Simulating Oriental Brush Character Considered with Aerial Action of Pen Tablet

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Introduction

The calligraphy is widely known in the oriental countries and has received art and high evaluation in history. The calligraphy is not only intended as a means of communication but also as a traditional culture that shows the artist using bristles and ink.

The artwork is a cooperative process that involves the unique features of an ink painting device. The ink painting is expressed by diffusion, scratchiness and the light and shade. The purposes of this research are the simulation of oriental brush character considered with the aerial action of the pen tablet.

In this research, we present an aerial action of oriental brush simulation in a focus on brush and tip pressure by using a pen tablet. The useful information is acquired from the pen tablet is XY-coordinate, pressure, direction, and altitude. If a pen tablet is detectable with a pen, even if the pen tip does not touch the input side, these data is acquired. If the pressure on the pen tablet is the pressure of the base, the pressure of tip becomes Z-coordinate from the pen tablet.

We express the light and shade by changing the pressure and Z-coordinate by using the droplet model. Additionally, the system reveals scratchiness and diffusion with an oriental brush that is affected by the amount of water and ink. As a result, users are able to write a calligraphy on the tablet with an oriental brush as a real brush and a feeling with a more delicate expression.
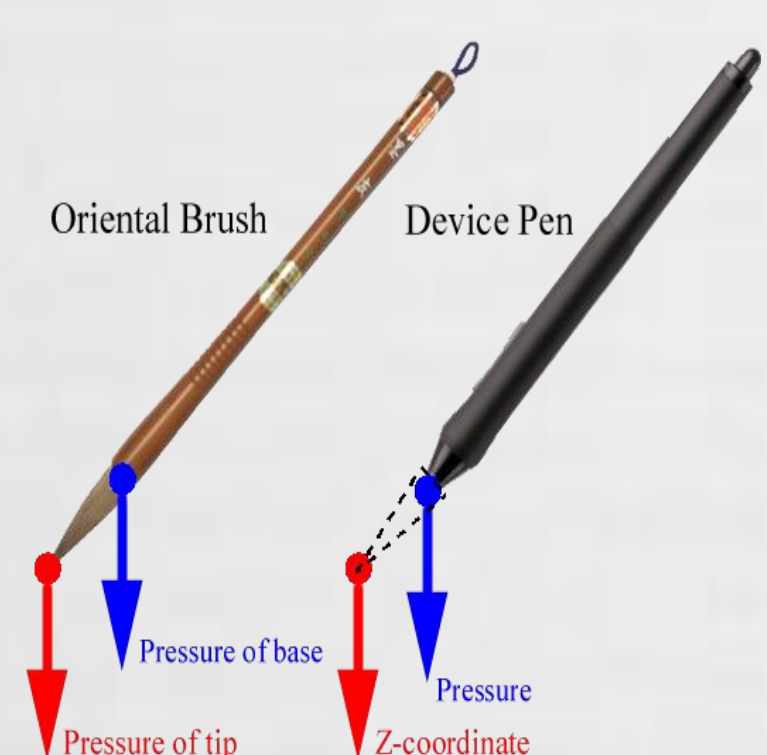

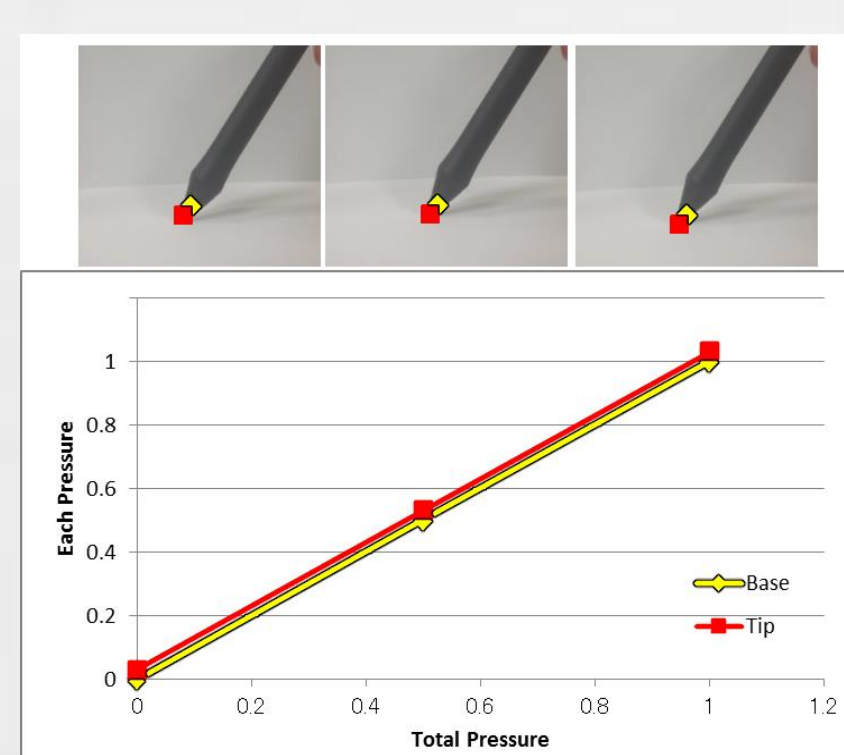Figure 1. The formation of the oriental brush and device pen.

