

PC-Video Image Management and Measurement System

ViS v2.90 Software Manual

(Plus Edition)

**Revision 2.9.3
Aug 2006**

© V.I.S.

All rights reserved. No part of this document may be stored in a retrieval system, transmitted, or used in any form
Or by any means, electronic, photocopying, recording or otherwise without the prior permission of the
Copyright holder.

Contents

| | Page |
|--|-------------|
| System Requirements & Settings..... | 2 |
| USB 2.0 Digital Imaging Camera Installation..... | 3 |
| USB 2.0 Digital Camera Troubleshooting..... | 7 |
| ViS Installation..... | 8 |
| Software Operation | |
| Quick Start..... | 10 |
| Work with Image Buffer..... | 11 |
| Image/Video Acquisition | 12 |
| Image Annotation (Drawing)..... | 14 |
| Image Processing..... | 15 |
| Enhancement..... | 16 |
| Effects..... | 17 |
| Calibration..... | 19 |
| Start Calibration..... | 20 |
| Measurement..... | 21 |
| Measurement Tools..... | 21 |
| Image Zoom Tool..... | 23 |
| Password Protection Settings..... | 25 |
| Appendix..... | 26 |

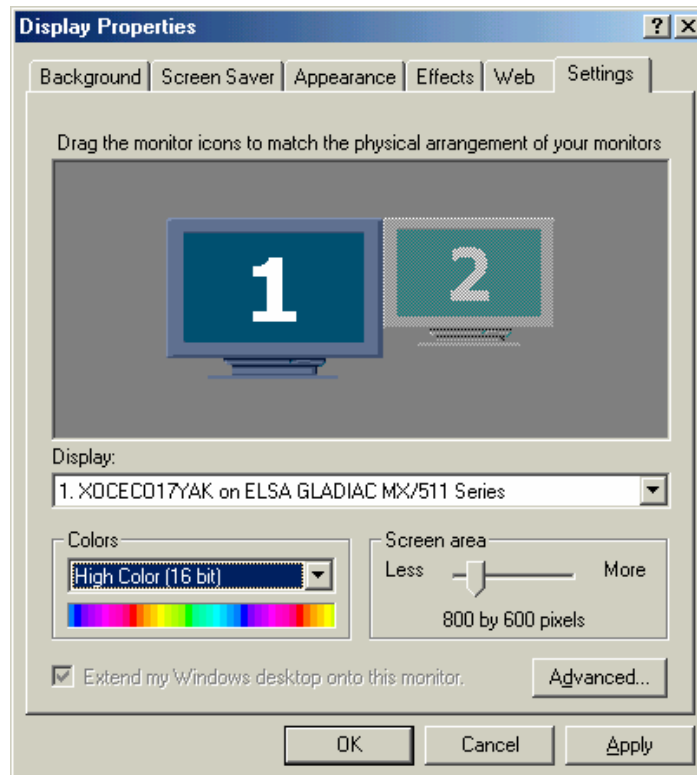
ViS v2.90 System Requirements & Settings

System Requirement

- Microsoft Windows 95/98/ME/2k/XP
- Pentium 200MHz or higher (if used with Video Capture Card)
- Pentium III 800MHz or higher (if used with Digital Camera)
- 128 MB RAM or more
- External Display Card Recommended (Shared VGA memory isn't recommended)
- 8MB Video RAM or more (must supports DirectX 7.0 & above)
- 1.2 GB Hard Disk or more
- XGA or SXGA Monitor Display (Res.:1024x768 or 1280x1024)
- PAL/NTSC Video Camera or Digital Camera (Direct Show, WDM)
- Color Printer (Optional)

Windows Settings

- Install DirectX 7 or above (CD bundled with DirectX 9.0)
- Set your Windows video display to 16 or 24 Color, Resolution 1024x768 Pixels or higher for larger view.



USB 2.0 Digital Imaging Camera Installation

Installing the Digital Camera (DC)

Installing the DC is easy. You'll need to do the following:

- Check the host computer configuration
- Connect the camera to the computer
- Install the driver software from the support CD
- Install the imaging software from the support CD (optional)

Checking the Host Computer

The computer you connect the camera to should meet the following minimum requirements:

- 800MHz Pentium II processor or above, Pentium IV 1.5GHz or greater for full performance
- 128MB system memory
- Hi-Speed USB 2.0 port
- Display card capable of true-color mode
- Microsoft Windows 98SE, ME, 2000 or XP

Since video processing is hardware intensive, a faster computer with a fast hard disk drive and extra memory will yield better results.

Some computers, particularly notebook computers, may only have USB 1.1 ports. You can use an DC camera with a USB 1.1 port, but the data transfer rate will be considerably slower than a Hi-Speed USB 2.0 port. You can also upgrade your system by adding USB 2.0 ports via an expansion card. If you install such a card, confirm that it is properly installed or the DC camera may not work properly.

Connecting the Digital Camera

You can connect USB devices to a computer while the computer is turned on. This "hot plug" capability is a convenient feature of USB products. To connect the camera to a computer does as follows:

- Plug the connector of the camera's attached USB cable into an open USB port on your computer.

When you connect the camera, it's power LED should light and the computer's Operating System should recognize it. When you connect the camera for the first time you will need to install the supplied driver software that comes on the Support CD. For more on this, see the next section.

Installing the Driver Software

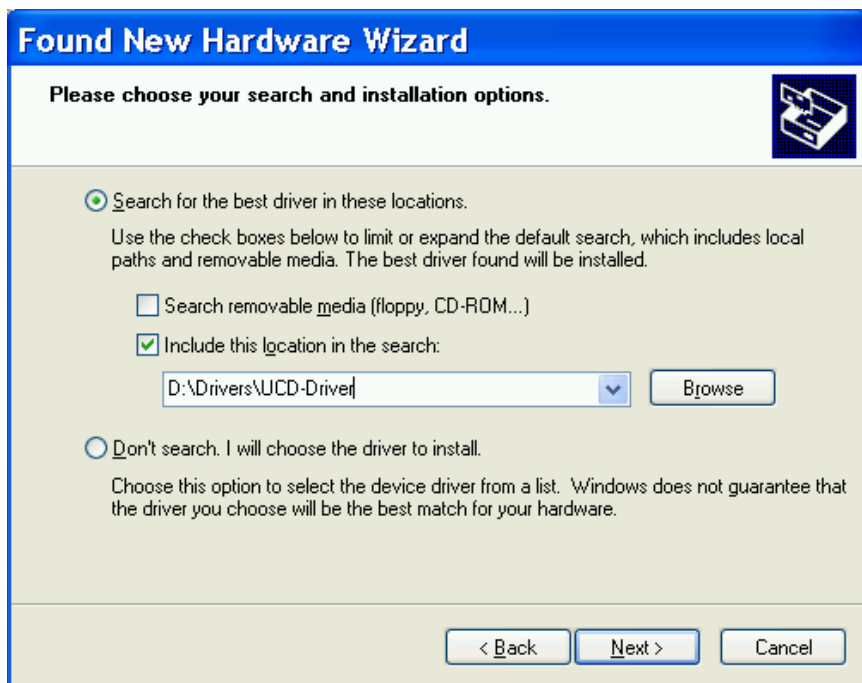
The DC comes with driver software on the Support CD. The driver software enables the CD camera to work with the computer. You must install it before you can use the camera.

As mentioned in the previous section, when you first connect the camera to a host computer, the Microsoft Windows operating system will automatically recognize that the camera is connected. You then need to install the camera's supplied driver software as follows. This explanation uses Windows XP as an example.

1. When you plug the camera into a USB port on the computer, the operating system will automatically detect it and display a message to that effect. It will also run the Found New Hardware Wizard. Use the “Install from a list or specific location (Advanced)” option.



2. Then, place the DC driver CD in the CD's drive and click “Browse” button to browse to the CD's driver location or enter the driver's path name. The wizard will automatically find the driver files on the driver CD and install them. Follow the instructions on the wizard screens. If a warning about the driver appears, press the Continue Anyway button.

