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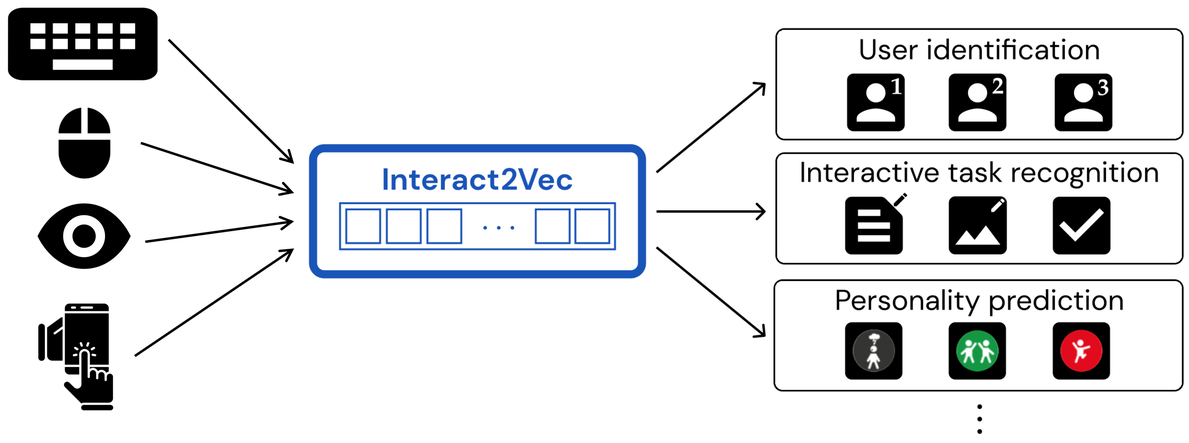
Learning Interactive Behaviour Embeddings

Introduction

- Current interactive behaviour modelling methods are data-driven, and need to be manually tailored to a specific application or task
- Consider user actions as an “interactive language”
- Inspired from representation learning research in NLP, e.g., word2vec[1], project the original interactive behaviour to a latent embedding space
- The space can be used to analyse the semantic meanings of interactive behaviour, and can generalise to different scenarios and downstream tasks

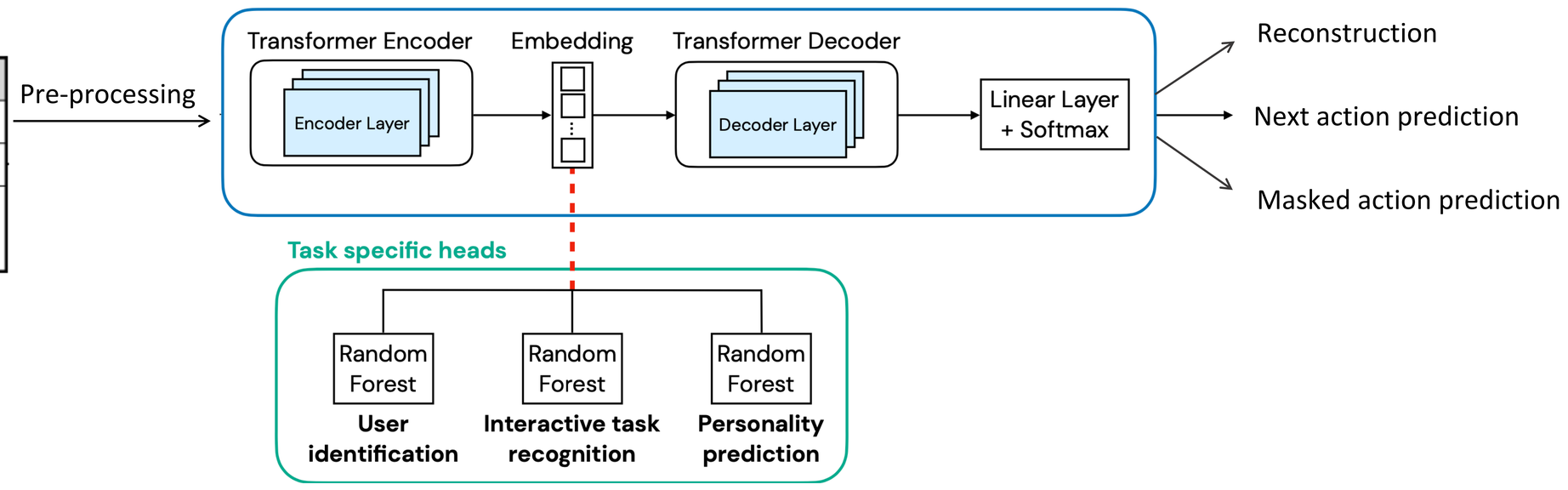


Approach – An ongoing project with mouse and keyboard data

- Log mouse and keyboard events with corresponding timestamps
- Train a Transformer-based autoencoder by reconstructing the input, predicting the next action or the randomly masked actions
- Consider the output of the encoder as the learnt embedding, then train task-specific heads to solve different downstream tasks

Mouse and keystroke events

Timestamp	Event Type	Event Value
1270927177311	MouseUp	left
1270927177878	KeyDown	NoValue
⋮	⋮	⋮



