International Journal of Engineering Research and General Science Volume 3, Issue 1, January-February, 2015
ISSN 2091-2730

PERCEIVING THE REGION OF INTEREST FOR HUMAN VISION PROCESSING

Cindralla George[1],Vijayakumar K , Sudheesh Madhavan

PG Scholar[1], Dept.of electronics and communication, Toc.H Institute of science and technology, Arakkunnam, Cochin,
Kerala.kunjugeorge@gmail.com

Abstract— Eye is the most interesting and most widely studied sensing organ in human body. The vision is always a magical phenomenon in the world done by the co-ordination of eye and brain. Artificial intelligent is making the life easier and more intelligent. Emulating the human vision intelligently is a challenging task for engineers. Finding the region of interest is related with the focused attention for human vision. Texture analysis and segmentation plays a vital role for perceiving the region of interest. There are several algorithms available for this. This project developed an efficient algorithm for finding the region of interest. As well as it finds the better texture analysis filter for perceiving the region of interest.

Keywords— ROI (Region of interest), Segmentation, Texture analysis, Saccadic movement ,Attracting factors, Visual gaze, High level factors, Low level factors.

INTRODUCTION

The human visual system the most widely studied and most understood mammalian sensory system. Not only the anatomical features is well described, but function of its neuron is have also been characterized at many stages of the visual pathway. Because of this reason, the visual system has become the system of choice for the study of both sensory coding as well as for such higher cognitive processes as memory and attention. Our visual world is very complex and most dynamic one. To successfully interpret this world beautifully, the human visual system performs the analysis of various attributes of the visual image and combines these attributes into a percept of a visual scene. The most fundamental characteristic of our visual world is that it is not uniform in time and space. The visual system is well designed to analyze these non-uniformities. Such fundamental dimensions of visual stimuli as spatial and temporal variations in luminance and chromaticity are encoded at the level of the retina, while the encoding of other more complex stimulus features like motion, complex form and depth, emerge at the level of visual cortex.

One of the extraordinary capabilities of the human visual system is its ability to find the attractive region in a complex visual scene. The region of interest is a particular region in a scene in which we are interested. It is essential to extract that region from the scene which has significant information. In order to extract significant region there need to determine its cognitive boundary. We treat this boundary as ROI which is different from existing definition of it. The selection of this cognitive boundary by human itself is difficult. This is because humans have different psychology of interest and decision making criteria.

In cognitive psychology, human interest is a mental state in which human feels intuitive or curiosity about some matter. In the a visual scene, human tries to observe the interesting objects in the scene. This needs selection of ROI which confines objects of interest in it. We usually feel interest when something draws our attention. Therefore, ROI is related with focused attention. In order to get focused attention there need to find combinations of features. Attention allows simple physical properties of objects to be combined correctly. In the case of perceptual grouping, some psychologists have suggested that attention is directed to perceptual groups. Therefore, object based attention selection is better for its perceptual importance. The cognitive boundary also depends on human psychology of relevance. Relevance theory claims that humans do have an automatic tendency to maximize relevance but because of the way our cognitive systems have evolved. The region of interest is used for the saccadic movement of eye. The saccadic movement is the rapid movement of eye for the fixation of eye.
The human vision system is attracted to some feature such as colour, contrast, size, motion etc., while human brain also include the intension or thoughts along with this features. Perceiving the region of interest by learned attentive mapping is for finding the region of interest by processing the low level and high level factors of vision

THEORY

Visual fixation is the maintaining of the visual gaze on a single location.co-ordination of eyes and brain is needed for this process. Visual fixation is never perfectly steady: factional eye movement [6] occurs involuntarily. In the current consensus, factional eye movement contributes to maintaining visibility, by continuously stimulating neurons in the early visual areas of the brain, which mostly respond to transient stimuli. Fixation is also used in experiments in vision science or neuroscience. Human subjects are often

told to fixate on an object on a monitor before any experiment takes place. This serves to direct the person's attention to the point where visual information.

