Chapter 47
The In-Depth Science of the Tic-Tac-Toe Game

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ABSTRACT

In the present chapter a robotic application bringing together games, informatics, robotics, artificial intelligence, and artificial vision is described. The development of a game player, thus performing an "intelligent" activity is presented. The authors thus suggest that, more than simulation only, the development of the system could offer a serious way of developing learning and interest on the underlying sciences. The system, which only uses off the shelf components, allows for the "intelligent" behavior to be shown through the use of a simple robotic system. In particular, advanced intelligent sensors are used, and the capacities are derived from the tasks of industrial automatic visual inspection, for which the system is designed. These are applied to the recognition of hand-written symbols for accomplishment of a playful activity. The result is a demonstrator, which has proved to be good at catching attention, curiosity, and publicity.

INTRODUCTION

I hear and I forget. I see and I remember. I do and I understand. (Confucius)

Learning is modifying existing knowledge, and may involve synthesizing different types of information. Learning is the basic skill of modern societies. Although games offer a rich landscape of adventure and challenge that appeal to a growing number of youngsters, they can be use on a motivational approach also. Games capture and hold the attention of players for hours. They can capture and enhance curiosity and learning desire. Games provide an interesting activity all over the times. Effectively it could be assumed that it is part of the natural systems skills to survive. Effectively games require reasoning, interpretation, decisions and the plethora of mechanisms that we use in everyday life, excluding the corresponding

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dangers. Games also provide an enjoyable activity for people. Not only have they provided a leisure time as they can be used as a skill training system. In this chapter the use of games is presented as an activity to promote the curiosity, the study and familiarization with thinking, vision and decision theory as a learning activity. Cooperative games emphasize participation, challenge and fun rather than defeating someone.

Games

Games have been used as a demonstrator in many activities, including robotics. When home computers first appeared, one common application was games. They provided the first contact with information technologies to many people, despite the age. Technical kits (beyond the plastic construction kits) have also been around for a long time. Most commons were remotely operated cars or airplanes to which everyone should be familiar. Similar systems not only arise in real life, as remotely operated systems are becoming more and more common. A similar trend is also been happening with robotics. Home robots are leaving from the science fiction projects to become an affordable toy. They allow interactions with humans in an involving way that just a screen. Robot interactions between humans have been described in the literature, (Rani 2006). The use of robots to provide a learning basis has been described by Fok, Aliane, Billiard, Oblinger and Widyantoro (Fok 1995; Aliane 2008, Billiard 2003, Oblinger 2006, Widyantoro 2009). Fok refers a tic-tac-toe game however, missing direct interaction. In the Iris robot, from Mind Project, (Anderson 2010) one of the demonstration skills is to play tic-tac-toe. Petre suggests that robotics can provide can provide a vehicle towards an effective understanding of programming and engineering principles (Petre, 2004). Usually, these systems reproduce the movements from an order provided trough a computer. In many applications the interactivity is done through the web (Marin 2005; Marques et al 2009, Brandão 2000). This has been extended to remote laboratories.

In this chapter the "intelligent" behavior of a robotic system, using 'of the shelf' components is described. The system can also be replicated with more simple systems. In particular it is explored an advanced system sensors, and the capacities derived from the tasks of Industrial Automatic Visual Inspection, for which the system is designed. These are applied to the recognition of hand written symbols for accomplishment of a playful activity, promoting the interaction with public. The system plays tic-tac-toe as an interactive task, using a board where symbols are written. Tic-Tac-Toe is a simple and wide known game from the public. The 'Tic- Tac-Toe' game - Tic-tac-toe (USA), Naught and Crosses (UK), Morphions(F), Filetto(I), Jogo de Galo(P), Jogo da Velha(Br) – was chosen, as it seems to be played in the most part of the world and known virtually to everybody. The implementation was made on a Scorbot ER_VII, used in class room in the Systems Laboratory of the Mechanical Engineering Department. The system should see the play from the public, interpret it and return the right move next, after which it should move away in order to allow the opponent to play. A vision camera is used to identify symbols. It allows the game to be performed in real time. An interface between the various systems is done through a Personal Computer where the game algorithm is also implemented.

The first step that is important to present is the repeatability of the system. Mainly, which is the span that the end grip covers when is moved to a particular position. Effectively this should be covered by the pen and a suitable displacement allowed in the writing system. To measured it we build a simple target with led's (to facilitate detection), and over several hundreds of movements measured the gravity center of the white dots. Images where taken with the camera facing the end position and mounted on a tripod. From the real distance between the led's distances where known and thus the error in the end effectors.