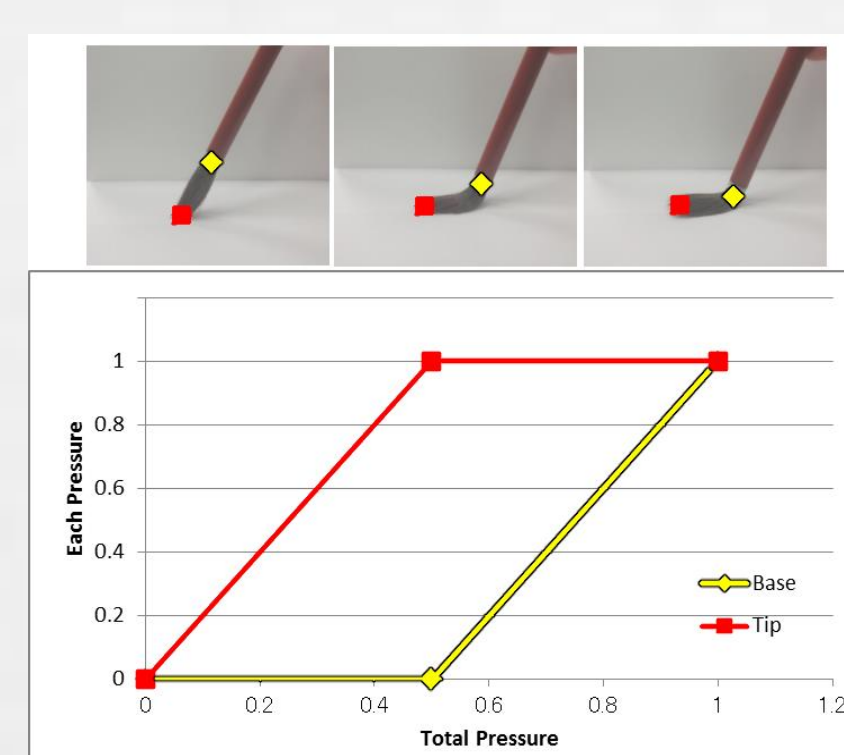Figure 2. Base and tip pressure of the device pen

Figure 3. Base and tip pressure of the Oriental brush

Proposed System For Writing Oriental Brush

In this paper, the main objective is to realize the oriental brush simulation in real time considering the pressure of the pen. We classify our system into two categories, a) Oriental Brush Modeling and Simulation and b) Calculate the Z-coordinates for the aerial action of the device pen.

In the oriental brush modeling and simulation, we describe the process of the droplet model, the action of ink color and tank, the ink diffusion, the ink scratchiness, and the light and shade of the ink.
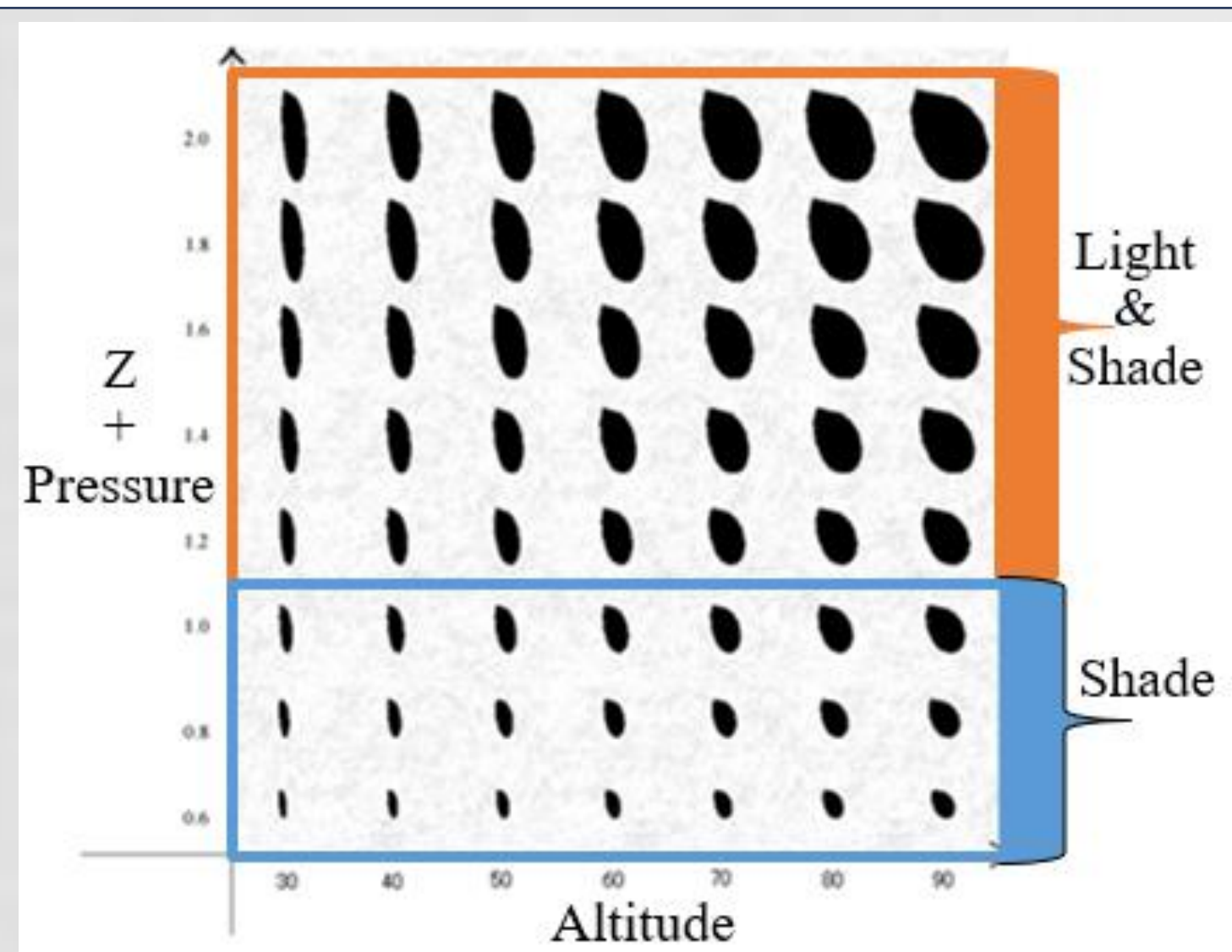

Figure 4. Droplet model of the system

Table 1. Example of Ink Color according to the diffusion level.

