Design Implementation of a Sketch Isolation Algorithm: A Computer Vision-based Approach

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Abstract— ***The process of digitizing sketches requires the intermediary process of scanning an actual paper. Through a computer-based program presented in this paper, the sketch, which is the foreground, is digitally extracted and isolated from the background creating a similar mask for a digital image. Through the sketch isolation process, prior sketches are excluded from the mask thus allowing individual editing of the most recent sketch. The gradient of the paper from the camera does not show in the final image, but instead shows a clean white background. The program does the process instantaneously allowing live sketch digitizing. It is suggested that the application be improved through the use of neural networks. The resolution of the final image was only as good as the input image, but it can be improved by converting it to a vector based graphic format the sketch will be easily scalable without losing detail through pixelation.***

Index Terms— **adaptive thresholding, computer vision, image processing, sketch isolation**

I. Introduction

Sketching, or sketch drawing, is the fundamental step in expressing artistic ideas and beginning an iterative process of design refinement. It allows artists in visually rendering quickly their ideas on paper through freehand drawing. The priority is to express concepts and ideas quickly, rather than exhibit every fine details, which sometimes leads to coarse and rough sketches due to loosely drawn work. After an initial sketch, feedback is used to iteratively refine the design until the final piece is produced.

The developments in digital image processing have allowed numerous applications in computer vision systems. Some of these applications focus mainly on quality assurance, object detection and monitoring of different processes from food production to manufacturing [1, 2]. Image processing, on the other hand, has extended its application through the help of neural networks for better processing of more complicated content such as paintings from the visual arts [3]. Sketch analysis is a product of image processing within a computer vision application. The common ways where sketch analysis can be applied is in the handwritten words or hand-drawn sketches recognitions [4, 5]. Other uses of sketch have a more practical application in the visual arts, such as sketch simplification, which greatly reduces the time needed to convert and complete the sketch in digital form [6].

In this paper, a novel method for sketch isolation was proposed. Digital artists often times use hand drawn sketches as a base guideline for their artwork. In the process of doing so, they will have to scan the paper in which the sketch was drawn. Nowadays, digital drawing tablets are indeed the better choice for instant digitalization. Moreover, the tablet provides a way for many people to collaborate in the sketching, but the implementation comes at a high cost [7]. With that, this paper presents a computer vision-based application that can replace the manual process of scanning sketches. It instantaneously digitizes the sketch as it is drawn only through the use of a single camera. It can be considered that this application plays in the middle either a step-up from the traditional, which is the manually scanning sketches, and a step-down from using expensive drawing tablets.

II. Image Thresholding

Image thresholding is considered to be the simplest process of image segmentation. This technique is very useful in creating binary images (see Fig. 1).

(a) (b)

Fig. 1. Sample of threshold effect from a) original image to b) binary image

In image processing, three kinds of image thresholding techniques can be applied: simple, adaptive and Otsu's method. Simple thresholding follows a straight-forward rule wherein if the pixel value is greater than a threshold value, it will just assign one value, either a white or black.

Meanwhile, for the adaptive thresholding, its algorithm calculate the threshold for a small regions of the image. Compared to the first one, it provides better results for images with varying illumination. Otsu's binarization method, on the other hand, calculates a threshold value from image histogram (foreground and background pixels) for a bimodal image [8].

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This method is very useful in noisy images whose histograms contains two peaks.

III. Block Diagram

Figure 2 below illustrates the proposed block diagram of the developed sketch isolation system.

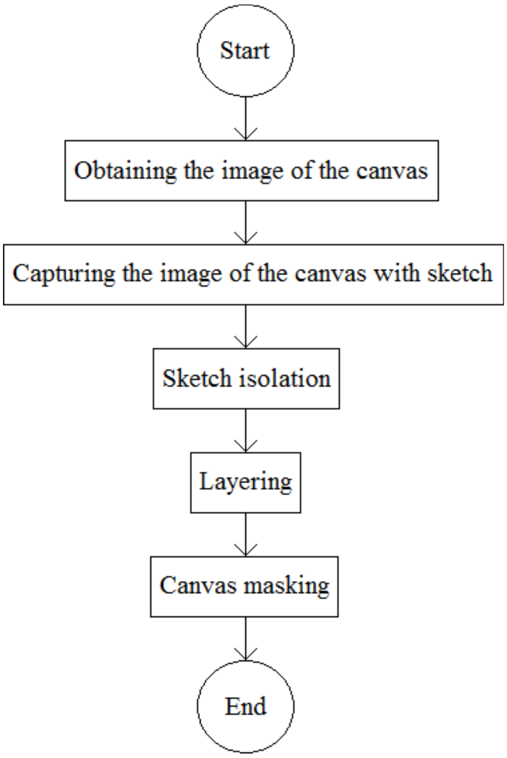

Fig. 2. Block diagram of the proposed sketch isolation system

The proposed system consists of five major blocks starting from getting the image from the canvas to the process of canvas masking.

