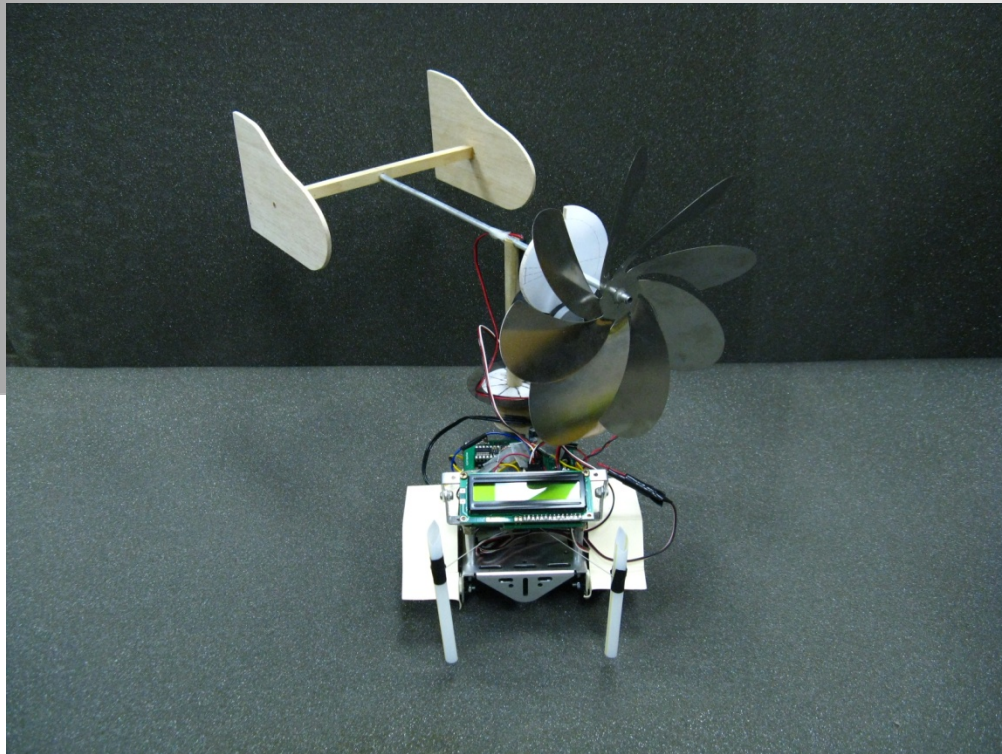


# Mechatronics Design Project 2008



## Project WindBot

Mikhail Bruk  
Anton Talalayev  
Momchil Dimchev

# Wind Power

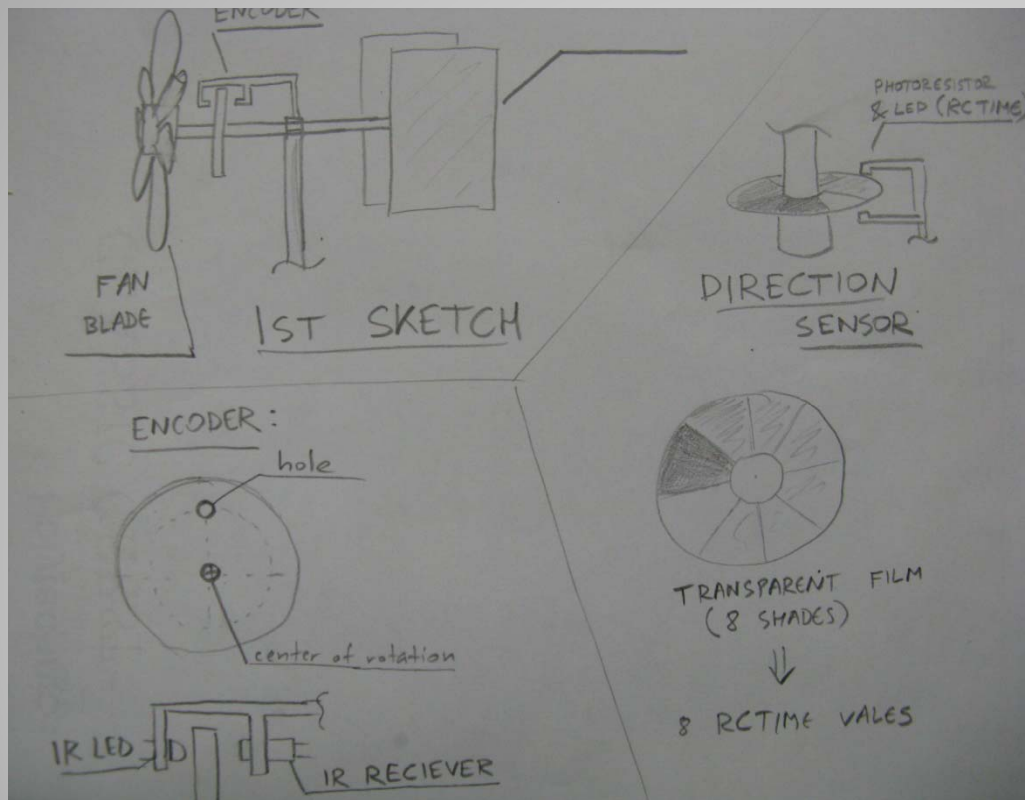
- Wind Turbine Sites
  - Satellite data inaccurate
  - Human testing impractical
- Cost efficient method for data acquisition
  - Little supervision required
  - Better precision
  - Reliable data



