



# Pediatric Dynamometer

*SUNFEST Summer 2007*



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# Background



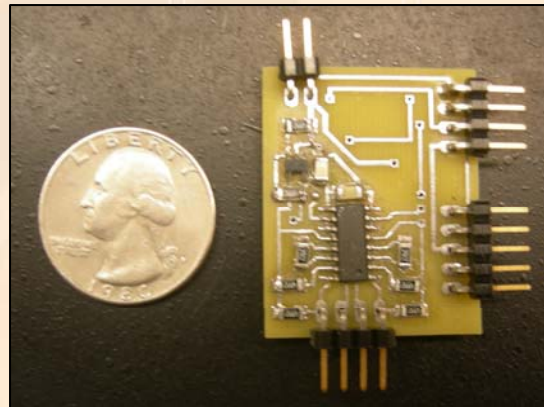
- **CHOP initiated project**
  - **Effects of exercise on bone-density**
  - **Study of pre-teens suggests correlation**
  
- **Other gauges of activity**
  - **Surveys are unreliable**
  - **Force plates impractical**
  
- **Peak force on foot is of particular interest for researchers**

# Solution-Pediatric Dynamometer

- *In-shoe device to measure force*
- *Measure force using PVDF sensors*
- *Store data for subsequent analysis*



*Dynamometer materials*



*Dynamometer circuitry*



*PVDF film*

# Design of the PD

## *Finished*

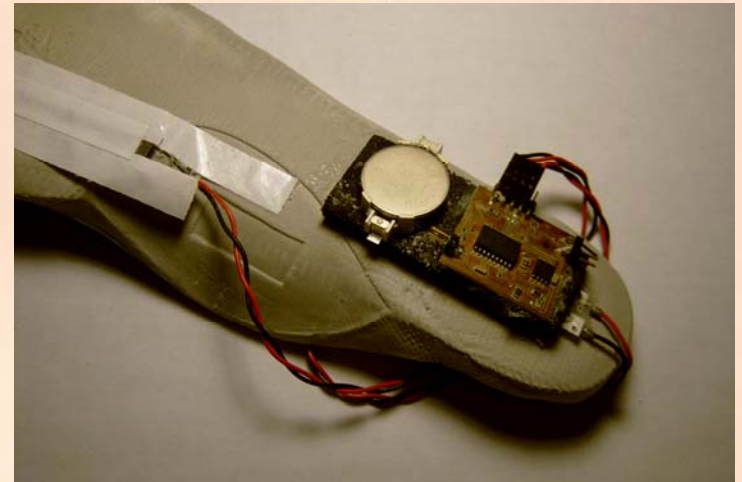
- **Electronics and programming**

## *Unfinished*

- **Integrated design of PD**

## *Requirements for the design:*

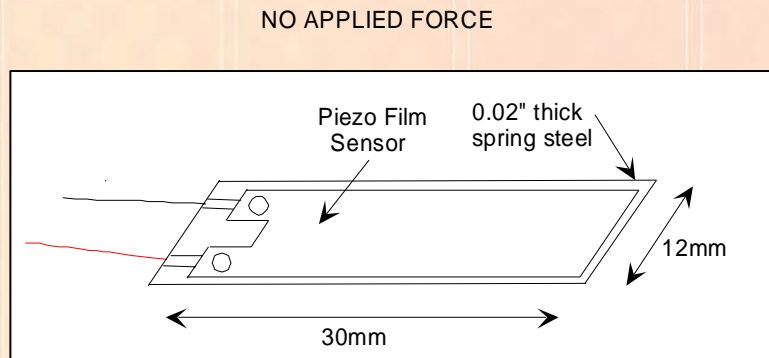
- **Accurately measure force within 5%**
- **Be inconspicuous to the user**
- **Inexpensive and easy to produce**



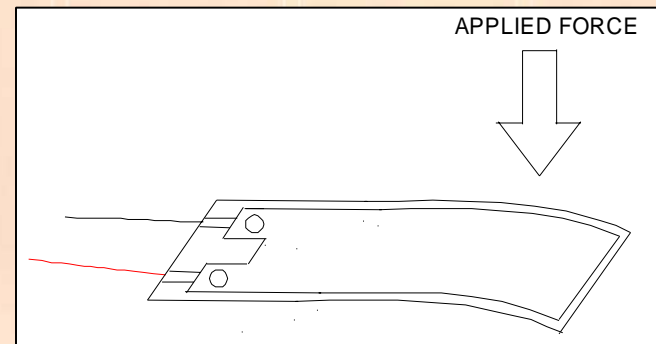
*Foot-PAD design attempt*



# Basics of the PD Design



" UP STEP "