A. Obtaining the Image of the Canvas

In this step, the image of the canvas, in which the sketch will be made, was captured using a digital camera (see Fig. 3). In this study, the camera used was a plug-and-play computer webcam.

Fig. 3. Image of the canvas used

This RGB image of the canvas will served as the reference image.

B. Capturing the Image of the Canvas with the Sketch

An RGB image of the sketch is captured once it has started its process of making the figure. Figure 4 shows the image of the sketch after going through the canvas.

Fig. 4. Image of the canvas with sketch

C. Sketch Isolation

In this stage, both the background and the foreground images were converted into grayscale images [9-11]. Then, the foreground image is subtracted from the background image by performing adaptive thresholding on the background and the foreground then subtracting the absolute difference of each element throughout the pixel array of the image. Figure 5 shows the obtained image after the canvas went through adaptive thresholding and a sketch is made.

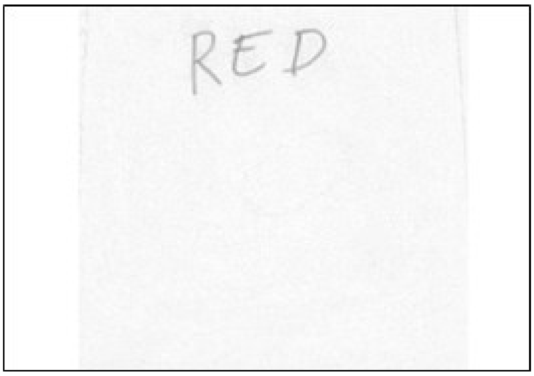

Fig. 5. Isolated sketch from background

The image obtained is in the form of a grayscale image. This image possesses none of the previous features, such as shadows and highlights, and serves as the new background for the sketch when the operation follows.

D. Layering

The binary difference image obtained is used in changing features into the sketch. This image is filtered using color select. Each pixel in the input image was replaced with a different RGB values. Figure 6 displays the color select window and in Figure 7a is the layered image of the isolated sketch.

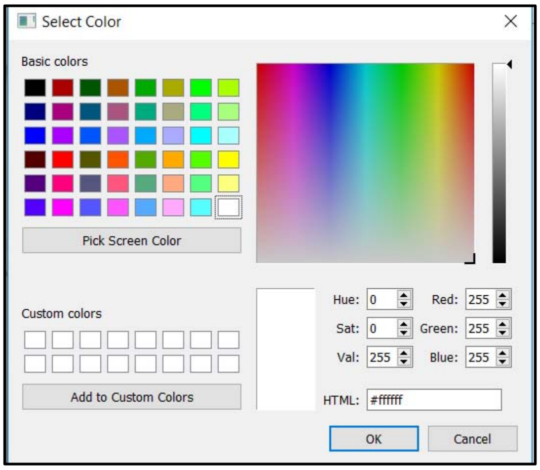

Fig. 6. Color palette

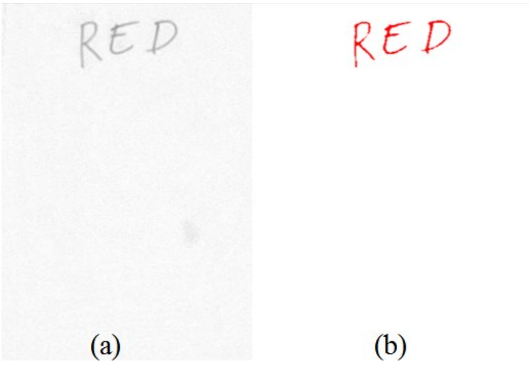

Fig. 7 a) Isolated sketch and b) red layered sketch

E. Canvas Masking

The last procedure is the canvas masking. Here, the binary image obtained in Figure 7 was used as the final canvas for the sketch. The original RGB image in Figure 4, containing the original sketch, was converted into an image file as depicted in Figure 8.

