

CRITICAL DESIGN REVIEW

Mike Pfeiffer







Agenda

- Introduction
- Strategy
 - Autonomous
 - Tele operated
- Robot
 - Early Design
 - Final Design
 - Chassis
 - Elevator
 - Shooter / Turret

- Electrical
- Software
- Program Management
- Communications







Our Team: FRC #2729

- Meet At Cherokee HS
- Consisting of Lenape and Cherokee High school students
- This is our Rookie year!



Team has 62 student
 members



1 Feb 2008



Lenape Regional Robotics



Class Distribution



1 Feb 2008

Lenape Regional Robotics

Our Strategy

- Autonomous Goal
 - Automatically shoot
 - Avoid being scored on
- Tele-Op Mode
 - Shooting
 - Accuracy
 - Reliability









Early Designs











Current Design

- Chassis
- Elevator
- Shooter/ Turret







Mechanical Chassis

Jake Ellis







Chassis Prototype

- Prototype is to scale
- Device made of wood, screws, wheels, and motors















Chassis Design Final

- Single sheet of machined metal
 - Reliable
 - Sheet metal
 - Simple design
 - Maintainability
 - Light weight











Motors

- 2 CIM motors
 - 5280 rpm
- Specifications
 - 2365g
 - 12 volts
- Benefits
 - Compact design
 - Reliability
 - Low Cost









Drive Train

- Chain Drive
- Tank drive
- One motor per side
 - Drives two chains
- High torque
 - 16:1 gear ratio
- Individual gear boxes
- Gearbox Specifications
 - 12:1 gear ratio
 - High torque / Low Speed
 - Low Cost
- Encoder interface



Lenape Regional Robotics





Drive Train Wheels

- 4 wheels
 - FIRST requirement
- 6 inch diameter
- High density tough plastic
 - Minimal traction
 - Friction
 - Static coefficient of $\mu = 0.06$
 - Simulate Lunar Surface

















Elevator

Jimmy Erskine







Elevator Design Concepts

- Horizontal conveyor belt
- Vertical conveyor belt









Current Elevator Design

- Height reduction
- Does this make me look fat?
- Starting From Scratch
- Get the ball to the Turret







Lenape Regional Robotics



Elevator-Turret Interface

- Lazy Susan
- Cable vs Chain
- Elevator to
 Flywheel















Shooter / Turret

Mike Britland









Prototype XY-45-1

- Aluminum tube
 - Drill motor
 - CIM motor
- Deflector
 - Plexiglass
 - Band Iron
- Friction is an issue
- Erratic shooting
- Ball destruction









XZ-1

- Plexiglass
- Range of 4-7ft
- Mechanically simple
- Easy to troubleshoot
- Less Weight than XY-45-1



- Range 12ft
- Trailer target test
 4 out of 5 successful
- 1" angle aluminum
- Flywheel
 - CIM motor
 - $-\frac{1}{2}$ in. axel (keyed)
- Camera

















Electrical System

Shadi Juraydini







Its Electric!! (boogie-woogie)

2009 FRC CONTROL LAYOUT



FIRS

Power Distribution Board

- Regulate power from battery
 - Breakers
- Transform voltage
 - 12 Volts
 - 24 Volts
 - 5 Volts













Compact RIO



- Brain of the robot
- Programming
- Autonomous control
- Analog Bumper
 - Analog Sensors









Digital Sidecar / Jaguar



Digital Sidecar
 – PWM driver



 Pulse Width Modulation (PWM)







Power Consumption

Fait Maine	Diaw (average) Diaw (illax)		
	Amps	Amps	
Chassis			
Drive Motor 1 RIGHT (CIM)	20	30	
Drive Motor 2 LEFT (CIM)	20	30	
Accelerometer	0.00035	0.1	
Encoder 1	0.015	0.1	
Encoder 2	0.015	0.1	
Ultrasonic Sensor	1	5	
Elevator			
Motor 3 Top (Fisher)	15	20	
Motor 4 Bottom (Fisher)	15	20	
Limit Switch (Top)	0.25	5	
Limit Switch (Middle)	0.25	5	
Limit Switch (Bottom)	0.25	5	
Shooter			
Flywheel Motor (CIM)	20	30	
Encoder 3	0.015	0.1	
Potentiometer	0.0833	0.1	
IR Emitter	0.2	0.5	
IR Reciever	0.2	0.5	
Turret Rotation Motor (CIM)	20	30	
Limit Switch (LEFT)	0.25	0.5	
Limit Switch (RIGHT)	0.25	0.5	
Camera	0.5	1	
Total	113.27865	183.5	

