日常生活活动识别(ADLR)

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[1] Zhu, Hongyi, et al. "A deep learning approach for recognizing activity of daily living (ADL) for senior care: Exploiting interaction dependency and temporal patterns." *Forthcoming at MIS Quarterly* (2020).

定义

日常生活活动(ADL)是指在日常生活普遍会进行的活动，包含表现自我照顾（例如自己进食、沐浴、更衣、整理仪容）、工作、家庭杂务及休闲娱乐的任何日常活动。可以通过使用ADL来监测独立生活的老年人的自理能力、健康状况、疾病进展等。

ADL的测量方法
- ①家庭护理或自我报告
- ②可穿戴设备或物体传感器

→ 人体传感器与物体传感器结合

ADLR的粒度

交互识别提取有关活动执行者和未指定对象之间交互的物理运动原语的信息。对象信息添加到交互来完成每个**手势**的语义。**活动识别**使用依赖于时间的手势序列来识别复杂且经常相互交织的操作。

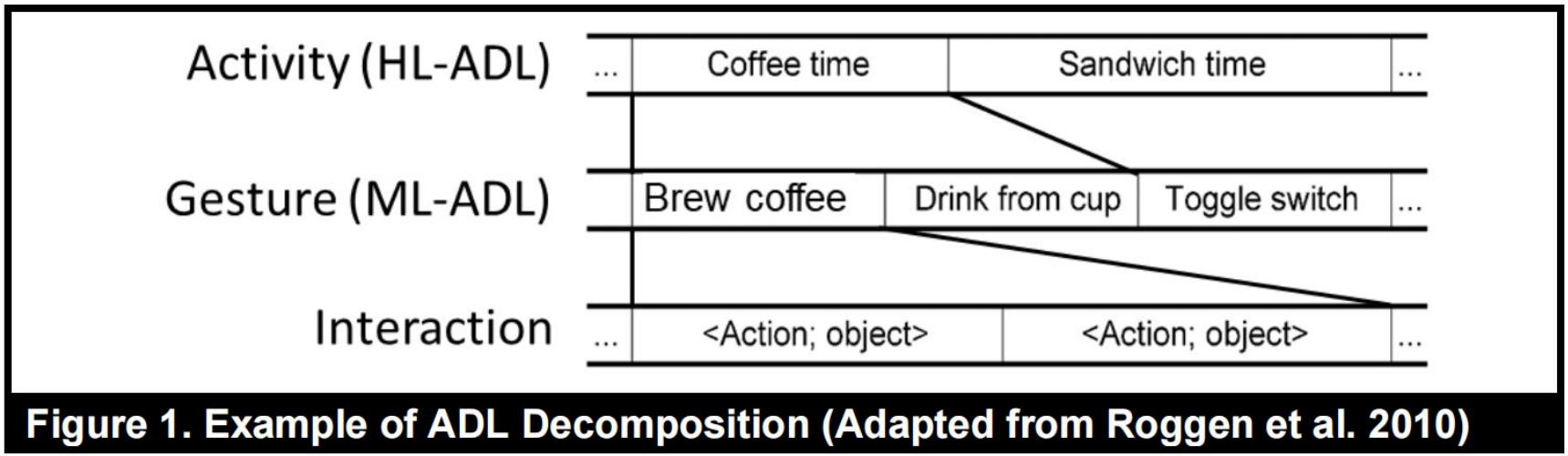

Figure 1. Example of ADL Decomposition (Adapted from Roggen et al. 2010)

Note: ADLs are decomposed hierarchically into three levels: activity (HL-ADL), gesture (ML-ADL), and interaction. Elements on each level follow time sequences.