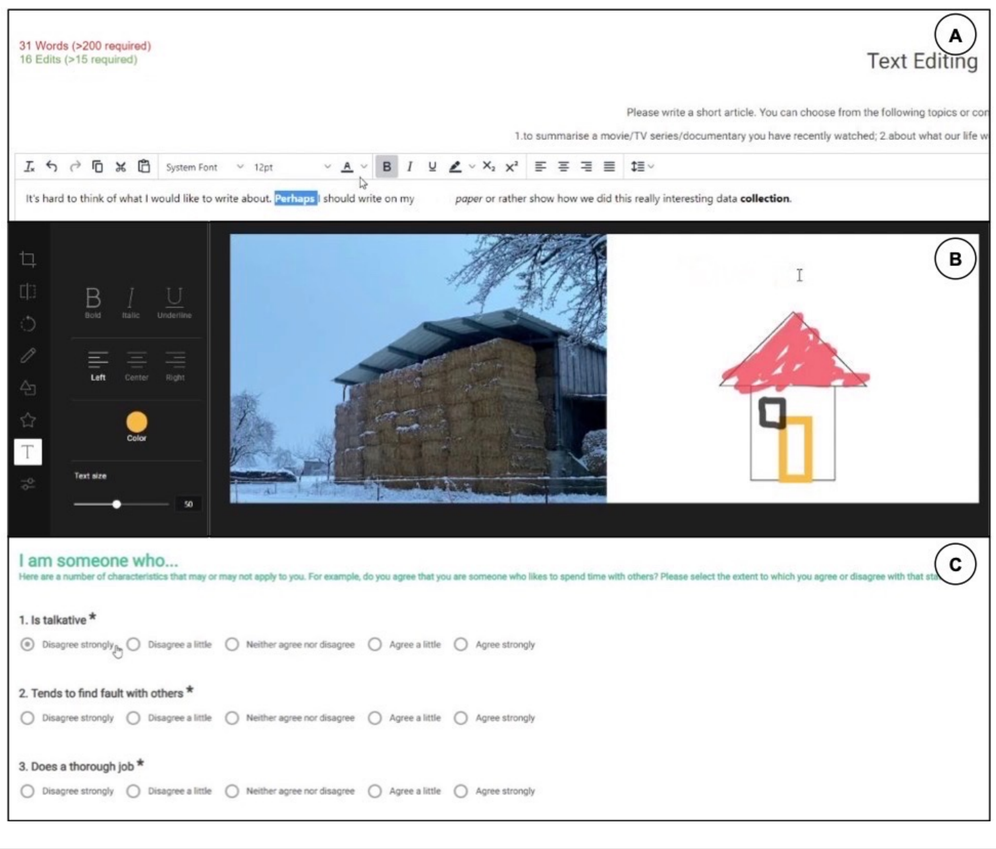
Datasets

Our in-the-wild dataset:

- 40 participants doing 3 interactive tasks (see below) that are pervasive on graphical user interfaces

ISOT dataset[2]:

- 24 participants using a social media platform

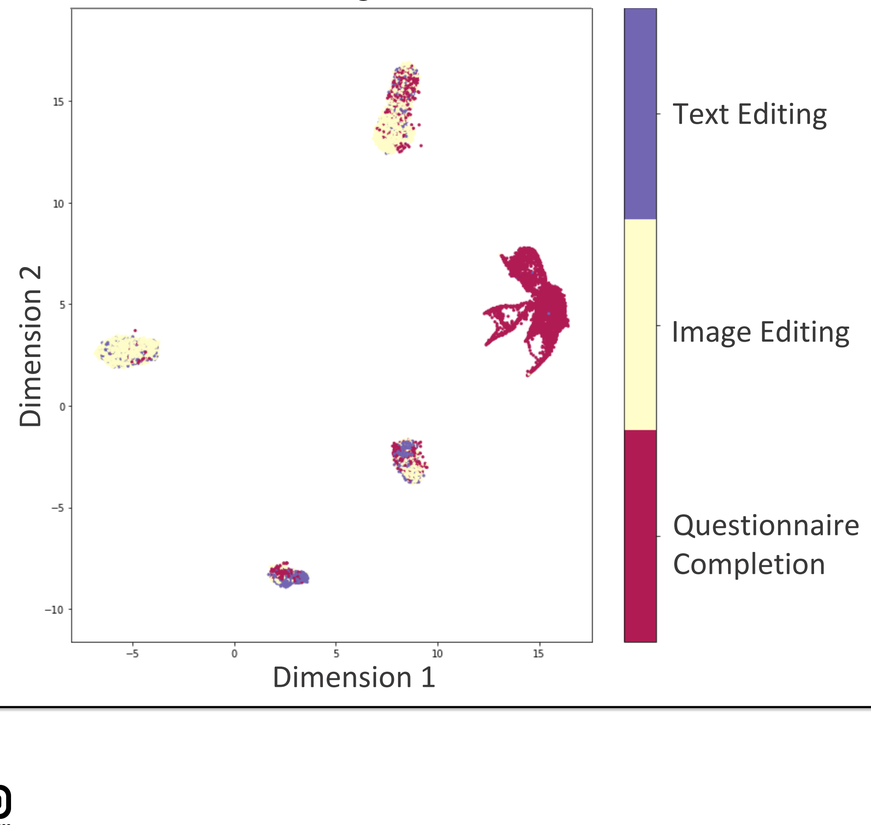


Results

The interact2vec model pretrained on our dataset generates useful representations, that on both datasets:

- Data that are semantically similar are closer in the embedding space, e.g., data from the same interactive task forms a cluster (see below)
- Results on different downstream tasks are comparable with classical methods, i.e., feature engineering + classifier (ongoing)

Uniform manifold approximation and projection (UMAP) on the learnt embeddings from our dataset



References

[1] Mikolov et al. 2013. Efficient estimation of word representations in vector space. arXiv preprint arXiv:1301.3781.
[2] Traore, Issa, et al. 2012. "Combining mouse and keystroke dynamics biometrics for risk-based authentication in web environments." *the fourth international conference on digital home. IEEE*.

PUI Perceptual User Interfaces
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