

# Tow Load Indicator with LCD Display

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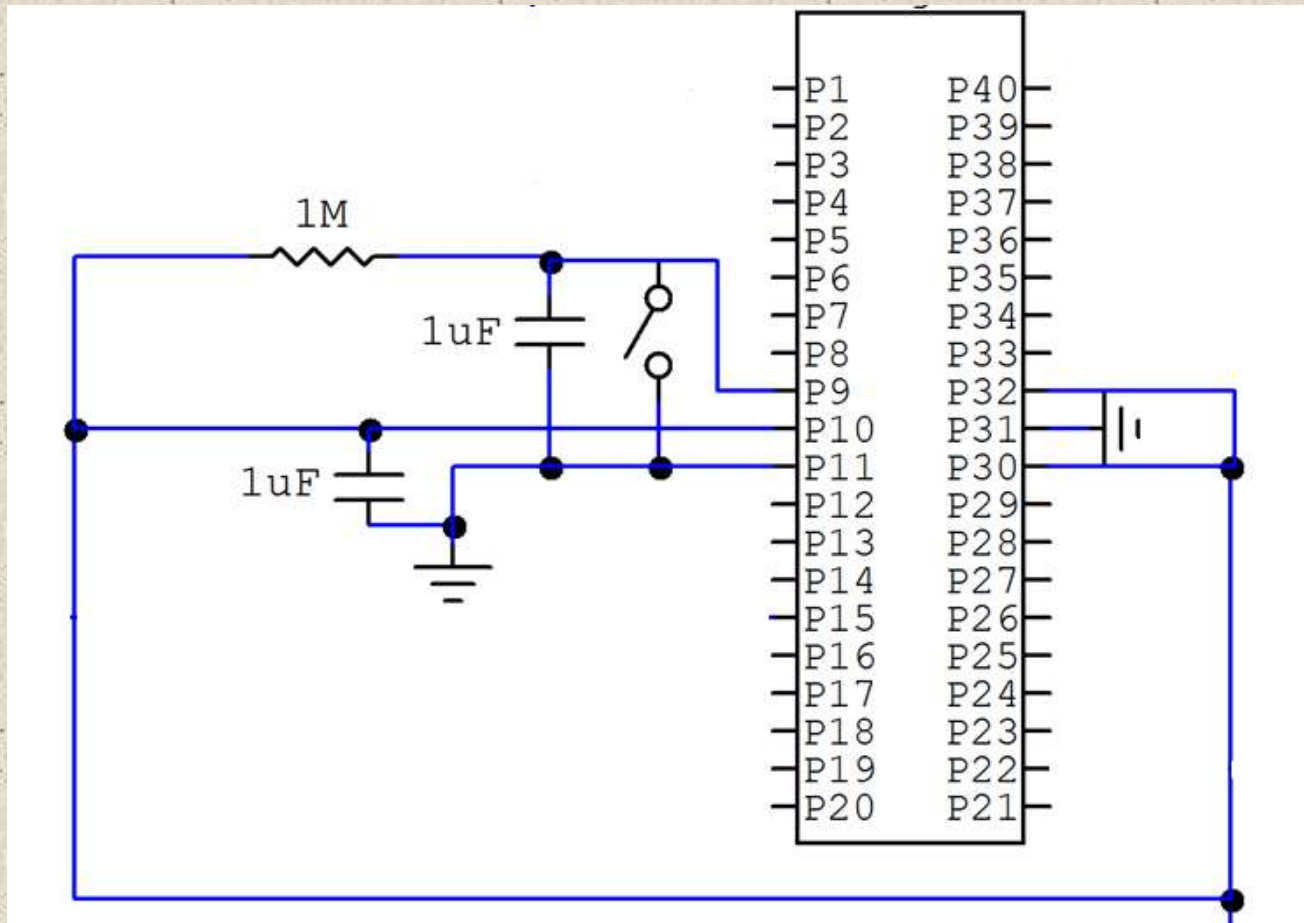
# System Requirements

