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An Improved Approach for Document Image Mosaicing

Mousumi Saha* Asst. Professor, Dept. of CSE Narula Institute of Technology, India

Mainak Chakraborty Asst. Professor, Dept. of CSE Dream Institute of Technology, India

Tamasree Biswas Asst. Professor, Dept. of IT Narula Institute of Technology, India

Abstract— Now a day many advanced devices are available to perform scanning operation of document images. But sometime those devices fail to scan a large document like newspaper in a single exposure. Here we present a simplest technique to troubleshoot this type of problems. Our proposed method is fully automatic and work properly against any type of document image. Using this technique the large document is captured in parts and mosaicing stitches them into a single image. Mosaicing is performed by pixel value matching of two split images which gives the overlapping region between them. The algorithms are tested on different types of complex document images and we get the desired results.

Keywords— Unidirectional scanning, Bidirectional scanning, Overlapping region, Mosaic image, Split image

I. INTRODUCTION

Today there are many advanced technique used for solving user requirement. For scanning operation devices like scanner, fax machine etc are used, but the disadvantage of those devices is original copy need to scan again if another copy of the document is required. Common examples found in offices are variations of the *scanner* where the document is placed for scanning. *Hand-held scanners*, mainly designed for electronics manufacturers, shopping mall and various types of product manufacturers who need to scan small or high density bar code to maintain their stock, where the device is operate by hand. In case of 3D scanners it first analyzes the object to collect shape and color to construct three dimensional digital model used for entertainment industry, reverse engineering, test and measurement, gaming and other applications. Mechanically driven scanners that move the document is typically used for large-format documents, where a flatbed design would be impractical.

Now a day's scanners use a charge-coupled device (CCD) or a Contact Image Sensor (CIS) as the image sensor. As image sensor a photomultiplier tube is used in old *drum scanners*. For high-speed document scanning *rotary scanner* is used, that is nothing but a drum scanner, instead of a photomultiplier it uses a CCD array. Other types of scanners are planetary scanners, which take images of books and documents, and for producing three-dimensional models of objects 3D scanners are used. Another category of scanner is digital camera scanners, which are based on the concept of reprographic cameras. Digital cameras have become an attractive alternative to regular scanners due to increasing resolution and new features.

An *image* is a 2D matrix such as a photograph, screen display whose rows and columns indices the position of a point, called pixels. They are *captured* by optical devices and natural objects like human eye or water surface. *Image processing* is a type of signal processing where an image is transformed to either an image or a set of characteristics related to the image after the computation.

Still it is impossible to capture a whole image in a single scan .For this reason the large image splits in different part, by scanning the original image part by part. To get the original image first analysis the split images and then mosaic the split images. This process is known as image mosaicing. Image mosaicing can be classified into direct methods and feature based methods. For mosaicing large overlapping regions , small translations and rotations direct methods are useful. In the other hand for small overlapping regions feature based methods are useful.

A *Document* is a physical or digital demonstration of information designed with the ability to communicate. A *Document* is also understood as a paper object containing information in the form of ink marks. *Document mosaicing* is one of the most essential steps for automatically regenerating ripped-up documents. In our work, we consider only two images to get the original mosaic image.

The rest of this paper is organized as follows. In Sections II we describe related work and provide some background on traditional image mosaicing. Section III presents my technique for creating document image mosaics. In section IV, we describe the experimental results. Section V concludes with areas for future work.

II. REVIEW OF PREVIOUS WORK

Many special techniques for document image mosaicing have developed till now. To capture large utility maps Szeliski (1996) proposed to use of flat bed scanners to[2]. The method selects the control points in different utility maps to find the displacement required for shifting from one map to the next. These control points are found from the pair of edges common to both the maps. However, the process requires human intervention to mask out the region not common to both the split images in image mosaicing.

I. Zoghlami,O. Faugeras,R. Deriche (1997) have presented a method to compute the homography between two images, with any rotation around the optical axis and a large zooming factor [3]. The method relies on finding geometric features, which contain more information than simple points. Which reduced the complexity of the matching between image features and hence to tackle more difficult cases than with points based methods.