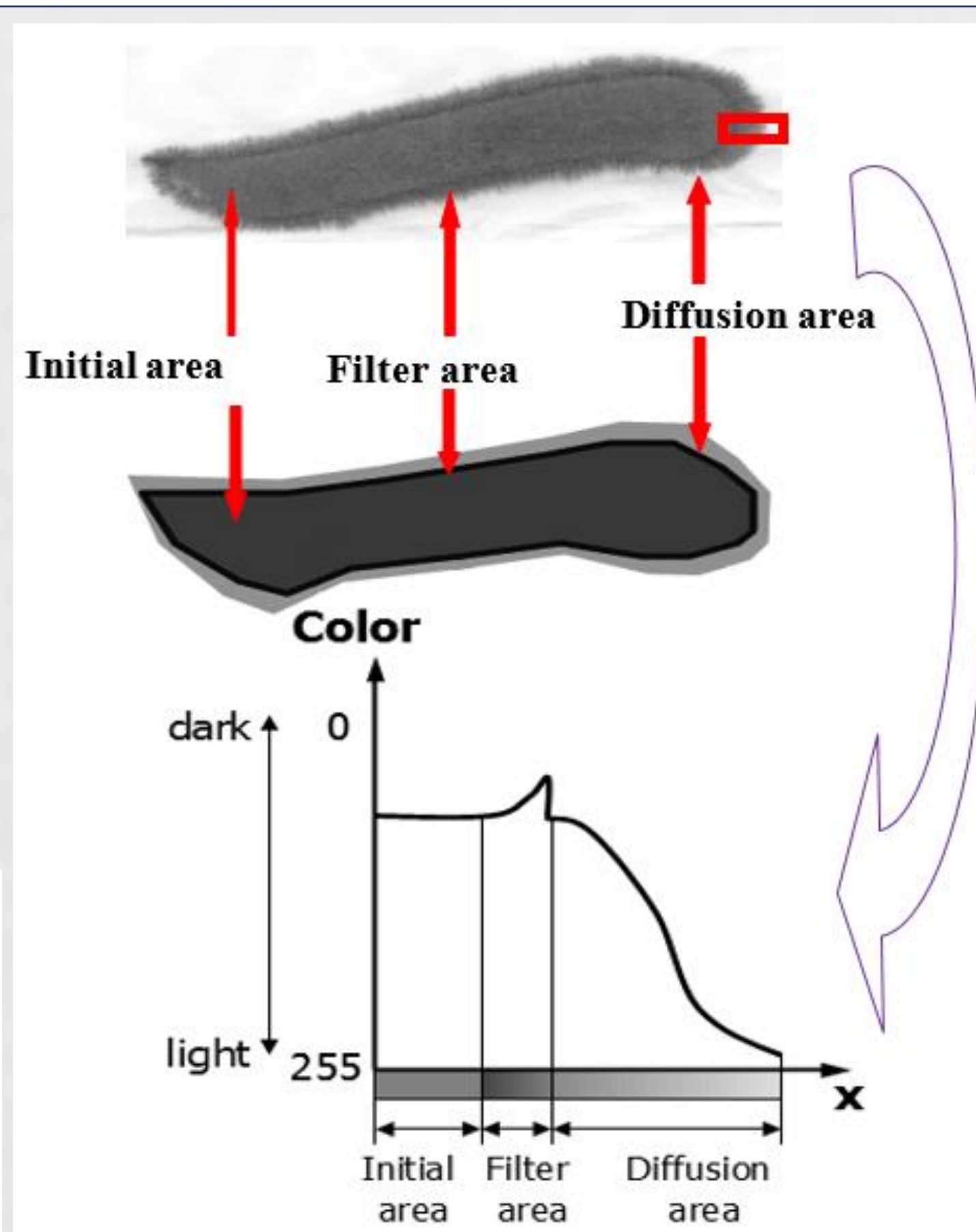| Water-Ink	Diffusion Level	Initial Area	Diffusion Area	Filter Area
-9	0	76	--	--
-8, -7	1	105	115	--
-6, -5	2	128	138	--
-4, -3	3	147	157	--
-2, -1	4	164	174	--
0	5	180	190	--
1, 2	6	194	204	189
3, 4	7	207	217	202
5, 6	8	220	230	215
7, 8	9	232	242	227
9	10	243	253	238

Figure 5. Partitioning of strokes when ink density is thin

The droplet model determines each droplet size and shape, which is calculated from the pen pressure from 0 to 1 range and the Z-coordinate of the device's brush. The Z-coordinate of the device pen deliberately gauges the center of the device's height from the tablet surface. Using the pen tablet, the system identifies its device pen if the pen in a certain height. In addition, the system obtains XY-coordinate of the brush tip from the tablet, even though it is not touching the tablet surface which reveals the pen identification area on the tablet surface.
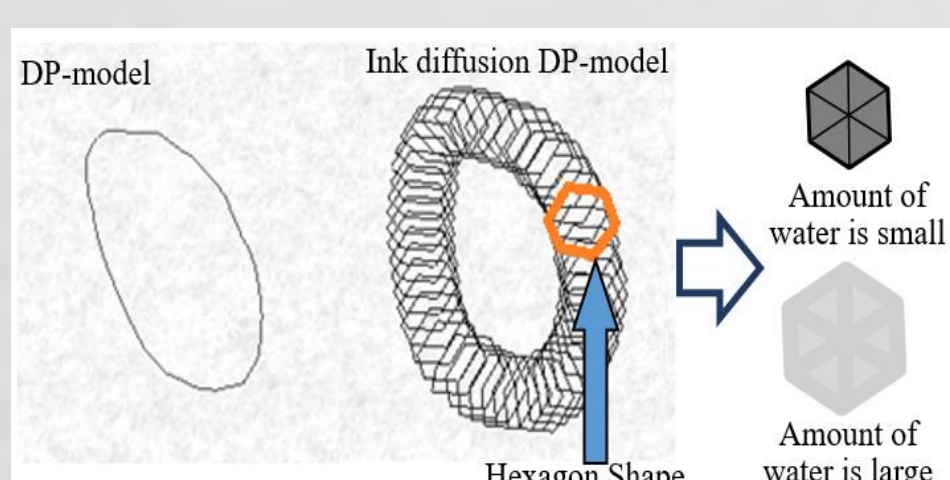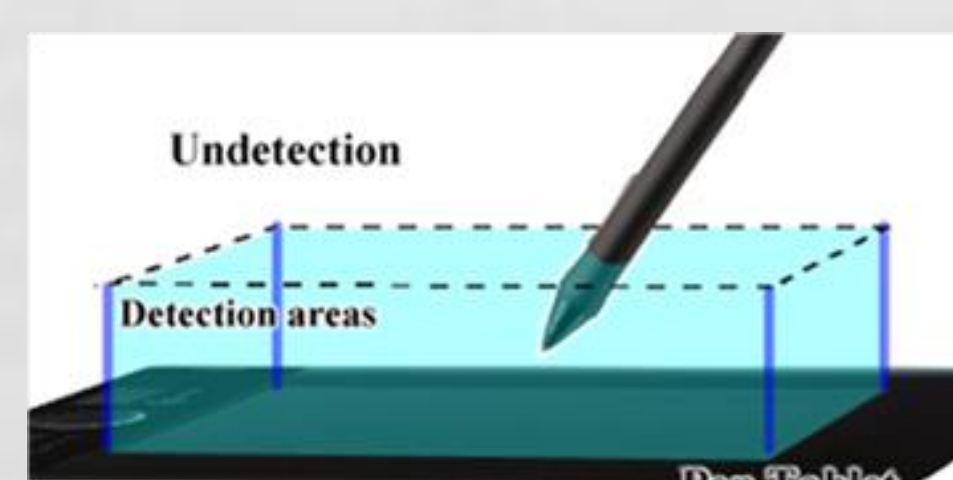

