Image Blending in Vista Creation using Kekre's LUV Color Space

H. B. Kekre and Sudeep D. Thepade

***Abstract*—Vista creation (Panorama construction) 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. This seam indicates where one image ends and the other image begins. These images should be combined in such a way that the final image does not have any spurious artificial edges. But if the partial images are differing in brightness, seam becomes visible in final panoramic view. To minimize this visibility of seam, here we are giving Image blending technique for panoramic view construction. In the proposed algorithm we are using Dr. Kekre's LUV color space for Image blending.**

***Index Terms*—Vista creation, Panoramic view, Image Blending, Dr. Kekre's LUV color space.**

I. Introduction

THE automatic construction of large, high-resolution image mosaics is an active area of research in the fields of photogrammetry [1], computer vision [2], image processing [3] and computer graphics [3]. Image panoramas can be obtained by mainly two ways: Using the imaging devices having specialized lens with a very large field of view or using parabolic mirrors to directly capture panoramic views [4] or by taking many regular photographic mages in order to cover the whole viewing space These images then must be aligned and composited into complete panoramic image using an image stitching methods [5].

Image stitching method aligns multiple partial images of the desired view over each other and blends them together. The first step of panoramic view construction is to estimate the common region (overlap) among the partial images. Then based on this estimate of overlap these images could be stitched together to form panoramic view. If the partial images differ in the brightness (i.e. if some partial images are darker than others), the stitch mark becomes visible in final panorama. To minimize this visibility of seam, we need to apply some averaging on the seam. Here for color images, averaging of individual R,G,B color intensity values creates color distortion and hence we need to apply averaging in Dr. Kekre's LUV color space.

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II. Literature Review

Many approaches have been proposed to solve the problem of intensity difference in panorama making. The task of image blending is to determine the value of a vista pixel based on pixels from all partial images. Many factors affect the quality of image vistas [6], including image alignment, lens distortion, pixel intensity difference among frames, and perspectives of each frame. There is a long history of study on how to create good quality vistas. The majority of image blending methods create a vista pixel based on a weighted sum of partial image pixels.

The simplest weighting function is a flat function that weighs all pixels equally. To reduce seams, a linear ramp weighting function can be used across the boundary region of two adjacent images [7]. A similar technique (feathering algorithm) was proposed in [5] to reduce seams. Image feathering assigns a pixel's weight based on its distance to the boundary. A better approach that intends to compute the best possible weighting function across boundaries was proposed in [8]. However, it involves an expensive iterative relaxation procedure. Recognizing the impact of the width of a transition zone centered across an image boundary, authors in [9] proposed a multi-resolution method based on Laplacian pyramid [10]. The basic motivation of this approach is that the width of the transition zone should be comparable to the size of features in images. All these approaches are computationally very expensive.

In this paper, a different method based on Dr. Kekre's LUV color space is proposed to explicitly correct for brightness difference of partial images. As a result, visibility of seam reduces with computationally better algorithm.

III. Overlap Estimation

The desired view is taken in form of multiple partial images. Estimation of the overlapping region in these images becomes the prerequisite for panorama construction. Here we have assumed that in one round, the algorithm deals with only two partial parts of the desired view as : left part (IL) & right part (IR) with some overlapping portion between them as given in figure 3.1. Also we have assumed that the partial image pieces should be considered strictly in sequence.

To estimate the extent of overlap between two consecutive partial images, first column of the right part image is considered with every column of the left part to compute the estimation factors using the equations given in 1, 2 as different approaches the overlap estimation algorithm.

Let, X = column of Left Part (n:1) and
Y = 1'st column of Right Part

C. Mean Squared Error

$$\text{Mean Squared Error} = \frac{(X - Y)2}{\text{Total number of pixels}} \qquad (1)$$

For whichever left column X Mean Squared Error is **lowest** that can be treated as the edge of Overlap.

D. Euclidian Distance

$$\text{Euclidian Distance} = \frac{\frac{1}{2}\sqrt{(X - Y)2}}{\text{Total number of pixels}} \qquad (2)$$

For whichever left column X Euclidian Distance is **lowest** that can be treated as the edge of Overlap.

Let the size of left part image be m x n and size of right part image be m x q, then the first column of right part is considered with last column (column n) of left part for computing estimation parameters. In next step the first column of right part is considered with second-last column (column n-1) of left part. This is continued till first column of left part. Then the decision about the boundary of overlap is made as per table 3.1.

Let, Left part Image--------IL //size of IL (m x n)
Right part Image------IR //size of IR (m x q)

Then the columns considered for matching can be given as follows….

