A Novel Approach for Converting 2D into 3D Images Using Hough Feature Extraction Technique

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A B S T R A C T

3D imaging is a familiar practice used in artificial intelligence and radar imaging. The main challenges in 3D imaging are the noise content of the input image and degraded quality of the reconstructed image. The aim of the study is to implement an improved technique for reconstructing 2D to 3D image, which is suitable in reconstructing 2D to 3D image, which will compare the correctness and precision of lines extracted of an image. The accuracy of extracting line will be related to global accuracy, whereas the precision concerns accuracy at a local level. It contains three extensions: the technique of line Hough edge detection, the application of Hough segmentation, and the detection of line segments. By analyzing the results of line extraction the efficiency of each algorithm can be analyzed with efficient Standard Hough Transform algorithm. The detected lines are used for 3D imaging to obtain a 3D reconstruction with high level accuracy.

INTRODUCTION

Acquiring 3D images has become an essential parameter for doing research in most of the areas such as defense, automobile industry, construction industry, biomedicine, radar imaging, cultural heritage preservation and computer games. This case is reasonable with the shapes of similar 3D objects (i.e., objects from the same class). An artist can estimate its shape based on appearance of images. The above result doesn’t produce the exact shape of the object, but it is often useful to estimate for many purposes. By the Motivation of this example, we propose a novel framework, for example based reconstruction of shapes from single images and line detection based on enhancement Hough Transform. The basic Hough transform, also called the Standard Hough Transform (SHT), has established itself as a default technique of straight line Hough transform evaluation. This popularity comes from the robustness to noise and very simple algorithmic implementation of SHT. Consider the common problem of fitting a set of line segments to a set of discrete pixels. To solve this efficient methods are required like Standard Hough Transform. Here, we constrain the reconstruction process by assuming that similarly looking objects from the same class (e.g., House, Naturals, Face, Fish), have similar shapes. A set of 3D objects, selected as examples of a specific class is maintained. Different file format of images of the objects in the class is saved along with their respective depth maps using these objects to produce a file data. For Example these objects enable us to provide a feasible mapping from intensities to shapes and also used to estimate the shape of objects in query images. Since input image often contains a novel object, exact same image exists in the database. Due to this a method is introduced to utilize the example, in the database to produce novel shapes and reconstruct the images by seeking extracted portions of the image and similar intensity patterns suggest possible reconstructions for different portions of the image. Coherent shape estimate is produced by merging this suggested reconstruction together. Thus, composing different parts of example objects produces novel shapes.
We evaluate the quality of the 3D single-view reconstructions by comparing the ground truth, with the estimated 3D shapes of real objects in a controlled environment.

We show that the 3D estimation is sufficiently accurate for a robot to estimate the pose of an object and successfully grasp it, even in situations where the part to be grasped is not visible in the input image. We also demonstrate that the 3D reconstructions allow 2D data, such as depth maps from stereo processing, to improve the recognition performance of two existing object detection systems. We have to use the algorithms like Gaussian smooth, canny for line detection, vanishing Point Calculator and Hough Transform. The contribution is then twofold. First, we propose a novel use of early aspects as “hints” it handles the difficult cases of detecting the number of fake edges and textures. Second, increases the time and space complexities.

**Related work:**

An extension of the Standard Hough Transform (SHT) is described to accurately detect line segments. This method is based on the robustness of SHT and then enlarged by three features: the “weighted” accumulation, the local maxima rule and the elimination of the agglomerate lines in the same area. The proposed systems also include the 3D image reconstruction using the vanishing point algorithm and reconstruction pixel calculation in our project.

In this project of reconstructing 3D objects from a single image, can be achieved with the help of using a learned 3D class shape model. The 3D class model is based on a set of 3D oriented primitives, and can be learned from a small set of labeled views of an object in the class. The single-view reconstruction also provides accurate 3D information for entire objects. The advantage of this paper is

1. Accurate image will be displayed during the reconstruction.
2. Reduced time delay in the reconstruction process.
3. Various enhanced algorithms are used for reconstruction from 2D to 3D.
4. Multiple images can be reconstructed.

(Q. Wei, 2005), presented a survey on converting 2D to 3D by considering a comparative study as follows.