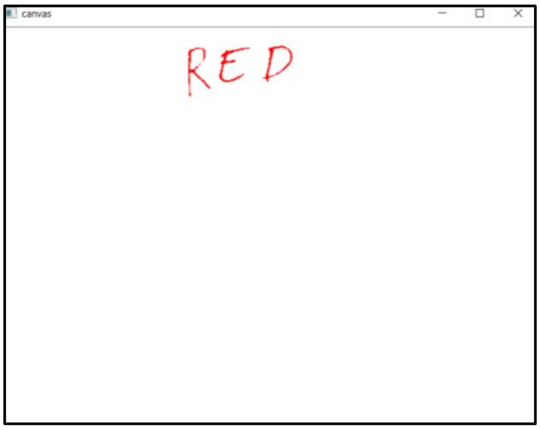

Fig. 8. Canvas mask

The image obtained is in the form of a grayscale image. This image possesses none of the previous features, such as shadows and highlights, and serves as the new background for the sketch when the operation follows.

IV. Results and Discussions

Based from the actual observation in Figure 9, the sketch has been digitized from the original canvas to an image array.

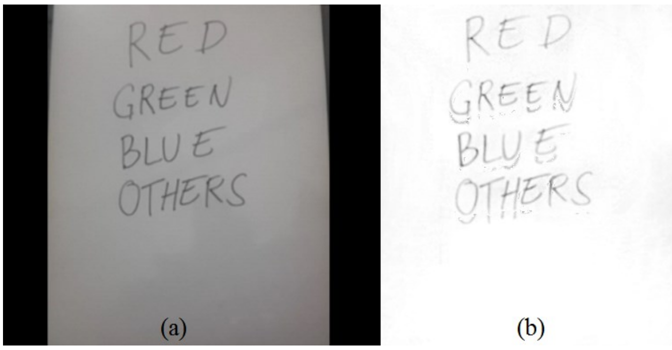

Fig. 9 a) Sample input image and b) scanned sketch

As shown in Figure 10, it was also demonstrated clearly that the final image can compile sketches in different colors. The gradient of the paper from the camera does not show in the final image, but instead shows a clean white background. It can also be seen that the resulting image does not perfectly mirror the sketch. For example, upon taking a closer look at the letter ‘G’ of the word ‘GREEN’, it can be observed that there are some missing parts. This is probably due to the adaptive thresholding.

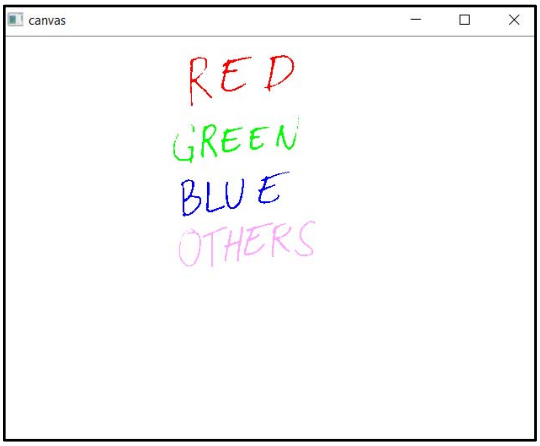

Fig. 10 Final output with different colors

The adaptive thresholding compares a pixel to its surrounding neighbors and makes a binary mask. When the pencil sketch gets too light from the majority of the sketch, the program considers it as part of the background, thus, the missing part.

V. Conclusion

Based on the results of the experiment, it can be said that using just computer vision is enough to isolate and digitize the sketch from the paper. It can be seen that the proposed system is more beneficial than using a conventional scanner. There might be pixels that were excluded in the final output, but it has made the simple initial sketching process much easier while only requiring low budget equipment.

Furthermore, it is suggested that the application be improved through the use of neural networks. The resolution of the final image was only as good as the input image, but it can be improved by converting it to a vector based graphic format the sketch will be easily scalable without losing detail through pixelation. The paper only shows the image processing procedure through a computer vision application. It can serve as the core program in any mobile application making it more appealing to use.

VI. ACKNOWLEDGEMENTS

The authors would like to acknowledge Philippine Department of Science and Technology – Engineering Research and Development and Development for Technology (DOST-ERDT) for the financial support, and the DLSU Biomedical Devices Innovation and E-Health Research Group for the research guidance and technical assistance.

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