# Project Proposal

- Design an autonomous robot
- Navigate through a predetermined path
- Collect wind velocity measurements
- Obtain wind direction
- Return to starting point
- Display optimal locations for a wind turbine

# Initial Design

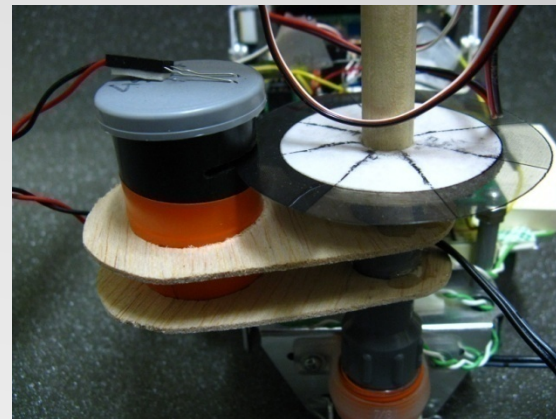
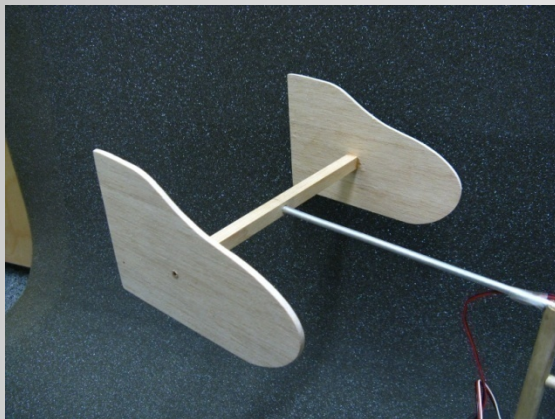
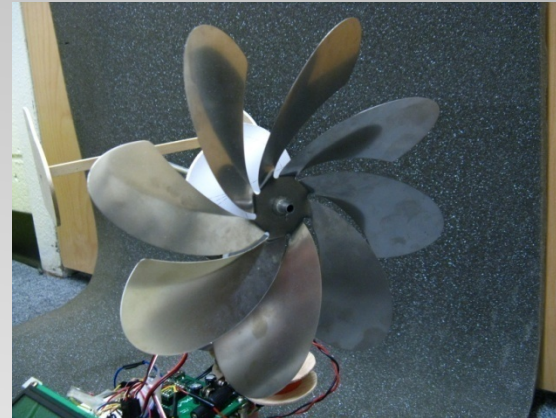


## Features:

- Propeller & Vanes
- Direction Sensor
- Tachometer
- Wheel Encoder
- Accelerometer or Compass
- LCD Display

