

Pre-Proposal Presentation

Team 1: Portable Micro-sensor Reader

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- National Science Foundation

Facilitator: Dr. Fathi Salem

Team Members: Ron Razalan, Brett Johnson, Thamer Alshuaibi, Evan Gardetto, Yuval Levental

MICHIGAN STATE
U N I V E R S I T Y

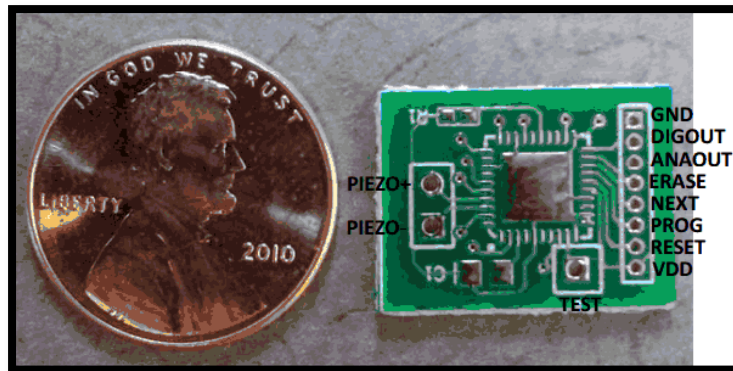


Overview

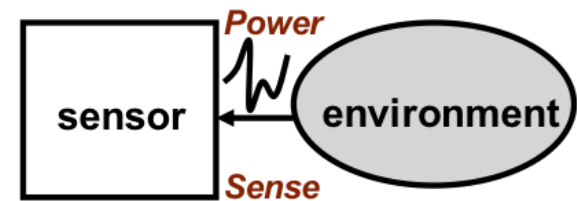
- Background
- Introduction
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- Arduino Design Description
- Raspberry Pi Design Description
- Design Evaluation
- Proposed Design Solution
- Areas of Concern
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Background

- Seven years of research and development by AIMLab at MSU has produced an extremely low power Piezo-floating gate (PFG) system-on-chip (SOC) sensor that measures stress magnitude and duration. Initial application was to monitor the health of civil and mechanical infrastructure.



PFG Sensor



- AIMLab at MSU has created a method to extract data from the sensor using an interface that responds to MATLAB functions from a host PC. While this method works, its size is cumbersome and does not meet the demands of a real-world product.

Introduction

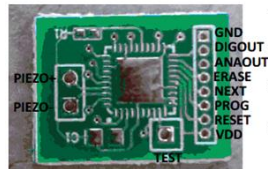
- Project Statement: Improve on current methods to interface with the PFG sensor, by developing a portable, low-cost solution that can provide real-world applications on a user friendly interface
- Application: Monitor impact forces of athletes during competition, specifically to research head injuries suffered by football players



Design Specifications

- Device must be all inclusive and self sustaining
- Provide hardware that can interface with the PFG
- Read/write to all pins as well as implement six software functions: ERASE, PROGRAM, AnalogREAD, DigitalREAD, RESET, and NEXT
- Saves data to be read via USB or SD card
- Portable and dependable under various environmental conditions
- Regulate an on-chip voltage of 1.8V-2.5V

Current Solution



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Arduino Design Description

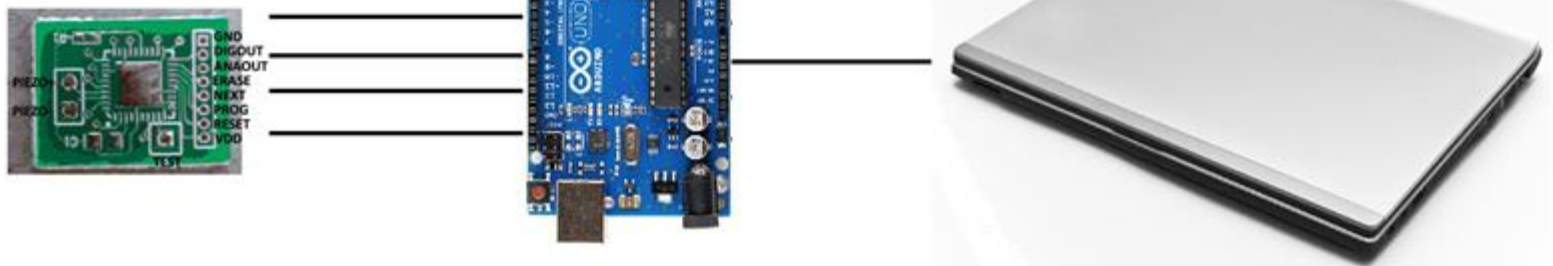
Arduino Uno Microcontroller board acts as gateway between PFG and Host PC. Simple computer program created by design team would send commands to Arduino via USB, then Arduino would output corresponding signals to PFG to initiate various actions. Assuming the user already has a computer available, this a low cost solution.

Required Components:

- Arduino Uno
- Laptop
- USB connection between Uno and PC, providing power and data lines
- Customized 8-pin connection between Uno and PFG Sensor.



