TPOTs 2003
Temasek Polytechnic RoboCup Team

Wee Teck Chew[1], Maung Yan Naing[2], Shen Xing, Wang Qiang

[1] CU Head , Robotics & Automation Group
Temasek Polytechnic, Temasek Engineering School
21 Tampines Avenue 1, Singapore
teckchew@tp.edu.sg
[2] Temasek Polytechnic, Temasek Engineering School
21 Tampines Avenue 1, Singapore
yannaing@tp.edu.sg

Abstract. This paper describes the 2003 version of TPOTs team that participated in the small-size league in Padua 2003 competition. Serveral enhancements have been made to our robots, including omni-drive mechanism, client/server setup, improved vision system, on-board control and mechanical structure.

1 Introduction

As a member of the RoboCup community, our team has been actively involved in the development of TPOTs team and participation in small-size league competitions, This paper describes the 2003 version of TPOTs robots, serval enhancements have been made to our design, including omni-directional drive system, client / server set up and on-board control algorithm. Figure 1.

Figure 1. TPOTS-2003

2 Robot Design

The TPOTs-2003 robots are omni-directional, using 3 orthogonal wheels, with PIC16F877 micro-controller, powered by 7 x1.5v rechargeable batteries, wireless communication module designed to support two different frequencies, 418 & 433Mhz RadioMetrix RF transceiver modules. The mechanical structure of the mobile platform are mainly made from 2mm aluminium sheet, for light weight and to reduce cost, kicker is a simple rotating bar, there is no dribbling mechanism for our robots. Figure 2.

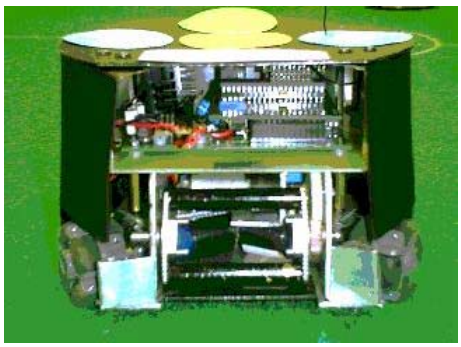

Figure 2. TPOTS-2003 robot

2.1 Omni-Directional Drive

The TPOTs-2003 omni-directional drive consist of three DC motors mounted at 120 degrees from each other on a circular base plate as shown in the Figure 1. The motors we used are DC 6v , with encoder, gear ratio 14:1 , the drive system is capable of maximum velocity of 2m/s. Combining omni-directional wheels allow the robots platform to achieve three stages of free motion, the motion of the robot platform depend on individual motor velocity, rotate on it's CG, turn around the centre located on the axis perpendicular to the turning wheel, it can also move in any direction without changing robot 'face' direction, Figure 3

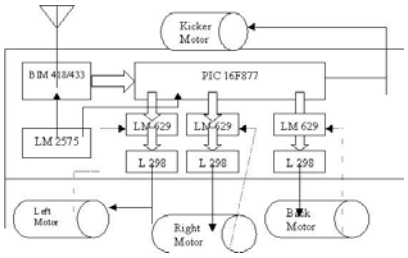

Figure 3. Motor Drive Schematic

2.2 Base plate & Kicker mechanism

The robot base platform are mainly made from 2mm aluminium sheet aluminum as shoen in Figure 4a. The kicker mechanism is a simple rotation bar , Figure 4b.

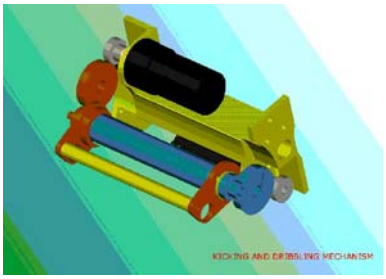

Figure 4a , 4b Base plate & kicker mechanism

2.3 Printed Circuit Board

There are two printed circuit boards, mounted on each robot, the *driver board* and the *processor board*. The processor board is based on Microchip PIC16F877 micro-controller, on board are radio frequency (RF) communications module, closed-loop position and velocity control module , and the kicking mechanism control module. The driver board consist of a LM629 PID motion controller and L298 motor driver . Figure 5.

Figure 5. Controller Board

2.4 RF Circuit Board

The The main components consist of RF BIM 418/433, Microcontroller P16F876, voltage regulator circuit and MX232. The size of the transmitter circuit board is 13cm x 6cm. RF data packets from the remote host computer are decoded to electrical data and passed to the micro-controller, it sends appropriate commands to the PID controllers and kicker motor accordingly..

