Pilot study: Capturing accelerometer outputs in healthy volunteers under normal and simulated-pathological conditions

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INTRODUCTION

- Physical activity (PA) is a key contributor to health [1]
- PA metrics are valuable for clinicians' decision making
- Accelerometer-based sensing is a tool that is used to assess PA [2] and might be used to long-term conditions e.g. rheumatology
- Activity classification algorithms based on normal conditions do not work well when applied in some pathological states

AIMS

1. Automatically identify whether a participant is a healthy or simulated-pathological based on their walking activity
2. Automatically identify different types of physical activity

METHODS

- **Participants**: N = 30 Healthy volunteers
- **Setting**: Lab-based environment
- **Data Collected**: Participants asked to undertake 9 pre-defined activities, twice. Initially with normal gait, and repeated with simulated pathological gait. Continuous triaxial accelerometer (MOX) signals recorded from ankle and wrist.
- **Analysis:** Algorithms derived using Activity Recognition Chain (ARC) process. 5 Machine algorithms trained separately on health and simulated gait, implemented with 10-fold cross validation. Accuracy of each algorithm reported.

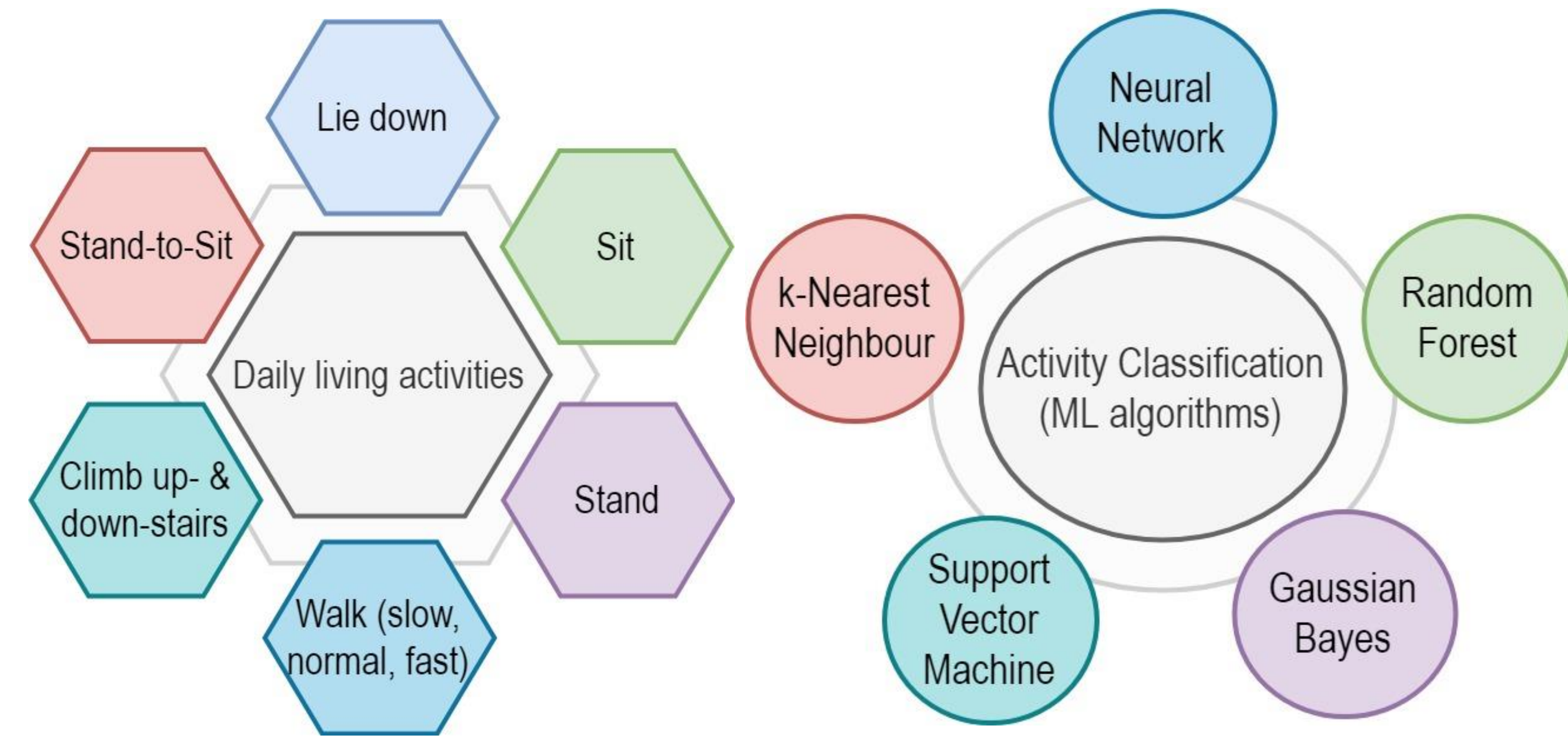
RESULTS

- Differentiation of walking and simulated-pathological gaits using Neural Network: 100% for both wrist and ankle locations
- Neural Network algorithms classifies activities most accurately
- Ankle placement provides slightly better results than wrist

