

iitorque

Integrated Intelligent Torque Measurement System

- IPRO 324: Power Measurement for Performance Bicycles
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Introduction

- Mission statement:

“Develop a system that measures the applied torque at the crankset of a bicycle. In contrast to existing solutions, we want to be able to retrofit our system to existing cranksets, obviating the need to abandon parts that the bicyclist already owns. “

Overview

- What's out there:
 - Power meters currently in the market
 - Pros/cons
- Power measurement for cyclists
 - Accurate
 - Low cost
- Project goals
 - Working prototype
 - Durable encasement
- Target market
 - Performance cyclists
 - Casual cyclists for general fitness



Goals of the Project

- Proposed solution
 - Torque measurement using strain gauges
 - Crankset attachment
- Impact on end user/target market
 - Affordable power measurement
 - Accurate power measurement for all cyclists
- Current solutions
 - Pedal systems
 - Rear hub
 - Chain vibration



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Organization of the Team (WBS)

Mechanical

- Design and build case
- Dynamic lab test
- Road test

Electrical/Programming

- Redesign circuit
- Rewrite code
- Establish wireless communication

Research

- Order parts
- Analyze market
- Prepare deliverables and documentation

Previous IPRO

- Design of product housing
- Testing procedure
- Strain gauge use
- Static testing and calibration
- Data acquisition method



Mechanical Team:

- Mechanics
- Power transfer through crankset to chain to wheel
- Law of energy conservation tells us that crankset deformation \propto power input

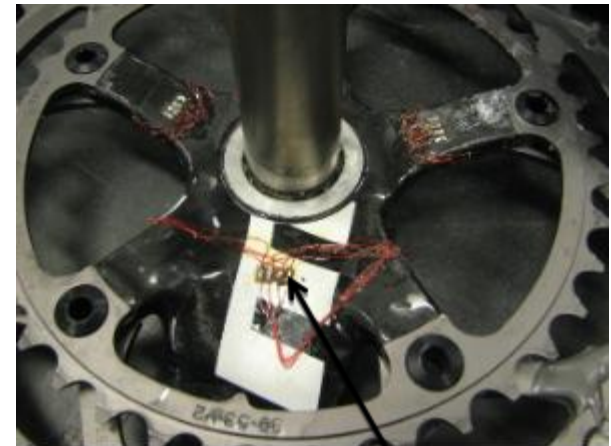


Power from calves
transferred to pedal

Power from pedal
transferred to crankset

Power measurement

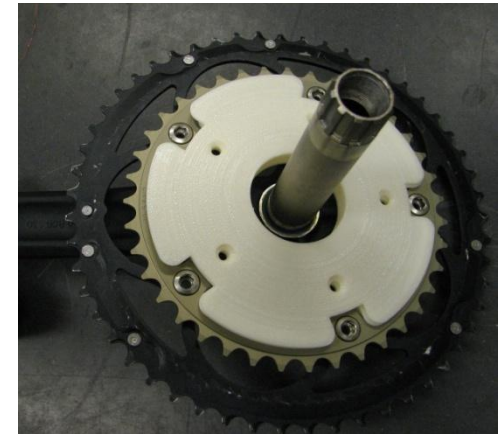
- Strain gauges measure electrical resistance
- Change in resistance \propto deformation \propto power input
- Recorded resistance values used to determine torque and hence power in lab view



Strain gauges attached to crankset

Accomplishments

- Designed and constructed the casing.
- Performed in-lab dynamic testing.
- Collected data and analyzed it
- Compared data of iitorque with other existing power meters



