Design and Implementation of an Interactive Animatronic System for Guest Response Analysis

Brian Burns
Georgia Southern University, bb02015@georgiasouthern.edu

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Within entertainment applications, animatronics must be identified as human partners to establish status for dynamic interactions for enhanced acceptance and effectiveness as socially-interactive agents. This research covers the design and implementation for human identification using a depth camera (Carmine from PrimeSense), an open-source middleware (NITE from OpenNI), Java-based Processing and an Arduino microcontroller into an animatronic dragon. Using the data from depth camera, people are identified by approximating a person's skeletal information. Based on the movements of the individual, the program tracks a human body, or bodies, within the camera's field of view. Joint locations, in the tracked human, are isolated for specific usage by the program. Joints include the head, torso, shoulders, elbows, hands, knees and feet. The dragon capabilities include a four degrees-of-freedom neck, moving wings, tail, jaw, blinking eyes and sound effects. These outputs instigate a movement in the tracked human, which establishes the cycle of human to animatronic interactions. This animatronic creature design will allow for future research in the effectiveness of interactive elements in themed environments.

A people-aware, autonomous, animatronic system can be designed for testing effectiveness of interactive animatronics. Interactive, animatronic behavior will be more entertaining than passive behavior.

Two small studies have been conducted with elementary school students and college students. No statistical difference was found between passive and interactive behaviors with the children. College students, without prior exposure to Kronos, ranked interactive behavior greater than passive.

The key input to the dragon for interactive behavior is the depth camera. The PrimeSense Carmine was chosen for the project and is pictured in the image below.

A depth camera holds a large advantage over a color camera in many robotic applications. Instead of identifying objects based on color, objects are identified by pixel locations in space. In the images to the upper right, white pixels represent the closer objects to the camera while the black represents those that are farthest away. The projector emits an irregular pattern of infrared dots of varying intensities. The infrared camera recognizes the pattern and constructs a depth image.

The x, y, and z coordinates of the head position are recorded and sent to the microcontroller. The program is capable of tracking multiple people at once.

All programming utilized OpenNI and NITE middleware libraries inside the Java-based Processing software. The software initiates a “handshake” with the Arduino microcontroller in order to relay the coordinates. The microcontroller serves as the central ‘hub’ of control and utilizes calibration equations to turn the coordinates into position commands for the motors and actuators, as well as, signals to the audio processor.

The interactive, animatronic behavior will be more entertaining than passive behavior.