Computer Controlled Human Soccer League: A new step towards the 2050s Goal

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***Abstract*—This proposal presents a novel idea to accelerate the software development for robocup 2050 goal. We suggest a mixture of human-computer agents to form a new league. A demo of the league in RoboCup 2013 is the subject of the proposal. The league allows reaching the standard human footbal conditions such as outdoor environment, field size and marking faster. So new challenges can be introduced. The idea also reduces the development and organization costs so that the number of players and the field size can be easily increased.**

***Index Terms*—RoboCup, Human-Computer Interaction.**

I. Introduction

IN year 2050 a team of fully autonomous humanoid robots wins against the human football champion". This is set as an indicator for the achievement of the scientific goal of the robocup community. There are however serious concerns whether the timing can be kept. Several major hard- and software challenges are to be overwhelmed, ranging from mechanical and control stability to efficient and reliable decision making.

A main blockage in efficient development of robotic systems has always been due to the pyramidal structure of such systems. In other words, the reliability and functionality of each level is strongly coupled with that of the lower levels. Suppose a high level software developer who tries to get a cooperative behavior work between two robots, which have partial problems in locomotion, perception, and communication. This is what all experienced robocup project managers have to struggle with all the time.

All together, much more effort goes to low level development rather than high level. Effective considerations has been made in league organization to break the above mentioned chain and decouple the development levels. For example in Simulation league hardware issues, in small size league, wold modeling , and generally in wheeled robot leagues the bipedal locomotion is bypassed. This is however not enough for the future as it should be played in an outdoor, rather improper for omni-wheeled robots, and almost impossible to precisely simulate environment.

This proposal suggests a more effective way to break the development chain by engaging human agents. The idea can be realized as a separate league or as a sub-class of the humanoid league and facilitates the development of perception and decision making regardless of the hardware platform.

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II. Idea

To reduce the complexity and cost of the development without much loss in the generality and reality of the human soccer problem we suggest to use human as the robotic platform. For this purpose each human player wears a portable device as shown in figure 1. The device is equipped with a set of sensors and a processor and is responsible for perception and decision making.

A. Agents

To minimize the effect of humans own cognition, his visual and acoustic senses are blocked using an eye cap and ear phone. Considerations can also be made to minimize the effect of his touch sense. Figure 2 shows a block diagram of the soccer controller. The structure of the device is similar to that used to control a humanoid robot, however no motion layer is implemented either in software or in hardware. Instead the motion command is acoustically transferred to the human via the ear phone. Common sensors such as a camera, IMU and compass are integrated with the controller. Wireless network equipment is also present for the cooperation and game status commands. As there is no direct feedback path from the agent to the controller, an optional further camera can be used on the device to calculate the pose of the agent and also to observe how the commands are executed.

B. Rules

Similar rules as robocup humanoid league can be applied to the CCHS league. Some restrictions can however be considered to avoid the own skills of the human players to affect the game. These are mainly regarding to how the ball is played. for example, long contacts with the ball can be avoided. In addition, the human players may be disallowed to communicate in any way. There hold also limitations to the soccer controller, mainly in regard with the acoustic interface. The controller may not give any direct sensory information to the players, enabling them to use their own cognition. This may be applied by limiting the command sentence grammar.

Number of players can be increased to the standard 11 and the size of the field to that of a standard football field. This reduces the construction and organization costs of the league and facilitates the further development towards RoboCup 2050 goal.

C. RoboCup for Blind

The same platform can also be used as an assistance for blind to play soccer. As there hold no more restrictions for the

Figure 1. A human agent wearing the soccer controller

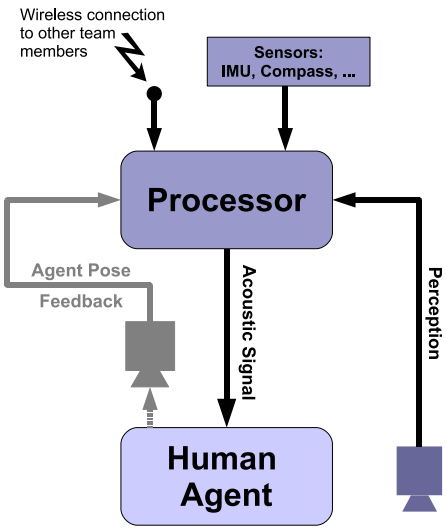

Figure 2. Block Diagram of a Computer Controlled Human Agent in CCHS

use of own cognition such as described above, plenty of useful sensory information can additionally be sent to the players, enabling them to play more efficiently.

III. Prototype

Figure 3 shows the portable soccer controller developed in our lab. The same control electronics as in our humanoid kid-size robots is used. The processor board carrying the perception and cognition is an IGEPv2. It is a generic Linux ARM board available in European market. The module has built-in wireless LAN, USB ports, audio I/O and several GPIOs. For visual perception a USB webcam is connected. The camera is fixed to an IMU module to measure its orientation. Part of the software previously developed for FUmanoids kid size team is ported and adapted to match the new architecture.

Figure 3. Portable Human Soccer Controller

IV. Results

Table I show estimated hardware costs for production of the human soccer controller for a single as well as for a team of 11 agents. Clearly the production cost of the system for a whole team is still below that of a single commercially available humanoid platform. This could encourage the contributions and accelerate the development. In addition, the new league offers highly dynamic games due to the increased number of players and their reliability and could therefore reach a significant level of acceptance in the auditorium.

Table I
Estimated Hardware Costs of the Soccer Controller

item	cost	for 11 units
Processor Board	200$	2200$
Camera	70$	770$
IMU, Compass	100$	1100$
Head Phone	50$	550$
Housing, Power	50$	550$
SUM	470$	5170$

V. Conclusion

In this proposal we presented a novel idea to reduce the complexity of the robot football problem. We suggested a mixed Human(oid) league, in which each agent is a human equipped with artificial sensorics and cognition. The suggested league accelerates the developments in high level cognition and perception without any loss of the generality and reality of the problem. Lower costs of development allow the increment of the number of players. Standard footbal fields can also be used which further reduces the organization costs. There is a high degree of campatibility between this league and other humanoid leagues, so that the achievements can easily be used on humanoid robots. We propose a demo of the league in RoboCup 2013.