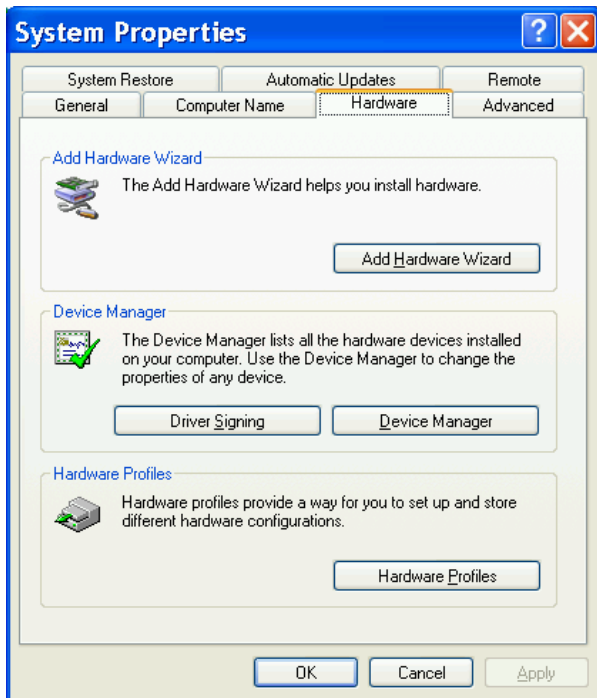




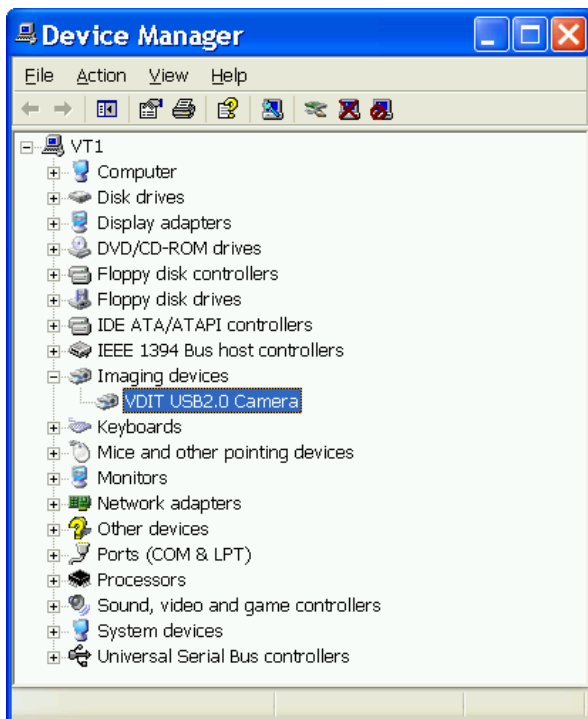
3. When the installation is completed, click on the “Finish” button to finish the camera driver installation.



After the driver is installed, you can check the installation status by executing the “Settings”->”Control Panel”->”System” dialog. The System Properties window will appear. Click on the Hardware tab and then the “Device Manager” button.



In the Device Manager window that appears, click on the “Imaging Device” item. You should see a listing for “VDIT USB 2.0 Camera”. Double click on it to bring up the properties windows for the device.



In the properties window, there should be a message indicating the device is working properly. If the message says the device isn't working properly, click on the Driver tab and click the Reinstall Driver button. Follow the process through to the end and then reconfirm that the installation was successful and the device is working properly. If it still is not working properly, consult your vendor.



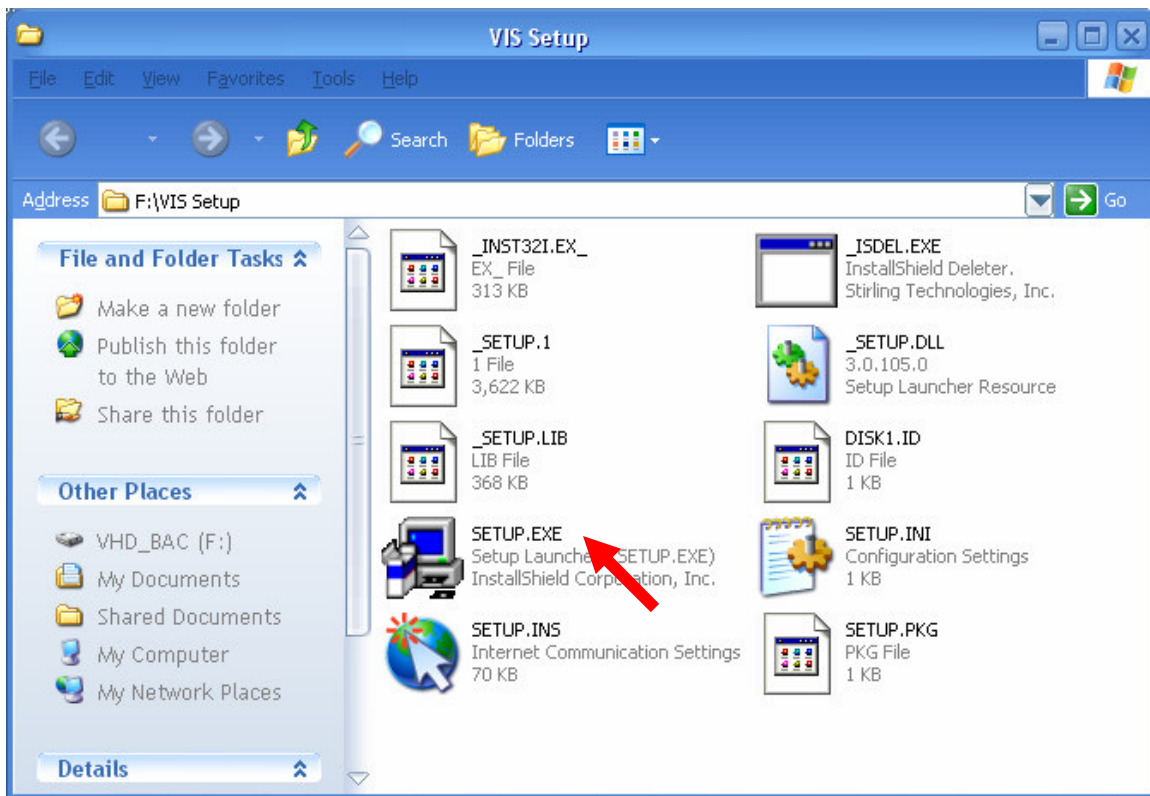
USB 2.0 Digital Camera Troubleshooting

This section covers a few points you can check in the event you have a problem using your camera.

