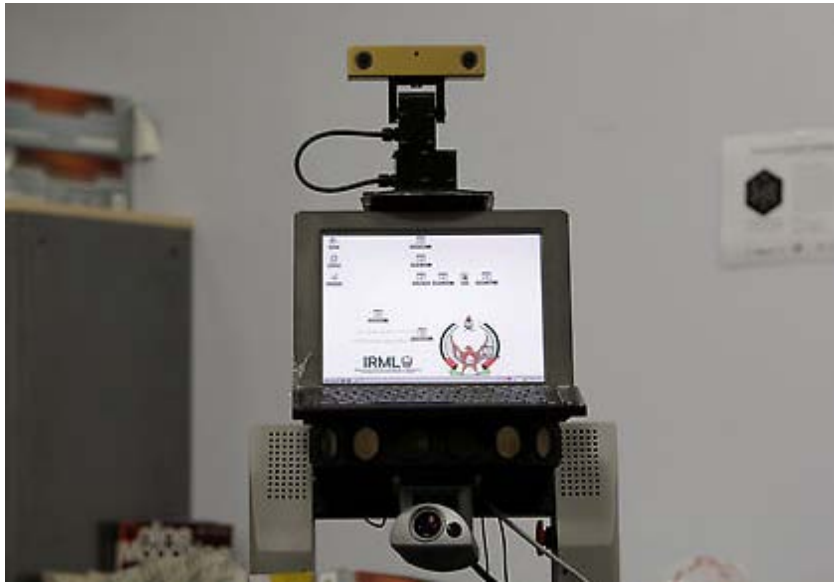
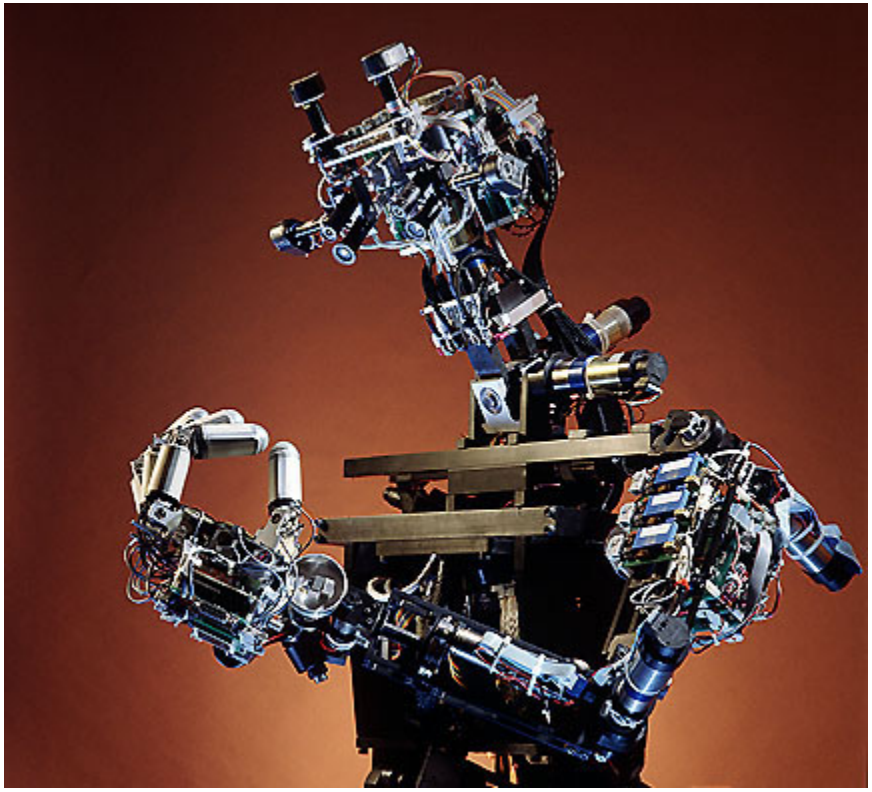
Vision System Enhancements:
Object Recognition Feature





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IRML
Interactive Robots and Media Laboratory
Where Robots, Humans, and Virtual Characters Live Together!

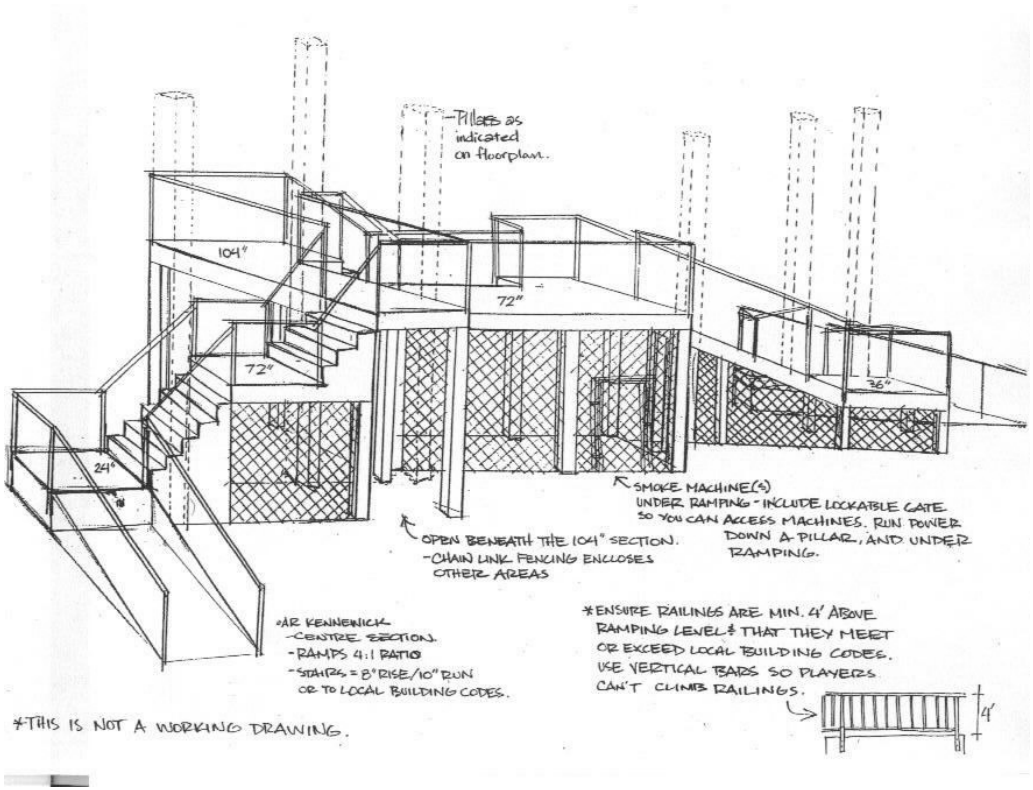
Agenda:

