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Machine Learning Validation for Wheelchair Propulsion Type Detection in Rehabilitation

Andrew Moganan*

Department of Biomechanical Engineering, Universiti Malaya, Kuala Lumpur 59100, Malaysia

Introduction

The fusion of machine learning techniques with rehabilitation technologies marks a ground-breaking intersection, offering novel avenues to enhance personalized care for individuals with mobility impairments. This study delves into the application of machine learning validation for wheelchair propulsion type detection, a critical aspect of rehabilitation for those reliant on wheelchairs for daily mobility. With a growing population of individuals facing diverse challenges in mobility, identifying the most suitable wheelchair propulsion type becomes paramount for optimizing both functionality and user experience. Leveraging machine learning algorithms for the validation of wheelchair propulsion types introduces a data-driven dimension to the selection process, promising to revolutionize how rehabilitation professionals tailor interventions to the unique needs of wheelchair users. Machine Learning (ML) validation is a critical aspect when developing models for wheelchair propulsion type detection in rehabilitation. This innovative application of ML aims to accurately identify and classify different wheelchair propulsion techniques used by individuals undergoing rehabilitation, such as manual wheelchairs, power wheelchairs, or hybrid models. The validation process involves assessing the model's performance and generalization ability using diverse datasets that represent various wheelchair users and propulsion scenarios. Researchers and engineers employ techniques like cross-validation, where the dataset is split into training and testing subsets to evaluate the model's ability to make predictions on unseen data [1,2].

Description

The research involves the integration of machine learning algorithms to discern and validate wheelchair propulsion types based on user-specific biomechanical patterns and preferences. By collecting real-time data from sensors embedded in wheelchairs and wearable devices, the study captures a comprehensive set of variables, including force applied, handgrip dynamics and wheelchair movement trajectories. These data are then processed through advanced machine learning models, training the system to recognize distinct patterns associated with various propulsion techniques. The study encompasses a diverse participant pool, representing a spectrum of mobility challenges, ensuring the applicability and inclusivity of the developed machine learning model. Ensuring the robustness and reliability of the ML model is paramount, particularly in the context of rehabilitation where accurate propulsion type detection can significantly impact the customization of assistive devices and rehabilitation plans. Validation metrics, including accuracy, precision, recall and F1 score, are employed to quantify the model's performance. Rigorous validation also involves testing the model against real-world scenarios and considering potential confounding factors such as variations in wheelchair design, user characteristics and environmental conditions [3].

Machine learning validation for wheelchair propulsion type detection contributes to advancing assistive technology and rehabilitation practices. Accurate identification of propulsion types enables healthcare professionals to tailor rehabilitation interventions more effectively, addressing specific needs and challenges faced by individuals with mobility impairments. Additionally, on-going validation efforts support the continuous improvement and refinement of ML models, ensuring their applicability across diverse populations and settings in the field of rehabilitation. This intersection of machine learning and rehabilitation showcases the potential for technology to enhance personalized care and improve the quality of life for individuals with mobility limitations. In addition to the technical aspects, the research incorporates user feedback and subjective experiences to refine the machine learning model. Participants are actively engaged in providing insights into their comfort, manoeuvrability and overall satisfaction with different propulsion types. This multidimensional approach not only ensures the accuracy of the machine learning model but also fosters a user-centered design philosophy, aligning with the principles of patient-centered care. The ultimate goal is to create a validated system capable of dynamically adjusting wheelchair settings based on real-time user inputs and biomechanical feedback, thereby optimizing the propulsion experience for individuals with diverse mobility needs [4,5].

Conclusion

In conclusion, the endeavour to validate wheelchair propulsion types through machine learning represents a transformative leap in the landscape of rehabilitation technology. By harnessing the power of data-driven algorithms, this research aims to transcend the traditional one-size-fits-all approach to wheelchair prescription. The integration of user-specific biomechanical data and machine learning models promises a paradigm shift toward personalized mobility solutions. If successful, this approach could significantly enhance the overall user experience, independence and quality of life for individuals dependent on wheelchairs for daily mobility. Furthermore, the implications extend beyond the immediate research context, offering a glimpse into the future of assistive technology in rehabilitation. The synergy between machine learning and wheelchair technology not only streamlines the process of selecting the most appropriate propulsion type but also lays the foundation for a more responsive and adaptive generation of assistive devices. As the study progresses, its outcomes have the potential to redefine the standard of care for individuals with mobility impairments, fostering a new era where technology and rehabilitation seamlessly integrate to empower users and enhance their mobility experience.

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Conflict of Interest

No conflict of interest.

***Address for Correspondence:** Andrew Moganan, Department of Biomechanical Engineering, Universiti Malaya, Kuala Lumpur 59100, Malaysia, E-mail: andrewmog@yahoo.com*

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