MU-Wallabies 2003 Team Description

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Abstract. The following outlines the research by The University of Melbourne's Mid Size Robocup team, known as the MU-Wallabies. It describes the robotic research platforms aimed at promoting research into a wide variety of related topics. These research platforms are designed to be highly modular to permit different research groups to implement their theoretical work onto a practical platform with minimal effort. These robotic research platforms are also designed to be capable of competing in international robotic soccer competitions in the F2000 Mid Sized League. The robots are designed to have superior ball handling by adding a ball-manipulating 'leg' that is able to position itself 360° around the robot to manoeuvre the soccer ball. The robots are also easy to assemble and disassemble to aid in transportation and mid game repairs.

1 Introduction

This project is headed by the Department of Electrical and Electronic Engineering in collaboration with the Department of Computer Science and Software Engineering. The University of Melbourne's main aim was to design a highly modular system, creating a robotics research platform that can be easily adapted to a large range of research tasks; including competing in the F2000 Mid Sized league of Robocup.

2 The Robotic Platform

Over the past year we designed a highly modular robotic research platform. Each robot consist of a custom made chassis, a ball handling device and electrical payloads. The chassis is constructed out of 3mm sheet aluminium. A dual wheel differential drive system is used, with casters to balance the robot. Above the drive system resides a tube mounted upwards acting as a pivot for supporting the ball handling mechanism. On top of the tube is an aluminium frame, covered by high density polyethylene (HDPE), to encase the remaining electrical payload. At the top of the payload case is a length of polycarbonate tubing with an omni directional mirror mounted on top and camera below [1].

The ball handling device consists of a 'leg' that can be rotated 360° around the body of the robot, with a rubber coated aluminium block at the end for

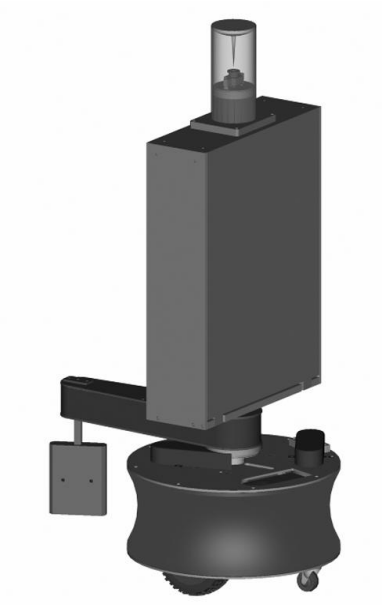

Fig. 1. MU-Wallabies robotic research platform

controlling the ball. A kick is achieved by rotating the 'leg' around the body of the robot and making contact with the ball.

The electrical payload consists of a 1.8 GHz P4 IBM Thinkpad R40 with an IEEE 802.11b compliant Wireless LAN card to transmit data between robots. The robot uses a USB Logitech Quickcam 4000 camera for image acquisition. The processing of the image is carried out by the laptop. There is a custom built motor controller that is also connected via the USB bus. The USB bus ensures that new devices can easily be added. We use FTDI's RS232 to USB bridges to make interfacing custom hardware trivial. This approach was applied to the motor controller which consists of an Atmel Mega8 micro-controller. The motors are powered by 12 volt 9AH NiMH batteries.

3 Research

3.1 Software

The software used to control the robots is based heavily on Melbourne University's Robomutts++ 2002 Sony Four Legged League team [2] with many systems sharing a common code base. The major components from this system are Particle Attraction Localisation, scripted behaviours, and vision.

The vision subsystem uses colour-based image segmentation in conjunction with run-length encoding (RLE) to produce an RLE bitmap for each colour.

Region-based techniques are then used for landmark identification. The underlying colour lookup table allows for colour clusters of arbitrary distributions in colour-space. To reduce the memory footprint of the lookup table, the least significant bits of each channel are ignored and the table itself is tiled on the most significant bits of each channel with empty tiles not stored explicitly. On a typical lookup table, tiling the table resulted in at least a five-fold reduction in the table footprint. Additionally, the fully autonomous calibration techniques used in the legged league [3] are being adapted for the Mid-Sized League and dynamic environments which will allow robot to dynamically self-calibrate during games.

3.2 The Recognition of Arbitrary Soccer Balls

A system is being developed that is able to learn and recognise any FIFA size 5 soccer ball, using support vector machines. This system is not yet refined to the point where it can be used in actual game play.

References

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