COST287 - STSM – Scientific report

Host institution

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Mission Period

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Purpose of the visit

In the course of my thesis, I have developed an algorithm for finger tracking using computer vision. The algorithm as been implemented in EyesWeb 3, a software application developed by InfoMus laboratory DIST-University of Genoa that provides computer vision building blocks for researchers. The algorithm is designed to work with hand moving on a plane (flat surface like a desk, for example) and was used in my thesis project for the detection of guitarist fingering. The aim of this scientific mission is to explore the possibility to use the algorithm or a similar one to perform a hand-tracking task in space. The objectives of the proposed scientific mission are consequently:

- To migrate the algorithm to EyesWeb 4;
- To modify the algorithm to perform hand tracking in general situations or to develop a new algorithm;
- To validate the algorithm by performing hand-tracking on a database of video image;

The algorithm for hand tracking will then be used to track hands of actors in an emotion database. The hand trajectories will then be analyzed to establish a set of cues (amplitude, rhythm, etc…) that hopefully can characterized hand motion associated with the expression of an emotion. The result of this study will be compiled and publish in the form of an article to be distribute on the Gesture Workshop, HUMAINE network or another pertinent network or conference.

Description of the work carried out during the visit

As the work on the upgrade of the fingertip detection algorithm started, it became clear that it would not be straightforward as first expected. In fact, the algorithm was built on Intel OpenCV library of functions. Although EyesWeb 3 supported the same image type as OpenCV, it is not the case in EyesWeb 4. An existing collaboration between InfoMus and the composer professor Doati also made the objectives of the internship change. As mentioned previously, my master thesis project was on the detection of the fingering of a guitarist. Professor Doati work is with ancient string instruments. It was therefore decided that all modules of my thesis work would be updated to work on EyesWeb 4 and that a meeting would be set with prof. Doati to discuss the usage of such a tool on other string instruments than the guitar. The work carried out was therefore the following:

- Write a tutorial on how to use OpenCV in EyesWeb 4;
- Upgrade the two main modules of the fingering detection algorithm to EyesWeb 4 (linear Hough transform for strings and frets detection and the circular Hough transform for fingertip detection);
- Write tutorials for these two blocks.

Description of the main results obtained

OpenCV Tutorial

For the purpose of the tutorial, a block using OpenCV implementation of the Canny edge detection algorithm was developed. The tutorial is in the form of commented source code. The tutorial explains the different preparation steps to use OpenCV inside Microsoft Visual Studio 6 in an EyesWeb project. It also explains how to use EyesWeb image type buffer within an OpenCV image. This is necessary to use OpenCV functions. The tutorial can be downloaded from the author website (http://www.music.mcgill.ca/~amburns/masterproject/) and will hopefully be available in the EyesWeb 4 documentation in the future. The tutorial is already used by InfoMus students.

Linear and Circular Hough Transform

Figure 1 and 2 respectively show the results of the linear and the circular Hough transform on basic tasks. These two images are screenshots of a simplified version of their respective tutorial. The linear Hough transform block implements three different algorithms, namely the standard, the probabilistic, and the multi-scale Hough transform. These three algorithms are a direct implementation in EyesWeb 4 of the OpenCV implementation of the linear Hough transform. The circular Hough transform block implements two different algorithms, the standard and the gradient circular Hough transform. The standard algorithm is an upgrade from the one developed by the author for EyesWeb 3. The gradient algorithm is a direct implementation of the OpenCV function. These two blocks will be available soon for download on the author website at the address mentioned previously. They should also be available in a subsequent distribution of EyesWeb.