Figure 6. Ink diffusion DP model.
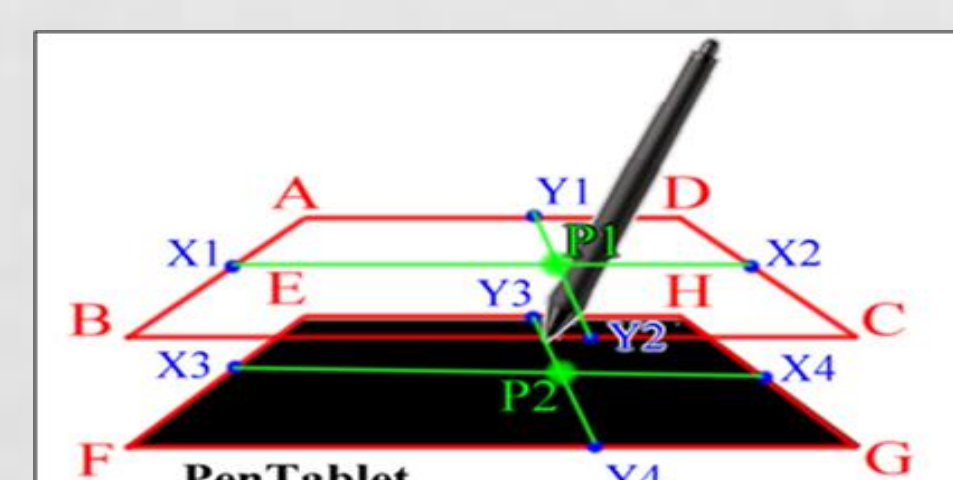
Figure 7. Detection area of the pen tablet.

Figure 8. Pen tablet in the acquired image.

Experiment, Results, and Discussion

During the experiment, the user performed the simulating oriental brush character by considering the XY-coordinate, pen pressure, pen direction, and altitude. The system measured the Z-coordinate of the user's device pen for performing the aerial action of the pen tablet.

In the brush simulation, users are drawn strokes using pen-tablet. The stroke size is based on the pen pressure and the angle, at the same time the XY-coordinates are dragged to the position. Before drawing a stroke, users can specify the color of the initial area and the amount of ink and water level. The color of the initial area can be specified from 0 to 254. The value 0 is that the stroke is drawn with the thickest ink and 254 is drawn with the thinnest ink. The level of ink and water quantity can be specified from 0 to 10. The value 0 means the ink quantity which does not diffuse any ink to the stroke drawing with the thickest ink, and the value 10 means the largest amount of ink contained in the brush.
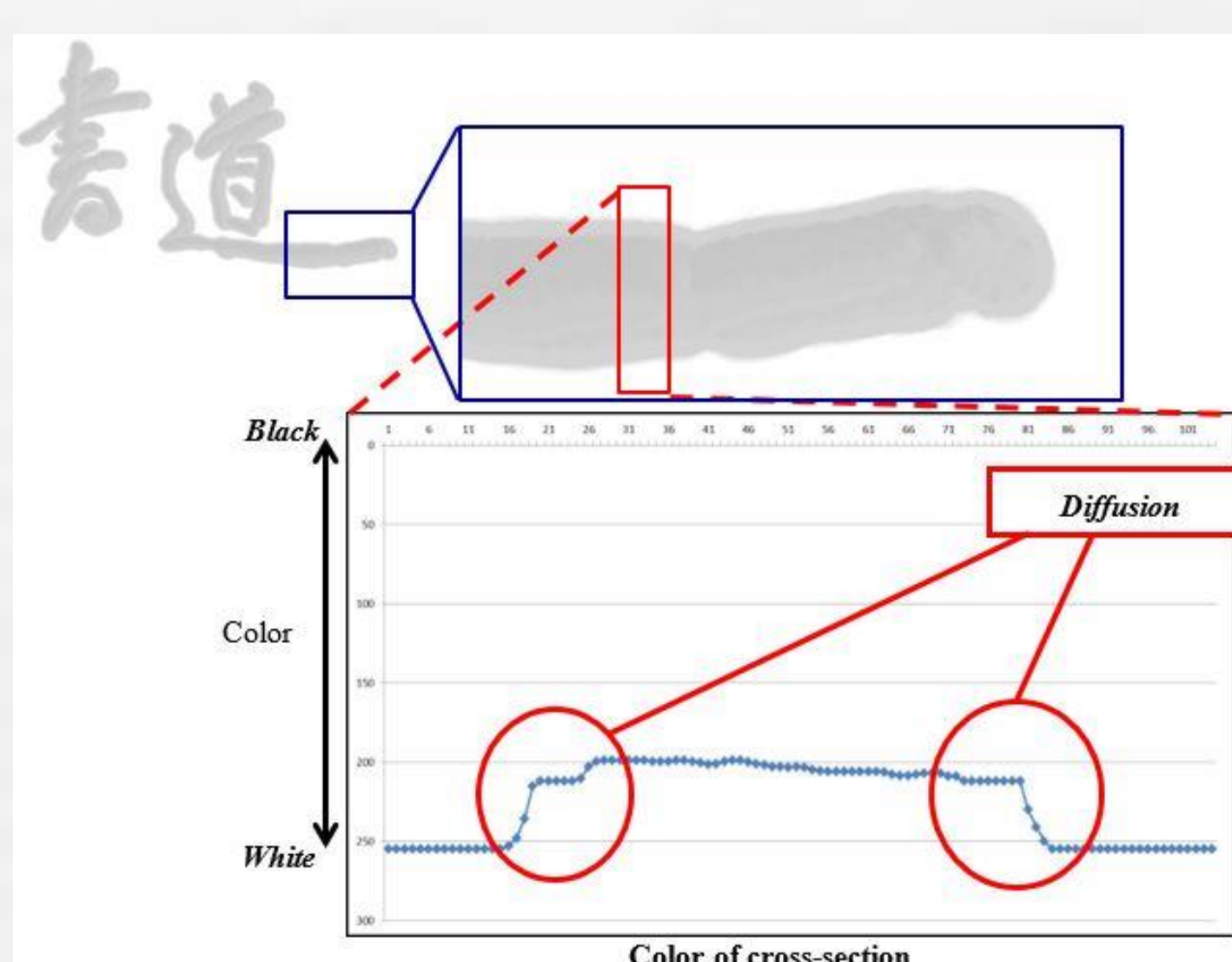

