Rotation Invariant Fusion of Partial Image Parts in Vista Creation using Missing View Regeneration

H. B. Kekre,   Sudeep D. Thepade

Abstract—The automatic construction of large, high-resolution image vistas (mosaics) is an active area of research in the fields of photogrammetry [1,2], computer vision [1,4], medical image processing [4], computer graphics [3] and biometrics [8]. Image stitching is one of the possible options to get image mosaics. Vista Creation in image processing is used to construct an image with a large field of view than that could be obtained with a single photograph. It refers to transforming and stitching multiple images into a new aggregate image without any visible seam or distortion in the overlapping areas. Vista creation process aligns two partial images over each other and blends them together. Image mosaics allow one to compensate for differences in viewing geometry. Thus they can be used to simplify tasks by simulating the condition in which the scene is viewed from a fixed position with single camera. While obtaining partial images the geometric anomalies like rotation, scaling are bound to happen. To nullify effect of rotation of partial images on process of vista creation, we are proposing rotation invariant vista creation algorithm in this paper. Rotation of partial image parts in the proposed method of vista creation may introduce some missing region in the vista. To correct this error, that is to fill the missing region further we have used image inpainting method on the created vista. This missing view regeneration method also overcomes the problem of missing view [31] in vista due to cropping, irregular boundaries of partial image parts and errors in digitization [35]. The method of missing view regeneration generates the missing view of vista using the information present in vista itself.

Keywords—Vista, Overlap Estimation, Rotation Invariance, Missing View Regeneration.

I. INTRODUCTION

THE photographs obtained from a hand held camera has a limited field of view. This is a major drawback when considering applications that require complete panoramic image covering a large field of view. Image vista can be obtained by mainly two ways. First method is hardware intensive [2,7] in which specialized lens cameras or parabolic mirrors are used to directly capture panoramic views. But the

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problem with the images obtained with wide angle lens is that the portion of the view on the boundaries gets compressed and we get actual size of view at centre only. The better method is to take many regular photographic mages in order to cover the whole viewing space These images then must be aligned and composited into complete vista images using an image stitching methods [3,5,7,45].

Using our technique of panoramic view construction the nonlinear compression of hardware intensive vista creation can be avoided. In this method multiple regular images of desired view could be taken with normal handheld camera device and then using panorama making methods those can be stitched together to construct vista [16,17,20]. The method is taking care of overlap in the partial images, scaling of them and rotation with arbitrary degrees [16,20]. Also method tries to generate the missing region of the panorama using Region Filling [15].

Using these methods photographic panoramas of natural scenery can be obtained using simple cameras. Satellites are taking the photos of the earth surface in form of stripes. These satellite images can be stitched together using this method to have bigger mosaics. Earth surface is curvy and final panoramas should be planer so the geometric corrections are needed [2,3]. After these corrections partial images could be stitched together using proposed methods. The method could be used in interior decoration planning and also in preparing architectural walkthroughs [7]. Even Denture X-rays [4] are captured using panorama construction. In this the X-ray film is moved around the jaw and X-ray of every tooth is taken. Finally all these X-rays are joined together. The computer Jigsaw puzzles are created using image panorama construction in which the partial images are having zigzag boundaries. One of the socially important application of this can be fingerprint mosaicking.[8] This could be used to obtain complete fingerprint using the partial (incomplete) fingerprints left by criminals at the site.

A region filling algorithm is posed for regenerating the missing part of digital images using the image contents only. The main contribution of this technique is the priority/patch-ordering mechanism that allows an Exemplar-based approach [9,10,15] to respect the structural features of the input image. Exemplar based texture synthesis contains the essential process required to replicate both texture and structure [9]. Simultaneous propagation of texture and structure information is achieved. The actual color values are computed using

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exemplar based synthesis [10]. Computational efficiency is achieved by a block based sampling process. Exemplar based approach is Simpler and faster region filling algorithm which does not suffer from blur artifacts. Exemplar based texture synthesis [9] is sufficient for propagating extended linear image structure.