1. Powered using a 12 volt accessory outlet inside the cab of a vehicle.
2. Will measure the tongue weight being applied to a standard under-bumper towing package.
3. Accurate to 10% of the theoretical towing weight.
4. Displayed on a liquid crystal display.
5. Will allow the user to choose from five different towing classes.
6. Ability to choose a desired safety tolerance of the overall weight class rating.
7. Capable of storing up to 3 user defined presets.
8. An alarm will sound if the measured tongue weight exceeds the tolerance of the rated weight.
9. Self contained unit and affordable for marketing.

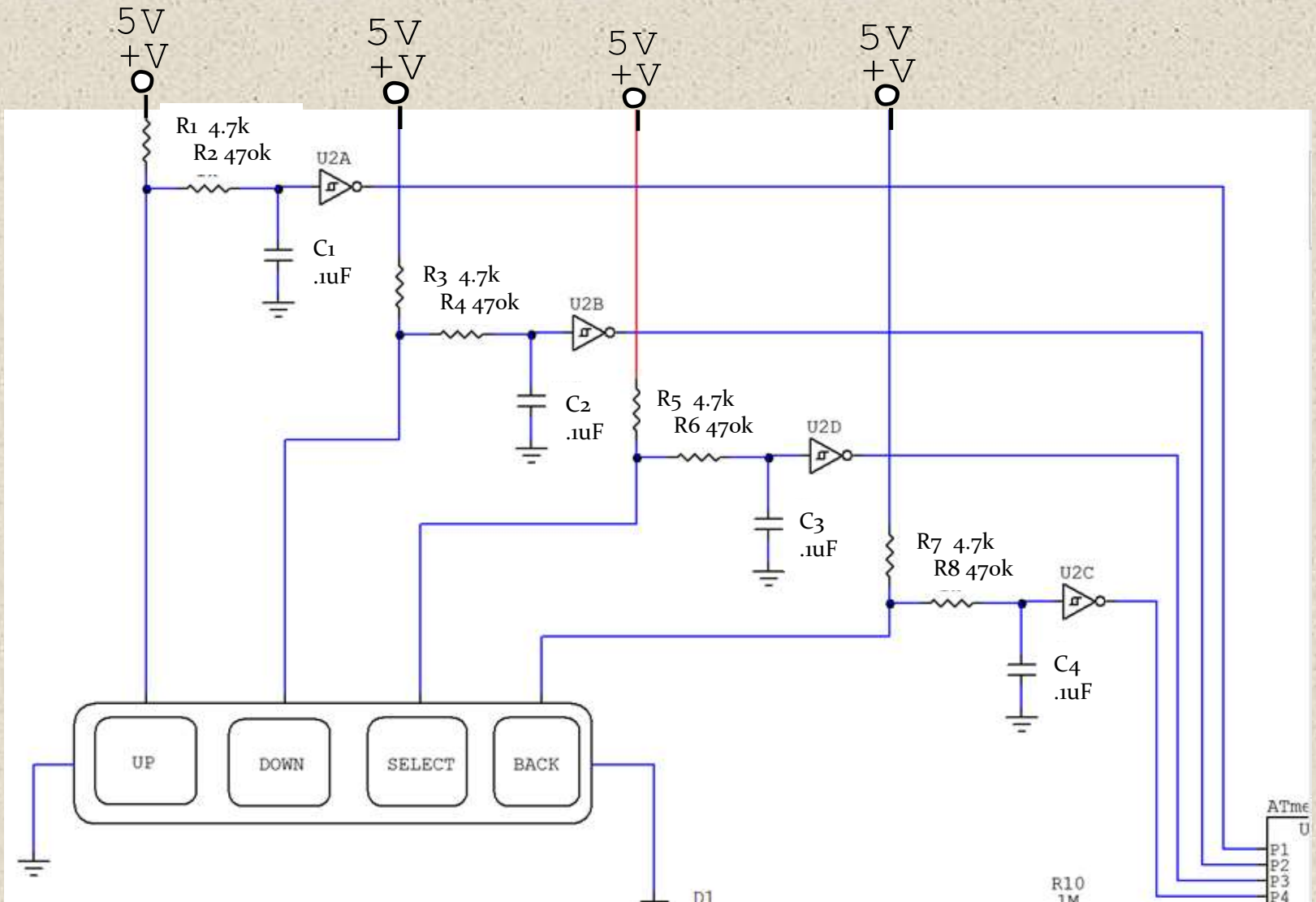
# Components

- Measuring Device
  - Strain gages in a Wheatstone bridge configuration
- Display
  - LED backlit Liquid Crystal Display (LCD) with serial transmission
- Microcontroller
  - 40 pin ATMega324
- Peripheral Devices
  - 4 button keypad with LED backlighting
  - Piezo Element (Buzzer)
- Amplifier
  - AD620 instrumentation amplifier
  - LM741 operational amplifier