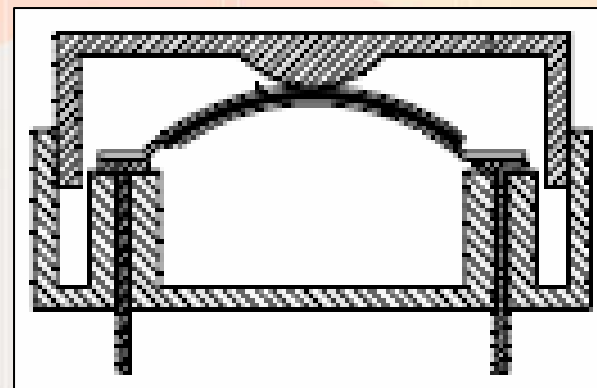
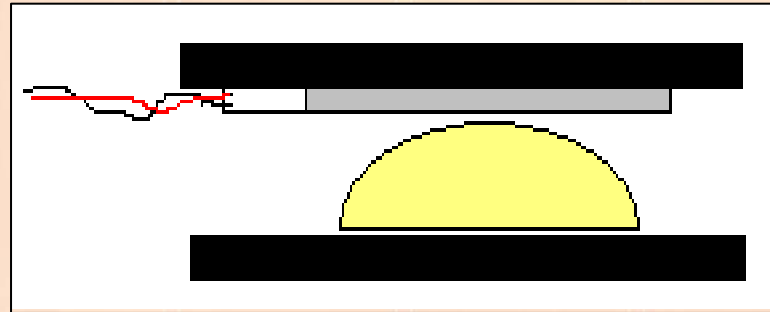
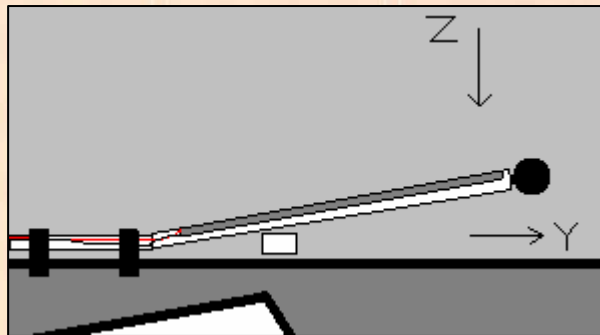


" DOWN STEP "

*Mechanical Stress → Proportional Tensile Strain*  
*Strain → Proportional Polarization*  
*Polarization → Proportional Charge*

*Observing the generated voltage allows us to determine an unknown mechanical stress.*

