

ROBOTIC VIDEO GAME LEARNING

USING SELF-DETECTION

ABSTRACT

Robotic Tool Use and Manipulation tasks are a major goal of modern robotics. Research in psychology has demonstrated a relationship between the ability to use tools and the ability to create a self-concept among primates. A simplified environment to test self-detection and an instant application is provided in the simplified world of simple gameplay in classic games.

HARDWARE

The main Piece of Hardware Used is the Upper Torso Humanoid Robot (middle). The robot is equipped with two 7-DOF Barrett Whole Arm Manipulators (WAMs). The robot is also equipped with two webcams as eyes and a microphone embedded in the head. The microphone was not used, neither was the right eye or the right arm.



40" Television

A Television with a large screen was placed in front of the robot to display the games. The exact brand of the television was trivial but the size and image quality had to be sufficient to accentuate the game textures



Joystick

The traditional controllers for all the games will be replaced with a Microsoft Sidewinder Joystick. The specific model was selected for its size relative to that of the Robotics hand. The joystick will be clamped to the table for ease of use.

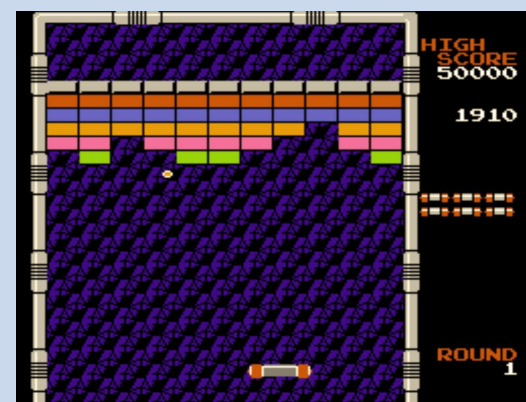
GAMES (INSPIRATION)

The games used were enhanced versions of classic video games and a 2D real-world application simulation



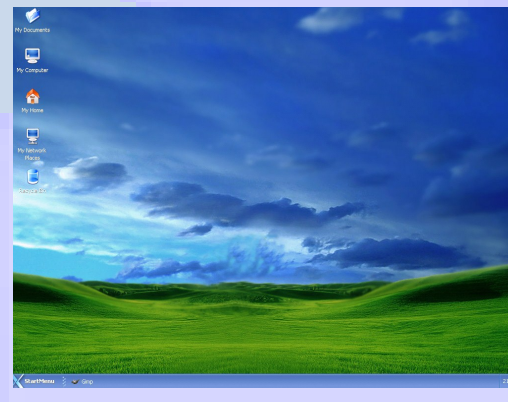
Pong (1972)

Pong is credited as being the first Game available to play in the home. It features head-to-head play and a vertical axis of movement.



Breakout (1976)

A simple paddle, ball, and brick game that was also known as BreakBrick and Arkanoid. In contrast to Pong, this game features a horizontal axis of movement and a single-player, high score-based play style.



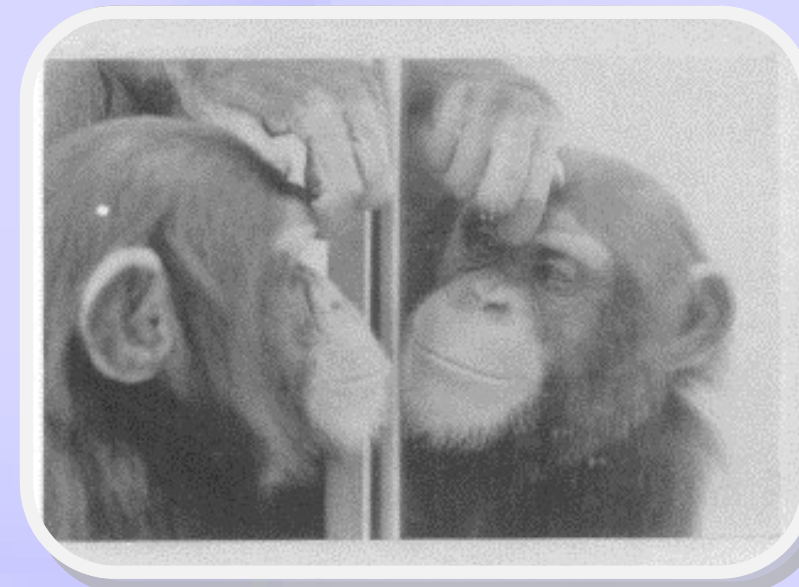
Desktop Sim

A natural Evolution of the two single-Axis games is a setup in which the robot can move in a two dimensional field to find a target.

