NeuronUnityIntegration2.0

A Unity application for motion capture and gesture recognition

Federico Becattini **Andrea Ferracani** **Filippo Principi** **Marioemanuele Ghianni** **Alberto Del Bimbo**

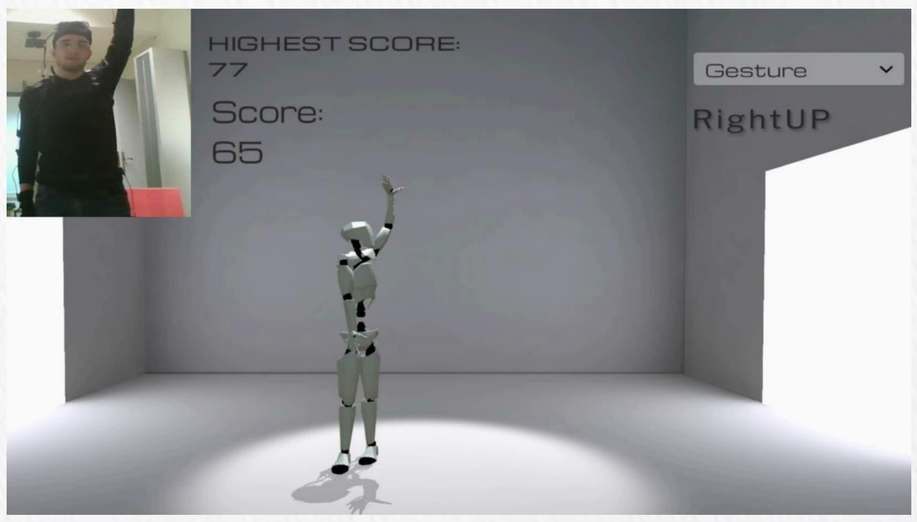
Media Integration and Communication Center (MICC) – University of Florence – name.surname@unifi.it

Introduction and Objectives

NeuronUnityIntegration2.0 is a Unity stand-alone application, developed for windows and powered by LibSVM, to perform motion capture and gesture recognition.

Essentially, it's an advanced integration on Unity of the motion capture system "Perception Neuron".

Easy-to-use tool, with a minimal but effective graphic interface, which can be used individually or as a backend tool for other gesture recognition based application.



Motion capture and Architecture

Mocap is the process of recording the movement of objects or people.

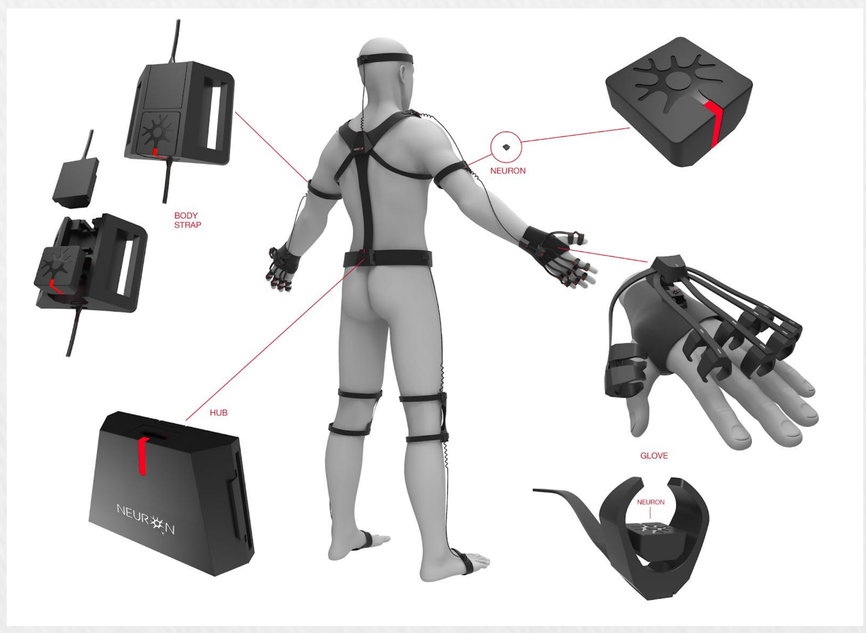
The animation data is mapped to a skeleton and a 3D model that replicates exactly live-action movement.

Perception Neuron

Full set-up of 32 sensors called "Neurons". Each is no larger than a penny and weighs just over a gram.

Position and rotation detection with accelerometer, magnetometer and a gyroscope.