# Potential Ideas



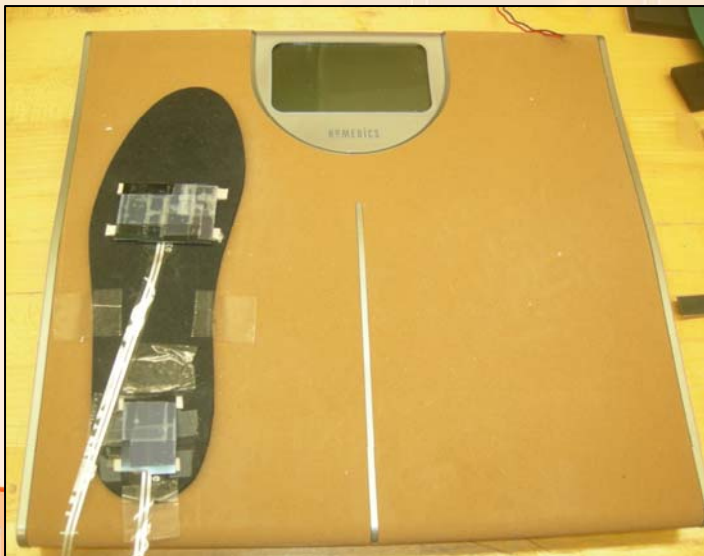
# Testing

## Periodic Motor

- Motion simulates walking
- Weight and foot simulate force

## Scale

- Measure applied force, voltage
- Create sporadic forces



*(left) Scale used to measure applied force on design*

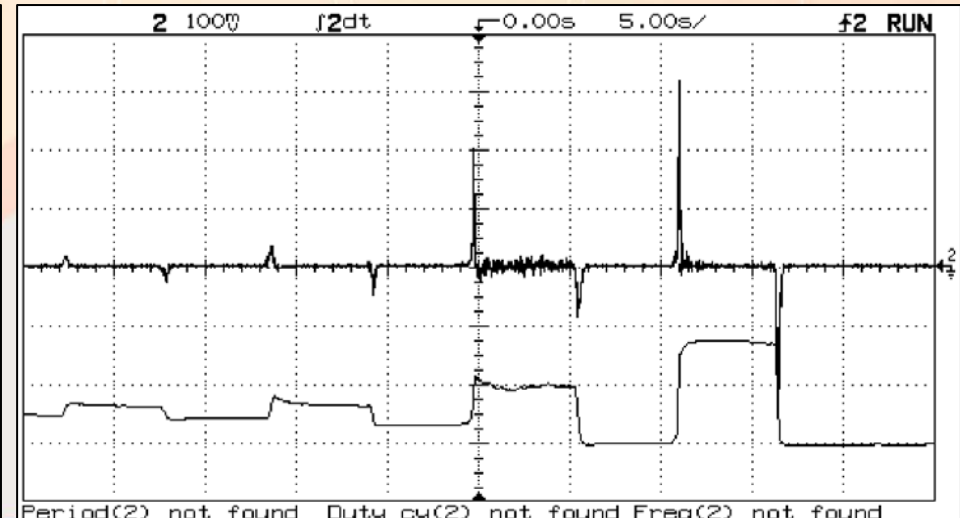
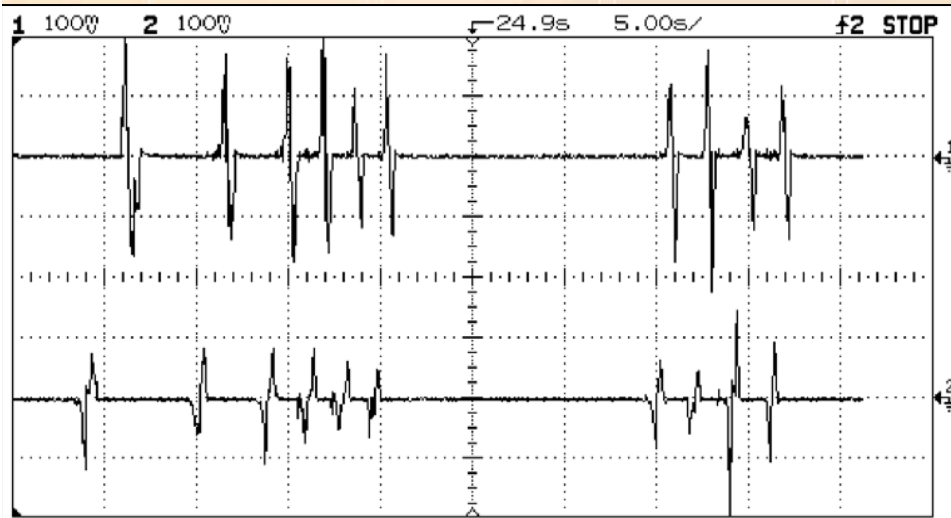
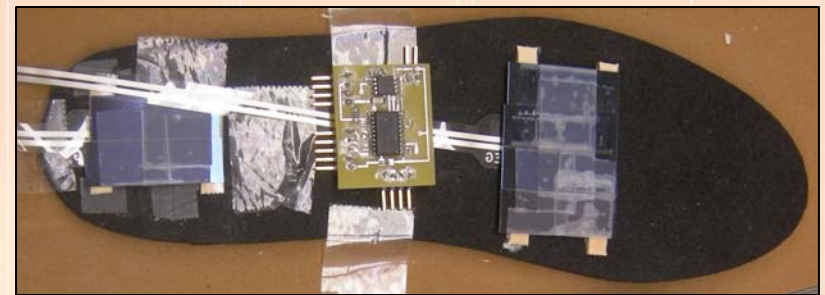
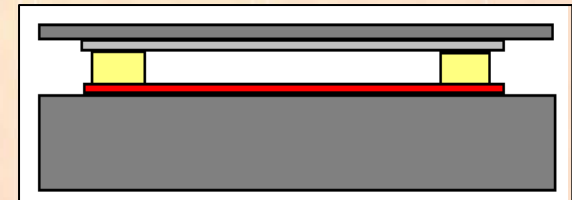


*(above) A simulation used to test designs.*

# Design Results

General design established!

