Pass-By: Development of Pedestrian Counts-based Art Installation for Passive Interaction

Jain-Lin Zhong
Graduate Institute of Animation and Film Art, Tainan National University of the Art, No. 66, Daqi, Guantian District, Tainan, Taiwan

R.P.C. Janaka Rajapakse
Graduate Institute of Animation and Film Art, Tainan National University of the Art, No. 66, Daqi, Guantian District, Tainan, Taiwan
E-mail: 1qazjk23@gmail.com, janakaraja@gmail.com
https://www.tnnua.edu.tw

Abstract

The trees in the streetscape grow as pedestrians pass by; we are always taking away and bringing in our surroundings without realizing it, perhaps some of the changes are very small, and we only notice them when they have grown to colossal size. This work presents a pedestrian counts-based art installation for multi-user passive interaction. This work focuses on the impact of people on their surroundings, which concerned a contemporary street scene projected in an open space and captured pedestrians' pass-by counts using an Arduino ultrasonic sensor. Based on the measured counts of pedestrians passing by, the developed application controls the color of the street scene and gradually decreases as the pedestrians cross. Based on the L-system mathematical model, the trees in the street scene progressively grow as the pedestrians cross.

Keywords: *L-system, Passive interaction, Interactive art, Touchdesigner*

1. Introduction

Most interactive artworks focus on tracking people's movements for instant reactions [1] [2] [3]. For instance, CutMod's Joy Displacement in Futura's Super Future event captures the human body movement and changes the image (Figure 1, left) [4]. Focus on real-time changes such as Daniel Rozin's Shiny Ball Mirror, two reflections being produced in front of the viewer using metal balls (Figure 1, right) [5]. This paper proposes an interactive art installation called "Pass-By," which does not create instant interactions and focuses on the long-term accumulated data for content generation.

The aim of the Pass-By installation is to emphasize the less frequently overlooked elements of our lives, such as the intersections that we pass by on our way out of our homes or the trees we see on the streets. Therefore, the street in front of my house was captured as the background of the installation, and the count of pedestrians passing by was recorded using the computer as the passive interaction technique.

Fig. 1 Joy Displacement (Left) [4], Shiny Ball Mirror (Right) [5]

The Lindenmayer system (L-system [6]) was used to create a gradient between the background trees and the background color as more people passed. As a pedestrian passes, the changes in color and the growth of trees in the projected scene are much more minor and are not immediately visible. However, as time passes and pedestrians again walk through the installation, changes in background color and tree growth can be noticeable, as shown in Figure 2. Furthermore, since pedestrians are treated as separate entities in the street scene, and our installation was considered to include them in the street scene itself, the composition of the scene allowed the shadows of pedestrians to be cast in the background when they pass through this artwork. The camera captures the moment of a passing pedestrian recorded in a particular day and transforms into a passing pedestrian playing the next day's background.

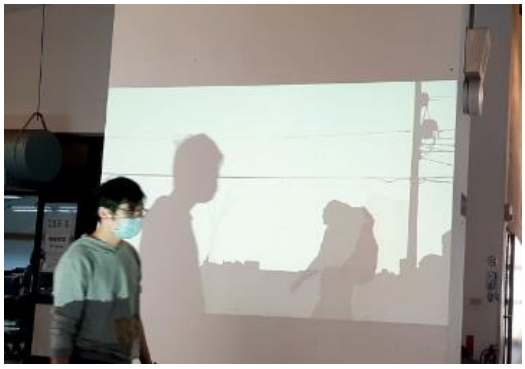

Fig. 2 Play the shadows of pedestrians as they pass by

2. Hardware structure

Figure 3 depicts the hardware structure of the installation, where the commodity webcam (Figure 4) was installed above the projector, recorded the pedestrians passing through information, and set up an ultrasonic sensor (Figure 4) below the projector to estimate the distance between the pedestrian and the projector. The installation maintained an appropriate distance between the projector and the projected screen, which allowed the audience's shadow to be cast on the screen and passively directed the audience to pass through.

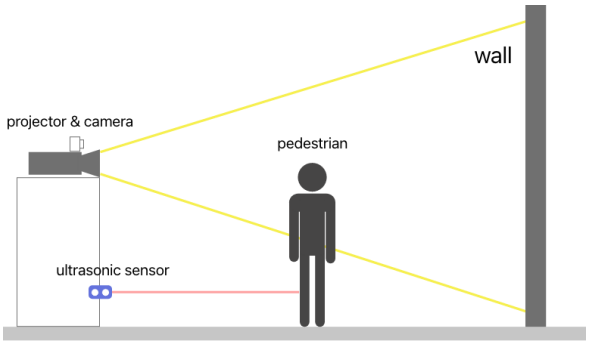

Fig. 3 Hardware structure

Fig. 4 Webcam and ultrasonic sensor

3. Visual Composition

A webcam on the projector recorded the pedestrians' posture. TouchDesigner [7] visual development platform converted the captured poses into a grey silhouette and saved them as a second-day animation when the pedestrian passes through (Figure 5).

The distance r measured by the ultrasound sensor is transferred to the TouchDesigner using serial data. As shown in Figure 6, data r is categorized into three ranges in the TouchDesigner and splits the three ranges into three variables a, b, and c Eq. (1).

$$\begin{cases} a: r < 20 \\ b: 20 \le r < 40 \\ c: 40 \le r < 60 \end{cases} \quad (1)$$

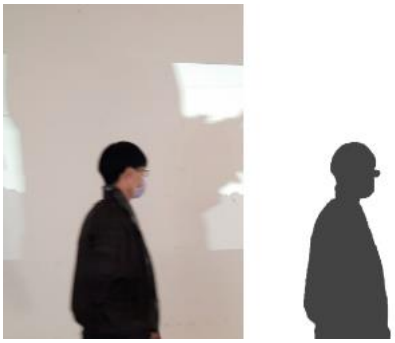

Fig. 5 Pedestrian transformed into silhouette

In addition, the number of people passing through three ranges, a, b, and c, is accumulated, and each person passing through the ranges increases the corresponding variable one by one. The three updated variables are exported to the projector view and generate changes.