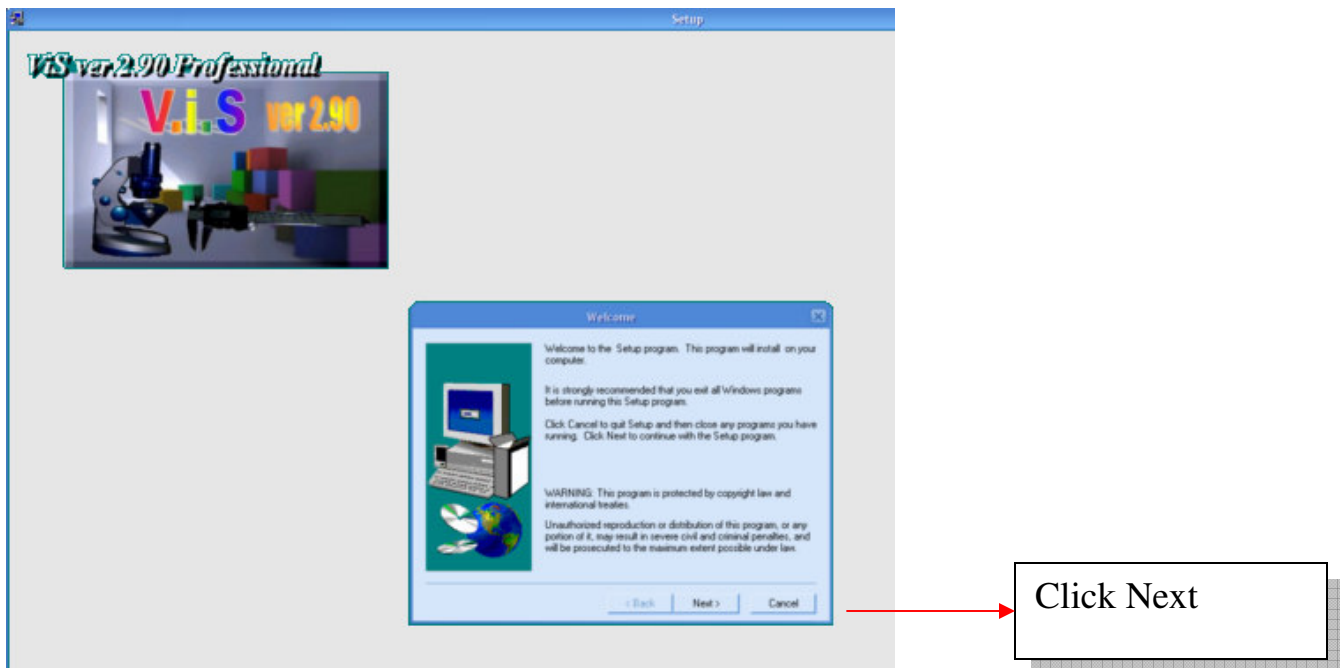
- Make sure the camera is connected to a Hi-Speed USB 2.0 port. USB 2.0 and USB 1.1 ports look the same. If you plug the DC camera into a slower Full-Speed USB 1.1 port, Windows XP will display a warning message. If you click on it, you'll see the troubleshooting window shown below.
- Make sure the correct driver software is properly installed. See the section on driver installation. You can check the driver information in the “Device Properties window”.
- Make sure the USB cables are correctly connected. The connector should be fully inserted in the port on the computer.
- Check the camera Video Capture Filter settings in software. Make sure the settings are for the specifications the DC supports, for instance, RGB 24 mode.

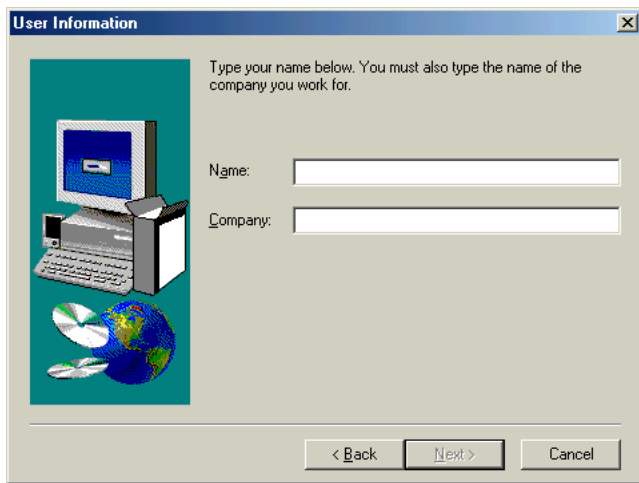
ViS Installation

Insert the ViS CD into the CD-ROM drive, and open the [CD-ROM]\VIS Setup folder,

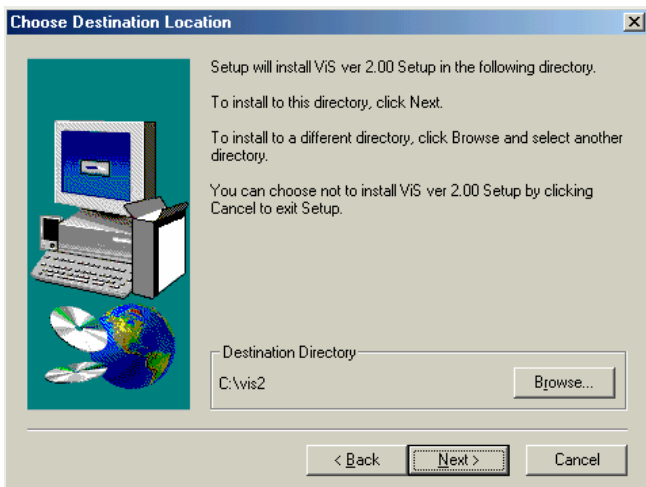


Then double click the “SETUP.EXE” to start the ViS software installation,



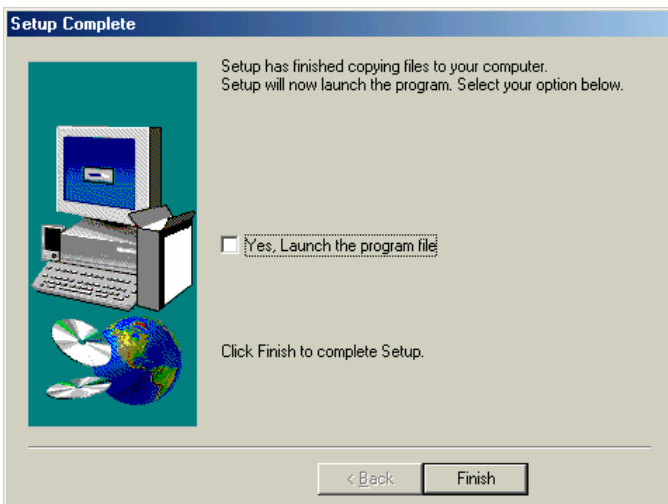


Enter your name and company name and Click Next



Select the destination directory name for ViS to install. Recommended to use the default name "C:\vis2"

Then, click "yes" in the next screen until the program is installed...

