2. IMAQ PCI 1411 Image Acquisition Board

2.1 Introduction

IMAQ PCI 1411 is a color or monochrome frame grabber board, highly flexible, that supports a diverse range of cameras. It acquires images in real time and can store these images in the on-board frame memory or transfer these images directly to the system memory.

The **IMAQ PCI 1411** ships with NI-IMAQ, the National Instruments complete IMAQ driver software you can use to directly control the PCI – 1411. You can use your applications without having to program the board at registry level.

The device supports NTSC and PAL color standards as well as the RS-170 and CCIR monochrome standards. The 1411 also provides one external I/O line that you can use as a trigger or as a digital input/output line.

2.2 Functional Overview

The PCI – 1411 features a flexible, high-speed data path optimized for the acquisition and formatting of video data from analog monochrome and color cameras.

The block diagram in Figure 2.1 IMAQ PCI – 1411 block diagram illustrates the key functional components of the PCI – 1411.

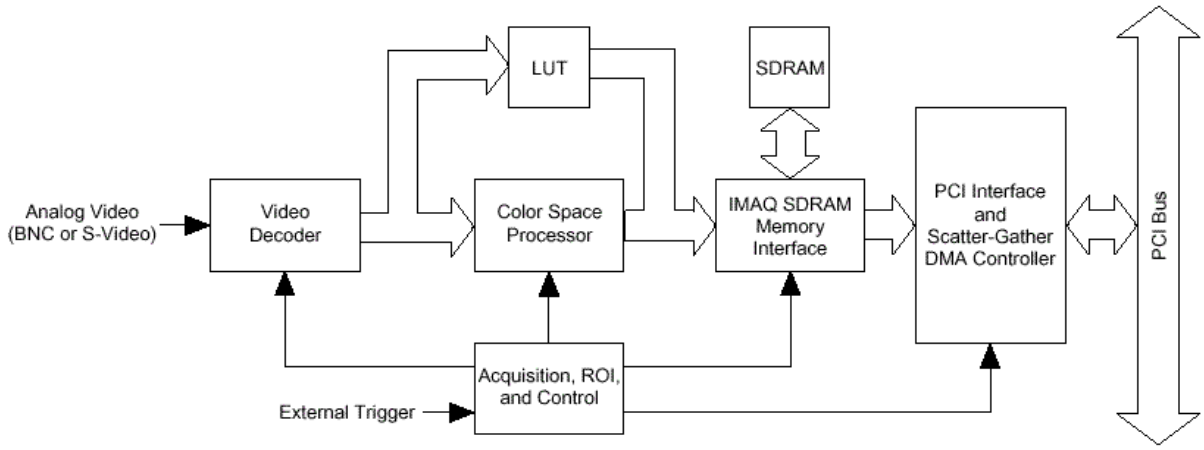


Figure 2.1 IMAQ PCI – 1411 block diagram

VIDEO DECODER

The PCI – 1411 supports NTSC and Pal video standards in either composite or S-Video format. The onboard video decoder converts the incoming video signal to Red, Green and Blue (RGB) data and passes this data to the color-space processor for further processing.

The video decoder also allows you to control various parameters to optimize an acquisition. You can independently adjust parameters such as analog input range, brightness, contrast, saturation, or frequency range.

COLOR-SPACE PROCESSOR AND LUTS

The color-space processor receives the RGB data from the video decoder and performs several different operations on the data before passing them to the memory controller. Processing functions include the following:

- Adjusting independent gain of the three signals (R, G and B)

- Applying three independent look-up tables to the R, G and B data
- Converting the RGB data into Hue, Saturation and Luminance (HSL)

SDRAM

The PCI – 1411 comes with 16 MB of onboard high speed synchronous dynamic RAM. The PCI – 1411 can use the onboard RAM as a first-in-first-out (FIFO) buffer, transferring the image data as it is acquired or acquiring the image data into SDRAM and holding it for later transfer to main memory.

ACQUISITION, SCALING, ROI

The acquisition, scaling and region-of-interest (ROI) circuitry monitors the incoming video signals and routes the active pixels to the SDRAM memory.

SCATTER-GATHER DMA CONTROLLERS

The PCI – 1411 uses three independent onboard direct memory access (DMA) controllers. The DMA controllers transfer data between the onboard SDRAM memory buffers and the PCI bus. Each of these controllers supports scatter-gather DMA, which allows to the DMA controller to reconfigure on-the-fly. Thus, the PCI – 1411 can perform continuous image transfers directly to either contiguous or fragmented memory buffers.

