# Spiking Neural Network-Based Fall Detection Using Wearable Sensors

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## 1 Abstract

Falls are the second leading cause of unintentional injury deaths worldwide and the leading cause of injury among older Canadians, accounting for 85% of senior hospitalizations [1] [2]. Rapid medical assistance following a fall is critical to long-term health outcomes. One study found that 55% of seniors who remained on the ground for over 60 minutes died within six months [3]. In response, several fall detection systems (FDS) have been developed, including camera-based, pressure-based, and wearable sensor-based approaches, the focus of this study.

Current wearable FDS typically employ traditional supervised learning algorithms, such as support vector machines, and modern deep learning models, such as deep convolutional neural networks, utilizing wearable sensor data. While these models achieve exceptionally high accuracy, precision, and recall (97+%), they often require computational resources that constrain edge wearable devices.

To address this limitation, we propose a binary fall detection model using Spiking Neural Networks (SNNs). SNNs emulate biological neurons through sparse, event-driven spike activity, which is more computationally efficient than the continuous values of artificial neural networks. SNNs are ideal for low-power, temporal tasks like fall detection. In our approach, filtered accelerometer and gyroscopic data from the SisFall dataset are encoded (e.g., via Delta and Time-to-First-Spike (TTFS) encoding) and passed through parallel convolutional layers for feature extraction. These features are then classified using a fully connected spiking output layer.

Our preliminary results demonstrate an accuracy of 97%, recall of 95%, and precision of 71%. In the future, we aim to improve precision and minimize false positives by tuning hyperparameters and continuing training. This early-stage work highlights the promise of SNNs as a low-power alternative to conventional fall detection models in wearable health monitoring systems.

# References


[1] World Health Organization, "Falls: Key facts," *World Health Organization*, Jun. 15, 2024. [Online]. Available: `https://www.who.int/news-room/fact-sheets/detail/falls` [Accessed: Jul. 22, 2025].

[2] Public Health Agency of Canada, "Seniors' falls in Canada: Infographic," *Government of Canada*, 2024. [Online]. Available: `https://www.canada.ca/en/public-health/services/publications/healthy-living/seniors-falls-canada-second-report/seniors-falls-canada-infographic.html` [Accessed: Jul. 22, 2025].

[3] J. C. Sim, E. Gowans, and S. A. Koblar, "Delayed medical review following an injurious fall is associated with higher mortality in older patients," *Prehospital Emergency Care*, vol. 18, no. 1, pp. 15–20, 2014. [Online]. Available: `https://www.tandfonline.com/doi/10.3109/10903127.2013.856504`