Easy_Video_Trainer

For CogniMem
IR and EB boards

Version 1.6

Distributed by Recognetics

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Introduction

The Easy_Video_Trainer is a very simple interface designed to visualize the live images acquired with the CM-IR board or the CM-EB board connected to a video sensor, to teach the neurons of the CogniMem chip and verify that its recognition engine works accurately. The application can save the knowledge file to disk and to the Flash memory of the board.

Since the recognition is executed by the hardware, the Easy_Video_Trainer can be closed and opened at any time to monitor the recognition on screen, teach more examples, etc. If the board is not using the USB power supply, but its own external power supply, the USB can also be disconnected and reconnected at any time. If the knowledge is saved to the Flash memory of the board, the later can resume recognition autonomously at power up.

What can I do with Easy_Video_Trainer?

Specifications

- View the live video images to adjust the positioning of the board
- Adjust the sensor settings to obtain the best image quality
- Define the region of interest to monitor
- Teach up to 7 categories of objects
- Activate the output lines of the board
- Save the knowledge you have built by teaching examples

Applications:

- High-speed inspection of objects, as a whole or as a part, appearing at a known location in the field of view
- Video monitoring of a fixed region in which discrete objects appear such as a face, a vehicle, etc.

Limitations:

- Discrimination of 7 categories of objects with the same size
- Single region of interest
- Limited adaptivity to change of scale and orientation
- Limited adaptivity to change of intensity

Easy_Video_Trainer is very simple and easy to use, but does not show the full potential of the CogniMem technology to address image recognition problems. For serious applications, it is highly recommended to build and validate your recognition engine using more sophisticated applications such as the Image Knowledge Builder (IKB) Suite of products from General Vision. For your convenience, the IKB Express is distributed by Recognetics free of charge with the board.

Installation

- Connect the CM-IR or CM-EB to the USB plug of your PC
- If you are using CM-IR or a CM-EB connected to a Micron MT9V022, you can launch the program immediately, otherwise you must first proceed as follow:
- Launch the CM-EB Diagnostics utility
- Edit the resolution of your sensor and click the Test Sensor button
- Quit the application if the video frame appears correctly
- Copy the sensor_data.ini file created by the Diagnostics utility to the Easy_Video_Trainer folder
- Launch Easy_Video_Trainer

What is new?

- The program does not initialize a new project at start up, but restores the knowledge residing on the CogniMem chip.
- The QuickLearn menu is limited to 7 categories plus an “Unknown” category. The teaching can be tuned from liberal, to moderate, to conservative.
- The Output Settings panel offers 4 options: None, Binary, Decimal and 7-segment. The last output is intended for use with the reference design of the EB_IO board supplied on the CD.
- At program close, the recognition engine of the board is stopped if the output settings is set to None.

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Getting started

At program launch, the knowledge residing on the CogniMem chip is retrieved. If you just powered-up the board, this knowledge is restored from the Flash memory to the CogniMem chip. The live video appears in a window with the outline of the region of interest (ROI). The ROI represents the area to learn and/or recognize and its coordinates are reported in the status bar. As soon as a knowledge resides in the neurons of the CogniMem chip, the program continuously reports the result of the recognition made on the board. The settings of the sensor can be modified and several output formats can be transmitted to the IO lines of the board.

When satisfied with the accuracy of a recognition, the entire project (settings and knowledge) can be saved to disk in a project file or to the Flash memory of the board. This last operation ensures that the board can resume recognition at its next power-up without any need for a computer!

1) name your categories of objects

Seven categories of objects can be taught. Their default names are Category 1, Category 2, etc. The names can be changed by clicking at the corresponding button while pressing down the right mouse button. An Edit box is prompted and a new name can be edited.

The first button is reserved for the “Unknown” or null category.

Examples of categories for a part inspection application:

- Good (category 1)

- Acceptable (category 1)
- Recyclable (category 2)

- Grade A (category 1)
- Grade B (category 2)
- Grade C (category 3)

Examples of categories for a traffic monitoring application:

- Car (category 1)
- Truck (category 2)
- Van (category 3)

