CAS CS 440/640 Artificial Intelligence

Spring 2015

Gesture Recognition

The goal of this assignment is to design and implement algorithms that delineate objects in video images and analyze their shapes.

You are asked to design and implement algorithms that delineate hand shapes (such as making a fist, thumbs up, thumbs down, pointing with an index finger etc.) or gestures (such as waving with one or both hands, rapidly closing and opening your fist, shaking your head, swinging, drawing something in the air etc.) and create a graphical display that responds to the recognition of the hand shapes or gestures. For your system, you may want to use some of the following computer vision techniques that were discussed in class/lab:

1. background differencing: D(x,y,t) = I(x,y,t)-I(x,y,0)
2. frame-to-frame differencing: D'(x,y,t) = I(x,y,t)-I(x,y,t-1)
3. motion energy templates (union of binary difference images over a window of time)
4. skin-color detection (e.g., thresholding red and green pixel values)
5. horizontal and vertical projections to find bounding boxes of "movement blobs" or "skin-color blobs"
6. size, position, and orientation of "movement blobs" or "skin-color blobs"
7. circularity of "movement blobs" or "skin-color blobs"
8. tracking the position and orientation of moving objects

You are also asked to create a graphical display that responds to the movements of the recognized gestures. The graphics should be tasteful and appropriate to the gestural movements.

One possible inspiration for your graphical display may come from the early 20th century Russian futurist opera "Victory Over the Sun". On April 23rd, the BU Center for the Humanities, the Center for the Study of Europe, and the BU Arts Initiative will sponsor a multimedia performance based on the aforementioned Russian Futurist opera. There is an opportunity for students of this class to collaborate on creating an interactive installation by writing software that analyzes a stream of images from the stage and produces an abstract graphical representation to be projected onto the stage. Here is some more information about the opera:

Victory Over the Sun is possibly the first major example of performance art. It was conceived by a composer (Matiushin), a visual artist (Malevich), and a poet (Kruchonykh). These three were united by their enmity toward logic and causality in art and their desire to conceive of a new kind of theater. Not much is left of the opera: parts of the script, some pages of the musical score and the designs for the costume and set. When it was performed in 1913, it was done with amateur actors, and no orchestra (just a piano). The script is weird, to say the least. Kruchonykh was attempting to develop a new kind of language (a language that was liberated from all the meanings that words had been weighed down by over the years), and he liked to use pure sounds and abstract images as a way of frustrating the bourgeois audiences hunger for traditional patterns of communication. (his most famous poem is called dyr bul schil which means nothing in any language). The idea of the opera is relatively straightforward: the sun (a symbol of reason and of traditional forms of authority) has been wounded and is locked up. Now that the tyranny of the past has been subdued, human beings can remake themselves and new forms of expression are possible.

Here is a link to a documentary on youtube in which a director describes his attempt to stage this opera (https://www.youtube.com/watch?v=AR9BRXgurfk).

Here is a Wikipedia link to the Russian artist Kazimir Malevic (http://en.wikipedia.org/wiki/Kazimir_Malevich). You can take a look at some of his Suprematist paintings to get an idea of the aesthetic that inspired the opera.

Of course, you are free to explore other ideas for your graphical display. Along with the program, the students should submit the following information about their graphics program:

1. An overall description
2. How the graphics respond to different hand shapes and/or gestures
3. Interesting and fun aspects of the graphics display

Project Report

Your project report should be a html document that includes:

1. A description about which gestures your computer vision system can recognize
2. A description how your system recognizes these gestures
3. A description of the assumptions that make your system work reliably
4. A hyperlink to your code
5. Your results (sample images and/or videos)
6. An analysis and discussion of your results, for example:
   (a) How often was your program able to correctly identify a gesture (number of true positive detections)?
   (b) How often did your program miss detecting a gesture (number of false negative detections)?

(c) How often did your program misinterpret a gesture (number of false positive detections)?

(d) What were the difficulties in recognizing gestures?

(e) Potential future work. What would you try (if you had more time) to overcome the failures/limitations of your work?

Submission

Each programming assignment submission should include the following: The source code for your assignment (in a directory named "src"), and a web page describing your method, experiments and results (in a directory named "html"). Grades will be based on the content of your web page, and on the quality of your code submission. Your webpage submission will be posted to the course web page for all of your classmates to look at.

All files should be made into a tarball or zip file and submitted using gsubmit. Before submitting a visual studio project, please remove all executable files, as these can be quite large. Visual studio has an option to clean the project.