- ✓ It is having good repeatability rate.
- ✓ Localization is not critical for many applications. For these reasons the Plessey operator is widely used in practice.

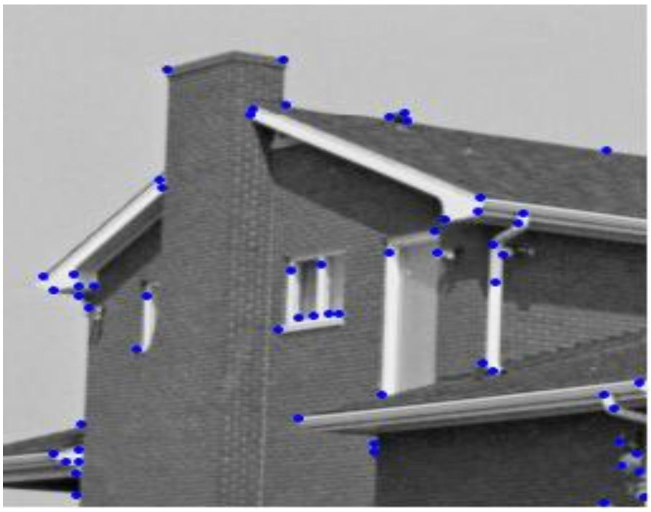

Fig 2. Example for Plessey operator

C. CURVATURE SCALE SPACE (CSS)

The Curvature Scale Space (CSS) corner detector is very robust with respect to image noise, and is believed to perform better than existing corner detectors. The following is an outline of the CSS corner detector [7].

- Extract the edge contours from the input image using any good edge detector such as Canny.
- Fill small gaps in edge contours. When the gap forms a T-junction, mark it as a T-corner.
- Compute curvature on the edge contours at a high scale.
- The corner points are defined as the maxima of absolute curvature that are above a threshold value.
- Track the corners through multiple lower scales to improve localization.
- Compare T-corners to the corners found using the CSS procedure and remove very close corners.

The CSS detector has been carried out for both edge detection and corner detection explicitly. The Curvature Scale Space (CSS) operator detects corners by directly looking for local maxima of absolute curvature. That is, it detects corners using the intuitive notion of locating when the contour of an object makes a sharp turn.. The obvious drawback in CSS is difficult to find corners in convex objects. Convex objects cannot be represented due to missing inflection points.

Fig3. Example for CSS

D. SUSAN EDGE & CORNER DETECTOR

SUSAN (Smallest Univalve Segment Assimilating Nucleus) presents us with an entirely different approach to low level image processing compared to all pre-existing algorithms [8]. It provides corner detection as well as edge detection .The SUSAN principle is implemented using digital approximation of circular masks, (sometimes known as windows or kernels). Four criteria for SUSAN edge and corner detection are given below. These have been used in similar form in a good deal of vision research. They are good detection, good localization, response and speed. The drawbacks are

✓ It is sensitive to noise and strong edges may find result false detection.

✓ Certain circumstances with real data where blurring of boundaries between regions occurs and there is a thin line half way between the two surrounding regions may cause corners to be wrongly reported.

Fig4. Example for SUSAN Edge Detector

III. MATERIALS AND METHODS

The overall approach for detecting the corners in images will involve foveating the image *i.e* done by using the Gaussian filter, then identifying the corner using Feature accelerated Segment Test (FAST) and then choosing a next likely corner location, and so on. The architecture for the feature detector is given in fig1.

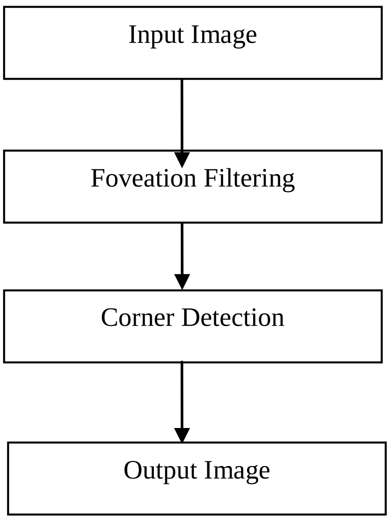

Fig.5: Architecture for feature detector systems

A. Foveation Filtering

There are many methods for creating foveated images. The most popular methods are

- ✓ spatial-domain foveation filtering
- ✓ wavelet-domain foveation.