II. LITERATURE SURVEY

Vista creation has been in practice since long before the age of digital computers. Shortly after the photographic process was developed in 1839, the use of photographs was demonstrated on topographical mapping [2]. Images acquired from hilltops or balloons were manually pieced together. After the development of airplane technology (1903), aerial photography became an exciting new field. The limited flying heights of the early airplanes and the need for large photomaps, forced imaging experts to construct mosaic images from overlapping photographs. This was initially done by manually mosaicking images, which were acquired by calibrated equipment. The need for vista creation continued to increase later in history as satellites started sending pictures back to earth. Improvements in computer technology became a natural motivation to develop computational techniques and to solve related problems in vista creation.

A. Vista Creation

The main approaches for vista creation are Cylindrical and Planar. In Cylindrical approach [3], the planar co-ordinates of image are converted into cylindrical co-ordinates and then focal length for each piece of image is computed. In next step the focal length of all pieces is adjusted to a common value and then the pieces can be joined in cylindrical co-ordinates and the mosaic's co-ordinates are converted from cylindrical to planar. By the approach of planar vista [5,18,19] the similarity among partial image pieces is found [13,14]. Based on this similarity factor the image pieces can be stitched together to get panoramas. Finally the visible stitch marks (seams) are eliminated.

In "Panoramic Image Mosaics"[3] some techniques for constructing panoramic image mosaics from sequences of images are presented. Their mosaic representation associates a transformation matrix with each input image, rather than explicitly projecting all of the images onto a common surface (e.g., a cylinder). In particular, to construct a full view panorama, they have introduced a rotational mosaic representation that associates a rotation matrix (and optionally a focal length) with each input image. A patch-based alignment algorithm is developed to quickly align two images given motion models. Techniques for estimating and refining camera focal lengths are also presented.

The tutorial " Image Alignment and Stitching: A Tutorial" [5] reviews image alignment and image stitching algorithms. Image alignment algorithms can discover the correspondence relationships among images with varying degrees of overlap. Image stitching algorithms take the alignment estimates produced by such registration algorithms and blend the images in a seamless manner.

The technique "Seamless Stitching using Multi-Perspective Sweep" [7] uses multiple intermediate cameras instead of single. As in other approaches, the non-overlapped regions are associated with their respective original camera locations. However, in this paper the columns in the overlapped area are associated with virtual camera locations between the two original camera locations. This minimizes object distortion (which is unavoidable unless full 3D is known or recovered everywhere) while producing a practically seamless composite. Computing the appearance of each column within the overlapped region is accomplished using a Multi-Perspective Plane Sweep (MPPS), because the resulting image is a Multiple Center of Projection (MCOP) image.

In "Fingerprint Mosaicking" [8] authors have developed a fingerprint mosaicking scheme that constructs a composite fingerprint template using multiple impressions. A composite template reduces storage, improves matching time. In the proposed algorithm, two impressions (templates) of a finger are initially aligned using the corresponding minutiae points. This alignment is used by a modified version of the well-known iterative closest point algorithm (ICP) to compute a transformation matrix that defines the spatial relationship between the two impressions. The resulting transformation matrix is used to stitch the two templates to generate a composite image.

A different approach to creating full view panoramic mosaics from image sequences is presented in "Creating Full View Panoramic Image Mosaics and Environment Maps" [6]. Unlike other panoramic stitching methods, which usually require pure horizontal camera panning, this system does not require any controlled motions or constraints on how the images are taken (as long as there is no strong motion parallax). The image mosaics are represented using a set of transforms, there are no singularity problems such as those existing at the top and bottom of cylindrical or spherical maps. Methods to recover camera focal length are also presented.

