Infant

1 Overview

Infant is an interactive installation. This project artistically demonstrates an infant's reaction to the external stimulation with the help of various information technologies, such as computer vision, machine learning and robotics.

In this project, the infant will react to three types of stimulation: visual stimulation, auditory stimulation and tactile stimulation. Each of them will pose impact on the infant's state in its own manner, resembling what would be expected of an actual human infant. For simplicity, the infant's state will be modeled with two distinct aspects: alertness and comfort, each with its own hidden progress bar.

For artistic expression, we employ a graphical infant projected on a plexiglass sheet to visualize the infant's state. To be more specific, the graphical infant's form and style will change according to the infant's level of alertness and comfort/discomfort.

2 Interaction with Stimulation

2.1 Visual Stimulation

Expected interaction A surveillance camera will detect visual stimulation, which manifests itself as the approaching and leaving of audiences. Such visual stimulation will only influence the infant's level of alertness. Specifically, when a new audience approaches, the infant's attention will be drawn. However, the longer the same audience stays, the less curious the infant will be.

Real-life correspondence A real-life infant's eyesight is not well developed yet, so the world it sees is very blurry. Thus, visual stimulation is the slightest one by which an infant will be affected, acting barely on the infant's state of comfort. However, infants do have the tendency to react to visual stimulation out of curiosity. It may stare at an object of interest, such as human faces and moving objects. On the other hand, when the same stimulation is constantly present, the infant will gradually lose its interest, which is known as *habituation*.

Technical details In order to track the approaching and leaving of audiences, we resort to RGB-image based human face detection and tracking algorithms.

Notably, we use *FaceBoxes*, a neural network based solution, to enable real-time face detection with CPU.

2.2 Auditory Stimulation

Expected interaction A sound sensor, which takes on the appearance of an ear-like sculpture, will detect sound resulting from the audience's playing a squishy toy. Such auditory stimulation is able to add to the infant's level of both alertness and discomfort. Specifically, if the squishy toy is played at an appropriate distance, the infant will be alerted. If the squishy toy is played too close to the "ear", the infant will feel uncomfortable.

Real-life correspondence Infants in the real life are sensitive to auditory stimulation. An infant starts to develop its hearing system before its birth. Moreover, it can react to various sounds as early as when it's one month old. Specifically, proper auditory stimulation can console an infant. For example, an infant may stop crying on hearing its mother's heartbeat. On the other hand, when there is a sudden loud noise, the infant will feel uncomfortable and even get scared.

Technical details We can directly know the noise intensity over time as the output of the sound sensor. By applying a moving average filter, we can robustly detect outbursts of loud noise.

2.3 Tactile Stimulation

Expected interaction A pressure sensor, which is hidden inside a silicon cylinder, will detect pressure by the audience. Such tactile stimulation may impact the infant's level of comfort/discomfort. Specifically, if the sensor is gently touched, the infant will feel comfortable. If the sensor is forcefully pressed or suddenly loosed, the infant will feel uncomfortable.

Real-life correspondence Real-life infants enjoy cuddling from their caregivers. It is believed that the tiny warm space as a result of cuddling can remind the infant of the uterus, giving it a sense of security. However, if too much tactile pressure is exerted on the infant, it will definitely feel uncomfortable.

Technical details Similar to the handling of auditory stimulation, we can directly know the pressure over time as the output of the touch sensor. By comparing the reading to preset thresholds, we can easily distinguish among different scenarios.

3 Reaction & Visualization

A graphical infant is projected on a plexiglass sheet to visualize the infant's state. It starts out as color blocks. The fluctuation in the infant's level of alertness and comfort/discomfort is visualized by changes in the form and style of the graphical infant. In the state of alertness, the color blocks gradually get refined to a graphical infant. The gesture of it will also change according to its level of alertness, as shown in Figure 1. Additionally, in the case of visual

(a) low alertness (b) normal alertness (c) high alertness

Figure 1: Infant's gesture changes according to its alertness level

stimulation from approaching audiences, it will follow the newcomer for a while.

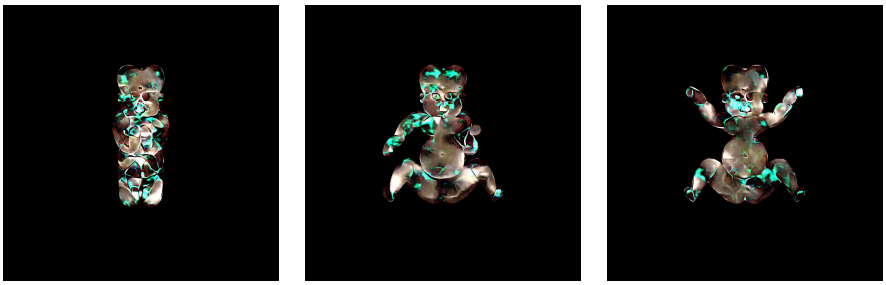
In the state of comfort, the graphical infant gradually appears to be brightly colored (see Figure 2). In the state of discomfort, the graphical infant gradually rots (see Figure 3). Moreover, too much pressure from the touch sensor will result in it being squeezed (see Figure 4a).

(a) low alertness (b) normal alertness (c) high alertness

Figure 2: Infant becomes brightly colored when comfortable

When the level of discomfort reaches a certain threshold, the graphical infant will display malfunction (see Figure 4b). In this case, it will no longer respond to the audience as stated above, representing the infant's crying behavior. The audience will be presented with two choices to stop the infant from "crying":

Consoling The infant's level of discomfort will be relieved on hearing the care-



(a) low alertness (b) normal alertness (c) high alertness

Figure 3: Infant rots when discomforted

(a) Infant gets squeezed (b) Infant displays malfunction

Figure 4

givers' heartbeat. For convenience, we use a pulse detecting sensor instead, which can detect the audience's pulses when touched with one's finger tip. Over time, the level of discomfort will be reduced. When it reaches zero, the infant stops crying, and the graphical infant restores to its normal form. This process takes 100 seconds.

Reset Instead of consoling the infant, leaving it for 1000 seconds will reset it and thus get it out of the crying state. As a result, the graphical infant goes back to the form of color blocks. A counter will show how many times the system is being refreshed.