多阶段ADLR框架

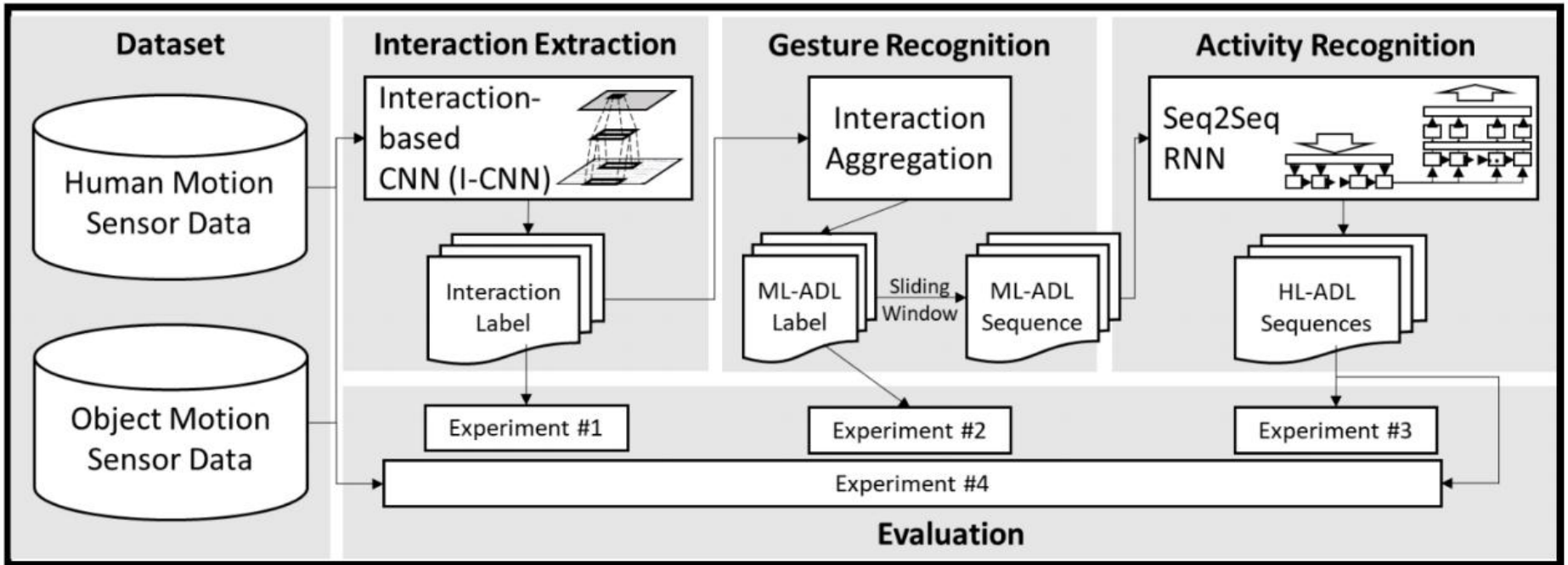

Figure 5. The Proposed Research Design: A Hierarchical Multi-phase ADL Recognition Framework

多阶段ADLR框架

Table 4. A Summary of the Proposed Hierarchical ADL Recognition Framework

Phase	Task	Model	Input	Output	Examples
1	Interaction Extraction	I-CNN	Raw human and object motion sensor data from one human-object sensor pair (< 10 seconds)	An interaction label: No Interaction, Push, Pull, Pick up, Put Down	Raw sensor data → "Push" interaction
2	Gesture Recognition	Heuristic-based	Interaction labels from all human-object sensor pairs: No Interaction, Push, Pull, Pick up, Put Down (< 15 seconds)	ML-ADL label: Open Fridge, Close Door, etc.	"Push" + "Fridge" → "Close fridge" gesture
3	Activity Recognition	S2S_GRU	A sequence of ML-ADL labels: Open fridge – Close fridge – Use fork … (> 1 minute)	A sequence of HL-ADL labels: Food prep – Food prep – Dining …	"Open fridge – Close fridge – Use fork -…- Open dishwasher" → "Food prep – Food prep – Dining -…- Clean-up" activity