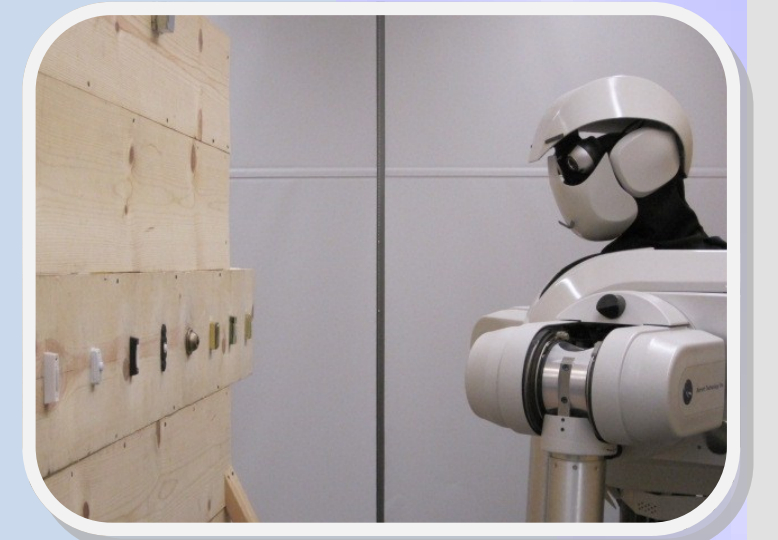
RELATED WORK

Manipulation

A developmental approach has proven effective in performing a variety of manipulation tasks including pushing buttons, lifting household objects, and simple tool use.



[Povenielli, et. Al., 1995]

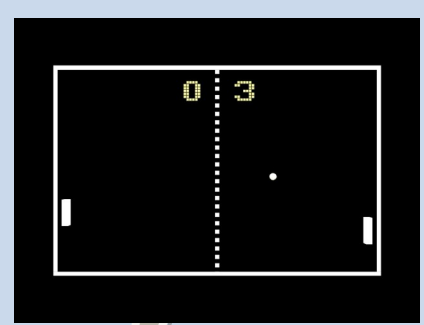


[Sukhoy et. Al., 2010]

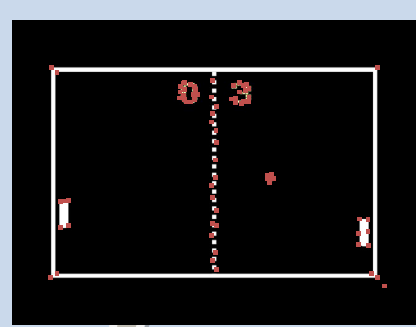
Psychology

The ability to Detect and Recognize the self in a mirror is an ability that has been demonstrated to be unique to orangutans and chimpanzees but not to other primates.

VISION PIPELINE

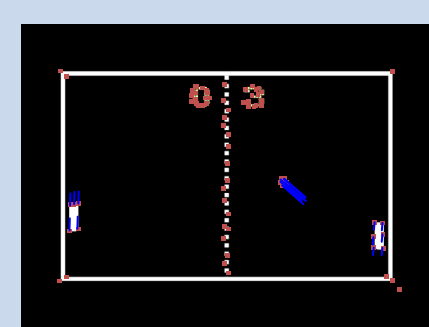


640X480 Pixel Images of the game are taken from the Robot's Webcam at 15 fps.

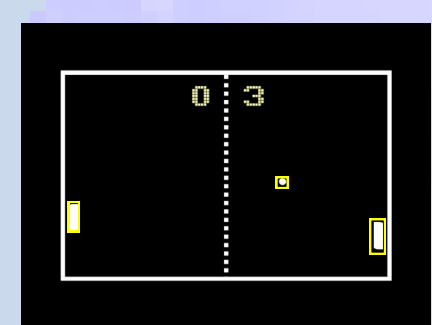


Corner Features are extracted using OpenCV functionality. The features here are represented with red boxes.

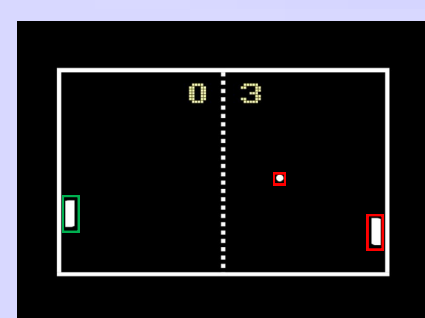
Optical Flow provides vectors representing the transition of each feature between frames.



