

## DEVELOP OF IMAGE ACQUISITION SOFTWARE

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*Abstract: Intrusive and non-intrusive methods has been utilized for study of several physical phenomena. The first, generally, more cheap do not have higher neither spatial nor temporal resolution. The other, however, are in several times expensive techniques once that sometimes includes instruments how lasers, ICCD, and so on. This work focus in develop of the software image acquisition and eventually shows one application. The hardware include CCD camera, lens and suitable filters besides one cheap commercial frame grabber. The software utilized Graphical language, LabVIEW with image package include.*

*Keywords: Image acquisition software, LabVIEW*

## 1. INTRODUCTION

At second semester of 2006 inside of course Introduction to the Acquisition Data Systems the topic Image Acquisition was given as the final exam. The main motivation is to visualize and to acquire images with different format utilizing Image Processing tools inside of LabVIEW Student Version 7.0. Student Version is more cheap and of course, more limited. The main idea was acquire an image with a camera through suitable acquisition device, load an image from a file store on hard disk, or convert the data stored in a 2D array to an image or vice verse.

Initial cares before the image acquisition are essential in order to obtain the most accurate measurements. Among them is the exact knowledge of your equipment, if it is able to capture your object of the appropriate manner. Also camera position need to perpendicular to the object under inspection. This is essential because if your camera acquires images of the some object from an angle will be occur perspective errors. Figure 1 present an example of the CCD camera utilized at flame studies.

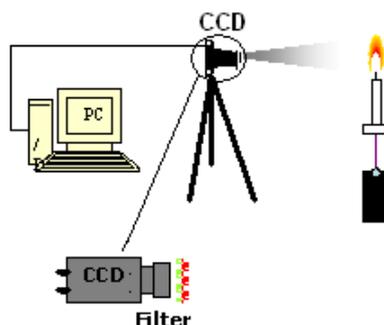


Figure 1: Image acquisition application

In example before, it is possible through image to obtain radicals profile, how C<sub>2</sub>, CH, CN, OH and NO profiles. These data could be after care analysis, for example, to be eventually correlates with pollutants emissions. The great advantage of the image acquisition system is that is possible to obtain information without any physical contact with the phenomena. In this way some errors are avoid. In the order hand, in most time, there is sophisticate equipments and necessity of the have domain over their.

## 2. IMAGE ACQUISITION SYSTEM

In order to obtain any image is necessary one suitable system. This includes camera, frame grabber and software with capacity to interact with both. The frame grabber is installed in PC bus and has one appropriate connector with camera, for example, BNC or an RCA connector output. The next paragraph, the resume for explain the purpose of the frame grabber.

An image can be thinking up as a two-dimensional array of intensity or color data. A camera, however, outputs a one-dimensional stream of analog or digital data. The purpose of the frame grabber is to acquire this data, digitize them, if necessary, and organize them properly for transfer them across of the PCI bus (or other bus) into system memory, from where it can be displayed as an image. In order to understand this process and to be able of troubleshooting display problems, one must to know the exact structure of the video signal which would be acquired. Table 1 describes some characteristics of the standard analog video formats in common use today.

Table 1: Standard Analog Video Formats

Format	Country	Mode	Signal Name	Frame Rate (frame/sec)	Vertical Line Resolution	Line Rate (lines/sec)	Image Size (WxH) pixels
NTSC	US, Japan	Mono	RS-170	30	525	15,750	640x480
		Color	NTSC Color	29.97	525	15,734	
PAL	Europe (except France)	Mono	CCIR	25	405	10,125	768x576
		Color	PAL Color	25	625	15,625	
SECAM	France, Eastern Europe	Mono		25	819	20,475	N/A

Digital video are much simpler than those for analog video, since the signal is already digitized. Digital frame grabber needs to be configurable in order to be compatible with all the different scanning conventions available.

Besides, image acquisition could occur with onboard memory not dependent of the system memory. Onboard memory became useful when there is a lot of traffic across the computer's PCI bus. Transferring images using an on-board acquisition is slower than a system memory acquisition because on-board image acquisition use Interrupt IO transfers and system memory acquisitions use DMA transfers. Some applications require on-board acquisition. The PCI bus can only sustain 100 MB/sec, but the there are onboard system with capacity to acquire up to 200MB/sec (32-bits/pixel with a 50MHz pixel clock). Using onboard memory allows the user to save the high speed event in onboard memory since the PCI bus can not handle 200MB/sec sustained. The system could save up to 80MB of image data and then the user could acquire these images from the high speed event and transfer them to system memory across the PCI bus more slowly, and all the high speed images would be saved on the IMAQ devices on-board memory. This is implemented with an on-board sequence acquisition. (Acquisition into Onboard Memory, 2006)

In resume, one complete image system includes both hardware and software, both with specifics characteristics.

