Vision Based Referee Sign Language Recognition System for the RoboCup MSL League

Paulo Trigueiros[1], Fernando Ribeiro[2] and Luís Paulo Reis[3]

[1,2] Departamento de Electrónica Industrial da Universidade do Minho, Campus de Azurém 4800-05, Guimarães, Portugal
[3]EEUM – Escola de Engenharia da Universidade do Minho – DSI, Campus de Azurém 4800-058, Guimarães, Portugal

ptrigueiros@gmail.com, fernando@dei.uminho.pt, lpreis@dsi.uminho.pt

Abstract. In RoboCup Middle Size league (MSL) the main referee uses assisting technology, controlled by a second referee, to support him, in particular for conveying referee decisions for robot players with the help of a wireless communication system. In this paper a vision-based system is introduced, able to interpret dynamic and static gestures of the referee, thus eliminating the need for a second one. The referee's gestures are interpreted by the system and sent directly to the Referee Box, which sends the proper commands to the robots. The system is divided into four modules: a real time hand tracking and feature extraction, a SVM (Support Vector Machine) for static hand posture identification, an HMM (Hidden Markov Model) for dynamic unistroke hand gesture recognition, and a FSM (Finite State Machine) to control the various system states transitions. The experimental results showed that the system works very reliably, being able to recognize the combination of gestures and hand postures in real-time. For the hand posture recognition, with the SVM model trained with the selected features, an accuracy of 98,2% was achieved. Also, the system has many advantages over the current implemented one, like avoiding the necessity of a second referee, working on noisy environments, working on wireless jammed situations. This system is easy to implement and train and may be an inexpensive solution.

Keywords: Hand gesture recognition, Support Vector Machine (SVM), Hidden Markov Model (HMM), Finite State Machine (FSM), RoboCup MSL

1 Introduction

RoboCup is an international joint project to promote Artificial Intelligence (AI), robotics, and related fields since 1996 [1]. RoboCup project has been held every year, and the progress that has been seen in applied technology is amazing, especially in the Soccer Middle Size League (MSL) [2]. RoboCup MSL is one of the most challenging, using real non humanoid robot teams to play with an ordinary soccer ball in an autonomously way. Since the main goal consists of a soccer game in 2050 between the humans world champions team against the robots world champions team, this paper presents a new system, able to interpret dynamic and static gestures of the referee, thus eliminating the need for a second person. In RoboCup MSL the main referee uses assisting technology, controlled by a second referee, to support him, in particular for conveying referee decisions for robot players with the help of a wireless communication system. On this system, the referee's gestures are interpreted by a vision-based system and sent to the Referee Box, which then sends the commands to the robots. The system uses a depth image acquired with a Kinect camera for hand feature extraction (centroid distance signature [3]) and an SVM model to classify hand postures (**Fig. 1**). For dynamic gestures, each gesture to be recognized is scored against 11 different HMMs that consists our defined language set (**Fig. 2**). The model with the highest score is selected as the recognized gesture. A finite state machine controls the transition between each system state namely: DYNAMIC, STATIC and PAUSE, to build the final referee command (**Table 2**).