Dave Name

Total Average Power: 113.3 Amps Total Max Power: 183.5 Amps

Theoretical Capacity	18	amp-hours	
Rate of Discharge	166	amps	
100% Discharge Time	0.096	hours	
80% Discharge Time	0.077	7 hours	
20% Discharge Time	0.19	hours	
Theoretical Capacity	18	amp-hours	
Rate of Discharge	112.28	amps	
100% Discharge Time	0.143	hours	
80% Discharge Time	0.115	hours	
20% Discharge Time	0.029	hours	















Software Chassis

Sean Lee







Software Environment

- Developing software in LABview
 - Easier learning curve
 - Increased feedback capability compared
- cRIO Operating Environment in VxWORKS









Software

- Three Joysticks
 - 2 for Tank Drive
 - 1 for Shooter
- Dashboard
 - Displays sensor information from robot



Traction Control







Autonomous Design Concepts

- Independent
 - Define Waypoints
 - Evasion Strategy
- Iterative
 - Real Time environment with 32 ms loops
 - Offensive Attack Strategy















Elevator Software

Chris Gumm









Elevator Concept Videos











































Elevator Software

- Collect Moon Rocks (Ammo)
- Moon Rock Space Management

 Limit Switches
- Load Shooter / Turret with Moon Rocks
- Provide User interface
 - Joystick Buttons















Turret Software

Andrew Broeker







Turret Software Design

- Target identification
 - Using camera and software detection
- Automatic Aiming
 - Predicts future target movement
 - Software tells turret where to go
 - Manual override
- Firing mechanism
 - Automatic and manual capabilities







Fire Control System

- Trajectory Calculations
 - Accelerometer on robot used to account for robot movement
 - Angle detection
 - Potentiometer
 - Camera
 - Encoder
- Target Range finding
 - Based on pixel width from camera

















Project Management

Adam Seeman









Budget

- Total robot \$3500
- Chassis material purchased
- Projected Purchases
 - Electric \$500
 - Plexiglass \$100
 - Bumper Material
 \$50







Lenape Regional Robotics



Schedule

Day	Wk 1 1/7	Wk 2 1/14	Wk 3 ^{1/21}	Wk 4 ^{1/28}	Wk 5 ^{2/4}	Wk 6 2/11
м	Brainstorming	Field Construction	Parts Fabrication	Manipulation Systems	Assembly & Debug	Build Crate
т	Strategy for Play	Field Construction Parts Fabrication	Parts Fabrication Chassis Assembly	Practice Driving Manipulation systems	Assembly & Debug	Practice w/ Robot Programming
w	General Design	Assemble & Check Controller	Parts Fabrication Chassis Assembly	Practice Driving Manipulation Systems	Assembly & Debug	Practice w/ Robot Programming
тн	Begin Drawing Design	Parts Fabrication	Assemble Control Board Drive Train	Practice Driving / Manipulation Systems Final Wiring	Assembly & Debug	Practice w/ Robot Programming
F	Begin Ordering Parts	Parts Fabrication	Assemble Control Board Drive Train	Manipulation Systems Final Wiring	Assembly & Debug	Practice w/ Robot
S	Game Piece Building	Parts Fabrication	Drive Train	Final Wiring	Prep for Shipping	Practice w/ Robot 2/16
Goal	Consensus on a design	Parts ordered & being built	Drive Train Assembled	Major Systems Assembled	Robot Completed	Pack & Ship

Legend:



Lenape Regional Robotics









Communications

Rebecca Cohen Elanor Williams









Marketing

- Community Service
 - Coloring book
 - Gracious Professionalism Poster
- Website
 - storm.lrhsd.org
- Fundraising
 - Letters to businesses
 - Bowling night
 - Engineering t-shirt sale









Coloring Book



- Distributed to surrounding elementary schools
- Book
 - Cut and paste coloring book
 - Information about First Lego League
- Prizes given out to best entry









Gracious Professionalism (GP)









Storm Watch- Weekly Newsletter

- Student written and edited
- Dedicated to sharing accomplishments about our team
- Distributed through email to keep our team green











Doing our homework!

- Working on a database of members for Storm Robotics
- Starting an awareness campaign through a colouring book project on First Lego League
- Keeping the Team Organized
 - Student name and info
 - Student attendance
 - Trip organization







Lenape Regional Robotics



Thank You Mentors

- Mr. and Mrs. Maurice Grontkowski
- Mike Hentrich
- Burt Hurff (and family)
- Falguna Patel







Thank You!

LOCKHEED MARTIN







Shamong Manufacturing









Questions?









Trajectory Calculations