Figure 9. The color of the cross-section of the simulated stroke when ink and water density is 1:10.
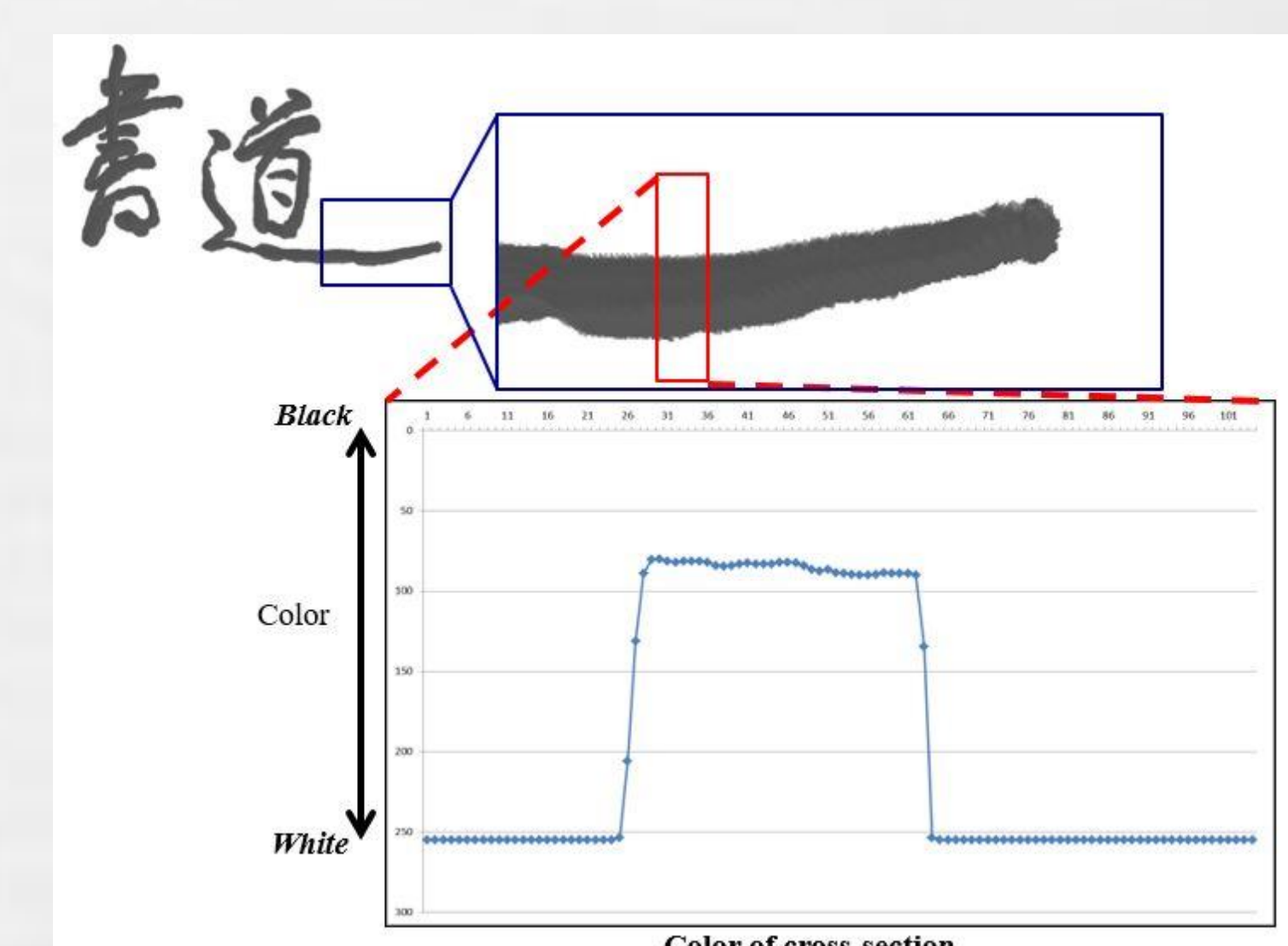
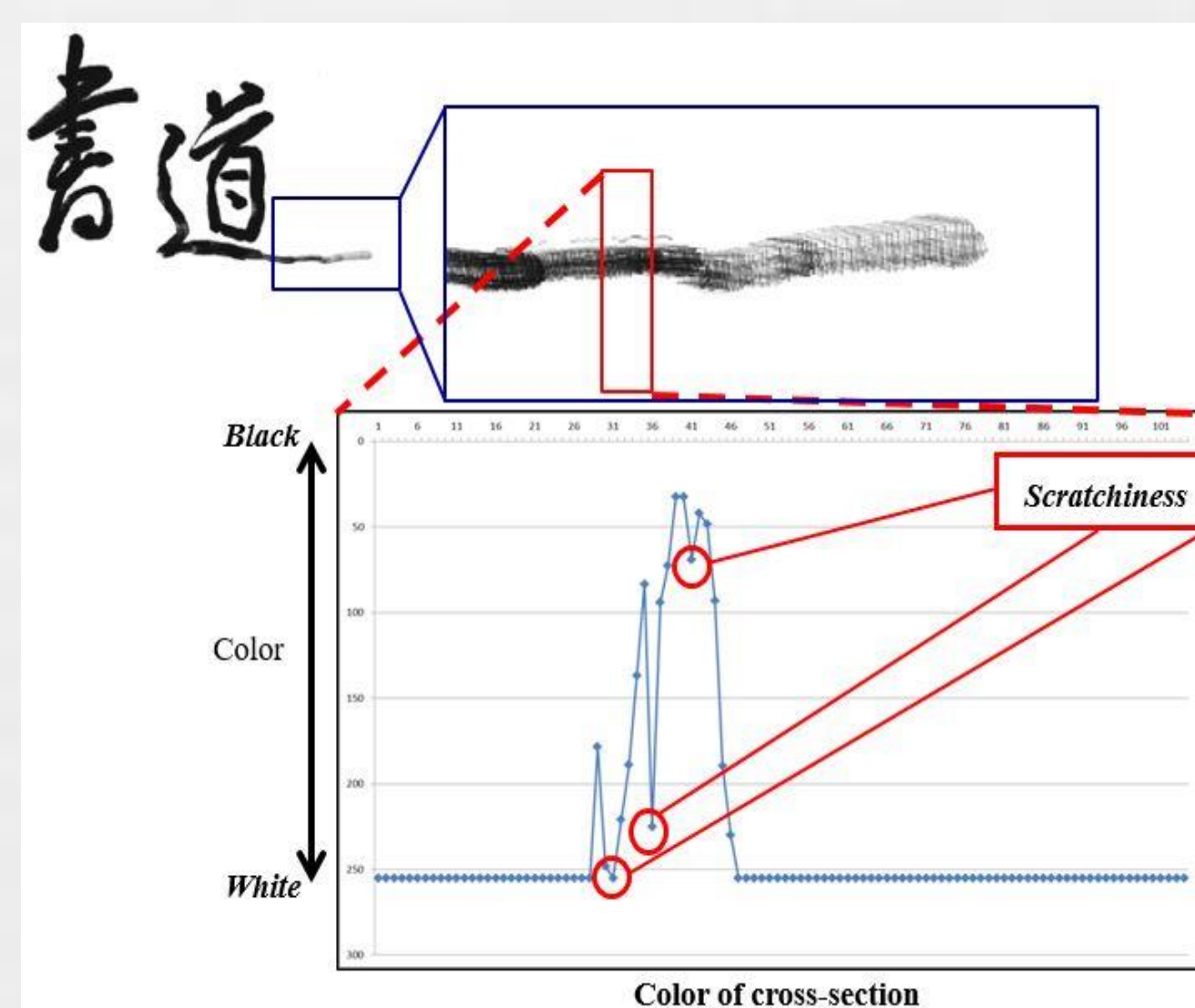Figure 10. The color of the cross-section of the simulated stroke when ink and water density is 5:5.

