

# Image Inpainting System Model Based on Evaluation

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## **ABSTRACT**

*Image segmentation algorithm and inpainting algorithm are the key ingredients in the process of inpainting after studying many image-inpainting algorithms. Therefore, analyzing, comparing and verifying the segment algorithm and inpainting algorithms, the system model which owns segment and repair evaluation function is constructed, so it can optimize the segmentation algorithms and the inpainting algorithms; finally make the inpainting result better. There is segmentation module and inpainting module in the system model, the former is to segment damaged area, and the latter is to repair image. They adopt expert system, which extract image characteristics and optimize segmentation algorithms and inpainting algorithms by heuristic rules in the knowledge database, evaluate the result of the inpainting which can feedback the heuristic rules for selecting better algorithms, finally adopt the best segmentation and inpainting algorithm. System model synthesizes two key ingredients of segmentation and inpainting, so that it can enhance the inpainting effect, and that the system will be constructed actually need to further study and to carry out.*

## **KEYWORDS**

*Segmentation, evaluation, inpainting evaluation, image inpainting, inpainting model*

## **1. INTRODUCTION**

Digital image inpainting is an important issue in the domain of image restoration and an international interesting research topic in recent years, and it has different terminology names in different areas. For example, it is called error concealment in the signal transmission, and is called art inpainting in art inpainting etc. Now many image inpainting methods proposed, which are mainly two categories. One repairs small-scale damaged digital images, and the other repairs large-scale digital image through filling with image information [1-6]. Those inpainting methods which can repair different damaged image have their advantages, disadvantages and applied range. The inpainting result will be evaluated by inpainting evaluation method. The result of evaluation can analyze the advantages and disadvantages of inpainting method. In order to overcome the shortcomings of the objective evaluation, the inpainting result will be evaluated by subjective evaluation, which can analyze and judge the advantages and disadvantages of result using the people's visual. Because the segmentation result influences the inpainting result, so it is necessary that damaged regions are segmented before inpainting. Image segmentation has been used in different fields, and has many other names, such as object delineation, threshold technology, image discrimination, target detection, target recognition etc[7]. Image segmentation aims at extracting the interesting region of user and adopts different segmentation algorithms according to the actual needs. Now there is no universal segmentation algorithm, which can solve the entire image segmentation problems. The target region, which is the interested region to the

user, is damaged region for inpainting, so it is keystone and difficulty of segmentation looking for appropriate segmentation algorithms for segmenting damaged regions. The segmentation result will be evaluated by the segmentation evaluation methods; it can guide system segmentation to adopt appropriate segmentation algorithms [8]. For lacking of evaluation of segmentation and inpainting result, it is proposed that image inpainting system model based on evaluation in order to improve the system effect of inpainting [9, 10].

## **2. THE MODEL OF INPAINTING SYSTEM**

In the paper, it is proposed image inpainting system model based on evaluation. Evaluation is the key in the system model. The module of segmentation guides the system to adopt suitable segmentation algorithms, and the module of inpainting guides the system to adopt suitable inpainting algorithms. The evaluation of the segment result and inpainting result analyze the applicability of algorithms.

The structure of system inpainting module has shown in fig.1. In the system model, damaged regions are classified by subjective classification and objective classification. Subjective classification analyzes the characteristics of the damaged region, and the characteristics of damaged region can be further analyzed using people's knowledge. Damaged region 1, damaged region 2, ..., and damaged region n, among  $n \geq 1$ . Damaged region segmented will be classified smooth patch, texture patch, or edge patch by classifier [11]. Then inpainting module selects inpainting algorithms to repair image, when inpainting has been finished, the repaired image needs to be treated such as smooth process so the inpainting result of quality can be improved. The inpainting result needs to be evaluated by subjective evaluation and objective evaluation. In common, the method of subjective evaluation is visual evaluation, and the methods of objective evaluation are PSNR and chromatic aberration [12].

Subjective classification of damaged region, objective classification of damaged region (it is classed by classifier)[11], inpainting algorithms used, evaluation of segmentation and inpainting and so on, are putted into the characteristic information database. Available information can be got through analyzing the historical information in the database, which can help segmentation module to guide segmentation of damaged region, In addition, inpainting module also analyze the historical information in the database, that can help inpainting module guide selection of inpainting algorithms. Segmentation module and inpainting module are two important modules, they have ability of intelligent learning, and can adapt well to add different types of segmentation and inpainting algorithms, with the increasing of the segmentation and inpainting algorithms, the system proposed has more ability of inpainting.

## **3. THE RESULTS ANALYSIS**

The model of segmentation regions can segment the damaged regions of image by the classifier [11]. Expert system selects optimally segmentation algorithms using heuristic rules of system, so that the damaged regions can be segmented very well. If all of segmentation algorithms cannot segment well, there are two methods which can be tried: 1) First considering the manual pre-treatment, then damaged regions are segmented; 2) if the above method cannot work, the system need to consider adding some new algorithms to improve the ability of segmentation of system.

