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Smart Harness: A Sensorized Harness for Safe Treadmill Testing

Scope

Treadmills are commonly applied in various biomechanical analyses and training. Safety switches are the conventional methods to maintain the safety and security of subjects using a treadmill. However, we found that these switches are too unreliable to be used for the impaired and other vulnerable subjects such as elderly people. Smart Harness is aimed to be an effective safety mechanism that can be considered a robust and responsive safety switch in treadmill training.

Objective

Design and implementation of a sensor system prototype that can detect falls during a treadmill training session and shut down the treadmill.

Method

The system was implemented using an S-type load cell connected to a safety harness. The load cell was mounted on an overhead rail to facilitate the subject's movements (Fig. 1). Load cell signal is first filtered and amplified by an HX711 amplifier unit and then recorded by an Arduino and sent to a PC. The software, hosted by the PC, feeds the data to the detection algorithm implemented based on [1]. The detection outcome is then relayed back to the Arduino to shut down the treadmill.

Results

The system was first tested with a subject walking normally at speed up to 5 km/h, where it detected no false positives. The subject was

Fig. 1. Safety harness connected to an S-type load cell

then asked to perform artificial falls by intentionally losing his balance. The system was able to detect 100% of the falls, matching the number reported in [1].

References

[1] F. Yang and Y. C. Pai, "Automatic recognition of falls in gait-slip training: Harness load cell based criteria," Journal of Biomechanics, vol. 44, no. 12, pp. 2243–2249, 2011.