Figure 11. The color of the cross-section of the simulated stroke when ink and water density is 10:1.
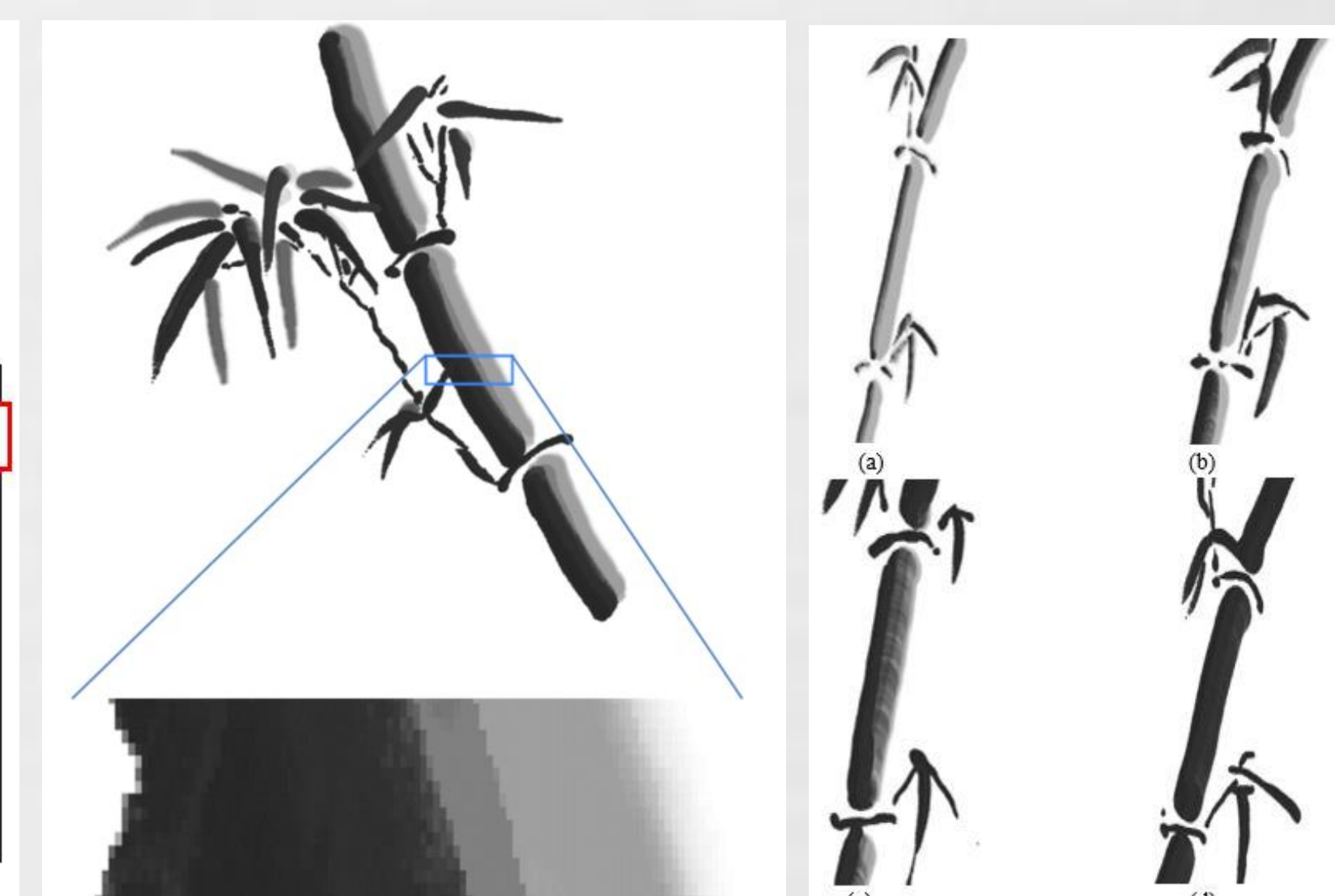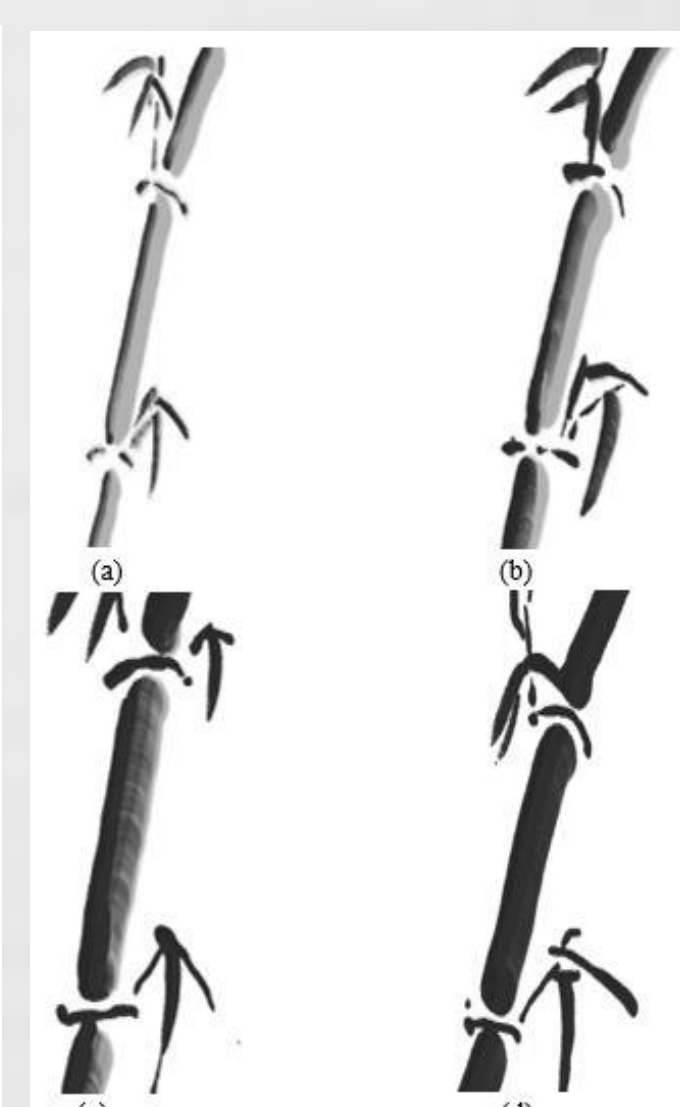
Figure 12. Results of the shade and light ink.