1. Milestones
2. Milestone 1: Integrate an Object Recognition project into Facebot
    1. Introduction
    2. Schedule
    3. Architecture
    4. Matlab Project
    5. FaceRec Project
    6. Case Tests
    7. Problems detected
    8. Proposals to improve the solution
    9. Conclusions
    10. Demo
3. Milestone 2: Integrate Face API into Facebot
    1. Introduction
4. Techniques/ Technologies that the team have learnt

Milestones:

The milestones designed for the team are the following:

ID	ALIAS	MILESTONE	DESCRIPTION
1	VSG1	Integrate new system to recognize objects	It is necessary to add new features into vision subsystem with using a Matlab project
2	VSG2	Test FaceAPI	It is necessary to test FaceAPI with a simple example
3	VSG3	Active Sensing for Face recording	Controlling PT of camera to acquire minimum number of faces with max. Variety of features
4	VSG4	Publising photos	Publish photos of person interacting with Sarah on Facebook in addition to status update

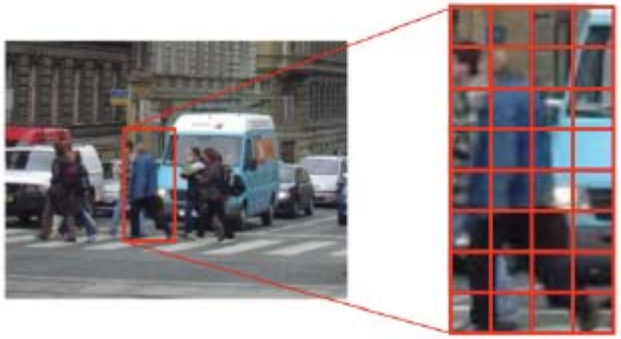


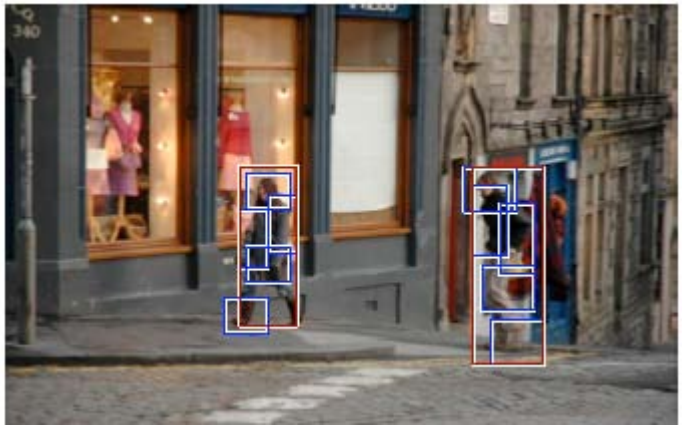
Milestone 1: Integrate Object recognition feature into Facebot

Introduction:

Using the technique: “Discriminatively Trained Deformable Part Models” [1] is possible recognize a number of objects from any picture. This is an implementation of a object detection system based on mixtures of multiscale deformable part models. The solution was developed in Matlab [2].

The Goal is to integrate the Matlab implementation into the Facebot project (C++).





[1] http://people.cs.uchicago.edu/~pff/latent/
[2] http://www.mathworks.com/

Milestone 1: Integrate Object recognition feature into Facebot

Schedule:

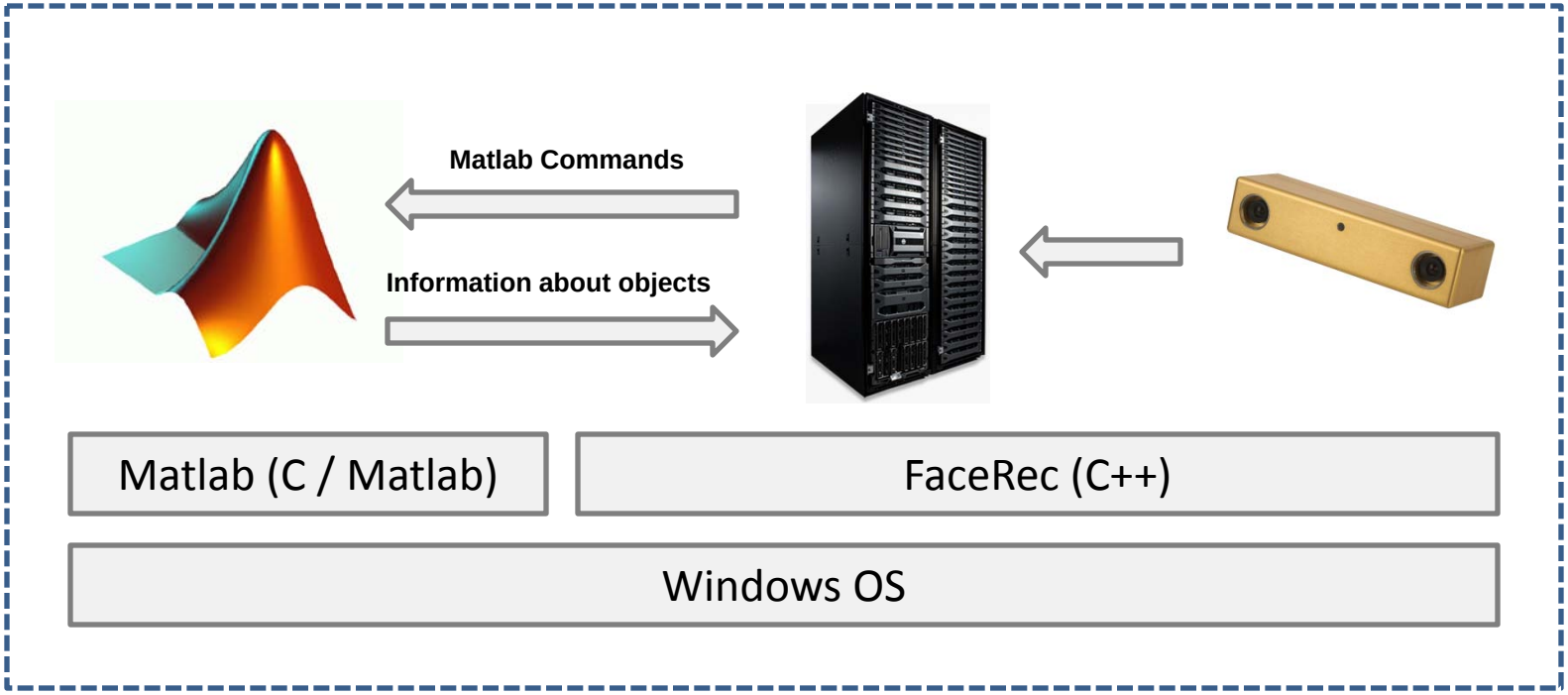
Time management was the following:

1. Week 1: (12/7-16/7)
    1. Understanding the current state of FaceRec environment (12/7)
    2. Test Matlab Project in Windows & Linux (13/7)
        1. Recode some codes to compile in Windows (14/7)
    3. Develop a sample to integrate Matlab into C++ (16/7)
    4. Analyze the models trained to recognize objects (16/7)
2. Week 2: (19/7-23/7)
    1. Design a general solution to integrate output from Matlab into C++ (19/7)
    2. Debug the solution (21/7)
    3. Integrate solution into FaceRec(23/7)
3. Week 3: (26/7-30/7)
    1. Develop ICE Method for object recognition (27/07)
    2. Testing & Debugging (28/7)
    3. Technical documentation (28/7)

Milestone 1: Integrate Object recognition feature into FaceRec

Architecture:

The architecture used to achieve the milestone is the following:



Milestone 1: Integrate Object recognition feature into Facebot

Matlab project:

To run the Matlab project was necessary to compile some non standard C code. The project was developed and tested for Mac OS / GNU Linux by the authors.

Challenges in this side:

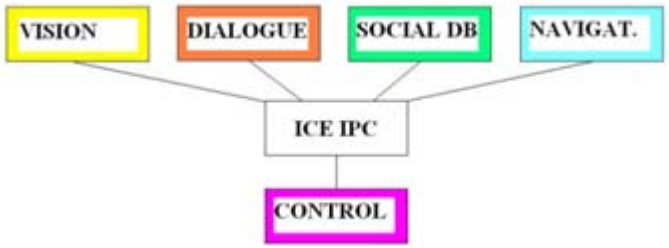
1. Recode original C code to run in Windows System
2. Integrate Matlab engine with C++
3. Learn how to send Matlab commands
4. Learn how to receive and process information from Matlab engine

Milestone 1: Integrate Object recognition feature into Facebot

FaceRec project:

FaceBot is composed of the following components:

1. **Vision**
2. Dialogue
3. Social DB
4. Navigation
5. Control



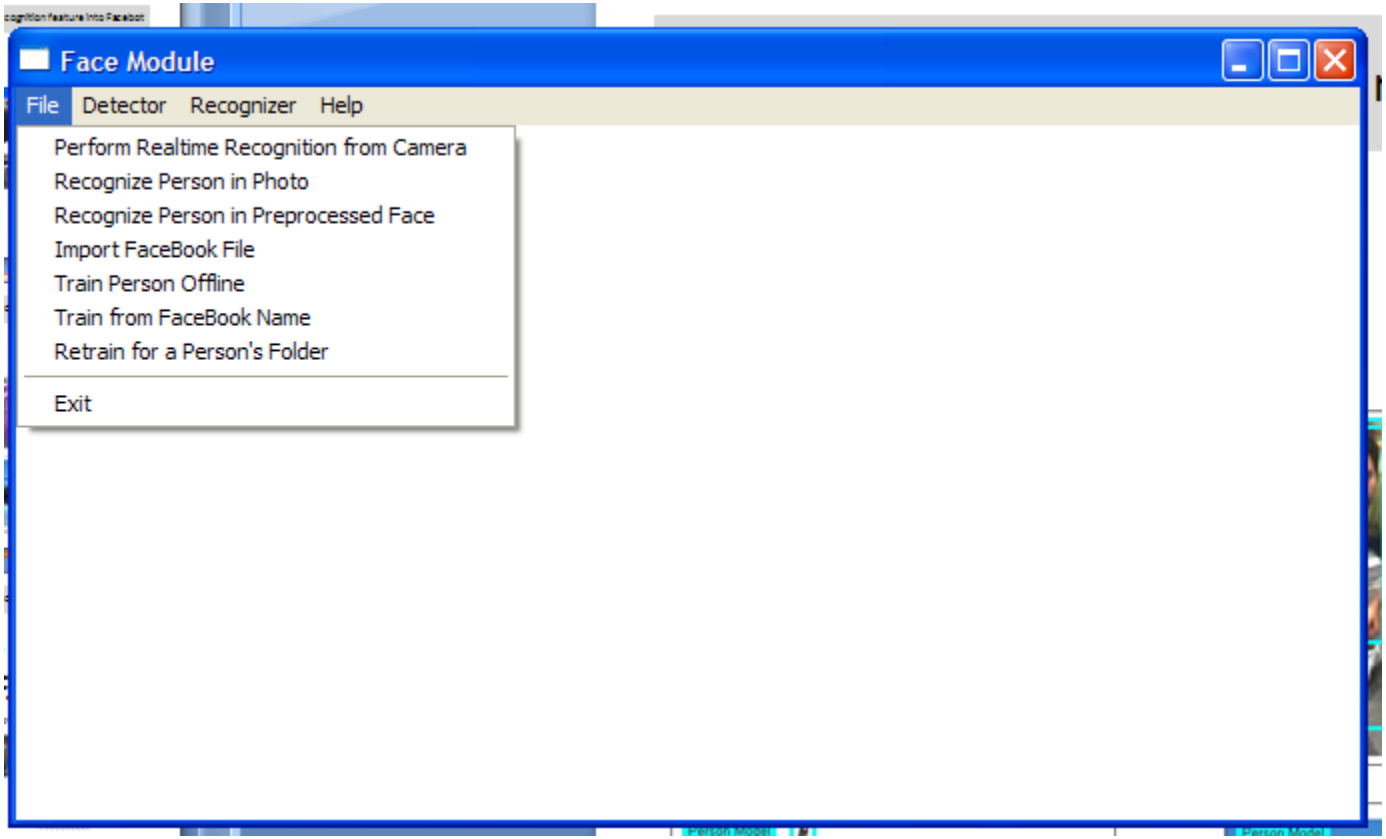
Challenges in this side:

1. Integrate Matlab Project into FaceRec
2. ICE Support

Milestone 1: Integrate Object recognition feature into Facebot

Previous release:

The previous release had the following options:



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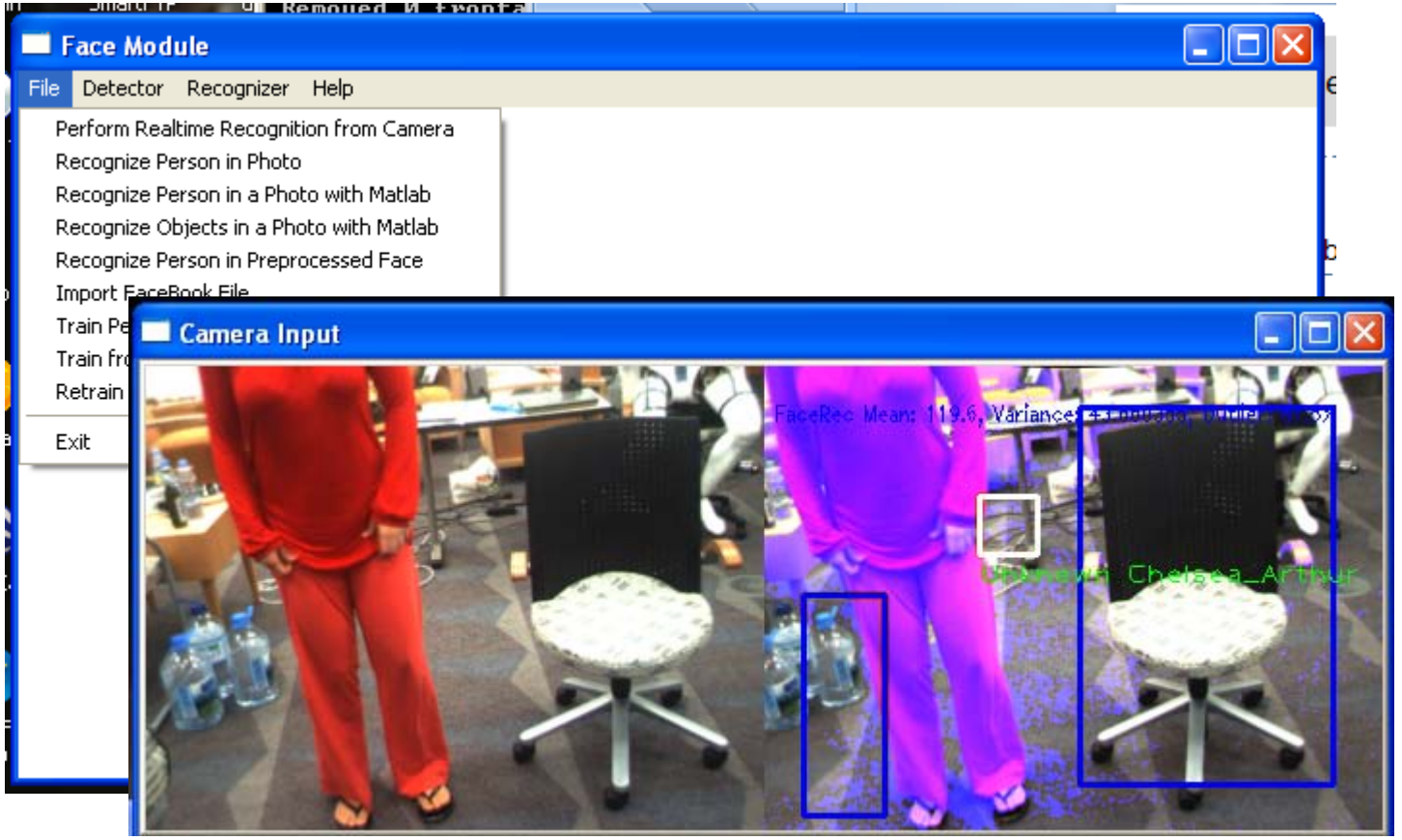
Case tests:

I have tested the following models:

1. Person
2. Chair
3. Bottle
4. Bike
5. Car
6. Bus
7. Plane



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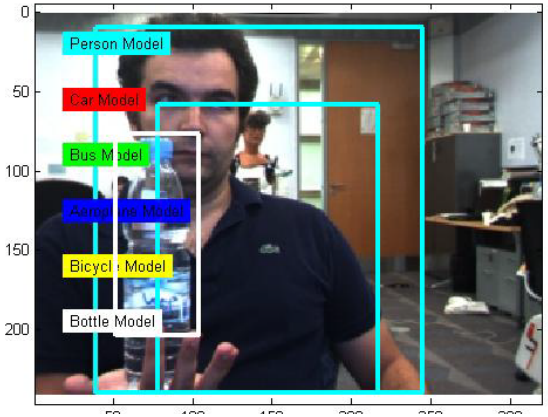
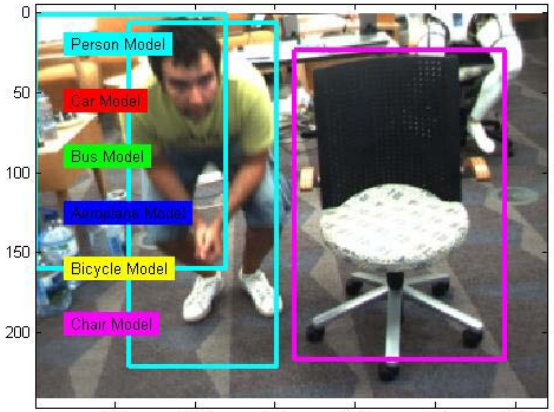
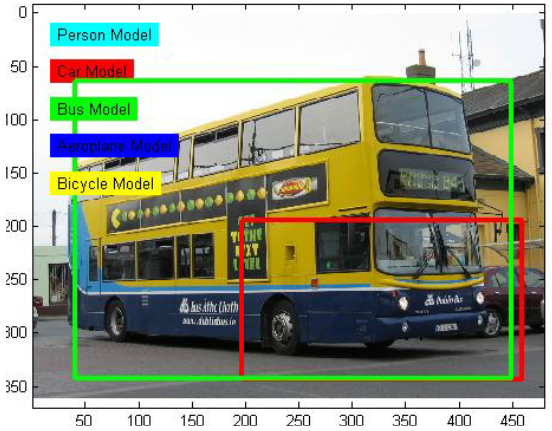
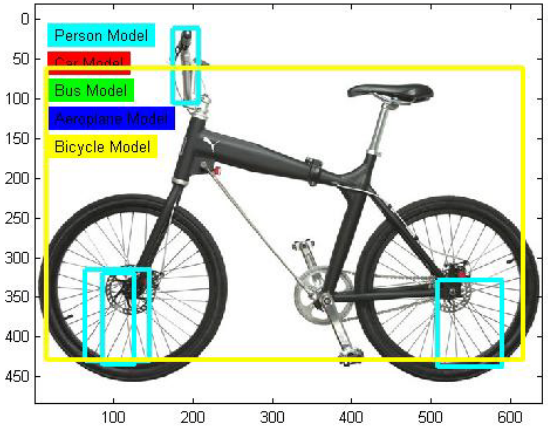
Case tests:

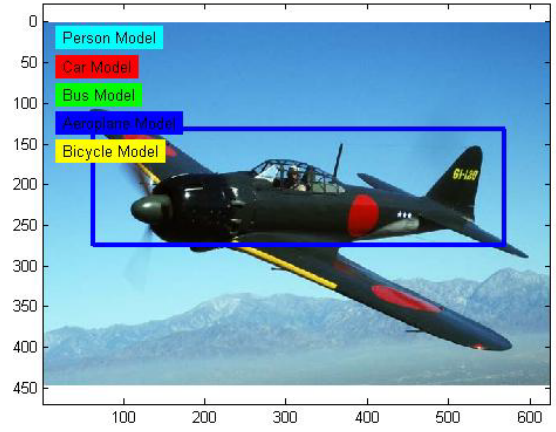
Some results:

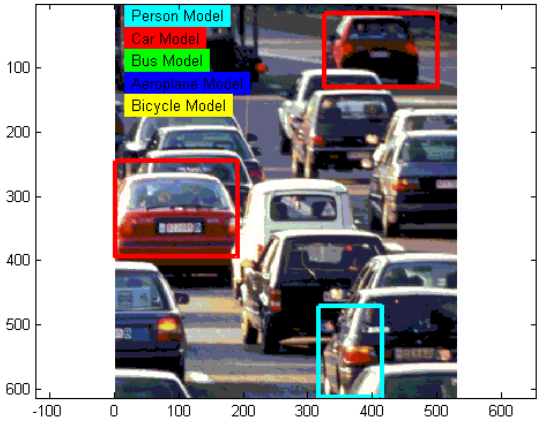










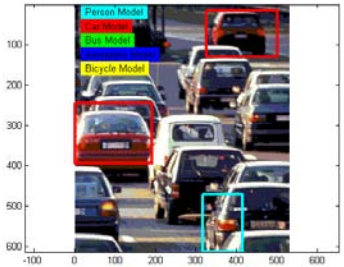


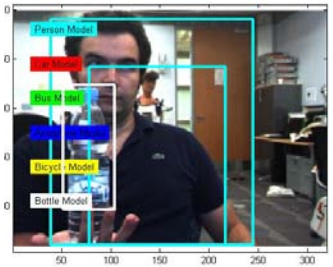
Milestone 1: Integrate Object recognition feature into Facebot

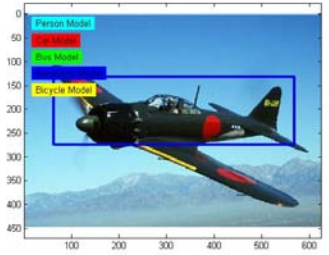
Problems detected:

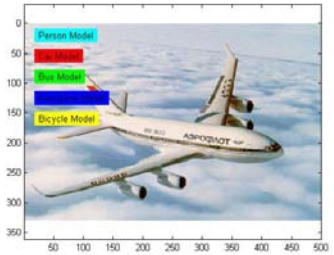
In the project, I have detected the following problems in the system to recognize objetcs:

1. Some Models for example Person Model run nice in many scenarios, but in some cases, the model detect false persons.
2. Some Models need to have the object closed to the camera to be detected. For example with the bottle detection
3. Some Models are not trained with many models. Example: Plane model.









Milestone 1: Integrate Object recognition feature into Facebot

Proposals to improve the system:

Some ideas to improve the system:

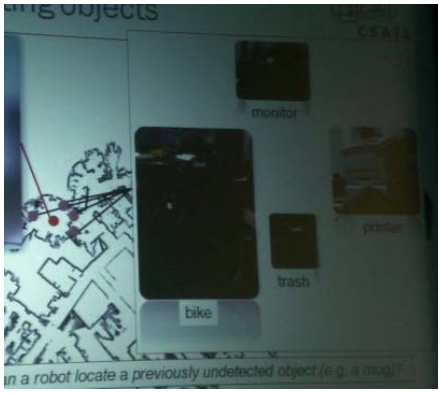
1. Learn and improve the training for some models
2. Migrate code from Matlab to Java/C++
3. Develop a project which include context problem.
4. Develop a system that detect Unknown object in a context.
5. Integrate a user interface using Speech Recognition to teach objects.
    1. http://www.youtube.com/watch?v=P9ByGQGiVMg
6. Train models using Web Services from popular CDN or Large Websites:
    1. Flirck, Picassa, Google Images, MSN Images or Facebook
7. Use Grid Computing platform (7.8 Teraflops per second) from the building to improve time performance

Milestone 1: Integrate Object recognition feature into Facebot

Conclusions:

My conclusions about the project are:

1. The system to recognize is good, some models are trained better than others.
2. Person model is nice as a complement for current Facebot system.
3. The number of objects is small.
4. The performance of the system decrease if the system tries to recognize many objects, so it is necessary to add a context system to discriminate the number of objects.
5. Currently the system is available for Real Time systems



