Please Smile

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ABSTRACT
Nowadays, with reductions in manufacturing costs and a transition toward lifestyles of convenience, robots are becoming pervasive in our homes, museums, and hospitals. In addition to increased demands for robots in these domains, recently more artistic robots that interact with audiences on a personal instead of a practical level are now being exhibited in art exhibition. This paper explains how people interpret artistic robots as more than mere machines in the theory of intentionality and introduces the implementation of the artistic robot, *Please Smile*, which consists of five robotic skeleton arms that gesture in response to a viewer's facial expressions. The paper also explores how individuals can use experimental designs to create artistic robots that can express various ideas that traditional, practical robots can often not convey.

Keywords
Artistic robots, computer vision, skeleton arms, smile detection

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation (e.g., HCI): User Interfaces; J.5 Arts and Humanities

General Terms
Design, Experimentation, Performance

INTRODUCTION
The production of robots has expanded to interdisciplinary fields that cover the design of mechanical and electrical components, sensor technology, computer systems, and artificial intelligence [5]. Denmark robotics scholars Luigi Pagliarini and Henrik Hautop Lund [7] suggested that groups from many walks of life such as philosophers, artists, scientists, engineers, and ordinary people are interested in and curious about robots because they have practical and sociable characteristics as well as various forms and designs.

Due to the complex interdisciplinary nature of the field, the definition of "robot" varies. Science journal describes robots as "microprocessor-controlled mechanical devices that perform functions or provide an intelligent interface between machines of processes. They can be intelligent enough to make on-the-spot manufacturing decisions. They can duplicate human manipulative skills with accuracy and precision" [6]. Another definition from the Robot Institute of America is "a robot as a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks without human intervention" [4]. All of these definitions discuss the functionality and control of primarily industrial robots. However, by broadening the range of robotic categories, we can explore robots on a more personal level according to their features and relationships with people, which are often acknowledged when audiences appreciate them as art forms. This paper discusses how people interpret artistic robots as more than mere machines using the psychological theory of intentionality; it also introduces the implementation of the artistic robot, *Please Smile*, and explores how developers apply their ideas of experimental design form and function to create artistic robots that differ from traditional, practical robots.

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THEORETICAL BACKGROUND
A philosopher and psychologist in the 19th century, Franz Brentano introduced the concept of "intentionality" used in philosophy and cognitive science to explain why people believe that machines can think without any human level intelligence. To explain mental phenomena, he used the phrase "intentional inexistence" [1]. German philosopher Edmund Husserl borrowed the term when he explained that consciousness is always intentional and links the mental and the physical world. Followed by Husserl, we detect the external physical world using our intentionality through our bodies.

The view is also supported by philosopher Daniel Dennett [3] in Intentional Stance. In his view, people applied three strategies to predict the behaviors of living organisms such as plants, animals, humans, and even artifacts. Whereas some are based on the laws of physics, or "the physical stance", others are determined by design, or "the design stance". Sometimes neither the physical nor the design stance is applicable, so another stance, "the intentional stance," can be adopted. The intentional stance treats plants, animals, humans, and artifacts as rational agents with beliefs and desires in order to further predict how they

are going to behave. In the same way, humans apply more meanings to a robot's perceived behaviors when the robot exhibits subtle predictable cues, so humans perceive robots as more intelligent agents.

IMPLEMENTATION

Please Smile combines artistic concepts and engineering technology to create a robot that interacts with humans. Compared to the traditional perspective of practical robots for manufacturing purposes, the new perspective of the artistic robot enables audiences to interact with robots on a more personal level and appreciate their aesthetic value as works of art.

Please Smile is an exhibit involving five robotic skeleton arms that change their gestures depending on a viewer's facial expressions. It consists of a microcontroller, a camera, a computer, five external power supplies, and five plastic skeleton arms, each with four motors (Figure 1). It incorporates elements from mechanical engineering and computer vision to create a more expressive robot. When people interact with the robotic arms, they encounter unexpected reactions.

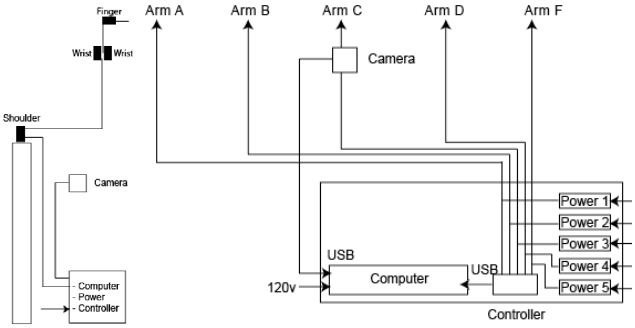

Figure 1. Structure of *Please Smile*

Audiences interact with "Please smile" in three different ways. When no human falls within the view of the camera, the five robotic skeleton arms choose the default position, which is bending their elbows and wrists near the wall behind them. When a human steps within the view of the camera, the arms point at the human and follow his/her movements (Figure 2, left). Then when someone smiles in front of it, the five arms wave their hands (Fig. 2, right). Through Please Smile, audiences foster positive behaviors such as smiling.

Figure 2. Interactions of *Please Smile*

From the sequence of images of the camera, the Smile Detector (SD) program (Figure 3) first detects frontal faces [9], and then the detected face regions are evaluated through our smile detection function. The function is trained in the SVM (support vector machine) algorithm in which HoG (histogram of gradient) [2] features are used as feature vectors. For training the SVM, we prepared training data from Genki-4K dataset [8], which contains 4,000 faces, smiling labels, and head poses. Since the faces are not preprocessed enough, we cropped the frontal face regions from the dataset using the head pose data. With HoG features defined as 6 X 6 cells and 8 X 8 blocks, our smile detection function showed 95.5963% accuracy.

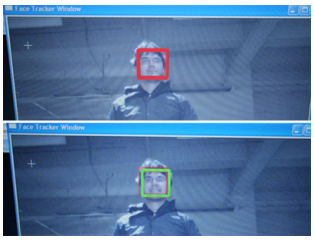

Figure 3. Smile detector (SM) program of *Please Smile*

CONCLUSION

Please Smile was exhibited at Buffalo Arts Studio, United States and FILE festival at Sao Paulo, Brazil in 2011. Hundreds of participants interacted with this artistic robot, and in their comments, they stated that it was sometimes "friendly" but also sometimes "scary." Because Please Smile's reactions to audiences' facial expressions imitate the movements of social creatures, it triggers people's imaginations and interpretations of intentionality, rendering the robot more life-like.

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