# Mechanical Components

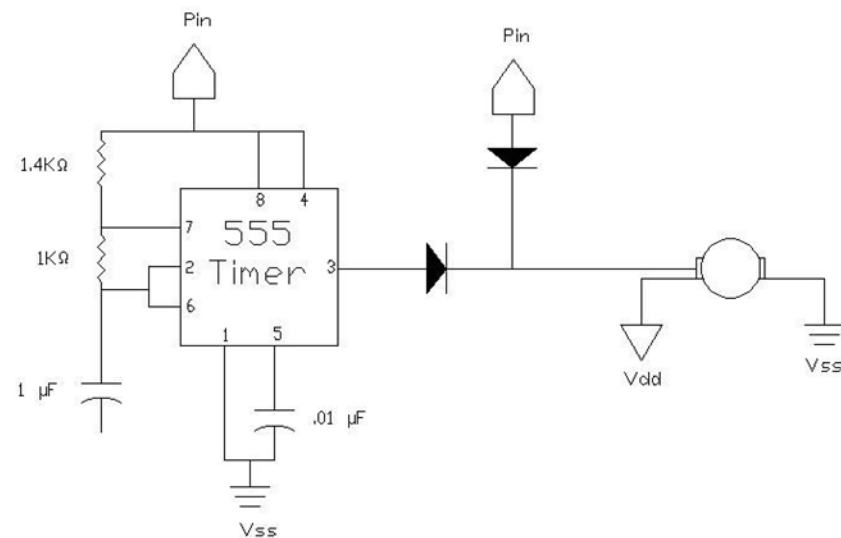
- Aerovane
  - Propeller and vanes
- Materials
- Sensor casings



# Electrical Components

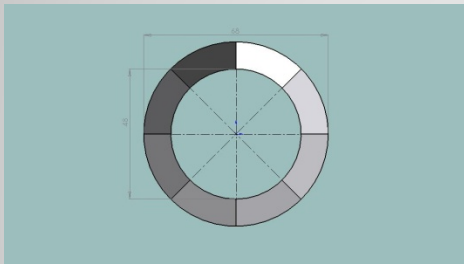
- Actuators
  - Two continuous servo motors
  - Controlled via 555 Timer

