



Pediatric Dynamometer

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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**

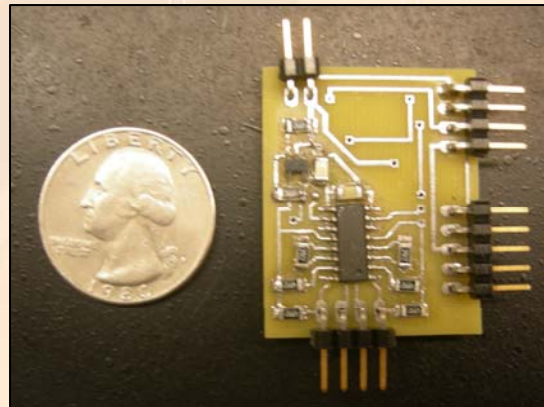
- **Peak force on foot is of particular interest for researchers**

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

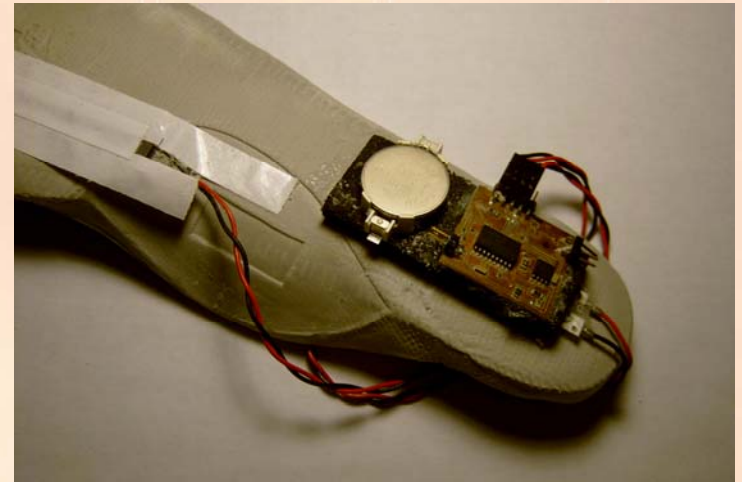
- **Electronics and programming**

Unfinished

- **Integrated design of PD**

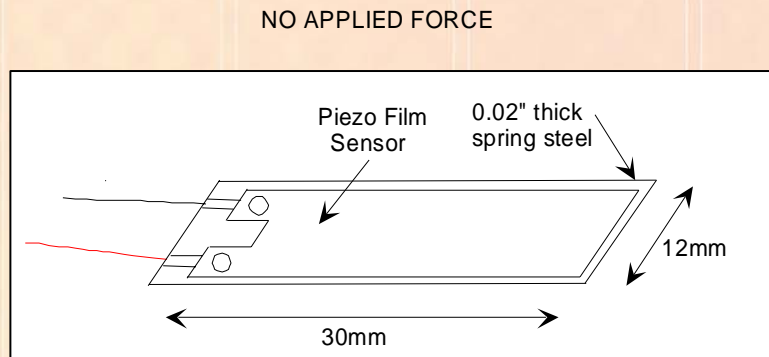
Requirements for the design:

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

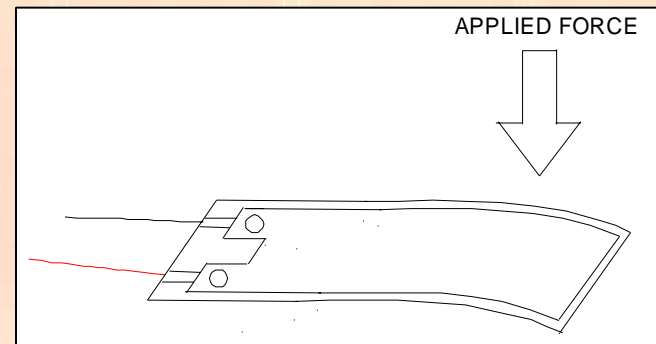


Foot-PAD design attempt

Basics of the PD Design



" UP STEP "