**Table 1: Comparative Study.**

<table>
<thead>
<tr>
<th>Depth Cues</th>
<th>Image Acquisition</th>
<th>Image Content</th>
<th>Accuracy</th>
<th>Dense/Sparse Depth map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere Scattering</td>
<td>Existing</td>
<td>Animated image</td>
<td>Comparative error rate: 9.8% of outdoor images</td>
<td>Dense</td>
</tr>
<tr>
<td>Shading</td>
<td>Existing</td>
<td>The image must be very light. in order to recover the shadow depth</td>
<td>Average error rate 4.59%, Extreme error rate 39.5%</td>
<td>Dense on surface</td>
</tr>
<tr>
<td>Linear Perspective</td>
<td>Existing</td>
<td>Symmetrical image</td>
<td>N/A</td>
<td>Dense</td>
</tr>
<tr>
<td>Patterned Texture</td>
<td>Existing</td>
<td>Appropriate segmented texture required</td>
<td>The angle between calculated and actual surface 8.02 degrees, which is an average error</td>
<td>Sparse/ Dense</td>
</tr>
<tr>
<td>Symmetric Patterns</td>
<td>Existing</td>
<td>Image with two-sided symmetric items</td>
<td>N/A</td>
<td>Recovered the essential values like Sparse, depth of symmetric objects</td>
</tr>
<tr>
<td>Statistical Patterns</td>
<td>Existing</td>
<td>Complete images</td>
<td>With base 10 as per log scale, the average error is 0.129</td>
<td>Dense</td>
</tr>
</tbody>
</table>

(Esma pakizeh, Maziar Palhang, 2010) have fragmented line segments of interested objects should be grouped to human made structures, for the detection of edges in building features like shadow can be modeled as 3D and by applying Hough transform the linear equation for a straight line is obtained. To apply in dense regions Hough transform technique can be used. But the proper value must be selected for its parameters. But the proper value must be selected for its parameters.

(Xuehui Chen, Ruqing Jia, Hui Ren, Yinbin Zhang, 2010) Used for 3D reconstruction of a scene the detection of vanishing points in a digital image is important. This detection includes (i) the straight line in the image is detected by first Hough transform. (ii) Points in a circle were translated into points on a line using a coordinate transform. (III) The position of vanishing points can be calculated by corresponding line parameters in pole coordinate but detection of a circle is more difficult than the straight line.

(Yuan-Kai Hao, Gen Wei, Yu-Dong Zhang, and Le-Nan Wu, 2010) utilized an adaptive threshold for the canny operator for this track the pixels which are higher than Th. Tracking continuous until grade lower T1 and track the values above higher threshold value by using this operation to then detect of fake edges and textures are possible.

(R.Liu, J. Han, 2010) presented Many images are collected when the Light source rotates around the optical axis of the camera the intensity of the same point is analyzed. Hough transform is used to find the sine curve hidden inside the intensity value and surface normals is found, the surface shape is generated by integrating the surface normals and the integration from the center. Hough transform is used to recover shape and albedo.
recovery of specular objects for this an improved RHT algorithm is used to detect line segment by using RHT the noises and the interference are reduced from the other connected regions. Sine curve detection will be difficult by using Hough transform technique.

(Jiang Lixia, Zhou Wenjun, Wang Yu, 2010) Proposed a new wavelet transform algorithm is appropriate for image edge detection and clear edge detection a result obtained complete image edge as well as accurate positioning and can reserve better detailed information.

(Bo Dai, Ye Pan, Hui Liu, Danhong Shi, Shixin Sun, 2010) discussed So we are used CHT to detect accurate lines RHT minimize the computation of CHT. Large invalid sample produced by random sample so it increases the time and space complexity by using RHT line length start and terminal position of the Line detection cannot be obtained directly.

(Zhibin Zhang, Yingying Lu, Yongsheng Song, Haixu Wang, 2012) proposed it eliminates cross row line segments using dual threshold and template matching. Exactness the crop row line developed through the integrating of peak and the pseudo peaks. By using this algorithm, multi rows extraction, good robustness and adaptability. In the field of robot vision guidance system this algorithm is valuable.

