

# Appearance analysis research on surface quality in reproduction of the work of fine art by ink-jet printing technology

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## Abstract

*The work of reproductions and restorations has been developed by continuously innovating state of the art technology to transfer cultural heritage to the next generation. Recently, inkjet printing coupled with pigment inks has become a powerful tool to make replicas of art archives. As original art archives have unique textures, careful attention must be paid so as to reproduce the appearances. In digitizing process of the original with quasi-3D textures, lighting setup should be well considered in conjunction with purposes and circumstances where the replica will be used. Appropriate amount of software retouching is often applied to improve the appearance of the replicas with shade effects. Perceptual illusion of human is taken into account in this retouching process. In some cases, we go back to the time when the original was created and use similar traditional media materials and finishing techniques as the originals have.*

## 1. Preface

The history that reproduction and reconstruction of the work of fine art have been performed among digital archive ceaselessly from the old time of era to keep them high quality is a cultural heritage.

On the other hand it is not always known to technique itself too much that the then best restoration and reconstruction have been performed using the advanced technique of the times.

The input device using the highest digital technology, image processing software, a print system and a projection system are used for reproduction, restoration, reconstruction of the work of fine art even at the present age.

Epson performs reproduction of the work of fine art with the ink-jet print by the names such as Epson Piezograph since 1998 while repeating trial and error.

I hope that my activities of arranging and writing reports on the technique that accumulated about reproduction of the work of fine art with the ink-jet print may contribute improvement and expansion of the digital archival technology.

## 2. Work attitude and a way of thinking

Work of fine art reproduction in itself is a business that the many members such as author of the work of fine art manuscript, a successor (an author), a current owner, a corporation and a producer who really produces are concerned with and participate.

It requires minute argument and adjustment among the people concerned and then they make a final decision on ways of

reproduction method because correct definition and interpretation of "reproduction and archivals" are not fixed yet.

I think there are the following three methods when make reproduction of the work of fine art manuscript.

### (1)Reproduction as there is

It just reprint a state of the manuscript as it is. The damage or the deterioration part leaves as it is without being eliminated so it becomes very close to the state of the manuscript.

For example, in the case of reproduction of the old painting and calligraphic work it becomes the premise to have on digital leaving the damage such as a wound or the mold.

### (2)Reconstruction

Reconstruct the original state in a state at the time of the production of the manuscript and reproduce it.

The then manufacturing method and the dossier of raw materials which may be grounds of estimate of the reconstruction helps to improve degree of precision and quality of the reproduction.

### (3)Restoration

Restore only a part of spoiling work characteristics of the manuscript and reproduce it. For example, the damage parts such as mold or the wound of the old painting and calligraphic work is eliminated by digital imaging technique, but often leave the change of color by the secular variation of the Japanese paper and the paint.

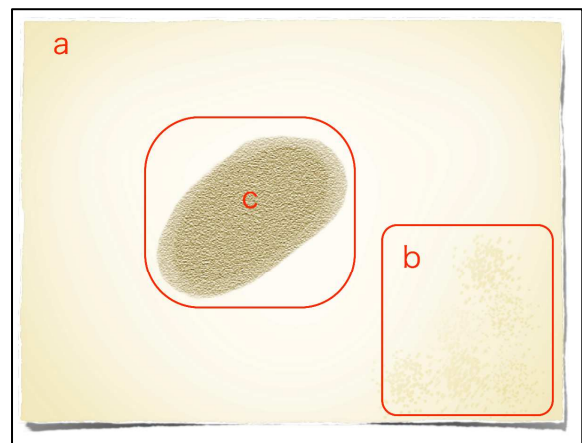


Fig1 Various damages and deterioration in the original

It is necessary to discuss and adjust about locations and degree of restoration parts which expose various damages like neighboring color variation of the paper such as a, a stain such as b, detachment of the gold paint such as c of Fig. 1.

The reproduction methods named as (1), (2), and (3) are not defined as an official name yet, but I distinguished for convenience in this report.

The above-mentioned methods are chosen by situations or purposes for exhibitions. For example (1) is chosen when restores as it is, (2) is chosen when investigates technology or techniques at the time, (3) is chosen when exhibits to many people at exhibition.

I think we need to respect for the work of fine art, the author, the history and the effort that have been stored to date even if you choose any method.

And we must note that the work of reproduction itself is a very important purpose to hand the then history and the efforts down for the future and future generation.

### 3.Reproduction technique

In the case of the reproduction technique of the work of fine art, firstly I choose the input processes of taking pictures or scanning which does not give any damage to the original. Secondly I choose to make the high quality of data which allows to make the highest quality of printing. You must not forget that you consider the perceptual illusion of the person who watches the work of fine art even if there is high plasticity either. This is the third production technique only by the work of fine art reproduction.

For example, even as for the calligraphic work the work of fine art is originally a three-dimensional object. When you assume to use a digital camera and a scanner as an input device and make a reproduction with an inkjet printer, naturally you must express this three-dimensional solid thing by two-dimensional digital data visually.

I introduce technique to use a perceptual illusion of a person who can recognizes the object by looking at luster and shadow against light.

#### 3-1 Luster / shadow technique

Assume to use digital input devices such as a flatbed scanner, a digital camera, a non-contact type large size scanner. whichever any input device is chosen, the original of the fine art manuscript must be placed perpendicular to an imaging part of a sensor of the device. The source of light to light up the manuscript locates at slanting angle as shown in Fig. 2.