Servo Connections

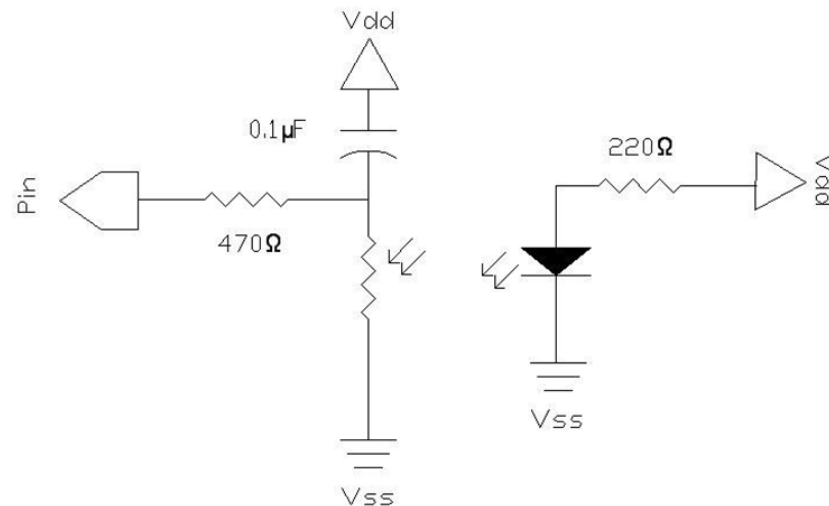


# Electrical Components

- Analog Sensor
  - RCTime circuit
  - Photoresistor and LED pair

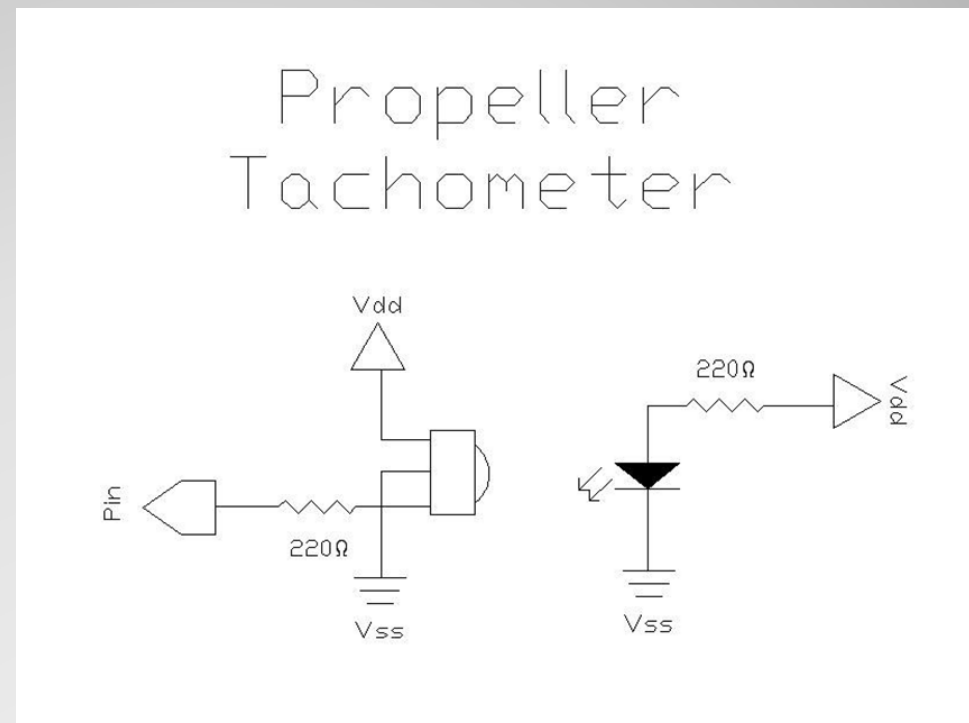
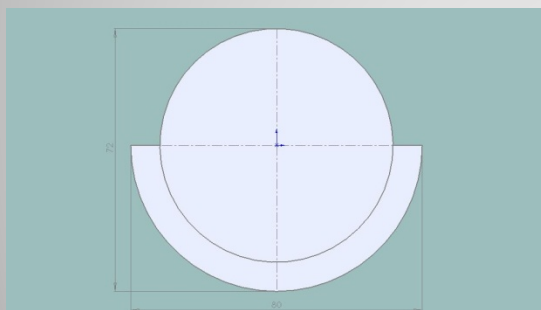


Wind Direction



# Electrical Components

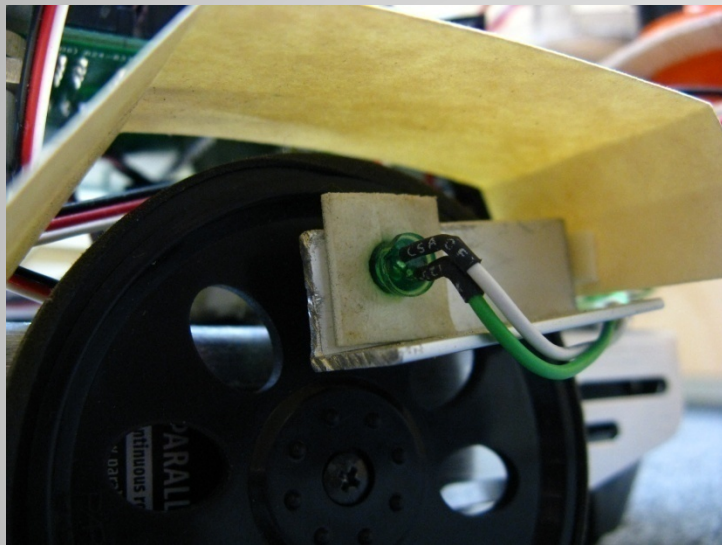
- Digital Sensor
  - Rotational Encoder
  - IR LED and Receiver pair



