Scanner Certification Tool for the Standardization of Digitized Documents: Focusing on Target Factors and Measurement Programs

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ABSTRACT

Scanners play an important role in digitally reproducing the color and imaging of original documents used in public offices; however, the current system lacks a standard for digitized documents created by scanners, complicating efforts to create a digitized system. In particular, macrography cannot guarantee the accuracy and reliability of digitalized color documents, pictures, and photographs created by scanners. To this end, we develop a standardized evaluation tool and test target to certify digitalized documents created by a scanner in the domestic environment. In this study, we enhance the accuracy and reliability of scanned data to create an advanced standard evaluation tool for scanners. Moreover, to produce a scanner certification standard, we overcome existing problems related to the growing market. We anticipate that this new standard will see a high degree of application in the current environment.

Keywords: scanner, standardization, target, documentation.

1. INTRODUCTION

Scanners are used to digitize documents and photographs by public agencies, a process in which it is important to record the exact original color and imaging. The current standard applied to digitalized documents produced by the National Archives of Korea is based on Japanese and American standards. According to the current policy of scanner evaluation method by the National Archives of Korea, we need to develop an adequate system for scanner certification. Therefore, we research an automatic comprehensive scanner quality evaluation program. And also, it consists of a standard target and a program to measure Macrography, automation test, and TWAIN test; however, in practice, this may not be the best way to measure the performance and quality of scanners. In addition, this standard uses macrography to measure and evaluate digitalized documents, and thus lacks accuracy and reliability due to variation among inspectors. In current system, we do not have a standard for verifying a scanner performance; therefore, we

focused on scanner certification tool for domestic standard. The accuracy and reliability of scanner certification program are not only for macrography but also for automation test and TWAIN test. In the previous system, there was not automation and TWAIN test so that we propose a new evaluation test for the accuracy and reliability. We have developed a standard certification tool for digitalized documents created by scanner. This tool consists of a program that evaluates image-quality factors and compares them against a reference target.

2. METHOD OF SCANNER QUALITY EVALUATION

Current Macrography based on America and Japan international standard is carried out by inspectors so that the results can be differed and dropped their reliabilities and objectivity. Most of all, we need to develop a standard which follows the international standard and objectivity. Therefore, we can confirm our research reliability and novelty in process of developing a new standard target and a program. The proposed evaluation factors for scanners are subjected to a macrography test, an automation test, and a TWAIN (Technology Without An Interesting Name) test. These factors
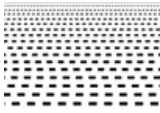
are based on an International Organization for Standardization (ISO) standard and are designed as a target (Scanner Certification Target Ver.1.0.). The measurement program (Scanner Certification Program Ver.1.0.) evaluates these factors.

2.1. Macrography test

A macrography test based on the ISO standard examines all factors of reproduced information, such as photographs, pictures, letters, dotted lines, and etc [1],[2],[3]. Table 1 details the measurement factors of macrography: picture, letter size, and thickness of dotted line.
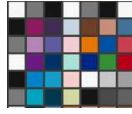
Table 1. Details of Macrography

Item	Picture	Letter size	Thickness of dotted line
Image			
Measuring factor	Photograph, picture, image reproduction (color, B/W)	Diverse letter size of Korean, Chinese, special characters, English capital/small letters	Dotted line, thickness of line
Related standard	JIS X6933, ISO/IEC 15775	JIS X6933, ISO/IEC 15775	JIS X6933, ISO/IEC 15775, ISO 11698-1
Evaluation	Grade on a 1–10 scale for photography gradation and color reproduction	Readability of the minimum letter size distinguished by the normal naked eye	Record the first distinguishable dotted line

2.2. Automation test

The automation test addresses the following measurement factors: color reproduction ability based on color difference, one- and two-dimension bar code recognition, evaluation of corner-color reproduction ability, and graduated ruler test for extended paper when using ADF (Automatic Document Feeding) [4],[5]. Each factor is based on the ISO standard, and we suggest a new factor and measurement method for practical purposes [6].[7].[8]. Each factor is measured 10 times and the results are compared to the original, with the measurement factors being graded as either pass or fail. Table 2 shows the details of the automation test.

Table 2. Details of automation test

Item	Color	Corner color	Bar code	Graduated ruler
Image				
Measuring factor	Scanner color reproduction	Identity of four-corner color reproduction ability	One-dimensional (code 128) and two-dimensional (QR) bar code recognition	Extended paper test when using ADF
Related standard	KS X ISO 12641 Color Checker SG	KS X ISO 12641	ISO/IEC 18004:2006, ISO/IEC 15417:2007	Newly proposed
Evaluation	Select color target and automatically calculate	Select 4-corner color target and automatic calculate	Select bar code and automatically recognize	Select graduated ruler on both right and left side

2.3. TWAIN test

This test evaluates whether a scanner has the standard interface, TWAIN. Since 1992, manufacturers (Adobe, Eastman Kodak, Hewlett-Packard, Epson, Logitech) of graphic or imaging input devices have produced a software standard interface to connect device and software. After installing the scanner driver on a PC, the TWAIN interface is examined. Table 3 shows the details of the TWAIN test.