In the paper "Panoramic view construction" [4], the problem of constructing the whole view of a scene background from an image sequence is considered. First, point or block correspondence between each pair of successive frames is determined. A new technique is introduced for the correction of accumulated frame alignment errors.

The algorithm in "Image Stitching Using Structure Deformation" [45] is to achieve seamless image stitching without producing visual artifact caused by severe intensity discrepancy and structure misalignment, given that the input images are roughly aligned or globally registered. The approach is based on structure deformation and propagation for achieving the overall consistency in image structure and intensity.

B. Missing View Regeneration

The missing view regeneration techniques fill holes in images by propagating linear structures (called isophotes in the inpainting literature) into the target region via diffusion. The missing view regeneration can be done mainly by two ways: "Texture synthesis" algorithms for generating large

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image regions from sample textures [11, 21] and "Inpainting" techniques [9,10,15,23] for filling in *small* image gaps [28]. The texture synthesis methods are good for "textures" repeating two-dimensional patterns with some stochasticity [24,27]. The Texture Synthesis [11,21] class of algorithms includes quasi-repeating patterns consisting of small objects of similar but irregular size[40,43,44], such as flower, fields, pebbles, tree branches [22]. These algorithms start from a sample image and generate a new image of arbitrary size the appearance of which is similar to that of the original image. This method is fast and its implementation is straightforward. Potential benefit of texture synthesis includes the ability to create large and/or tillable textures [26,29,30] from a small sample in a direct manner [41,42].

Image inpainting [9,10] is the process of filling in missing data in a designated region of a digital image. Applications range from removing objects from a scene to re-touching damaged paintings and photographs. The goal is to produce a revised image in which the inpainted region is seamlessly merged into the image in a way that is not detectable by a typical viewer. Traditional image inpainting [38] has been done by professional artists. In photography and film making, inpainting is used to revert deteriorations (e.g. cracks in photographs or scratches and dust spots in film). Inpainting could also be used to add or remove of elements (e.g. removal of stamped date and red eye from photographs).

C. Real World Implementations

PhotoStitch Software and REALVIZ Stitcher are the commercial products available in real world for Image Mosaicking. PhotoStitch comes with Canon digital camera. It stitches the photo pieces which are in Horizontal/ Vertical/ Square shape only. REALVIZ Stitcher needs user interface to roughly position the image pieces at their respective positions in Panorama and then simply stitches them together. The information about the product is available at URL http://www.realwiz.com.

III.   METHODOLOGY

The goal of vista creation is to seamlessly integrate the individual partial images into a complete picture. A sequence of spatially overlapping images is given as input. The geometric anomalies like scaling and rotation are removed. It is assumed that each image has some overlapping region with its immediate neighbor. The overlap is estimated and then vista is obtained. Earlier we have proposed scaling invariant grid based scaling The rotation of partial image parts may introduce some missing region in the vista. This missing region is regenerated using the existing information in the vista itself.

A. Steps in Vista Creation

The vista creation involves the following steps:
a.   Correcting geometric deformations in the image parts such as scaling and rotation differences.
b.   Finding the span of overlap regions in the partial images obtained from a hand held camera.

c.   Joining the sequence of images with varying degrees of overlap and pasting them in order to obtain a panorama.
d.   Generation of the missing part in the image panorama.

B. Initial Assumptions

The algorithm of stitching is considering two parts of desired view at a time for panorama construction. The partial images have to have some common region (overlap) in them. The method considers input of image parts to be given strictly in ordered sequence.

The algorithm of inpainting is limited to produce good results when similar patches exists for the synthesis of the selected target region. Inpainting algorithm is not designed to handle structures in background image whenever that structure is required be considered in the patch. Depth ambiguities are not handled.

C. Overlap Estimation [14, 16,17]

Overlap Estimation is one of the important step in panorama making. The main goal of this step is to find the common region in two consecutive images along with the span of that overlap. We are using block matching techniques from [14,17] for this purpose. The five methods proposed to find overlap using block matching are Matching Ratio, Correlation Coefficient, Mean Square Error, Euclidian Distance and Pearson's Coefficient. Out of these overlap estimation factors Mean Square Error, Euclidian Distance and Correlation Coefficient gives better and clear estimation.