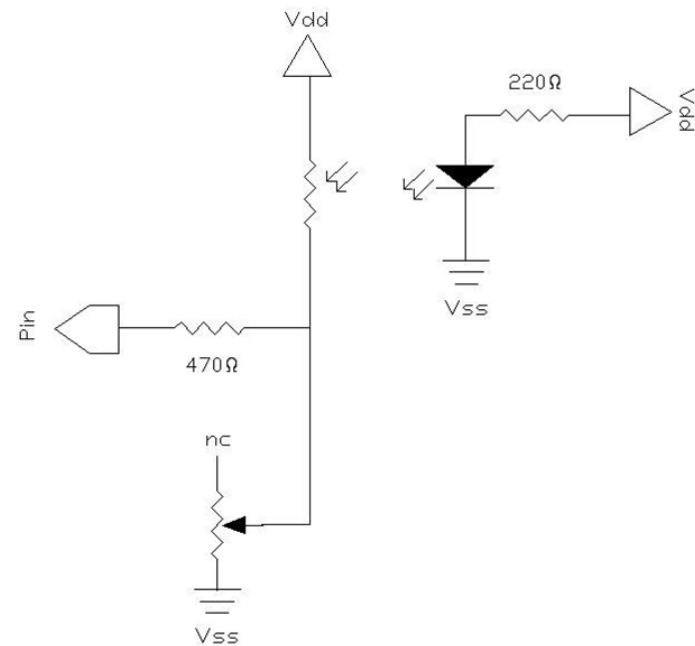


# Electrical Components

- Digital Sensor
  - Wheel Encoders



Wheel Encoder



# Project Analysis

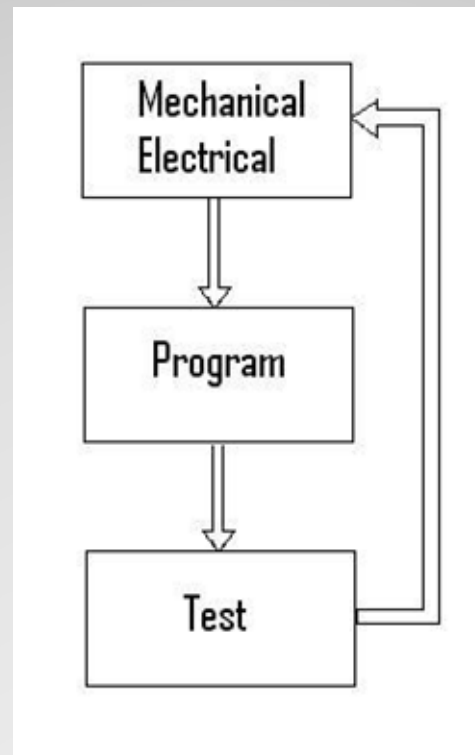
- Priority:
  - Wind Measurement
  - Precise navigation
  - Versatility