2.3 Input/Output Connectors

The PCI – 1411 uses one S-Video and two BNC connectors on the front panel to connect the video data inputs and the external trigger signal. a. shows the position of the three connectors.

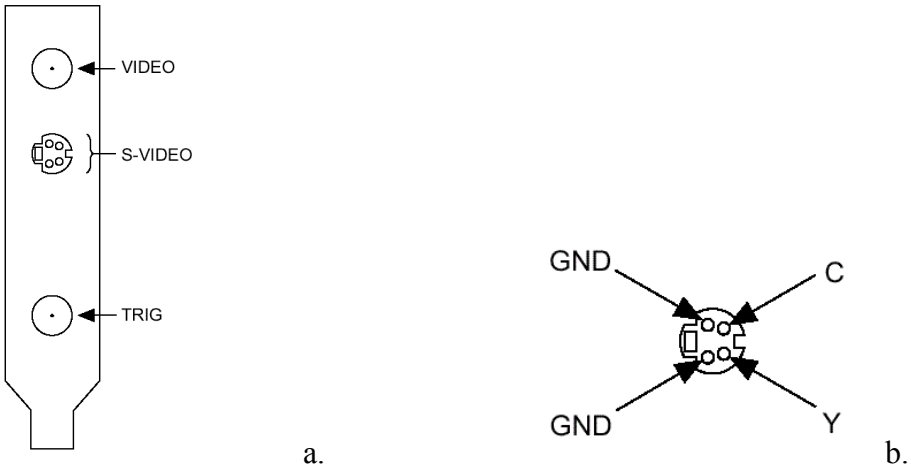


Figure 2. 2

a. PCI – 1411 Connectors
b. S-Video Connector Pin Assignments

Video -- Composite Video
S-Video -- A connector composed of two signals, as follows:
Y – The Y signal of the S-Video connection contains the luma and synchronization information of the video signal
C – The C signal contains the chroma information of the video signal
TRIG -- External trigger: A TTL I/O line you can use to start an acquisition or to control external events.

2.4 IMAQ Vision functions used for acquisition

IMAQ Init

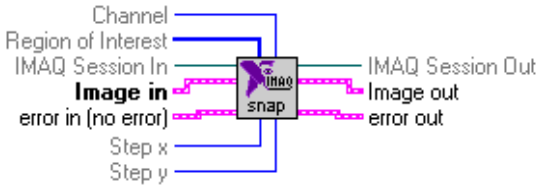
Loads an NI-IMAQ configuration file and configures the IMAQ device. If no inputs are connected, this VI automatically loads the standard interface file (img0).

Interface Name is the name of the interface to be loaded. The name must match the configuration file name used in the Measurement & Automation Explorer for IMAQ. The default value is img0.

IMAQ Session Out is a unique identifier to an IMAQ session that identifies the Interface file.

IMAQ Snap

Acquires a single image into Image out. A snap is appropriate for low speed or single capture, where ease of programming is essential.



Channel specifies from which channel on the IMAQ device to acquire.

Region of Interest specifies a rectangular portion of the image to be captured. Region of Interest is defined by an array of four elements [Left, Top, Right, Bottom]. You must set the width [Right-Left] to a multiple of eight. If Region of Interest is not connected or empty, the entire acquisition window is captured.

IMAQ Session In is a unique identifier that identifies the Interface file. If you are using the default interface, img0, no connection is needed.

Image In is the reference to the image that will receive the captured pixel data.

Step x is a horizontal sampling step or horizontal reduction factor. If it is set to its default value of 1, each column of the image is transferred. Only accepts values of 1, 2, 4, or 8.

Step y is a vertical sampling step or vertical reduction factor. If it is set to its default value of 1, each line of the image is transferred. Only accepts values of 1, 2, 4, or 8.

IMAQ Session Out has the same value as **IMAQ Session In**.

Image Out is the reference to the captured image.

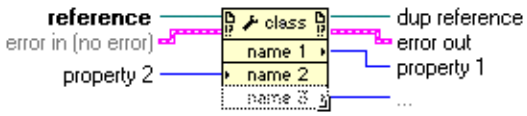
IMAQ Close

Stops the acquisition if one is in progress, releases resources associated with the acquisition, and closes the specified IMAQ Refnum.

IMAQ Session In is a unique identifier that identifies the Interface file.

Property Node

Gets (reads) and/or sets (writes) properties of a reference.



reference is the refnum associated with an object across a TCP connection. For the VI class, the default is the VI containing the Property Node.
dup reference returns **reference** unchanged.