D. Rotation of Partial Image Parts

While capturing the photo parts for vista creation the camera may get tilted slightly this may cause rotation anomalies in the parts. This rotation of camera creates problems for panorama construction. In vista creation before stitching these photo parts the rotation anomalies should be abolished. Here the rotation algorithms can be used with overlap estimation techniques.

• *Rotation with Standard Degrees*

In this we have considered the rotation of fractional images by standard degrees in multiple of 90. In implementation simple AFFINE transform is used to rotate fractional images in degrees 90, 180, 270 and to obtain the correlation values. Using AFFINE transform [12] the new location for every pixel (x, y) of original image is computed as (x', y'). The transform is given in equation 1.

$$\begin{vmatrix} X' \\ Y' \end{vmatrix} = \begin{vmatrix} \cos(a) & \cos(a) \\ -\sin(a) & \sin(a) \end{vmatrix} \begin{vmatrix} X \\ Y \end{vmatrix} \tag{1}$$

where, (X , Y) = original position of pixel, (X', Y') = rotated position of pixel

The Standard Degree Rotation Algorithm used is……….
a.   Reading the image which has to be rotated.
b.   Reading the angle of rotation 'a' (in multiple of 90 degrees).

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c. Calculate new location (X',Y') of every pixel in original image with location (X,Y)
d. X' = X * Cos (a) + Y * Sin (a)
e. Y' = - X * Sin (a) + Y * Cos (a)
f. Shift intensity value of pixel to new computed location (X',Y') to get rotated image.

- *Rotation with Arbitrary Degrees*

This algorithm rotates an image by the angle degrees in the CCW direction. Degrees may be any number. The algorithms will put degrees in the range 0 to 360 degrees and then into a range of -45 to 45 degrees after performing elementary 90 degree rotations. The rotation performed is the 3 Pass Separable rotation using FFT-based methods to perform the skews [12]. The trigonometric equation of 3 Pass Rotation is given as Eq 2.

$$\begin{vmatrix} X' \\ Y' \end{vmatrix} = \begin{vmatrix} 1 & -\tan(a/2) \\ 0 & 1 \end{vmatrix}\begin{vmatrix} 1 & 0 \\ \sin(a) & 1 \end{vmatrix}\begin{vmatrix} 1 & -\tan(a/2) \\ 0 & 1 \end{vmatrix}\begin{vmatrix} X \\ Y \end{vmatrix}$$

(2)

where, (X, Y) = original position of pixel, (X', Y') = rotated position of pixel

First Skew (First Pass of Rotation)

$$\begin{vmatrix} X1 \\ Y1 \end{vmatrix} = \begin{vmatrix} 1 & -\tan(a/2) \\ 0 & 1 \end{vmatrix}\begin{vmatrix} X \\ Y \end{vmatrix}$$

(3)

where, (X, Y) = original position of pixel, $(X1, Y1)$ = position of pixel after First Skew

Second Skew (Second Pass of Rotation)

$$\begin{vmatrix} X2 \\ Y2 \end{vmatrix} = \begin{vmatrix} 1 & 0 \\ \sin(a) & 1 \end{vmatrix}\begin{vmatrix} X1 \\ Y1 \end{vmatrix}$$

(4)

where, $(X1,Y1)$ = position of pixel after First Skew, $(X2,Y2)$ = position of pixel after Second Skew

Third Skew (Third Pass of Rotation)

$$\begin{vmatrix} X' \\ Y' \end{vmatrix} = \begin{vmatrix} 1 & -\tan(a/2) \\ 0 & 1 \end{vmatrix}\begin{vmatrix} X2 \\ Y2 \end{vmatrix}$$

(5)

where, $(X2, Y2)$ = position of pixel after Second Skew, (X', Y') = final rotated position of pixel after third skew

Aliased spectral components are masked after EACH skew using the MaskImage function. This function pads images during the rotation process. Images can be non-square, but odd dimensions will cause incorrect padding. Therefore an error is returned, if a dimension is odd. As Matlab fft functions are capable of non-power of 2 transforms, dimensions need not be powers of 2.