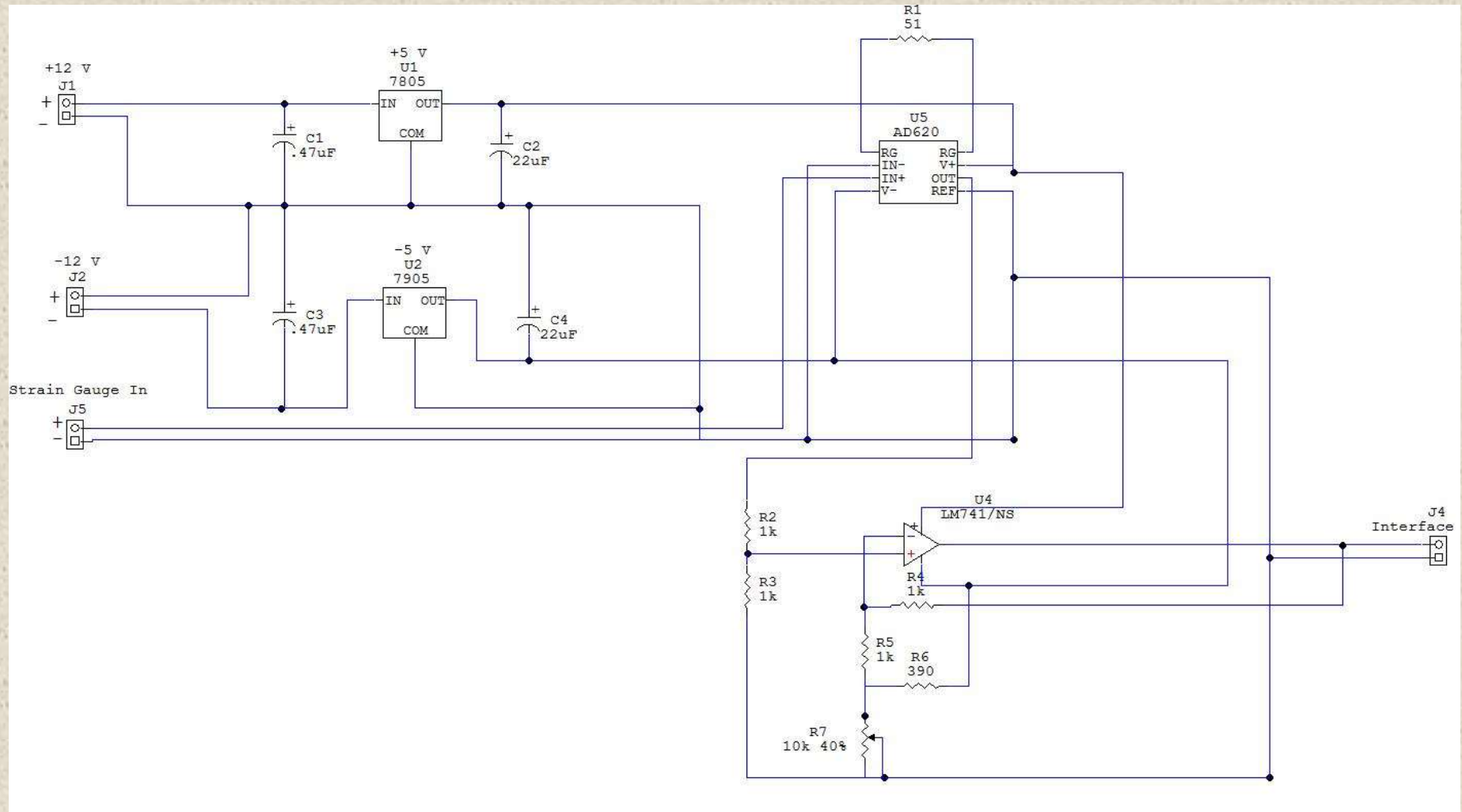
# Microcontroller Configuration



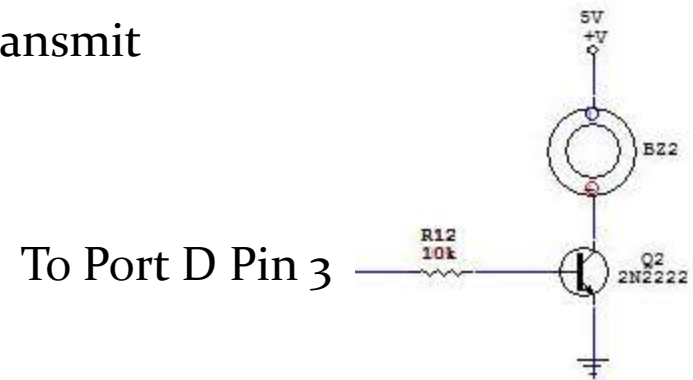
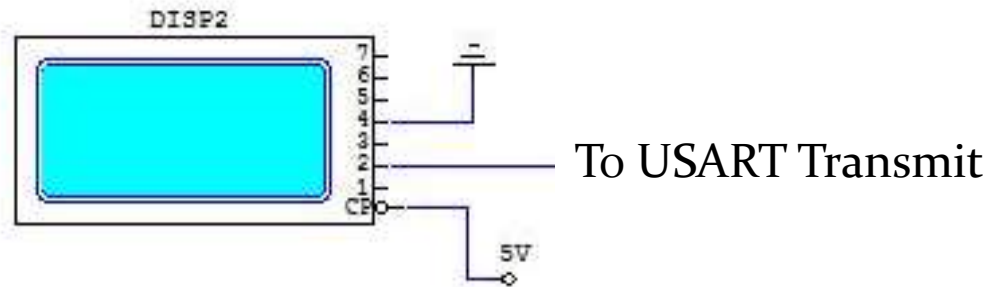
# Keypad Configuration



