International Journal of Information, Control and Computer Sciences
ISSN: 2517-9942
Vol:2, No:5, 2008

Creating the Color Panoramic View using Medley of Grayscale and Color Partial Images

Dr. H. B. Kekre, Sudeep D. Thepade

***Abstract*—**Panoramic view generation has always offered novel and distinct challenges in the field of image processing. Panoramic view generation is nothing but construction of bigger view mosaic image from set of partial images of the desired view.

The paper presents a solution to one of the problems of image seascape formation where some of the partial images are color and others are grayscale. The simplest solution could be to convert all image parts into grayscale images and fusing them to get grayscale image panorama. But in the multihued world, obtaining the colored seascape will always be preferred. This could be achieved by picking colors from the color parts and squirting them in grayscale parts of the seascape. So firstly the grayscale image parts should be colored with help of color image parts and then these parts should be fused to construct the seascape image.

The problem of coloring grayscale images has no exact solution. In the proposed technique of panoramic view generation, the job of transferring color traits from reference color image to grayscale image is done by palette based method. In this technique, the color palette is prepared using pixel windows of some degrees taken from color image parts. Then the grayscale image part is divided into pixel windows with same degrees. For every window of grayscale image part the palette is searched and equivalent color values are found, which could be used to color grayscale window. For palette preparation we have used RGB color space and Kekre's LUV color space. Kekre's LUV color space gives better quality of coloring. The searching time through color palette is improved over the exhaustive search using Kekre's fast search technique.

After coloring the grayscale image pieces the next job is fusion of all these pieces to obtain panoramic view. For similarity estimation between partial images correlation coefficient is used.

***Keywords*—**Panoramic View, Similarity Estimate, Color Transfer, Color Palette, Kekre's Fast Search, Kekre's LUV

I. INTRODUCTION

PANORAMA making of images have 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 [19]. Images acquired from hilltops or balloons were manually pieced together.

After the development of airplane technology (1903) aerophotography 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 mosaicking 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.

Panoramic view generation is an established technique in many disciplines [34], including computer vision, image processing, computer graphics [33], and photogrammetry [18]. It helps to generate wide-view (panoramic) images – provided that some overlapping exists among neighboring images [29], [30]. The image panorama making software has now been accepted as a tool for the people who use digital cameras. A commercial product such as Photoshop provides a function of panoramic image generation. In addition, there has been a growing interest in the use of mosaic images to represent the information contained in videos [31], [32]. The panoramic view generation technique is interesting and work effectively in, for example, video indexing, search, and manipulation [33]. Most of the existing panoramic view generation systems assume that images are taken by a camera which is placed at a fixed position [34]. Panning, tilting, and zooming are the possible camera operations. However, this assumption is not convenient in some cases.

Some of the problems in seascape formation are similarity estimation in partial images [21],[22], sequencing of partial images, brightness difference in image parts [9], geometric deformations of image parts (like scaling or rotation) [22], missing regions in the panoramic view [22], irregular boundaries of image parts [20]. Many researchers have proposed the techniques to solve these problems.

Creating the color panoramic image from medley of color and grayscale partial images is one of the challenges in panorama making [23]. Colorization can increase dramatically the visual appeal of grayscale images and perceptually enhance scientific illustrations. The re-coloring of grayscale image parts using semi-automated techniques, where users provide clues in order to facilitate the image re-coloring, has been investigated by several research groups.

Grayscale image colorization can find its applications in black and white photo editing [1],[12], classic movies colorization [5],[13],[14] and scientific illustrations [1],[2],[8]. Colorization can increase dramatically the visual appeal of grayscale images and perceptually enhance scientific illustrations.

The task of "colorizing" a greyscale image involves assigning three-dimensional (RGB) pixel values to an image which varies along only one dimension (luminance or intensity) [1]. Since different colors may have the same luminance value but vary in hue or saturation, the problem of colorizing greyscale images has no inherently "correct" solution. Due to these ambiguities, human interaction usually plays a large role in the colorization process. Even in the case of pseudocoloring, [5,8] where the mapping of luminance values to color values is automatic, the choice of the colormap is commonly determined by human decision. Pratt [8] describes this method as an image enhancement technique because it can be used to enhance the detectability of detail within the image [1].

