

# Restoration of Digitized Image of Cracked Paintings -A Review

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**Abstract**— Old paintings are our cultural and historical heritage. There is a need to preserve them for our future generation. Old paintings are corrupted by many natural factors such as distinct weather conditions, dust, smoke etc. Old paintings affected by many problems like cracks. Cracks are most frequent occurs in the old paintings which are degraded the quality of painting. Wall paintings are no longer survived so it is necessary to preserve them. Several methods have been developed for detection and removal of cracks in digitized image of old paintings. I have reviewed various techniques which are used to restore old digitized images of old paintings.

**Key words:** Digital Image Processing, Digitized Image, Cracks, Nearest Neighborhood, Restoration

## I. INTRODUCTION

Many paintings, mainly old ones are suffer from cracks and other deformities. The painting materials like the paint, or the varnish are the most responsible factor for crack development in the old paintings. Cracks are developed by aging, drying, and mechanical factors in the old paintings. Age cracks can result from non-uniform contraction in the canvas or wood-panel which support and stresses the layers of the painting. Drying cracks are usually developed by the evaporation of volatile paint components and the consequent shrinkage of the paint. Finally, mechanical cracks result from painting deformations due to external causes, e.g. vibrations and impacts. The appearance of cracks on paintings are degraded the image quality. Digital image processing techniques are used to restore digitized images of paintings.

## II. LITERATURE SURVEY

Restoration of digitized painting image is a process of recover the original appearance of old paintings though image processing. Various technology and methodology are used for restoration of digitized image old paintings. Most frequently used algorithms for restoration of digitized image of old paintings -

“An inpainting system for automatic image structure-texture restoration with text removal”. In this paper Inpainting is a restoration technique that is used to repair damaged areas of digitized paintings by filling-in their missing areas and cracks. Inpainting technique is classified as structure inpainting and texture inpainting. Structure painting is basically is used to define main parts of images like boundaries, edges etc. Texture inpainting is only used to define text data printed on the paintings. In 2008 Pnevmatikakis, E. A., & Maragos, P.

“Image and pattern analysis of 1650 BC wall paintings and reconstruction”. In this paper Image segmentation technique is used to depict initial and region border extraction. In restoration process, all the initially

depicted Fragments are gathered, then clean each fragment in the lab, and reassemble each composition from its constituent fragments. Main motive of this process is to restore the reassembled wall paintings by detecting and filling in the missing parts. In 2008 Papaodysseus, C., Exarhos, M., Panagopoulos, M., Rousopoulos, P., Triantafillou, C., & Panagopoulos, T.

Morphological algorithm was proposed to detect missing areas and also incorporates edge information. In the case of cracks and small missing areas, finding their boundaries and grouping them is enough for their rough identification. To detect cracks morphological top- hat transformation. To fill these cracks the median or related filters in the neighbourhood of cracks are used.

“Digital restoration of painting cracks”. In this paper the authors have developed a method for the restoration of cracks. The local minima were detected by the top-hat transformation. In this paper two methods were used for filling the cracks, one was based on order statistics and another one was based on anisotropic diffusion. They remove the thin dark brush strokes, which were misidentified as cracks through the MRBF neural network. In 1998, Giakoumis, I., & Pitas, I.

“Digital colour restoration of old paintings”. This paper presented techniques for restoration of colour of old wall paintings. The various physical and chemical changes degrade the visual appearance of old paintings. For this purpose, the five colour restoration methods (Mean sample matching, linear approximation, ICP approximation, White point transformation, RBF approximation) were used to simulate the original appearance of paintings. All methods have small computational requirements. In 2000, Pappas, M., & Pitas, I.

“Digital image processing in painting restoration and archiving”. This paper presented three applications of image processing. First was crack restoration of old paintings. Second was colour restoration of wall paintings and third was mosaicing of partial images of works of art painted on curve surface. Crack detection was done by morphological top- hat transformation. Crack filling was done by applying the median or related filters in the neighborhood of cracks. A digital achieving system was also described in this paper. In 2001, Nikolaidis, N., & Pitas, I.

“Contour-shape based reconstruction of fragmented, 1600 B.C. wall paintings”. In this paper a methodology is introduced for the reconstruction of the wall paintings of Greek island Thera (Santorini) which were painted in the middle of the second millennium B.C. According to this each fragment was photographed, its picture was introduced to the computer, its contours were obtained and all of contour fragments were compared. In 2002, Papaodysseus, C., Panagopoulos, T., Exarhos, M., Triantafillou, C., Fragoulis, D., & Doumas, C.