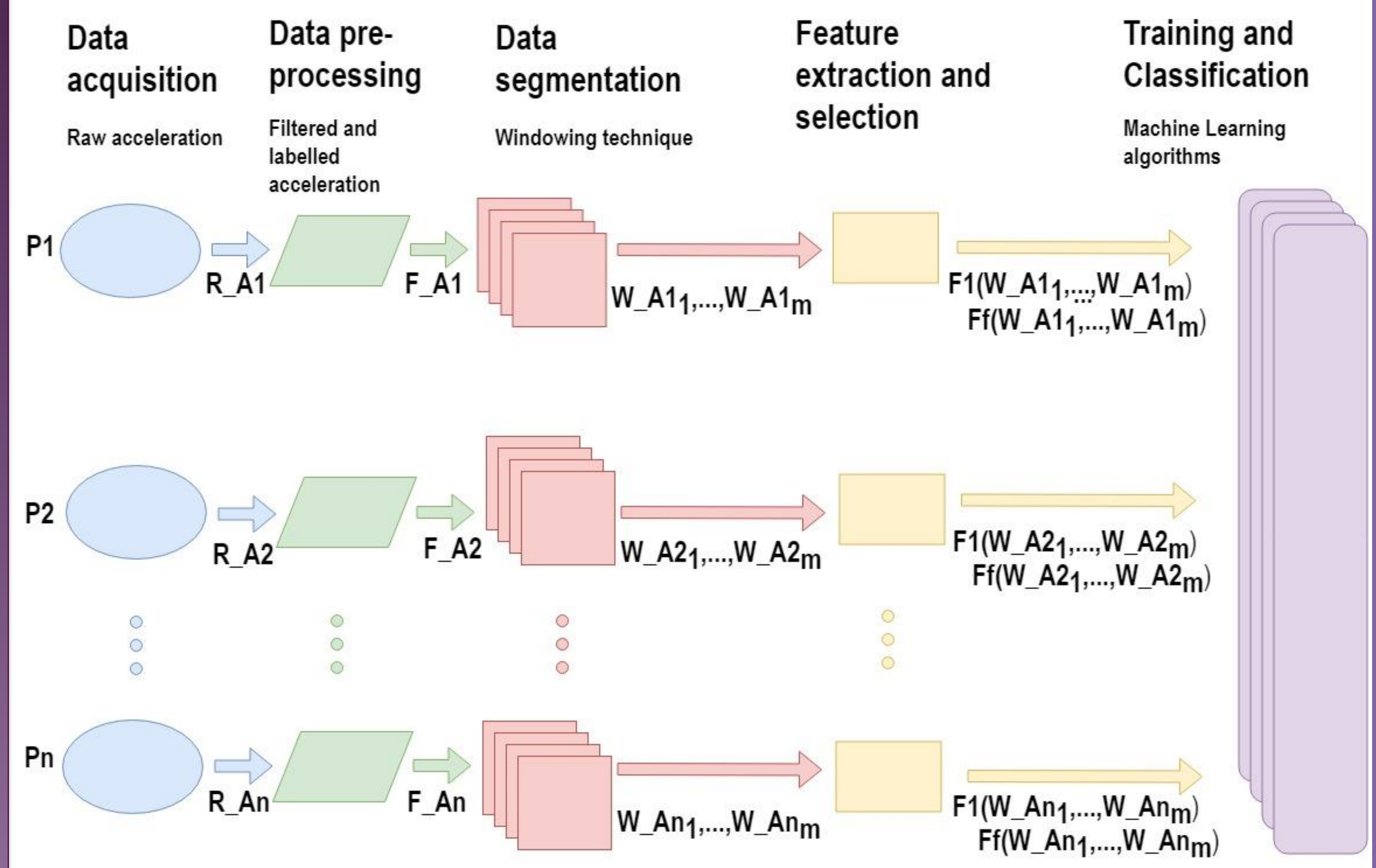
CONCLUSION

- Healthy and simulated pathological gaits can be differentiated
- Wearables based on healthy patient data do not work for pathological conditions
- Wearables based on pathological data work for pathological conditions

Machine learning algorithms **trained** using **pathological** datasets **improve** the accuracy of activity classification in people with **abnormal gait**.



Activity Recognition Chain



Activity classification (Accuracies)

Act_Class: Static, Dynamic, Transition | Act_Task: specific activities

		Group (Train/Test)	Neural Networks	Random Forest	k-Nearest Neighbour	Gaussian Bayes	Support Vector Machine
Wrist	Act_Class	Healthy/Healthy	**0.985**	0.960	0.968	0.867	0.975
		Simulated/Simulated	**0.966**	0.933	0.940	0.775	0.911
		Healthy/Simulated	**0.460**				
	Act_Task	Healthy/Healthy	**0.916**	0.907	0.909	0.725	0.836
		Simulated/Simulated	**0.864**	0.780	0.825	0.508	0.623
		Healthy/Simulated	**0.312**				
Ankle	Act_Class	Healthy/Healthy	**0.988**	0.978	0.983	0.925	0.982
		Simulated/Simulated	**0.960**	0.943	0.957	0.713	0.938
		Healthy/Simulated	**0.746**				
	Act_Task	Healthy/Healthy	**0.954**	0.926	0.940	0.742	0.838
		Simulated/Simulated	**0.879**	0.820	0.820	0.558	0.730
		Healthy/Simulated	**0.354**				

References

[1] Lipperts, M., van Laarhoven, S., Senden, R., Heyligers, I. and Grimm, B., 2017. Clinical validation of a body-fixed 3D accelerometer and algorithm for activity monitoring in orthopaedic patients. Journal of Orthopaedic Translation, Volume 11, pp. 19-29

[2] Wise, J. and Hongu, N. (2014). "Pedometer, accelerometer, and mobile technology for promoting physical activity", College of Agricultural Life Sciences, University of Arizona. Retrieved May 2017, from https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1491-2014.pdf

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