Welsh et al. [1] proposed a grayscale image colorization method that works very impressively for natural images and scientific illustration images. They introduced color transfer technique to colorize grayscale images. In general, Welsh et al.'s method works well on scenes where the image is divided into distinct luminance clusters or where each region has distinct textures. However, their technique does not work very well with human faces. In there method grayscale re-coloring was achieved by asking users to identify and associate small rectangles, called "swatches," in both the source and destination images to indicate how certain key colors should be transferred. Using a technique reminiscent of image analogies, Levin et al [12] produced grayscale re-colorizations of *video* by having users pick colors from a source image and draw freehand curves to cue where and how color transfer should occur for selected destination *frames*. Also of interest is an image re-coloring scheme for *gamut* replacement described in [15, 16] that uses grayscale re-colorization methods.

One of the most common tasks in image processing and editing is to alter an image's color. Recently, Ruderman et al. [3] developed a color space, called $L\alpha\beta$ color pace, which minimizes correlation between channels for many natural scenes. Reinhard et al. [2] used this color space to transfer color from one color image to another and achieved impressive visual effect. The basic idea of that paper is to combine the color transferring technique in [2] with texture synthesis techniques. This technique works very well on scenes where the image is divided into distinct luminance clusters or where each of the regions has distinct textures. However, the technique does not work very well with faces. It fails to classify the difference between skin and lip. More generally, this problem exists in colorizing grayscale images with regions that with similar or confusing luminance distribution. Directly employing this technique will fail to colorize these different regions with user specified colors, even though with the help of swatches.

The techniques given in [2] and [3] are referred as non-interactive (i.e. fully-automated) color transfer techniques, Reinhard et al [2] used statistical methods in order to *color correct* natural landscape images by transferring color "characteristics" from a source image to a destination image. Their transfer methods relied heavily on the properties obeyed by natural images when they are analyzed in Ruderman's $L\alpha\beta$ color space [3].

In [12],[13],[14] grayscale image matting algorithms are used with to combine with color transferring techniques to achieve object-based colorization, where objects in the same image are colorized independently. In [17], the authors have demonstrated the possibility to color many grayscale images in a way that is completely automatic. Here the source image is found from database of color images based on feature matching. Here the paper proposes comparatively simpler method for color trait transfer [23] to grayscale images. Our method works well on all type of images. To further improve the coloring process speed we have used Kekre's fast search algorithm [22]. The quality of coloring is improved using Kekre's LUV color space [9],[23],[24].

After coloring all partial grayscale images the next step is the fusion of images by estimating the common region (overlap) between consecutive image parts [19]. Overlap is the common region in consecutive picture parts. Overlap boundary 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. Stitching aligns two images over each other and blends them together. For this overlap estimation, we are using Correlation Coefficient and Mean Square Error as similarity measures as given in [19] and [20].

A. Kekre's LUV Color Space

Here we have used Kekre's LUV color Space. Where L gives luminance and U and V gives chromaticity values of color image [23],[24]. Negative value of U indicates prominence of red component in color image and negative value of V indicates prominence of green component over blue. To get Kekre's LUV components we need the conversion of RGB to LUV components. The RGB to LUV conversion matrix given in equation 2 gives the L, U, V components of color image for respective R, G, B components.

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

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

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

II. PROPOSED PANORAMIC VIEW GENERATION METHOD

Following steps are involved in proposed color panoramic view generation technique using medley of color and grayscale partial images.

i. Read the medley of partial images
ii. Isolate the partial color and grayscale images
iii. Generate the color palette using the color partial images

iv. Search the respective matches for grayscale pixels from grayscale partial image in the color plank.
v. Transfer the colors from best found plank match to grayscale pixels in grayscale partial image.
vi. Correcting geometric deformations in the image parts such as scaling and rotation differences.
vii. Overlap Estimation in partial images.
viii. Stitching partial images for getting panoramic view

A. Color Palette Generation

The color palette is a lookup table where the color values for group of grayscale pixels are stored. This table is generated using the color partial images and used to find the approximate possible colors for group of pixels of grayscale partial images.