# Amplifier Circuit

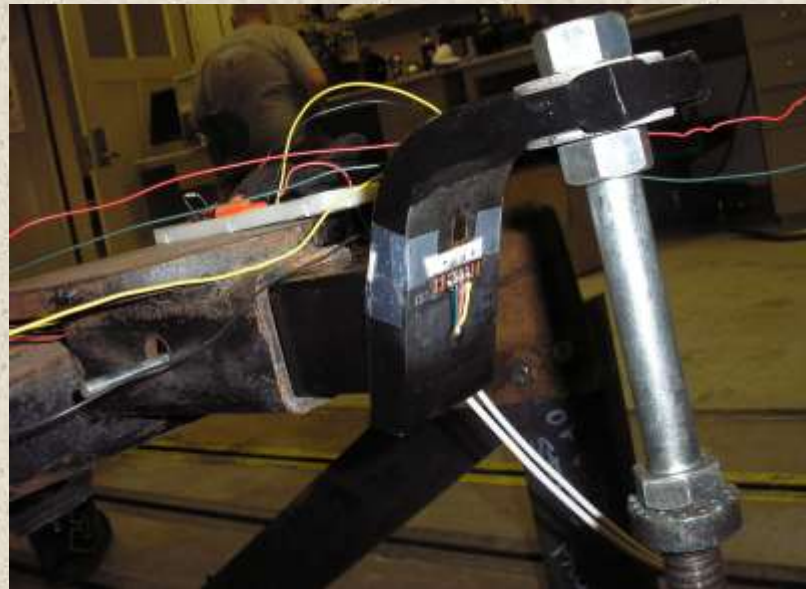
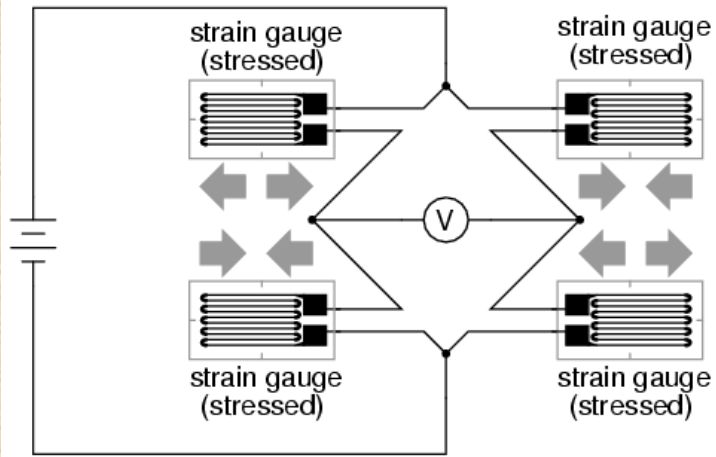


