Roué Wheel Training Aid

Senior Design Project 11303

Team Members : Bryce Mankowski (EE), Matt Rothberg(EE), Jared Burdick(EE), Brian Dominiak(ME)
Faculty Guide : Gerry Garavuso

Roué Wheels:
Roué wheels are aluminum cast wheels ranging in size from 5-6 feet in diameter. The performer holds the wheel from the inside while engaging in skillful spins. Roué wheels are typically found in acrobatic performances such as Cirque du Soleil.

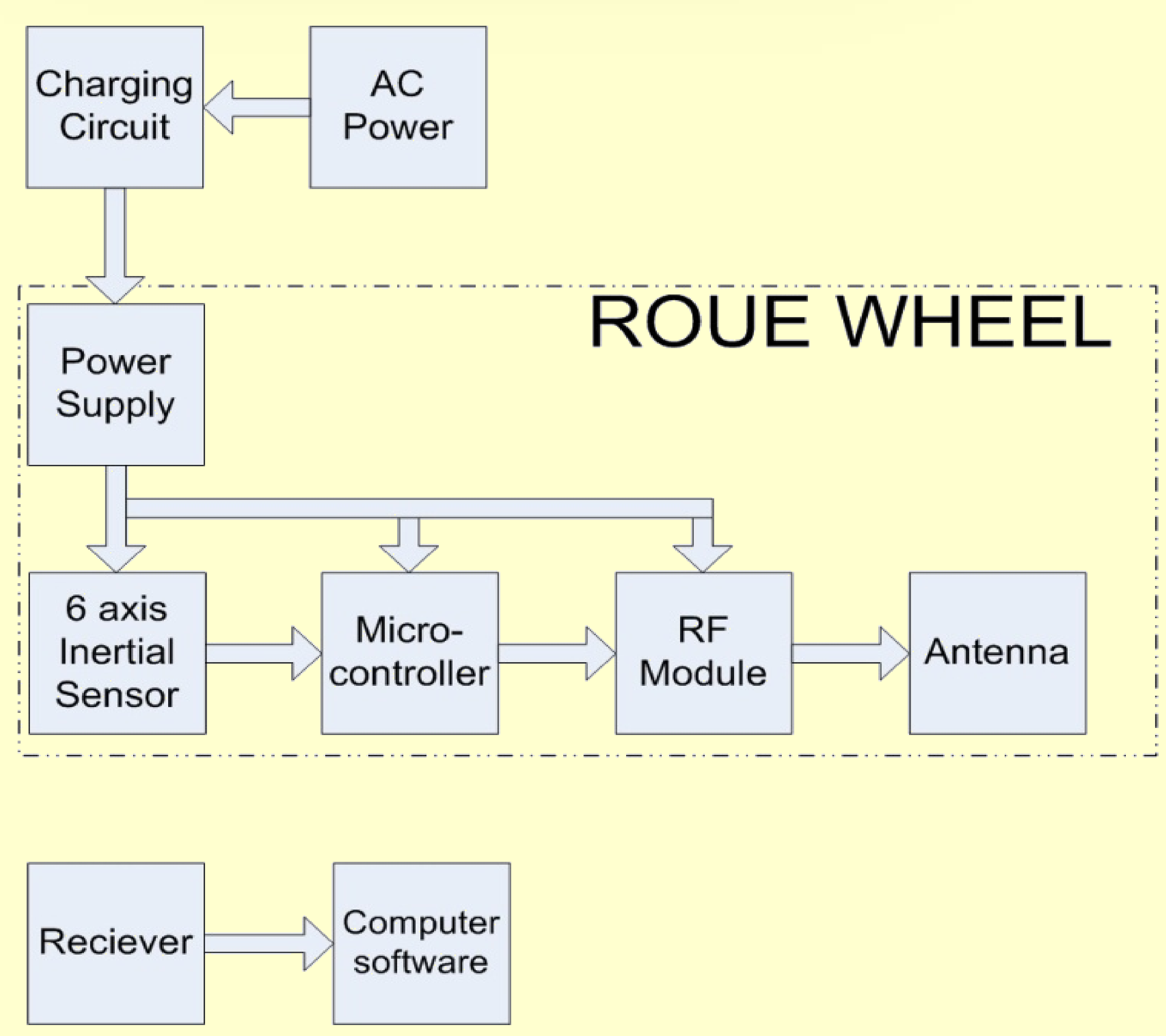
Customer
Sam Tribble and Ian Mankowski

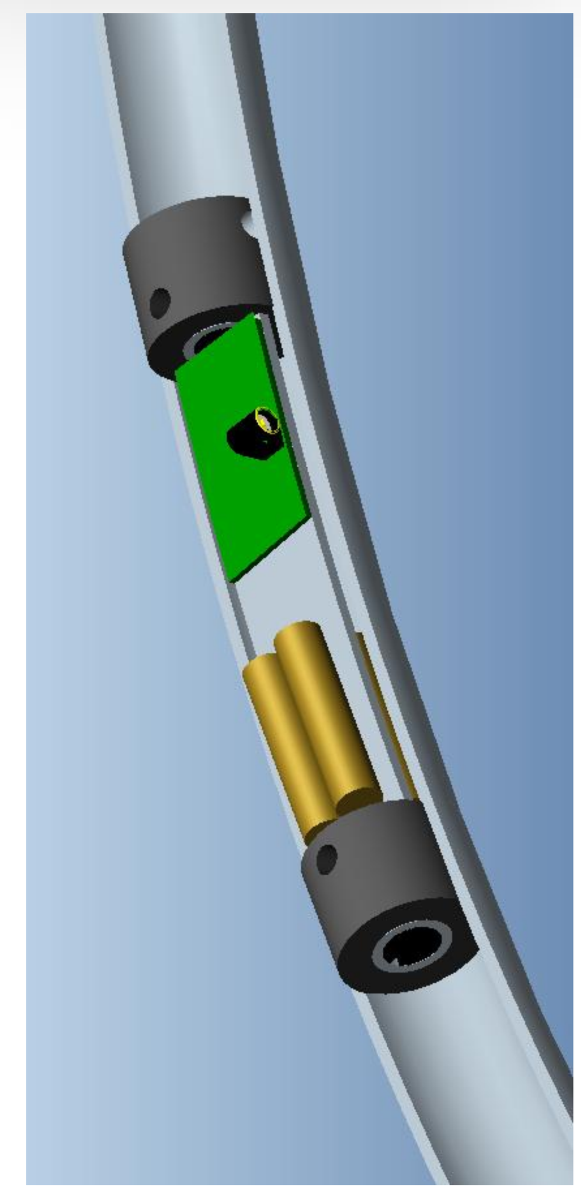
Background:
The objective of this project is to develop a training aid for a Roué wheel. This system will collect a series of position and time data including x, y, z, and t. This data will represent the Roué wheel performer's routine. The data will be processed by a computer for review and real time feedback.

Objectives:

- Devise a method to obtain roué wheel position data
- To not impede the rider in any way
- The data is to be accurate
- To operate for 8 hours
- To withstand daily use
- Provide real time feedback
- Free from a wired connection

System Design Flow Chart:





Component Selection:

Digi Xbee:
- 300 ft indoor, 1 mile outdoor range
- 2.4 GHz
- 250kbps serial rate

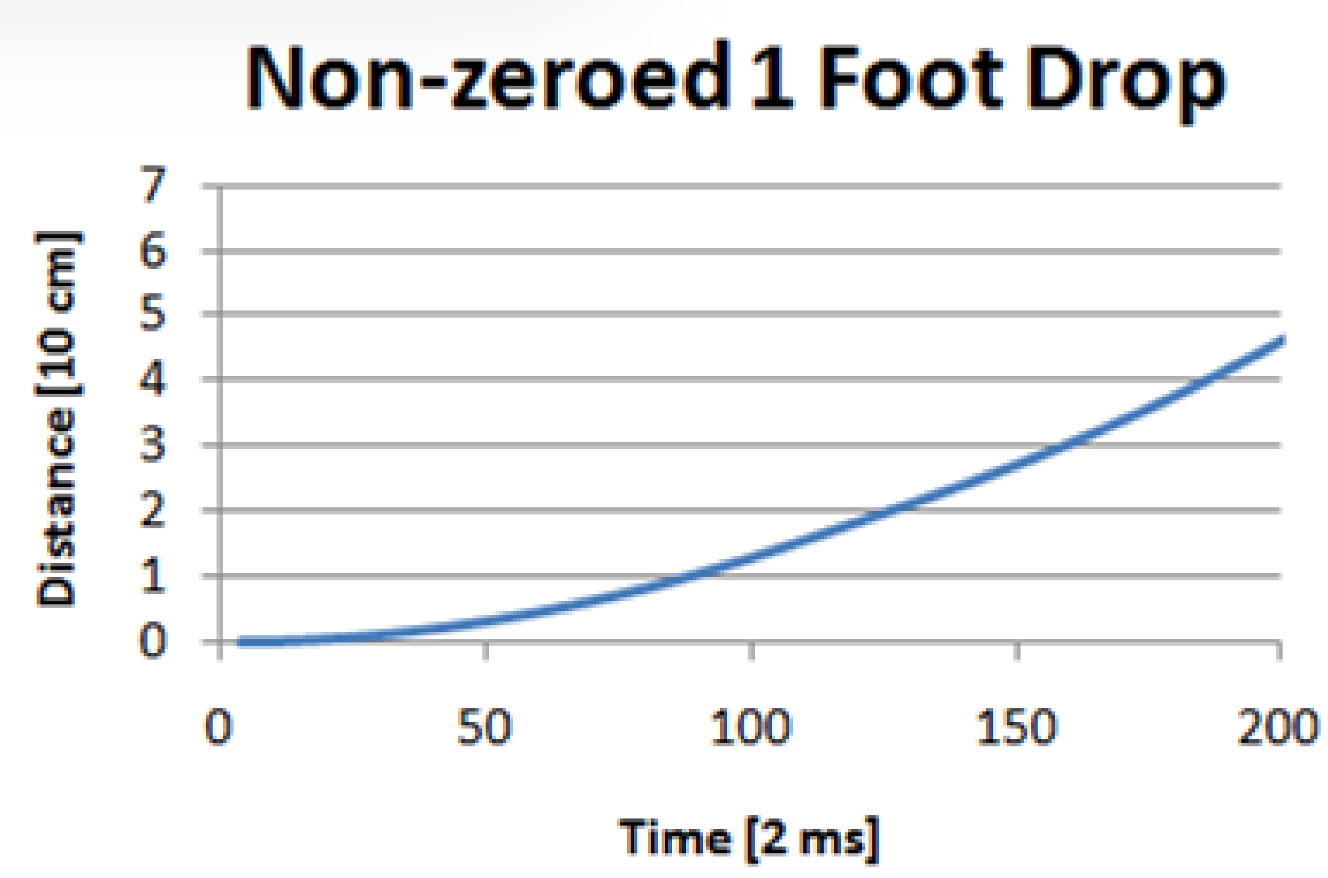
3 Axis Accelerometer :
- 2g/±4g/8g dynamically selectable full-scale
- 10000 g high shock survivability

Triple Axis MEMS Gyroscope:
- Digital-output X-, Y-, and Z-Axis angular
- one integrated circuit
- sensitivity of 14.375 LSBs per °/sec
- full-scale range of ±2000°/sec

Microprocessor:
- 2-UART, 2-SPI, 1-I2C
- 16-bit, 40 MIPS
- Fast Wake/Fast Control

