Lehigh RoboCup Team

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Project History

- The conceptual design of a robot for RoboCup Competition was completed last semester and served as the starting point of the project.
- The overall objective of the project is to build 10 robots (2 teams) to enter the RoboCup Competition at the end of the year.
- The goal for this semester is to build 2 robots that can play soccer with each other.
- This will be the first Lehigh RoboCup Team. All the robots are built with the help of the conceptual design report.
- The whole team is split into 3 groups:
  - Mechanical Engineering
  - Electrical Engineering
  - Computer Science
What is RoboCup?

- RoboCup is an international joint project to promote robotic and artificial intelligence development
- The ultimate goal is to develop an autonomous humanoid team of robots that can defeat a championship human team
- Competition divided into 5 leagues:
  - Simulation League
  - Small Size Robot League (F-180)
  - Middle Size Robot League
  - 4-Legged Robot League
  - Humanoid League
- Systems integration of several disciplines
- Draw participants from multiple departments

F-180 League Rules Outline

The F-180 League Playing Field

- 16' 0"
- 11' 2"
- 28"
- 7"
F-180 League Rules Outline (cont.)

Maximum of 5 robots
- Must have at least 1 robot
- Robots may be interchanged
- 1 robot may designated a goalkeeper

Dimensions
- Must fit within cylinder 180mm in diameter
- Max height of 150mm

Mechanical Design Goals
- Minimize weight
- Low center of gravity
- Minimize maintenance downtime
- Optimize available space
- Maximize acceleration in all directions
- Maximize kick velocity and accuracy
- Integrate mechanical design with electrical and vision systems
Mechanical Design Elements

- Omni-Directional Drive Architecture
- Drive Motors
- Wheel Selection
- Dribbling Mechanism
- Kick Mechanism
- Chassis Design

Drive Architecture

4 wheel omni-direction drive platform:
- Offers greatest power
- Highest traction on playing surface
- Overall higher acceleration than 3 wheel design

Omni-Directional Drive Wheel
- Allows movement parallel to rotational axis

Brushless DC Motors
- Highest power to weight ratio
- Longer lifespan than brushed motors
Motor Selection

Performance Goals:
- Maximum acceleration: 10 m/s\(^2\)
- Maximum velocity: 3 m/s

Motor Specification
- Required max torque: 0.448 N m
- Required max speed: 840 Rpm

Size Constraints:
- Maximum diameter: 3 cm
- Maximum length: 3.5 cm

Motor Selected: Castle Creations MMB25-CM2042

Drive Component

- Collar – motor shaft / wheel connection
- Motor mount – motor / chassis connection
- High Impact Acrylic (Plexiglass)
Drive Assembly

- Wheel / Motor Assembly

Drive Assembly

- Motor / Chassis Connection
Ball Control

Dribbling Bar:

- High speed roller creates backspin on ball

Dribbling Mechanism

Cornell 2005 Robot

Dribbler Mechanism

Initial Design Concept
Standard Cylindrical Bar

Chosen Design
Hour Glass Design
Ball Control

Kicking Mechanism

Common Kicker Designs

- Spring loaded “crossbow” design
- Spinning kicker bar
Kicker Design – Injection Molding

Top View

Isometric View

Front View

Side View

Kicker Design – Water Jet Cutting

2-D geometry – easier to manufacture
Kicker with Solenoid

Chassis Design

- Preliminary 2-D AutoCAD design
Chassis Design Implementation

Collaboration with ECE group

- Microprocessor Implementation
  - controls the mechanical devices
  1. Drive Motor Speed Control
  2. Kicker (Solenoid) Speed Control
  3. Dribbler Motor Speed Control

- Electrical Components Mounting
  1. Circuit Board
  2. Batteries
## Project Costs
### For Two Robots

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<th>Part</th>
<th>Description</th>
<th>Unit Cost</th>
<th>Quantity</th>
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