

IoT Based Function Point Analysis Of Detecting Vanishing Point In Unstructured Environments Using Optical Dominant Method

D.Srivaishnavi¹, Dr.C.S.Anita², Dr. K.V.S.S.S.S.Sairam³, Dr.Nachiyappan.S⁴,
Dr. Nilamadhab Mishra (PhD Taiwan)⁵

¹Assistant Professor, Department of Computer Science and Engineering, Sri Krishna College of Engineering and Technology, Kuniyamuthur, Coimbatore- 641008, Tamilnadu, India.

²Professor, Department of Computer Science and Engineering, R.M.D.Engineering College, Kavaraipettai- 601206, Tamilnadu, India.

³Professor, Department of Electronics and Communications Engineering, N.M.A.M. Institute of Technology, Karkala Taluk, Udipi District, Karnataka-574110, India.

⁴Associate Professor, School of Computer Science and Engineering, VIT Chennai, Vellore Institute of Technology, Chennai-600127, Tamilnadu,India.

⁵Assistant professor (Sr.), School of Computing Science and Engineering, VIT Bhopal University, Madhya Pradesh- 466114,India.

Abstract - Identifying a site-based road in a structured environment is a challenging issue because there are no clear and unchanging features that can describe a road or boundary in a structured environment. The edges, boundaries, paths and tire tracks left on the road merge into a single point called the vanishing point. It is important to measure the invisible point for the Autonomous Navigation System (ANS) in structured and unstructured environments. The Optimal Local Dominance Orientation Method (OLDOM) is used based on image format analysis to quickly calculate the invisible area in structured environments. The combined action of the four Gabor energy responses is used independently to find the local dominant trend. The resulting vector is the correct local dominance trend. A positive distance-based voting scheme is used to determine the location of the disappearance. This approach indicates that each dominant trend will give more votes than the points closest to its beam. The invisible point where the pixel that eventually gets the most votes counts.

Index: Autonomous Navigation System, Oldom, Gabor Energy, Adaptive Distance Based Voting Scheme, IoT

1. INTRODUCTION

An important feature inherent in the design of image processing systems is the testing and testing that is usually required before reaching an acceptable solution. This feature suggests that the ability to quickly design policies and prototype candidate solutions plays an important role in reducing the cost and time required to implement the access system. An image can be defined as a two dimensional function, where $f(x, y)$, where x and y are spatial

coordinates, and the intensity of the action on any pair of coordinates (x, y) or the grayscale image at that time. When the amplitude values of x, y, f are all finite and different dimensions, it is called a digital image. The Digital Image Processing field refers to the processing of digital images by a digital computer. Note that a digital image contains a limited number of elements, each of which has a specific position and value [1].

These factors. Pre-processing of remotely sensitive images usually involves two different processes: 1. Image enhancement or radiometric correction, 2. Geofering or geometric correction. Image enhancement or radiometric correction is the process of removing any internal distortions in an image to make any classification [2]. Geofering is the process by which all remotely sensitive images are subjected to the use of images in combination with other data sources. The rest of the paper is arranged as follows. Section 2 Displays the system design and specifies the procedure. Section 3 introduces the implementation of the proposed algorithm. Section 4 describes the use of function point analysis to measure disappearing points. Finally, conclude the article in Section 5.

2. PROBLEM STATEMENT

2.1 Linear perspective

The linear perspective relates to the mathematical approach to creating three-dimensional objects on a two-dimensional surface. This is called a "linear" view because objects, figures and space are realistically reconstructed using horizontal and vertical dividing lines. There are three types of linear perspectives. They include one-point view, two-point view and three-point view. All views have a horizon line and a fixed position (observer position). From one angle, there is a point where all lines radiate. From a two-point angle, there are two points emanating from the lines of an object [3].

The shoulders of the object disappear as one of two points disappearing on the horizon. The vertical rows of an object do not correspond to the angles of the horizontal lines. By changing the disappearing points of the object, the size of the object can be increased or decreased. There are two points that disappear somewhere on the horizon from a three-point angle; However, in contrast to the two-point perspective, there is also a point where the columns disappear above or below the horizon [4]. The horizon line is the theoretical line indicating the position of the observer's eye. Only in a large flat plane, such as the ocean, is the horizon equal to the horizon. Often geographical features (hills) and other objects (trees and buildings) lift the horizon above the horizon. Horizon diagrams are shown in Figure 1.