3 Software Description

Since the new generation TPOTs-2003 robot was redesigned with three omni-directional wheels, and there were also major changes in the hardware compared to the past previous years generations, the software had to be modified too.

3.1 Mobile platform control

The robot motion control has been significantly improved, the tasks of the PIC16F877 micro-controller firmware is to retrieve and decode received RF information, generation of the trajectory and filter parameters for the PID controller, activation of the kicker. The program was developed using C language. Figure 6.

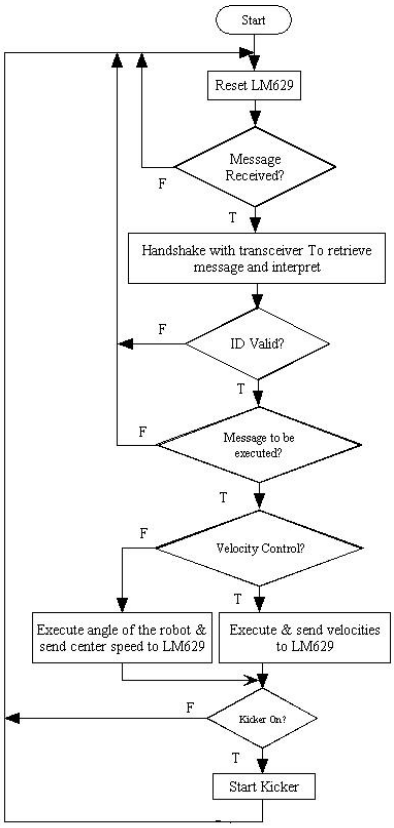

Figure 3.6 Flow chart of onboard software

Figure 6 . Firmware flow chart

3.2 Strategy & GUI

The high level strategy program consists of three main components i.e. the Graphical User Interface (GUI), the Strategy and Communication Component. The GUI was designed to provide an interactive medium between the user and the mobile robots, including robot motion testing, start and stop game, strategy selection (e.g. attack or defense), field swapping, speed settings etc. The real time image of the robots and ball positions is also displayed on the GUI so that user can observe game progress. Figure 7

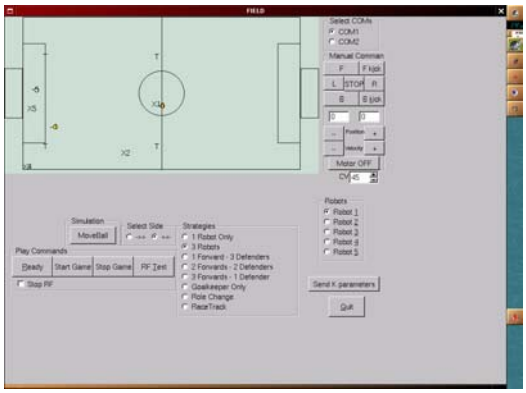

Figure 7. TPOTS-2003 GUI

3.3 Data Protocol

This channel is based on a serial communication link using the Radiometrix RF module, information were sent in short packets messages as shown in Figure 8.

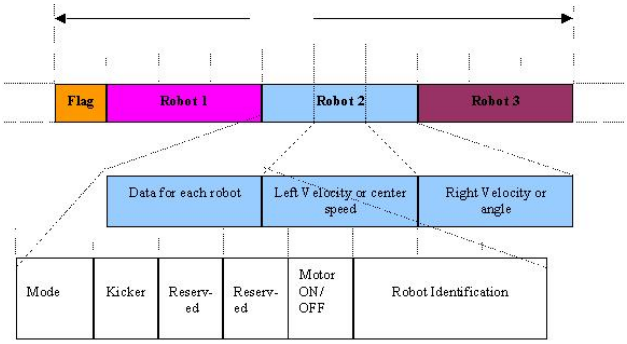

Figure 8. Data Protocol

3.4 Role assignment & obstacle avoidance

Role & task assignment for each robots is based on a few parameters, own position, ball position, team robots position, opponent's robots position, individual robots would be assigned with 'attack', 'follow', 'block' or 'defend' behavior. Figure 9.

Figure 9. Robot role & task assignment

It was a challenge in deciding the amount & type of obstacle avoidance techniques to deploy. It should be highlighted that a minimum amount of obstacle avoidance be implemented into the strategy algorithm in order to play a more 'attacking' game.

4 Conclusion

The design and improvement of TPOTs RoboCup team is a never ending task, ever year improve our design and software strategy, 2003 has been a year of consolidation and redesign of our robots, we had made lots of change to our platform and software algorithm.

References

1. Temasek Polytechnic RoboCup team web site "http://rag.tp.edu.sg"
2. RoboCup official web site "http://www.robocup.org"