# LCD and Alarm Configuration

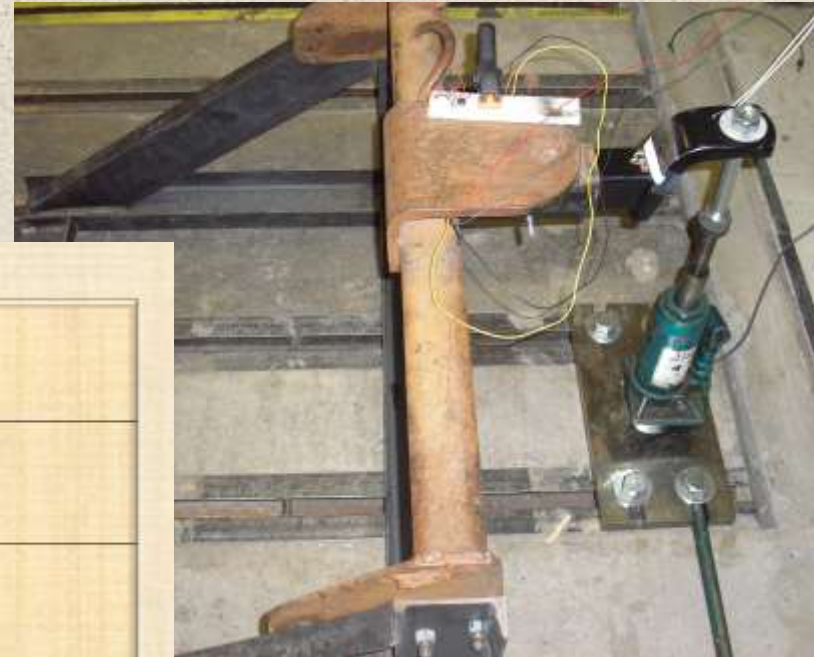


# Strain Gage Placement

Full-bridge strain gauge circuit

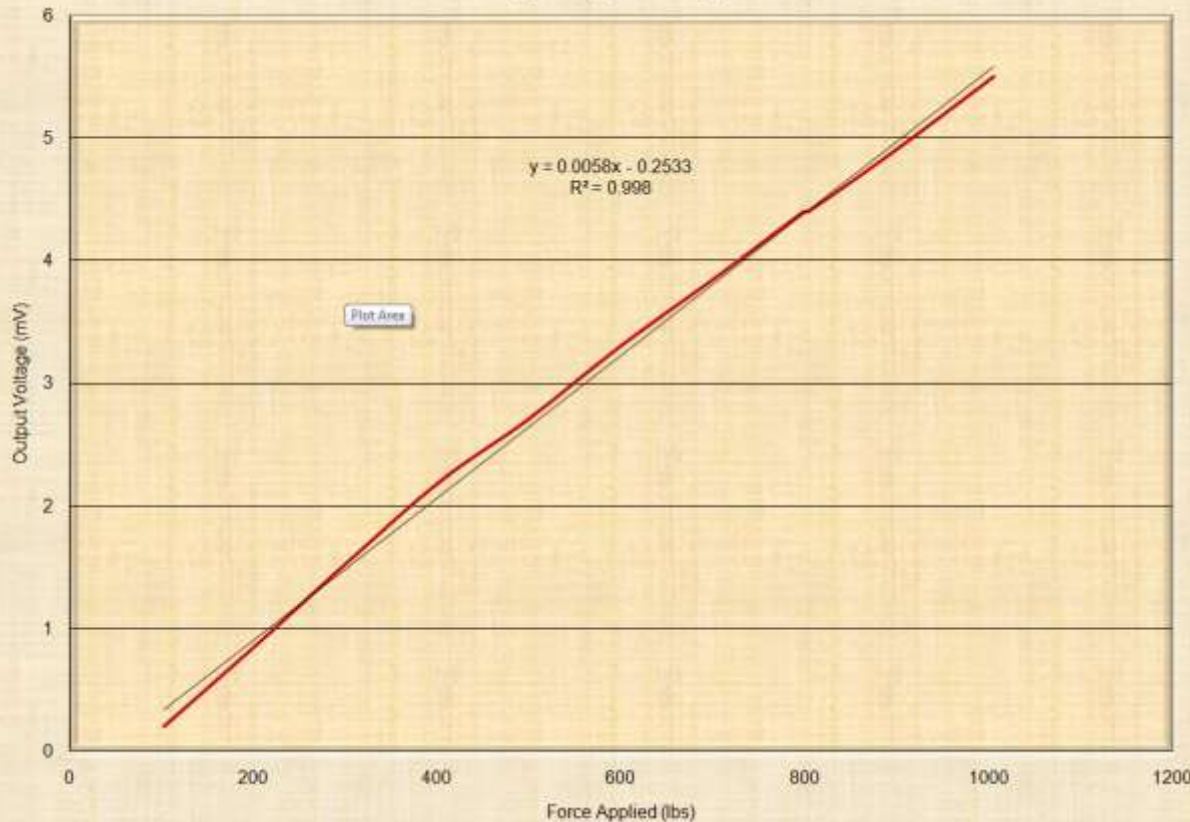


# Testing



**Strong Floor Jig**

**Tongue weight Loading**



**Strain Gage Characteristic Load Curve**

# Cost Analysis

<b>Parts Cost List</b>	
<b>Part</b>	<b>Price \$</b>
<b>Microcontroller</b>	7.76
<b>Strain Gages and Components</b>	74.00
<b>Piezo Element (Buzzer)</b>	1.50
<b>LCD Display</b>	74.00
<b>Towing Ball</b>	10.55
<b>Hitch</b>	43.95
<b>Enclosure</b>	11.00
<b>Total</b>	<b>\$222.76</b>

# Advancements

- Electronic Braking System
- Airbag Suspension
- Load Balancing



Questions and Comments?