BACKGROUND

Work-related low back pain contributes to lost productivity, reduced quality of life and billions of dollars lost each year in the U.S. Much of this pain can be traced back to poor lifting technique, especially in the manual labor workforce. Ergonomics has shown that weight distribution and center of pressure in the feet during a lift is important in avoiding injury. If workers could be trained on the job and receive automated live feedback about their lifting technique, debilitating back injuries, lost wages, and workers compensation claims could all be decreased. The “Lifting Coach” smart insole is designed to be a solution to these problems by providing live lifting data to aid in injury prevention.

PROJECT SCOPE

❖ Design and build a smart insole system to monitor the user’s weight distribution in real time, using force sensing resistors (FSR).
❖ Implement communication protocol between insole and the user’s device.
❖ Provide information to the user: forces applied & center of pressure.

TESTING & RESULTS

❖ Compression tests were performed with an Instron 5969.
❖ 3 replicates of the test were run with each sensor (12), for 36 data sets.
❖ Predictive equations were implemented to relate Force (N) to Arduino digital outputs (0-1023).
❖ This equation was fit to the sensors, each having a unique set of coefficients.
❖ Compression tests were performed again to determine the error.
❖ The design goal was to measure within +/- 5 Newtons.

ACCOMPLISHMENTS & FUTURE WORK

❖ Met Design Metrics.
❖ Established Bluetooth communication.
❖ Characterized equations to calculate forces at each sensor.
❖ Forces and Center of Pressure (COP) calculated from voltage resistances and visually displayed to the user in real time.
❖ Information can be sent via Bluetooth up to 10.6 meters away.
❖ Component cost per unit is $450.00
❖ Using digital potentiometers to automatically adjust sensing range
❖ Phone app user interface

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