## Testing:

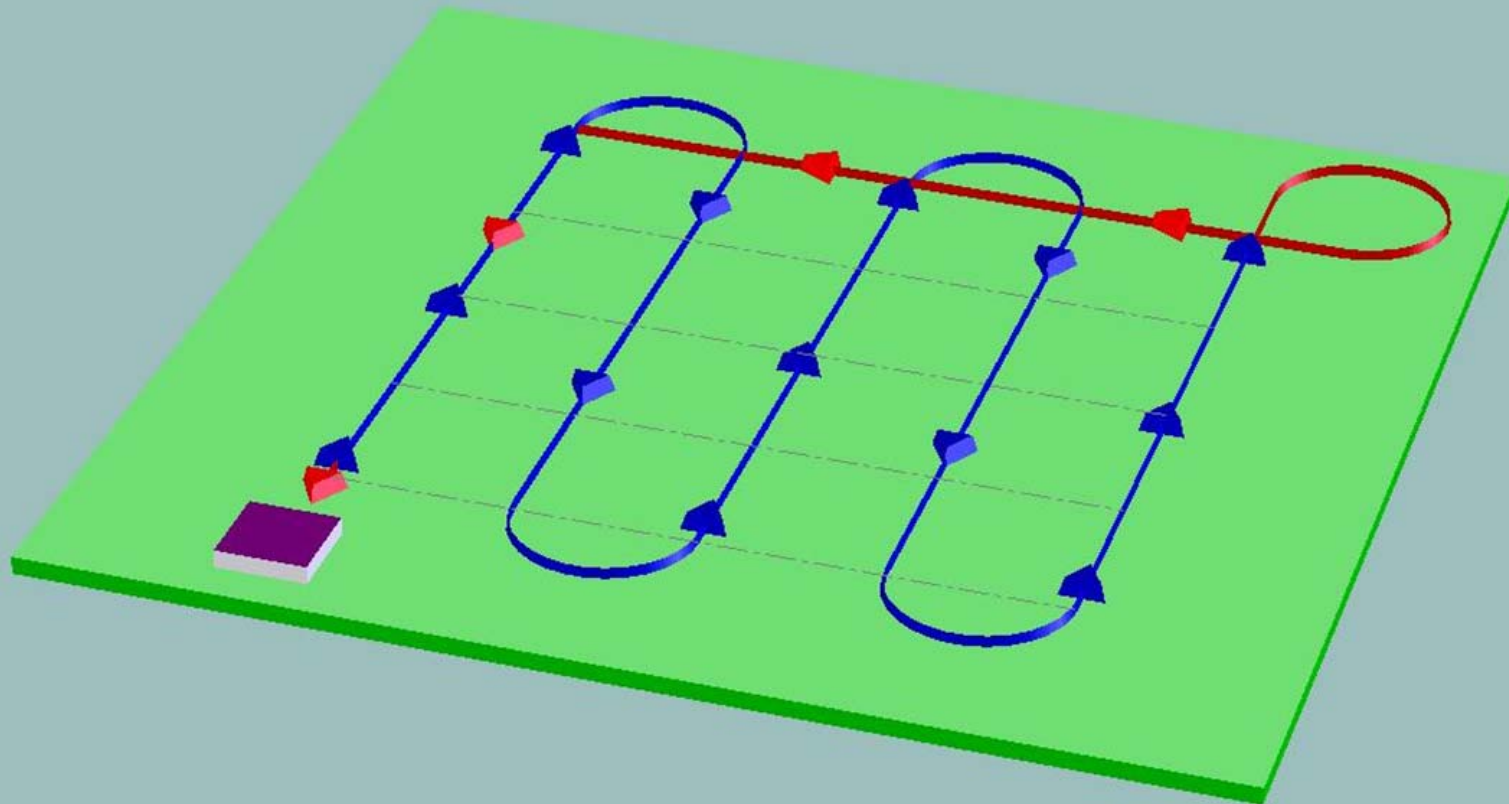
- Variable conditions
- Repetitive data

# Project Analysis

## Design Approach



# Project Analysis



# Programming and Testing

- Calibration Programs
  - Wheel alignment
  - Speed adjustment
  - Velocity calibration
  - Encoder adjustment
- Main Routine
  - Follow the grid
  - Record and save data
  - Retrieve data

# Programming and Testing

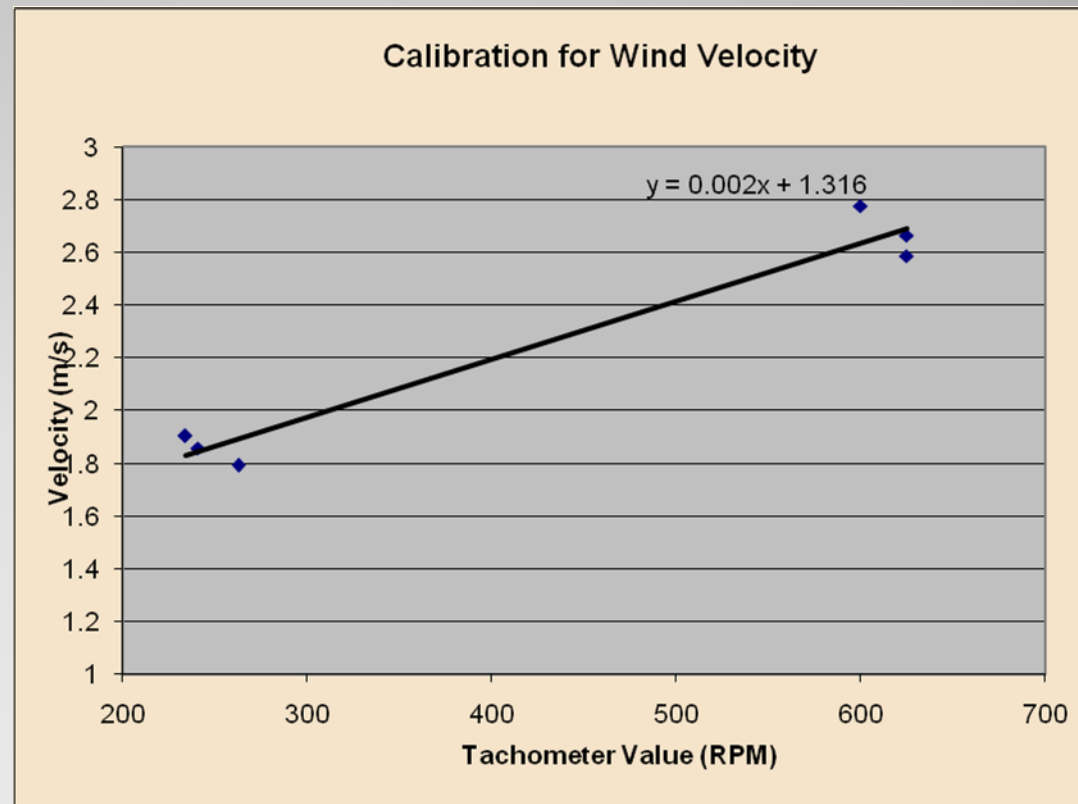
- Subroutine approach
- Easy modification
- Reused variables
- Fail-safe encoders