B. Searching Best Color Match for Grayscale Pixel

The target grayscale image is also divided into the pixel windows of same size MxN. Every window is represented as array of grayscale intensity values of inclusive pixels. For every row of grayscale intensity values the best match is searched from the color palette using Mean Squared Error (MSE). For searching either exhaustive search or Kekre's fast search are used.

C. Color Transfer to Grayscale Partial Image

Assigning colors to the group of grayscale pixels is nothing but color transfer. If the color palette is generated using RGB color space the grayscale pixels will be getting R, G and B color components directly assigned to them. If color palette is generated using Kekre's LUV color space, the grayscale pixels will be getting their L, U and V components which should be converted to R, G and B to get colored image.

D. Color Transfer using RGB Palette

The Red, Green, Blue component values from best match palette entry are copied to the target image array as respective pixels Red, Green, Blue component values. All these Red, Green, Blue intensity values are then transferred back Red, Green and Blue planes of target image at respective pixel window positions. Thus the target image is constructed using these pixel windows as a color image with Red, Green and Blue planes.

E. Color Transfer using Kekre's LUV Palette

The L, U, V component values from best match palette entry are copied to the target image array as respective pixels L, U, V component values.

Then the L values are multiplied by 3. All these L,U and V intensity values are then transferred back L, U and V planes of target image at respective pixel window positions. Using LUV to RGB transformation matrix the Red, Green and Blue planes of colored target image are obtained and thus the target image is constructed using these pixel windows as a color image with Red, Green and Blue planes.

F. Correction of Geometric Deformations

Partial images may differ in the size because of camera resolutions if are taken by different cameras [26]. This different sizing of partial images should be removed using scaling techniques [26],[27]. While capturing the photo parts for panoramic view generation the camera may get tilted slightly this may cause rotation anomalies in the parts [21]. 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 from [21] can be used with overlap estimation techniques.

G. Overlap Estimation

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 [19],[25],[26] 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.

H. Stitching Partial Images

Using the estimated overlap information the partial images are stitched to get panoramic view. Two consecutive partial images are considered in one pass for stitching. The result image after stitching of all partial images gives color panoramic view.

III. COLOR PALETTE GENERATION

Color palette can be generated using RGB color space or using Kekre's LUV color space.

A. Color Palette using RGB color space

The colored partial images are converted into grayscale images. The colored and grayscale equivalent images are then divided into the pixel windows of size MxN. Every window is represented as array of grayscale intensity values and respective Red, Green, Blue component values of inclusive pixels. This array is referred as the color palette which is used to squirt colors in target grayscale image part.

B. Color Palette using Kekre's LUV color space

Here the very first step is to transfer RGB components of source color image into respective Kekre's LUV color components. Then these LUV color components are considered for color palette generation.

The colored source image is converted from TGB to Kekre's LUV color space. As component L is addition of R, G and B, instead of converting the image into grayscale L component is divided by 3. The source images are then divided into the pixel windows of size MxN. Every window is represented as array of L, U and V values of inclusive pixels. This array is referred as the color palette which is used to squirt colors in target grayscale image.

IV. SEARCH IN COLOR PALETTE

For searching the best possible source color palette match of grayscale windows searching is needed. Here we have used exhaustive search which is computationally heavier. Then we tried with Kekre's fast search which computationally is lighter but at the cost of poor quality of colored target images.

A. Exhaustive Search

Here the MSE value is computed of grayscale target pixel window in color palette from first record to last record. Wherever the MSE value is lowest that is considered to be best match. Thus for every pixel window of grayscale target image all the records in color palette are considered in exhaustive search.