Table 3. Details of TWAIN test

Item	Contents
Auto Feed	ADF function test
Duplex	Both-sided scan function test
Brightness	Brightness control function test
Contrast	Contrast control function test
Image File Format	Supported image storage type test
Pixel Type	Supported paper size test
Supported Sizes	Supported pixel type test (BW, GRAY, RGB)

X Resolution	Supported X axis resolution test
Y Resolution	Supported Y axis resolution test
Enabled UI Only	Supported user interface setting test
Customs Data	Profile creation or application support

Storage	Temperature 23±2 ℃, relative humidity 50±20 % (ISO 16067-1:2005)
Limitation	Disuse a target based on each factor test 10 times average value, if it is over error range 1.0.

3. DEVELOPMENT OF SCANNER CERTIFICATION TOOL

We have developed a newly designed target (Scanner Certification Target Ver.1.0.) and a program (Scanner Certification Program Ver.1.0.) for the standardization of digitized documents. Figure 1 is the process of study.
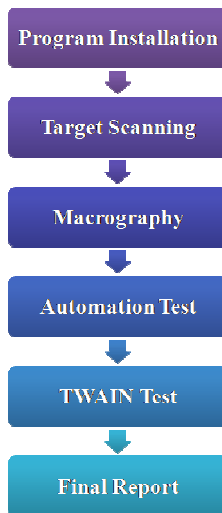

Fig.1. Process of scanner certification tool

3.1. Macrography test

In Fig.2, we present a test target (Scanner Certification Target Ver.1.0.) in our program, which consists of a macrography test and an automation test. We incorporated the tests into a single target for reasons of convenience, ease of use, practicality, and economy. The target specifications are shown in Table 4.

Table 4. Specification of test target

Printer	Epson R 2880
Calibration device	Gretag Macbeth Eye-One
Paper	Epson premium semi-gross paper

Fig.2. Scanner Certification Target Ver.1.0.

3.2. Development of program

We have developed software to certify scanners for use in digitizing documents. The software features 3 tests: a macrography test, an automation test, and a TWAIN test. Fig.3. shows the program's interface.
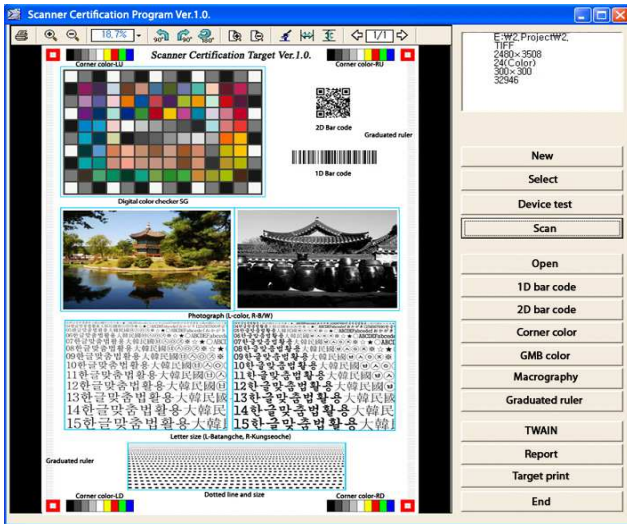
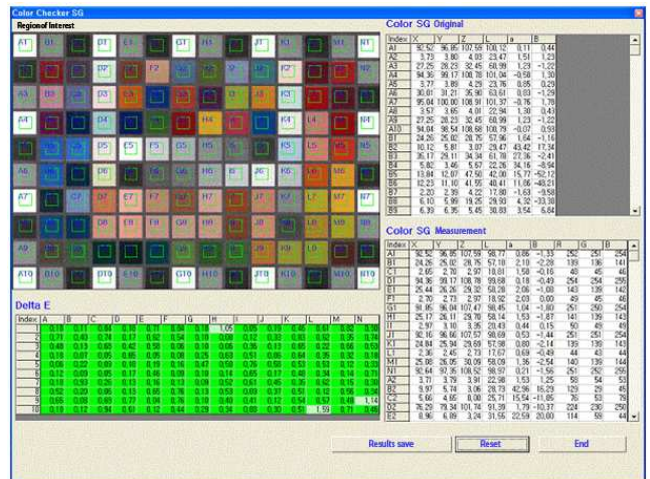Fig.3. Scanner Certification Program Ver.1.0.interface

3.3. Program report

Once the scanner certification program is installed on a PC, it is used to scan a target set at paper size A4, resolution 300dpi, and image mode 24 bit. The program reports the results of the macrography, automation, and TWAIN tests.