# Velocity Calibration

VIDEO

# Data from Velocity Calibration

- Plot velocity vs. Tachometer Value
- Obtain a conversion factor





# Cost

•Boe-Bot Robot	\$ 159.95
•555 Timer IC (2)	\$ 2.95
•Power Supply: (4 AA's)	
\$ 2.99	
•Breadboard (1)	\$ 7.99
•LCD Terminal	\$ 29.95
•Hitachi HM55B Compass Module (1)	\$ 29.95
•Balsa Wood (1/8" x 6" x 36") (1)	\$ 3.95
•Tube Fitting (1)	\$ 2.95
•Aluminum Rod (1/16" x 12" x 1/4") (1)	\$ 2.36
•Stainless Steel Propeller (1)	\$ 10.95
•Miscellaneous	\$ 12.00

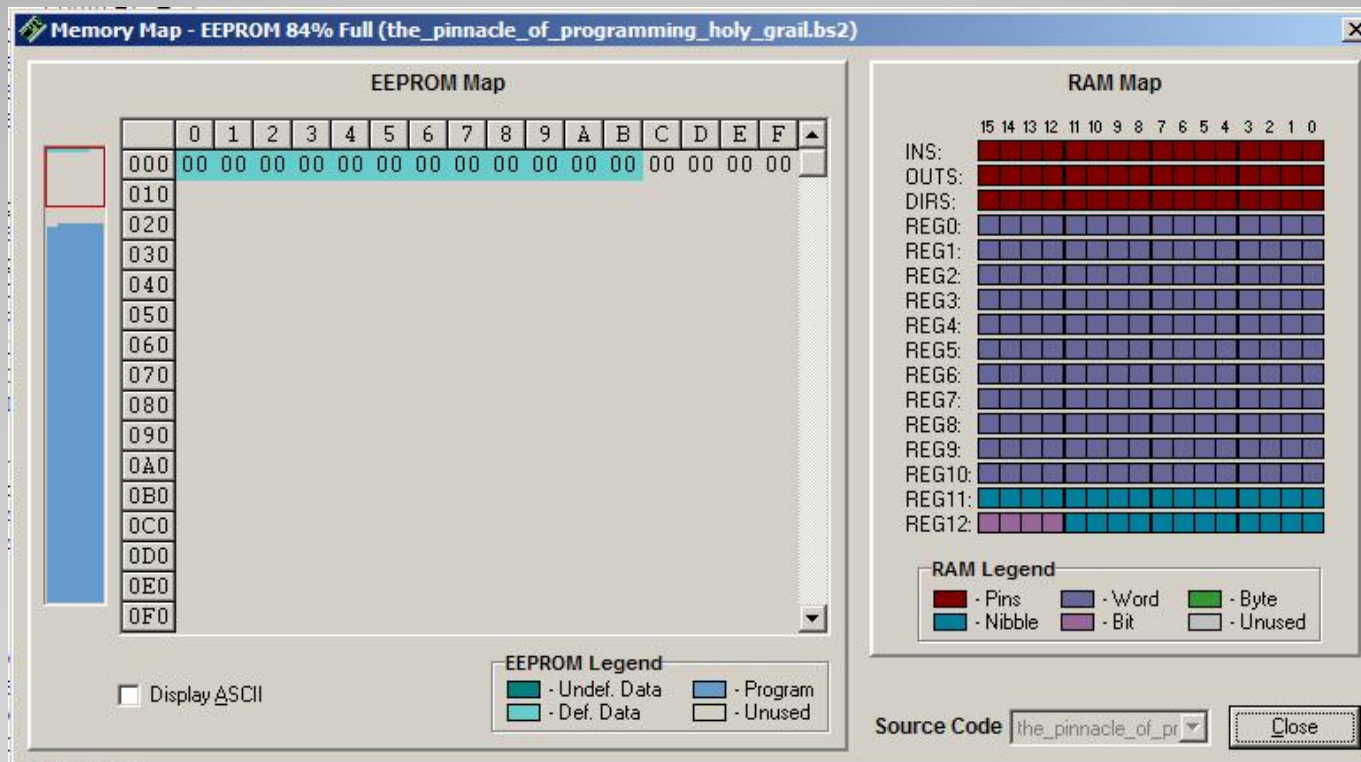
**Total:**

**\$ 253.99**

# Major Challenges

- Follow the preset trajectory
- Sensor reliability
- Program – sensor connection
- Relative Angle Measurement
- Basic Stamp limitations:
  - RAM and EEPROM

