An Approach to Reassemble Forensics and Archaeological Image Fragments into Equivalent Original Image

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Abstract—Reassembling of Image fragment problems arises in many scientific field like archeology, forensics and many others. To solve such a problem of reassembling of image fragments by human intervention takes a lot time. And sometimes it might be costlier. To overcome this problem, we are working on a system which will automatically reassemble those image fragments to form original image. With the help of 2D image fragment and contour detection algorithms we can make an efficient use of this system. Reassembling technique is divided into four types. Initially content based image retrieval system is used to identify spatially adjacent fragment. The second step is dynamic programming technique to identify matching contour segment. Third step is to identify optimal transformation to align matching contour segment and last step is overall image reassembling. With the help of these algorithms an optimal transformation in contour can be detected. Doing automation in such work will certainly help in faster, more efficient and patiently reassembling this image fragments.

Key words: Archeology, Contour, Dynamic Programming, Spatially Adjacent, Optimal Transformation

I. INTRODUCTION

As stated earlier the problem of reassembling of image fragments in scientific fields like archeology and forensic arises frequently. In excavation findings archeologist mostly finds image or painting fragments.

Also in forensic study, forensic experts come across various image, painting or some evidence which are split into various fragments and assembling such destroyed image or painting is a complicated task. It will also take a lot of time to reassemble fragmented image. Thus Automation of in this field is very important and can lead faster and more efficient reassembling of images and painting. To solve this problem, we have studied 2D image fragments and contour detection algorithms. The challenge of how to recover original image from fragments along with noisy information is executed using 2D image restoration technique.

In this paper, we are using four step models. First step is to identify spatially adjacent fragment in order to reduce the computational burden of subsequent steps. In this step several color-based techniques are employed which is implemented using content based image retrieval system (CBIR) technique. Then Second step is identification of matching contour segments. This step employs a neural network based color quantization approach to identify image contour which is implemented by dynamic programming technique, which use smith-waterman algorithm to identify matching image contour.

Once matching contour segments are identified, then third step came into action. In this step, the geometrical transformation takes place. In which best align two fragment contour are matched. This step is implemented using popular technique known as Iterative Closest Point (ICP) method. It reduces the effect of noise on the registration performance. The last step of reassembling problem is overall image reassembly of image fragments. This operation is performed by a novel algorithm. It employs both the contour matching results and the alignment angels of the fragments, achieved during second and third step respectively. As each step of algorithm depends on its previous step. Hence error in any step will affect reassembling of image at greater extent or may even fail completely. Our goal is to build most robust techniques in order to produce accurate results at each intermediate step.

II. LITERATURE REVIEW

A. Fast, Robust and Efficient 2D Pattern Recognition For Reassembling Fragmented Images:

In Fast, robust and efficient 2D pattern recognition for reassembling fragmented image⁴ paper, an important Italian art, split into thousand of fragments by allied bombing in second world war, was reassemble as original image implementing discrete Circular Harmonic expansion based on sampling theory. Because of rotation invariance properties and successful optical implementation, Circular Harmonic decomposition is used in pattern matching. The moments constructed by correlation of image with circular harmonic system is overall information, used for a complete comparison with another signal. They provided good results on small scale and local registration problem but still difficult to implement algorithms where feasible and reasonable compromise among robustness and location-rotation resolution can be realized on large scales.

B. Virtual Assembly of Pottery Fragments Using Moire Sur-Face Profile Measurements by Iqbal Marie, Hisham Qasrawi:

Reconstruction of archaeological monuments and potteries from fragments found at archaeological sites is a tedious task that requires many hours of work from archaeologists and restoration personnel. Excavations from famous archaeological sites in Jordan such as Petra, Jerash, Um Qeis, Ajlun etc. indicated civilization throughout centuries, from prehistoric periods, up to present. The restoration process is tedious and lengthy due to the mass of fragile fragments which consists of thousands of shreds found at excavation sites. An approach is the use of shadow moire experimental technique to obtain the 3D model of pots from 3D measurements of the surface profile using the photos captured. This method is a non-destructive optical technique used for visual surface inspection, and surface profile measurements. The approach is simple, requires minimal mathematical calculations and reduces the risk of frequent handling of the fragile sherds, because the photos can be
captured using a simple experimental setup in the site. Matching of fragments and aligning them geometrically is based on matching the profiles and edges of the broken parts virtually. This virtual assembly technique may assist the archaeologists as much as possible in solving their task with minimum time and minimum damages to fragments. The technique, of course, does not completely replace the archaeologist, but provides a useful estimation of valid fragment combinations, and accurately measures fragment matches. It also simplifies modeling the pots virtually using 3D-MAX modeling software to obtain the missing pieces.