ADLR案例

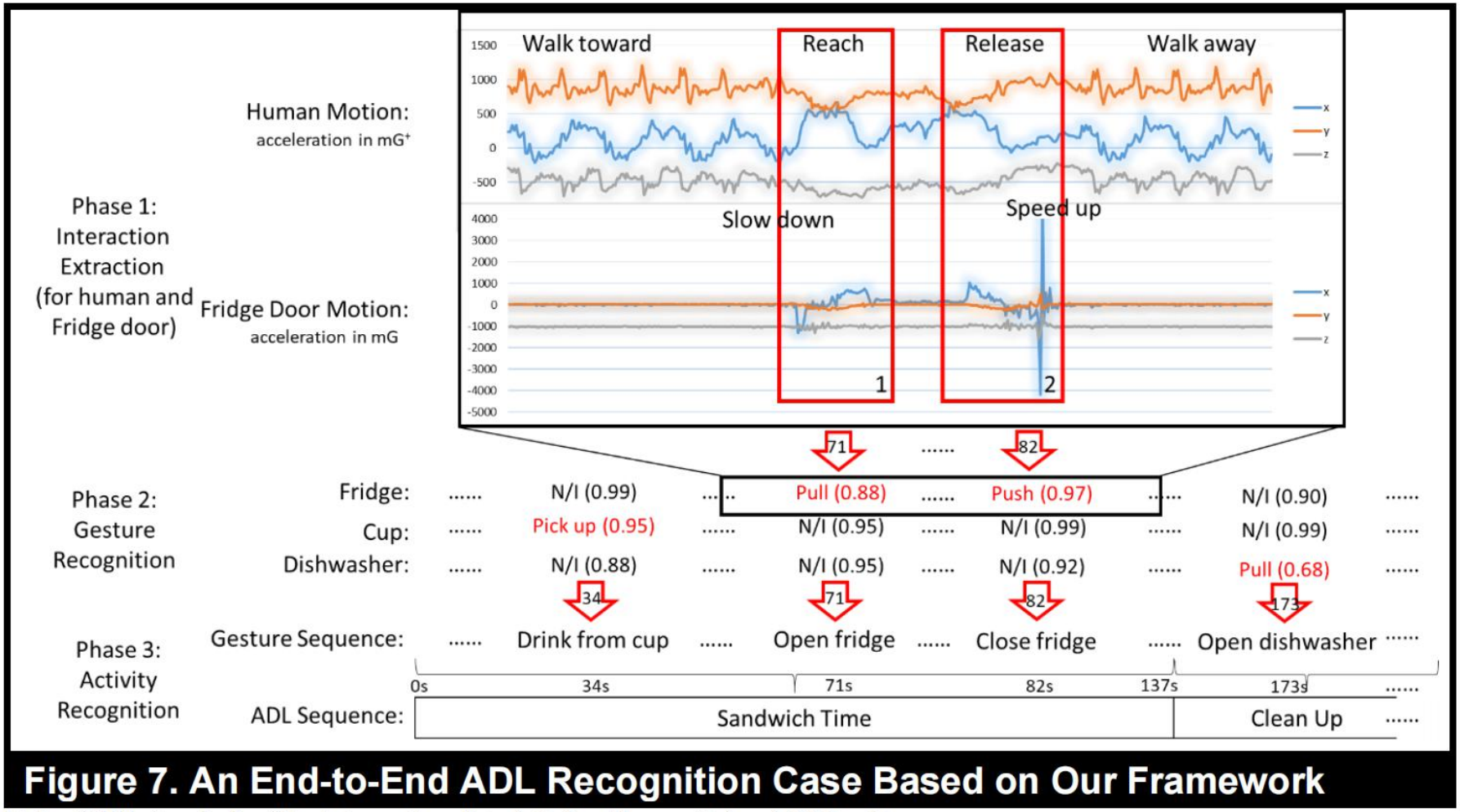

Figure 7. An End-to-End ADL Recognition Case Based on Our Framework

Note: "N/I" stands for "No Interaction." +: 1 G (earth gravity) = 1,000 mG.

Thank you