Spatial domain foveation filtering is the straightforward method in which bank of low-pass filters is applied to the image on a point-wise basis, with bandwidths monotonically decreasing with eccentricity.

In the wavelet domain approach, selectively sub sample and quantize the image data in the wavelet domain, leading to decreased resolution away from the fovea. Such techniques have proven very effective for image and video compression. In this paper, the simple and direct method of foveation filtering with Gaussian filters is used because of its simplicity [9].

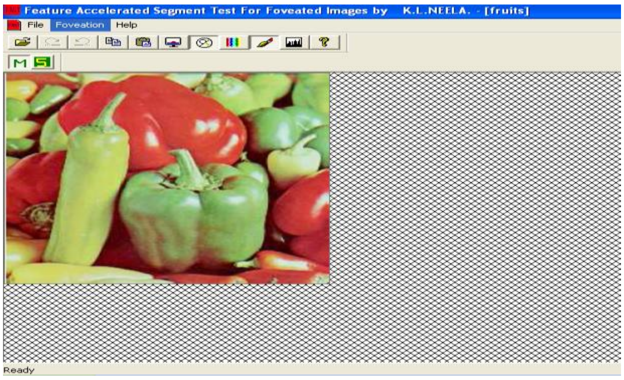

Fig 6. Original Fruit Image

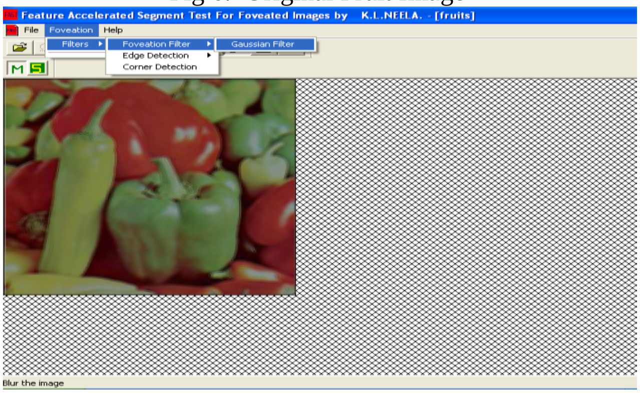

Fig7. Image after applying Gaussian filter

B. Corner Detection

Corner can be detected in foveated data by using Features from accelerated Segment Test (FAST) algorithm [10]. The feature detector considers circle of sixteen pixels of radius *r* around the candidate point p. If *n* contiguous pixels are all brighter than the nucleus by at least I_{p+t} or all darker than the nucleus by $I_{p-t,}$ then the pixel under the nucleus is considered to be a feature. The resulting detector is reported to produce very stable features.

If p is a corner then consider either region that is, brighter than Ip + t or darker than Ip - t. If neither of these is the case, then p cannot be a corner. The full segment test criterion can then be applied to the remaining candidates by examining all pixels in the circle. In order to build a corner detector for a given n, first, corners are detected from a set of images using the segment test criterion for n and a convenient threshold. For each pixel simply tests all 16 locations on the circle around it. For each location on the circle x ε {1…16}, the pixel at that position relative to p (denoted by p →x) can have one of three states:

Choosing an x and computing Sp→x for all p ε P (the set of all pixels in all training images) partitions P into three subsets, Pd; Ps; Pb, where each p is assigned to $P_{Sp \to x}$. Since the segment test does not compute a corner response function, non maximal suppression can be applied to remove the false corners in the image.

