Google Summer of Code 2009

Work Report :: MidTerm

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Mentoring Organization

Before Code Begins

Made an enhanced Viola and Jones training. Started to check ways for subtracting the background of complex setups(Median, Movement, Absolute Frame Difference, Adaptative, and so on), like the one Seth provided me on the application period, and that is showed on my Google Summer of Code Proposal. Because that opens the implementation to more different setups. Also, the period was taken to study more the OpenCV library , as I had used it before, but would need to extract a lot from it, and to later optimize aspects of the code as we are dealing with a real-time application. Downloaded the CCV code from the SVN, compiled it in the Codeblocks and Visual Studio 2008, made some modifications for fun. Studied the architecture of the code, checked the best way to insert my module later in the code without generating bugs or incompatibilities. Checked licenses, and the most suitable until now has being the GPL v2.0, as it is in accordance with the used libraries.

Week 1 - May 24th to May 30th

Main point here was to try to get a working setup myself, using all kind of setups (Mtmini, DI, DSI) and also working with my project manager at the University, but we could not finish it, due to non-existence of some materials. It was justified because of the necessity to use that on the Pseudo Hand-Tracking tests using just the blobs information. Also, the research aspect became deeper as I managed to check lots of articles, equations, researches reports from a variety of institutes looking for the most suitable algorithm that could be used in the CCV Hand-Tracking. Some important requirements were set: it should be robust to occlusion, and handle well scale and rotation that are very common aspects in the Multi-Touch context.

Week 2 – May 31st to June 6th

Started the fight for trying to get an algorithm robust for pseudo hand-Tracking. Got some problems due to the lack of setup at our lab. Some geometric aspects showed themselves quite inconclusive without a prior type of calibration. Due to this time implemented most of code using the OpenFrameworks. I was willing to use some CGAL classe with Vertex to provide some calculations on ConvexHulls, did not work, either.

Week 3 – June 7th to June 13th

3D models plotted in the 2D plane and complete Hand Models (using Metacarpal, distal, inter-phalangeal,...) showed to be very complex and not suitable for the Multi-Touch context due to the lack of some information and the frame rate were the application performs and also as many hands may appear in the “search window”. It is important to emphasize that after a long and careful look in all the found techniques , AAM[1] was chosen due to very technical reasons, and mainly because it satisfies all the requirements we were seeking in the Week 1.

Week 4 – June 14th to June 20th

Made the first AAM training for the old videos from our setup at the University and from some extracted parts from the few videos that I could get from Seth to work on. As most of the demo ones from the CCV are mostly “blob related” and do not have many useful hand characteristics on them. Even with those restrictions the “Appearance” trained showed a reasonable behavior when applied to the test images.

Week 5 – June 21st to June 27th

Presented a paper at conference in Germany related to the work being developed in the GSOC. Got some insightful ideas/feedbacks from there, that were very important to the quality of the future work in the project. Had also a meeting with my mentor in which could get the videos in a way more near to what I was needing to conclude the project.

Week 6 – June 28th to July 04th

Problems in the computer, flight delays , train delays, “time difference” problems, participation in the Robocup with my team were some of the aspects that made of this week not very productive on the GSOC field, and I could not finish the implementations I was wanting to show before the GSOC mid-term deadline.

Week 7 – July 05th to July 11th

More flight delays, no sleep at some days. Had until the July 06th to finish all the demands for the mid-term. Then, it was extended to the July 11th. Managed to make a quite impressive training on Laurence's Video setup, and the AAM model is handling very well occlusion, scale and rotation. Started to make some screen casts for publicity on results from the work being developed for the GSOC and also to document the past/actual and future work.

MID-TERM EVALUATION DEADLINE

if approved...

Week 8 - July 12th to July 18th

Time to analyze the progress , to organize ideas, set priorities/requirements/schedule and guidelines with the Mentor, to receive suggestions and to take a deep breath for working hard

in the final period.

VACATIONS

Universities tests/semester ends July 20th , so some weeks with full-time(24h) for GSOC :)

Week 9 – July 19th to July 25th

Finish the algorithm. Code Writing to implement in a way to integrate with the CCV².

Week 10 – July 26th to August 1st

Finish the code writing of the “algorithm” in “CCV-style”.

Week 11 – August 2nd to August 8th

Insert the module into the CCV.

SUGGESTED PENCILS DOWN

Week 12 – August 9th to August 15th

Check problems/bugs. Make adjustments. Discuss with mentor the final steps.

FIRM PENCILS DOWN

FINAL EVALUATION

Week 15 – August 30th to September 3rd

Code Submission to Google.

Additional Information

[1] AAM : Active Appearance Model

Definition(taken from the Wikipedia)

An **active appearance model (AAM)** is a computer vision algorithm for matching a statistical model of object shape and appearance to a new image. They are built during a training phase. A set of images together with coordinates of landmarks, that appear in all of the images is provided by the training supervisor.

The approach is widely used for matching and tracking faces and for medical image interpretation.

The algorithm uses the difference between the current estimate of appearance and the target image to drive an optimization process. By taking advantage of the least squares techniques, it can match to new images very swiftly. It is related to the active shape model.

History

AAM was first proposed by Dr. G.J. Edwards, University of Manchester. It's closely related to Tim Cootes' ASM (Active Shape Model), namely, smart snakes, and Andrew Blake's ACM (Active Contour Model), namely, snakes. In 2004, Dr. Simon Baker and Dr. Ian Matthews developed a fantastic solution to AAM based on inverse compositional image alignment.

More information is provided also at http://www2.imm.dtu.dk/~aam/tracking/.

[2] Code Integration with the CCV

Requirements

1. User selection whether to use or not the Hand-Tracking.
2. Provide the information in the TUIO string
3. On-screen visualization of the tracking as occurs with the Blobs currently.

Implementation

1. More detailed training is going to be done according to more data collected from setups.
2. Coded using OpenCV and other common libraries, no problem for CCV with that.
3. The model is going to be stored in the CCV folder, so it is going to be called by the

application when necessary.

4. The search/fitting is going to be restricted to ROI(Regions of Interest) with movement.
5. The “application” code is mainly going to be added to the additional module that was implemented in the OpenFrameworks directory structure provided in the CCV repository.
6. The “algorithm” does not create any restriction/drawback to the real-time behavior of the CCV as extensive description on the academic literature proves that it can run fast enough for the current/future envisioned purposes.