B. Kekre's Fast Search

Color palette is sorted with respective to every grayscale value column of source image. Thus the columns of MxN window size color palette are sorted first with respect to grayscale intensity value of pixel (1,1) of every window, then the color palette is divided into two parts upper and lower. The upper part is sorted w.r.t pixel (1,2) and divided into two subparts. Even the lower part is sorted w.r.t pixel (1,2) and divided into two subparts. This process is repeated till pixel (M,N).

While searching the grayscale target window match in color palette, the first grayscale target window pixel i.e pixel (1,1) is compared with the source grayscale pixel (1,1) at the center of palette. If source pixel value is greater the search should be done in first half else in later half. Then the search limits are minimized by repeating these steps for grayscale target pixel (1,2), pixel(1,3),…till pixel(M,N).

V. Color Transfer to Grayscale Partial Images

Coloring of grayscale partial images depends on the method of color plank generation. Color transfer using RGB and using Kekre's LUV color spaces are given below.

A. Color Transfer using RGB Palette

The Red, Green, Blue component values from best match palette entry are copied to the target image array as respective pixels Red, Green, Blue component values. All these Red, Green, Blue intensity values are then transferred back Red, Green and Blue planes of target image at respective pixel window positions. Thus the target image is constructed using these pixel windows as a color image with Red, Green and Blue planes.

B. Color Transfer using Kekre's LUV Palette

The L, U, V component values from best match palette entry are copied to the target image array as respective pixels L, U, V component values. Then the L values are multiplied by 3. All these L,U and V intensity values are then transferred back L, U and V planes of target image at respective pixel window positions. Using LUV to RGB transformation matrix the Red, Green and Blue planes of colored target image are obtained and thus the target image is constructed using these pixel windows as a color image with Red, Green and Blue planes.

VI. Stitching Partial Images

The fusion is categorized as fusion of 'color with color partial image' and that of 'color partial image with colored-grayscale partial image'. For both cases the number of columns in seascape image will be….

The number of columns in Seascape Image =
(Number of columns in left part image) +
(Number of columns in right part image) –
(Number of common columns in both image parts)

A. Color with Color Partial

Here the panoramic view is constructed by directly copying the non overlapping portions of left part image and right part image as it is. For the overlapping region the average intensity values of the common pixels in left and right part are taken as the respective pixel values in the seascape image.

B. Color Partial with Colored Grayscale Partial

Here the seascape image is formed by directly copying the non overlapping portions of left part image and right part image as it is. For the overlapping region the intensity values of the common pixels in color image are taken as the respective pixel values in the seascape image. This improves the quality of colors in the seascape image.

VII. Coloring Quality

As the process of coloring grayscale image is very subjective to the target image and source color image, the objective criteria to measure the quality of colored target image cannot be considered. At the most we can convert some color image into grayscale image and then recolor it using source as same original color image. Then the Mean Squared Error (MSE) difference of re-colored image with original one could be considered to compare the proposed algorithms with each other

VIII. Experimental Results

For coloring the grayscale partial images, four methods are discussed in the paper. The RGB and Kekre's LUV color spaces are compared for the quality of the coloring. Also exhaustive search and Kekre's fast search are compared for the speed of coloring the grayscale partial image. The method s discussed in paper were implemented in MATLAB 7.0 and tested on Intel Core 2 Duo T8100 processor with 2 GB RAM.

Fig.1 shows the color images converted into grayscale equivalent and then colored using the following methods.

i. RGB-ES (RGB color space and Exhaustive Search),
ii. RGB-KFS (RGB color space and Kekre's Fast Search),
iii. LUV-ES (LUV color space and Exhaustive Search),
iv. LUV-KFS (LUV color space and Kekre's Fast Search).

Table I shows the mean squared error in the original color image and the colored image using respective color spaces and searching methods. Table II shows the time needed to color the target grayscale image using color source. Results shown in Fig.1 and the statistical data from table I proves that the quality of coloring is best in LUV-ES than that of RGB-ES and other methods. It also shows that the quality of coloring is better in exhaustive search than Kekre's fast Search.