### Hardware

- Vision camera - The camera analog or digital must have suitable parameters according your frame grabber capacity. The camera manufacturer is responsible for to provide documentation detailing the properties in each attribute.
- Frame Grabber - There are thousands of models and the user must to define one compatible with their necessity.

## Software

- Vision Acquisition Software - Normally, the frame grabber manufacture supply some simply software, which generally is able only to capture images. User is then responsible for development some useful software, sometimes in Language C. When possible is more easy for user to acquire some suitable and friendly software.

The more important matter is that the software and hardware necessarily must be compatible. Unfortunately, this not always it is occur. Now, it considering that the hardware and software was correctly installed, without any conflict between them, the next step is to configure the camera and to start up image acquisition.

In this work, the following system was utilized:

Camera -	CCD Marshall Camera (8 bits, 520 x 480 pixels)
Frame Grabber -	PCI 1405 Single Channel Color/Monochrome Frame Grabber, National Instruments
Software -	LabVIEW Student Edition, Version 7.1.1 and the IMAQ Vision package evaluation.

Figure 2 shows the experimental apparatus.

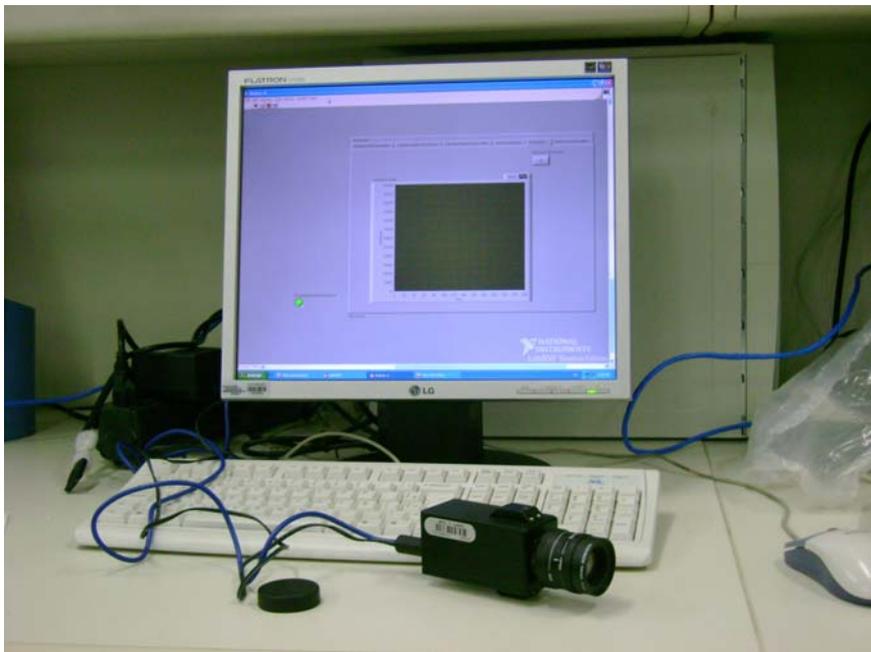


Figure 2 – Experimental apparatus.

The central idea is to develop one simple and not so expensive image acquisition system. The early listed items, considering medium configuration, are very cheap. Basically, hardware to capture images and after, perform automated image processing on the acquired image through software.

The next section detailed description about software development.

## 3. THE SOFTWARE

Figure 3 shows the fluxogram of the program. First, is necessary to acquire one video. These occur because the frame grabber available has not on board memory. In the next step, this video can be divided in frames, images. These images follow to treatment. The treatment includes the possibility of to obtain threshold, histogram or average of images acquired.