Arduino Solution

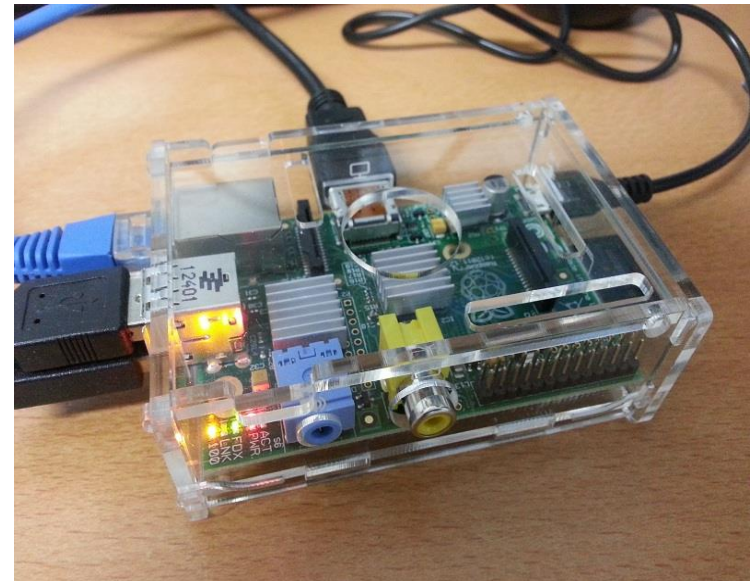


Raspberry Pi Design Description

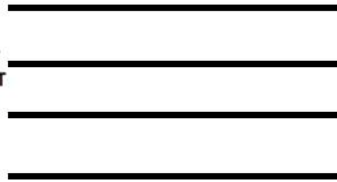
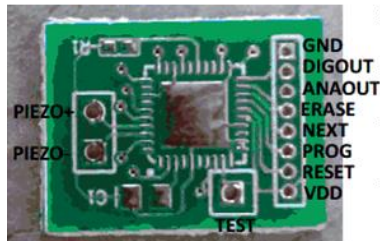
Portable Raspberry Pi computer running a Linux OS, complete with battery power and screen display with a simple button GUI, all contained within a durable enclosure. Pi connects directly to PFG via custom 8 pin connector. The Raspberry Pi is a more powerful and capable device than the Arduino Uno, but costs about \$20 more.

Required Components:

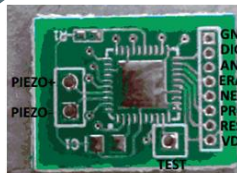
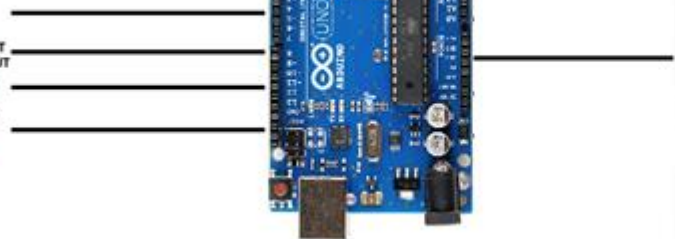
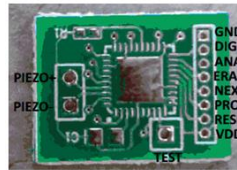
- Raspberry Pi
- Touch Display (4-7")
(Analog or HDMI)
- Battery Power
- Voltage Regulators
- Connector for PFG sensor
- Enclosure for components