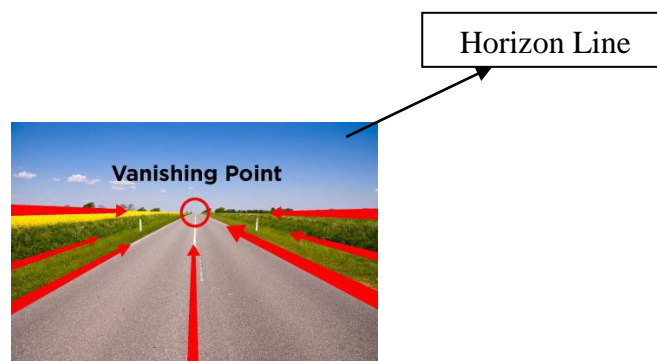


Figure1 : Horizon Lines detecting vanishing point

At the eye level of the viewer, the horizon line runs across the canvas. Horizon means the sky appears to meet the earth. The point of disappearance should be in the middle of the horizon. Disappearance means that all parallel lines (orthogonal) running towards the horizon meet like long-distance rails [5].

2.2 Vanishing point

The points on the horizon line where the backward lines meet disappear. The point (v.p.) that disappears when an object has parallel planes parallel to the earth is on the horizon. The point where the horizontal lines appear to go backwards. It is used in a linear perspective with respect to a fixed point (observer position). Objects seem to disappear at the time of disappearance. The point of disappearance is shown in Figure 2. All parallel lines from a one-point angle meet at a single point on the horizon, which is called point disappearance. The most difficult thing about 1-point perspective drawing is finding this horizon line. The point of disappearance from a two-point perspective is still on the horizon, but this time there are two of them (one point disappears as seen from a 1-point perspective).

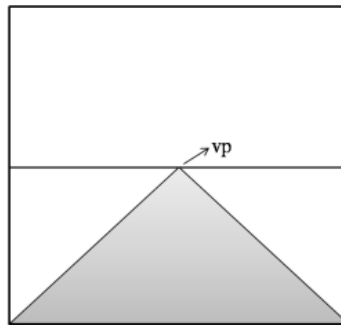


Figure.2 : Vanishing Point Representation in data plane

For three-point perspective drawing the outside edges will form convergence lines that suggest a third vanishing point.

3. SYSTEM IMPLEMENTATION

The system diagram includes the simple view of all the three modules shown in Fig 3.

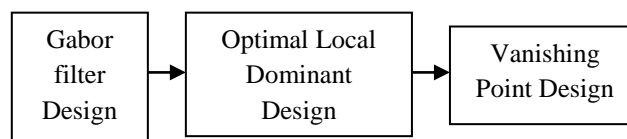


Figure 3: Vanishing Point Detection - Process

3.1 Gabor filter design

2-D GABOR Function 2-D GABOR Function Modulated Oriented Complex Sinusoidal Grating. The parameters of the Gabor function specify the frequency, the orientation (or center frequency) of the sinusoid, and the scale of the Gaussian function. Local trends and spatial frequencies are used as a hallmark of texture processing in Gabor filters. The input image is usually filtered by a family of Gabor filters tuned to different resolutions and orientations.

3.2 Optimal Local Dominance Orientation Design

Image local orientation assessment plays an important role in many computer vision and image processing tasks, such as edge detection, image segmentation and image analysis. 2D local orientation estimation is directly related to optical flow estimation, which is a generalization of the trend in 3D space / time volume. Several methods for the trend have been suggested before. Gabor filters are used to determine the dominant orientation of an area [3].

3.3 Disappearing point design

Defining the point of disappearance is the appearance of a point on the horizon, beyond which it disappears or disappears or parallel lines meet. The disappearing points also indicate the distance at which the two ends of the road meet. It is often used in predicting oncoming curves on the road; So the correct line to determine the entrance speed and distance. If the disappearing point goes towards you or towards you, the curve is tight. If the disappearing position deviates from you or comes to the center, the curve will be straight.

Function Point Analysis (FPA)

Function point analysis is a construction technique for classifying parts of a system. A method used to divide systems into smaller parts so that they can be better understood and analyzed. In function point analysis, systems are divided into five main classes. The first three classes are External Inputs, External Output and External / Data Questions. These classes or components deal with files, so they are also called transactions. The next two classes are internal logic files and external interface files. Data is stored in these classes and they form logical information.