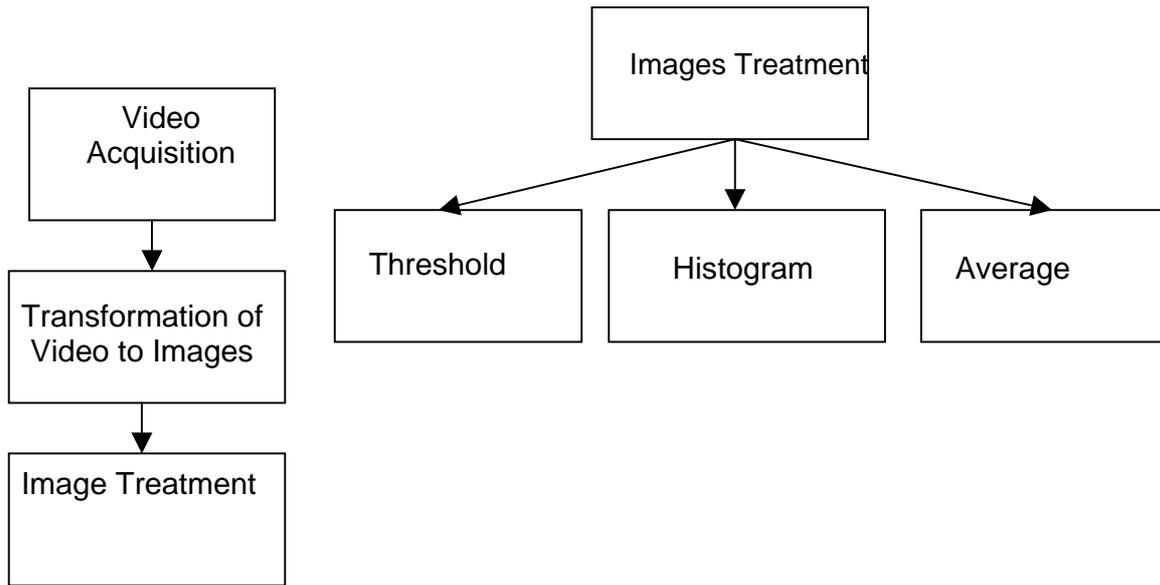


Figure 3 – Software fluxgram.

The following paragraphs, details about the program.

### Graphical User Interface

The User Graphical Interface is a hybrid of the image acquisition and the processing image. Figure 4 shows the completed VI that will be used during testing of the Image Acquisition. In left shows "Video Acquisition" and in right already in processing section "Add Images". This single program, know as a virtual instrument (VI) in LabVIEW, will control the entire system from startup to shutdown, when the user to finished the image treatment. In order to accomplish this, there are several controls and data indicators to be displaced on one screen for the user.

As mentioned it was necessary to utilize the IMAQ Vision Package joint to LabVIEW software. This package could be thought how an additional tool of LabVIEW. IMAQ Vision for LabVIEW is organized into four main function palettes: Imaq Acquisition, Vision Utilities, Image Processing, and Machine Vision. Imaq Acquisition has functions utilized to acquire image from external device. Vision Utilities functions allow to manipulate and display images in IMAQ Vision. Image Processing use functions to analyze, filter, and process images. Machine Vision VIs are high-level VIs. The last is able to simplify common machine vision tasks. Details can be obtained IMAQ Vision for LabVIEW User Manual (2004).

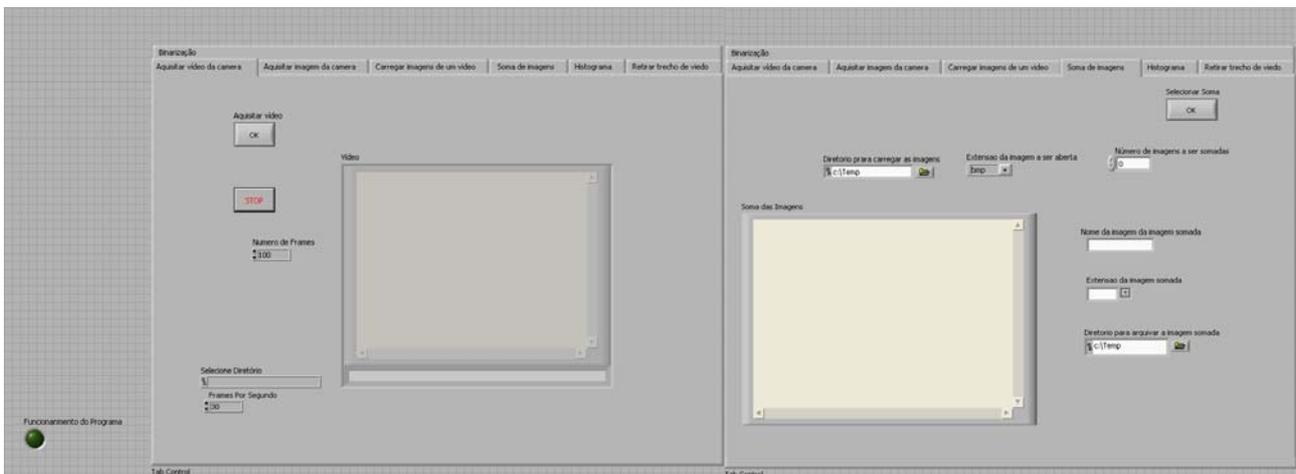


Figure 4 – Completed VI for Image Acquisition

Multiples functions of the IMAQ Vision Package were utilized during program development. The result was the following possibilities:

Video Acquisition or Image Acquisition - The purpose is to acquire videos, only in AVI format. Images format, however, could be saves as BMP, TIF, JPG or GIF formats. This was possible because one suitable subroutine was building for this task.

