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Research paper

A proposal for scientific analysis on the signboard color of gwanghwamoon

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Abstract

Background/Objectives: The analysis plan on the signboard of Gwanghwamoon is the research inferencing the background color and the handwriting color of the signboard by scientifically analyzing the gelatin glass plate image of Gwanghwamoon (1916) possessed by National Museum of Korea, the gelatin glass plate image of Gwanghwamoon (1902) possessed by The University of Tokyo, Japan, and the printed image of Gwanghwamoon (around 1893) possessed by Smithsonian Museum, USA.
Methods/Statistical analysis: This study aimed to reproduce the then photographing condition and equipment of the old pictures in order to compare and analyze the three old pictures aforementioned.
Findings: The restoration of tangible cultural properties through picture analysis and reproduction research will lay a cornerstone and the excellent case for future restoration project of similar tangible cultural properties. In restoration of cultural properties, scientific historical research is critical and basic process. Moreover, in case that photograph data exists, it can be utilized as a very valuable evidence data.
Improvements/Applications: On the other hand, the photograph data can also be a dangerous trap without scientific research analysis that reproduces the condition of the time of the shooting; hence, the results of this study can be a good example of scientific analysis in restoration work.

Keywords: *Gwanghwamoon; Signboard; Color Representation; Gelatin Glass Plate; Cultural Heritage; Photography.*

1. Introduction

Cultural heritage is the products in which the spirit of the Korean race is dwelt; hence, it is the heritage to be conserved in good manner and inherited to the younger generation in future. Korean has history of getting damages on the cultural heritage through the periodical situation including Japanese colonial rule and Korean War. Huge effort has been being taken at the national level to restore and manage the cultural heritage, experiencing trials and errors [1-2]. Shapes and colors of tangible cultural properties, in particular, are changed by physical conditions including temperature, humidity, and light; hence, restoration and management should be processed after conducting sufficient researches based on scientific evidences. In order to resolve such problem, comprehensive effort in terms of history, culture, and science is required. Photographs are frequently used as the resource ascertaining historical fact and one of the representative objective resource.
The signboard of Gwanghwamoon that is currently located in the south of the Gyeongbokgung Palace, Seoul has been restored to black handwriting in white background according to the historic research based on the gelatin glass plate images under the possession of National Museum of Korea and The University of Tokyo, Japan that was taken in 1916 and 1092, respectively. However, a printed photograph of Gwanghwamoon in 1893 (estimated to be after September) under the possession of Smithsonian Museum, USA was found after the restoration process and it was claimed that the colors of the background and the handwriting are switched when comparing the current signboard of Gwanghwamoon and the photograph. Hence, a multidisciplinary research inferencing the color of the signboard of Gwanghwamoon is required [1-3]. This study aimed to propose the method of inferencing the color of the background and handwriting of the Gwanghwamoon signboard through scientific approaches. Furthermore, this study also aimed to promote the experts to obtain more objective research results by proposing them the scientific analysis method. Necessity of scientific analysis on the color of Gwanghwamoon signboard is summarized below.

- Need for the establishment of fundamental data enabling the management of cultural heritage through scientific analysis.
- Scientific evidence establishing objectivity of the fundamental data.
- Physical demonstration determining the color of Gwanghwamoon signboard in objective view.
- Suggesting the objective characteristics of the colors and pigments for restoration of Gwanghwamoon signboard.

2. Contents and methods

2.1. Research contents

This study will compare and analyze the two (one from National Museum of Korea and one from The University of Tokyo, Japan) gelatin glass plate images and one printed image (from Smithsonian Museum) taken for Gwanghwamoon. For this, the background color and handwriting color will be analyzed by simulating the photographing condition, photographing equipment, photographing method, and printing process in those days. To minimize the scientific error, additional validation will also be conducted

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through photographing the actual image and photographing the set that is in similar condition in those days [4-6].
Below are the research contents.

- Reproduction of the gelatin glass plates possessed by The University of Tokyo and National Museum of Korea and the printed image possessed by Smithsonian Museum (refer to as existing photographs hereinafter) through the identical procedures performed for the existing photographs by comparing and analyzing the existing photographs
- Absolute requirement of additional validation through photographing the actual image and photographing the set that is in similar condition in those days in order to minimize scientific errors
- Spectral characteristics study of UV with regard to the paint and varnish in consideration of that most of the physical characteristic of the gelatin glass plate is the blue sensitivity [7].
- Enhancing the reliability of the scientific analysis study through a study on conservativeness of numerous paint and varnish and historical record investigation in relation to historical parameters

2.2. Proposal of research method

- By taking hypothetical-deductive method for the research method, the color of the signboard of Gwanghwamoon will be scientifically drawn by adopting the hypothesis that can be disproved by the photographed images.

[Setting Hypothesis Predicting the result Photographing validation proving the hypothesis. Design the experiment based on the hypothesis and establish a new hypothesis with the occurrence of the results and variables that are contrary to the hypothesis. The hypothetical-deductive method is a scientific research method that was emerged based on empirical thinking for long time; hence, it is a proper research method for this study.]

