Kepros Diagnostic Posture Training Device

DEC1605 | **Anthony Branson, Benjamin Engh, Jiahui Quan, Samuel Eue**

Introduction

Problem:

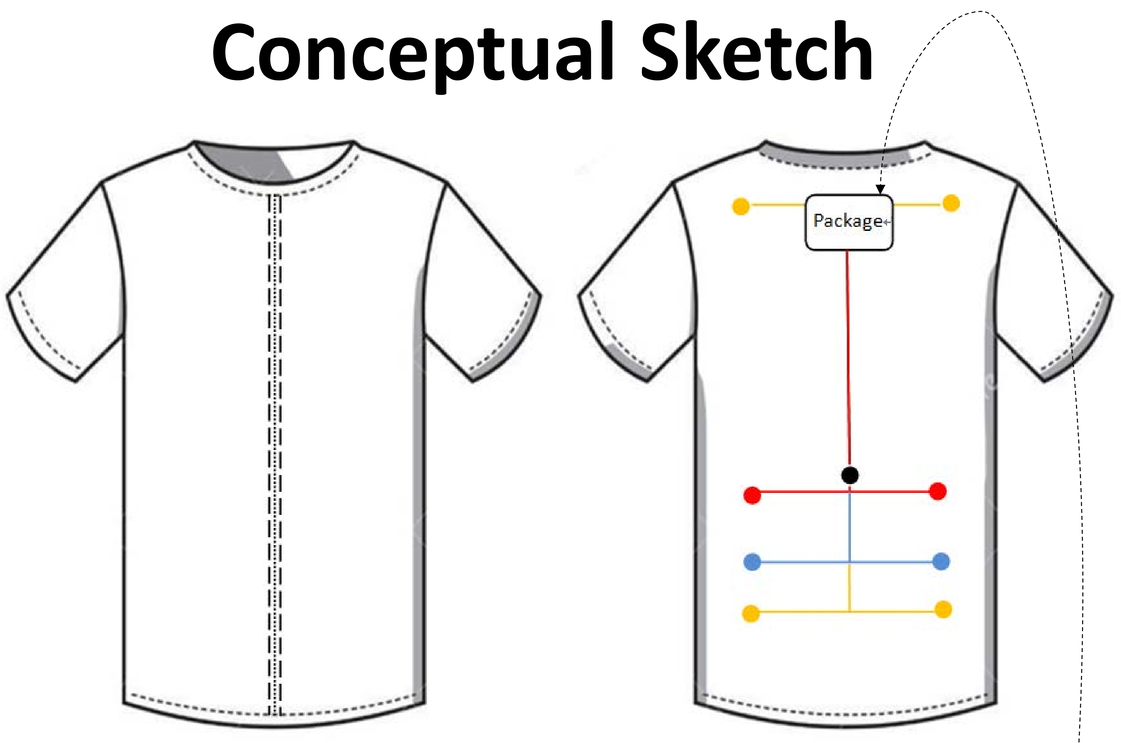
There does not yet exist an efficient and accurate way to measure someone's posture over a period of time, recording values indicative of poor posture relative to one's homeostatic lumbar levels. Physical therapists and clinicians have to physically touch a patients back muscles to understand what positions are causing unwanted tensions. Because of this, physical therapists and clinicians rely almost entirely on patient testimony, and snapshot observations of patient posture. One can obviously see how these testimonies may be unreliable, not fit for practical medical use.

Athletes and other clients rely on physical their physical therapists to diagnose pain and optimize the use of their bodies. Ted Kepros and KeprosPT realized this problem and called upon the engineering students of Iowa State University to come up with a solution.

