Painting Skill Transfer Through Haptic Channel

Ahsan Raza(✉), Muhammad Abdullah, Waseem Hassan, Arsen Abdulali, Aishwari Talhan, and Seokhee Jeon

Department of Computer Science and Engineering, Kyung Hee University, 1732, Deogyrong-daero, Giheung-gu, Yongin-si, Gyeonggi-do 17104, Republic of Korea
{ahsanraza,abdullah,waseem.h,abdulali,aishwari99,jeon}@khu.ac.kr

Abstract. In this paper, we focused on designing a system that can guide and train a user in painting an art work. Initially, we aim to develop a system which can guide a user with basic strokes of Korean language calligraphy. The proposed system is implemented in a sequence of three steps. Firstly, we collected the data from the surfaces of the canvas and different orientations of a painting brush. Then based on the data, a relationship is established among the collected parameters by building a machine learning model. Finally, actuators attached with the handle of the brush provides the vibrotactile and force feedback based on the built model. The actuator guides the user in order to paint the required object.

Keywords: Haptic painting · Painting skill · Haptic guidance · Deep learning · Haptic rendering

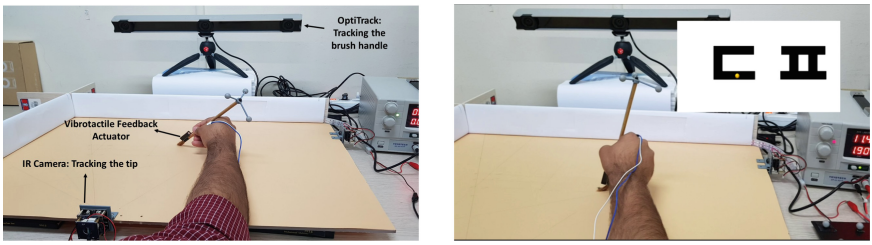
1 Introduction

Every art has a unique way that forces our senses to perceive the world in a distinct manner. Painting is among those arts that makes human beings to perceive the world in an exclusive and thoughtful way. This skill can be mastered by acquiring the native techniques and practices under the guidance of an expert. During the course of a painting, some parameters such as the force of a stroke and brush orientation are considered important in order to produce elegant artwork. However, in the modern world this form of art is on its decline due to lack of experts and interest. Therefore, the need of the hour is to device modern methods to preserve such art. One such method can be to use technology to preserve the knowledge and skills of expert painters and use that preserved knowledge to teach new students [2,3].

As the number of experts is ever declining, we need to design a system which can guide a naive user to achieve expert level painting skills. In order to design such a system, we need to establish a relationship between all the subtle parameters of painting such as force, acceleration, brush orientation etc., when a master creates a painting. Such system allows users with poor painting skills to be guided

H. Kajimoto et al. (Eds.): AsiaHaptics 2018, LNEE 535, pp. 66–68, 2019.
https://doi.org/10.1007/978-981-13-3194-7_14

through the process of learning art in the absence of an expert. However, the calculation of the required parameters should be done precisely so the system can guide the user in a similar way as an expert guides. Thus, a framework consisting of data collection, modeling and rendering is needed in order to build the required system.



(a) Tracking system (b) Demonstration scenario

Fig. 1. Illustration of the overall system

In order to achieve a realistic skill transfer system, the collected data should cater for the all the subtle nuances of painting. This realism is dependant on various parameters, i.e., the brush tip position, brush handle orientation, brush stroking velocity, surface texture of the canvas, and friction of the canvas. The brush tip, handle, and stroking velocity are tracked in real time. All these data are recorded during the data collection phase.

A sophisticated machine learning model is created from these data using deep learning. This model is intrinsically based on the intricate relationships between the collected data parameters. Therefore, it can be assumed that this model has the ability to preserve the finer details of the painting skill, as a result of which the realism of the model enhances significantly.

The last step in this system is rendering the haptic response. Rendering is a two step process in this system. First, a vibrotactile feedback of the surface profile is rendered by reproducing the tool-surface-interaction vibrations using the system proposed in [1]. Second, a force and torque feedback, for keeping the naive user on the correct track, is provided by using an asymmetric sine wave.

The main contributions of this work are listed as follow:

- Real time tip tracking using two infrared cameras and OptiTrack V120.
- Using deep learning to create a unified and realistic model that caters for the various parameters involved during painting.
- Haptic guidance using force feedback generated by using an asymmetric sine wave.
- A prototype paint brush equipped with various sensors for haptic guidance for painting skill transfer.

2 Demonstration

The purpose of this demonstration is to provide directions to the user to paint or draw a specific object. In the current scenario, the user will be learning basic strokes of Korean language calligraphy. The user will select a specific alphabet from the list of alphabets, and the system will guide and help the user to draw the alphabet aesthetically correctly. The haptic actuator can guide the user to keep track of a specific pattern to paint the required object. If the user deviates from the path, the actuator provides force feedback which keeps the user on the directed path. An illustration of the equipment (Fig. 1(a)) and a reference example (Fig. 1(b)) is shown in Fig. 1.

Acknowledgement. This research is supported by Ministry of Culture, Sports and Tourism (MCST) and Korea Creative Content Agency (KOCCA) in the Culture Technology (CT) Research & Development Program 2017.

References

1. Abdulali, A., Jeon, S.: Data-driven rendering of anisotropic haptic textures. In: International AsiaHaptics Conference, pp. 401–407. Springer, Heidelberg (2016)
2. Baxter, B., Scheib, V., Lin, M.C., Manocha, D.: Dab: interactive haptic painting with 3D virtual brushes. In: Proceedings of the 28th Annual Conference on Computer Graphics and Interactive Techniques, pp. 461–468. ACM (2001)
3. Vandoren, P., Van Laerhoven, T., Claesen, L., Taelman, J., Raymaekers, C., Van Reeth, F.: Intupaint: bridging the gap between physical and digital painting. IEEE (2008)