Project Design Specifications

#44- Step rate monitor for treadmill

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Client: Dr. Bryan Heiderscheit

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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. The step rate monitor will be mounted on the treadmill and a step will be identified from the resulting vibrations that are carried through the treadmill. It is intended that this device will be used in the clinical setting, 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 a visual feedback for patients as they are being taught to alter their stride to minimize ground reaction forces while running. Furthermore, it will be beneficial for our device to differentiate between left and right foot strikes as this information can be used to identify a level of symmetry in the patient's running mechanics.

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

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. Should not interfere with patient's running mechanics

c) *Accuracy and Reliability*

i. Must accurately measure step rate within 2 steps

ii. Must be able to differentiate between left and right foot impact

iii. Accurately relate resultant vibration magnitudes in the treadmill to ground reaction forces

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

h) *Size*

i. Contained within treadmill cover

ii. 3 x 3 x 3 in

i) *Weight*

i. Testing must be performed to determine if weight will affect vibrations

j) *Materials*

i. Computer

ii. Display screen

iii. Treadmill

iv. Accelerometer

v. Data acquisition system

k) *Aesthetics*

i. Accelerometers 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) *Standards and Specifications*

i. To be determined

b) *Customer*

i. Runner's Clinics

ii. Home users

iii. Fitness centers

c) *Patient-related concerns*

i. Must not interfere with patients running mechanics

d) *Competition*

i. Market step rate monitors