# Major Challenges

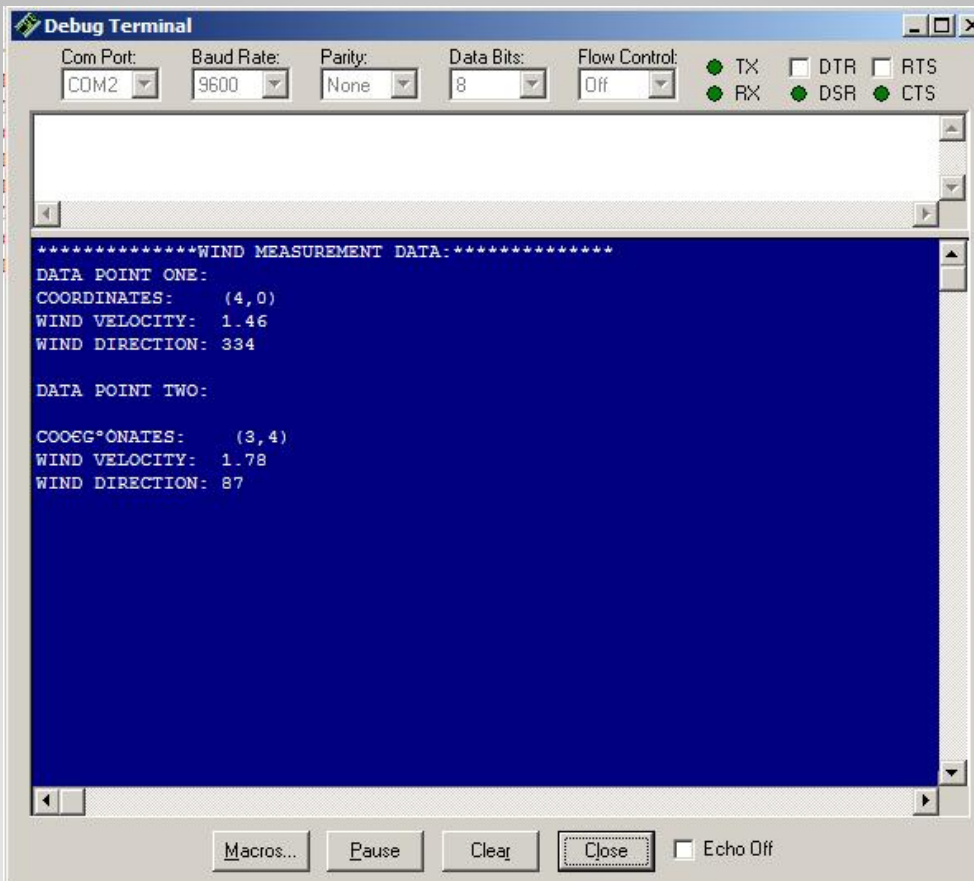


Memory Map

# Full Demo

VIDEO

# Demo Data



The image shows a screenshot of a 'Debug Terminal' window. The window title is 'Debug Terminal'. At the top, there are configuration options: 'Com Port' is set to 'COM2', 'Baud Rate' is '9600', 'Parity' is 'None', 'Data Bits' is '8', and 'Flow Control' is 'Off'. To the right of these are status indicators for TX, RX, DTR, DSR, RTS, and CTS, with TX, RX, DSR, and CTS being active (green dots). The main area of the terminal is a blue background with white text. The text reads: '\*\*\*\*\*WIND MEASUREMENT DATA:\*\*\*\*\*', 'DATA POINT ONE:', 'COORDINATES: (4,0)', 'WIND VELOCITY: 1.46', 'WIND DIRECTION: 334', 'DATA POINT TWO:', 'COORDINATES: (3,4)', 'WIND VELOCITY: 1.78', 'WIND DIRECTION: 87'. At the bottom of the window, there are buttons for 'Macros...', 'Pause', 'Clear', 'Close', and an 'Echo Off' checkbox.

```
*****WIND MEASUREMENT DATA:*****
DATA POINT ONE:
COORDINATES: (4,0)
WIND VELOCITY: 1.46
WIND DIRECTION: 334

DATA POINT TWO:
COORDINATES: (3,4)
WIND VELOCITY: 1.78
WIND DIRECTION: 87
```

# Prototype Suggestions

- GPS navigation
- Meteorological equipment
- Obstacle Avoidance Program
- Video camera (human operator)
- Larger Memory

# Conclusion

- Systematic testing approach
- Acquire more memory
- Increase project cost for better accuracy

# Acknowledgements

- The Italians
- Prof. Sean Peterson

Thank you!