International Journal of Information, Control and Computer Sciences
ISSN: 2517-9942
Vol:2, No:5, 2008

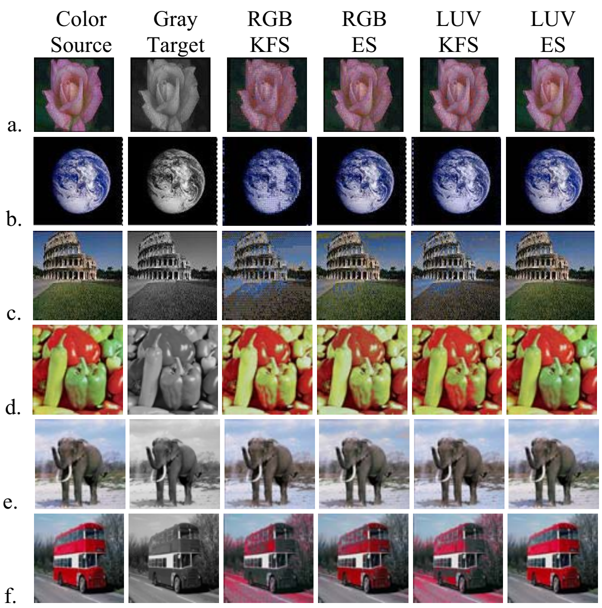


Fig. 1. Colored target gray images for comparing the coloring techniques LUV-ES, LUV-KFS, RGB-ES, RGB-KFS

TABLE I
QUALITY COMPARISON OF DISCUSSED COLORING TECHNIQUES

Image	Size	Mean Squared Error			
		RGB KFS	RGB ES	LUV KFS	LUV ES
Rose	85x90	1579.5	238.2	1508.6	17.1
Earth	96x96	5419.7	137.3	4639.3	8.1
Roman Coliseum	72x96	5083.8	379.9	5038.3	8.4
Peppers	256x256	4655.9	2749.8	4523.0	37.73
Elephant	256x256	1960.8	224.9	1900.8	15.1
Bus	256x256	8585.1	1285.9	8352.4	13.9

TABLE II
SPEED COMPARISON OF DISCUSSED COLORING TECHNIQUES

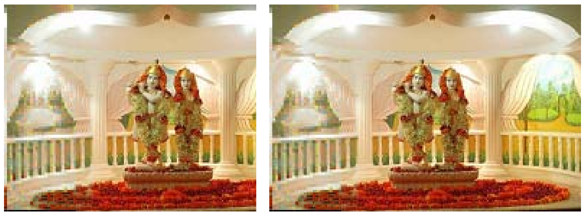
Image	Size	Elapsed Time Needed in Coloring (in ms)			
		RGB KFS	RGB ES	LUV KFS	LUV ES
Rose	85x90	0.37	4.74	0.33	4.76
Earth	96x96	0.47	7.01	0.45	6.99
Roman Coliseum	72x96	0.34	3.99	0.29	3.93
Peppers	256x256	11.59	401.98	60.40	433.79
Elephant	256x256	10.47	406.27	60.33	426.43
Bus	256x256	10.83	392.09	58.56	431.17

In Fig.2 three parts of Shree RadhaKrishna Seascape are given as 2.a where first part is grayscale. This part is colored using proposed technique as shown in 2.b and then using Mean Square Method of image fusion the seascape is formed as given in 2.c and 2.d.

