Haptic Technology and Motion Capture to Make Dance More Accessible for the Blind and Visually Impaired

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ABSTRACT

This practice work seeks to explore how haptic and motion capture technology might be utilised to make the act of experiencing dance more accessible for a blind audience. Though visual impairment and blindness can mean differing things and speak to different experiences, this paper will utilise the term "blind audience" in reference to the group this technology will focus on. I had three guiding principles in this work:

•Can dance be translated into a haptic experience for those who are visually impaired/blind?

•Can this be done through designing a wearable garment that houses the haptic technology?

•Can this experience shape or alter an individual's understanding of dance?

CCS CONCEPTS

• **Dance and technology**; • **Embodied cognition and movement**; • **Interactive, experiential performances and installations**;

KEYWORDS

Wearable technology, accessibility, motion capture, kinaesthetic empathy, haptic technology

ACM Reference Format:

MAX, Mcp, Percy. 2022. Haptic Technology and Motion Capture to Make Dance More Accessible for the Blind and Visually Impaired. In *8th International Conference on Movement and Computing (MOCO'22), June 22–24, 2022, Chicago, IL, USA.* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3537972.3538026

1 EXTENDED ABSTRACT

In this demonstration, we will invite a blind audience member to experience the haptic glove. While they don the wearable, a dancer positioned in front of a motion capture (Kinect) device will dance. The information received via the Kinect with send code through a computer and trigger a haptic experience felt by the audience.

Initially, I will pair the haptic experience with audio description. This is to give the audience an understanding of the patterns and parallels between the choreography and the haptic experience generated in the glove.

After some time, I will retract the audio description while the dance continues. I am interested in finding out how much of the dance is still perceived in the mind's eye of the blind audience with only the haptics to provide information.

The dancer will progress from a still, neutral body to a body in motion. Each of the dancer's four limbs (right arm, left arm, right leg, left leg), monitored by a Kinect camera, corresponds to one of four motors embedded within the glove. Data from the performer's tracked body in motion is transmitted wirelessly to the palm and fingers of an audience member's hand, triggers the motor, and is felt as a series of touch sensations inside the glove. The greater the distance from the dancer's limb to their heart centre and the neutral body, the more vigorously the motor will vibrate. For the audience member, this sensations received from the haptic glove will trigger neurological information from the nerves of the hand to the tactile centres of the brain. Here the impulses can be translated such that an understanding of the dancer's movements in space unfold for the non-sighted audience member.

The materials used include; Xbox Kinect, Haptic Motors x 4, Wire, Arduino Leonardo, a glove with alterations, a computer (Figure 1).

Figure 1 shows the first prototype of the circuit created to demonstrate how information relating to physical bodily movement is detected by the Kinect camera and translated into a haptic vibration via wireless transmission and computer programming. The prototype takes inspiration from the tactile language of Braille such that blind and visually impaired audiences will be able to perceive the flux of a dance in real time. The important idea here is that the visually impaired wearer of the haptic glove will be able to experience the dynamics of the dance in alternate sensory ways, i.e. via stimulus to their hand, and thus an enjoyment of dance becomes not purely the prerogative of sighted audiences. The glove, in conjunction with other tools for accessibility (audio description / touch tours) might be able to help blind and partially sighted audiences experience dance beyond sight.

I have identified two schools of thought in order to identify the optimal position of the haptic motors on the hand and where they might correspond on the body. Firstly, the varying theories around the Eastern practice of Hand Reflexology; Zone Theory developed by William Fitzgerald, Energy Pathways and Pain Theory. They stipulate that zones in the hand correspond to places on the body due to the convergence of nerves and canals referred to as meridians. The second are a series of tests used in medical rehabilitation which include; proprioceptive testing: tests the ability to sense the position of a body part with the eyes closed. two-point discrimination: ability to perceive difference between one or two points of touch at the fingertips or elsewhere; this test of fine sensation is measured in