Frames Acquisition - Permit to take some frame from previous video file in AVI format. As mentioned, this frame could be saved at different images formats.

Thresholding - Several times the images were corrupted by noise during its acquisition and transmission. Denoising is a main work in many image-processing applications. The goal of this is to remove the noise while keeping the important image features as much as possible. It is usual image denoising using nonlinear filter. Thresholding algorithm is an orthogonal transform domain, such is a subband or wavelet transform, is a nonlinear filter (Guangmin and Fudong, 2003).

Image Search - In a typical vision application, it is possible to extract measurements from ROIs (Region Of Interest) rather than the entire image. To use this, the parts of the object of the interest in must always appear inside the ROIs previously defined.

Histogram - The histogram interpretation is the most important concept in order to working images. A histogram can indicate whether the image acquired has been properly exposed, whether the lighting is harsh or flat, and what adjustments will be necessary. This program was developed to generate the histogram of frequency of an image. This it will possibility better choice (more appropriate) of the level which will utilized for the thresholding. The histogram plots the number of pixels in the image (vertical axis) with a particular brightness value (horizontal axis).

Image Average - Takes the sum of pixel value from the specified number of scan and use arithmetic as the final value in the image. In this way is possible to preserve those persistent pixel values that are mostly specific signal while divide away along times those fluctuated values that are mostly noise. Average is able to reduces noise and improve image quality.

The full program, program source code, includes different functions how can be visualized in Figure 5.

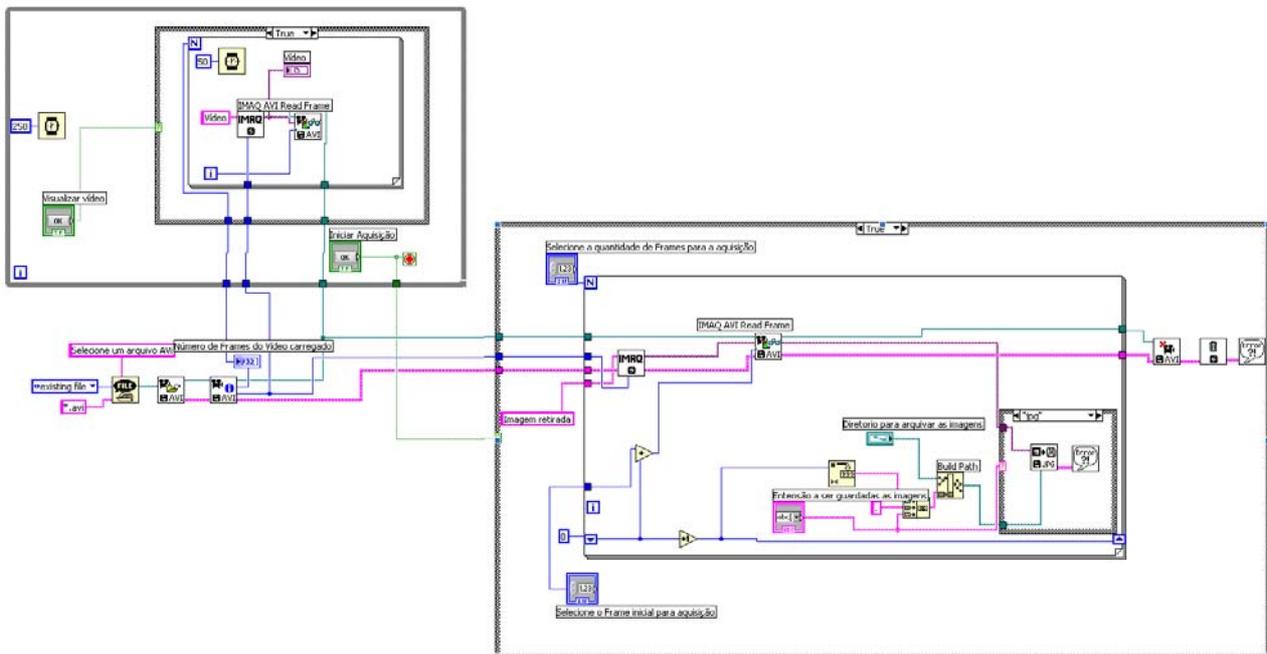


Figure 5 – LabVIEW program source code.

