Identifying Post-Stroke Fall Risk Through Performance in Virtual Reality Exercises: A Retrospective Machine Learning Analysis

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Motivation

- Assessing fall risk after a stroke is particularly important due to the high incidence of falls in this population[1] and the significant impact that falls can have.
- In recent years, numerous reviews and meta-analyses have summarized findings on the effectiveness of VR-based interventions for improving balance after stroke [2].
- This study aims to evaluate the potential of performance metrics obtained while interacting with a virtual reality (VR)-based stepping exercise to predict post-stroke fall risk

Methods

Participants

- 132 patients with stroke participated in the study.
- All participants had at least 10 sessions with the VR-based stepping exercise.
- Exclusion criteria included a delay of >30 days between the VR exercise sessions and balance assessments.

Interventions

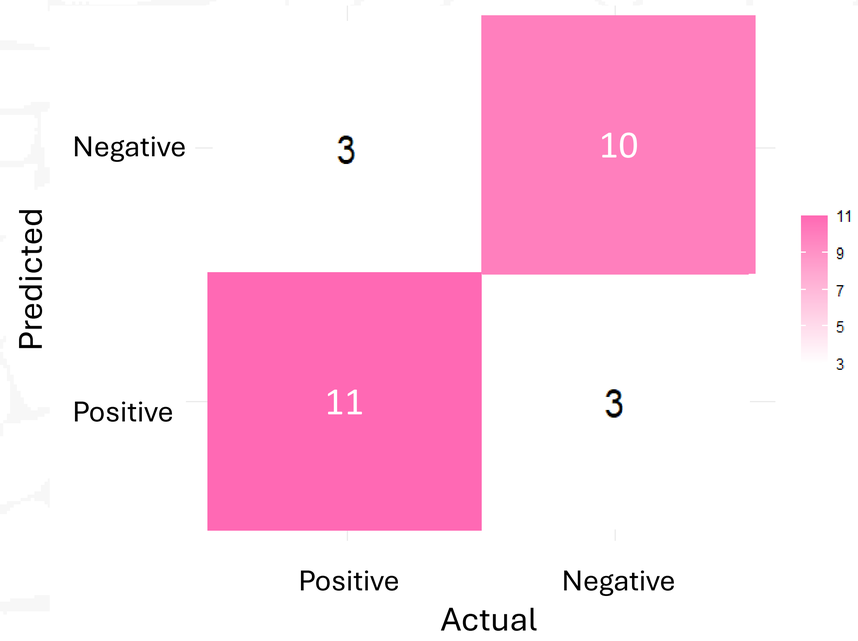
- Participants engaged in tailored VR-based stepping exercises as part of their neurorehabilitation program.
- The exercise involved stepping on virtual targets displayed in a dynamic environment, with difficulty levels adjusted to each participant's capabilities.
- The motor condition of the participant, including balance, was assessed at admission, every six months after admission and at discharge.

Data analysis

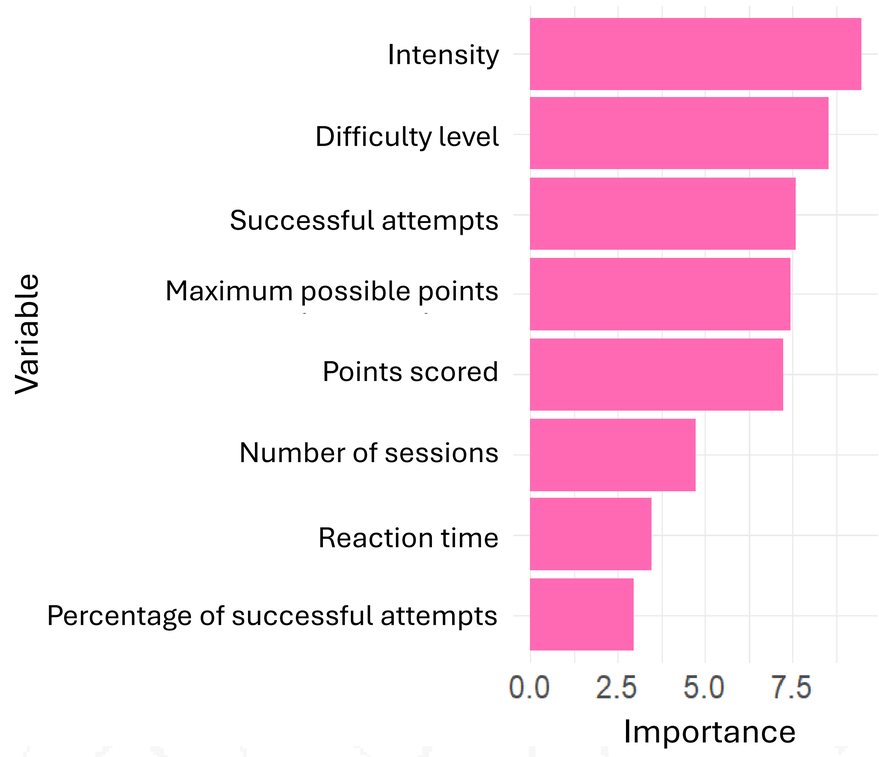
- For each participant, the game session closest to their balance assessment was identified.
- Fall risk was identified based on Berg Balance Scale < 50[3].
- Different machine learning models were trained to classify between fallers and non-fallers.

Results

- Among all machine learning models, the Latent Dirichlet Allocation model showed the highest predictive accuracy (85,19%), with a sensitivity of 84,6%, specificity of 85,7%, and an area under the ROC curve (AUC) of 0.85.



- The most important predictors included intensity, difficulty level, successful attempts and maximum number of points possible.







Conclusions

- This study underscores the feasibility of using VR-based stepping exercises to predict fall risk in stroke patients, demonstrating the potential of machine learning to enhance rehabilitation strategies.
- This approach could streamline resource allocation by identifying high-risk patients and tailoring interventions to their specific needs.

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2. Stocchetti N, Zanier ER. Chronic impact of traumatic brain injury on outcome and quality of life: A narrative review. Vol. 20, Critical Care. BioMed Central Ltd.; 2016.
3. A. Shumway-Cook, M. Baldwin, N. L. Polissar, and W. Gruber, “Predicting the probability for falls in community-dwelling older adults.,” Phys Ther, vol. 77, no. 8, pp. 812–9, Aug. 1997,.

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