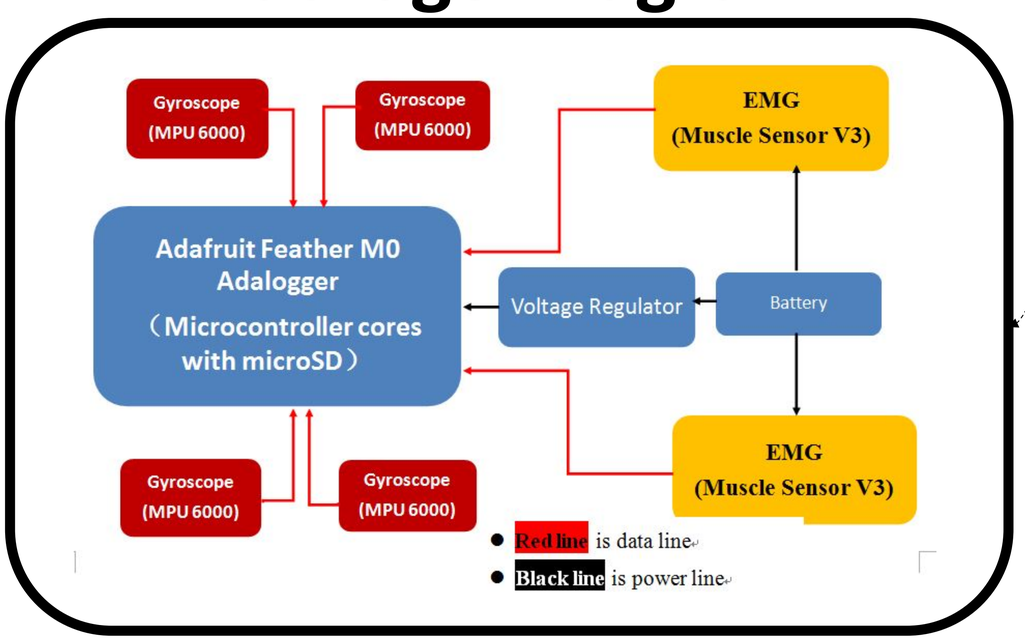
Solution:

Ted Kepros and KeprosPT proposed a wearable device to measure patient posture. This device would ideally be able to measure the posture of a patient over the course of a day, without seriously impeding their usual routine. Also, it was proposed that the device be able to measure a snapshot of a patient (typically an athlete) performing some kind of athletic motion. The device should be able to record the data and display in way that is not only readable by the therapist, but the patient as well.

