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Entertainment Robotics

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Overview: Education and entertainment are important applications for humanoid robots. Dual arms, vision, audition (audio input), and compliant control make these robots capable of musical and artistic performance.

Theremin-Playing Robot: The theremin is one of the only musical instruments which is played without being touched. In addition, it is the oldest electronic musical instrument. Both the pitch and volume of the theremin are controlled by waving one's hands in the proximity of two metal antennas. Playing the theremin is difficult. Because the nonlinear response of the pitch antenna means that notes higher in pitch are located closer together spatially. Moreover, unlike conventional instruments such as the piano or guitar, there is no physical reference between any note and its location relative to the instrument.

A humanoid robot has been developed which overcomes these problems and performs music with the theremin. In order to produce perfect musical notes, the robot plays "by ear," as opposed to memorizing the locations of notes relative to the antenna. Pitch detection software allows the robot to detect any error between a desired note and the note currently being played. Soft pneumatic arms facilitate the production of human-like effects such as vibrato and tremolo. Additional software allows the robot to be controlled via any MIDI (Musical Instrument Digital Interface) device, such as a synthesizer or guitar. Notes played on such devices are translated into commands for the robot, which quickly moves to play the note on the theremin.

Example Application:

OTHMAR-Drawing Robot: OTHMAR is a new soft arm robot under development, which explores the limits between man's creativity and automation in the field of visual art. OTHMAR has the ability to observe a person and to precisely mimic the motions of that person. By observing an artist in the process of drawing and by recording the motions, the robot can then reproduce the drawing itself at a later time. Because of the compliance of its soft arms, OTHMAR is unlikely to reproduce the drawing exactly. Each time it reproduces the artist's actions the robot will add its own subtle variations. Through experimentation with the robot, the artist can learn how to manipulate it so that the robot's added variations occur within the artist's plans for his work. Moreover, since the robot reproduces the artist's physical motions in creating the drawing, the robot's motions are a performance in themselves..

Potential Applications: Musical education, entertainment, and performance art.

References:

1. Kawamura, K., Wilkes, M.W., Pack, R.T., Bishay, M., and Barile, J.B., "Humanoids: Future Robots for Home and Factory," Proceedings of the First International Symposium on Humanoid Robots, Waseda University, Tokyo, Japan, October, 1996, pp. 53-62.