

## **Project Design Specifications**

### **Project #44- Step rate monitor for treadmill**

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#### **Function:**

Our proposed design project is to create a device that will identify a runner's step rate as they are running on a treadmill. This device is intended to be used in clinical settings, such as runner's clinics. Additional capabilities of our device will include quantifying the relative magnitude of the ground reaction force. This information can be used as real-time visual feedback for patients as they are being taught to alter their stride to minimize ground reaction forces while running.

#### **Client Requirements:**

- Real time identification of runner's step rate while running on a treadmill
- Quantify relative magnitude of ground reaction forces while running on treadmill
- Must not interfere with patient's running mechanics
- Securely mounted to treadmill
- Visually appealing
  - Device should be hidden from view on the internal structure of the treadmill
  - Simple, easily understood display of step rate
- User friendly software that can be used by multiple clinicians

#### **Design Requirements:**

##### 1) Physical and Operational Characteristics

###### a) *Performance requirements*

- i. Accurately measure step rate
- ii. Display real-time visual feedback to the clinician and patient
- iii. Easily operated by multiple clinicians

###### b) *Safety*

- i. Non-distracting visual display
- ii. Components should not detract from the safety features of the treadmill
- iii. Device attachment should not compromise the durability of the treadmill
- iv. Should not interfere with patient's running mechanics

###### c) *Accuracy and Reliability*

- i. Must accurately measure step rate within 2 steps/minute
- ii. Accurately relate resultant vibration magnitudes in the treadmill to ground reaction forces
- iii. Function should not be compromised after multiple uses and patients

###### d) *Life in Service*

- i. Match or exceed the life of a treadmill

- ii. 10 years
  - e) *Shelf Life*
    - i. Not applicable
  - f) *Operating Environment*
    - i. Clinical gait analysis setting
    - ii. Biomechanics research lab
    - ii. Dry environment
  - g) *Ergonomics*
    - i. Easily maintained
    - ii. Device must not interfere with runner
    - iii. Display must not interfere with safety of the runner or cause the runner to alter his/her mechanics to view visual display
  - h) *Size*
    - i. Must be contained within treadmill cover
    - ii. 3 x 3 x 3 inches maximum
  - i) *Weight*
    - i. Weight of sensor-attachment system should not restrict vibration detection
  - j) *Materials*
    - i. Computer with data processing capabilities (Matlab)
    - ii. Display screen (TV or computer monitor)
    - iii. Treadmill
    - iv. Accelerometer
    - v. Power supply for accelerometer
    - vi. Data acquisition system
  - k) *Aesthetics*
    - i. Accelerometer hidden from view
    - ii. Visually pleasing display
- 2) Production Characteristics
- a) *Quantity*
    - i. One complete system
  - b) *Target Product Cost*
    - i. \$200
- 3) Miscellaneous
- a) *Customer*
    - i. Runner's Clinics
    - ii. Home users
    - iii. Fitness centers
  - b) *Patient-related concerns*
    - i. Must not interfere with patients' running mechanics
  - c) *Competition*
    - i. Pedometers
      - a) Garmin systems, Olympus
    - ii. Force-plate instrumented treadmill