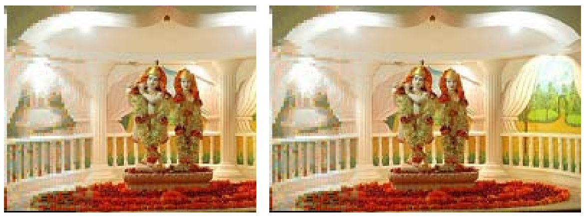
a. Set of partial images of seascape

ES KFS

b. Coloring of Grayscale part



c. Seascape from 3.a and 3.b colored using ES



d. Seascape from 3.a and 3.b colored using KFS

Fig. 2. Shree RadhaKrishna Panoramic View Formation using Mean Suared Error Method of fusion

Fig. 3.a and 3.b the medley of partial images for roman coliseum panorama, where Fig. 3 b is grayscale and the other part is color image. So for generating color panorama second part is colored using LUV-ES method using color source as Fig. 3.a.

a. Color First Part

b. Grayscale Second Part

c. Colored Second Part   d. Color Panoramic view

Fig. 3. Color Panorama Making for Roman Coliseum

Fig. 4 gives the set of partial images as 4.a, 4.b and 4.c. The color plank is prepared using colors from partial images 4.a and 4.b, then Fig 4.c is colored. Fig 4.d shows stitched color parts and 4.e shows colored 4.c. The final panorama is generated by stitching 4.d and 4.e.

a. First Part   b. Second Part   c. Third Part

d. partial Panorama   e. Colored Third Part

e. Seaview Panorama

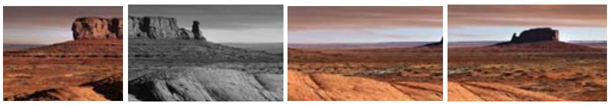
Fig. 4. Color Seaview Panorama Making using color and gray partial images

Fig.5.a. and Fig.6.a. are medley of partial images where some of these are grayscale. The gray parts are colored using the colors from color parts. Finally color panorama are generated.

a. Medley of partial images for tribal people panorama

b. Colored Part   c. Color Panoramic view of Tribal People

Fig. 5. Color Panoramic View using color and gray partial images of Tribal People



a. Medley of partial images for tribal Desert panorama

b. Color Panoramic view of Desert

Fig. 6. Color Panoramic View using color and gray partial images of Desert

IX. Conclusion

Panoramic view generation is the fusion of plenty of small images to create one large image consisting of bigger view contained individually in those smaller images.

The paper has presented simple, computationally light and easier techniques for color traits transfer to grayscale partial images by using the colors of color partial images. For improvement in searching time Kekre's fast search is used. Global color transfer does not have adequate spatial consideration, so it cannot avoid the problem that if the source or target image contains different color regions, the global transfer cannot distinguish the different statistics and will mix regions up. As the color traits transfer technique is highly subjective, the quality of colored image can not be expressed by any objective criteria. But the quality of coloring can be improved using Kekre's LUV color space.

The Overlap estimation is one of the very important steps in seascape formation. The overlap estimation techniques based on the principle of Correlation Coefficient, Mean Square Error, are used to find the common region among the partial images. Using these Estimation Parameters, the extent of the common region can be accurately determined. Finally the partial images can be fused using stitching step and color panorama can be constructed.

X. Future Scope

The color palette is generated using the color partial images of the same panoramic view. Further the images could be classified into categories and for every category the attempts could be made to generate global standard palette.

The quality of the coloring is proved to be better if Kekre's LUV color space is used than using RGB color space. Further testing the methods for different color spaces could be future direction. Also the patches considered for palette generation could vary in their shape and size. So the patch size and shape could be related to the quality of coloring.

REFERENCES

[1] T. Welsh, M. Ashikhmin, and K. Mueller, Transferring color to grayscale images," *ACM TOG*, vol. 20, no. 3, pp. 277–280, 2002.

[2] E. Reinhard, M. Ashikhmin, B. Gooch, and P. Shirley, "Color transfer between images," *IEEE Computer grahics and applications*, vol. 21, no. 5, pp. 34–41, September/October 2001.

[3] D. L. Ruderman, T. W. Cronin, and C. C. Chiao, "Statistics of coneresponses to natural images: implications for visual coding,", *J. Optical Soc. Of America*, vol. 15, no. 8, pp. 2036–2045, 1998.

