Joint Robocup Team

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Abstract. A joint team in Robocup with participants from Sweden and Korea, where at least two universities combine their strengths is proposed. Several countries have already identified robotics as an interesting future technology, and the cooperation will have as a goal to strengthen the bands between Sweden and Korea, and by designing a winning team both countries can increase their efforts in the robotics area.

1 Introduction

Robocup started in 1997, the same year as Deep Blue beat Kasparov in Chess. The fifty years from when the transistor was born (1947) has meant a lot for the whole world. This IT-revolution is of the same magnitude as the first industrial revolution. The fact that a computer could beat the human in such a complex game as chess, fed the idea to setup a similar difficult challenge for robotics. The ultimate goal is to develop Robots in the coming 50 years, such that a team of robots should meet the FIFA world champions and win the game!

The idea behind Robocup, is to foster AI and research in robotics, and by having different leagues various problem areas are differently addressed. The simulation league concentrates on the strategy, the small league is a league where all problems with sensors are reduced to a minimum - all robots are seen from a high mounted video camera. The four legged league is based on the Sony Aibo, and the teams can concentrate on the programming, since all sensors and actuators are given by the hardware platform. The Mid size league is the league closest to the ultimate league - the humanoid league. In the mid-size team all sensors are on the robot, the field is growing bigger every year, and all modifications of the FIFA-rules are also reduced year by year. In the start white borders were used and the goals were painted yellow and blue. The borders disappeared several years ago and the painted goals are soon gone. The size of the field started as 6x12 meters and are for the competition 2007 in Atlanta 12x18 meters. The ultimate league the humanoids the main problems to solve is controlling of all the arms and legs.

The development over the last years has been quite impressing. The four legged the games are impressing with good coordination between the robots. In the small sized the games are very fast and tight, and the the defense play is really good, and the robot having the ball is really fast. In the mid-sized you see more of different combinations and there is are first attempts of passing the ball. Finally you can see robots in the humanoid league that not only is able to walk, but to take the ball, and shoot it against the goal. Similarly a humanoid robot that is standing in the goal area can see the ball coming and throws itself sideways in order to block the ball from going into the goal.

2 Proposal to arrange a unified team Sweden-Korea

At MDH a robot has been designed for the Mid-sized league. It consists of a base system which is 400 mm in diameter equipped with a omni directional driving mechanism consisting of three motors, Maxon motors with a gearbox of 1:18, oriented in 120 degrees, each equipped with a 'Swedish' wheel with 18 smaller rubber wheels on the rim. There are three PCBs with reflective sensors for finding the white lines. A neural network is used to update the direction, X- or Y-coordinate of the robot, given an estimate of the robot position together with the values from the 24 sensors. The sensors are directly coupled to the FPGA on the main computer board.

The current kicker mechanism is based on discharging of a high voltage capacitor through a coil, and using the resulting magnetic force to move a solid cylinder of steel and thereby give the required power to kick the ball.

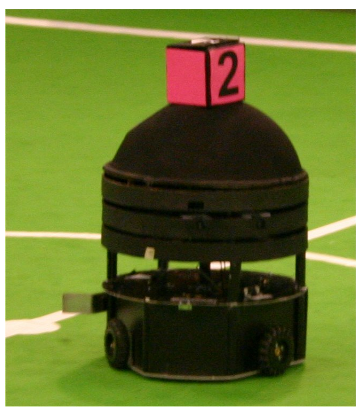

Fig. 1. The Aros robot. The base holds standard batteries for electric power tools, the three Swedish wheels, line sensors, and the main computer system. Above a fixed disk and two rotating disks. The top 'head' is fixed and will have three fixed cameras.

The base system also holds batteries and one of the latest FPGAs from Xilinx which contains an internal PowerPC (Model 405), used as the main computer. A vertical construction is mounted on the base system which constitutes the physical layer of an optical CAN-bus, forming the intra communication backbone of the robot.

The physical layer of CAN has one recessive bit, and one dominant bit. In the optical version of the CAN-bus the dominant bit is 'light on'. It is enough to have one send out light to signal to all other layers that a dominant bit is taking over. The various sensor subsystems are mounted on circular discs and mounted on this vertical axis.

Each disc is equipped with an optical CAN transceiver, a stepper motor for independent 360 degree rotation capability. The motor has a wheel with 10 teeth and the disk has 72 teeth. Since the stepper motor has 200 steps (with micro steps even more) each step represents a rotation of 0.25 degrees. Each disk has a magnetic index switch to tell the microcontroller on the disk how the disk is oriented relative to the robot. The motor controller on each disc can lock onto the robot direction or lock to the field 'geostationary', using the output from a disc equipped with a gyro.

Out of the important areas of robotics, the Aros team is focusing on the following areas:

- The vision subsystem; ChipVision,
- The inter robot communication subsystem with both IR and ultrasonic sensors
- A Safety Critical approach for the control software