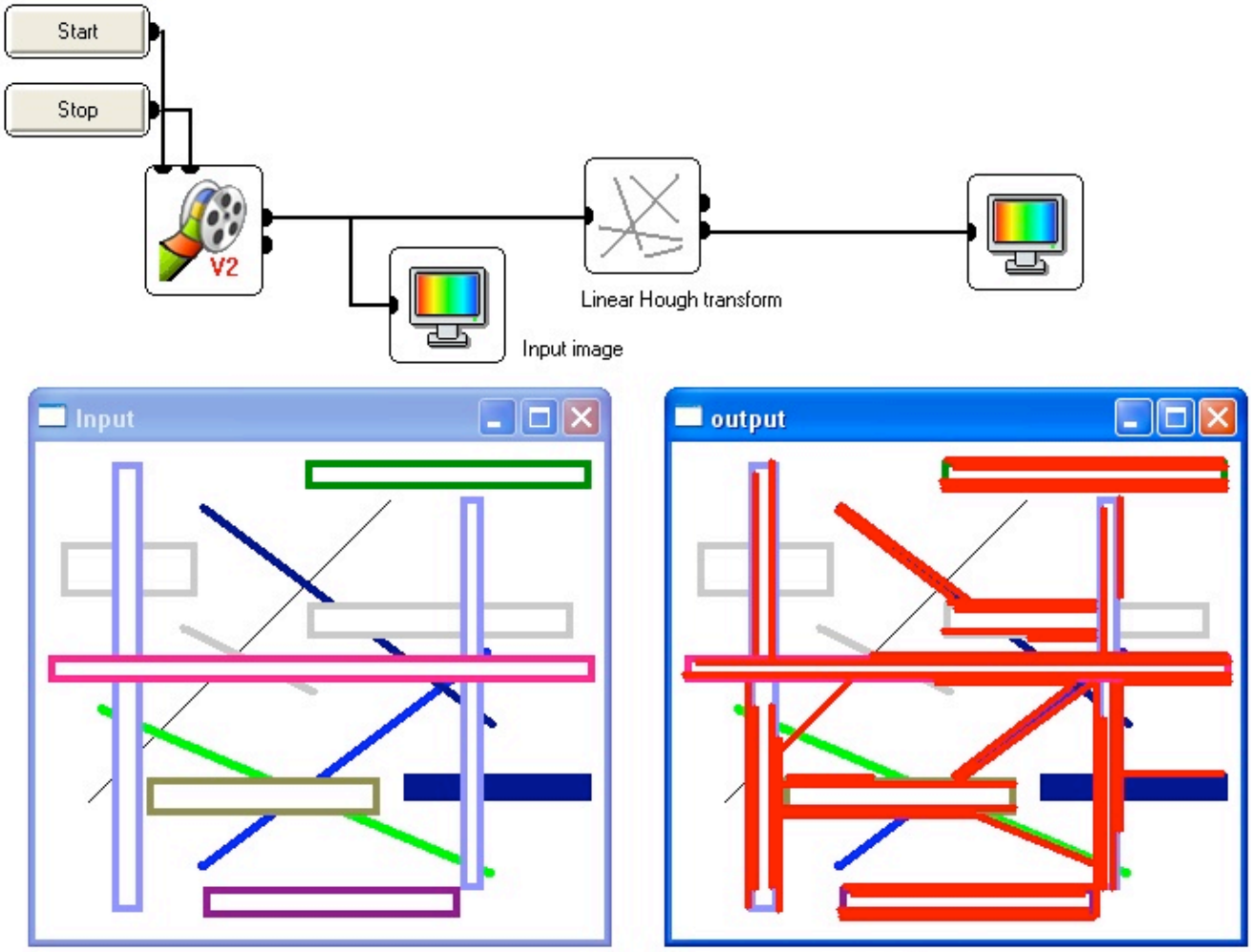

Figure 1 - Linear Hough transform tutorial

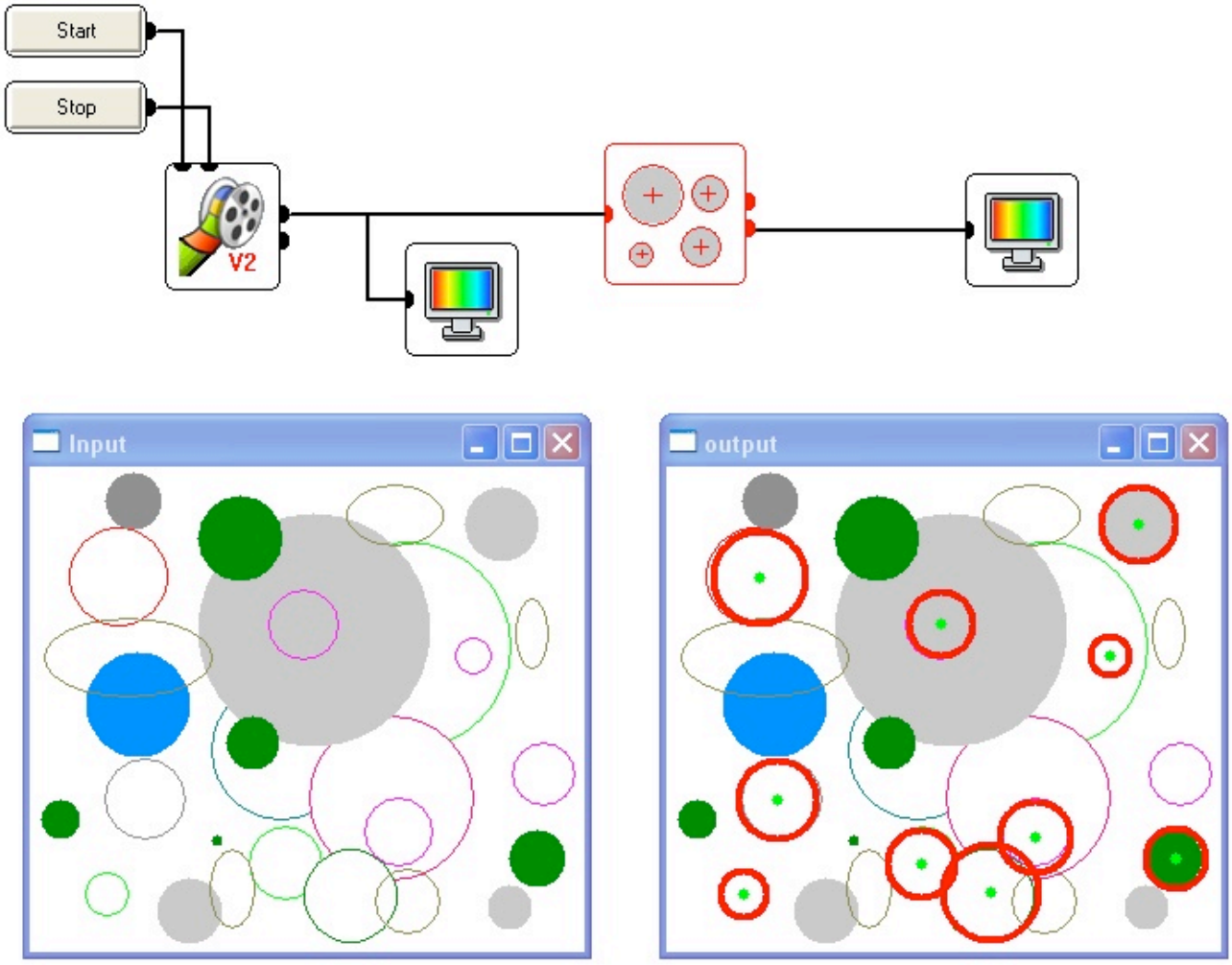

Figure 2 - Circular Hough transform tutorial

Future collaboration with host institution

A meeting with prof. Doati is planned for the 16th of May. Future collaboration should be decided as an outcome of this meeting.