Figure 13. Different level of light and shade area.

The system obtains the Z-coordinate from the image which is taken using a web camera. The system calculated the distance from the tablet to the pen. This distance is Z Coordinate which is the pressure of the brush tip.
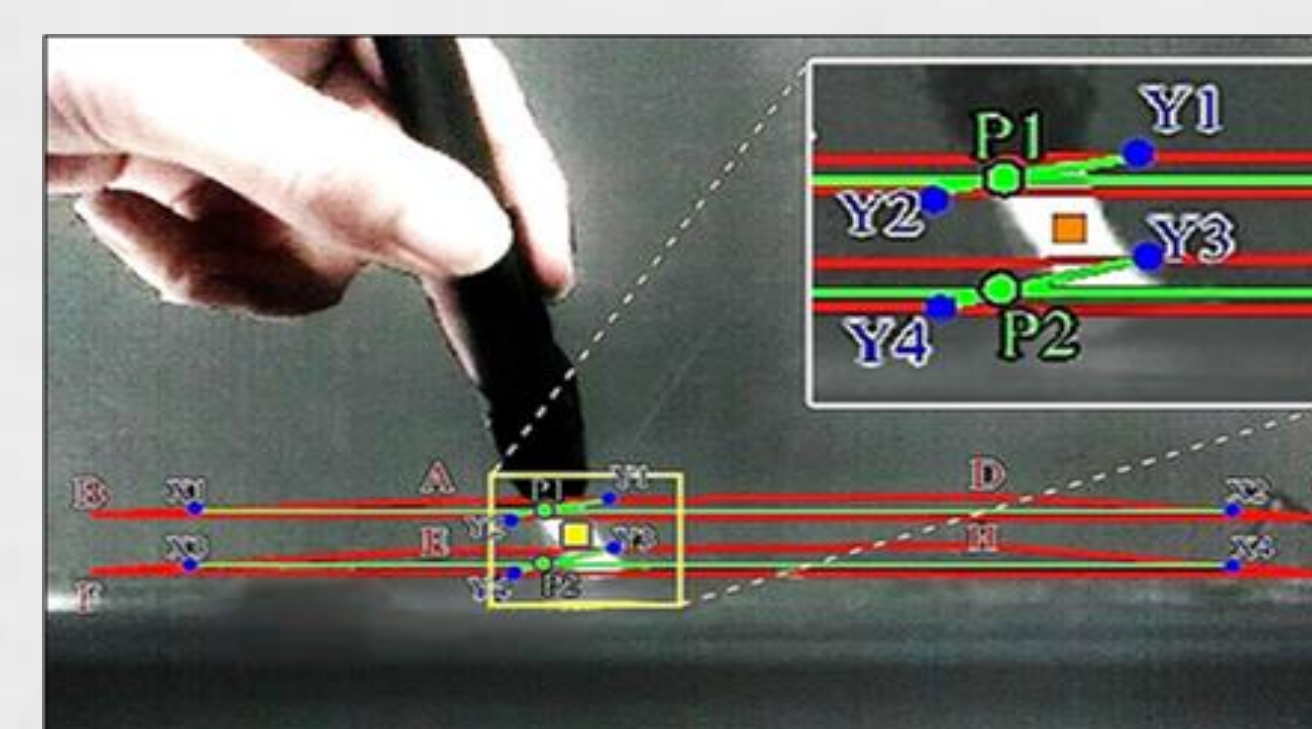

