Running Impacts Product Design Specification (PDS)*

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Function: The completed prototype will measure the impacts of running using tibial acceleration data. The device should use accelerometers, which will record data to an incorporated data logger. The device must be easily worn by the user, and the hardware should have the ability to do most of the data processing. The design should include a system to attach the hardware to the runner's body. This instrument will be used to diagnose stress fractures and other injuries related to running.

Client requirements (itemize what you have learned from the client about his / her needs):

- $1500 budget excluding data logger
- Durability and battery life are important for field use
- Continuous, solid, reliable signals are required
- Ensure that accelerometer does not move with respect to the tibia
- Data should be processed either by the data logger or software
- Unilateral tibial acceleration measurements will suffice for the first prototype
- System should be portable
- Must have a system to securely attach the device to the runner
- Accelerometer should be calibrated

Design requirements:

1. Physical and Operational Characteristics

a. *Performance requirements*: Ideally, the runner will take the device into the field and record data from three runs. The battery life and memory must be able to accommodate this criterion. The accelerometer must be secured tightly to the leg to prevent it from sliding on the leg while running, which could result in inaccurate data.

b. *Safety*: The equipment and wiring needs to be secured to the runner.

c. *Accuracy and Reliability*: Data logger should record data at a sampling rate of 1-2 kHz. The accelerometer should be able to record peaks of 40g's, although it should have good resolution for the 0-20g range since this is the normal range. Additionally, a testing system should be developed to ensure that the data collected by the system is accurate.

d. *Shelf Life*: Device should be able to be powered off when not being used to save power.

e. *Operating Environment*: The device will be used primarily outdoors. Therefore, the device must be able to withstand variations in temperature and other weather elements like wind and humidity. The device would be exposed to considerable dirt and dust from the atmosphere. The device will be moving up and down with the runner, so all connections should be secure.

f. *Ergonomics*: Any device pieces that are worn on the leg should be placed on the outside or back of the leg to prevent damage due to running style. The wiring should not interfere with the runner's strides. The individual components should be tightly secured to the runner's body to prevent bouncing.

g. *Size*: Everything must be able to be worn while running.

h. *Weight*: The unit should be as lightweight as possible to maximize comfort. The portion of the device that is worn on the tibia must be especially light so that it does not interfere with the runner's gait

i. *Materials:* The device must be attached to the runner's tibia using a material that will conform to the leg's shape either by wrapping or using a relatively elastic material.

2. Production Characteristics

a. *Quantity*: One.

b. *Target Product Cost*: The budget for the product is $1500, excluding the cost of the data logger.

3. Miscellaneous

a. *User*: The device should be comfortable to wear when running (for example, the device doesn't bounce when running and the wires don't snag easily).

b. *Patient-related concerns*: The device must be able to be wiped with a disinfectant between patients.

c. *Competition*: Current set-ups are stationary, so the patient must come to the lab to partake in the study. The impacts cannot be measured over the runner's normal paths. No portable devices can be found on the market.