Osberger w et al (1998) presents a method for automatically determining the perceptual importance regions of different regions in an image [8]. The algorithm proposed is based on human visual fixation and saccadic movement of eye characteristics [9]. Several features known to influence human visual attention low level factors and high level factors including are evaluated for each region of a segmented image to produce an importance value for find out the most attracted region [3]. The calculated values of each low level factors and high level factors are combined to produce an Importance Map, which classifies each region of the image in relation to its perceptual importance.
Human visual attraction is controlled by both low level factors and high level factors, where High level factors generally involve some feedback process from memory and involving template matching. Low level processes are generally fast, feed forward mechanisms involving relatively by simple processing. Low level factors which have been influence visual attention include[4]: Contrast, Size, Shape, Colour and Motion. Several high level factors have also should considered. They are Location, Foreground/background, and context.

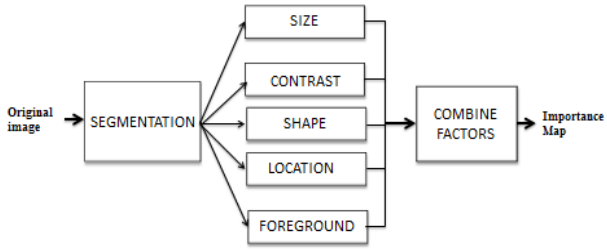

Figure 1:Importance map calculation

Zhang J et al (2008) propose a novel approach for the region of interest using the combination of visual attention model and watershed segmentation [5]. This approach extracts the region of interest by automatically. Proposed research uses visual attention model to locate salient point, here the winner point, the most salient point selected as seed point of watershed transformation.
Image segmentation is the prior step for the detection of region of interest. Several algorithms are developed for image segmentation. Senthilkumaran N (2010) propose several image segmentation 10 technique [1]. Image segmentation is an initial and vital step in a series of processes for overall image understanding. Image segmentation means partition an image into meaningful regions with respect to a particular application. The segmentation is based on measurements taken from the image which might be grey level, colour, texture, depth or motion. This proposed paper mainly aims to understand the digital image segmentation techniques [7] and to gain practical experience in implementing an image segmentation using MATLAB functions[9].
The main objective of image segmentation[12] is used to distinguish different objects in the image content. The image is divided into two parts: background and foreground. The foreground is defined as the interesting objects and the background as the rest [11]. Image segmentation is simply distinguishing and separating the two from one another. There are mainly three approaches for segmentations are Threshold based Segmentation, Edge based Segmentation and Region-based segmentation. Threshold techniques make decisions based on local pixel information and are effective when the intensity levels of the objects fall squarely outside the range of levels in the background. Because spatial information is ignored, however, blurred region boundaries can create havoc.

Edge-based methods center around contour detection used their weakness in connecting together broken contour lines make them, too, prone to failure in the presence of blurring. A region-based method usually proceeds as follows. The image is partitioned into connected regions by grouping neighboring pixels of similar intensity levels. Adjacent regions were then merged under some criterion involving perhaps homogeneity or sharpness of region boundaries. Over stringent criteria create fragmentation; lenient ones overlook blurred boundaries and over merge.

FINDING REGION OF INTEREST

The ability to look at things is a familiar part of the process of seeing. Looking is achieved by orienting the eyes, that is to say directing their visual axes to point to a new location. Large orienting movements involve co-ordinated action of the eyes, head and body, but smaller movements, such as those made when looking at a picture are made with the eyes alone. Automatic detection of regions of interest in images is one of the most critical problems in computer vision. For a human observer, detecting a perceptually

important region in an image is a natural task which is done instantaneously, but for a machine it is far more difficult, as the machine lacks the cultural references and knowledge to identify the content of the scene. One of the causes for this difficulty is the subjective nature of the notion of region of interest (ROI) [10]. In the most general sense, a ROI, as its name suggests, is a part of the image for which the observer of the image shows interest. Of course, the interest shown by the observer in viewing the image is determined not only by the image itself, but also by the observer's own sensitivity. For a given image, different people could find different regions of interest. However, it can be said, in most cases, regions of interest generally have visually and structurally distinctive features than the rest of the image. Then some structural characteristics can be used to detect the ROI of an image without making hypotheses about the semantic content of the picture. The detection of the ROI consists in finding a region of the image which appears different from the background with respect to low-level features such as contrast, colour, region size and shape, distribution of contours or texture pattern. Different methods have been proposed to detect regions of interest in an image. Some are based on models of low-level human vision which detects perceptually important regions on the image by building importance maps based on various visual characteristics.