2) define the region of Interest

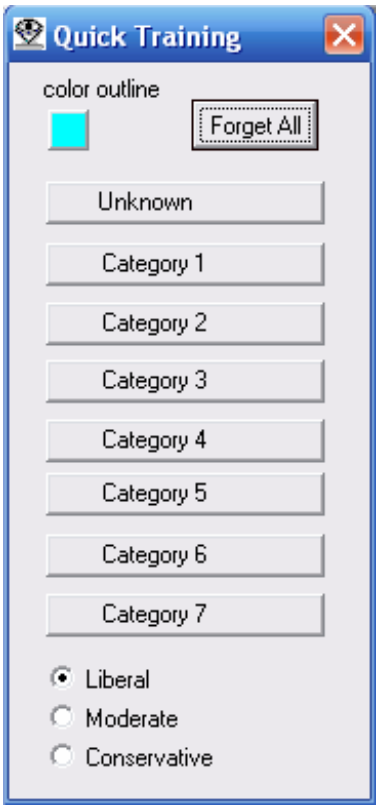
The size and position of the ROI is easily edited on screen using the mouse cursor (left mouse click moves the region, right mouse click resizes the region).

The region of interest should be defined as the smallest rectangle including the objects to recognize. Note that it does not need to necessarily include the entire object, but can be limited to the portion showing its discriminating features. The only constraint for a given project is to keep the same aspect ratio for the ROI at all time.

In the example to the left, the region of interest contains the entire bottle cap. However, if the purpose of the inspection is to detect that a cap is present and the filling level is correct, a thinner and longer vertical rectangle would be appropriate.

Teaching

To teach an example, move the **ROI** over a relevant location and click at a corresponding category button. Examples can be picked up at different locations in different images.



As soon as one example is taught, the board starts recognizing the region of interest in real-time. The recognized category is reported in the image window.

At first, the engine will classify all images as belonging to the one and only known category. If the image content looks really different from the learned example, the response can be “Unknown”. This will continue until a second and more categories are taught. The more teaching, the better the discrimination between different categories of objects.

Click **Forget All** to clear the entire knowledge and start a learning session from scratch.

Remember that teaching an incorrect example can corrupt an entire knowledge, so back up can be important. The knowledge can be saved at any time during a learning session using the **File/Save project** menu. It is a good idea to do so regularly naming the project file with an incremental index as the number of neurons increases.

Three tendancies of teaching are available: **Liberal, Moderate and Conversative**.

Liberal	Learn the example inside the region of interest. This method uses the most the generalization capabilities of the neurons.
Moderate	Learn the example inside the region of interest, plus an “unknown” example selected automatically at one block length from the center of the region.
Conservative	Learn the example inside the region of interest, plus an “unknown” example selected automatically at 2 pixels from the center of the region.

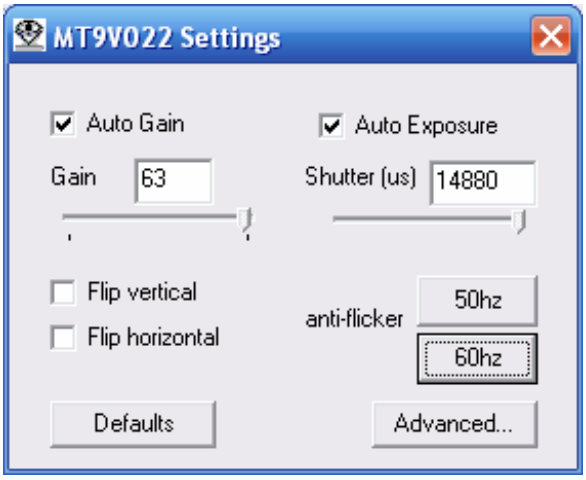
Counter examples can always be selected and taught manually by teaching the “Unknown” or Category 0 manually.

Sensor Settings

Changes made to the video settings can be observed immediately on the screen.

Case of the Micron MT9V022

If the sensor is a Micron MT9V022, the panel lets' you modify the following settings:



Gain is the sensor analog gain. It ranges between 16 and 64.

Shutter is the total integration time of the sensor in number of rows.

The **Auto-Gain** and **Auto-Exposure** options adjust the gain and exposure time of the sensor automatically in order to maintain the best intensity dynamic and contrast when the ambiant light varies. Auto Gain and Auto Exposure are turned on by default.

The 50Hz and 60Hz **anti-flicker** buttons set the shutter speed to a value limiting the flickering effects of a fluorescent light powered with a 50 or 60 hertz power supply.

Flip vertical and **Flip horizontal** change the readout order of the lines and columns of the CMOS sensor. These options are convenient to retrieve images showing objects always in the proper orientation independently from the orientation of the CM-IR.

Clicking the **Advanced** button prompts the universal I2C sensor controller applicable to Other sensors (see next paragraph).