(Xingyu Fu, Hongjian You, and Kun Fu, 2012) described during testing SAR image a statistical edge detection based on successive square difference of average has been calculated. Constant false alarm rate performs good demonstration more region shapes. To improve the edge detection result post processing approach includes edge thinning and adaptive double threshold processing.

**Proposed method:**

Our method utilizes a standard Hough transform reconstructing 2D to 3D images. The proposed system primarily comprises four phases namely (i) Image Pre-processing (ii) Canny algorithm (iii) Line Point Segmentation (iv) Vanishing Point. These Four phases consecutively performed and reconstruction of 2D to 3D image more effectively. Fig. 1 shows the workflow of our proposed method.

![Workflow of Reconstructing 2D to 3D image](image)

**Line Hough Transform:**

Hough Line transform is the simplest form of the Hough transform while attempting to describe lines that match edges in a two-dimensional image. To use the Hough transform, we need to characterize a line for using the Hough transform one description of a line is the slope-intercept form \(y = mx + b\) where \(m\) is the slope of the line and \(b\) is the y-intercept (that is, the y component of the coordinate where the line intersects the y-axis). Given a point \((x, y)\) can be iterated through any number of lines that pass through it using given character of a line. By iterating through fixed values of \(m\), we can solve for \(b\) by \(b = y - mx\). However, this method is not very stable. The magnitudes of \(m\) and \(b\) grows infinitely as the lines get more and more vertical the most useful description of a line is its normal form.

\[ x \cos \theta + y \sin \theta = p \] (1)
The above representation indicates a line passing through \((x, y)\) is perpendicular to the line drawn from the origin to \((\rho, \theta)\) in polar space (i.e., \((\rho \cos \theta, \rho \sin \theta)\) in rectangular space). For each point \((x, y)\) on a line, \(\theta\) and \(\rho\) are constant. Now, for any given point \((x, y)\), we can obtain lines passing through that point by solving for \(\rho\) and \(\theta\). By iterating through possible angles for \(\theta\), we can solve for \(\rho\) by the equation directly. This method proves to be more effective than an equation, as it is numerically stable for matching lines of any angle.

Developers working with existing programs repeatedly have to address concerns (features, aspects...) that is not well modularized in the source code comprising a system. (Esmat pakizeh et.al., 2010) In such cases, a developer has to first locate the implementation of the concern in the source code consisting the system, and accordingly the concerned to be documented in order to be able to understand it and the change task to be performed. The existing methods available to assist the software developers locate and manage sprinkled concerns use a representation based on lines of source code. Description of such a line-of-code enables it difficult to understand the concern and limits the analysis possibilities.

**Canny Algorithm:**

This algorithm is mainly used for edge detection in an image. Edge detection is one of the algorithms used to detect the edges in the image, while protecting the important structural properties of an image, it reduces the amount of data and to remove the useless information. The Canny edge detection algorithm is also giving the optimal edge detector. Canny intentions had been to enhance the many edge detectors already out at the time.

The first and most obvious is low error rate, no responses to non-edges. The second criterion is that the edge points are well localized - the distance between the edge pixels as found by the detector and the actual edge is to be at a minimum. A third criterion will have a response to a single edge. The above first 2 criterion has not completely eliminated the possibility of multiple responses to an edge. So, the canny edge detector first smoothes the image to eliminate noise and then finds the image gradient to highlight regions with high spatial derivatives. The gradient array is now reduced based on current given gradient region and past given gradient region. Hysteresis is used to track along the remaining pixels that have not been compressed. Hysteresis uses two thresholds and if the magnitude is below the first threshold, it is set to zero (non edge). The hysteresis will be set on edge if the magnitude is beyond the high threshold, it will be zero if the magnitude is between the 2 thresholds, then it is set to zero.

**Algorithm CANNY:**

Step1. Smoothing: Blurring of the image to remove noise.

Step2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.

Step3. Non-maximum suppression: Only local maxima should be marked as edges.

Step4. Double thresholding: Potential edges are determined by thresholding.