The aim of this project is to find the region of interest in an image for emulating the human vision processing.

The main steps to be follow for detecting the ROI are

- Texture analysis
- Image segmentation
- Feature extraction
- Finding the region of interest

There are several texture analysis methods are available. And the project aims to find out the best texture analysis method for finding the ROI and also the best algorithm for the image segmentation better for human vision processing. Human vision is an active process in which information is sampled during brief periods of stable fixation in between gaze shifts. Foveal analysis serves to identify the currently fixated object and has to be coordinated with a peripheral selection process of the next fixation location. The region of interest gives the location for next fixation.

METHODOLOGY

Simulation is a challenging problem, where the concept should be realized and arranged well to get the result. The steps should be followed can be representing as follows. The input to ROI block single image by combining the two images from the camera (two eyes in the case of human).

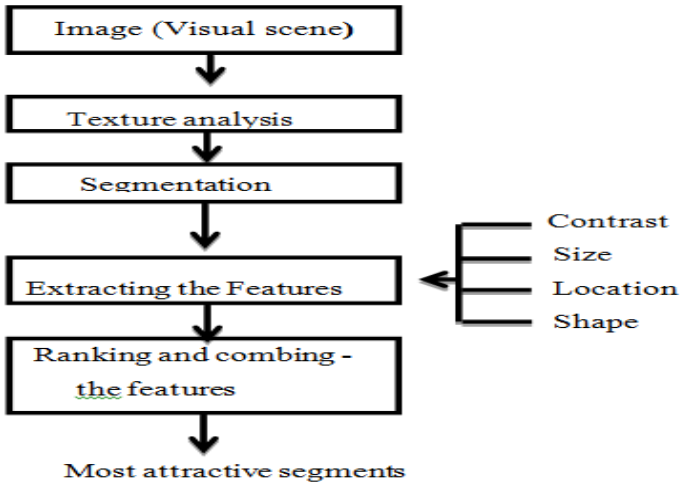

Figure 2: Algorithm for perceiving the ROI

The image from the camera has a size of 1600×1200. The image from the two camera of same size will combine to from a single image have the same size, which will be a colour image. For the simulation we are starting with the image of simple shapes. It will be the feed to ROI block.

Texture analysis: Image segmentation is an initial and vital step in a series of processes aimed at overall image understanding. Image segmentation is to partition an image into meaningful regions with respect to a particular application. The segmentation is based on measurements taken from the image and might be grey level, colour, texture, depth or motion. The first process is going to do by ROI block is the texture analysis before segmentation. Natural image processing put in obviousness the necessity to build reliable models for image analysis taking to account some textured regions for a posterior interpretation. Texture analysis is an important problem in image processing because it conditions the quality of image segmentation and interpretation. A texture is a region of an image, for which a window with minimal dimensions can be defined, such that the visual perception of an observation inside the window, is the same for all possible translation of the window inside the region.

There a three commonly used texture analysis algorithms. They are fuzzy based algorithms. There a three commonly used texture analysis algorithms. They are fuzzy based algorithms. These use three statistical texture filtering functions. They are based on

- Local standard deviation of an image
- Local entropy of an image
- Local range of an image

Local standard deviation of an image calculate local standard deviation of an image.in this technique it will specify defining a neighborhood around the pixel of interest and calculating the statistic for the neighborhood to determine the pixel value of output image. Local range of an image: it finds the local range of image. Range filter is used to find the edge with an image and works only for monochrome. The colour value of each pixel is replaced with difference of maximum and minimum of colour value surrounded in the region. We can specify neighborhood or different shape and size. Local entropy of an image: entropy of a small section of noted pixel is calculated and noted pixel is renewed by the obtained entropy value. Using entropy filter, a smooth portion in an image quality is extracted from the original image. The entropy filter technique specification defining a neighborhood around the pixel value of interest and calculating the statistics defining a neighborhood to determine the pixel value in the output image

The best filter the suitable of Human vision processing is local entropy image. Because it gives a shape and smooth portion of object in image. Segmentation: Extracting the features for finding the region of interest is the next step. The features are size, contrast, location and shape of an image. The size can be calculated by estimating the pixel count of an object. The average value of intensity of all pixel will give the contrast of the object. The location can be finding by considering the centroid of a segment. We have to find out the centroid of complete image and centroid of the segments. Calculating the distance between the centroid of complete image and segments by using quadratic equation will give the location. Finally the shape of an object can be calculated by calculating the roundness of an object.

