1. Abstract
Lack of regular physical activity in the general population is a top public health concern, and this problem is even more acute among the 300,000 individuals with spinal cord injuries in the US.\(^1,2\) In prior work, our team developed pattern recognition techniques to automatically detect physical activity and energy expenditure for people in wheelchairs.\(^3,4\)

The aim of this study is to develop and evaluate a just-in-time adaptive intervention (JITAi) using wireless sensors for assessing activity and providing feedback about physical activity levels in individuals with spinal cord injury.

2. System Development
A commercial, Bluetooth-based wheel rotation monitor (Panobike) and a wrist smartwatch stream data to an Android smartphone.

We are adapting machine learning models to detect wheelchair-based physical activity that we developed in our previous research.\(^3,4\)

The smartphone computes energy expenditure (kCal) and distance travelled (miles) in real time.

3. Data Collection

![Table 1: Raw accelerometer data from smartwatch for pattern recognition for various physical activities](image)

4. Intervention

![Fig. 3. Desktop app for researchers to monitor participants' activity and compliance](image)

![Fig. 4. Participant actively presses app's notification bar](image)

![Fig. 5. Weekly energy expenditure summary](image)

5. Results and Conclusions

We have deployed an offline-trained algorithm in a real-time PA monitoring system using commercial wearable technologies.

Just-in-time adaptive interface system provides:
- Passive feedback in the form of daily and weekly summary of energy expenditure and distance travelled, and
- Active feedback in the form of watch notifications that are both adaptive and personalized to individuals while they are physically active.

6. Validation study

A pilot test is being conducted in 20 wheelchair users with spinal cord injuries (SCI) in the Philadelphia area.

- Hypothesis 1: Physical activity (PA) level of individuals with SCI in community settings will be low (only 20% of the participants will be performing regular PA compared to the PA level recommended for individuals with disabilities in general).
- Hypothesis 2: PA levels of the participants, when obtaining passive feedback about their PA levels during the second month of the study, will not be significantly different compared to Month 1 without any intervention.
- Hypothesis 3: PA levels of the participants will be significantly higher for the third month of the study (light-level PAs by 25% and moderate-level PAs by 7%) compared to their own Month 1 without any intervention.

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References