Whichello & Yan (1998) have presented a successful method of automatically mosaicing document images taken with a low cost digital camera and they have also successfully used the same method with images captured using a small flatbed scanner[5]. They used an image pyramid and a form of correlation, namely summing XORS of pixel values to speed up the process. To reject misleading solutions in the correlation, They make use of *a priori* knowledge of image placement and overlap. A template-matching procedure is used to search for the ORs present in the split document images. Usually, the template-matching procedure is a time-consuming method. In addition, this approach assumes that the printed text lies on straight and horizontal baselines, which is not always possible in many pragmatic applications.

B. Rousso, S. Peleg,I. Finci,A. Rav-Acha (1998) have presented a pipe projection which enables to define high-quality mosaicing even for the most challenging cases of forward motion and of zoom[4]. In addition, view interpolation, generating dense intermediate views, is use to overcome parallax effects.

A. Zappala, A. Gee, and M. J. Taylor (1999) have worked on document image mosaicing (DIM)[6]. They have shown how it is possible to obtain high resolution images of whole documents using standard CCD cameras. The process is robust, quick and fully automated, and the quality of the resulting images is sufficient for OCR or printing . The overall system provides a flexible, convenient alternative to the flat-bed scanner. As it stands the system relies on the document containing predominantly text and are prone to failure in case of general documents containing pictures. However, in practice, a typical document contains text, pictures and tables.

Jian Liang,D. DeMenthon,D. Doermann (2005) have proposed a robust method of extracting texture flow fields from textual area, a novel approach for projected ruling detection and vanishing point computation, and the usage of texture flow fields and projected rulings to recover the surface and it does not require a calibrated camera[7]. The proposed system is able to process images of document pages that form general developable surfaces, and can be adapted for typical degenerated cases: planar pages under perspective projection, scans of thick books, and cylinder shaped pages of opened books.

Jian Liang, Daniel DeMenthon and David Doermann (2006) have implemented a framework for mosaicing camera-captured document images to reconstruct a full page image [8]. Their two-step image registration method can align document images with as little as 10% overlap and severe perspective distortion. They also propose an image blending method that is optimized for document images, which addresses the inconsistent lighting, 'ghost' image, and varying sharpness problems. So the framework relies on accurately computing the projectivity between any two document images with an overlapping area as small as 10%.However, the overlapping region of two images may be more than 10%.

T Kasar and A G Ramakrishnan (2007) have presented a new feature-based approach for mosaicing of camera-captured document images [10]. A novel block-based scheme is employed to ensure that corners can be reliably detected over a wide range of images. 2-D discrete cosine transform is computed for image blocks defined around each of the detected corners and a small subset of the coefficients is used as a feature vector. A 2-pass feature matching is performed to establish point correspondences from which the homography relating the input images could be computed.

J. Hannuksela, P. Sangi, J. Heikkila,Xu Liu,D. Doermann (2007) have presented a new technique for creating document image mosaics with mobile phones[9]. The images are capture with the help of device motion estimation and user interaction. The captured images are automatically stitched with good quality and high resolution.

Heeseung Choi, Kyoungtaek Choi, Jaihie Kim (2010) have presented a novel touchless fingerprint sensing device which covers three views of a fingerprint and a method for mosaicing these images to expand the effective area of a fingerprint[11]. The device is composed of a single camera and two flat mirrors and it offers an alternative to an expensive multiple-camera-based system.

The main problem in image mosaicing is the problem of determining how the pixels in an overlapping area should be represented. As per D.L. Milgram, finding the best separation border between overlapping images has the potential to eliminate remaining geometric distortions [1].

III. PROPOSED METHOD

Here we present a simple technique to mosaiced image using two split images. This technique removes all drawbacks mentioned above. The main motivation of this technique is to find the overlapping region between two split images. The objective of this paper is attained by comparing all row pixels values of two split images. Here it is considered that the overlapping region exist between bottom end of first image and the top end of second image. All the comparison done row wise so the worst case complexity O (m^2) where m is the number of rows in the split images.

A. Unidirectional scanning

This section represent an algorithm, which takes two split images as input and produce the original mosaic image. The algorithm compares all pixel values of first image with all pixel values of second image starting from top to bottom. If the whole row matches then the pointer *i* (represents the row of two split images) incremented by one in both images. If the whole row does not match then the pointer *i* of first image is incremented by one but the pointer *i* of second image remains unchanged. This procedure is repeated till the overlapping region is found in the split images. The algorithm terminates when the pointer *i* of first image reach *m* (number of rows in the image).