Contrast is a very strong visual attracter. The human visual system converts luminance to contrast. The region which have more contrast than its surroundings have more visual attraction. This particular region is selected as the perceptually important region. The larger region is more attract our attention. So the Size is also likely to have an important role in the calculation of perceptually important region. However a saturation point exists, after which the importance due to size levels off.

Long and thin (edge-like) Shape have been found to be visual attractors. They are more likely to attract attention than rounder regions which of the same area and contrast. Viewer's eyes are directed at the center 25% of a screen for a majority of viewing material and more likely to be attracted to objects in the foreground than those in the background. So we have to find out priority of the features to find out the most attractive region or region of interest. The steps that should follow for prioritizing the features is,

For finding the ROI ,the features have to be ranked. From person to person the order of attractive features will vary. For Some person the most attractive features will be colour, and for some others it will be size. So assigning the priority is designer friendly. For human vision processing the order of priority of features is,

1. Contrast
2. Size
3. Location
4. Shape

SIMULATION RESULTS

Image segmentation is an initial and vital step in a series of processes aimed at overall image understanding

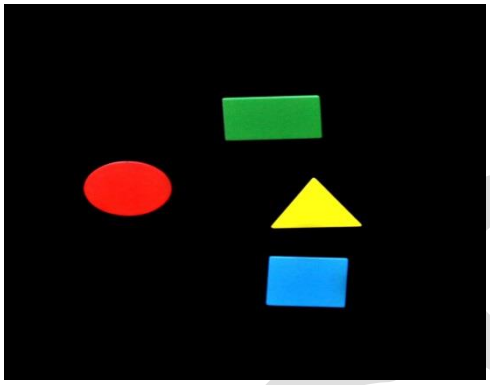

Figure 3: Input Image

It seems that local entropy an image filtering method gives an output better than other filtering technique. It gives a smooth portion of an object from the image. So this filtering method selected for texture analysis for this project.

After texture analysis we have to do a segmentation of this object. Initial step is to find the connected component in the image. It will give all objects in the image and number object in the connected component or object. The result of this particular input image will have number of connected component as 4.

Once the connected component found, finding the location of object in image is the next step. And also want to find out the pixel value of the object. After separating the each object, a boundary box should be drawn according to the size of object. According to than ranks which we give the most attractive region can be found. The priority assigned to finding the region of interest for Human vision processing.

Features	Rank
Contrast	40
Size	30
Location	20
Shape	10

Table 1: Rank value of each features

And the final segments according to the priority is given in the figures below,

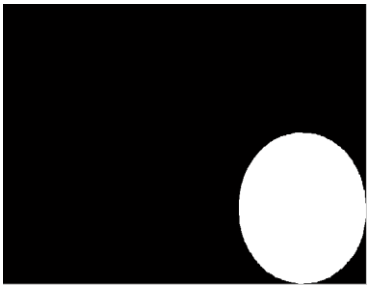

Figure 4: Segment of circle with First priority

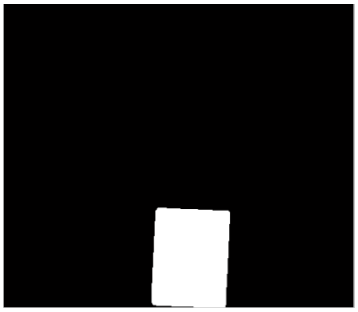

Figure 5: Segment of rectangle with second priority

Figure 6: Segment of triangle with third priority

Figure 7: Segment of square with Last priority

CONCLUSION

Different methods have been proposed to detect regions of interest in an image. Some are based on models of low-level human vision which detects perceptually important regions on the image by building importance maps based on various visual characteristics. From the experiments for finding the better texture analysis method is give the result that texture analysis by finding the local entropy give a smooth portion of an object. And the proposed algorithm simulated successfully. The proposed algorithm simulated by using the images of simple shapes.

ACKNOWLDGMENT

First of all, I am grateful to GOD ALMIGHTY, for showering His blessings upon me for enabling me to doing this project work. I am deeply indebted to the management of TocH Institute of Science and Technology, for all the help during the course of this work.

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