MOCO'22, June 22–24, 2022, Chicago, IL, USA

ACM ISBN 978-1-4503-8716-3/22/06…$15.00
https://doi.org/10.1145/3537972.3538026

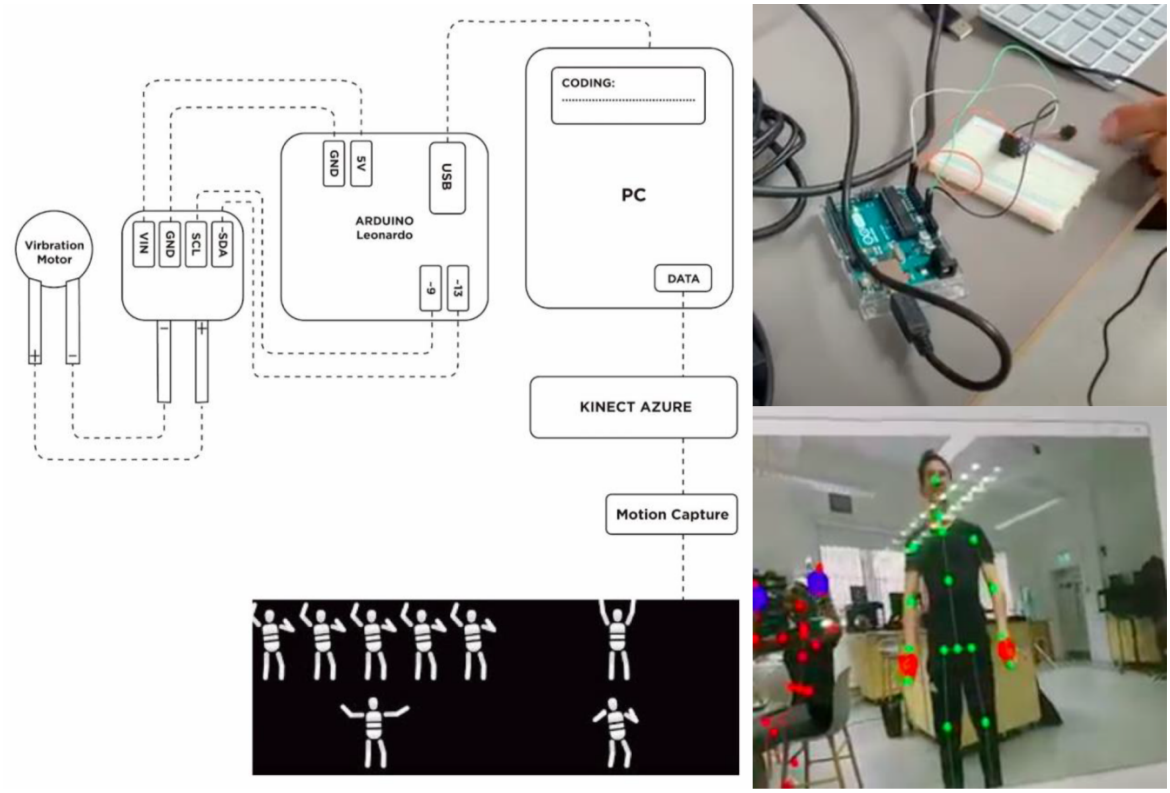

Figure 1: The first map and prototype of the circuit (top left and right), and the Kinect motion capture (bottom left and right). Photograph and images by Max Percy & Mingke Wang.

centimeters or millimeters. vibrator sense examination: tests the patient's ability to feel vibrations with use of a tuning fork. To ensure that these two schools of thought are relevant to the intended audience I will consult members of the blind and visually impaired community.

In addition, the Eastern practice of Reflexology has already linked specific areas of the hand with a corresponding zone on or within the body (Figure 2). The premise being that massaging or applying pressure causes a physical change to the supposedly related areas of the body, including some organs. In practice, I hope that this may tie in to the concept of Kinaesthetic Empathy and allow the audience members to internalise, experience and feel the performed dance. Though not scientifically proven, practices of reflexology clam to have calming or even restorative effects. This may present new avenues for choreographers and dance makers to explore.

On the haptic glove, the positions of the motors have informed by theories of hand reflexology. While this practice work only presents a prototype with four motors, this chart demonstrates the possibilities of an understanding for even more detail of movement while we wait for motion capture technology to advance and become more widely available for commercial use.

The first iteration of this research was supported by East London Dance and the London College of Fashion on their Creative Lab program - a week of interdisciplinary research and collaboration looking at convergences between dance, Technology and wearable

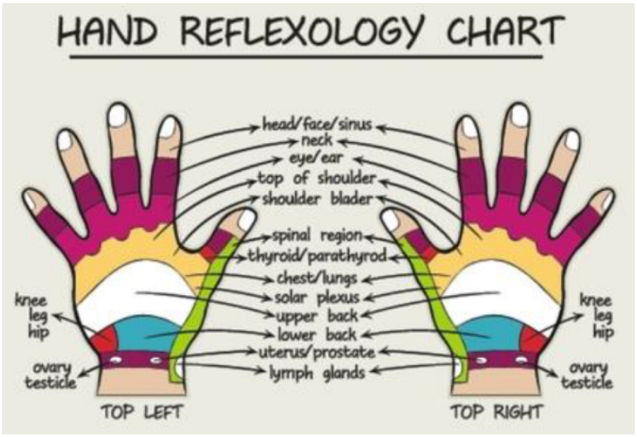

Figure 2: Illustration by Halim Qomarudin, via 123RF. (https://www.123rf.com/profile_halimqomarudin)

design. Here, I gained insight into each of the disciplines with presentations lead by the programme's facilitators. Another participant on the programme, Mingke Wang, had helped me produce the first prototype of the device. In order to do this, we had researched pioneers in dance accessibility. We then created a circuit with a single haptic motor, the Arduino Leonardo and Xbox Kinect. We identified

the rules for the code and inputted it with help from Mouhannad Al-Say, and created it with the support of Michèle Danjoux, both of whom are faculty at the London College of Fashion. The week culminated with a presentation of this prototype and a presentation of the working technology.

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