Dance With Me

CPSC 547 Project Proposal

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Introduction

How might we use the data we generate to connect with others?

Dance With Me is an interactive art installation that visualizes similarities between people's body movement. For 60 seconds, a user moves around in front of a motion sensor and sees their movement projected on a screen in front of them. This user can also see the movement of the person who used Dance With Me immediately before them. The previous user's movement footage is played timestamp-for-timestamp on top of the current user's movement. Similarities between the current and previous users' movement are visualized: physical overlaps in 2D space are mapped to shapes, similarities in joint positions are mapped to hue, and similarities in depth are mapped to luminance. At the end of the experience, the current user can keep the image generated by these intersections.

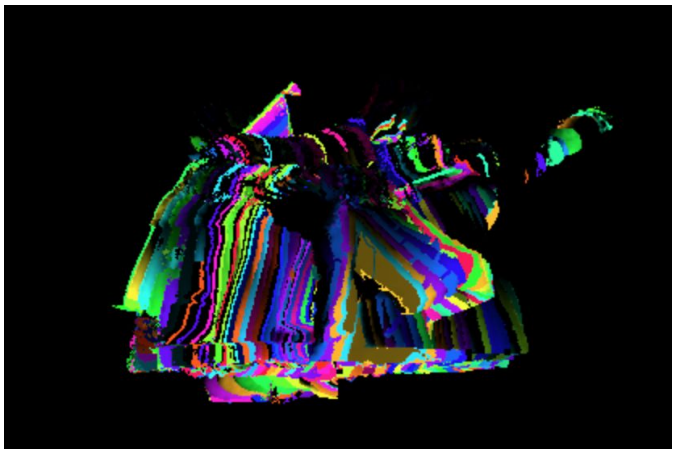

Figure 1. Example of an output image from Dance With Me.

Because of the dependence on the previous person's footage, the experience of the current person using Dance With Me has a direct effect on the next person's experience. The installation aims to explore how this dependency affects the relationships that users have with their data.

Dance With Me is my ENPH 479 capstone project. I am working in a team of four; we began working on the project in September 2019 and will wrap up development in December 2019. It currently supports the visualization of similarities between the current and previous user as described above. Work is currently underway to support the visualization of similarities within your own movement data; we are visualizing most frequented areas in space and most common joint positions. Thus, the capstone project will support two visualizations: current user vs. previous user and current user vs. themself.

For CPSC 547, I will design and implement an additional visualization: current user vs. all.

Domain, Task, and Data

Dance With Me is an art installation. The installation's main purpose is to provide an engaging and fun user experience.

A typical user will be completely unfamiliar with Dance With Me. By interacting with the installation, a user can generate artwork and explore how their movement compares to the movement of others. The user's anticipated tasks with the current user vs. all visualization are:

- **Generate** artwork using body movement
- **Discover** others' experiences by interacting with the installation
- **Discover** similarities between their movement and others' movement

The dataset is the movement data generated by all people who have used Dance With Me. This data can be organized by timestep, joint position, and location in 3D space. It is important to keep Dance With Me comprehensible and engaging; challenges with using this dataset include showing meaningful similarities to the current user, filtering down the data to be consumable in a short, real-time experience, and designing the visualization to encourage the current user to interact with the scene.

Depending on storage constraints, it may be necessary to limit the dataset to only include the most recent *n* people, e.g. the last 1000 people.

Proposed Solution

To visualize similarities between a current user and all previous users without cluttering the view, data will be filtered by time step, position in space, and joint position. As the current user moves around, the silhouettes of previous users who were at the same place at the same time will be displayed. A maximum of five previous silhouettes will be displayed; if no previous silhouettes are found at the current location at the current time, Dance With Me will look at adjacent locations in space to find previous silhouettes. These silhouettes will be distributed around the current user such that they are not completely occluded by the current user's silhouette. The previous silhouettes will continue moving while fading away, such that after one second, the silhouettes will have faded away completely.

If there is enough data, the data will also be filtered by joint position to retrieve previous users who were at the same place at the same time with similar joint positioning.

This design encourages the user to explore the scene by providing interactivity wherever the user moves. It also encourages the user to reflect on their movement through time and space. The exact output image from this visualization is to be determined.

Dance With Me can be sorted by time step: it runs for 60 seconds at 16 frames per second. This will make it straightforward to sort movement data into the correct time step. Next, the view is 512 x 424 pixels (width x height) and will be divided into evenly sized squares. Position data will be sorted by identifying the location of the current person's torso and determining which square the torso best maps to. Finally, joint position will be stored in a 16-bit number that encodes 16 boolean values that represent the

body, e.g. right wrist above right elbow, etc. This provides another key to sort movement data with. In this way, data can be organized and retrieved based on the current person's position at a given time step.

Dance With Me will be pre-populated with at least 20 previous experiences so that this current user vs. all visualization is not empty.

There is room to explore how to visualize the trails left behind by the silhouettes after they appear.

Figure 2. Example visualization of the current user vs. all users. As the current user (C, pink) moves around, the silhouettes of users who were in the same place at the same time as C will be displayed around C. The silhouettes will continue moving while fading away, such that after one second, the silhouettes will have faded away completely.

The current user vs. all visualization will be displayed alongside the visualizations of current vs. current user and current vs. previous user. The exact output image from this visualization is to be determined.