Other sensors

This control panel is a simple Read/Write interface sending the I2C serial commands described in the CM-IR and CM-EB board manual (i.e. an 7 bit register and 16-bit data). Provided that you know the slave address and the registers of the sensor, this interface lets you change the values to the sensor's registers and observe modifications in the live video images. The I2C registers usually include the gain, shutter speed, binning options, triggering options, and more. Refer to the documentation of your sensor for details.

Output Settings

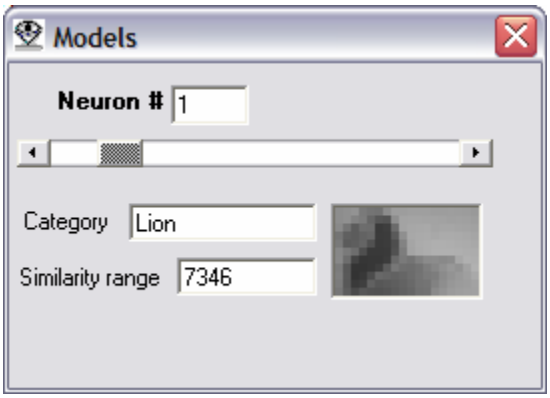
Four options are available to transmit the category recognized by the real-time recognition engine of the CogniMem chip (i.e. FEATCAT register) to the 8 output lines of the board.

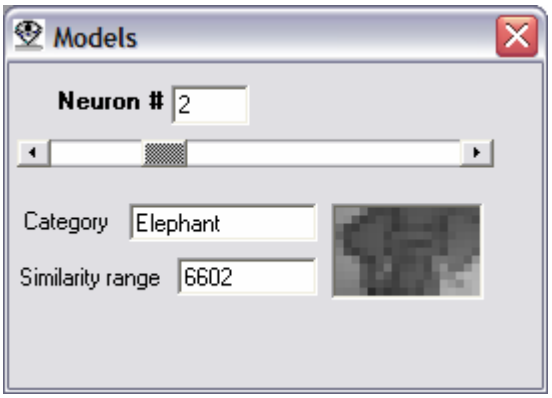
None	The output is disabled and the 8 IO lines are pulledup.
Decimal	The lower byte of the category value is transmitted as is
Binary	The lower 3-bits of the category value (bbb) are encoded into an 8-bit binary format (2 ^bbb)
7-segment	The lower byte of the category value is encoded for display on a 7 segment LED (refer to the EB-IO board reference design for more information)

View Knowledge

The View Neurons menu allows to review the contents of the neurons, the pattern they hold, their category and more. This utility can be helpful to understand why some erroneous or uncertain classifications occur. It can also point to examples which are irrelevant because showing too much background.

The content of a neuron comprises a reference pattern, a category and a similarity range. The reference pattern is displayed in a format proportional to the region of interest.





In the illustrations above, the first neuron describes the Lion. If the signature of a region of interest (ROI) looks similar to this “iconic” representation of the lion and the distance between the two patterns is less than the similarity range of 7346, Neuron #1 fires and reports the category of the ROI as being Lion. Neuron #2 will perform the same comparison and report the category “Elephant” if the difference between its reference patterns and the ROI is less than 6602. In the event that both Neuron #1 and #2 fires at the same time, the classification is uncertain. Looking at the reference patterns stored in the neurons can reveal the lack of examples showing discriminant features, or the abundance of examples which are too similar.

Image Collection

The CogniMem neural network has very good generalization capabilities and is also very adaptive. It is best taught by showing as many examples as possible, representative of the variety of products and conditions encountered in an application.

When applicable, it is a good idea to collect images per type of objects to recognize and store them into corresponding folders. Examples can also be organized per type of working conditions they represent such as lighting conditions, cases of known and/or unknown background, ranges of scale, ranges of angular positions, etc. The resulting images can be used to build and validate recognition engine with more sophisticated application such as the Easy_Image_Trainer and Image Knowledge Builder.

Project Management

The File menu allows to save project to disk on a file called CogniMem Knowledge File (*.ckf), or to the Flash memory of the board.

An CogniMem Knowledge file includes all the necessary information to resume the current recognition:

- Sensor settings,
- Definition of the region of interest
- Knowledge or the contents of the neurons
- Names of the categories

Board interface

The commands initiated from the Easy_Video_Trainer are transmitted to the board for execution by the FPGA or the CogniMem chip depending on the selected register. As a result, the application cannot run without the board.

When the application is closed, the real-time recognition executed on the board remains active unless you have set the output settings to None. This means that the board continues recognizing the video images. Furthermore, if the board is powered through an external power supply, the USB cable can be plugged and unplugged without impact on the recognition executed on the board. The only requirement is to have the USB connected when the Easy_Video_Trainer is started.