Components are formed from large groups of features that maintain a constant distance from each other.

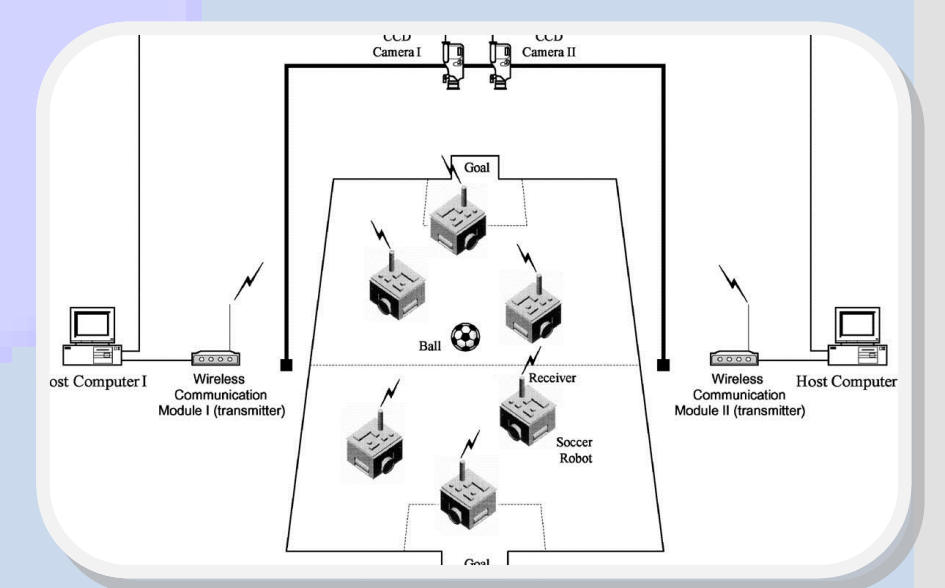


Components whose perceived moments are contingent on the robot's actions are classified as "Self". The rest are classified as "Other".



Games in Robotics

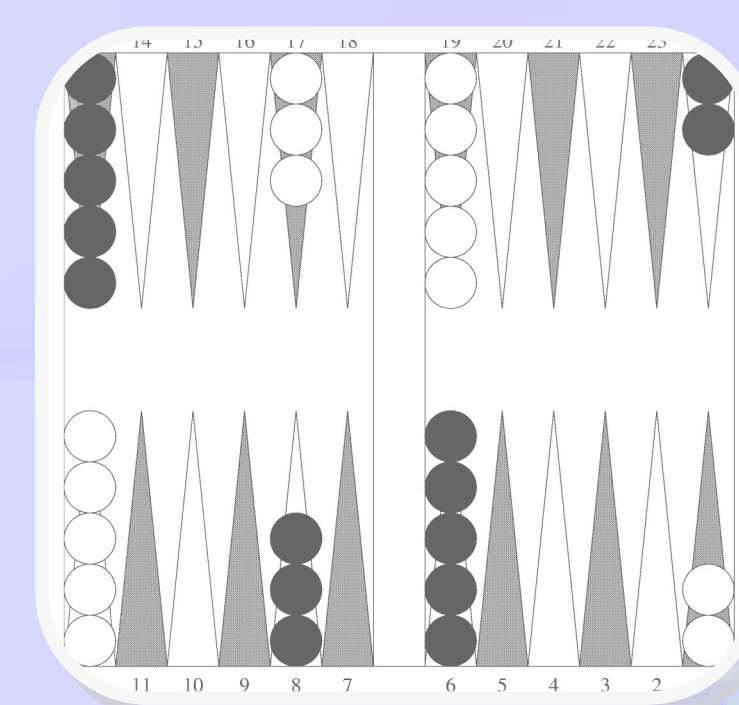
Real-time games have become increasingly popular in robotics research and have become a major point of competition. The most famous of these contests is a series of robotic soccer competitions on a variety of platforms



[Huang et. Al., 2002]

Games in AI

The ability to compete and surpass human performance in a variety of games has always been a significant driving force in AI research. These games include Chess, Checkers, Backgammon, and Poker



[Tesauro, 2002]