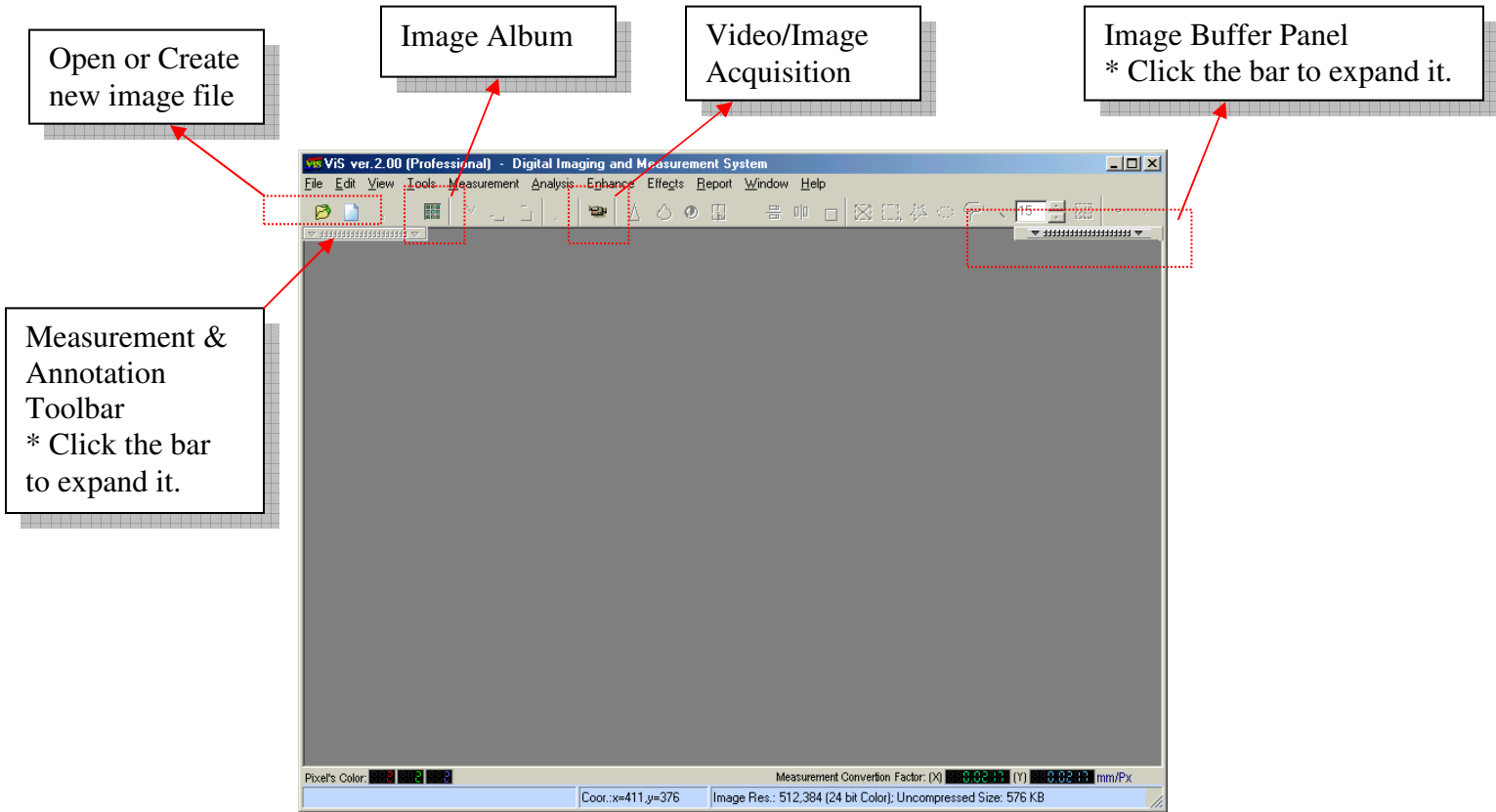


The installation is completed and you are to use the ViS 2.90. Do ensure that the digital camera or video capture card is installed also.

Basic Software Operation

1.) Quick Start

When ViS is just started, the program main interface shall be displayed as shown below,



User may use any of the above options to open image or create new image. All these features can also be found in the Main Menu (Pull-Down Menu).

Click on the “Image Buffer” or “Image Album”, the below dialog shall be displayed.



Image Buffer

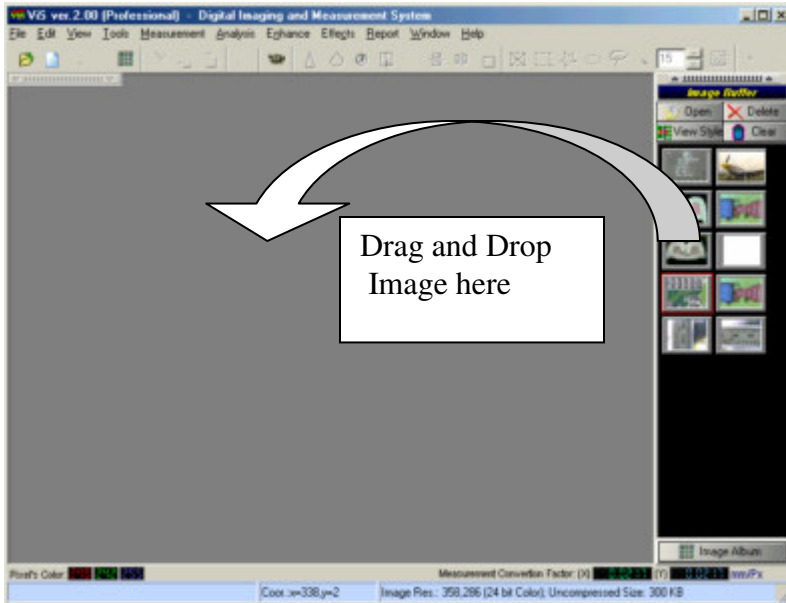


Image Album

Image Buffer meant for temporary image achieving and retrieving. Images in the image buffer will always retain even the program is closed or restarted until user deletes or clears the image.

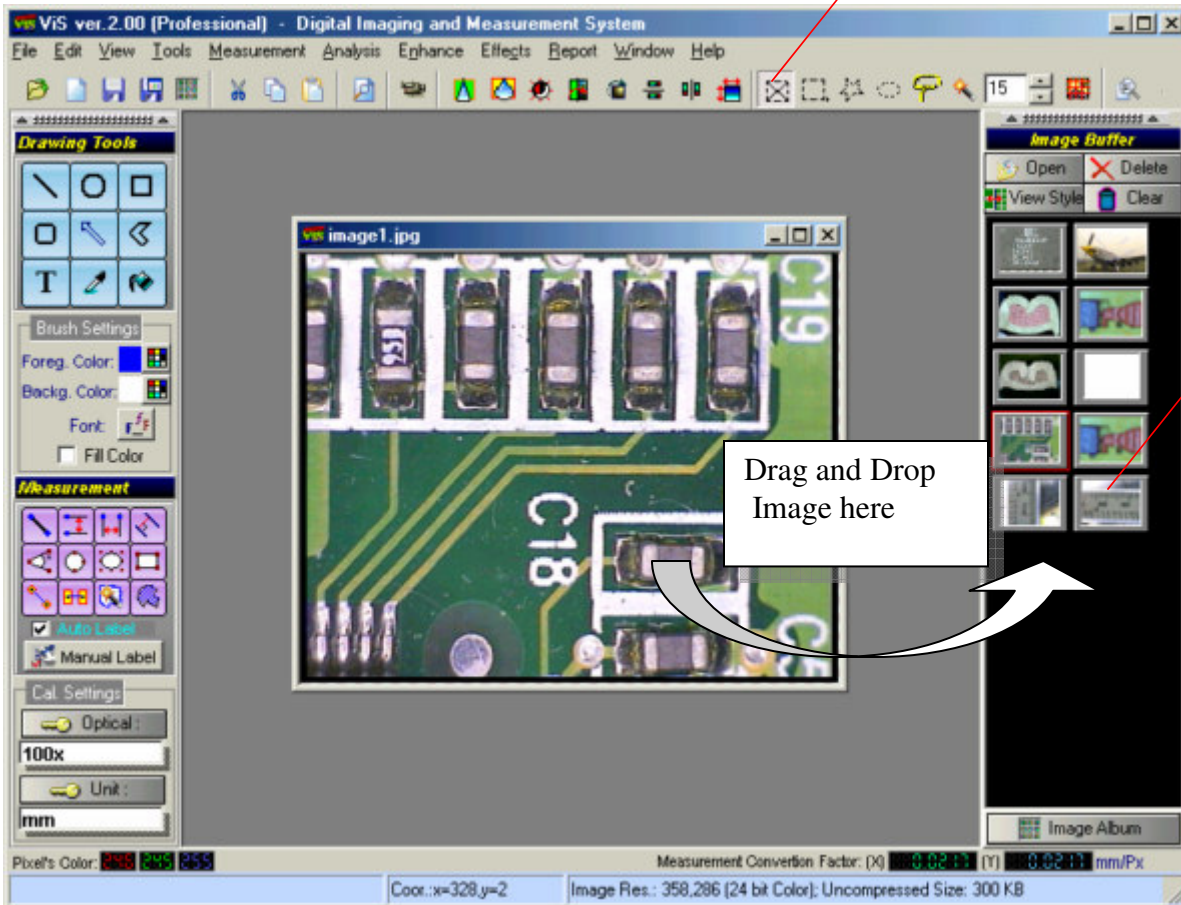
Whereas, the **Image Album** is for the purpose of permanent image achieving. User can easily transfer the image from Image Buffer into the Image Album by Drag-And-Drop the image to Image Album.

2.) Work with Image Buffer



User can drag and drop an image from the Image Buffer to the Main Working Space to open the image. On the other hand, Image in the Working Space can also drag and drop into the Image Buffer

* Note : To do Drag and Drop on the image. ROI tools must be deselected using this button.

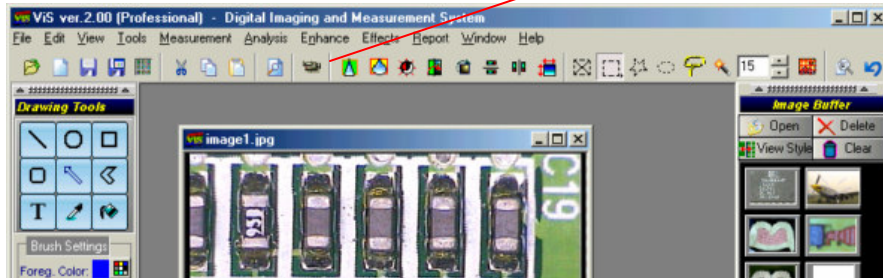


Hold down SHIFT or Ctrl key for multi images selection with mouse clicks.

