

Pattern recognition using Inertial Measurement Unit

Laboratory:

Swiss Data Science Center

Type:

Semester project

Description:

Gesture recognition is the interpretation of human motion by a computing device. From touch screen to depth camera, user interfaces can provide intuitive and seamless integration in many situations. In this project, we will focus on tracking the 3D trajectory of a small device equipped with an IMU – a pen or magic wand, used to write shapes in the air – a challenge related to online handwriting recognition [2, 3].

Various approaches and types of gestures can be used; this will be decided at the beginning of the semester. As an example, one could focus on simple shapes and handle the motion as a sequence of symbols; fuzzy matching could then be used to recognize predefined spell-like sequences. The measurement device may be a smartphone, or any other device with an IMU. The student is expected to design and execute a data collection procedure, in order to build an annotated dataset.

While the initial goal of this project is a supervised classification of simple shapes, it would be interesting to explore unsupervised settings. Similar to language models in natural language processing (NLP), probability models can be trained on unsupervised data – unannotated recordings of an IMU. [1] explores how a recurrent neural network (RNN) can capture patterns in a 2D space.

Goals/benefits:

- Working with signal processing and machine learning libraries in Python
- Hands-on experience, from data collection to visualization

Prerequisites:

- Python (advanced skills)
- Machine learning (intermediate skills)
- Linear algebra and signal processing are a plus
- Interested in human-computer interaction

Deliverables:

- Well-documented code
- Written report and oral presentation

References:

[1] Shan Carter et al. “Experiments in Handwriting with a Neural Network”. In: Distill (2016). doi: 10.23915/distill.00004. url: <http://distill.pub/2016/handwriting>.

[2] Anoop M Namboodiri and Anil K Jain. “Online handwritten script recognition”. In: IEEE Transactions on Pattern Analysis and Machine Intelligence 26.1 (2004), pp. 124–130.

[3] Felix Ott et al. “Benchmarking Online Sequence-to-Sequence and Character-based Handwriting Recognition from IMU-Enhanced Pens”. In: arXiv preprint arXiv:2202.07036 (2022).

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