C. Reconstruction of 2d Image Fragments, By Richa Mishra & Saurabh Tripathi:

Digital images may be considered as collection of pixels. If a single image is divided into more than one part, then these subparts are treated as fragments for an image. Joining of 2D fragments of an image means we have to reassemble these images fragments. The joining of fragments to reconstruct images and objects is a problem associated in several applications, like archeology, medicine, art restoration, and forensics. We mainly focused on 2D Image Reconstruction by joining two 2D fragments. This approach is based on the information generated from the boundary. Local curvature is calculated to obtain the lines in order to find the angle between them to rotate the second fragment. Based on the information of the boundary comparison is done to obtain maximum matching parts among fragments. Finally, longest matching parts can be joined to obtain single image. The techniques illustrated in this paper constitute the core of a more general method for reassembling n fragments we are developing.

D. Curve Matching for Open 2D Curves by P. Wonka, A. Razdan:

Given two curves as input, we seek to find what part of the first matches the best with a part or the whole of the second curve. This type of query is useful in many applications involving shape comparison. Example applications areas are computer vision, geospatial analysis and registration of images, computer aided geometric design, manufacturing, etc. this technique is also include whole part matching and part to part matching. After start points and end points on both curves have been decided, we can estimate the similarity transform between them using a well known method.

The first two columns show the percentage of correctly reassembled images, as described above, for the case of 10 fragments and 20 fragments, respectively. The last two columns show the respective mean computational time. The last row shows mean manually reassembly time efficiency (the performance of manually reassembly is not measured). Eight people of ages between 23 to 31 participated in this experiment. We have averaged the time needed for each person to correctly reassemble each fragmented image. As expected, the overall performance will be higher when the first stage is omitted. However, in this case the computation cost is higher, since both the second and the third step are executed for every couple of input image fragments. In the first case, where the the amount of fragments is somewhat small (10 fragments), the reassembly time efficiency is high in every case (with/without first step, manually reassembly). As the amount of fragments per input image increases, the time efficiency deviations become higher. Table 1 shows that the choice whether to employ the first step on the reassembly process depends on the computational cost that is associated within the input image fragments. As the amount of image fragments increases, the higher overall performance of the variation that omits the first step gives way to the higher computational cost that is associated with it. Fig. 9 displays aligned couples of image fragments produced during the second and the third stages. The overall reassembled image is shown in Fig. 8. It can be seen that its reconstruction is nearly perfect. The white region in the middle of the reassembled image is due to missing pieces of paper that were not scanned.

IV. STEPS AND ALGORITHM

A. Step 1:
In the first step we use Content Based Image retrieval Algorithm the motto of that algorithm is that we have to pop out our fragments in a image box. Google has been implemented that concept when we search and we type name of any animal and select in image category then what happens lots of images comes within a different different image boxes same like that one we also use that concept to retrieve our fragments.

B. Step 2:
In the Second step we use Smith - Waterman Algorithm is employed in order to match the colors appearing in the contours of adjacent image fragments. Various color similarity criteria are being evaluated. Based on such similarity criteria, for each image fragment, one matching contour segment with other image fragments is retained.

C. Step 3:
The purpose of this step is to find the appropriate geometrical transformation of one fragment relative to its adjacent one, in order to align them along their matching contour segments. Many variants of the ICP algorithm are employed and evaluated to this end.

D. Step 4:
In the last step of our module Once the matching contour segments of couples of input image fragments are identified and properly aligned, the remaining step is the reassembly of the overall image. Since the criteria that are based on the
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Contour matchings do not suffice for the overall image reassembly, a novel feature, namely the alignment angles found during step 3, is introduced.

V. SCREEN SHOT OF MODULE

Fig. 1: Startup GUI of the Tool

Fig. 2: Authentication and Authorization

Fig. 3: GUI Window

Fig. 4: Select Folder Popup Window

Fig. 5: Fragmented Are Inserted In Box.

Fig. 6: Fragmented Are Begin To Load.

Fig. 7: Contour Matched And Begin To Load

Fig. 8: Contour Matched and Loaded.
This paper presents various algorithms like CBIR (Content Based Image Retrieval System) for retrieving of images, Smith-Waterman Algorithm for finding out the contour and ICP for alignment of contour.

In this paper we started with the image pixel needs and what is pixel then we identified the algorithms that can be used for image retrieval in the system. We explained each algorithm with an effective and easy to understand example including the role each algorithm plays in the vital role in reassembling of images.

VII. REFERENCES

[4] Massimo Fornasier, Domenico Toniolo, ”Fast, Robust and efficient 2D pattern recognition for re-assembling fragmented images” 14 March 2005