RoboCup: A Soccer Playing Robot
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Sponsors: Raytheon, Texas Instruments, Dewald Fluid Power Company

Background
IPFW and Raytheon established a partnership to build their own team of robot soccer players over a 5 year period, from 2007 – 2012, to compete in the RoboCup’s Middle Size League in 2012. The goal was to promote robotics, artificial intelligence, and engineering in the Fort Wayne area. The focus of this design project was to create a mobile robot base prototype which will be used by future design teams.

Overview
The goal of the project was to design and build a kicking robot, which had sufficient speed and mobility to be competitive. The robot has an integrated kicker and is capable of easily incorporating a communication and vision system. Several designs were proposed and evaluated for the platform, wheel orientation, kicking mechanism, power supply, drivers and microcontrollers. The final design is a combination of conceptual platform designs and four omni-directional wheels that are controlled by single channel motor drivers. It has a pneumatic swinging kicking mechanism which can approximately achieve a 3 meter kick in the air. The robot was designed to achieve a minimum velocity of 2 m/s. It uses a high-level 32-bit microcontroller and is powered by a single 25.9V Li-Polymer battery. The robot uses multiple sensors. The robot was expandable with a CAN bus and a high-speed USB port. The robot complies with the rules and regulations of the RoboCup Middle Size League as of 2008.

Mechanical Design Examples

Spreadsheet with embedded equations utilized to vary and calculate pneumatic/kicker requirements

Chart utilized to select pneumatic tubing for the system

One of many cylinder selection charts utilized to fulfill requirements

Thermodynamic analysis of pressure tank to determine proper tank size

Free body diagrams created to calculate torque required for each motor

Electrical / Software Design Examples

Omni directional motor control zones / methodology and accompanying equation

Syren10 regenerative current motor drivers and accompanying circuit

Multisim software was used to design the PCB and allowed for the creation and modification of the board’s design

Module software programs were written in C and On-Chip Flash Programmer was utilized to compile

Final Design

Raytheon

Nitrogen Tank

Omni Wheel

Human Power Jack

Motor Drivers

Printed Circuit Board

Hall Effect Sensor

Magnets

Motor

Serial / CAN Ports

TMS320F28335 DSC chip for eZdsp Development Board capable of incorporating vision and communication systems

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