IL(n) . IR(1)
IL(n-1) . IR(1)
IL(n-2) . IR(1)
.
.
IL(1) . IR(1)

IV. IMAGE BLENDING

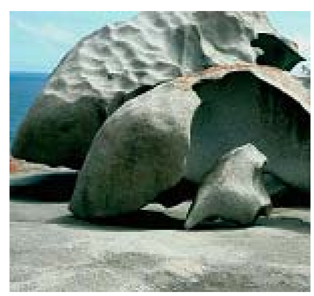
If left and right images have intensity differences (i.e. one is darker and other is brighter) then for obtaining the mosaic one option could be to take simple average of the respective pixel intensities from left and right parts in overlap region. But the seam (stitch mark or boundary of overlap) remains visible in the panorama constructed using such method. For color images we are proposing the image blending algorithm based on LUV averaging for panoramic view construction.

A. IMAGE BLENDING USING SIMPLE AVERAGING

The Algorithm for image blending using simple averaging for panorama construction to nullify intensity difference is……….

a. Read left and right images to be stitched FOR panorama construction.
b. Calculate Overlap Estimation parameters for all blocks.
c. Finalize extent of overlap.
d. While constructing the overlap region of panorama take average of intensities of pixels which are present in left part image and right part image.

In figure 1, left part image and right part image are given as 1.a and 1.b. The left part is comparatively darker. Here the algorithm of image blending should be used to obtain the panorama. The panorama obtained by simple averaging is shown in figure 1.c. The lacuna of this simple intensity averaging is that the seams (stitch marks) are clearly visible in the panoramic view (shown as figure 1.c). This looks very odd and needs some different technique to equalize overall brightness (light intensity) of panoramic view depending on brightness of partial images



1.a

1.b

1.c

1.a Left part of Stone (140x150)
1.b Right part of Stone (140x125)
1.c Panorama (140x200) constructed using averaging of intensities technique

Fig. 1 Result of simple averaging image blending algorithm: Stone Panorama

B. IMAGE BLENDING USING Dr. Kekre's LUV COLOR SPACE

In this algorithm we need the conversion of RGB to LUV components. The RGB to LUV conversion matrix given in equation 3 gives the L, U, V components of color image for respective R, G, B components.

$$\begin{vmatrix} L \\ U \\ V \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ -2 & 1 & 1 \\ 0 & -1 & 1 \end{vmatrix} . \begin{vmatrix} R \\ G \\ B \end{vmatrix} \qquad (3)$$

The LUV to RGB conversion matrix given in equation 4 gives the R, G, B components of color image for respective L, U, V components.

$$\begin{vmatrix} R \\ G \\ B \end{vmatrix} = \begin{vmatrix} 1 & -2 & 0 \\ 1 & 1 & -1 \\ 1 & 1 & 1 \end{vmatrix} . \begin{vmatrix} L/3 \\ U/6 \\ V/2 \end{vmatrix} \qquad (4)$$

The Algorithm for image blending using LUV averaging for panorama construction of color images to nullify intensity difference ……….

a. Read left and right images to be stitched to form panorama.
b. Convert R, G, B components of left and right images into respective L, U, V components using the conversion matrices given as equation 3.
c. Calculate average L component of left part.
d. Calculate average L component of right part.
e. Compute L component increment
   I = | (average L left part) – (average L right part) |
f. If (average L left part) == (average L right part)
   then go to j.
g. If (average L left part) > (average L right part)
   then assume
   Leftincrement= -I/2, Rightincrement = I/2 and go to i.
h. If (average L left part) < (average L right part)
   then assume
   Leftincrement= I/2, Rightincrement = -I/2 and go to i.
i. Modify all values in L component of left and right part as
   L component value of left
   = (L component value of left + Leftincreament) and
   L component value of right
   = (L component value of right + Rightincreament).
j. Repeat steps c. to i. for U and V components of left and right part images.
k. Convert these modified L, U, V components of left and right part images in to respective modified R, G, B components.
l. Now apply any of the overlap estimation technique on these modified left and right part images for the panoramic view construction.

The panoramic view constructed from partial images shown as figure 1.a and 1.b, by applying image blending algorithm using LUV averaging is shown in figure 2.b.

2.a.Stone panorama (140x200) constructed using image blending with simple averaging

2.b Stone panorama (140x200) constructed using image blending with LUV averaging.

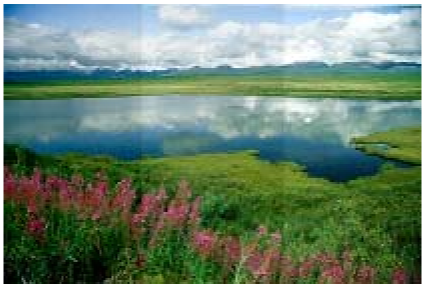
Fig. 2 Comparing panoramas obtained by image blending with simple averaging and LUV averaging

V. ADDITIONAL RESULTS

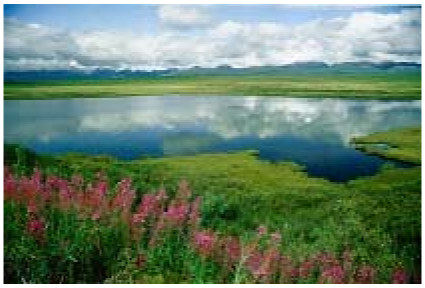
Figure 3.a shows the darker left part and 3.b shows the comparatively brighter part of pond scenery image. The panoramic view shown as 3.c is constructed after applying simple intensity averaging technique where the seams visible. After applying LUV averaging algorithm on 3.a and 3.b the result panorama is shown in 3.d, which gives better panoramic view as compared to 3.c.