[4] A. A. Efros and T. K. Leung, "Texture synthesis by nonparametric sampling", In *International Conference on Computer Vision*, pages 1033–1038, Corfu, Greece, September 1999.

[5] Rafael C. Gonzalez & Paul Wintz, "Digital Image Processing", Addison-Wesley Publications, May, 1987.

[6] A. Hertzmann, C. E. Jacobs, N. Oliver, B. Curless, and D.H. Salesin, "Image analogies", In *Proceedings of ACM SIGGRAPH,* pp. 341- 346, 2002.

[7] SILBERG, J., Cinesite Press Article, 1998. http://www.cinesite.com/core/press/articles/1998/10_00_98- team.html

[8] Pratt, W. K. "*Digital Image Processing"*, John Wiley & Sons, 1991.

[9] Dr.H.B.Kekre, Sudeep D. Thepade, "Image Blending in Vista Creation using Kekre's LUV Color Space", In SPIT-IEEE Colloquium, SPIT Mumbai, INDIA, Feb 4-5,2008.

[10] Anat Levin, Dani Lischinski, Yair Weiss, "Colorization using optimization", ACM Transaction on. Graphics, 23(3):689–694, 2004.

[11] G. R. Greenfield, D. H. House, "A Palette-Driven Approach to Image Color Transfer", Computational Aesthetics in Graphics, Visualization and Imaging ,2005.

[12] Tongbo Chen, Yan Wang Volker Schillings, Christoph Meinel, "Grayscale Image Matting And Colorization", In Proceedings of ACCV-2004, Jan 27-30, 2004, Korea.

[13] Y. Y. Chuang, A. Agarwala, B. Curless, D. Salesin, and R. Szeliski, "Video matting of complex scenes," ACM Transaction on Graphics, vol. 11, no. 4, 2002.

[14] A. R. Smith and J. F. Blinn, "Blue screen matting," in *Proceedings of ACM SIGGRAPH*, 1996, pp. 259–268.

[15] Karl Rasche, Robert Geist, James Westall, "Re-coloring Images for Gamuts of Lower Dimension", EUROGRAPHICS , Volume 24 , Number ,2005.

[16] Stone M. C., Cowan W. B., Beatty J. C., "Color gamut mapping and the printing of digital color images", ACM Transactions on Graphics, Vol.7-No.4 Oct.1988.

[17] Luiz Filipe M. Vieira, Rafael D. Vilela, Erickson R. do Nascimento, "Automatically choosing source color images for coloring grayscale images", In Proceedings of the XVI Brazilian Symposium on Computer Graphics and Image Processing (SIBGRAPI'03), 2003.

[18] P.R. Wolf, "Elements of Photogrammetry", McGraw-Hill, Second edition, 1983.

[19] Dr.H.B.Kekre, Sudeep D. Thepade, "Approaches of Overlap Estimation in photo parts for Panorama making",In Proc. of IEEE International Conference on Advances in Computer Vision and Information Technology (ACVIT-07), 28 -30 Nov. 2007., Held at Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. MS-INDIA.

[20] Dr.H.B.Kekre, Sudeep D. Thepade, "New Methods of Image Stitching", National Conference on Applications Digital Signal Processing (NCDSP – 2007), 19-20 Jan 2007, held at FCRCE, Bandra (W), Mumbai.

[21] Dr. H.B.Kekre, Sudeep D. Thepade, "Rotation Invariant Fusion of Partial Image Parts in Vista Creation using Missing View Regeneration", WASET International Journal of Electrical, Computer, and Systems Engineering (IJECSE),Vol. 2, No.2, Spring 2008,www.waset.org/ijecse.

[22] Dr.H.B.Kekre, Sudeep D. Thepade, "The Algorithm for Fusion of Color and GrayscalePartial Imagesin Seascape Formation", National Conference on Algorithms (NCA – 2008), held at FCRCE, Bandra (W), Mumbai.

[23] Dr.H.B.Kekre, Sudeep D. Thepade, « Color Traits Transfer to Grayscale Images », IEEE International Conference on Emerging Trends in Engineering and Technology (ICETET-2008), held at G. H. Raisoni College of Engineering,, Nagpur, INDIA.

