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A Study of Iconographic Representations on Ratneswar Temple, Bhattabati and Digital Restoration through Image Inpainting Process

Hrishita Barman
Asst. Professor, Techno International Newtown
Email: hrishitabarman@gmail.com
Anustup Chatterjee
Asst. Professor, Techno International Newtown
Email: anustupnarendrapur@gmail.com

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Abstract

Abstract: The clay temples' conditions are deteriorating as a result of neglect and lack ofawareness. Terracotta images and panels that depict historical stories are being destroyed on a daily basis. Through numerous studies, a method to electronically repaint or repair the damaged area of the terracotta work has recently emerged. The terracotta decorations in this case are beingrepaired using an image processing technique.

By duplicating the necessary visual information from the known portion of the image, image inpainting repairs a damaged or missing piece of an image. This method was put out for a variety of uses, including the digital restoration of ancient pictures, old documents, and old paintings. The methods used in these applications primarily deal with various artefacts, such as water blotches and cracks. The two parts of this present study highlighted the study of iconographic features on terracotta panels and the image inpainting technique to restore and recreate electronically, the damaged terracotta icons of Ratneswar Temple.

Keywords: Iconography, Image inpainting, ANN, Ratneswar Temple.

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Introduction

According to history, the Ratneswar temple was constructed in the first half of the 18th century at Bhattabati village in Mursidabad, West Bengal. This Shiva temple, which features magnificent terracotta artwork, may be the most attractive in the area and is readily comparable to any other terracotta temple in West Bengal. The terracotta plaques placed in niches of varied shapes and sizes on four walls of the five-pinnacled Ratneswar Shiva Temple are well-known. The terracotta pieces are both aesthetically and socio-culturally significant. The pieces are of exceptional artistic quality, demonstrating the ability of Bengal artisans. The topics discussed on the panels are also quite important, since they disclose a piece of regional, social and religious history. Bengal's own regional iconographic development can be seen on some of the unique terracotta images on the walls of this temple.

Due to the lack of maintenance, awareness, the conditions of the terracotta temples are going in a bad phase. The designs, the art, the historical story telling terracotta images and panels are being destroyed day by day. Recently, a process to repaint or repair the destroyed portion of the terracotta work, electronically has evolved through various researches. Iconography is the study of how and why cultural ideas and their visual expressions develop historically, as well as the context in which an image is created and disseminated. Here an image processing technique is involved to repair the designs. Shih K. Timothy and Chang Rong-Chi [Timothy K, et al, 2005] proposed a new algorithm of image inpainting by a layer fusion strategy to restore Chinese and western damaged artworks. The recovery of edges, extrapolation of nearby pixels, curvature-driven diffusions, and other modern techniques of painting from a variety of perspectives (e.g., an image from movie or visual representation from a distinct period or viewpoint) is shown by Chan T. F. and Shen J.[Chan.T.F. et al, 2001]. A straight forward and quicker approach for filling the damaged region was suggested by Oliveira et al. [Manuel. M, et al, 2001]. This method can quickly paint an image, and it may be used to interactively create precise masks. According to variational principles and the image prior mode, Chan and Shen [Chan.T.F. et al, 2002] create inpainting schemes, by this method some elements of the human disocclusion process in vision psychology are satisfactorily explained.

An essential part of image processing is the region filling procedure used after information is lost in digital photographs. Image inpainting is the term for restoration techniques intended to naturally eliminate imperfection or undesired elements from an image so that a viewer who is not biased would mistake the outcome for the original image.

The present study involves two sections. The first section of the study will highlight Bengal's unique regional iconographic features demonstrated on terracotta panels of the very culturally rich temple of Ratneswar, Bhattabati in Murshidabad district, West Bengal. The second section will deal with the image inpainting technique to restore and recreate electronically the damaged terracotta icons on this temple.

Methodology

Iconography is the study of how and why cultural ideas and their visual expressions develop historically, as well as the context in which an image is created and disseminated. The information about the particular cultural symbols and motifs included in a piece of artwork could assist in the process of identifying the concerned matter. We must be familiar with the meanings of such symbols in order to comprehend them. The iconographic study has three steps which are as follows:

1. Pre-iconographic (primary or natural subject matter): it is the identification of the pure forms.
2. Convention and precedent (iconography): it involves finding a text or oral tradition that describes what we are seeing.
3. Uncovering the intrinsic meaning (iconology): This process, which is known as iconology, is actually an extension of iconography. In reality, it would be more accurate to refer to the full methodology as the iconographic-iconological method; art historians occasionally combine this third stage with other methodologies because it is cumbersome. This entails setting the image within its particular period, place, and culture.