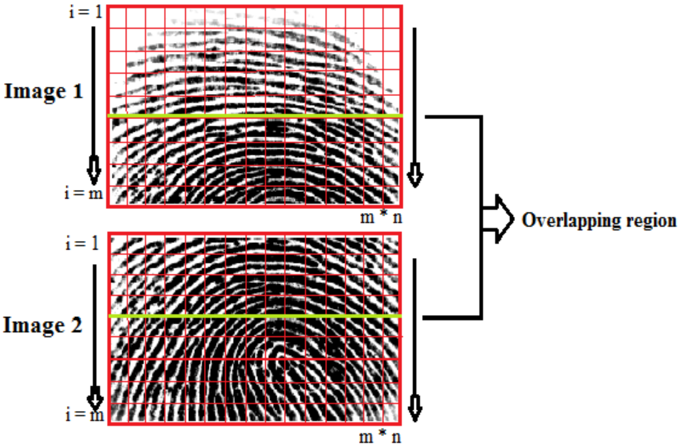


Figure 1: Mosaicing of two split images using Unidirectional scanning.

Algorithm 1: Topdown_mosaic(Image1 , Image2)

1. For each row *i:=1,2,3…m* of Image1 and Image2
   For each column *j:=1,2,3…n* of Image1 and Image2
   If (Image1[i,j]= Image2[i,j]) Then j:=j+1, in both Image1and Image2
   If whole row matches then Rowmatch:=true
   Else i:=i+1 in Image1 and, i and j of Image2 are again initialized to 0
   [i of Image2 remains in the first row but i of Image1 moves to next row]
   For end.
   If (j = n) and (Rowmatch = true) then i:=i+1 in both Image1 and Image2
   [If whole row matches then increment both the pointers in Image1 and Image2]
   For ends
2. If (i = m) and (Rowmatch = true) then Success:=true [Overlapping region is found]
   Else Success:=false [overlapping region is not found]
3. If Success=true then
   Join the images such that the overlapping regions of both images match with respect to their coordinates.
   Else no overlapping region exists

Algorithm 1 ends.

B. Bidirectional scanning

Here we present an algorithm that is nothing but an extension of algorithm1 but it uses block matching to find out overlapping region. This algorithm reduced the time complexity to get a mosaic image from split images.

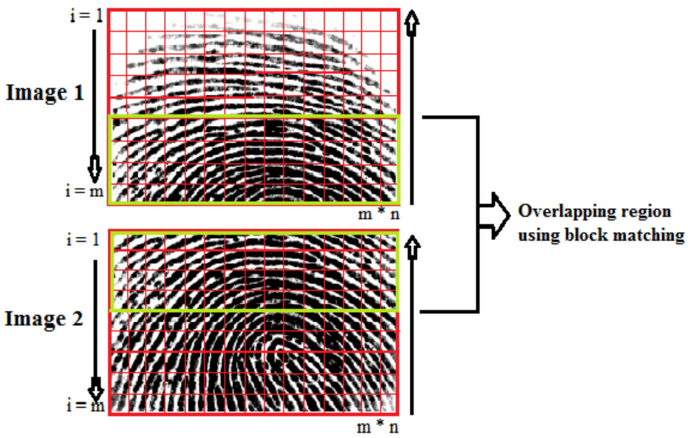


Figure 2: Mosaicing of two split images using Bidirectional scanning.