The Arbitrary Degree Rotation Algorithm used is
a. Read image to be rotated
b. Read degrees of rotation
c. Put degrees into the range [0,360]
d. Count number of elementary 90 degree rotations to put rotation in range [-45,45]

e. Calculate Trigonometric Values
f. Perform First skew
g. Perform Second skew
h. Perform Third skew

Each Skew is performed using FFT based technique which has stages like
a. Pad image rows or columns as per type of skew (Rows for row dependent skew and columns for column dependent skew)
b. Forward FFT image
c. Calculate image's center coordinates
d. Prepare to use the Fourier Shift Theorem
e. f(x-deltax) <=> exp(-j*2*pi*deltax*k/N)*F(k)
f. Initialize constant part of the exponent expression
g. Compute Skew dependent part of expression
h. Calculate the angles
i. Rotate the complex numbers by those angles
j. Mask aliased components from skew
k. Inverse FFT the image

In vista creation if the partial image has rotation in multiple of 90 degrees, then that image should be rotated back to original angle. This could be done by rotating back the partial image with same degrees in reverse direction. In figure 1.b the right part of image is shown. The right part is needed to be rotated by 90 degrees in clockwise direction. After rotation the 1.c is obtained. Now 1.a and 1.c can be considered for vista creation. Figure 1.d shows the estimated overlap between 1.a and 1.c and using this overlap vista 1.e is created as final result.


1.a   1.b   1.c

1.d   1.e
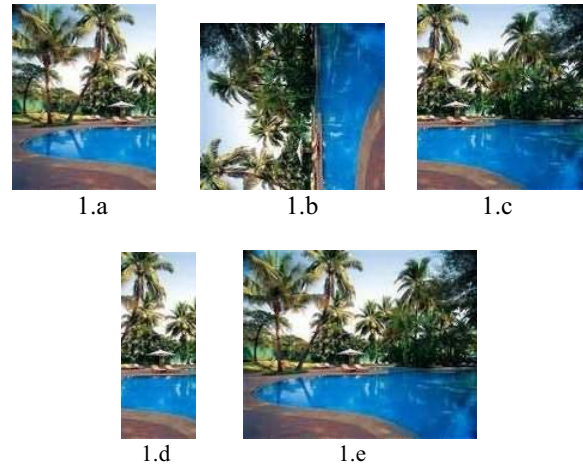
1.a Left Part (155x120)   1.b Right Part (140x155)
1.c Rotated Right Part (155x140)
1.d Overlap between a and c (61x120)
1.e Vista of poolside (199x155)
Fig. 1 Vista creation with Standard Rotation

In vista creation if the partial image has arbitrary rotation because of camera movement, then that image should be rotated back to original angle. This could be done by rotating

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back the partial image with same degrees in reverse direction. In figure 2.b the right part of image is shown. The right part is rotated by 9 degrees in counter-clockwise direction while capturing the image. After rotation by 9 degrees in clockwise direction 2.c is obtained. Now 2.a and 2.c can be considered for panorama making. The vista constructed using 2.a and 2.c is shown in figure 2.e and the overlap is given in 2.d. Here because of rotation of partial images the final vista contains some missing part (the black portion appeared in 2.e), which should be automatically filled in visually plausible way.

