Team Canuck 2002

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Abstract. This paper contains an overview of Team Canuck. We will describe mechanical and electrical designs of the robots, and vision and control software that compute the state of the game and commands for the robots. Past experience and future plans for Team Canuck will be described as well.

1 Introduction

Team Canuck is the F-180 RoboCup team hailing from the University of Alberta located in Edmonton, Alberta, Canada. It is the first Canadian entry in RoboCup F180 and is composed mostly of Computing Science and Electrical Engineering graduate students.

1.1 Team History

Team Canuck was formed in September 2000. We successfully qualified for RoboCup 2001 in June 2001 and, from August 2-6, 2001; we competed in Seattle at our first ever RoboCup. RoboCup 2001 proved to be an interesting and rewarding learning experience for our team because of several technical difficulties we experienced as a rookie team. These difficulties were related to both system hardware and the vision software. However, after four sleepless nights we overcame all of our difficulties except for a major radio problem, and managed to participate in all of our round robin games. The round robin preliminary competition wasn't very successful for our team although we did manage to score our first-ever goal at RoboCup.

Presently Team Canuck 2002 plans to qualify easily for RoboCup 2002 and, assuming we receive the necessary funding, to be a competitive entry in Fukuoka, Japan at RoboCup 2002.

1.2 Team Members

Team Canuck consists of ten team members, six robots, and an array of computers, cameras and other associated hardware. The ten team members are all currently associates of the University of Alberta. Dr. Hong Zhang is Team Leader and faculty advisor of Team Canuck from the Department of Computing Science. Jonathan Backer, Zhen Deng, Jonathan Kelly, Matthew McNaughton, Chris Parker, Marc Perron and Andrzej Zadorozny are all M.Sc. students in Computing Science. Sean Verret is an M.Sc. student in Electrical Engineering, and Doug Kondor is an undergraduate in Computing Science.

1.3 Collective Robotics at the University of Alberta

Team Canuck provides a platform for several students and team members to conduct research in several areas of multi-agent systems and collective robotics. Although, the actual robots of Team Canuck do not yet fully exploit the potential of collective intelligence research, it is the goal of Team Canuck to eventually have a fully collective robotic soccer team in the F-180 league of RoboCup. Some of the collective research currently on-going at the U of A includes collective building, collective sorting and evolutionary computation applied to collective robotics.

2 Robot Hardware Description

Below is a very brief description of the micro-controller, motor control circuitry, chassis, motors, wheels, and radios used by Team Canuck.

2.1 Micro-controller (MCU) and Motor Controller Circuitry

Team Canuck uses the mini-robomind (MRM) as the control computer on board of each robot. The MRM contains a MC68HC332 at 25MHz as well as 512k flash EPROM. This board provides us with more than enough computing power for the time being and will be a staple to our team in the future.

Team Canuck uses a standard L293 h-bridge interface to drive its two motors. The signals used to control come from the TPU of the MCU of the MC68HC332.

2.2 Chassis

The machine shop in Department of Mechanical Engineering at the University of Alberta fabricated the chassis of our robots. The chassis is constructed out of $^{1}/_{8}^{th}$ inch aluminum. There are three main plates or tiers. The bottom plate holds the motors and batteries, the middle plate holds the motor control circuitry, and the top

plate holds the MCU and radio. For 2002, we are looking to decrease the weight of these plates in order to improve on the dynamics of our robots.

2.3 Motors and Wheels

Team Canuck uses Faulhaber motors purchased from MicroMo. These motors are the DC coreless motors 2224 series. In 2001 we used these motors with a 23:1 gear ratio, but for 2002 we will experiment with a 14:1 gear ratio in hope of speeding up our robots. These motors also provide 16-bit quadrature encoder feedback to our MCU to allow closed-loop velocity and position control of the wheels.

Team Canuck uses 2" airplane wheels from Robart and we use an aluminum hub created by the Mechanical Engineering department at the University of Alberta. Differential drive is used for steering.

2.4 Radio

Team Canuck uses the RPC radiometrix product for its wireless communication. Last year's attempts at using another system (the Unilink) failed at competition and is not recommended.

3 Software Description

Team Canuck uses several different software and firmware packages/languages when programming its agents, MCUs, and vision software.

3.1 Agent Programming

Team Canuck has created several different agents for each of the different types of soccer players that exist. Specifically, we have a goalie agent, defense agent, and a forward agent. All of these agents are compiled in C++ and interact with the vision system and the radio system. These agents currently do not interact with each other but hopefully for RoboCup 2002 cooperation among the various agents will be introduced to improve the quality of play.

3.2 Programming the 332

Team Canuck uses a GPU C cross-compiler to program its MCU's from a Linux host. We are also currently looking into a method of using the Linux tool "gdb" to reduce the code downloading time.

3.3 Network Communication

Currently Team Canuck has several programs running at once on a local area network. In order for this to operate successfully, communication must occur between the different levels of programs. We have created a UDP protocol so that the vision system can communicate to each of the individual agents the current state of the field (robot and ball positions). UDP protocol is also used so that the software agents can transmit commands to the robots using a single common radio channel.

4 Vision System

Team Canuck uses a Sony color CCD camera with a 1-8mm zoom lens. We use de-interlaced video to generate images of 640x240 pixels. A WinTV video PCI capture card is installed on a Linux 2.4 machine to provide the video input to the vision agent.

Team Canuck uses a simple decision tree method to distinguish the ball, our opponents' robots, our robots, and our robots orientation.

Finally, the vision system uses all of this information to pass on a UDP packet to our agents that contains the current state of the field. This UDP packet contains information about the position of the ball, the position of our opponents' robots, and finally the position and orientation of our robots.

5 Conclusion

Team Canuck is a team with a relatively short history. Many lessons were learned in Seattle and we are taking these experiences to improve our robots. In the future we plan on the use of 3-CCD camera (hardware) and tracking (software) to improve our vision performance. We also are currently creating a GUI for our robots that will make it much easier to control our robots between stoppages. Plans are also currently in the works to reduce the individual weight of each of our robots as well as adding a solenoid-powered kicker. Finally, we hope to add the ability of holonomic motion to our robots but will unlikely be able to feature this at RoboCup 2002.