Step5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

**Gaussian Smoothing:**

Gaussian smoothing is often applied because the noise or the nature of the object observed might be of a Gaussian probable form. The bi-dimensional Gaussian Kernel stated by its kernel size and standard deviation(s). The formulas for 1D and 2D Gaussian filter given below and shown as SDx and SDy are the standard deviation for the x and y directions respectively.

\[
K_{1D(i)} = e^{-\frac{i^2}{2SD^2}}
\]

\[
K_{2D(i,j)} = e^{-\frac{i^2}{2SD^2} - \frac{j^2}{2SD^2}}
\]

Where

1D- One dimensional

2D- Two dimensional

SDx- Standard Deviation for x

SDy- Standard Deviation for y

i, j- constants

The Gaussian filter works like the parametric LP filter, but the larger kernels can be chosen with some difference and in 3D view also. Below a Gaussian filter is shown in 2D top view with horizontal and vertical cross sections and also in 3D view. There is the standard deviation of 10x10 and a kernel size, of 35x35 pixels for the Gaussian function provided. Notice that a large part of the kernel for the y direction contains values very
close to zero due to the low standard deviation in this direction. The general implication of the height values will not be introduced by the normalizing filter kernel during the filtering process.

**Standard Hough Transform:**

The well-known SHT and Progressive Probabilistic Hough Transform (PPHT) are two of the most efficient algorithms for line detection. The advantages of the SHT algorithm are its robustness to noise and discontinuities in the patterns. It provides only the \( \rho \) and \( \theta \) parameters of the straight lines. This simple transform fails to determine any more information about the length or the start and end points. PPHT, which is an advanced Hough transform algorithm, can solve the problems that occur in SHT. Since it is originated in Probabilistic Hough Transform, PPHT is also a randomized version of the Hough Transform. The use of the same one-to-many voting pattern with probabilistic methods can decrease the requirements of computation and storage while detecting the line segments. Line segments are obtained by PPHT; however, there are a few problems that affect the accuracy of this algorithm, making it less accurate than the SHT.

In this paper, we present an extension of the SHT to detect line segments accurately; this extended transform is mainly based on the robust features of the SHT. This extension is simple and can yield effective results. Thus, it can be considered as an improvement of both the standard transforms and the probabilistic transform. The reason why we have chosen SHT and its extension in this paper is that the standard algorithm can detect most of the lines in an image. An experimental result of the proposal is shown in this project in order to compare the SHT extension to the PPHT. From these comparisons, we can understand the effect of the extension of the standard algorithm; we can also determine whether it can overcome the disadvantages of SHT and PPHT or not.

**Vanishing Point Calculator:**

The main idea is that orthogonal vanishing points can be used to calibrate a camera. Therefore, one criterion checks the reliability of the deduced camera parameters. On the basis of this, the three vanishing points are searched for which have the highest votes and fulfill these three criteria. This exhaustive search is computationally more expensive than other approaches.

**Vanishing Steps:**

Due to various reasons is the perspective projection of a line segment of the 3D scene onto the 2D image not congruent with the line segment detected in the image. This perfect projection of a line segment can be denoted as a projected line segment. Hence, all vanishing point detection methods have to formulate either implicitly or explicitly a distance function between a vanishing point and a detected line segment. KTH website, In this situation we ask, How secure is a projected line segment \( s' \) with vanishing point \( VP \) to its corresponding line segments. In order to answer the question we represent a line segment with the midpoint representation \( (mpx, mpy, l, \alpha_s) \). We define the perfect line segment \( s' \) of a line segment \( s \) has the same midpoint as \( s \) and has \( vp \) as vanishing point. Based on this definition a distance function \( d(vp, s) \) between a vanishing point \( vp \) and a line segment \( s \) can be defined as the angle \( \alpha \) between the corresponding line segments \( s' \) and \( s \). Fig. 2 gives an example for a finite vanishing point. This distance function fulfills the requirements: Finite and infinite vanishing points are treated in the same way and the distances between points and line segments are independent of their location on the image plane.