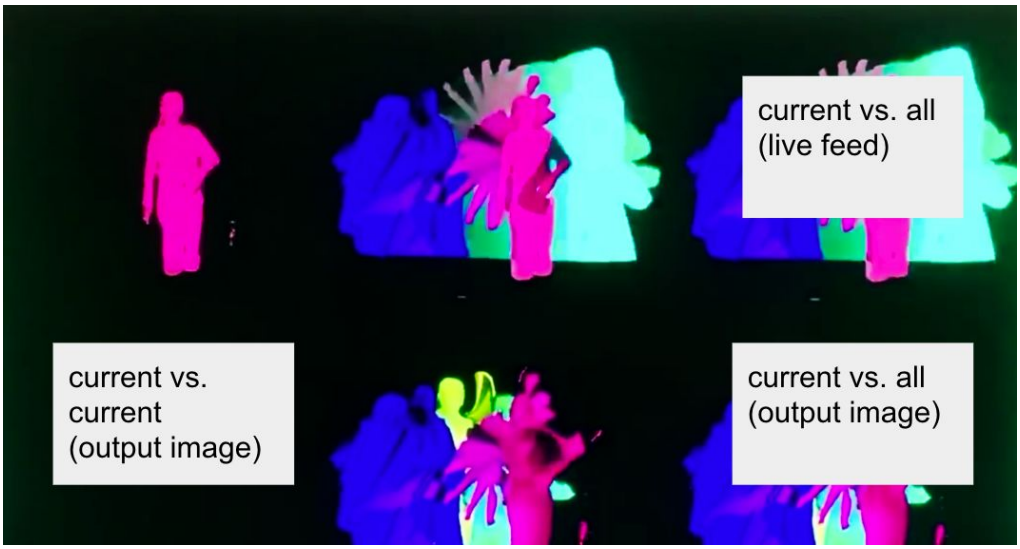

Figure 3. Example display that a user will see. The left column shows current vs. current user. The middle column shows current vs. previous user. The right column shows current vs. all users. The top row shows the moving scene in real time, while the bottom row shows the output images being generated in real time.

Scenario of Use

The following scenario assumes that data is not being filtered by joint position.

Anna walks through the AMS Student Nest at UBC. She sees a pop-up installation called “Dance With Me”, where she hears music playing and sees people dancing around in front of a projector screen. Intrigued, and with half an hour before her next class begins, Anna decides to check out the installation.

An installation organizer explains Dance With Me to Anna: for a minute, she can move around in front of a motion sensor and see her movement projected onto the screen in front of her. Three visualizations will be displayed in real time for her: similarities within Anna’s own movement, similarities between Anna’s movement and the movement of the person who used Dance With Me before Anna, and similarities between Anna’s movement and the movement of *everyone* who used Dance With Me before Anna. At the end of the minute, Anna can be emailed three output images—one for each visualization. The installation organizer also briefly describes what similarities will be visualized and how: for example, joint position similarities map to hue.

Anna stands in front of the projector screen and begins to move around. She sees all three visualizations as described, but is particularly interested in her similarities with everyone who used Dance With Me before her.

Anna notices that as she moves around in space, different-hued figures pop up around her. After these figures appear, she notices that they continue on their movement trajectories for about a second before fading away completely. Anna remembers that these figures are past Dance With Me users who were in the same space at the same time as Anna, and that the hues represent the past users’ joint positions at that point in time. As she continues moving around, more figures appear and fade away wherever Anna moves.

At the end of the minute, Anna gets images of the generated visualizations emailed to her. She also receives a short text file that reiterates what movement similarity information is encoded in the images. Anna finds it amusing that she was able to use her body movement to generate art on her own, with a stranger, and with a whole crowd of strangers. She wonders how the next people will use her movement to generate art of their own.

Implementation Plan

Dance With Me is being developed using Processing and uses a Kinect motion sensor to collect body data. We have built a prototype that reads and writes body data. It also visualizes 2D physical overlaps, joint position similarities, and depth similarities between a current and previous user, and visualizes similarities within a current user’s experience, i.e. a heatmap of most frequented locations and joint positions at those locations.

The current person vs. all visualization will also be developed in Processing. Because of the large amount of data that this visualization requires, an external database will likely be used to store data. This database will be queried at each timestep to fetch relevant body data.

Personal Expertise

This project marks my first time using Processing and a Kinect. This is also my first time working with body movement data. However, I have experience with programming and limited experience using databases.

Milestones

Task	**Estimated time (h)**	**Deadline**
Proposal	5	Nov. 4
Finalize technical details—what database to use, how to compute similarity, and what the output image should show	3	Nov. 11
Build proof of concept—determine how to organize data within database, set up database reading/writing, and ensure that reads and writes can be done without introducing significant lag (i.e. user feels like data is being rendered in real time)	20	Nov. 17
Preparation for Project Review 1	2	Nov. 19
Implement visualization details—encode silhouettes with correct colours, produce meaningful output image, etc.	10	Nov. 24
Conduct user testing	5	Nov. 28
Update visualization based on testing feedback	8	Dec. 1
Preparation for Project Review 2	2	Dec. 3
Presentation	10	Dec. 10
Final paper	10	Dec. 13

Acknowledgments and Previous Work

This idea for the current user vs. all visualization was heavily inspired by a discussion with Tamara Munzner about this project. To guide the visualization's design, I intend to research movement trajectory dataset visualizations to see what work has been done in this space. For example, Filho et al. [1] propose a 3D virtual reality Space-Time cube to visualize people's movement across space and time. There are also several sketches in PoseNet Sketchbook, developed at the Google Creative Lab, that map body movement to different channels [2].

References

1. Filho, J. A. W., Stuerzlinger, W., & Nedel, L. (2019). Evaluating an Immersive Space-Time Cube Geovisualization for Intuitive Trajectory Data Exploration. *IEEE Trans. Visualization and Computer Graphics*, 1–1. doi: 10.1109/tvcg.2019.2934415
2. Man, M. (2019, July 12). PoseNet Sketchbook. Retrieved November 4, 2019, from https://github.com/googlecreativelab/posenet-sketchbook