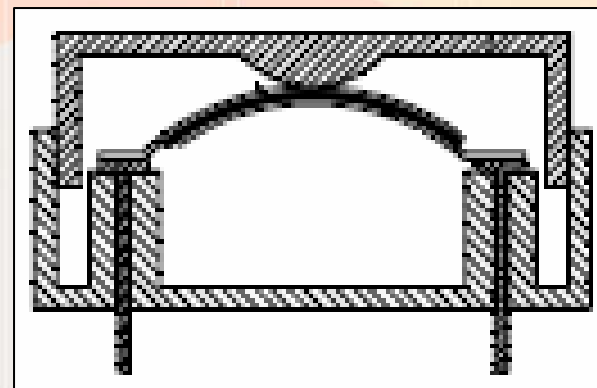
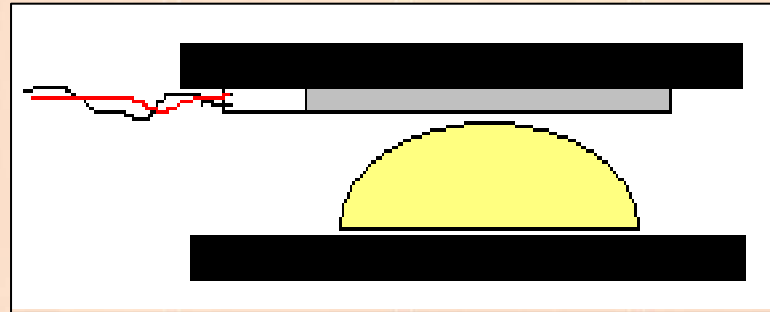
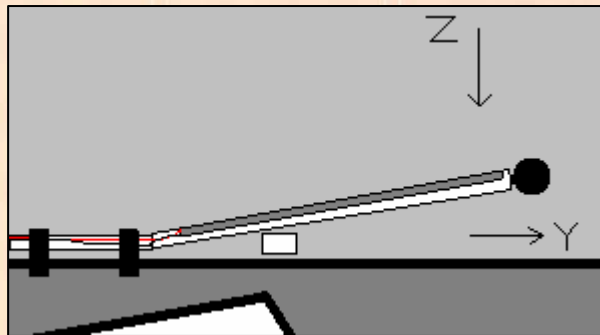
" DOWN STEP "