Milestone 1: Integrate Object recognition feature into Facebot

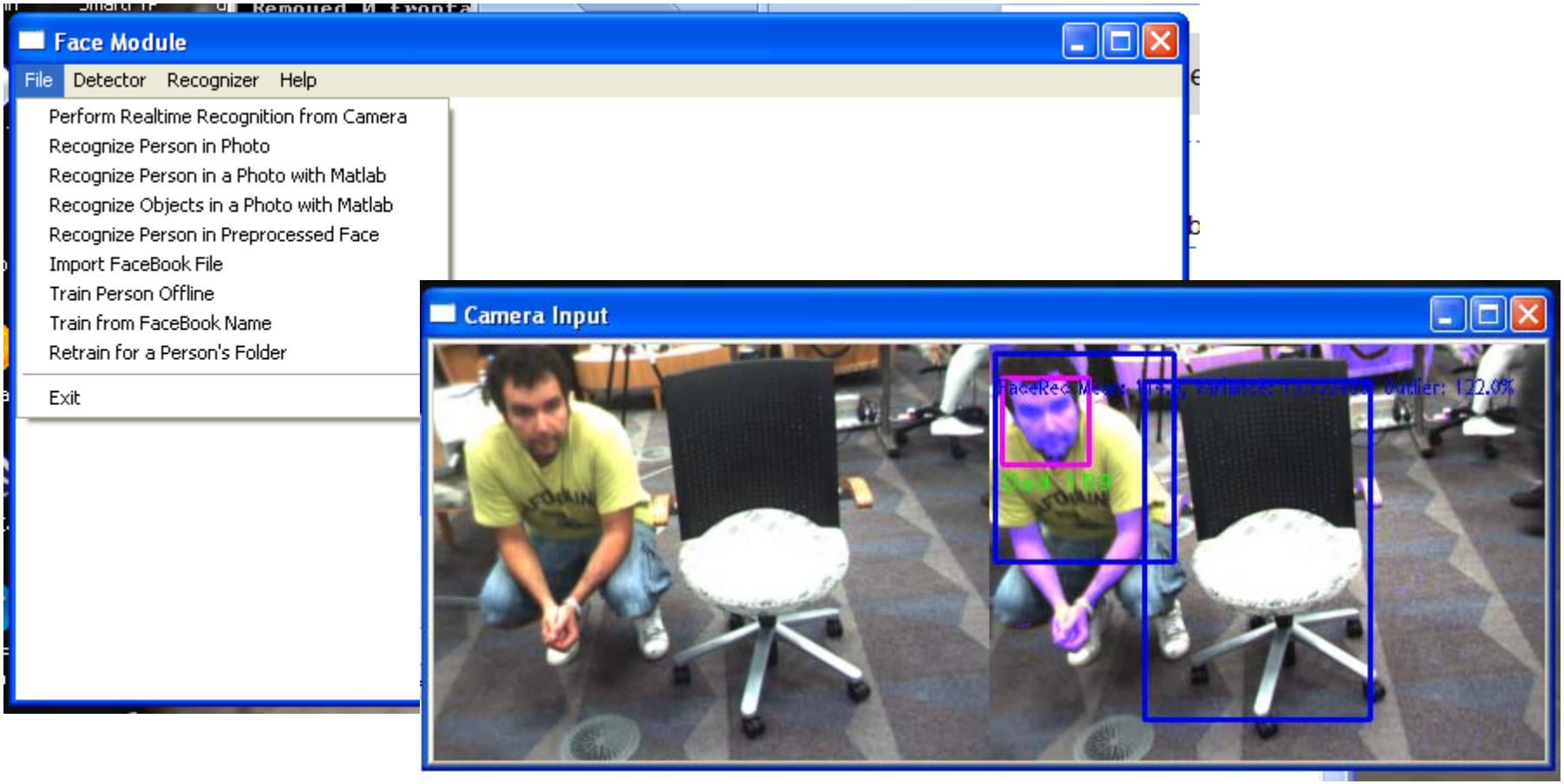
Demo:

1. Recognize objects using a bumblebee2 camera
    1. Using the models: person, chair & bottle
2. Recognize person objects from a picture
3. Recognize objects using the following models: Person, Car, Bus, Plane, Bicycle, Chair & Bottle
4. Call a ICE Function which recognize person objects from a picture

Milestone 1: Integrate Object recognition feature into Facebot

Demo:

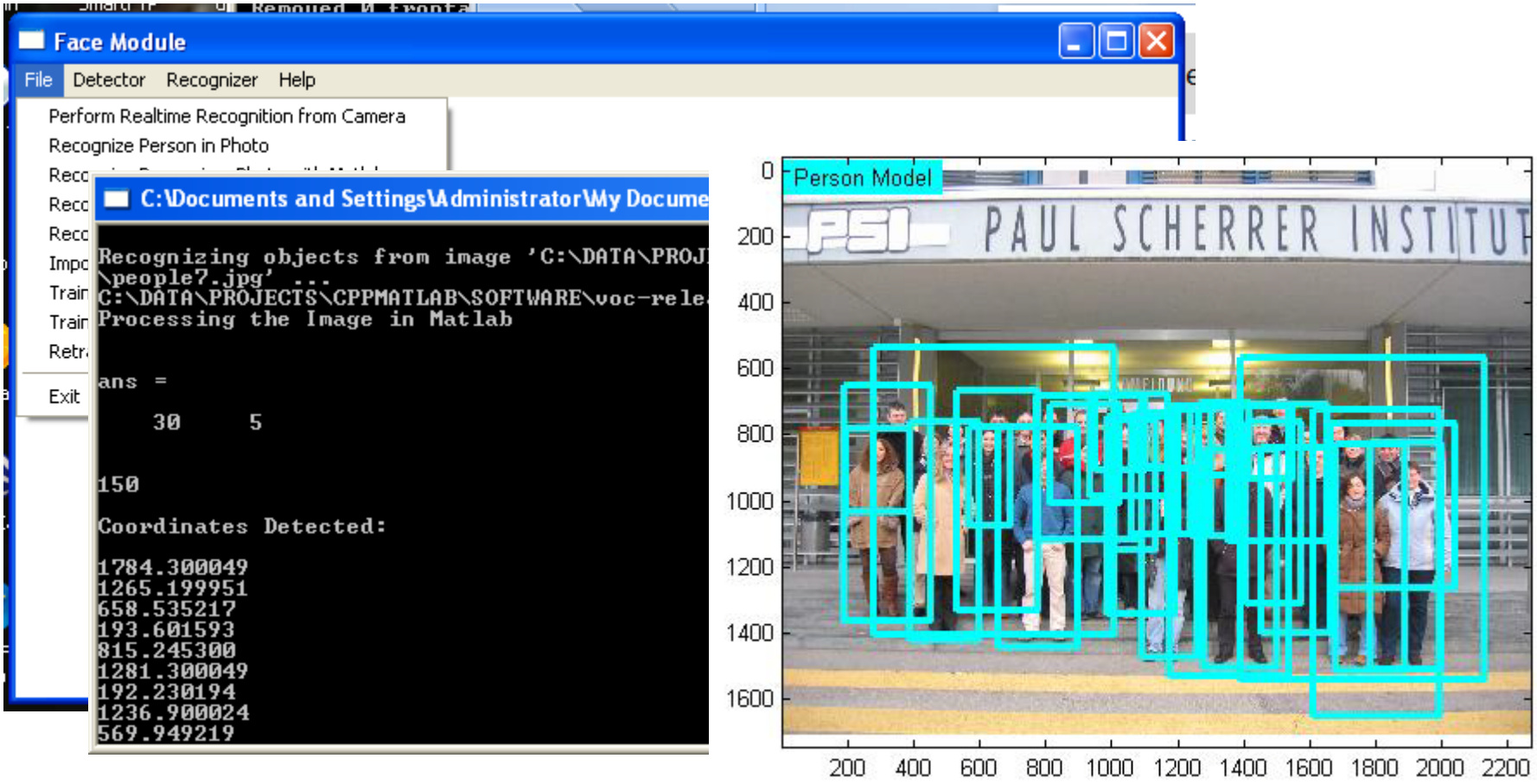
Recognize objects using a bumblebee2 camera:



Milestone 1: Integrate Object recognition feature into Facebot

Demo:

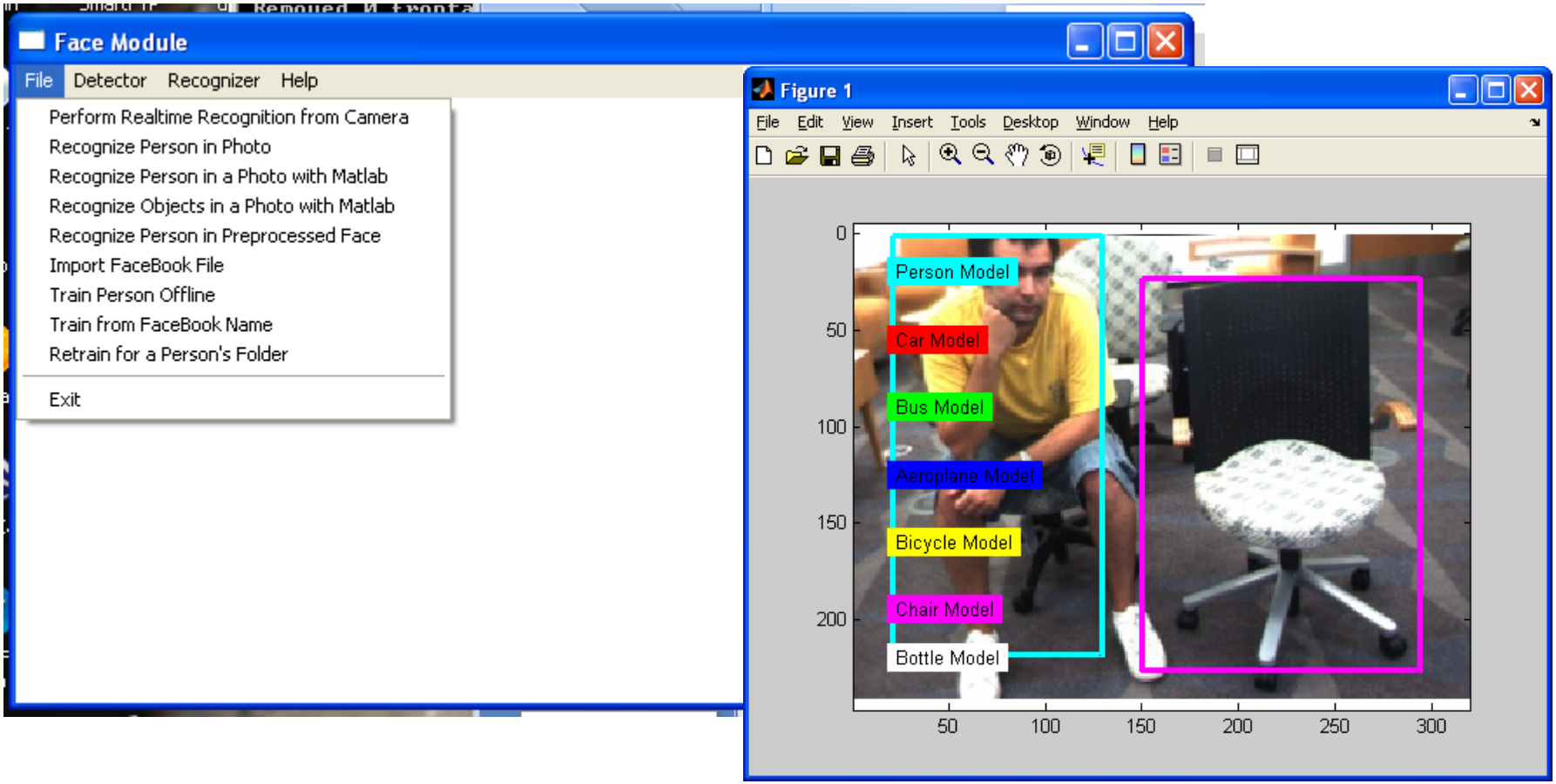
Recognize person objects from a picture:



Milestone 1: Integrate Object recognition feature into Facebot

Demo:

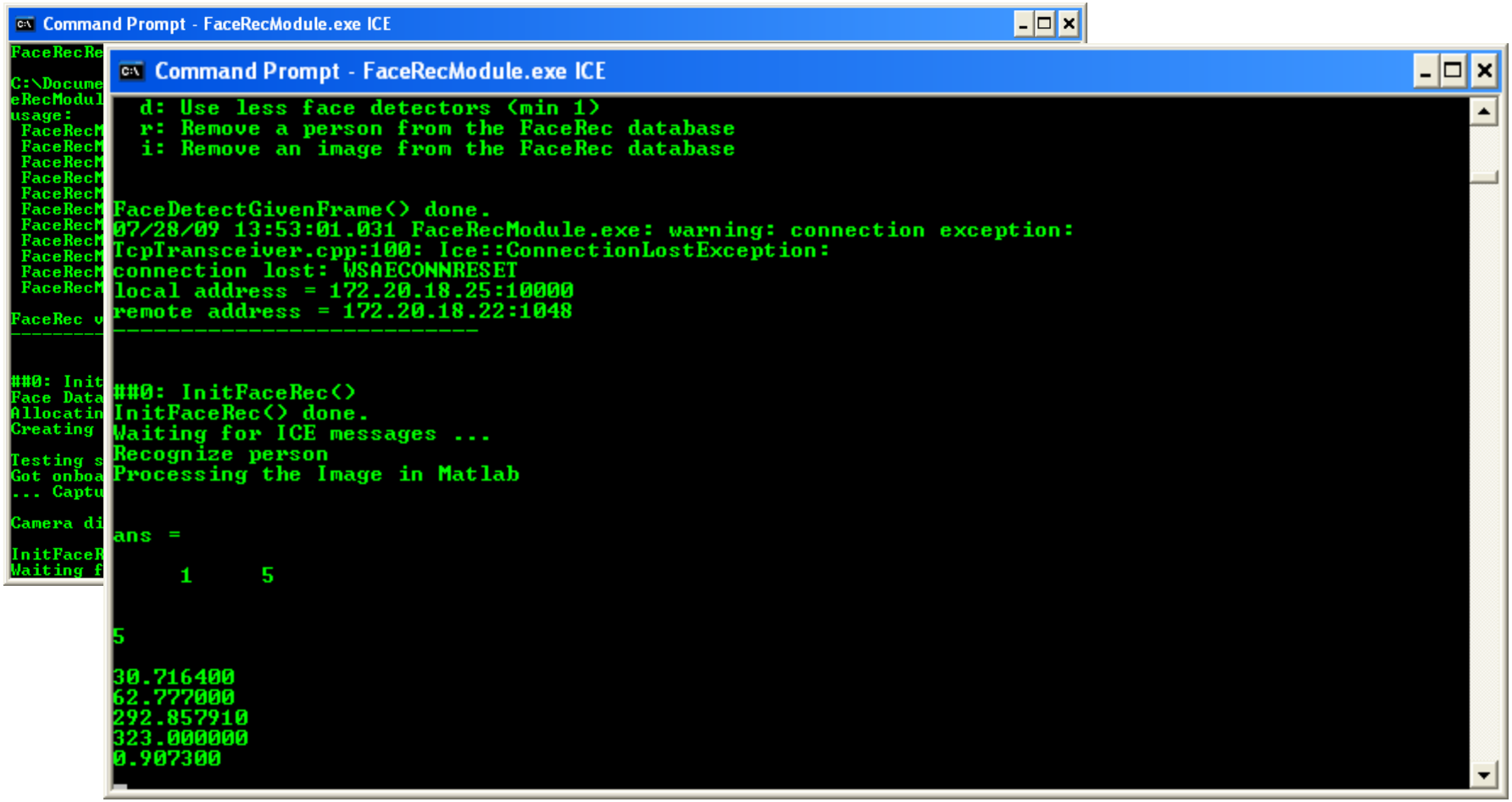
Recognize person objects from a picture:



Milestone 1: Integrate Object recognition feature into Facebot

Demo:

Call a ICE Function which recognize person objects from a picture

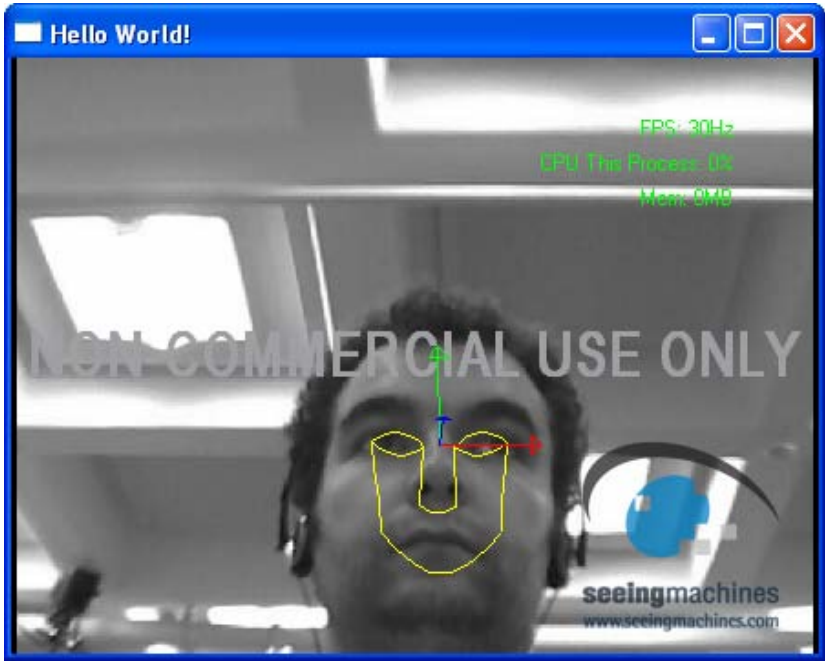


Milestone 2: Integrate Face API into Facebot

Introduction:

Face API is new system to detect faces and facial expression with Low Power CPU.

In this part, I couldn't create a mini example using OpenCV and FaceAPI due to the current license (non commercial) doesn't allow to use an external image data from other sources, for example OpenCV.



faceAPI

Techniques/ Technologies that the team have learnt

In the Summer Camp in IRML, UAE, we have learnt:

1. Milestone 1:
    1. Compile Large C++ project on MS Visual Studio 2008
    2. Add new features in Large C++ projects
    3. Matlab Engine:
        1. How to use Matlab from C++
        2. How to send commands to Matlab
        3. How to receive information from Matlab
    4. OpenCV:
        1. How to use bumblebee2 with OpenCV
        2. How to draw objects in a OpenCV Window
    5. ICE Technology:
        1. Update ICE Slides
        2. Add new features
        3. Test remotely new ICE features
        4. Learn how to use ICE with Java & C++
2. Milestone 2:
    1. Face API:
        1. How to run a simple example with Face API