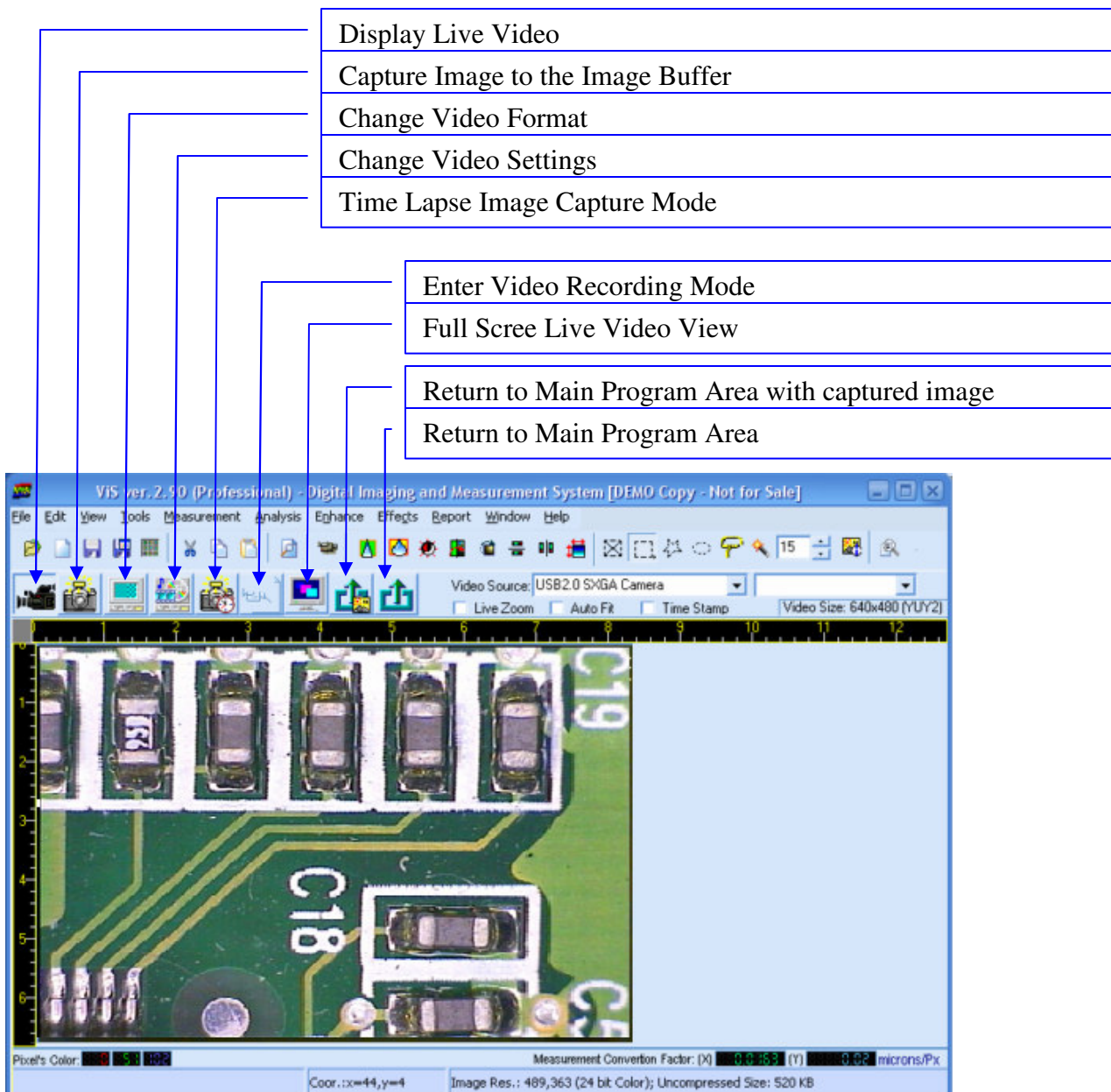
Drag and Drop Image here

3.) Image/Video Acquisition

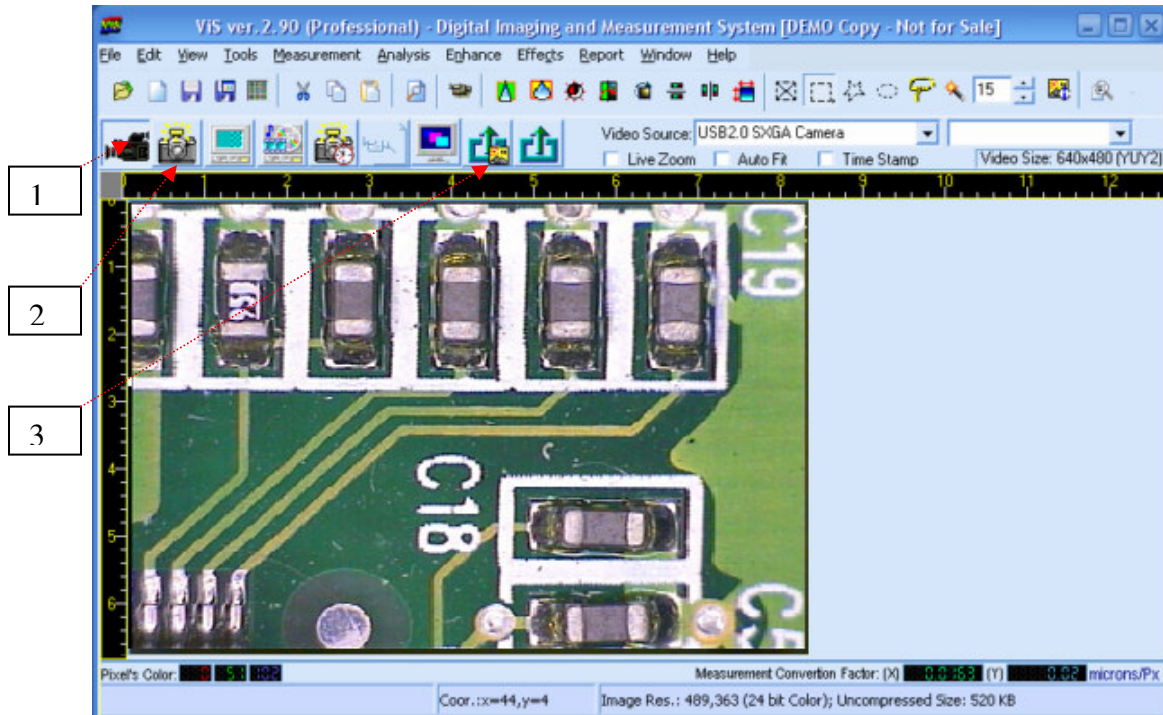
To acquire or capture image or video from the camera, click on the “Video Camera” icon,



Then, user should enter to the video/image acquisition window like below,

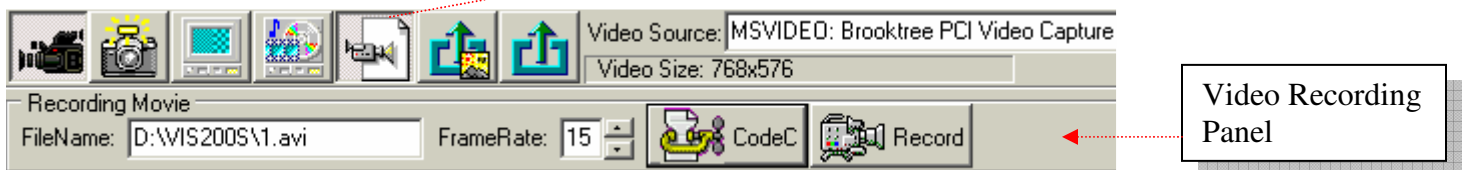


- 1 Before capturing, the “Live Video” button must be clicked to enter the Live/Preview Video Mode.
- 2 To capture multiple images during the acquisition session without freezing the live video, user should use the “Capture to Image Buffer” button to grab images.
- 3 To capture the live image and immediately return to the main area for measurement or processing, click the “Return to Main Menu with Image”.