3.a 3.b

3.a Darker Left part (140x140)
3.b Right part (140x140)
Fig. 3 Example of image blending : Pond Scenery image

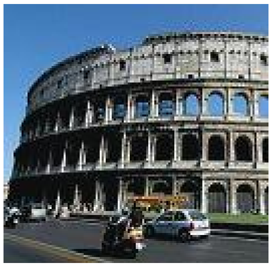


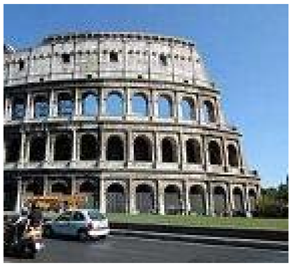
3.c.Pond Scenery panorama (140x209)
Constructed using simple averaging



3.d Pond Scenery panorama (140x209)
constructed using blending (LUV averaging).
Fig. 3 Example of image blending : Pond Scenery image (Contd..)

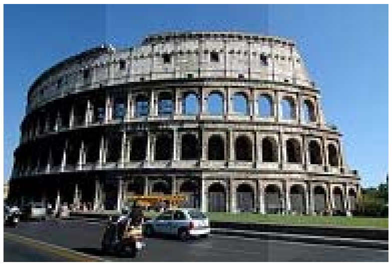
Figure 4.a shows the darker left part and 4.b shows the comparatively brighter part of roman collosium pond scenery image. The panoramic view shown as 4.c is constructed after applying simple intensity averaging technique where the seams visible. After applying LUV averaging algorithm on 4.a and 4.b the result panorama is shown in 4.d, which gives better panoramic view as compared to 4.c.



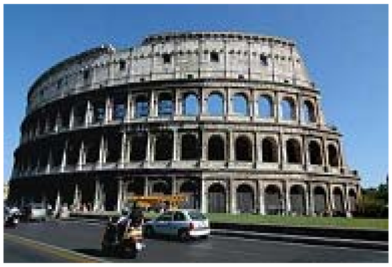


4.a 4.b

4.a Darker Left part (129x132)
4.b Right part (129x142)
Fig. 4 Example of image blending : Roman Collosium image



4.c.Roman Collosium panorama (129x192)
constructed using simple averaging



4.d Roman Collosium panorama (129x192)
constructed using LUV averaging
Fig. 4 Example of image blending : Roman Collosium image (contd..)

Figure 5 shows results of LUV averaging on image of elephants of periyar wildlife sanctuary.

5.a Darker Left part (125x190)

5.b Right part (125x163)
Fig. 5 Example of image blending : Elephants-periyar-wildlife-sanctuary

5.c.Elephants panorama (125x242)
constructed using simple averaging

5.d Elephants panorama (125x242)
constructed using LUV averaging.

Fig. 5 Example of image blending : Elephants-periyar-wildlife-sanctuary (contd..)

VI. Conclusion

We have presented image blending method using Dr. Kekre's LUV color space for creating vista. This method eliminates the visibility of seam (stitch mark) without distortion of colors in the vista. With the examples which we have shown this could be justified.

Even the method is computationally lighter, as the RGB to Dr, Kekre's LUV conversion as well as the blending algorithm majorly involves addition and subtraction.

Finally, we have presented Dr. kekre's LUV color space based image blending Algorithm to get rid of seam visibility problem in image vista creation in case of brightness difference in partial images of vista.

VII. References

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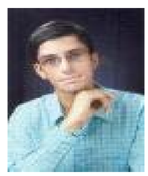
VIII. Biographies

Dr. H. B. Kekre has received B.E. (Hons.) in Telecomm. Engg. from Jabalpur University in 1958, M.Tech (Industrial Electronics) from IIT Bombay in 1960, M.S.Engg. (Electrical Engg.) from University of Ottawa in 1965 and Ph.D.(System Identification) from IIT Bombay in 1970. He has worked Over 35 years as Faculty and HOD Computer science and Engg. At IIT Bombay. From last 11 years working as a professor in Dept. of Computer Engg. at Thadomal Shahani Engg. College, Mumbai. His areas of interest are Digital Signal processing and Image Processing. He has more than 145 papers in National/International Conferences/Journals on his credit



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