Affordable and efficient MOCAP system, bringing the dream of motion capture in every home, one step closer to reality



NeuronUnityIntegration2.0

We propose NeuronUnityIntegration2.0, a plugin for Unity which adds motion capture functionalities exploiting the Perception Neuron suit and custom gesture recognition.

The plugin can run either in record mode or recognition mode and does not require any technical effort and knowledge in order to train the gesture classifier.

- **Record mode:** the user can collect a dataset of gestures and poses. Through the interface the user can select if the recording is a pose (single frame) or a gesture (sequence of poses) and assign a label to it. Once a set of samples has been collected, it can be saved as a dataset to train a pose/gesture classifier.
- **Recognition mode:** NeuronUnityIntegration2.0 provides Unity scripts that can be attached to avatars in Unity. It can also communicate as a standalone tool with external applications providing gesture recognition API via web socket. Any application can connect to the socket and receive a stream of poses or simply be notified when an event occurs, namely a successfully recognized gesture or pose.

Pose and Gesture Recognition

Once a dataset is acquired in record mode, a pose/gesture classifier can be trained and used in recognition mode. Configure and train a multi-class Support Vector Machine (SVM). SVMs are learned with libSVM.

Pose = 32 sensors * 3 spatial coordinates = 96-dimensional feature vector.

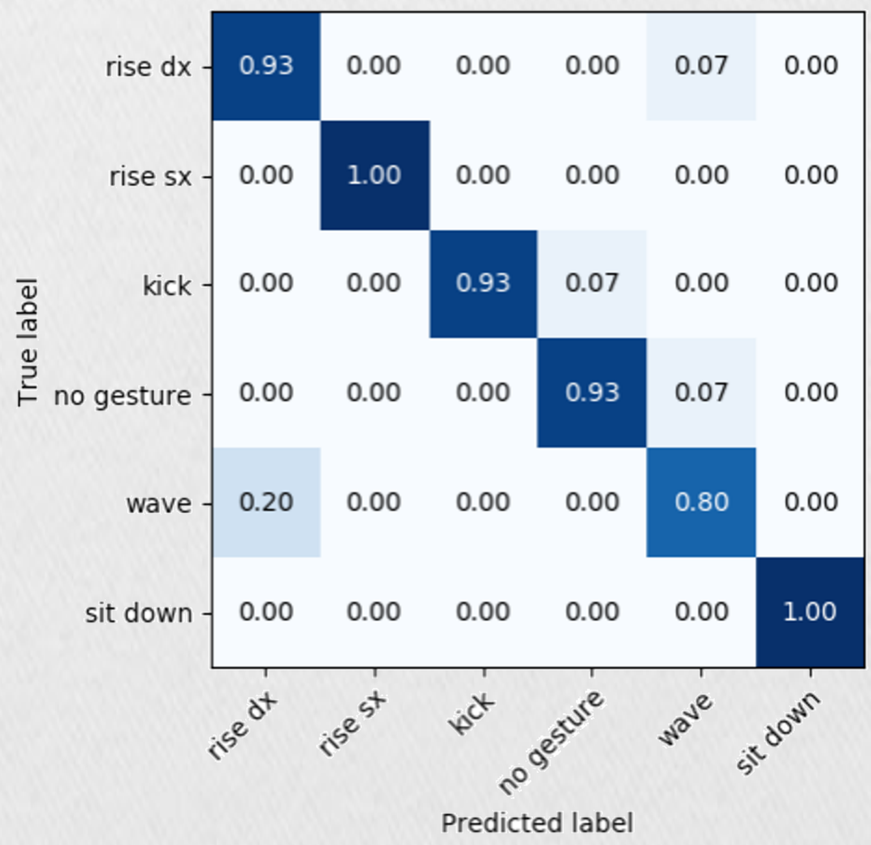
To classify gestures, we uniformly sample 10 poses from training samples to represent different length sequences with a fixed-size descriptor. Our gesture classifier therefore operates in a 96 × 10 = 960-dimensional space.

Gestures are recognized in real time by applying the classifier in a sliding window fashion, over the last N frames.

Testing and Validation

Tested on a dataset with 2 poses and 5 gestures (plus a "no gesture" class), recorded by 13 users of different age, weight, height and gender.

Poses are always perfectly recognized. On gestures, the system obtains an accuracy of 93.3%. All gestures are recognized almost perfectly as shown in the confusion matrix. The most difficult classes do distinguish have proven to be wave and rise_right_hand which may share common traits depending on how the action is executed.



Acknowledgments

This work was partially supported by Regione Toscana PAR FAS 2007-2013 IMAGACT-MED project.