4.) Video Recording

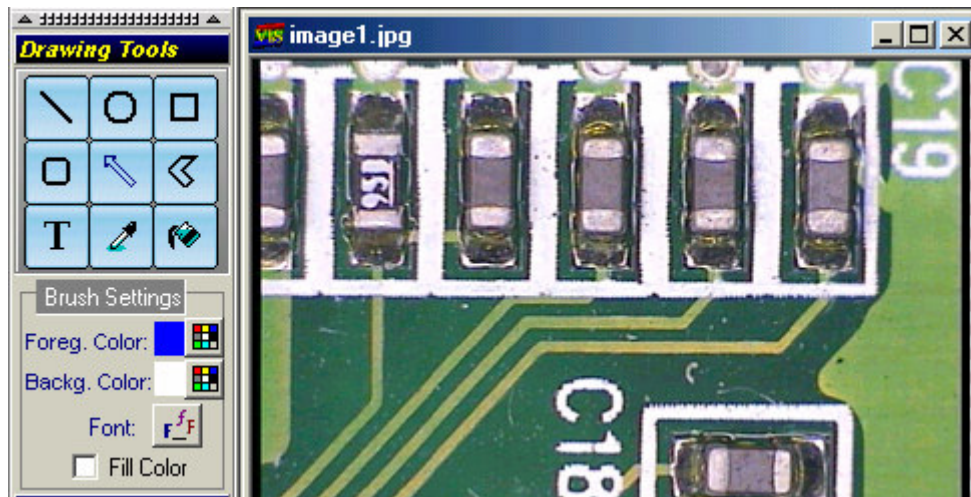
To enter to the Video Recording Mode, click the “Video Recording” button to show the video recording panel.



Then, enter the file name of the video movie to be recorded and choose the video Frame Rate (Higher Frame Rate will increase the Video File Size). Next, choose the CodeC or Video Codec which is the video recording compression engine to be used during the recording session (it shall display all available codec drivers that installed in this computer). Lastly, click on the “Record” button to start and stop movie recording.

Image Annotation (Drawing)

With the annotation tools, user able to stamp text, draw arrows, lines, pick color etc. For more information about the tool icons, just move the mouse cursor to the icon and read the pop-up tips. User can also select font type, background color, size, etc.



To stamp text on your image:

1. Click the "Text" icon.
2. Click the cursor on to the image.
3. To edit the text, just click on the text box.
4. To stamp the text permanently, double click the text box or click on the image.

To draw arrows:

1. Click the 'arrow' button and position cursor to the desired location. Then click and hold down the mouse button, and move it to another location which is the arrowhead.
2. User may change the arrow style by changing the "Brush Settings".

To Draw Shapes

1. Click on the desired shape that you require.
2. Draw on the image.

Image Processing (Enhance and Effects)

User can perform image enhancement or effects on the whole image or selected image region (ROI – Region Of Interest) using the following ROI tools, inclusive of Rectangle, Polygon (Multi Points), Ellipse, Lasso and Magic Wand ROI Tools.

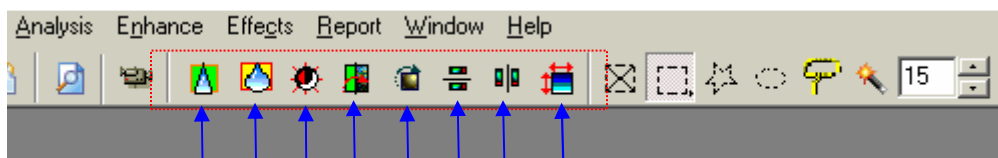


ROI (Region of Interest) Tools

Click the “Deselect” button if user doesn't want the ROI selected. Only in this mode, user is allowed to Drag and Drop image to the image buffer.

Image Processing Toolbar

Now, user can select the image processing tools in the Main Menu (Pull-Down Menu) or the toolbar as shown below,



Resize Image

Mirror Image

Flip Image

Rotate Image

Emboss Image

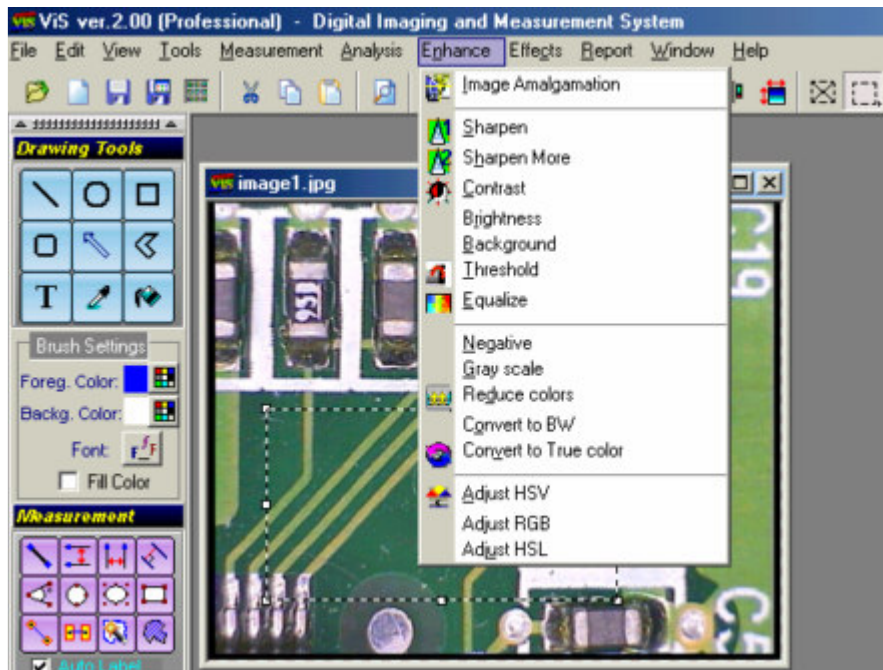
Change Image Brightness and Contrast

Smoothen Image

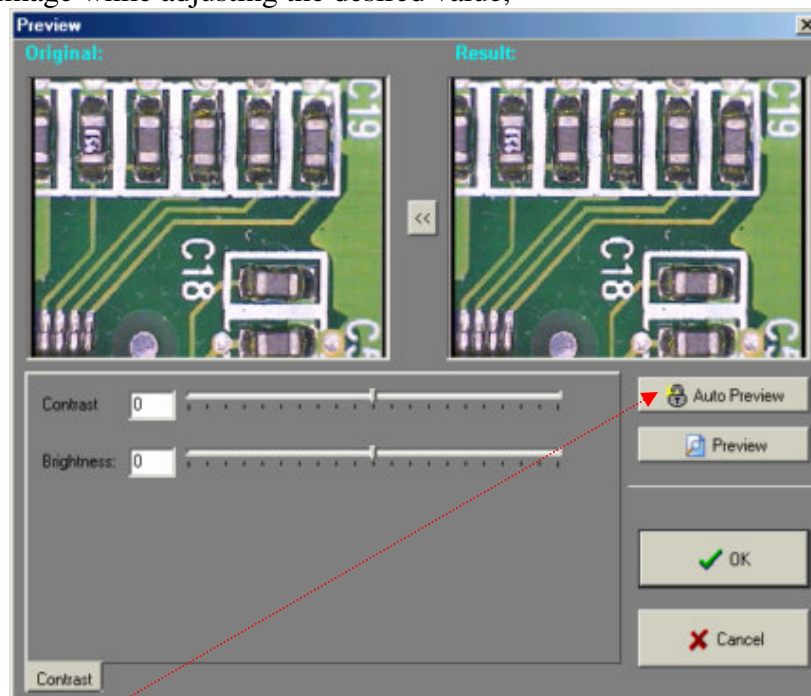
Sharpen Image

Image Enhancement

For more image enhancement tools, click on the Main Menu -> Enhance and select the desired tools.