#### **4. THE MODULE OF INPAINTING**

Referring the contents of historical inpainting information, the module of inpainting guilds system to select optimal inpainting algorithms according to the category of damaged region. The module of inpainting gets some useful information by analyzing the historical inpainting information; which is about the applicability of inpainting algorithms and recommends optimal inpainting algorithms to the system or user. If the inpainting result obtains the high evaluation about subjective evaluation and objective evaluation, the inpainting algorithm can be provided to user, in order to improve the effect of inpainting [10].

#### **5. SEGMENTATION EVALUATION**

If the problems of the image segmentation are need to be solved, it is necessary to study how to evaluate image segmentation technique. In fact, in recent years the performance evaluation and comparison of the segmentation algorithms are paid widely attention to. Through studying the performance of segmentation algorithms, segmentation evaluation can reach the purpose of improving and enhancing the performance of existing algorithms, optimizing the segmentation, improving the segmentation quality and guiding how to study the new algorithms. There is a method which connects evaluation and segmentation, it combines artificial intelligence, constructs segmentation expert system which can generalize effectively the evaluation result of segmentation and establish the heuristic rules, thus the image segmentation process will go up to the stage which system can select segmentation algorithms automatically from the blind experimental improvement stage at present[8,13].

The image characteristics of input image are extracted the characteristic contains mainly targeted area, shape, roughness degree of contour and so on, they will inspire system to select rules, guild system to select optimal algorithms. Judging the result of segmentation can verify the consistency of heuristic rules designed, which is established by prior knowledge. Posterior knowledge of segmentation result will inspire new round inspired rules until heuristic rules can achieve consistency demand. This feedback process is a process which information is extracted and approached gradually. The selection of algorithms will be optimized step by step in the process, and finally the optimum result can be obtained, and also the optimal algorithm can be selected. Because the feedback is a process which data-driven approach can lead the self-adjustment of segmentation process, therefore it is a bottom-up process, and more quickly and easily. Because of the complexity of segmentation algorithms, evaluation knowledge of algorithms is constrained frequently by various factors, so it is necessary to require some heuristic knowledge sometimes which can add the rules of subjective understanding of segmentation performance in segmentation and evaluation process [14].

#### **6. IMAGE INPAINTING MODULE**

Image inpainting module is similar with image segmentation module. When the damaged regions are segmented, image inpainting module can guide system how to select inpainting algorithms in the inpainting knowledge database according to the characteristics of the damaged regions. The evaluation of the inpainting result is sent to the knowledge database and inpainting algorithms module, which can make inpainting algorithms selected repair the damaged region better. The evaluation result can be obtained by subjective evaluation and objective evaluation.

## 7. CONCLUSION

Aiming at the present condition of the field of digital image inpainting for lacking general algorithm to repair various damaged image, a new system model of image inpainting is proposed. The system contains many inpainting algorithms, avoids looking for a single "universal" inpainting algorithm, can select appropriate inpainting algorithms according to the characteristics of the damaged regions. In order to make more types of damaged images in different domains be repaired better, the evaluation of inpainting result can be used to guide system to select algorithm and help to construct Heuristic rules. Segmentation result influences the inpainting result, so it must be considered that damaged regions are segmented before inpainting. Segmentation module is added in the system, it guides user or system to select appropriate segmentation algorithms by analyzing the characteristics of the segmentation algorithms. The valuation of the segmentation result guides system to construct Heuristic rules, and select appropriate segmentation algorithms. Segmentation algorithms can be selected to segment damaged region better. The system proposed in the paper solves two problems: segmentation and inpainting. It is more general to guide segmentation and inpainting by the evaluation. The system will be constructed actually need to further study and carry out.

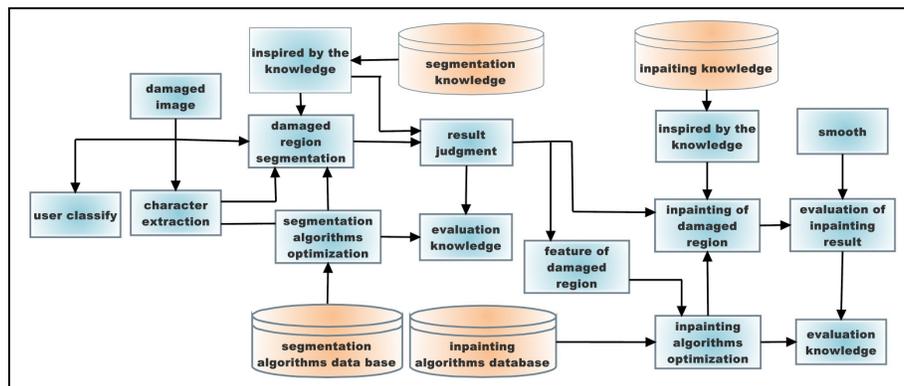


Figure 1. System model of inpainting with estimation and study integrated

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