SSAR: BUILDING SCALABLE MICRO-ACTIVITY RECOGNITION VIA LIMITED SUPERVISION

Final Project Presentation Week 10 Sarah Okome August 10, 2023

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Problem Statement

The objective of this project is to develop a scalable AR model that can effectively recognize and classify human activities via minimal supervision by leveraging pseudo labels in a semi-supervised setting

Introduction

- Human Activity Recognition (HAR)
 - Technique to identify tasks humans perform through video, sensor readings and signals reflected from the human body (Thapa et al, p. 2).



Figure: Overview of HAR techniques (Hussain et al.)

Introduction

- Activities of Daily Living
 - Basic tasks for physical needs 0
 - e.g. walking, sitting, standing



Ambulation



Bathing





Dressing

Feeding

Semi-supervised learning (SSL)

- Combination of supervised and unsupervised learning
- Small portion of labeled data with large quantity of unlabeled data.



SUPERVISED LEARNING vs SEMI-SUPERVISED LEARNING vs

Semi-supervised learning use-case





Pseudo Labels



- Proxy Labels
 - Data used to approximate labels that aren't available in the dataset
- Types: Self Training and Multi-view training
 - Self Training: a supervised classifier trains labeled data and pseudo labeled data from previous iterations of the algorithm (van Engelen and Hoos)
 - E.g. *Pseudo labels*: using a labelled data model to predict labels for unlabelled data

Overview of Framework- Pipeline



Results - Supervised Setting



Forehand ServicePBackhand ServiceRClear Lob Overhead ForehandRClear Lob Underarm ForehandRClear Lob Underarm BackhandRNet Shot Underarm ForehandRNet Shot Overhead ForehandRDrop Shot Overhead ForehandRSmash Overhead BackhandS

BAR dataset



Forehand Service

Backhand Service Clear Lob Overhead Forehand Clear Lob Overhead Backhand Clear Lob Underarm Forehand Net Shot Underarm Backhand Net Shot Underarm Backhand Drop Shot Overhead Forehand Drop Shot Overhead Forehand Smash Overhead Backhand Smash Overhead Backhand

Classification methods



Results - SSL Setting - 30% labeled dataset 0 0.028 0.083 0.083 0.056 0.19 0.028 0

0.038 0.032 0.0073

Forehand Service **Backhand Service** Clear Lob Overhead Forehand 0.042 0.16 **Clear Lob Overhead Backhand Clear Lob Underarm Forehand** Clear Lob Underarm Backhand 0.0078 0.031 0.016 Net Shot Underarm Forehand 0.0035 0.025 0.018 Net Shot Underarm Backhand Drop Shot Overhead Forehand 0.0058 0.026 0.026 Drop Shot Overhead Backhand 0.0015 0.021 0.032 Smash Overhead Forehand 0.0018 0.03 0.0089 Smash Overhead Backhand 0.0021 0.026

BAR dataset

Service Servic Forehand Backhand

0.056 0.17

0 0.025 0.016

0 0.027 0.015

0 0.023 0.019

0.081 0.026 0.064 0.064

0.01

0.054

0.0071 0.021

0.0058

0.035 0.02

0.023 0.041

0.059 0.041

0.039

0.039 0.035 0.035

0.026 0.0088 0.78 0.038

0.081

0.063

0.05

0.034

0.034

0.0085

Smash Overhead Forehand Overhead Backhand Drop Shot Overhead Backhand Clear Lob Overhead Forehand Clear Lob Overhead Backhand Underarm Forehand **Clear Lob Underarm Backhand** Net Shot Underarm Forehand Net Shot Underarm Backhand Drop Shot Overhead Forehand **Clear Lob** Smash



WISDM dataset

Conclusion & Future Works

- This project demonstrates that it's possible for a HAR model to correctly classify human actions that vary in range of complexity in motion.
- The proposed method can be upgraded in the future to improve the performance and distinguish more complex human actions



Skills learned

- Reading academic papers
- Python in ML
- LaTeX-Overleaf
- Google Colab
- Supervised, Unsupervised & Semi-Supervised learning

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