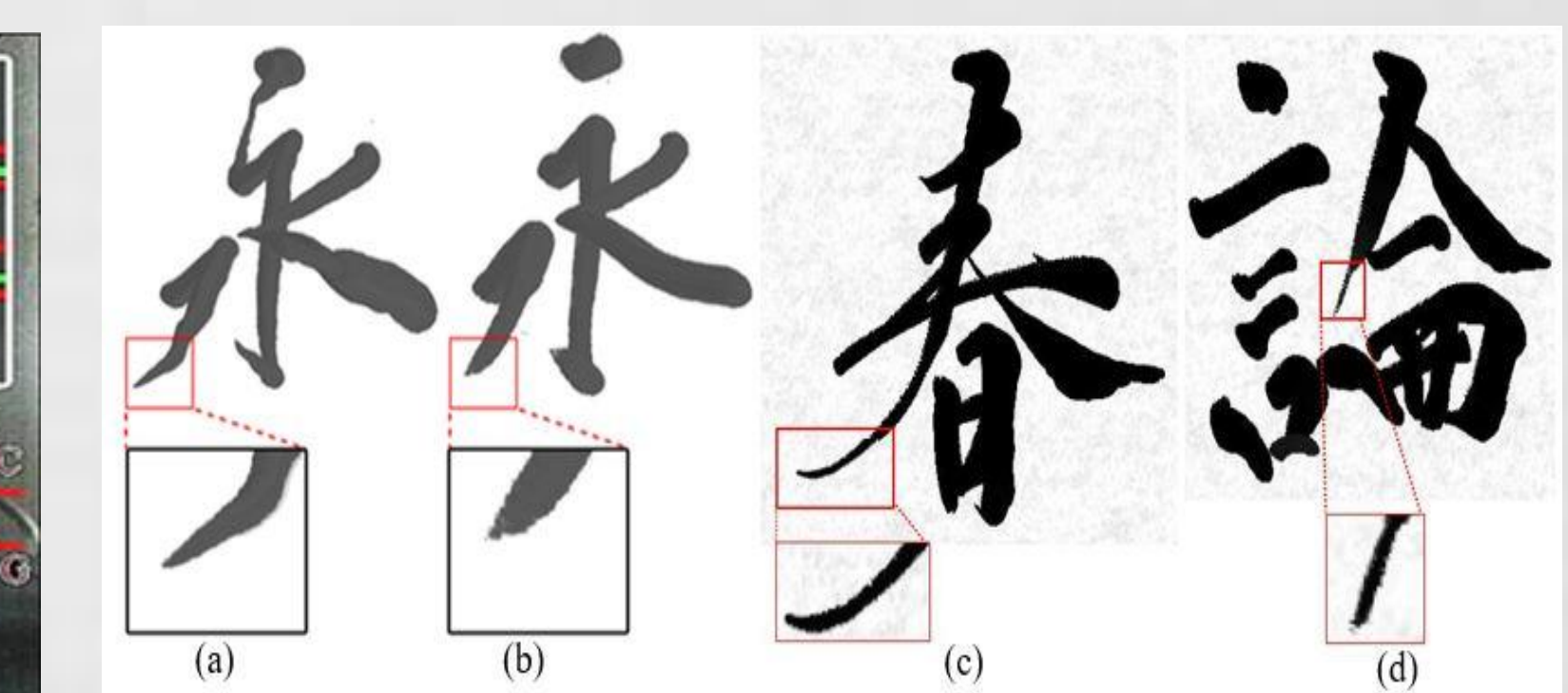Figure 14. A detecting process of writing the brush type device pen

Figure 15. Simulating brush character: (a) Considering Z-coordinates, (b) Without Z-coordinates, and (c , d) Example of character simulation with Z-coordinates

Conclusions

This paper presents the aerial action of the device pen which is considered to simulate the oriental brush character. The users simulate oriental brush with the same as the real brush. In this system, Z-coordinate can be acquired in real time and easy to detect the brush tip of the device pen by using the images of a web camera and pen tablet.

This Z-coordinate was considered to be an extension of the pen pressure and it had changed the size of the stroke when the base of the real oriental brush pressures the paper, the stroke hardly changes.

The user performed brush simulation by considering the XY-coordinate, pen pressure, pen direction, and altitude and by measuring the distance from brush tip and pen tablet to execute the aerial action of the device pen.

The aerial action of the device pen is reflected in different aspects, such as the droplet model size and shape, ink uses, ink diffusion and scratches, which enable the user to write calligraphy with device pen and feel that they can use a real oriental brush and make more fine expressions.

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