“Identification of geometrical shapes in paintings and its application to demonstrate the foundations of geometry in 1650 BC”. The aim of this paper was to introduce an original general methodology to determine whether a handmade shape corresponds to a given geometrical prototype. To achieve this, three mathematical criteria are introduced, two of them being of statistical nature and the other one being based on fuzzy logic. The application of these criteria to the very important Late Bronze age wall paintings, decorating the internal walls of an edifice excavated at Akrotiri, Thera, shows that the spirals depicted on these wall paintings correspond to linear (Archimedes) spirals with exceptional accuracy. In 2005, Papaodysseus, C., Exarhos, M., Panagopoulos, T., Triantafillou, C., Roussopoulos, G., Pantazi, A. & Doulmas, C.

“Image and pattern analysis of 1650 BC wall paintings and reconstruction”. In this paper colour image segmentation method and pattern analysis was used in connection with the extraordinary 1650 B.C. wall paintings of the Greek island of Thera. They used colour image segmentation methods to decay many problems and provide a very good approximation of the initial fragment depiction. Specific pattern matching techniques were used for the reconstruction of wall paintings. In 2008, Papaodysseus, C., Exarhos, M., Panagopoulos, M., Rousopoulos, P., Triantafillou, C., & Panagopoulos, T.

“An inpainting system for automatic image structure-texture restoration with text removal”. In this paper the authors deal with inpainting problem and with the problem of finding text in images. The main focus of this paper was combination of the inpainting techniques with the techniques of finding text in images. Simple morphological algorithm was used to link them. In this an automatic system is developed for text removal and image restoration that requires no user interface at all. In 2008, Pnevmatikakis, E. A., & Maragos, P.

“Determination of the method of drawing of prehistoric wall-paintings via original methods of pattern recognition and image analysis”. In this paper a method of construction of prehistoric wall painting was implemented. The approach consist of algorithms that perform pre-processing of the contours of the figures appearing in the wall painting, determination of patterns repetitions in the contours of the depicted entities, classification of these repeated patterns into proper geometric prototypes and curve fitting. In 2009, Rousopoulos, P., Arabadjis, D., Panagopoulos, M., Papaodysseus, C., & Papazoglou, E.

“Research on computer colour recovery system for traditional Chinese painting”. In this paper the authors developed manual and automatic computer Chinese painting’s colour recovery prototype system for the colour recovery of Chinese paintings by using the digital image processing technologies and implement the basic functions by using programming tools such as VC++ and GDI+. In this colour consistency problem is also resolved. Good colour consistency result in digital restoration was achieved. In 2012, Ding, H., & Ding, H.

“An integrated system for digital restoration of prehistoric Thera wall paintings”. They implemented an integrated system which restores missing parts of various sizes and shapes that appear in Thera wall paintings. In this, the missing area was stitched by applying the seam less

image stitching algorithm and the total variation in painting was used for area extraction and repair. The non-local inpainting mechanism was used for elimination of minor defects on the retrieved parts. The graph cuts were used for missing area with complicated boundaries. In 2013, Karianakis, N., & Maragos, P.

After reviewing the various techniques of old painting restoration. Making fragments of old painting is a time consuming and difficult task for image processing. Morphological algorithm detects only the cracks and missing area in the digitized image of old painting. To overcome these limitations a new algorithm is used for more improvement in the quality of digital old wall painting, which is considered by Sukhjeet Kaur, IJECS Volume 3 Issue 12 December, 2014 Page No.9581-9586 Page 9584 in which cracks and white spots are detected as well as removed and nearest neighborhood algorithm is improved by increasing the contrast and saturation. So the quality of the wall painting images can be improved.

### III. CONCLUSION

Restoration wall painting is a process of recover the wall paintings which are corrupted by many natural phenomena like unfavourable weather conditions, dust ,smoke etc. due to which the wall paintings affected by many problems like cracks. This paper present various techniques for restoration of wall paintings and their comparison on the basis of their use in different applications and their advantages. A number of digital image restoration techniques are used to recover the original appearance of the wall paintings but during this review I concluded that morphological processing is quite better as compared to other techniques. The advantages of Morphological algorithm are that, it is used to detect missing areas with complicated boundaries as well as incorporates edge information using iterated graph cuts. In future we are working on nearest neighbour algorithm with smoothing filters for the restoration of the wall paintings to detect and remove the cracks in the old paintings digitized image.

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