Fig. 3 Explanation for the distance function \( d(vp, s) \) between a line segment \( s \) and a finite vanishing point \( vp \). Now it is possible to formulate and can fill the accumulator space. KTH website, The points intersect at infinity, of all pairs of non-collinear line segments are measured as accumulator cells, that is potential vanishing points. A line segment \( s \) votes for an accumulator cell \( \alpha \) if the distance \( d(\alpha, s) \) is below a certain threshold \( t \) and the vanishing point does not lie on the projected line segment \( s' \), which correspond with us. In the search step we are interested in the total vote of an accumulator cell and this vote depends on the length of a line segment.
(assuming that longer line segments are more reliable) as well as on the distance between accepting line segments and the accumulator cell. We describe

\[ \text{vote}(\alpha) = \sum w_i \left( 1 - \frac{d(x,s)}{t_s} \right) + w_2 \left( \frac{\text{length of } s}{\text{maximal length of } s} \right) \]  \hspace{1cm} (4)

All accepted s of \( \alpha \) as the total vote of an accumulator cell \( \alpha \) where the weights \( \omega_1 \) and \( \omega_2 \) establish this trade off.

**Reconstructing Image:**

The standard approaches of 3D reconstruction of single images, usually are concentrating on recognizing object using geometry information. In Fig. 2, the vanishing point method is shown. In the vanishing point method, the basic plan is proposed with similar rectangle included in images, and the vertical plane is calculated using cross-rules. Using these methods, the regular rectangle or triangle shapes are easy to reconstruct. But, for the complex architecture of the building, it is difficult to consider the entire image as object recognition. To save computational time, which is taken during the mass images processing, the project concentrates on reconstruction from a single image, establishing vanishing point coordinate system to provide the learning model.

**3D image view:**

In 2D images we can see the images according to x, y coordinates. But In the 3D image view can see the image on x, y, z coordinates. It depends upon the user value on x, y; z. The user can change the values x, y, z and scale factor value. Also the module creates indoor and outdoor model of the image.

**RESULTS AND DISCUSSIONS**

Implementation is the most crucial stage in achieving a successful system and giving the user’s confidence that the new system is workable and effective.

Implementation of a changed for replacing the existing. If there are very few changes in the system. It is relatively easy to handle this type of conversation.

Each program was tested individually at the time of development using the data and has verified that this program linked together as per the specification for this program, for the user satisfies the computer system and its ambient is tested. Computer system and its environment are tested to the satisfaction of the user. The developed system is accepted and proved to be satisfactory for the user. Hence the system will be implemented shortly. A plain operating procedure is provided so that the user can understand the different functions clearly and quickly.

Initially as a first step the executable form of the application is to be created and loaded in the common server machine which is accessible to the entire user and the server is to be connected to a network. The end stage is to provide the operating procedures of the entire system including components.

Implementation is the stage of the project when the theoretical design is turned out into a working system. Hence, the same can be considered as the most critical stage in achieving a successful new system and in giving the user, this new system will give the confidence to the user that it is working effectively.
The implementation stage consists of careful planning, investigation of the existing system and its constraints on the implementation, designing of methods to achieve changeover and evaluation of changeover methods.

Implementation is the process of converting a new system design into operation. The implementation phase focuses on site preparation and file conversion for installing a candidate system, user training. The important factor that to be considered here is that the conversion should not disrupt the functioning of the organization.

We expect more random variation in results when there are few objects per image, as results become more dependent upon exactly which objects were drawn. Identical sets of test images were used when comparing the Hough Transforms. The following acronyms are used in graphs:

- SHT – Standard Hough Transform
- PHT – Probabilistic Hough Transform
- RHT – Randomized Hough Transform
- HHT – Hierarchical Hough Transform

**Fig. 4:** Comparison with different methods.

The accuracy rate of the system is given in Fig. 5. We have taken a human living environment image and proved that our system produced an accuracy rate of 99.7%.

**Fig. 5:** Accuracy rate Calculation.
Fig. 6: (a) load image (b) line Hough (c) line Mile (d) Hough Transformation (e) Gaussian Smoothing (f) Canny Edge Detection (g) Vanishing Point (h) 3d Reconstruction (i) Indoor (j) Outdoor

Conclusion:

In this paper, we propose the efficient standard Hough Transform algorithm for the edge and line detection. It detects lines more accurately and efficiently. And finally the vanishing point is calculated and the 2D images are reconstructed to 3D. Canny algorithm is mainly used for edge detection in an image by protecting the important structural properties of an image, it reduces the amount of data and to remove the useless information.

In future, it handles the difficult cases of intersection between ascending and descending strokes of adjacent lines. And also to find other ways to handle it correctly, which cause most of the errors by classification.

REFERENCES