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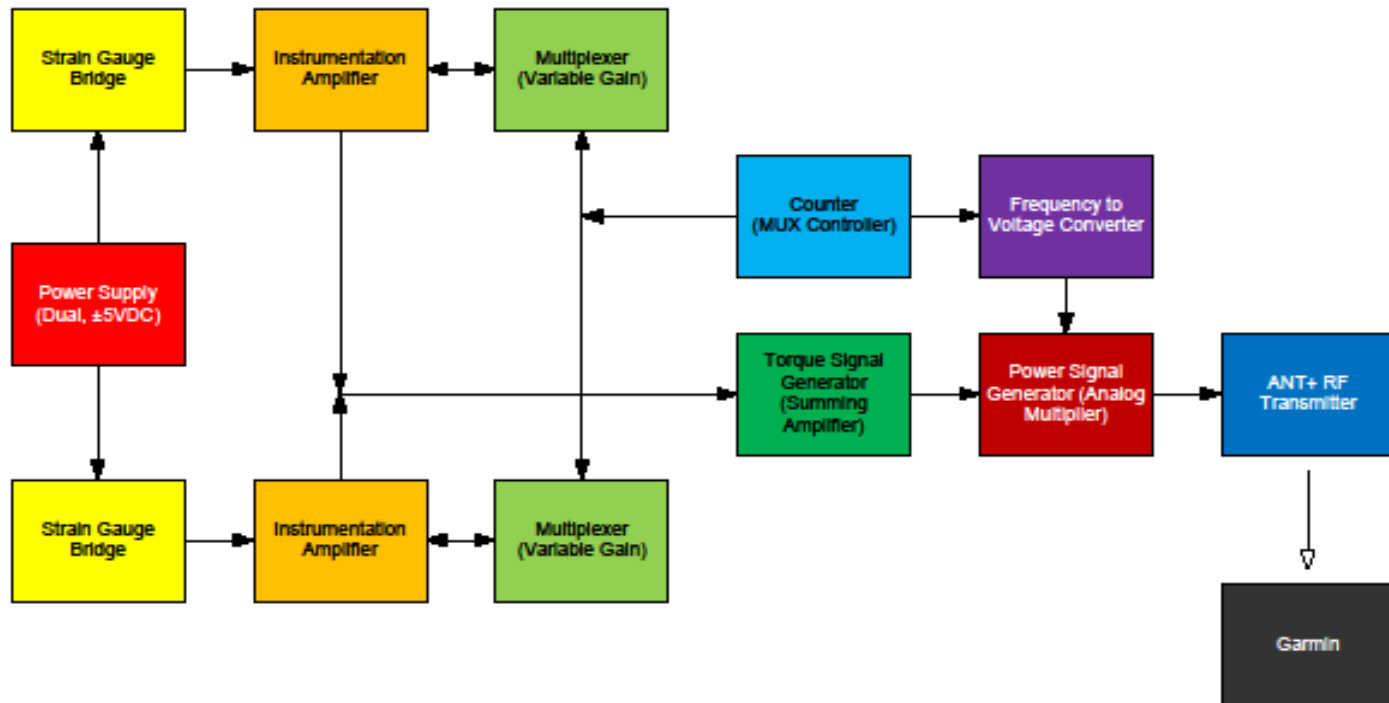
Electrical/Programming Team:

- Previous IPRO work
 - Digital circuit with microprocessor (PIC18)
 - Automatically generated ANT+ code
- ANT+ background
 - wireless sensor network protocol
 - specifically for sport and health devices
 - Bike power sensors
 - Heart monitors
 - Speed Sensors etc.



Electrical/Programming Team:

- Process:
 - Designed an analog circuit
 - Eliminates microprocessor and code



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Electrical/Programming Team:

- Tested simplest mode of ANT+, Sensrcore, to transmit power signal



Computer Running Sensware
with ANT+ Chip2



Garmin Display

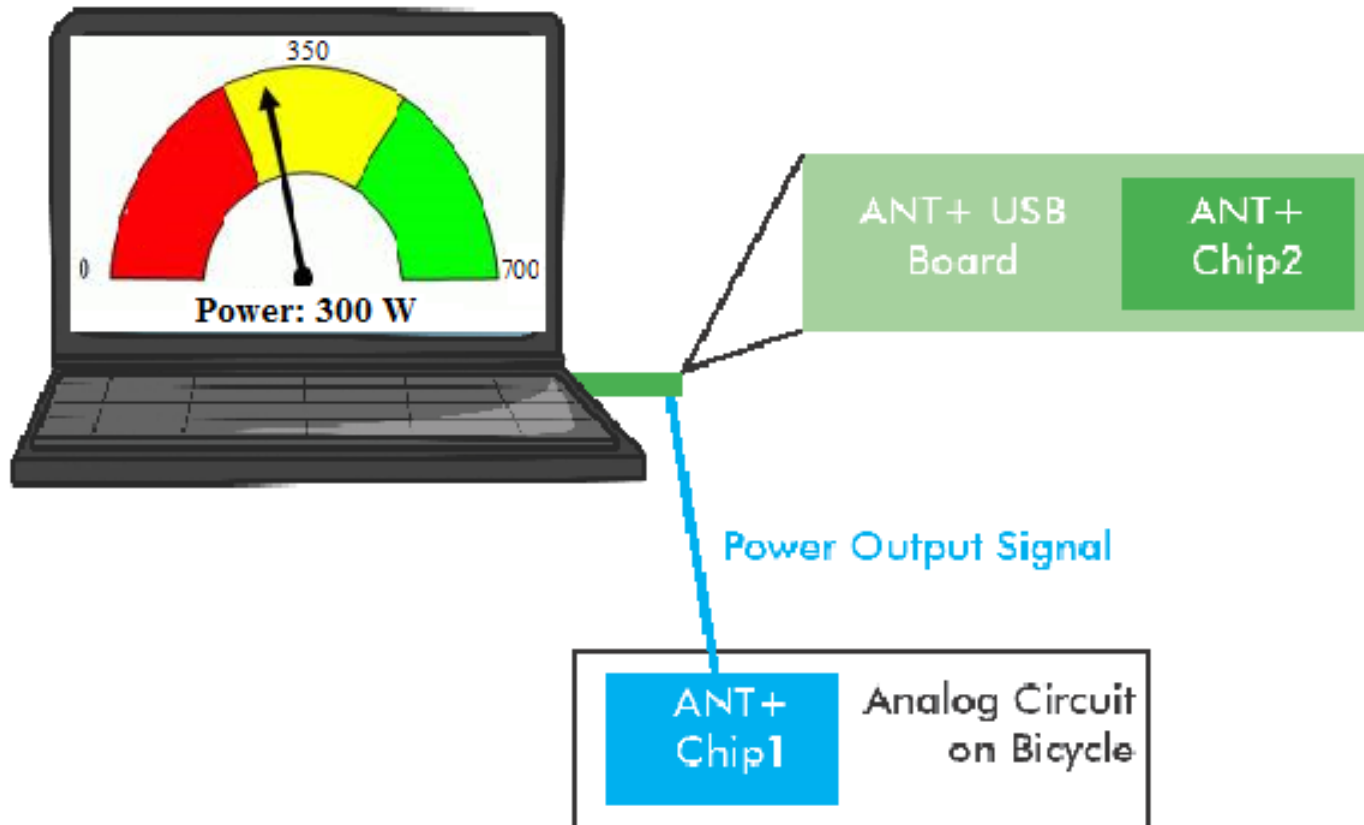
- Later discovered Sensrcore's purpose is testing only a few types of signals

Electrical/Programming Team:

- Brainstormed solutions
 1. Revert back to a simplified version of previous semester's code
 - Add microprocessor to current circuit
 2. Move forward by using current circuit
 - Create interface for power signal output on a PC

Electrical/Programming Team:

- Final System



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Electrical/Programming Team:

- Future work:
 - Add a microprocessor
 - Program the microprocessor so the ANT+ can communicate with the Garmin
 - Code would be simple and minimal

Research Team

Accomplishments:

- Built an informative website for the project and document the work done.