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



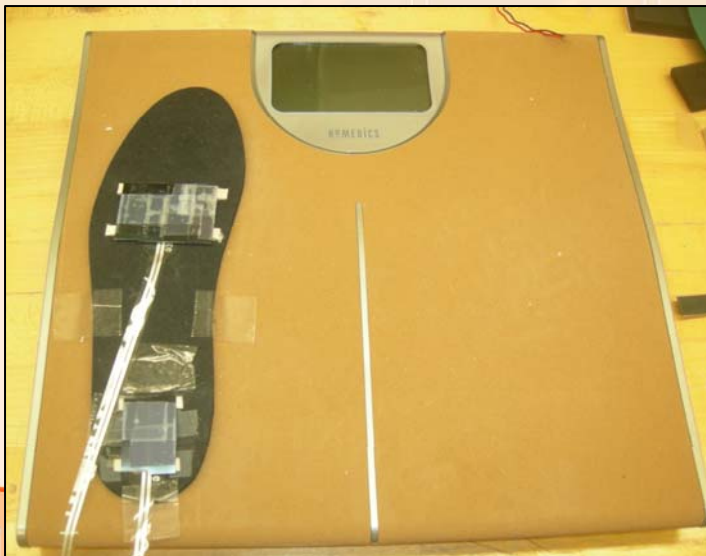
Testing

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

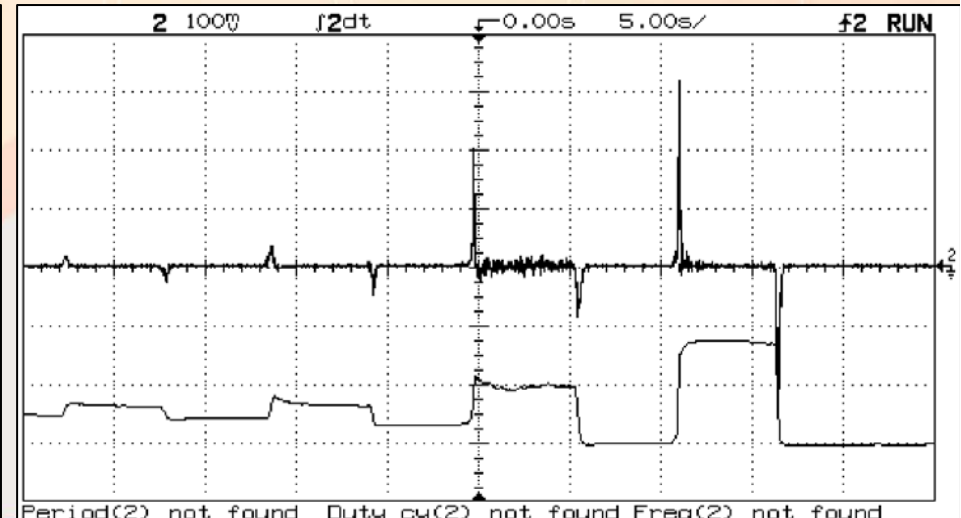
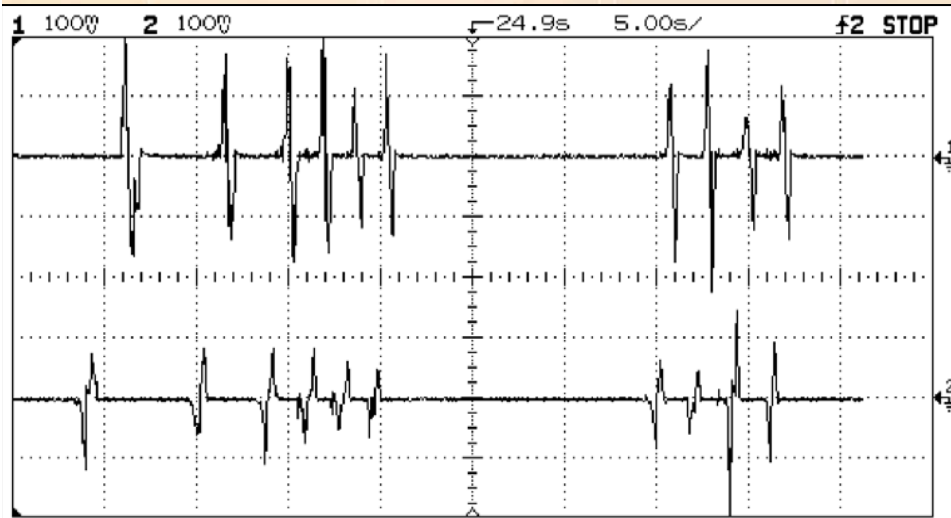
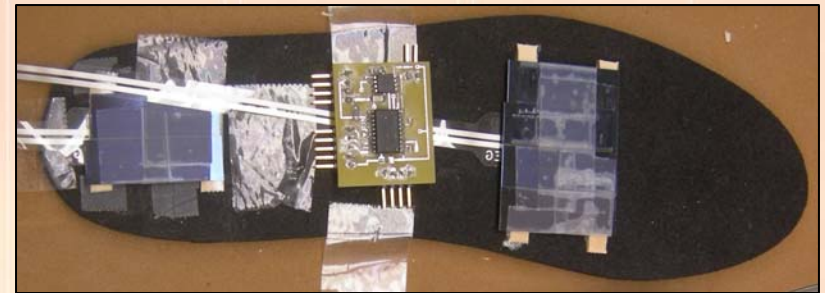
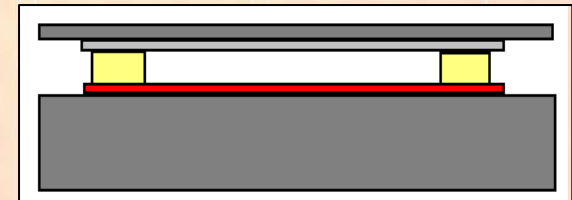


(above) A simulation used to test designs.