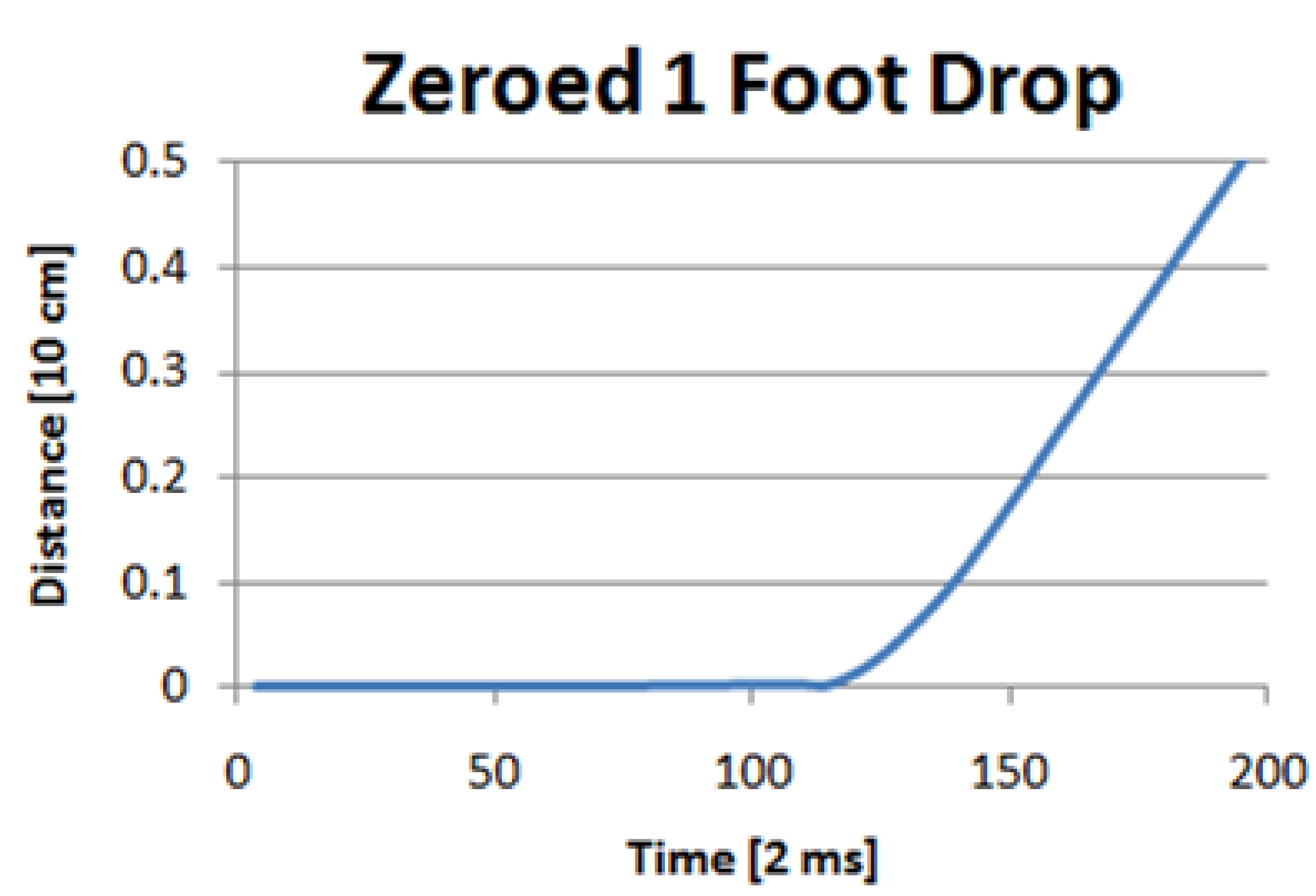
Taoglas FXP70 Freedom:
- 80% Efficiency
- 5dBi gain
- 50 ohm impedance