"a" is part of the object with gold or painted, "b" is a paper part of the manuscript, "c" is a light source, "d" is an image capturing of input device such as a digital camera and the scanner. The source of light of "c" locates it to hold angle  $e$  in the upper part side of the manuscript by all means.

Then "f" part becomes lighter than average in the salient such as "a" called a luster impression portion. On the other hand "g" becomes darker than the average called a shadow impression portion. As the surface of the paper is not consistently flat, actual data of "f" and "g" vary respectively and shows differently.

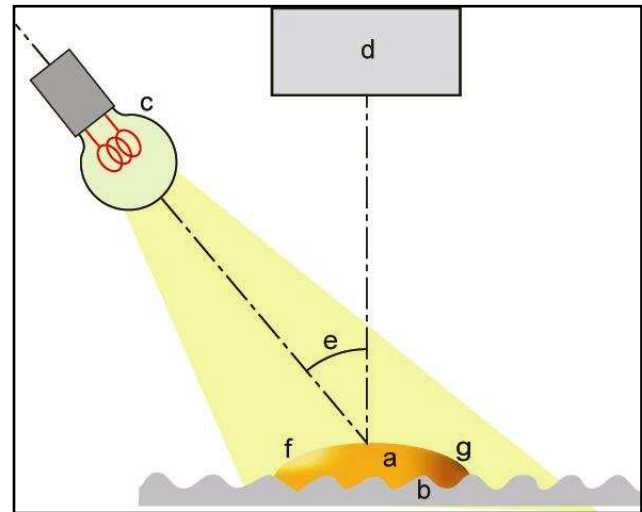


Fig2 Layout drawing of input device

By making an adjustment of small "f" and "g" respectively it can create better surface quality in conjunction with actual surface of the paper.

I use Photoshop (R) to perform corrections to the luster or the shadow part which I made at the time of input. Because I cannot change degree of the angle  $e$  in the case of the scanner method, the adjustment of the generation degree of f/g which is created by the three-dimensional object and smaller f/g come from surface quality of the paper. Therefore I usually make digital corrections to parts of f/g respectively so it look like three solid perception by the image processing software.

On the other hand the digital camera can change angle  $e$ . But light may be hard to reach the lower part or surrounding part of the manuscript depending on a position of source of light c because neither source of light c nor digital camera d moves like a scanner.

Various problems may occur like the image distortion at surroing portion by the lens distortion and the influence of environmental neighboring light.

Therefore digital corrections performs to supplement the parts where problems occurred because of such a special photo-taking.

In addition you may need to make additional correction technique to the luster or shadow parts because considering where people watch the reproduction.

For example, when the hanging scroll is displayed in the tea-ceremony room, it is required to make bigger rough at the lower part and smaller rough at the upper part of the reproduction in conjunction with location of light source and digital corrections with assumption that people watch sitting.

#### 3-2 Finish (taking a lesson from the past)

When an ink-jet printer prints digital data created in this way, I use the technique of a picture framer who performed reproduction of the old work of fine art or I often really cooperate with them as a team.

For example it is required to use a very thin paper to print on when the manuscript is a hanging scrool, the framed painting or the calligraphic work.

In this case it is possible to make a reproduction close to the original manuscript more by using the multi-layer structure of Japanese paper called "Aihagi" or "2-piece struction of the paper".

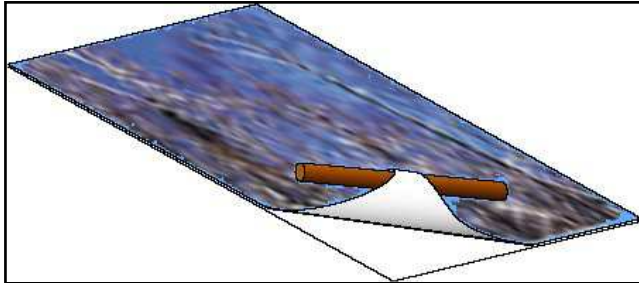


Fig3 Traditional technique "Ai-Hagi"

#### 4. Summary (mental attitude)

I usually use a family of the large size type inkjet printers with Epson's K3 ink systyem which has the wider color area expression capability which is important to such luster and shadow expression and can support various types of papers including a Japanese paper and the cloth.

But the following attention must be paid when a printer manufacturer performs reproduction of the work of fine art.

Reproduction of the work of fine art, reconstruction, restoration in itself is one of extremely important industries which lasts since the ancient time of years and worldwide

It requires both improvement to the older manufacturing technique and adaptation of the most advanced technology at the time.

This industry always adopted advanced techniques of the times with improvement of the old production technique.

I hope that a printer is used in the same way as a writing brush and mineral colors in this industry as the same way as in the past.

#### 5. References

- [1]The Kohei Iwamoto "reproduction of fine arts, photograph expression and the work of fine art by the ink-jet" (2008, The Imaging Society of Japan the first technology meeting for the study)
- [2]The Kohei Iwamoto Technique of the texture expression with the ink-jet print" (2009, The Society of Photographic Science and Technology of Japan annual conference pre-article)

#### 6. Author Biography

*Kohei Iwamoto received his BS in color science and color psychology from Kyoto Institute of Technology (1983). Since then he has worked in the Corporate R&D at Seiko Epson in Nagano, Japan. His work has focused on the research of human sensibility value and the development of its expression technology. He made a lot of speech at academic conferences such as the Imaging Society of Japan.*