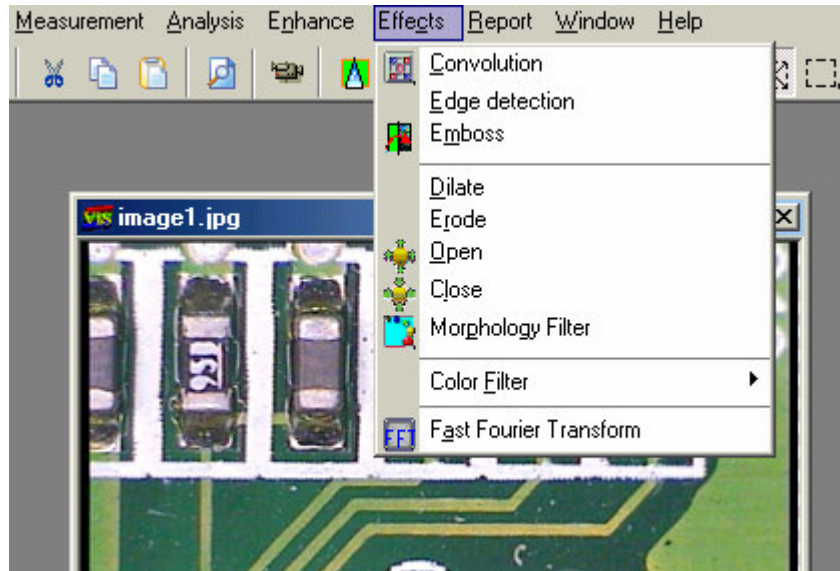
For certain tools, e.g. Contrast, Brightness, Threshold etc, a Preview dialog box like below will be displaying for user to preview the image while adjusting the desired value,



Click the “Auto preview” button to enable the auto preview mode that shall refresh the result image (Right Image) automatically while user is adjusting the value.

Image Effects

Besides Image Enhancement, there are another set of image processing tools, which is the “Effects”, as shown in below, for more advanced image processing purposes,



Convolution

Min/Median/Max: Three statistical filters of progressively higher strengths are available. They replace the target pixel with the min/median/max luminance of the neighboring pixels. They can reduce impulsive image noise without degrading edges or smudging intensity gradients. They are valuable for use on images gathered using low-light fluorescence microscopy, x-ray scanners, and Scanning Electron Microscopy.

Hi-Pass: Passes detailed high frequency image information, while attenuating low frequency, slow changing data.

Gaussian: This is a 3x3 convolution is designed to perform a normalization by applying a discrete approximation of a Gaussian surface.

Sobel: This filter highlights edges using the sum of the gradient in the X direction with the gradient in the Y direction, using 2 3x3 convolution filters and computing the square root of the sum of the squares.

Edge Detection: This Edge detection allows you to find edges or periodic patterns along lines and match these patterns. Edge detection can be used for gauging parts in manufacturing inspection, measuring phases in materials, detecting the position of peaks in one-dimensional gel analysis, and detecting the spacing of radial features in systematic biology (such as the rings on fish scales or tree rings).

Emboss: This function raises the object's surface of image into different 3D pattern.

Dilate: A morphological operation which moves a probe or structuring element of a particular shape over the image, pixel by pixel. When an object boundary is contacted by the probe, a pixel is preserved in the output image. The effect is to "grow" the objects.

Erode: The converse of the morphology dilation operator. A morphological operation which moves a probe or structuring element of a particular shape over the image, pixel by pixel. When the probe fits inside an object boundary, a pixel is preserved in the output image. The effect is to "shrink or erode" objects as they appear in the output image. Any shape smaller than the probe (i.e. noise) disappears.

Open: An erosion followed by a dilation, it is the opposite of the closing morphological operator.

Close: A dilation followed by an erosion. A morphological operator useful to close holes and boundaries.

Image Analysis

The Image Analysis features are available in the Main Menu, inclusive of a set of image analysis tools like listed below,

Histogram – The x axis of the histogram is the light intensity scale. By default, the histogram spans the range from black (minimum value of the luminance range) to white (maximum value). The color value of white is dependent upon the bit depth of the image. For example, an 8-bit image has a maximum color value of 255, a 16-bit image has a maximum possible color value of 65,535, and so forth. The y axis of the histogram is the number of the pixels found for each color value in the range. User can constrain the ranges by specifying values in the High and Low fields.

Total Image Color - To calculate the total color of the image.

Line Profile – To show the pixels profile along a line that drew by the user, consists of RGB colors.

Get HSV Channels – Extract the image into the 3 (HSV) channels images,

- H (Hue) is from 0 to 359 (corresponding to 0..359 degrees around hex cone).
- S (Saturation) is from 0 (shade of gray) to 99 (pure color).
- V (Value) is from 0 (black) to 99 (white).

Get RGB Channels – Extract the image into the 3 (Colors) channels images,

- R = Red
- G = Green
- B = Blue

Spatial Calibration

Calibration is a very important step before you start using the measure system of ViS. It should not be skipped and should be done after the installation.

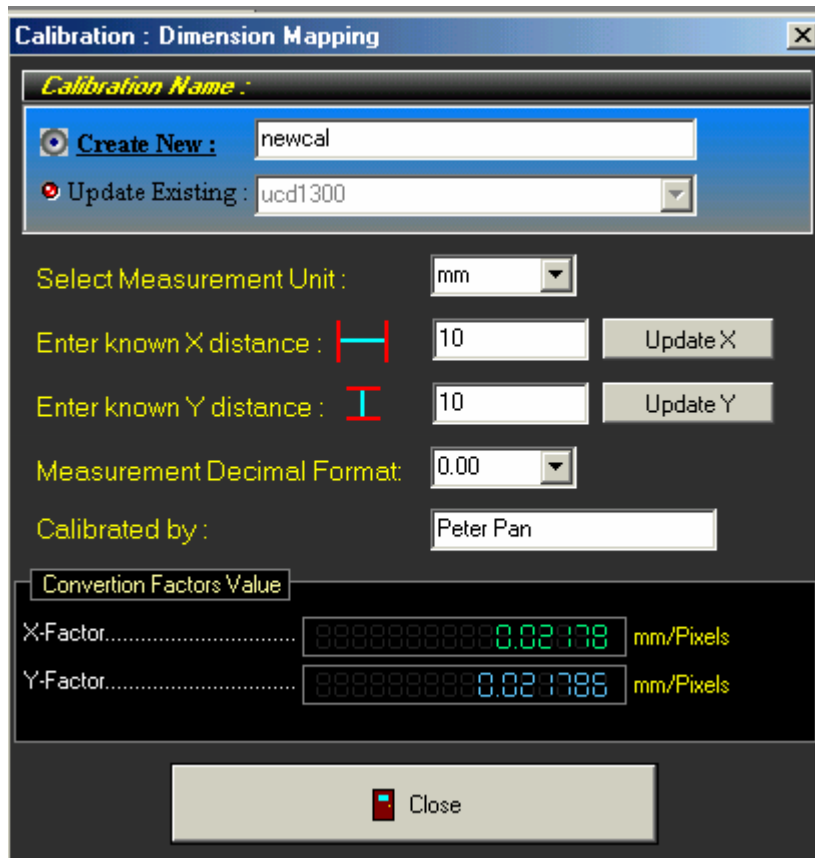
Use this option in the pull down menu to perform the calibrations. Calibration is the process of supplying ViS with a scale for establishing a size relationship for objects in the image frame. Until you calibrate ViS, the default calibration shipped with ViS will be the calibration available for use. The default calibration is very likely will not produce the results you want. To ensure accurate results, users should create a new calibration specific to their imaging applications and processes.

