Enhanced Fall Detection using Optimized Random Forest Classifier on Wearable Sensor Data

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Abstract	This study aims to enhance the performance of fall detection systems for elderly care using wearable sensors by optimizing the Random Forest (RF) algorithm. Falls among the elderly are a major health risk, and timely detection can mitigate serious injuries or fatalities. The primary contributions of this research include developing an optimized RF model specifically tailored for real-time fall detection on resource-constrained devices such as smartwatches. Our approach involves feature engineering, hyperparameter tuning using Grid Search and Randomized Search, and model evaluation to achieve optimal performance. Key findings indicate that the optimized RF model achieved an accuracy of 92%, precision of 91%, recall of 89%, and an F1-score of 90%, with an average processing time of 0.045 seconds per prediction. These metrics underscore the model's capability for real-time deployment, demonstrating improved computational efficiency and predictive accuracy compared to traditional machine learning algorithms and deep learning models. The novelty of this study lies in its targeted optimization of the RF model to balance accuracy with low computational demand, addressing the limitations of existing methods that are either computationally intensive or prone to misclassification. This research provides a scalable solution for continuous fall monitoring, with significant implications for wearable healthcare technology, improving both accessibility and response times in elderly care.Ã‚Â
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Author	Dr LASMEDI AFUAN, S.T, M.Cs