[24] Dr. H.B.Kekre, Sudeep D. Thepade, "Boosting Block Truncation Coding with Kekre's LUV Color Space for Image Retrival", WASET International Journal of Electrical, Computer, and Systems Engineering (IJECSE),Vol. 2, No.3, Summer 2008,www.waset.org/ijecse.

[25] Dr. H.B.Kekre, Sudeep D. Thepade, "New Methods of Image Stitching", In Proc. of National Conference NCDSP 2007, FCRCE, Bnadstand, Bandra(w), Mumbai.

[26] Dr.H.B.Kekre, Sudeep D. Thepade, "Scaling Invariant Fusion of Image Pieces in Panorama Making and Novel Image Blending Technique", International Journal of Imaging (IJI), Issue 1, Volume 1, 2008.

[27] Dr.H.B.Kekre, Tanuja K. Srode, Sudeep D. Thepade, "Grid Based Image Scaling Technique", International Journal of Computer Science and Applications(IJCSA), Issue 1, Volume 1, 2008.

[28] F. Nielsen, "Randomized Adaptive Algorithms for Mosaicing Systems", IEICE Trans. of Inf. & Syst., Vol.E83-D, No.7, July 2000.

[29] H. Y. Shum and R. Szeliski, "Panoramic Image Mosaics", Technical Report, Microsoft Research, 1998

[30] M. Massey and W. Bender, "Salient Stills: Process and Practice", IBM Systems Journal, Vol.35, No.3&4, 1996.

[31] M. Irani, P. Anandan, J. Bergen, R. Kumar, and S. Hsu, "Mosaic Representations of Video Sequences and Their Applications", Signal Processing: Image Communication, Special Issue on Image and Video Semantics: Processing, Analysis, and Applications, Vol.8, No.4, 1996.

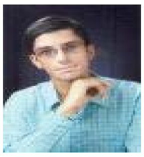
[32] J. Assfalg, A. Del Bimbo, and M. Hirakawa, "A Mosaic-based Query Language for Video Databases",Proc., IEEE Symposium on Visual Languages, 2000.

[33] M. Petrou and P. Bosdogianni, "Image Processing The Fundamental", John Wiley & Sons, 1999.

[34] Yang Linhong, Masahito Hirakawa,"A Stitching Algorithm of Still Pictures with Camera Translation", In Proc.of the First International Symposium on Cyber Worlds (CW.02),2002.

AUTHOR BIOGRAPHIES

Dr. H. B. Kekre has received B.E. (Hons.) in Telecomm. Engineering. 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 of Electrical Engg. and then HOD Computer Science and Engg. at IIT Bombay. For last 13 years worked as a Professor in Department of Computer Engg. at Thadomal Shahani Engineering College, Mumbai. He is currently Senior Professor working with Mukesh Patel School of Technology Management and Engineering, NMIMS University,Vile Parle(w), Mumbai, INDIA. His areas of interest are Digital Signal processing and Image Processing. He has more than 210 papers in National / International Conferences / Journals to his credit. Recently five students working under his guidance have received best paper awards.



Sudeep D. Thepade has Received B.E .(Computer) degree from North Maharashtra University with Distinction in 2003. M.E. in Computer Engineering from University of Mumbai in 2008 with Distinction, currently Perusing Ph.D. from SVKM's NMIMS University, Mumbai. He has more than 06 years of experience in teaching and industry. He was Lecturer in Dept. of Information Technology at Thadomal Shahani Engineering College, Bandra(w), Mumbai for nearly 04 years. Currently working as Assistant Professor in Computer Engineering at Mukesh Patel School of Technology Management and Engineering, NMIMS University, Vile Parle(w), Mumbai, INDIA. His areas of interest are Image Processing and Computer Networks. He has 28 papers in National/International Conferences/Journals to his credit with a Best Paper Award at International Conference SSPCCIN-2008.