2.a   2.b   2.c

2.d   2.e
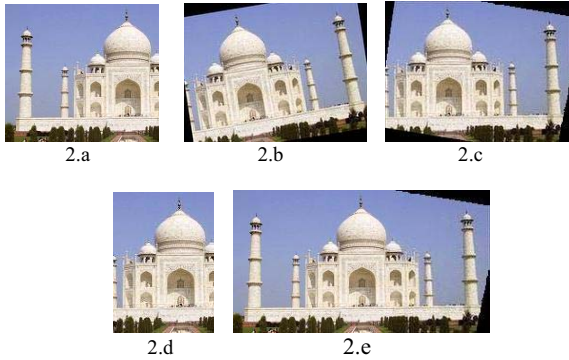
2.a Left Part (150x170),

2.b Right Part (150x204),

2.c Rotated Right Part (150x204),

2.d Overlap (150x104),

2.e Vista of Tajmahal (150x270)

Fig. 2 Arbitrary Rotation in Vista Creation: Tajmahal
(Figure 2.b Right Part (9 degrees CCW), 2.c Right Part for panorama construction obtained by rotation of figure 2.b by 9 degrees in clockwise direction.)

In figure 3.b the right part of image is shown. The right part is by 10 degrees in clockwise direction during the capturing process. After rotation by 9 degrees in counter-clockwise direction it is considered for panorama making. The panoramic view constructed using 3.a and rotates 3.b is shown in figure 3.c.
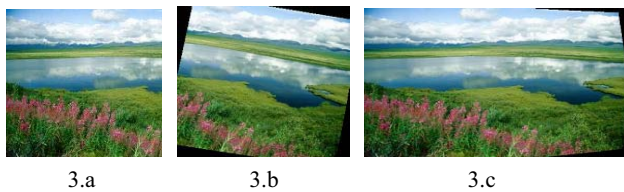

3.a   3.b   3.c

Fig. 3 Arbitrary Rotation in Vista Creation: Pond Scenery
[3.a Left Part (168x168), 3.b Rotated Right Part (168x168), 3.c Vista of Pond Scenery (168x254)]

E. Missing View regeneration in Vista Creation [9,10,15]

To regenerate the missing part of panoramic view we are proposing the use of this algorithm of missing view regeneration using image inpainting. In panorama construction if the partial image has arbitrary rotation because of camera movement, then that image should be rotated back to original angle. This could be done by rotating back the partial image with same degrees in reverse direction, which will create missing region in the panorama because of rotated partial image as shown in figure 2.e and figure 3.c. Even if

partial images are not enough to cover the desired view completely, some part of panorama may appear as missing. Sometimes because of some reasons, any part of the view may get corrupted [39]

A number of algorithms specifically address the image filling issue for the task of image restoration [32,33] , where speckles [36,42], scratches [34,37], and overlaid text [40,41] are removed. These image inpainting techniques fill holes in images by propagating isophotes [9] into the target region. The core of the proposed inpainting algorithm is an isophote driven image sampling process. Figure 4 illustrates the point of exemplar-based synthesis is sufficient to propagate both the texture and structure into the target region.

To regenerate the missing region in the panorama we are using image inpainting technique [10]. The region to be filled, i.e. the target region is indicated by T, and its contour is denoted by dT. The contour evolves inward as the algorithm progresses and so it is referred as the "fill front" [10]. Source region, S (S = I - T) , which remains fixed throughout the algorithm, provides samples used in the filling process.

To see how the structure and texture are adequately handled by exemplar based synthesis is shown in Fig 4(b) – 4(d). The square template $W_p \in$ T centered at the point P (fig 4b) is to be filled. The best match from the source region comes from the patch $W_{q'} \in$ S , which is most similar to those parts that are already filled in W_p. From Fig 4(c), we can see that if W_p lies on the continuation of an image edge , the most likely best matches will lie along the same edge.(e.g. W_q) . All that is required to propagate the isophote inwards is a simple transfer of the pattern from the best match source patch (Fig 4.d). From this it is noticed that the isophote orientation is automatically preserved. In this exemplar based method patch-based filling approach is focused and this improves the execution speed. Further patch based filling improves the accuracy of the propagated structures.
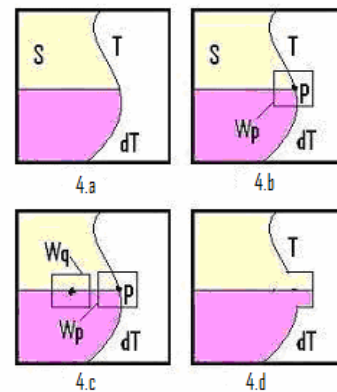