#### 4. APPLICATION EXAMPLE

This section shows one application example which the early development program described was utilized. Here, the intention is to show how it can be utilized for example to study the radical emission in one natural gas flame. In chemistry, free radicals are atomic or molecular species with unpaired electrons or an otherwise open shell configuration. Unpaired electrons make the species more attracted to a magnetic field (they are said to be paramagnetic). This gives free radicals a highly reactive nature. They are capable of independent existence and act as intermediates in chemical reactions. Although they have the ability to exist independently, they usually have a fleeting existence. Free radicals play an important role in combustion, atmospheric chemistry and many other chemical processes.

Figure 6 shows the flame picture taken by a digital camera Sony Cyber Shot.

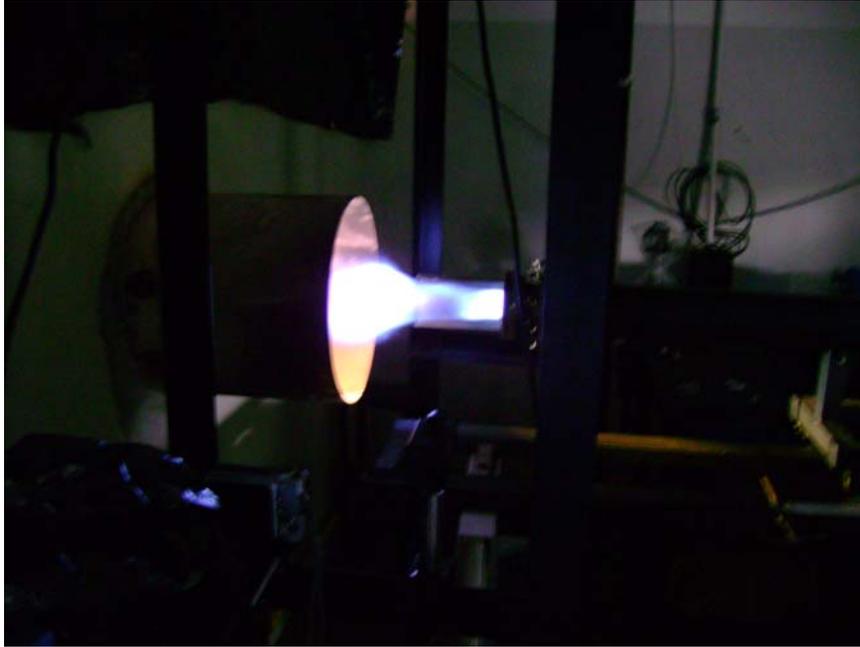


Figure 6 - Picture of flame taken by Digital Sony Cyber Shot model

Figure 7 shows the same flame with the system described in this work. Imaging was taken without a filter.

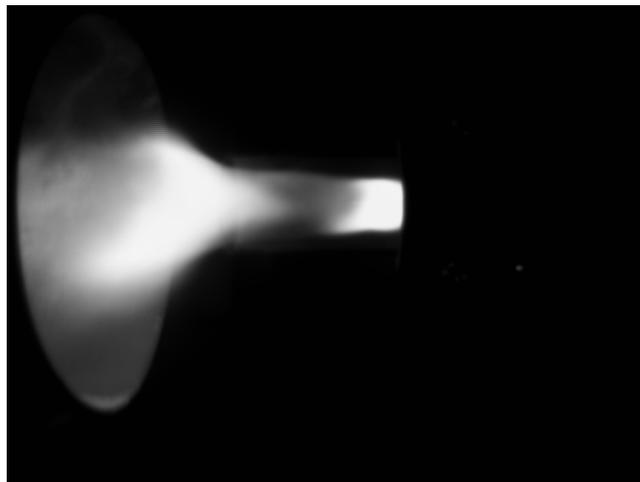


Figure 7 - Picture of flame using the developed image system.

Figure 8 shows the image acquired at a wavelength of 432.22 nm.



Figure 8 - CH radical emission.

#### 4. CONCLUSION

This primary goal in this work was develop one simple and reliable image system acquisition as same easy to operate. Throughout the design and implementation was necessary to utilized multidisciplinary academic foundation includes instrumentation knowledge. The objective was achieved and one of them possible application was demonstrated. Here, how example, chemiluminescence emissions from CH free-radicals were acquired with a CCD camera and the image was analyzed utilizing the develop program.

#### 5. REFERENCES

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#### 6. RESPONSIBILITY NOTICE

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