Function points measure systems from a functional perspective, which is different from technology. Therefore, regardless of technology, language, development method, or hardware / software used, the number of function points per system remains constant. In function point analysis the variable is the effort required to provide a given number of function points. Most instructors of Function Point Analysis (FPA) agree that there are three main objectives in the FPA process:

1. Measure the software by measuring the amount of activity requested and provided by the customer.
2. Measure independently from the technology used to implement software development and maintenance.
3. Measure software development and maintenance regularly across all projects and organizations.

Function point calculation

1. No. Of user inputs : Input Image, Filtered image, image orientation (3)
2. No. Of user outputs : Filtered Image, Orientation of images, vote values, Vanishing point (4)
3. No. Of user inquiries : Image location (1)
4. No. Of files : Pixel values, orientation range, voting values (3)
5. No. Of external interfaces : Gabor filter, orientation method, voting scheme (3)

$$\begin{aligned}
 \text{FP} &= \text{count total} * [0.65 + 0.01 * \Sigma (\text{Fi})] \\
 \text{Count total} &= 127 \\
 \Sigma (\text{Fi}) &= 46 \text{ (since this is a moderately complex project)} \\
 \text{FP} &= 127 * [0.65 + 0.01 * 46] \\
 \text{FP} &= 140.97
 \end{aligned}$$

Table 1. Function point calculation

4.2 Gabor Filter Implementation

First step is to take input image that is any road image. Import this image into the Matlab. Then the following gabor filter equation is applied for the particular image using Matlab coding.

$$\mathbf{g}(\mathbf{x}, \mathbf{y}; \lambda, \Psi, \theta, \Omega, \gamma) = \exp(-(\mathbf{x}^2 + \gamma^2 \mathbf{y}^2) / 2\Gamma^2) \cos(2\Pi(\mathbf{x} / \gamma) + \Psi)$$

Where

$$\begin{aligned}
 \mathbf{x} &= \mathbf{x} \cos \theta + \mathbf{y} \sin \theta \\
 \mathbf{y} &= -\mathbf{x} \sin \theta + \mathbf{y} \cos \theta
 \end{aligned}$$

This equation is applied for all orientation (0, 45, 90, 135 degrees).

After applying this equation the values we get are in the complex form. The next step is applying the convolution function for the input image and the gabor filters values. This can be done by the following equation:

$$\begin{aligned}
 \mathbf{I} \varphi \mathbf{n} (\mathbf{p}) &= \mathbf{I}(\mathbf{p}) \otimes \mathbf{g} \varphi \mathbf{n} (\mathbf{p}) \\
 \mathbf{E} \varphi \mathbf{n} (\mathbf{p}) &= \text{square root} (\mathbf{Re}(\mathbf{I} \varphi \mathbf{n} (\mathbf{p}))^2 + \mathbf{Im}(\mathbf{I} \varphi \mathbf{n} (\mathbf{p}))^2)
 \end{aligned}$$

Now the magnitude values are obtained.

Optimal local Dominant Orientation

Optimal local dominant orientation can be calculated by the following steps:

Each Gabor energy response is considered as a vector whose magnitude is proportional to the Gabor energy response value $E\varphi(\mathbf{p})$ and its direction corresponds to its preferred orientation φ . Next, these Gabor energy responses $E\varphi(\mathbf{p})$ are sorted based on their magnitudes in descending order ($E\varphi_1(\mathbf{p}) > E\varphi_2(\mathbf{p}) > E\varphi_3(\mathbf{p}) > E\varphi_4(\mathbf{p})$) for each pixel location $\mathbf{p}(\mathbf{x}, \mathbf{y})$. Then, the resulting vector \mathbf{V} of the two most dominant filter activation strengths will be used to represent local texture orientation as follows:

$$\begin{aligned}
 \mathbf{V} (\mathbf{p}) &= \mathbf{V}_x (\mathbf{p}) + \mathbf{jV}_y (\mathbf{p}) = \text{Summation} (\mathbf{E} \varphi_i (\mathbf{p}) \mathbf{e}^{\mathbf{j} \varphi_i} 2\mathbf{i}) \\
 \text{Gabor energy responses can be identified by the following equations:} \\
 \mathbf{S1}(\mathbf{p}) &= \mathbf{E} \varphi_1 (\mathbf{p}) - \mathbf{E} \varphi_4 (\mathbf{p}) \text{ where } \varphi_{\mathbf{S1}}(\mathbf{p}) = \varphi_1 \mathbf{p} \\
 \mathbf{S2}(\mathbf{p}) &= \mathbf{E} \varphi_2 (\mathbf{p}) - \mathbf{E} \varphi_3 (\mathbf{p}) \text{ where } \varphi_{\mathbf{S2}}(\mathbf{p}) = \varphi_2 (\mathbf{p})
 \end{aligned}$$

Table 2. Gabor energy

After finding the sorted values, substitute these values in the above equation to determine dominant orientation pixels. Thus the optimal local dominant orientation was determined [table 2].