To get the open IMAQ session right-click and choose **Select IMAQ Class/IMAQ** option.

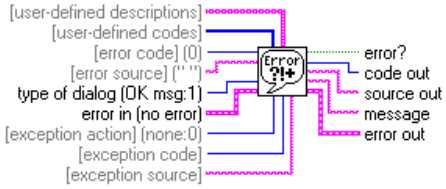
To get a certain property use the right-click and choose **Property** option.

To get property information, right-click the node and select **Change to Read** from the shortcut menu. To set property information, right-click the node and select **Change to Write** from the shortcut menu.

To add new properties to be read/write right-click and select **Add Element** option.

General Error Handler

Indicates whether an error occurred. If an error occurred, this VI returns a description of the error and optionally displays a dialog box.



2.5 Practice

2.5.1 Using the Measurement & Automation Explorer

The aim of this first part of the experiments is to get familiar with the way of setting the parameters of the IMAQ PCI – 1411 acquisition board. In order to do this, you have to open *Explore IMAQ* and choose the following shortcut: *My System/Devices and Interfaces/IMAQ PCI-1411:img0/Channel 0* as you can notice in Figure 2. 3.

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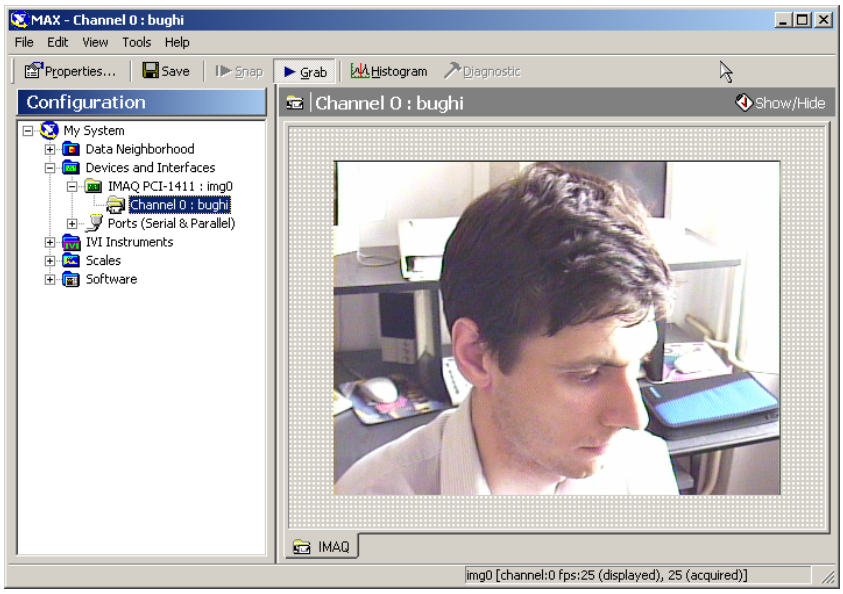
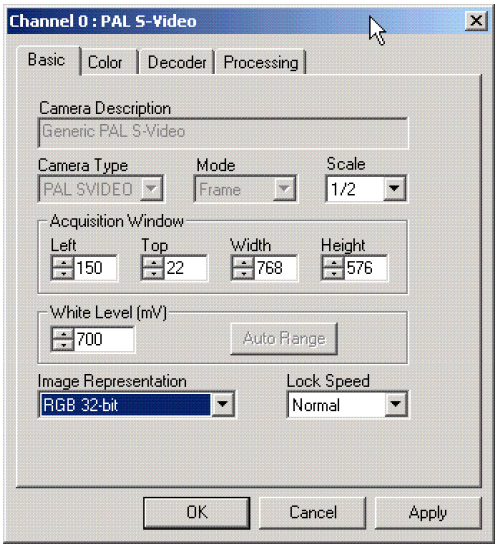


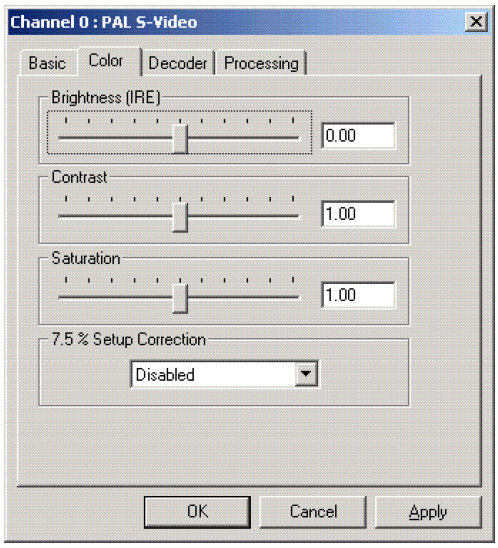
Figure 2. 3

To start the acquisition process you can press the button or choose *Tools* menu, then *IMAQ, Grab.*

You can modify the zooming or focus the camera by rotating the 2 components of the lens. Notice the effect!