Conceptual Sketch



Package Diagram



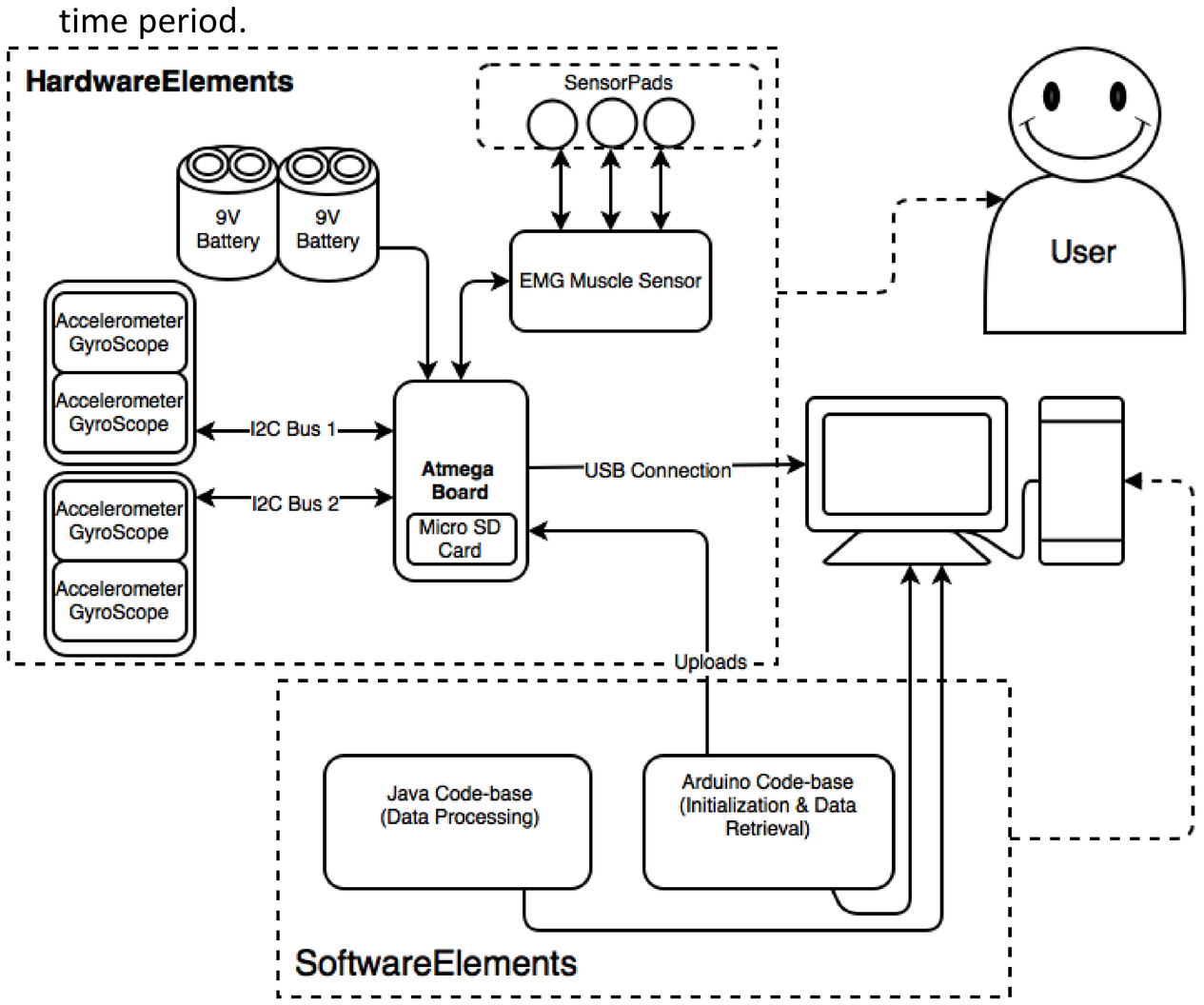
Users and Uses

The intended users of this device include athletes and anyone else who may experience chronic back pain. For these users, the device serves as an accurate testimony of the daily muscular activity of their back. For the therapists and clinicians, this device provides observations of patient activity that they otherwise could not obtain.

Design Approach & Technical Details

The Components:

- **MPU6000 | Accelerometer & Gyroscope**
  These four sensors allow us to retrieve angle data using basic calculus.
- **Muscle Sensor V3 | EMG (Electromyography)**
  This sensor provides a tension level of the muscle using electromyography
- **Adafruit Feather M0 Adalogger | Board**
  This serves as the brain, connecting all sensors with Arduino Software
- **2 9V Batteries | Power Source**
- **Flexible Athletic Fitting Shirt | Wearable Host**
- **Arduino Code Base | Board Programming**
  Initializes the sensors and retrieves data
- **Java Code Base | Data Processing**
  Processes the sensor data and outputs human readable values over a given time period.



Requirements

Functional Requirements:

1. The vest should be able to obtain accurate and meaningful data pertaining to the wearer's posture and back.
2. The data should be presented in a way that can assist with the correction of bad posture.

Non-functional Requirements:

1. The vest must not hinder the user's movement. They must be able to perform physical activities close to their normal standards.
2. The vest should be compact. The wearer must be able to go about their daily life without everyone noticing that they are wearing it beneath their shirt.
3. The program must be able to record data over the course of a day.

Test Plan

Iterative Testing Methodology

(Was repeated with the addition or modification of new design elements)

Hardware:

Phase One - Proof of design elements concept
Phase Two - Optimization of element within design
Phase Three - Integration with system as a whole

Software:

Phase One - Proof of software design concept
Phase Two - Optimization of software design
Phase Three - Integration of software within system as a whole

Iterative Prototype Refining

(Once all new hardware/software elements were integrated within the system)

Prototype:

Phase 1 - Collaboration of components
Phase 2 - Optimization of prototype device

Website: http://dec1605.sd.ece.iastate.edu/