Stage M2R Informatique / LIMSI (AMI group)

Interactive Visualization of Hidden Markov Models for User-defined Gesture Recognition

Information

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Dates : 01/03/2018 to 31/07/2018
Lab : Laboratory LIMSI-CNRS, Plateau du Moulon, Bât. 508, 91403 ORSAY.
Research Group : Architectures and Models for Interaction (AMI).
Salary : Legal compensation.
Follow-up as PhD : wished.
Keywords : Gesture-based and Whole-body Interaction, Gesture Recognition, Visualization, Human-Computer Interaction, Machine Learning.

Context

Human movement has a tremendous potential for efficient and expressive interaction with digital media in dynamic contexts, beyond the mouse-keyboard interaction paradigm. Although interaction techniques based on gesture recognition have largely benefited from recent advances in machine learning, user personalization of gestural interaction techniques remains difficult. Yet, user-defined gestures are promising: because they are easier to memorize and execute than predefined gesture sets, they can allow for richer and more expressive interaction. However, creating gestures remains hard for novice users. On one hand, users' creativity is often limited by a "legacy bias": they tend to imitate or reproduce the interaction techniques they already know (e.g. gestures used in tactile interaction). On the other hand, misconceptions about movement sensors and about the abilities of machine learning techniques used for recognition can strongly limit the efficiency of the created gesture vocabularies.

This internship proposes to study what factors can limit novice user's understanding of gesture recognition techniques, and to develop appropriate visualization tools that support the design of efficient gesture sets and recognizers. This project belongs to the emerging research field of Human-Centered Machine Learning.[1] This internship could be pursued as a doctorate with a broader scope, related to audio and/or visual feedback as a tool to facilitate user-centered machine learning.

Goals

The main goal of this internship is to design, implement and evaluate a visualization interface for Hidden Markov Models, a machine learning technique used for gesture recognition. The proposed interactive visualization technique will extend the existing prototype[2] (see Fig. 1) to the case of multidimensional gestures. Then, the student will conduct a user study (design the protocol, conduct the study, analyse the results) aiming to evaluate the benefits of such visualizations. The study will compare several feedback modalities (for example: instructions on the algorithm vs visualizations)

[1] See recent workshops in major HCI conferences, for example: http://hcml2016.goldsmithsdigital.com/
[2] Françoise, J., Bevilacqua, F., & Schiphorst, T. (2016). GaussBox: Prototyping Movement Interaction with Interactive Visualizations of Machine Learning. CHI EA'16.

and their influence on (1) the efficiency of the gesture vocabularies and recognizers created by the participants, and (2) the participants' understanding of the underlying mechanisms of the gesture recognition process. To this end, the intern will conceive an experimental protocol using mixed methods involving quantitative measures of user interactions as well as interviews. The student will be in charge of specifying the protocol, developing a prototype from the existing platform, conducting the study, and analyzing the results.

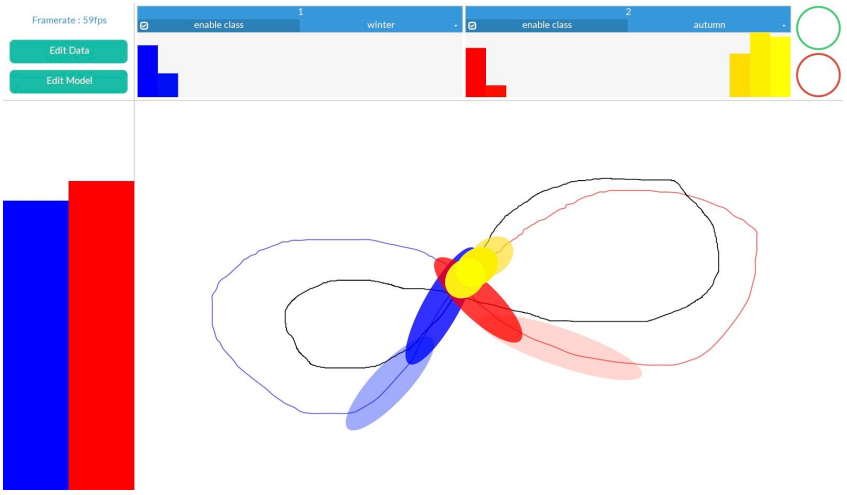

Fig. 1 : Screenshot of an existing prototype for HMM visualization. See also : https://www.julesfrancoise.com/gaussbox/

Through the use of mixed methods, we expect to obtain two types of results. First, the study will produce quantitative results on a specific task: the influence of the visual feedback on the creation and recognition of user-defined gestures. Second, we expect the interviews to provide a deeper understanding of the cognitive processes at stake when people learn to use machine learning techniques, in particular regarding their understanding of how machine learning model work.

Overview of the work

The work will include the following steps:

1. State of the art on human-centered machine learning and visualization.
2. Design, implementation and pilot evaluations of various visualization techniques
3. User study evaluating the proposed method: from the specification of the protocol to the analysis of the results.

How to apply

Send a CV, cover letter, and recent grades records to: jules.francoise@limsi.fr