4.a   4.b

4.c   4.d

Fig. 4 Steps in Missing View Regeneration

[(a) Original Image, with the target region T, its contour dT and the source region S clearly marked. (b)The area delimited by the patch W_p centered at the point p ∈ dT is required to be synthesized. (c)The most likely candidate matches for Wp lie along the boundary between the two textures in the source region, e.g. W_q (d) The best matching patch in the candidate set has been copied into the position occupied by W_p thus achieving partial filling of T. The target region T has now shrank and its front dT has taken a different shape.]

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In this algorithm, each pixel maintains a *color* value (or empty", if the pixel is unfilled) and a *confidence* value, which reflects our confidence in the pixel value, and which is frozen once a pixel has been filled. During the course of the algorithm, patches along the fill front are also given a temporary *priority* value, which determines the order in which they are filled. Then, this algorithm iterates the following steps until all pixels have been filled.

The main contribution of this algorithm is the priority/patch-ordering mechanism that allows an exemplar-based approach to respect the structural features of the input image. The priority is composed of a *confidence term, C(p),* and a *data term, D(p),* both defined over pixels:

$$C(p) = \frac{\sum_{q} \in Wp \cap (1-T)C(q)}{Awp} \qquad (6)$$

$$D(p) = |\, dIp^{dIp} \times np \,| \, / \, \alpha \qquad (7)$$

where Awp is the area of $W_{p.}$, α is a normalization factor,
n_p is a unit vector orthogonal to the front ,
dT in the point p, dIp denotes the orthogonal operator.

Intuitively, the confidence term measures how sure a pixel is of its own value; this is computed from the confidence of surrounding pixels that have already been filled (or weren't in the fill region to begin with). Confidence tends to decay as the center of the fill region is approached. Because of this, if the priority only consisted of the confidence term, the patches would be selected in an "onion-peel"[10] manner, which is typical of current exemplar-based approaches. Confidence ignores structural information in the image, however. This is why the data term is necessary; it is a combination of how strongly an *isophote* at a pixel collides with the contour at that same pixel. An isophote is basically the gradient at a pixel rotated by 90 degrees---it captures the "strength of flow" of an edge. If only the data term is used in the priority, however, edges end up propagating where they shouldn't. It is the harmony between the two factors that creates good results. In this vein, both quantities are normalized (to lie between 0 and 1) by appropriate factors. The next step is to propagate the texture and structure information from .Once all priorities on the fill front have been computed, the patch Wp with highest priority is found. Then the filling starts with the data extracted from the source region S. After the selected patch is filled with new pixels, the confidence C(p) is updated. As filling proceeds, confidence values decay, indicating that we are less sure of the color values of the pixels near the center of the target region.

The Algorithm for Missing View Regeneration with Inpainting is

a. Select the initial front dT

b. Compute Data term for all pixels in source image.

c. Identify the fill front dT. If dT = {}, exit. else goto step c.

d. Compute Confidence term C(p) for all pixels in dT.

e. Compute priorities P(p) = C(p)*D(p), for all p in dT.

f. Find the patch Wp with maximum priority P(p). i.e. Wp | P = argmax { p in dT }

g. Find the exemplar Wq in S that minimizes the sum squared error (SSE).

h. Copy image data from Wq to Wp.

i. Update C(p) for all p | p in (Wp intersect T) and go back to step c.

