Collision Alert Device for Sensing Potentially Harmful Foot Impacts

Dorminy, Rebekah (School: Sola Fide Home School)

The CDC estimates that 25% of people with diabetes will develop foot ulcerations (2014). When even mildly traumatic foot injuries are not detected immediately, ulcerations may develop and become infected. This puts patients with peripheral diabetic neuropathy at higher risk for lower extremity amputation because they cannot feel the initial injury. Currently, patients are instructed to visually inspect their feet daily (Grennan, 2019). However, the continued prevalence of foot ulcerations and resulting infections call for more attention to prevention. Through several stages of research, the researcher constructed devices using piezoelectric transducers as impact sensors. The final device uses a microcontroller to collect data and communicate through Bluetooth to the user's phone, alerting users when the piezos are activated indicating a potentially harmful collision. A testing stand was used to determine the collision forces necessary to activate the sensors. The force gauge data logger was placed in the collision target and the device was applied to the outside of an athletic shoe on the foot of a prosthetic lower leg. The leg was attached to the stand and the foot moved to standard heights before being released 20 times for each height: 1.5 cm averaged impacts of 20.6N with 100% Bluetooth notification activation, 1.0 cm averaged 18.7N with 100% activation, 0.5 cm averaged 15.9N with 90% activation, and 0.3 cm averaged 10.9N with 70% activation. The device successfully provides a method to warn people without sensation in their feet of potentially dangerous collisions.

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