3.3.1. Macrography test result: In the macrography test, the scanned target is compared with the original at 100% size using the naked eye. The inspector grades macrography items and records the values in the program (refer Fig.4.)
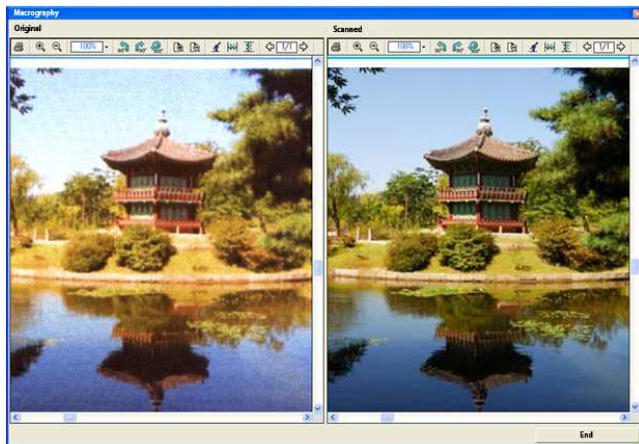

Fig.4. Macrography interface

3.3.2. Automation test result: For preventing the error from many different monitors, we made a controlled test environment. We calibrated a monitor to make a standard color using by X-rite's 1Xtreme. Gretag Macbeth's Digital Color Checker SG target is based on color target and it can measure XYZ, CIELAB, and RGB. To convert RGB values to CIELAB values, we follow CIE 1976 standard and use standard light source D50. When the inspector clicks and drags the Region Of Interest (ROI), the program automatically calculates and reports the automation test items: one- and two-dimensional bar code, color, four-corner color, and graduated ruler for ADF (refer Fig.5.).

Fig.5. Color Automation test interface

3.3.3. TWAIN test result: The TWAIN test determines whether the selected scanner complies with the standard interface and compares the selected scanner's capabilities with those of the standard interface (refer Fig.6.). .
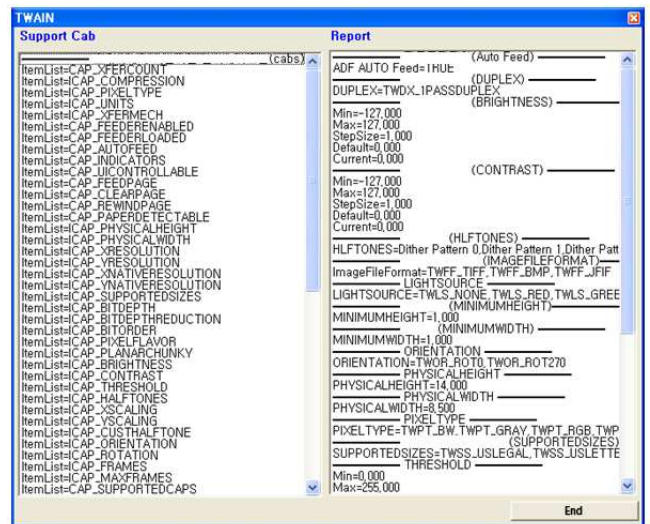

Fig.6. TWAIN test interface

3.4. Program considerations

In this research, we made a scanner certification target and a program to evaluate scanner's performance. In the previous system, inspectors wrote down its macrography test results manually, therefore its efficiency and speed of scanner certification test have been insufficient to verify scanner's performance. However, we proposed a new tool for a scanner which can record and save test results automatically so that we can enhance the speed, accuracy and reliability of test results. Especially, automation test by using color differences value can be an objective tool for measuring color reproduction in case of different devices. Automation test can show its result as a number to record, therefore we can expect the high reliability of program. Moreover, there are one and two dimension bar code, ADF paper extension measurement, and TWAIN standard interface. Those are the automatic measuring system

for acquiring objectivity.

4. RESULT

Throughout this study, we measured Delta E for color testing, which was difficult to define in previous macrography systems. This allowed us to measure the accuracy of scanner color reproduction with the objectivity of a scanner certification program. In addition, we designed a synthesized target that contains a variety of items, such as letters, dotted lines, photographs, bar codes, and graduated rulers. This target, which is based on ISO standards, works for our program and evaluates the scanner's performance. The program makes the test process faster and improves its objectivity. We hope that this research will provide a solution to the problem of scanner certification for digitized documents, which is due to a lack of a specific scanner standard, and will improve the conservation of original documents in a digitized form.

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