Vanishing Point Estimation

For a straight road segment on planar ground, there is a unique vanishing point associated with the dominant orientations of the pixels belonging to the road. The Vanishing Point estimation can be done by using Vanishing Point Voting method. This approach implies that each dominant orientation gives higher vote to the points closer to it than to the points further away along its ray r_p . We define a function based on the normalized Euclidean distance between each dominant orientation location $p(x, y)$ and each point on its ray r_p . The distance value is first normalized by the maximum possible distance D_p between the pixel $p(x, y)$ and the intersection point of its ray with the image perimeters. Vanishing Point Voting is shown in Fig 5.

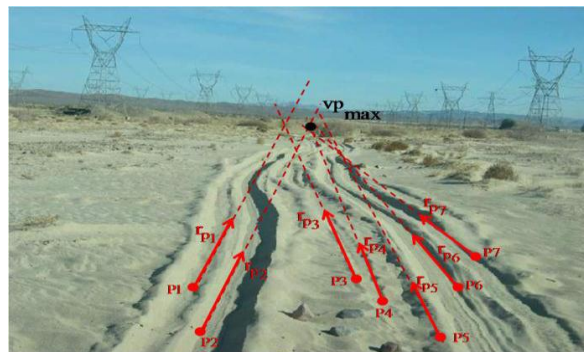


Fig 5: Vanishing Point Voting

Vanishing Point is estimated by the following steps:

1. The function based on the normalized Euclidean distance between each dominant orientation location $p(x, y)$ and each point on its ray r_p . The distance value is first normalized by the maximum possible distance D_p between the pixel $p(x, y)$ and the intersection point of its ray with the image perimeters.
2. To define a function based on the normalized Euclidean distance between each dominant orientation distance and the intersected point.

Then the distance function $y_j d$ is computed as:

$$y_j(d) = \text{exponential power of } (d^2/2\sigma^2)$$

$$d = d/D_p$$

$$d = \text{square root } ((x - x_j)^2 + (y - y_j)^2)$$

where

y_j is the distance function

d is the distance between dominant orientation $p(x, y)$ and any point (x_j, y_j) on its ray r_p

d is the normalized distance

σ^2 is the variance which is set experimentally to 0.25.

Table 3. Vanishing Point Calculation

Consequently, each ray r_p with dominant estimated orientation θ_p is first weighted based on the sine function of its dominant orientations ($\sin \theta_p$) and then it is multiplied by the distance function $y_j d$ to give higher vote to the points closer to its origin than to the points further away along the ray r_p .

Creates a set of synthetic images with relevant basic truth trends to determine the accuracy of a specific OLDOM. Each image has a white line with an intensity of 255 on a black (zero

intensity) background. Each line goes from 0 to 180 in the center of the image at a set angle. Oriented Gabor filters are applied to each pixel location of the input image and Gabor power responses are calculated at each randomly selected 10 points. Row. After calculating the dominant trend, a new voting method is introduced to find the disappearing area, which gives an appropriate weight to each beam drawn with the dominant trend. The distance-based voting scheme further amplifies those huge beams to overcome the bias towards the high pixels in the image. Finally, the pixel with the maximum auxiliary beams announces that the candidate will disappear from the main part of the road.

4. CONCLUSION

In this paper we suggested a new invisible point calculation method for structured road conditions. The technology relies on the combined functionality of four Gabor filters to predict the dominant trend in each pixel area of the image, making it ideal for direct applications. After calculating the dominance trend, a novel voting method was introduced to find the disappearing area, which gives each beam drawn with the dominance trend an appropriate weight. The distance-based voting scheme further amplifies those huge beams to overcome the bias towards the high pixels in the image. Finally, the pixel with the maximum auxiliary beams announces that the candidate will disappear from the main part of the road. In the future, two new technologies that differ in the parameter space used to collect votes via Huff Transform will be used. The first method, based on the probability method, works in the polar space. The second method, which focuses on critical analysis, works directly at the image level. These two references are used to find the missing point that produces the most straight lines in the image. These two approaches can be combined with a complex approach to find potential approaches and more reliable results.

5. REFERENCES

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