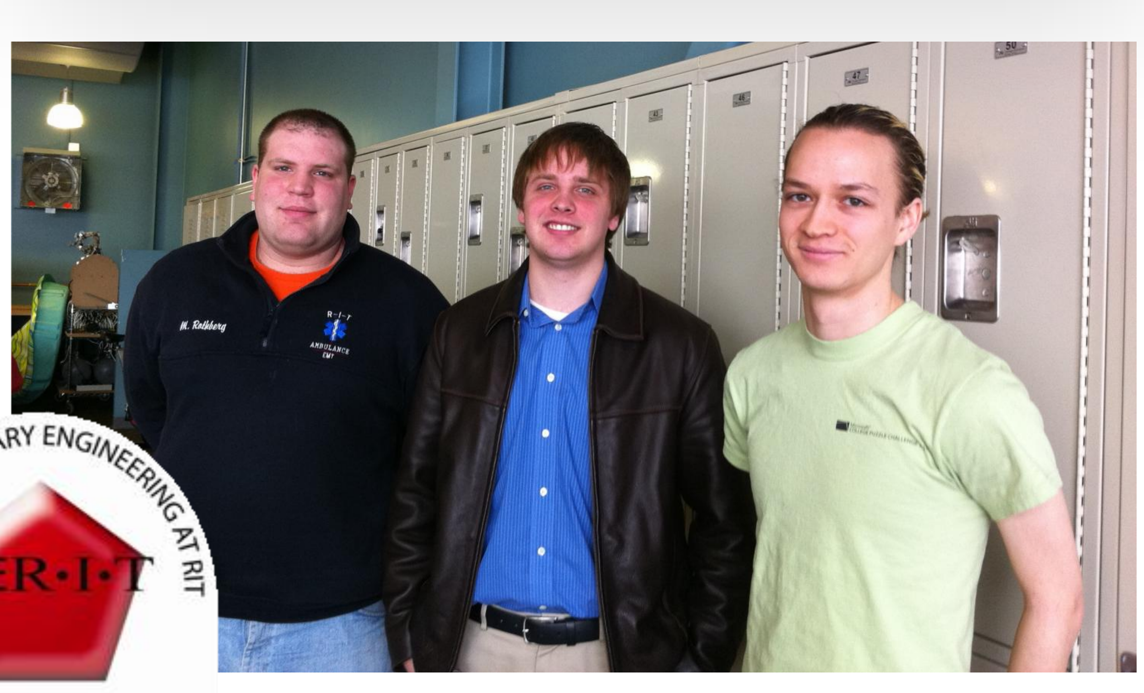
Lithium ion Batteries :
- 3.7V AAA size battery
- Light weight & high energy density



Project Results:

- Sensor acceleration data proved to be accurate to at least 8 bits and potentially up to 12 bits
- It was extremely difficult when determining position from acceleration data. This is due to the two error terms from integration. A constant with time and a constant growing with time made position calculations inaccurate.
- Position calculations generally were only accurate to within 500 to 1000 milliseconds from initialization. To track the position and orientation of the wheel for training or choreography purposes, this proved to be insufficient.
- Drift components in the acceleration due to error in the physical sensor were observed. This error is present in the integrations performed, resulting in yet more inaccuracy in calculating position.
- Drift error may be taken out at the source by allowing the accelerometer to initially at a motionless starting position. The initial offset may then be mathematically processed out at the laptop side of the process.





MULTIDISCIPLINARY ENGINEERING AT RIT
MER·I·T
Senior Design

Potential Future Improvements:

- Improve the signal processing methods by creating error bounds on the physical limitations of a projected roué wheel path
- Lower error accumulation by frequently resetting/recalibrating the accelerometer & gyro setup when outside the error bounds
- Narrow the error bounds by using the RF transceiver as a digital radar system to determine distance between the roué wheel and the receiver
- Provide additional hardware in the wheel to utilize triangulation techniques
- Change the hardware to utilize different sensors (ultrasonic sensors)