Image processing: It is a technique for applying various procedures to an image in order to improve it or extract some relevant information from it. Image inpainting is a conservation process where damaged, deteriorating, or missing parts of any artwork are filled in to present a complete image. It is a kind of signal processing where the input is an image and the output can either be another image or features or characteristics related to that image. This process can be applied to both physical and digital art mediums such as:

- Paintings, sculptures, terracotta figurines
- Chemical photographic printing
- Digital images reconstruction

Existing image inpainting techniques can be divided into two different groups: traditional and deep learning-based methods. Here in this study the deep learning-based method is used. Image inpainting now has the tool it needed thanks to recent significant advancements in deep learning, particularly Convolution Neural Networks for image recognition. Translation-invariant operators are built into both the CNN and the sparse auto-encoder. This significantly lowers the performance of DL techniques when a task calls for translation-variant interpolation (TVI). These DL techniques are effective, but they still cause some blurriness in the image and cannot paint on complicated scenes since they lack a semantic knowledge of the image. The CNN method employs a coarse-to-fine network with a contextual attention module (CAM). By computing the cosine similarity between the background and foreground feature patches, the CAM may determine where to borrow background data for the whole region. The model uses two layered generative networks (coarse and refinement networks) to create an initial image, which is then refined by the refinement network using CAM to create the inpainting's final output. By producing unique objects that are not in the original image and semantic hole filling, deep learning approaches have significantly enhanced the quality of image inpainting and shown promising outcomes.

Area of Study Ratneswar Temple, Bhattabati

Within 5 kilometres of Lalbagh Sadar Ghat is Bhattabati, which is under the jurisdiction of Nabagram Police Station. The second Qanungo of Bengal Joy Narayan is supposed to have resided in this area at Bhattabati around the early 18th century, when the Ratneswar Temple is said to have been constructed. The Ratneswar Temple is Shiva temple with five pinnacles (*Ratnas*). It is well known for the terracotta plaques that are attached to each of its four sides.

The temple has a foundation area of 8.75 square metres and faces south. The doorway's first arch measures 2.85 metres in height. The second arch that hangs over it from the plinth is 4.37 metres tall. Whereas the third arch is 5.80 metres tall. Between the first and second arches, there is a rectangular area that is richly embellished all around the edges and decorated with a variety of motifs. A dancing girl and a female "Tabalchi" are seen performing before a nobleman in the lower right corner of the image.

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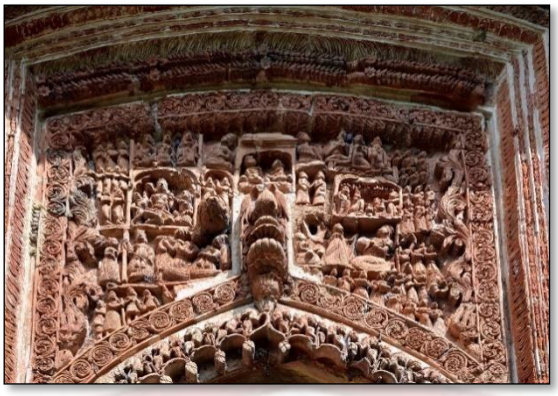

Fig.1: Construction between 1st and 2nd arches

Fig.2: The western facade ceramic panel.

There are also images of king and queen sitting in court with courtiers all around them. A wedding is happening to the right, and even the lucky mango leaves that are draping the happy couple are unique. A nobleman and a lady are represented as though they are having a conversation while seated on a throne in the middle of the picture. A magnificently carved series of "mangal-ghats" arranged vertically above one another divide the entire facade in half (Fig.1). A set of 24 tiny panels showing the Dasavatara flanked by ganas such as Narada, Kali, etc. are supported by the smaller arch above.

A stunning ceramic panel depicting the full Mahisarura Mardini manifestation, including Lakshmi, Saraswati, Kartick, and Ganesh, can be found on the western facade (Fig.2). When one turns to face the north, they are immediately astounded by the enormous Vamanavatara sculpture. The sculpture has significant damage, and the legs of the bowed Bali are visible. But Vamana's three

actions are obvious. This magnificent object is topped by an excellent rendering of the Rasa-lila, which is also damaged.

Allover these Four sides of the temple are decorated with terracotta panels and the panels may be listed and classified as Ramayana Plaques, Krishna Leela Plaques, Dasavatara plaques of Vishnu, Devi Durga Panel, and Chaitanya Leela Panel. The focus of this study is on the 1st and 5th avatars of Hindu god Vishnu which were carved on Dasavatara plaques of Vishnu in Ratneswar Temple.

Fig. 3: Damaged Matsyavatara(left) and Vamanaatara(right) at Ratneswar temple: Bhattabati

Image processing using Neural Networks

Neurons or nodes are the building blocks of multi-layered networks called neural networks. The central processing elements of the neural network are these neurons. They are made to function similarly to human brains. They take in data, educate themselves to spot patterns there, and then forecast the results. A basic neural network has three layers: Input layer, Hidden layer, Output layer. Image inpainting is a conservation process where damaged, deteriorating, or missing parts

of any artwork are filled in to present a complete image. This process can be applied to both physical and digital art mediums such as:

- Paintings, sculptures, terracotta figurines
- Chemical photographic printing
- Digital images reconstruction.

