Multisensor Recognition of Activities of Daily Living with PPIE-Informed Parkinson's Protocol Design

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INTRODUCTION

Parkinson's Disease (PD) is a neurodegenerative disorder where motor fluctuations related to medication intake remain difficult to monitor in daily life [1]:

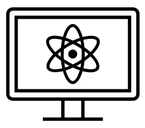
ON

OFF

How medication impacts Activities of Daily Living

Patient-reported questionnaires + short clinical appointments [2].

IMUs are low cost, non-invasive and wearable [3].



Combined with Machine Learning (ML), they enable continous monitoring [4].

- A comprehensive understanding of medication effects during **ADLs** can enhance **clinical characterisation** and **pharmacological management** of PD.

This study proposes a **multimodal wearable protocol** for automatic **ADL recognition** in healthy adults, extensible to **ON/OFF medication state monitoring** in people with PD.

METHODOLOGY

1 Patient & Public Involvement (PPI)

6	3	3
People with PD	Clinicians	Carers

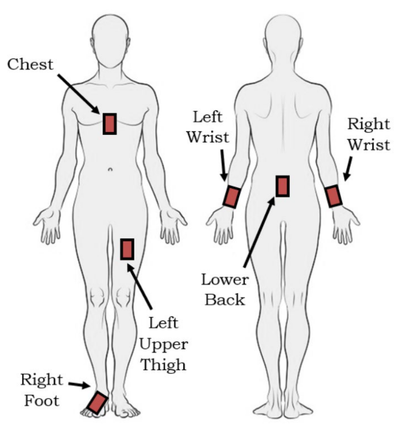
- **Aims:** Protocol feasibility, relevant ADLs, technology acceptability, and protocol refinement
- **Method:** Braun & Clarke (2006) thematic analysis → 5 themes emerged

Clinical Value | **Usability** | **Psychological Factors** | **Data Interpretation** | **Feasibility**

2 Activities of Daily Living selection

- Activities from PDQ-39 and PPI

3 Experimental Protocol



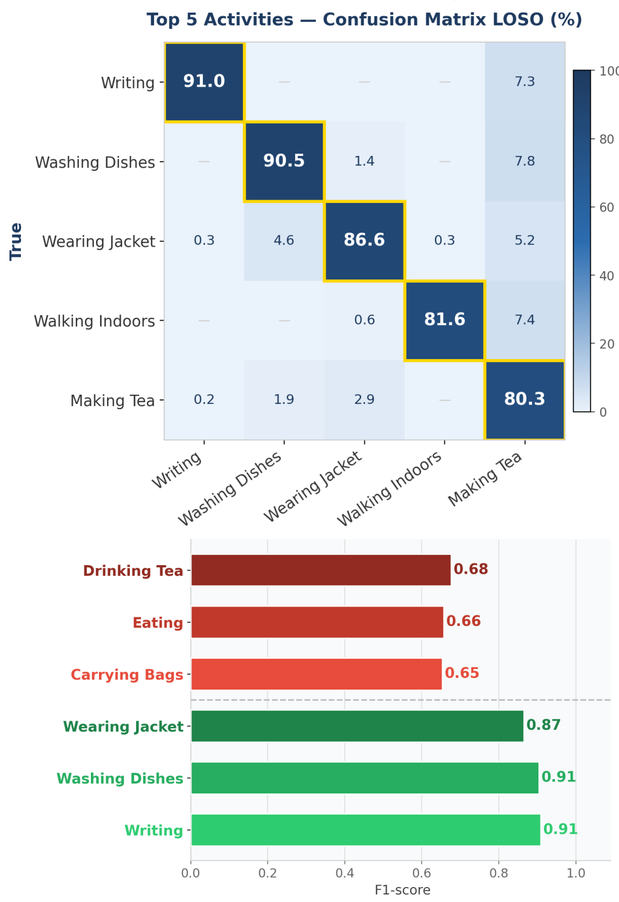
Six XSENS IMUs:
Both wrists, left thigh, right foot, lower back, chest.

Additional modalities:
- RGB cameras, radar
- RFID tags (objects + meds)
- Smartwatch

20 healthy adults

RESULTS AND DISCUSSION

1 Machine Learning



- **Best Model:** Random Forest
- **Accuracy: 84%**
- **F1-score: 0.81**
- Method: LOSO
- Participants: 20 subjects
- Activities: 10 ADLs

Most Challenging
Drinking Tea (F1=0.68), Carrying Bags (0.70), Eating (0.71)

Best Classified
Writing (F1=0.93), Washing Dishes (0.90), Lying Down (0.89)

2 Sensor configuration

Sensors	Features	F1	Accuracy
Right Wrist + Lower Back	231	0.77	0.80
Right Wrist + Lower Back + Left Thigh	**297**	**0.79**	**0.82**
Right Wrist + Left Thigh	231	0.76	0.80
All	**495**	**0.81**	**0.84**

CONCLUSIONS

✓ A multimodal wearable protocol for ADL recognition establishes a critical **baseline** for **ON/OFF medication state monitoring** in Parkinson's Disease.

✓ **Random Forest** achieved **84% accuracy** (F1=0.81) across 10 ADLs with LOSO cross-validation in 14 subjects; Writing, Washing Dishes and Lying Down best classified

✓ **PPIE** confirmed clinical relevance of ADL monitoring and shaped protocol design, reducing **sensor complexity** and improving usability and **real-world applicability.**

➢ Future: test in **older adults** and people with PD, **ON/OFF detection** during ADLs, **minimal sensor configurations**, and larger cohorts.

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