Design Results

General design established!

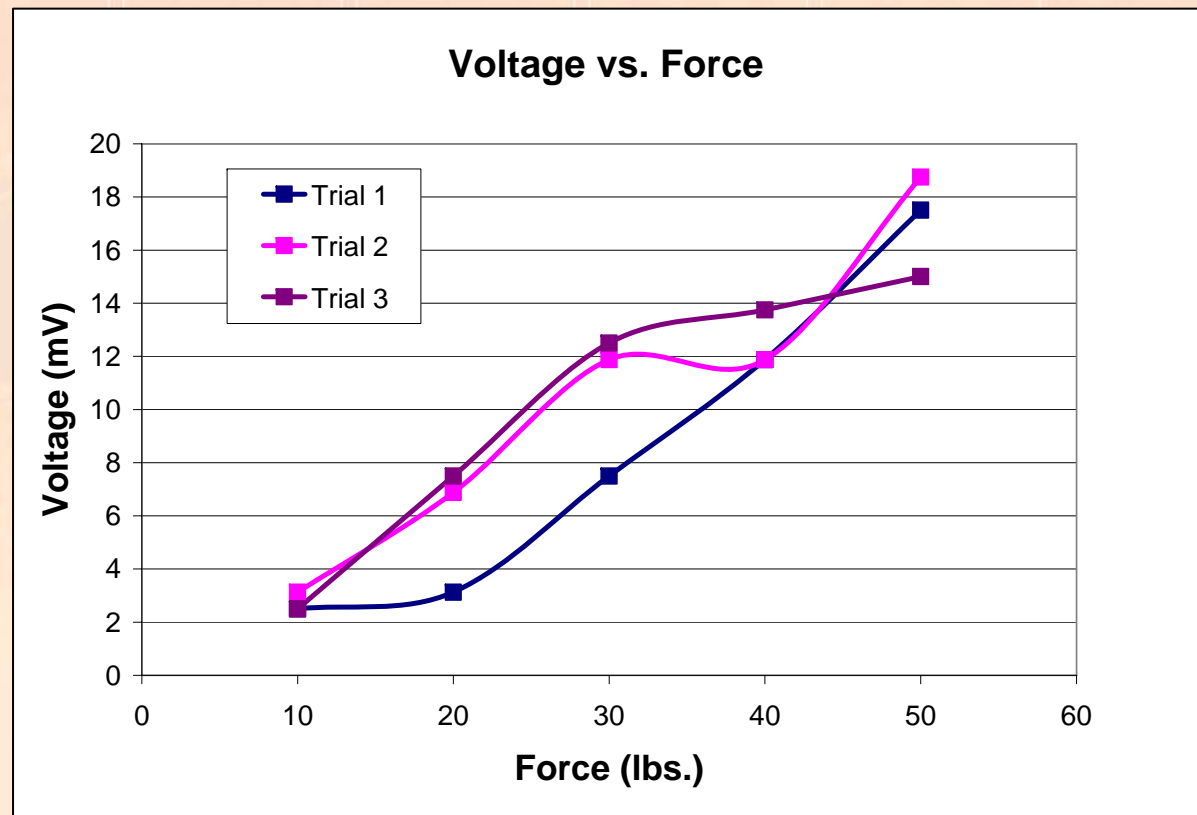
- uses “bridge” design
- accuracy
- comfort



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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