To modify the acquisition/display parameters, press the button and one of the following windows will appear:

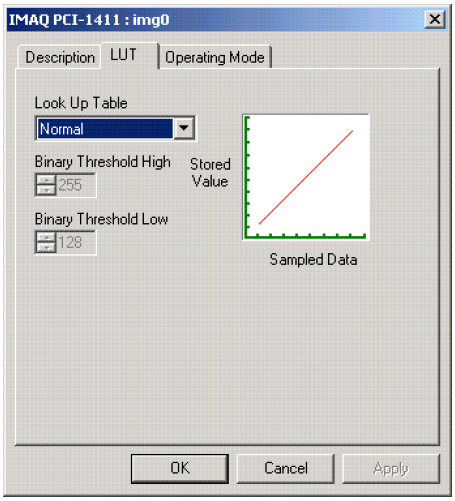




You can choose different representations of the image by selecting one of the options from "*Image Representation*" combo-box: RGB 32-bit, Red 8-bit, Green 8-bit, Blue 8-bit, Luminance 8-bit and capture an image (in BMP or PNG format) for each representation. You can save it using *File* menu, *Save image.*

Modify the level of luminance, saturation and hue and notice what happens with the grabbed image.

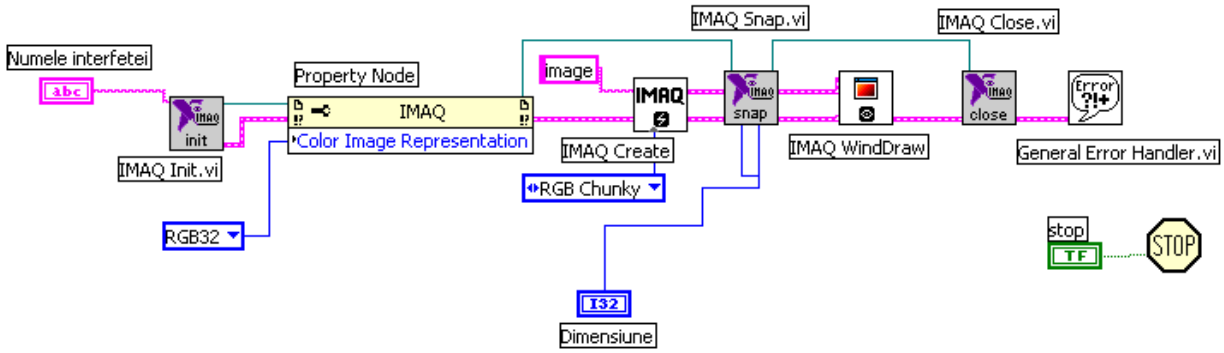
Select *Measurements & Automation, IMAQ PCI – 1411: img0* shortcut, and push the button. In the window that opens, you can select the input connector and the parameters of the acquisition board.



Choose (from the *Look Up Table* combo-box) *Inverse* and start a new acquisition process. Notice the changes and save a frame of the grabbed sequence. Repeat the algorithm for each possible options of the menu.

2.5.2 Using the IMAQ functions for controlling the acquisition board

Open a new Lab View session
Create a new project
Add to the **diagram** window the required IMAQ functions in order to obtain the chart below:



The user interface should look like:

Run the application using the *run continuously* option ****. Modify the *Size* parameter's value. How do you explain the fact that the window's size doesn't change for none of the values?

Modify the application in order to obtain the acquisition by using a "*while*" loop, active until the pressing of the STOP button.

2.6 Questions and exercises

1. Delete all the supplementary items from the chart presented at 2.5.2, in order to make it functional.
2. Modify the "Color Image Representation" parameters from the chart at 2.5.2. Add other parameters as: *invert, Look-up-table, Interface type, Serial Number, Bits per pixel, Bytes per pixel, Channel, Frame timeout*.
3. Implement an application which allows the capture in real time of a video sequence by using the **IMAQ Grab Acquire**, **IMAQ Grab Setup** functions.
4. Modify the previous application to close the display window when the STOP button is pressed.
5. Modify the chart from 2.5.2 to allow only 1, 2, 4 and 8 as values for the **Size** control.