- The research is conducted in [2] separated steps including reproduction of the existing photographs, historical research; and each step of the research is as shown in the research plan below in [Figure 1].
- To reproduce the existing photographs, take photographs based on the results of the analysis on the existing photographs. There may be various variables in photographic reproduction. Ground portion in the south of Gwanghwamoon, which becomes the light source of the signboard, is different from that in the past; hence, the reproduction must be done in separated two steps including photographing the actual image actual and photographing the set

In the course of the reproduction, there are variables including the one based on the storage media such as camera, film, and photographic paper and the one due to the environment and condition of the photographing including height and projection angles of the Sun, the kind of the light source (cloudy day and sunny day), photographing angle, and color temperature [8,9].

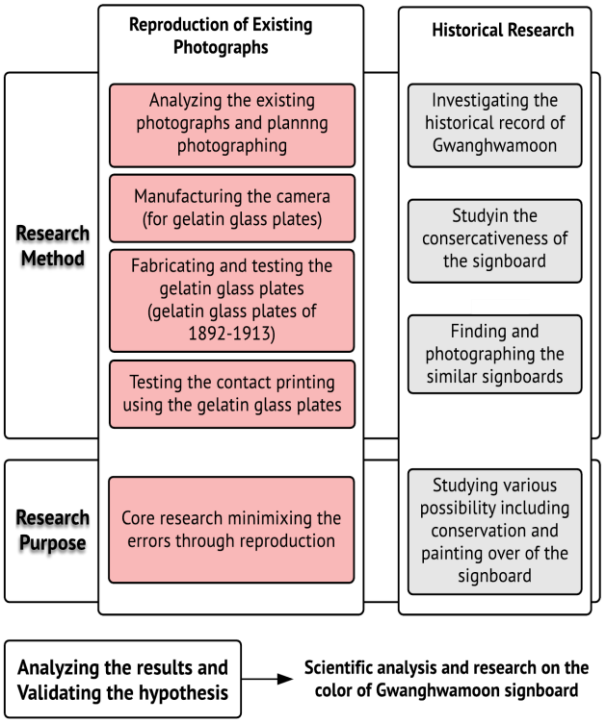


Fig. 1: Research Plan.

- Invisible spectrum test is testing the presence of the peculiar optical phenomena in consideration of the chemical characteristics of the black and white signboard at that time.

The then signboard was blue sensitive and sensitive to ultraviolet ray. In case of black and white, the results may be different from what expected from the concentration of the visible spectrum, since the index of refraction and fluorescence reaction in the wavelength range of UV vary by certain matters [10], [11].

- In Historical research, conservativeness test is conducted by predicting the kind of paints and varnish through the investigation of historical record about Gwanghwamoon.

This experiment is validating if the tone of the signboard in the three existing photographs taken in different period has been changed by the discoloration and fading. In addition, the possibility of painting over of the signboard while moving the location of Gwanghwamoon during Japanese colonial period in early 1900 or due to the passage of time is studied as well.

2.2.1. Setting research questions and hypotheses

In this study, various investigation including historical researches and investigation of historical record are ongoing simultaneously. However, this study aimed to achieve answers for the below two questions with respect to the reproduction of photographs.

The research questions set for this study and hypotheses according to the questions are as below.

[Research question 1] Can the concentration of the background color and handwriting color of the signboard be changed by the color sensitivity?

Two photographs (possessed by National Museum of Korea and by The University of Tokyo) among the three photographs of Gwanghwamoon signboard were taken with the dry plates and one photograph (possessed by Smithsonian Museum) is a printed image and the kind of its original film is unknown. The photographs possessed by National Museum of Korea and by The university of Tokyo are taken with the dry pates and blue sensitive.

<Research hypothesis 1> In case of the photograph possessed by Smithsonian Museum is taken with the orthochromatic film or pan chromatic film, the concentration of the Smithsonian photograph and that of dry plate photographs may differ by the background color or handwriting color.

[Research question 2] Can the concentration of the handwriting color be changed by regular reflection and diffuse reflection?

<Research hypothesis 2> The concentration can differ between when the light source is regular reflection and when the light source is diffuse reflection in case that the handwriting is glossy material whereas no change occurs by the type of light source reflection in case that the background is mat material.

The photographs below are the tests conducted prior to the research by setting the photographing condition similar to that of the past, showing the example photographing with regard to the hypothesis with the possibility of having the signboard with reversed tone (the example photographing was done with one signboard) [Figure 2].