Raspberry Pi Solution

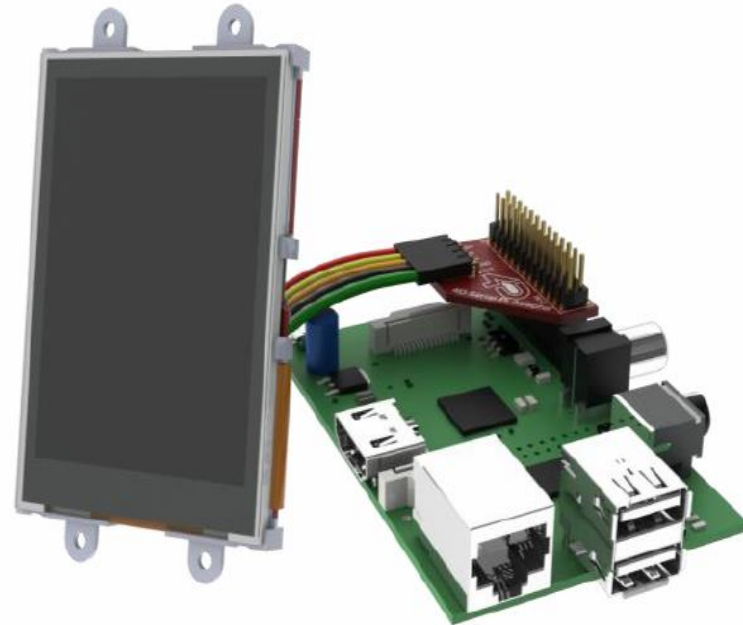


Solutions Overview



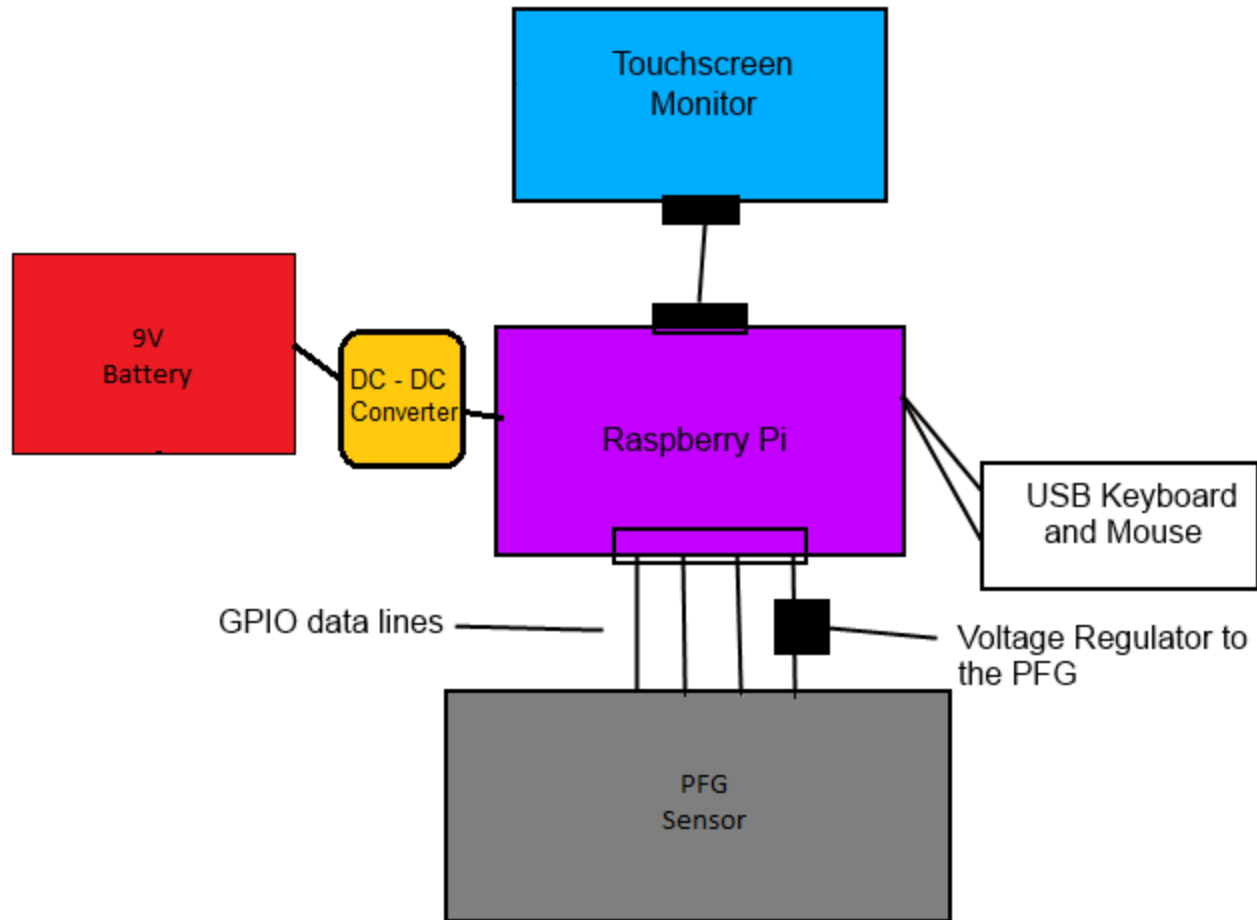
Proposed Design Solution

- LCD touchscreen display module
- 4D Serial Pi Adaptor
- Raspberry Pi chip includes two USB inputs
- Power Supply (DC-DC adaptors)
- Enclosure case



Raspberry Pi Display Module Pack connected

Prototype Block Diagram





Areas of Concern

- Reader performance reliability
- Effect of unstable power on components
- Component cost management
- Product competition with simpler, more effective designs

Project Management

- The project will be divided into four sections:
 - **Power management:** Design and validation of the power supply
 - **I/O:** Incorporation of the Input/Output connection between the Raspberry Pi and the sensor
 - **Software:** Implement a custom, programmable GUI program within the raspberry pi to read and write data to the microcontroller
 - **Enclosure:** Development of a robust housing

Budget

Maximum Budget: \$500

- Purchased Parts:
 - Raspberry Pi B with 8GB SD Card: \$40.00
 - TFT Display: \$76.27
 - 2x Power Supply Regulators: \$39.74
- Planned Parts:
 - Enclosure Case: \$5
 - Cables: \$10
 - Power Switch: \$2
 - 9V Battery: \$5

Prototype Cost Estimate: \$178.01 - \$188.01

References

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Questions?