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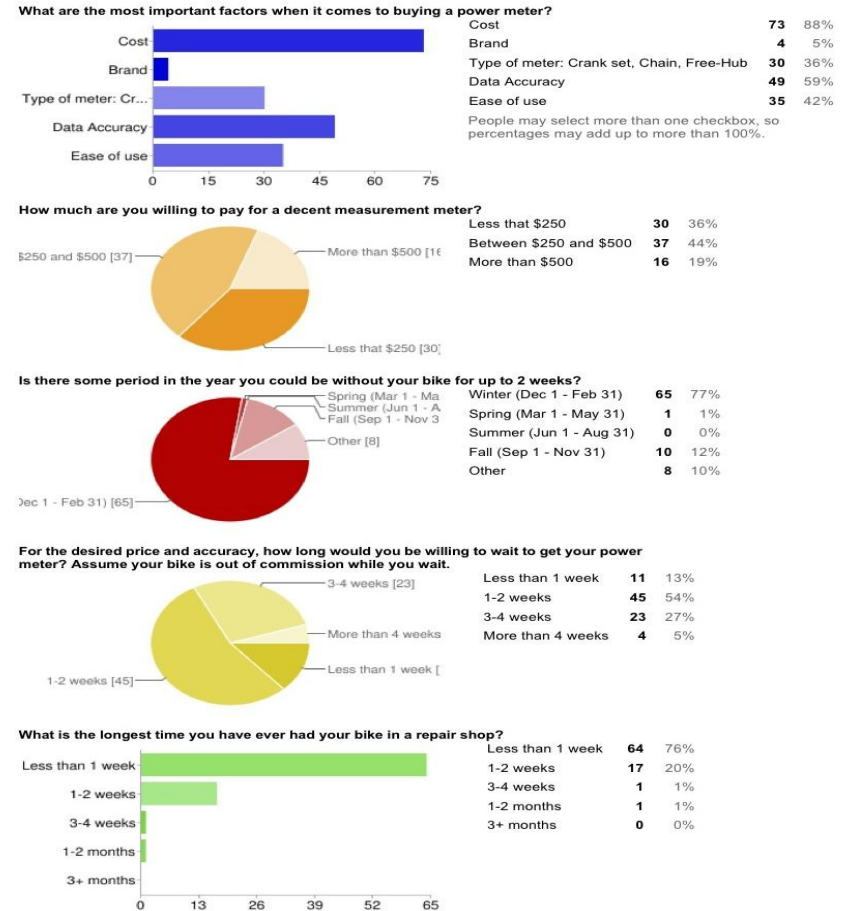
The IPRO team is working to develop a system that measures the torque that a bicyclist applies at the crankset of the bicycle and transmits the data to a commercially available bicycle computer. Our goal is to have a design that is suitable for retrofitting existing cranksets for high-end racing bicycles. In contrast to existing solutions we want to be able to retrofit our system to existing cranksets, obviating the need to abandon parts that the bicyclist already owns. According to tests we have done during previous incarnations of this IPRO, this can be done, in principle, using sets of quite inexpensive strain gauges. However, being able to get accurate torque measurements will require some advanced processing of the signals from the strain gauges. These signals can then be transmitted wirelessly to a bicycle computer like the Edge~705 sold by Garmin. There is a defined wireless protocol (ANT+Sport) that has been developed specifically for the purpose of transmitting exercise data (including cadence, power output, heart rate, etc.) to small computers. Chipsets and development kits for this protocol are also available commercially. Our task will therefore be to find an optimal configuration of strain gauges that will be attached to the crankset, to develop an algorithm to process the strain gauge data in order to isolate a signal that is proportional to the applied torque, and finally to demonstrate that the system we are envisioning can provide sufficiently accurate power data to a commercial bicycle computer.

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Research Team

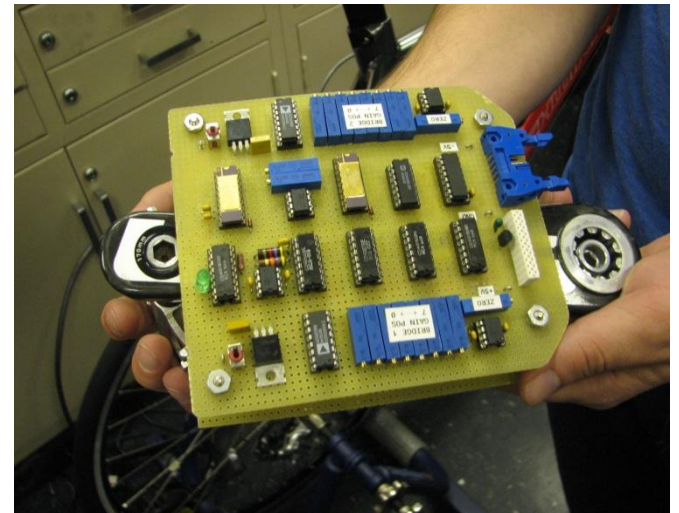
Accomplishments:

- Conducted a survey for Cyclists and collected data to refine the product/service features of iitorque



Conclusion

- Project idea has been successful
- Data collection is accurate as compared to data from powermeter
- For semesters to come, IPRO should fine tune system and determine how to reduce size of ANT+ data receiver



Questions?



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