The missing view regeneration algorithm is applied to the color image of figure 5.a and the result obtained is shown in figure 5.b.

5.a   5.b
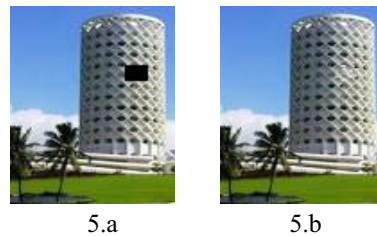
5.a Nehru Center Image with missing view
5.b Image after regenerating missing view

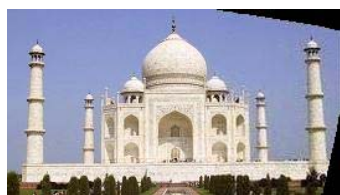Fig. 5 Example of Missing View Regeneration : Nehru Center, Worli.

Figure 6.b is obtained after applying the missing view regeneration algorithm on 6.a.
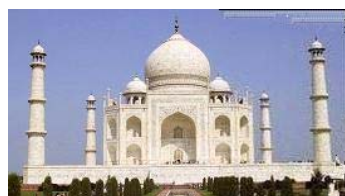

6.a

6.b

6.a Vista with missing region (80x270),
6.b Vista after missing view regeneration(80x279)

Fig. 6 Example of Missing View Regeneration : Water fall scenery.

Figure 7.a is the panoramic view generated in chapter 6 (figure 2). After applying missing view regeneration algorithm the panoramic view is improved as shown in figure 7.b. Thus the anomalies introduced because of rotation of partial images could also be minimized using missing view generation.

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7.a

7.b

7.a Vista with missing region
7.b Vista with missing region regenerated

Fig. 7 Example of Missing View Regeneration in Vista Creation:
Tajmahal Vista

After applying missing view regeneration algorithm the panoramic view 8.a is improved as shown in figure 8.b.

8.a

8.b

8.a Vista with missing region (168x254)
8.b Vista with missing region regenerated (150x270)

Fig. 8 Example of Missing View Regeneration in Vista Creation:
scenery vista

IV. CONCLUSION AND FURTHER WORK

Image vista creation is the integration of plenty of small images to create one large image consisting of a panoramic view contained individually in those smaller images. The resolutions of cameras are limited, so they can obtain limited view. Very often, to get the necessary amount of detail in one single image, the use of wide angle lenses have to be employed. This restriction imposed by the hardware can be overcome by the use of software tools developed in Panoramic View Construction using partial Images. Thus using the developed algorithms, one can minimize cost and at the same time achieve the desired result. Further, even with the use of hardware tools such as wide angle lenses, there still is a limit imposed upon the wideness of the image, whereas panorama construction using partial images does not have such limitations.

The Overlap estimation based on the principle of Matching ratio, Correlation Coefficient, Mean Square Error, Euclidian Distance and Pearson Coefficient is one of the very important steps in Image Panorama Generation.

The geometric anomalies are bound to happen while capturing the individual partial images. Image Rotation algorithms developed can be used to minimize the impact of these geometric distortions in final panoramic view. So Image Rotation feature allows the user to create panorama even if the partial images are rotated due to camera tilting.

In vista creation if the partial images have arbitrary rotation because of camera movement, then the images are rotated back to original angle, which may create missing patch. Even sometimes because of irregular overlap, final panorama may have missing region in it. To regenerate the missing part of panoramic view, the algorithm of missing view regeneration is developed. The structure of original image vista is retained by region filling technique because it follows priority based patch filing.

Here to obtain the vista, the sequence of partial images is supposed to be known. Further one can try to get rid of the sequencing. The depth ambiguities can also be added to these algorithms for further improvements. One of the possible extension to the algorithms of panoramic view construction using partial images could be considering local details of partial images.

Thus, these vista construction algorithms are of great use to photographers, archeologists, scientists and weather forecast departments.

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