3.1 *Color of background*

The first step is to input three variables a, b, and c into the RGB of the street scene, each with a negative value, the first variable a to red, the second variable b to blue, and the third variable c to green. The higher the value of the corresponding range, the more color loss occurs as each pedestrian passes through having a specific color, as shown in Figure 7.

3.1. *Grow tree by L-system*

L-system is an iterative function that uses mathematics. The central concept of L-systems is that of rewriting. Rewriting is a technique for defining complex objects by successfully replacing parts of a simple initial object using a set of rewriting rules or productions. Use this method to simulate the growth of plants and model. As seen from the Algorithm of Plant Beauty [6], the L system is complete in plant construction, such as creating a forest scene, the growth of a vineyard over a house, and a Lily of a valley.

In this work, the L-system is used to create a slow-growing tree in the scene, as shown in Figure 8. And design a, b, and c are three models of different branches, each of which corresponds to three variables of ultrasound output. The three branches grow to different degrees depending on the number of people passing through the respective regions.

4. Real-time self-localization method

The bottom layer of the projector is a street background (Figure 9). Only an empty street background and the trees above it are projected when no pedestrians pass by. When the ultrasonic sensor detects(i.e., at a distance r < 60) a pedestrian passing, an animation of the previous day's pedestrian passing is displayed on the upper layer of the background and trees. As shown in Figure 10, the top layer of the image is the shadow of the current pedestrian.

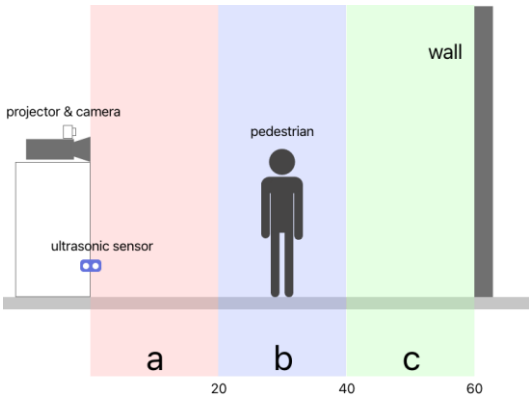

Fig. 6 Range of three intervals

Fig. 7 Gradually yellowing of view

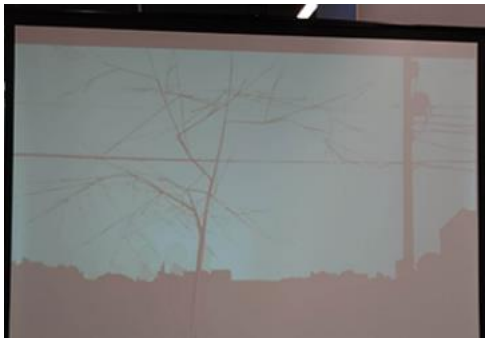

Fig. 8 The tree in the scene generated by L-system

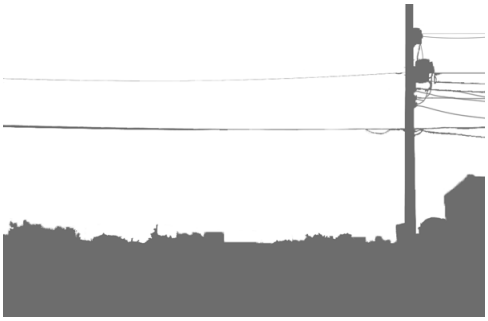

Fig. 9 Background

5. Conclusion

Pass-By can see the audience's own shadows projected onto the surface as part of the creation and contributes to the growth of the trees in the scene, with the appearance of the trees varying from one exhibition to the following (Figure 11). Some visitors stopped to inspect the trees when the Pass-By installation was exhibited at the testing exhibition. And few visitors were walking back and forth and trying to speed up the changes in the scene, especially children; they were waving their arms in front of the work to try to control the direction of the growth of the trees.

The future version would add the local weather conditions and affection of the sun's position to the scene's background, which would guide us to be more in tune with the time and place of the day and that each time and location will have its own characteristics.

Fig. 10 Layers Sequence

Fig. 11 Exhibition in the real world

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Authors Introduction

Mr. Jain-Lin Zhong

He received his B.Sc. degree from the Department of Physics, National Taiwan Normal University, Taiwan, in 2021. He is a Graduate student at the Graduate Institute of Animation and Film Art, Tainan National University of the Arts, Taiwan. His research interests include interactive art, computer animation, projection mapping, human motion, and public art.

Dr. Janaka Rajapakse

R.P.C. Janaka Rajapakse is an Associate Professor at the Graduate Institute of Animation and Film Art, Tainan National University of the Arts, Taiwan. And he is also a visiting scholar in the Media and Image Technology Department at the Faculty of Engineering, Tokyo Polytechnic University, Japan. He was a Postdoctoral Researcher at the Center for Hyper Media Research, Graduate School of Engineering, Tokyo Polytechnic University. He received his Ph.D. in Knowledge System Science from the Japan Advanced Institute of Science and Technology in 2008. His research interests include computer animation, motion capture, VR/AR/MR, haptic interfaces, AI, computer graphics, and Kansei Engineering. He is a member of the Motion Capture Society, The Society for Art and Science, ASIAGRAPH, and SIG-Design Creativity.