- uses “bridge” design
- accuracy
- comfort

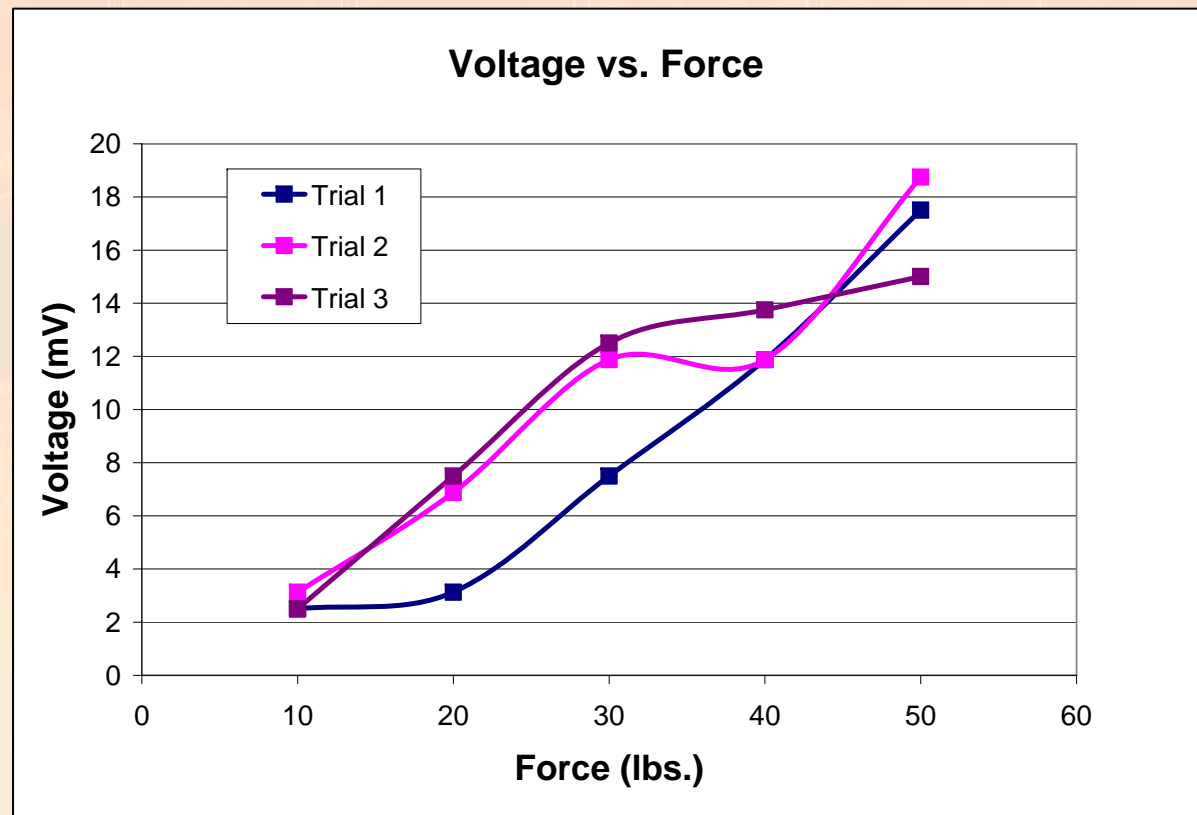




# Future Work

## *Modeling techniques to optimize design*

- *Width of steel*
- *Height of Supports*
- *Elastomer Stiffness*
- *Placement of PVDF*
- *Support Material*
- *Size of PVDF*



# Summary

- *CHOP: Method needed to study bone growth and development of children.*
- *Conclusions can be drawn from an analysis of physical activity.*
- *Designs were tested throughout the summer research.*
- *Bridge-like design works best, but not accurate enough.*
- *Future work needs to optimize design, material properties.*

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# Citations

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# Questions?



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