The tools used for this image processing are:

1. OpenCV are around 2000+ optimised algorithms in this collection that are helpful for computer vision and machine learning.
2. Scikit-image is an image preparation library that is open-source. With just a few built-in functions, it can execute complicated manipulations on images using machine learning. It is a reasonably straightforward module that works with numpy arrays. operations that can be done using scikit image are :
    - Use the try_all_threshold() method on the picture to implement thresholding operations. Seven global thresholding techniques will be used. The filters module contains this.
    - Utilize the sobel() method in the filters module to accomplish edge detection. We must first convert the image to grayscale because this method demands a 2D grayscale image as an input.
    - Use the filters module's gaussian() function to achieve gaussian smoothing.
    - Use the exposure module to apply histogram equalisation, the equalize_hist() method to apply conventional histogram equalisation to the original image, and the equalize_adapthist() method to apply adaptive equalisation.
    - Use the rotate() function found in the transform module to rotate an image.
    - Use the rescale() function from the transform module to rescale the image.
    - Use the binary erosion() and binary dilation() functions in the morphology module to perform morphological operations.
3. PIL stands for Python Image Library. A wide variety of image formats, including PPM, JPEG, TIFF, GIF, PNG, and BMP, are supported. The steps are:
    - The open() method can be used to load an image.
    - Use the show() function to display a picture.
    - Utilize the format attribute to learn the file format.
    - Use the size attribute to determine the image's size.
    - Use the mode attribute to learn more about the pixel format.

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- Use the save() method to save the image file after the desired processing. The image file is saved by Pillow in the png format.
- Use the resize() method, which accepts two arguments (width and height), to resize the image.
- Use the crop() method, which accepts one argument that is a box tuple that specifies the position and size of the cropped zone, to crop the image.
- Use the rotate() method, which accepts one argument that is an integer or float number denoting the degree of rotation, to rotate the image.
- Use the transform() method, which accepts one argument from the list below, to flip the image. FLIP LEFT RIGHT, FLIP TOP BOTTOM, and Image.ROTATE 270, Image.ROTATE 180, and Image.ROTATE 90.

4. Numpy library is use to carry out basic picture operations like flipping, feature extraction, and analysis. Numpy multi-dimensional arrays can be used to represent images, hence their type is NdArrays. A three-dimensional numpy array is a colour image.

Fig.4: (a) Input file image, (b) Defining Mask, (c) Output file image

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Results of Restoration through image inpainting for Matsyavatara:

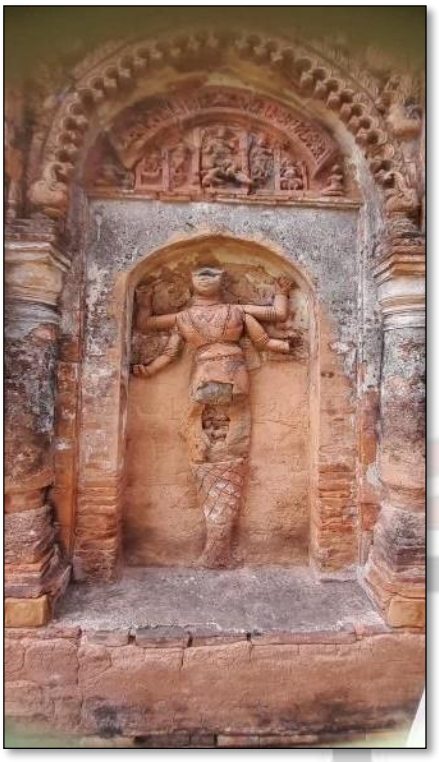

Fig. 5a: Before image inpainting

Fig. 5b: After image inpainting

Recreated objects: Head, 4 hands, head of fish, Tail of fish.

Restoration through image inpainting for Vamanavatara:

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Fig.6a: Before image inpainting

Fig.6b: After image inpainting

Recreated objects: Right hands, Right leg, Bali (Grand son of Prahlada), Left leg

Conclusion: The image of Matsyavatara and Vamanavtara by using image inpainting can be compared with the other heritage images of these avatara. From the image of Matsyavatara of Charbangla temple at Baronagar, Murshidabad and Vamanavatara of Narayan temple at Hadal-narayanpur, Bankura it can be concluded that the image inpainting of the avataras of Ratneswar temple are almost similar.

Fig.7a: Matsyavatara, Charbangla temple

Fig.7b: Vamana avatara, Narayan temple

Image inpainting may be consider as an essential tool for image restoration, identification of iconographic features & iconographic study. Many of the terracotta images depicted on the walls of the temples in West Bengal are in fragile condition which are gradually deteriorating, so it's the right time to restore these terracotta images digitally with the help of modern technology. This process is not only limited to the terracotta images but can also be applied in different aspects of iconographic study of the different sculptural remains unearthed during excavations. Scientific tool such as a robotic arm may be used in excavation process which will help in digging out the ancient remains and then, using the image inpainting process the sculpture could be reconstructedfor further iconographic investigations [Parua, et. al, 2021]

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