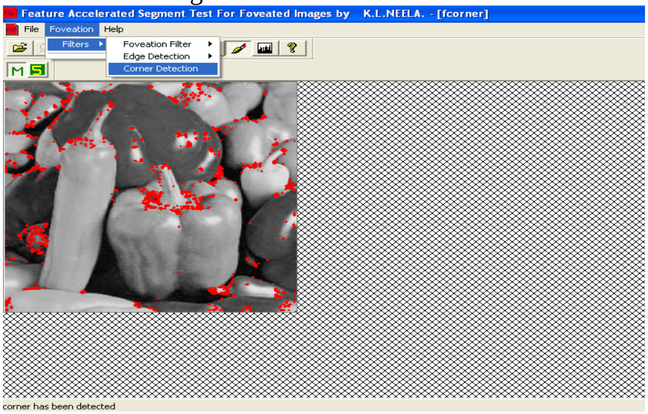

Fig8. Corner detected Image

IV. CONCLUSION

The Foveated images can be created based on foveation filtering. Foveation filtering can be done by using Gaussian Filtering technique. Corner can be detected by using Feature Accelerated Segment Test algorithm which is a good locator in foveated images. It considers all the regions such as darker, brighter and similar region in the images. It is a high speed corner detector which uses techniques for avoiding false corner detection.

REFERENCES

[1] B.K.Chauhan , L. Mitra, and H.K. dabas . Facts and Figures: Indian fruits and Vegetables. National Horticulre Board, Gurgaon, India.1997.

[2] S. Kiranyaz, H. Liu, M. Ferreira and M. Gabbouj ," An Efficientapproach for boundary based corner detection by maximizing bending ratio and Curvature", Proceedings of IWSSIP ,2006, pp. 475-378.

[3] Q. Ji, and R. Haralick, " Corner detection with covariance propagation" in Proceedings. IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 2006, pp. 362–367.

[4] H. P. Moravec ," Visual Mapping by a Robot Rover" *International Joint Conference on Artificial Intelligence*, pp. 598-600, 1979.

[5] C .Harris, and M. Stephens, "A combined corner and edge detector", in 4th Alvey Vision Conference Proceedings,1988, pp. 147–151.

[6] J.A. Noble ,"Finding corners", Image and Vision Computing, vol. 6, no.2,1988 pp.121–128.

[7] F. Mokhtarian, and R. Suomela, "Curvature Scale Space Based Image Corner Detection", Proceedings of European Signal Processing Conference, Island of Rhodes, Greece,1998, pp. 2549-2552.

[8] S.M. Smith, and J.M. Brady, "SUSAN—a new approach to low levelimage processing," International Journal of Computer Vision., vol. 23, no. 1,1977, pp. 45–78.

[9] T. L. Arnow, and A. C. Bovik, " Finding corners in images by foveated search",. IEEE Transactions on Image Processing, **Volume:**16 ,2007, **Page(s):** 813 – 823.

[10] E. Rosten, and T. Drummond, "Machine learning for high speed corner detection," in 9th Euproean Conference on Computer Vision, vol. 1, 2006, pp. 430–443.

Ms. Neela. K.L. received her B.E. degree in Computer Science and Engineering in 2006 from Oxford Engineering college, Trichy and Master's degree in Computer Science and Engineering in 2008 from J.J.college of Engineering and Technology (Anna University), Trichy. She is working as Asst.Professor in University College of Engineering, Thirukkuvalai, TamilNadu, India. Her field of interest is Network security and Image Processing .

Mrs. P. Mercy Nesa Rani received her B.E. degree in Computer Science and Engineering in 2003 from The Indian Engineering College, Vadakkangulam and Master's degree in Computer Science and Engineering in 2008 from J.J.college of Engineering and Technology (Anna University), Trichy. She is working as Asst.Professor in College of Post Graduate Studies,Central Agricultural University. India. Her field of interest is Expert system and Image Processing. She has published papers in two International Journals.

Dr. T. Rajesh received his Doctoral Degree in Agriculture from Tamilnadu Agricultural University(TNAU) during 2005. He is working as Asst.Professor in College of Post Graduate Studies,Central Agricultural University. India. His field of interest is fungal diseases of crop plants and biocontrol. He has published papers in three International Journals.