Algorithm 2: Topdown_Bottomup_mosaic(Image1 , Image2)

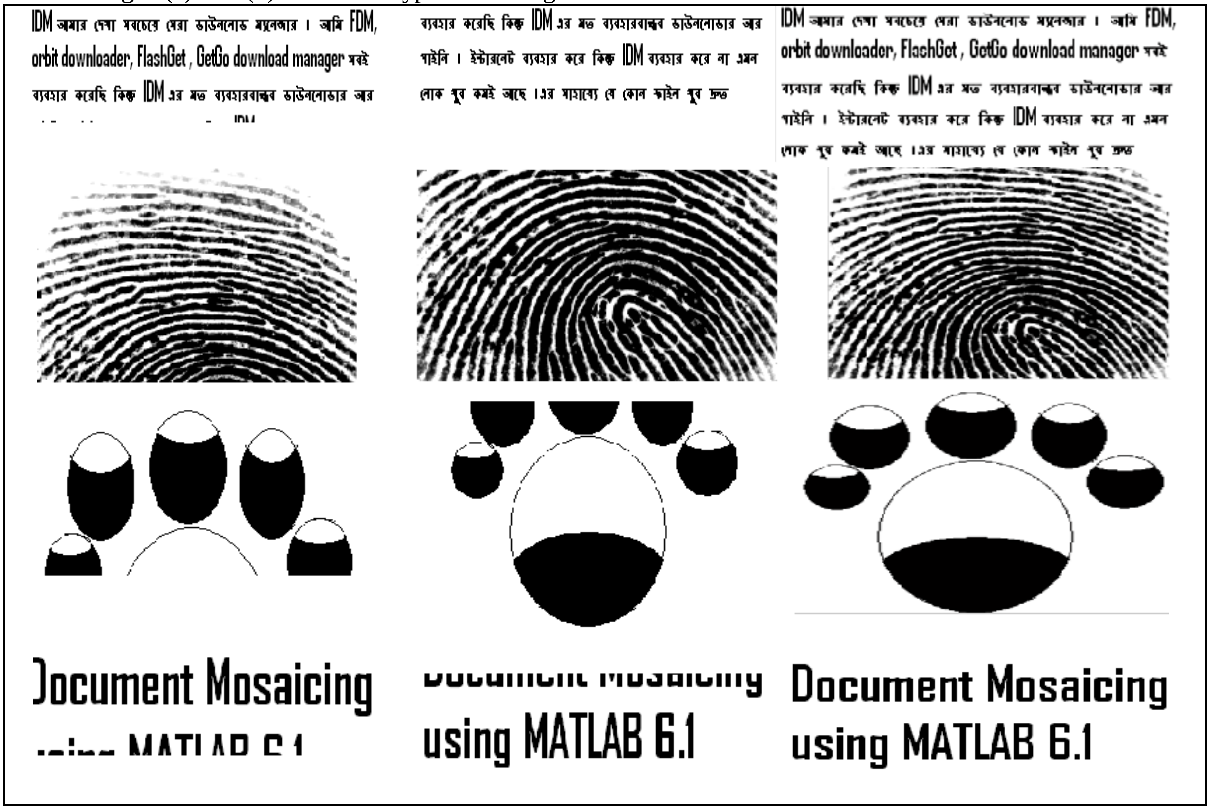
1. Determine the distance (D1) between the first row and the beginning position of overlapping region in Image1 by employing algorithm 1.
2. Determine the distance (D2) between the first row and the beginning position of overlapping region in Image1 by employing algorithm 1 and by changing pointer positions i and j of Image1 start from the m^{th} row in Image1, and i and j of Image2 starting from the m^{th} row of

Image2.
3. If (D2 < D1) then the D2th position is the beginning position of actual overlapping region in Image1.
4. Mosaic the split images.

Algorithm 2 ends.

IV. EXPERIMENTAL RESULTS

To demonstrate the performance of the algorithm, we used two split document images and checked that the proposed algorithm works for any type of document images. The process continues, building up a composite picture (c) from the individual images (a) and (b). Different types of testing result shown in below.



(a) (b) (c)

Figure 3: Document images. Where (a) & (b) is the split images and Figure (c) is the final mosaic image.

V. CONCLUSIONS

In order to retrieve the information lost due to the damage, the technique of mosaicing is employed where in much of work done so far in this field involves joining of the fragments using the overlapping method based on scanning each fragment of the ripped document individually. We have presented a simple yet effective technique for document image mosaicing that takes two split images as input. In our whole work we consider that the overlapping region exist between the bottom end of first image and the top end of second image. It works well for all types of document images. Some of the results are shown in Fig. 3. In all cases, the result is accurate. The major advantage of our work is that, the algorithm can be applied on all kinds of document images. The algorithm fail to mosaic curved document images. That is our future work.

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