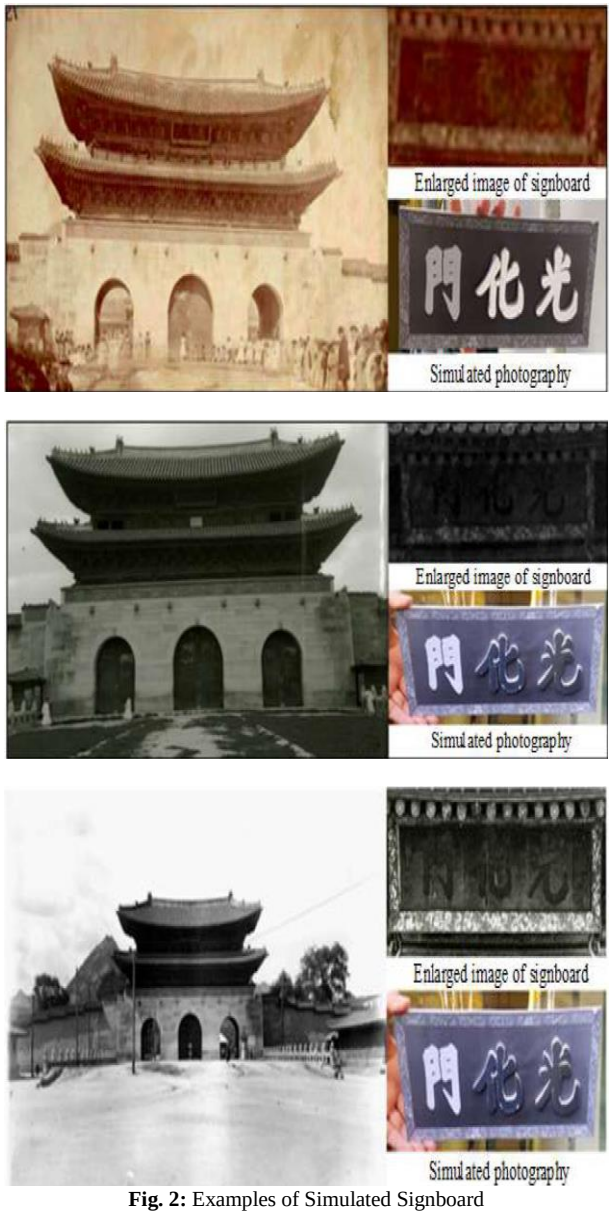


Fig. 2: Examples of Simulated Signboard

3. Expectation and utilization of the research results

- Validation of the objective evidences based on the scientific analysis and its outcome by reproducing the existing photographs (technical and mechanical) in production of Gwanghwamoon signboard
- Validation of the importance of the scientific analysis of photograph data in restoration of tangible cultural properties
- Attainment of the subdivided range of error through research investigation based on the optics since the invisible spectrum test is the experiment minimizing the errors that may occur while reproducing the tone of the black and white photographs.
- Serving as a foundation of reproduction and analysis of photographs as the research on various possibilities including the conservativeness of the signboard and painting over of the signboard is based on existing researches.
- 3D simulation saves both time and cost that may be consumed for photographing actual images and 3D results draws high degree of visual completion by compensating the limitation of the photographing the actual image and photographing the set.
- Building the active network between experts in relevant fields and the foundation of the digital restoration and reproduction of cultural heritage.
- Laying the cornerstone for excellent restoration cases of similar cultural properties in future through the restoration of tangible cultural properties by researching and analyzing the photographs.

Historical research is very important and basic step in the restoration of cultural properties. When photographs exist, it can be used as a critical evidence data. However, such photograph data can also be dangerous trap in the absence of the scientific research and analysis reproducing the photographing condition at that time. The results of this study can lay the cornerstone of the scientific analysis and approach to the restoration procedure.

- The 3D modeling simulation and media contents that will be drawn as the results of this study can be utilized as the case of scientific reproduction of honorable cultural properties at domestic and international exhibition.

4. Conclusion

In Korea, there are large amount of gelatin dry glass plate resources. Photographing using gelatin dry glass plates have been used in various fields around early 20th century in Korea and they are important historic resources. “Photographs have been recognized with its ability as the evidence without any specific objection since its initial invention and have performed its duties as objective evidences in all modern studies thereafter. However, recognizing objectivity of photographs as the academic resources is not only because of the physical properties of photographs. It was rather because of the almost absolute privilege that was given to vision in behavior of “observation”, which becomes the base of the academic disciplines since 17th century” (Seoul National University Museum, 2004). However, analysis of photographs without considering the then condition can cause the loss of objectivity of the photographs.

After 19th century, various manufacturing methods of film have been announced and each of those films was made of different photosensitizers. Each of photosensitizers has different light reactive spectrum region. Dry glass plate is the black and white negative film. Particularly, silver bromide was used among other silver halogenide in order to improve the light reactive speed and silver bromide is not reacting to the light with the wavelength over 480 nm.

This study was focused on the tone change of the image by the color sensitivity of the dry glass plate and the tone change by the materials of the handwriting color depending on the light source. Such results can scientifically prove that the concentration of the handwriting color and background color of Gwanghwamoon signboard may differ by the photographs. By proving that the color can be inferenced even in black and white photographs based on scientific analysis performed by photograph experts and that the color can be changed by the lighting, it can be a good example showing the necessity of scientific research through historical background rather than the analysis of the visible image and reputation of photographs as an objective resource can be distinguished.

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