A word about calibration

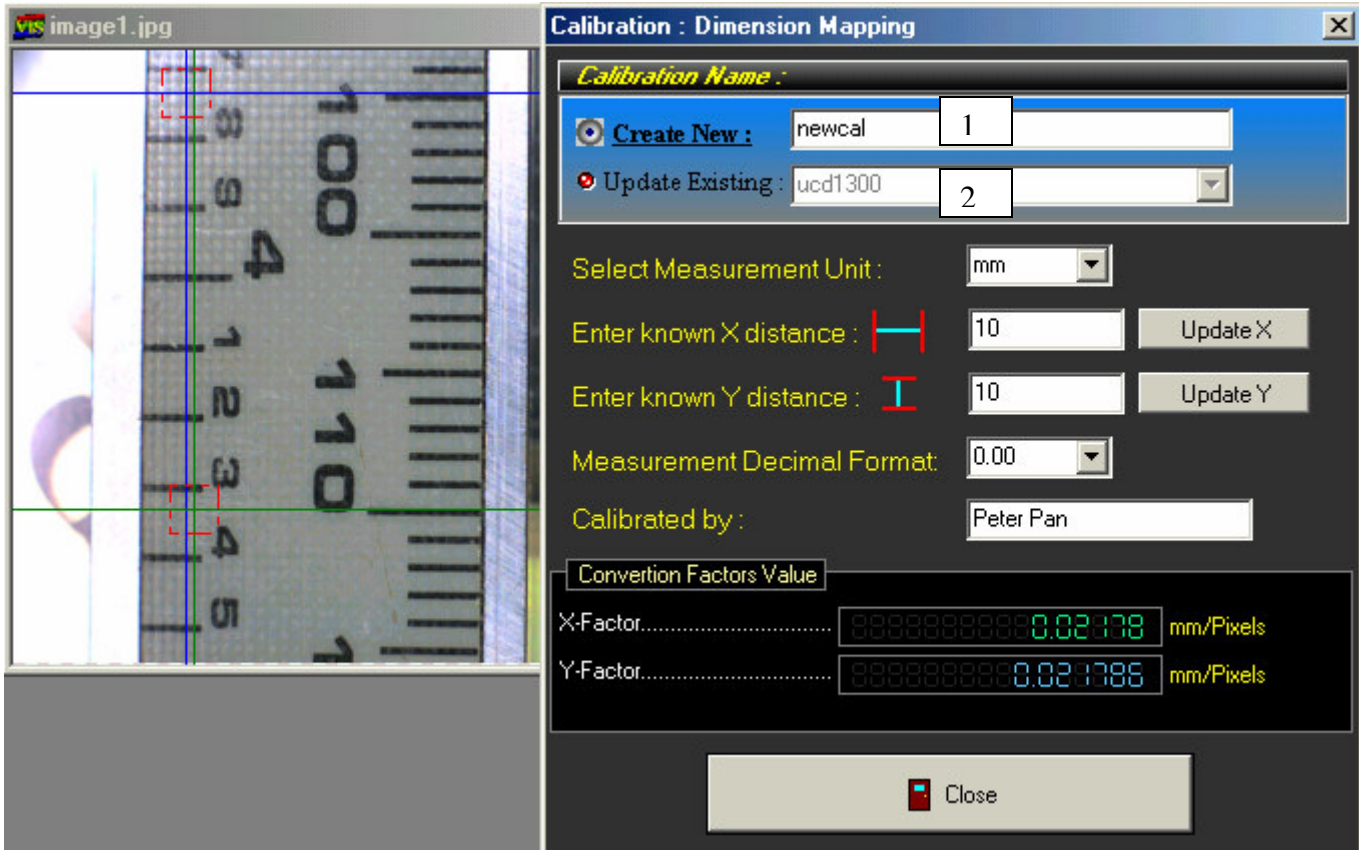
If you want to work with pixel-based calibrations you must understand how ViS thinks of pixels. In the world of two-dimensional digital images a pixel has no spatial dimension, no spatial meaning, by itself. We can talk about a pixel's color or a pixel's position but not its shape. A pixel is a point represented by a number. Only when more than one pixel exists can we talk about pixel dimension; and then only in terms of the distance between pixels. Hence, ViS is pixel center-oriented. So, in reality, we are dealing with a pixel coordinate space.

Start Calibration (Manual)

Start the calibration using Main Menu -> Measurement -> Calibration, the calibration dialog box shall be appeared as shown in below,



Then, load or open an image with already known dimension,



- **Note:** User can opt to update the calibration for an axis (e.g. X or Horizontal) at a time.

Select if you wish to

- 1 **Create a new calibration or**
- 2 **Update the existing calibration**

- Then, for the above case, adjust the 2 horizontal lines to fit the known dimension ruler lines (e.g. 10mm, depending on your own dimension),
- Select the appropriate unit and decimal point (for your measurement result display in future),
- Enter the known dimension for the lines Y-distance (e.g. 10mm),
- Enter your name,
- After that, click the “Update Y” to update the calibration value for Y direction.


Now, load another image with known dimension for calibrating X direction and repeat the above steps. Click “Close” to return. Please note that “Close” won’t save or update the calibration except the “Update X” and “Update Y” buttons. So, make sure to click these any of these 2 buttons to save the value.


Measurement


The measuring operations of VIS are the digitized method of the more traditional planimetry with optical system, e.g. microscope, zoom lens etc. A measuring operation of VIS generates one or more pieces of output information. Each operation results at least in some graphics on the target image. Most operations also create textual annotation describing the quantitative outcome of the measuring operations, and entries in the table of the table of the measurement results windows.





To perform the image measurement, open an image and select an appropriate tool and start measure on the image. To select the first point and the current mouse position. The second click ends the measurement. A short description showing the distance will appear in a text box annotation. A new entry will be appended to the measurement results box. Measurement to hold the value of the distance


-  Measure distance between 2 straight horizontal lines; no matter where your cursor is, the line will be always horizontal.
- Move and click to specify two lines. A movable horizontal line is being drawn during the line selection. The second click ends the measurement.

-  Measure distance between 2 straight vertical lines; no matter where your cursor is, the line will be always vertical.
- Move and click to specify two lines. A movable vertical line is being drawn during the line selection. The second click ends the measurement.

-  Measure Angle
- Click to specify three controlling points. The angle made by the line passing through the 1st and the 2nd point, and the line passing the 2nd and 3rd point, will be measured. To to thatm, hold down the mouse from the first point and release it at the second point, then click again at the third (last) point to complete.

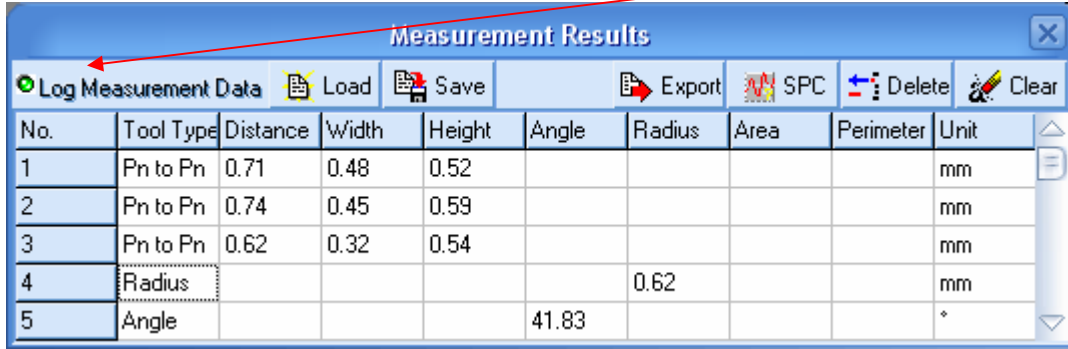
-  Measure ellipse diameter in X(Width) and Y(Height) directions.
- When this feature is enabled, a movable and sizable circle will appear on the image. Move and adjust the circle to fit on the object and finally double click the circle to complete the measurement.

-  Measure area and perimeter of a rectangle.
- When this feature is enabled, a movable and sizable rectangle will appear on the image. Move and adjust the rectangle to fit on the object and finally double click the rectangle to complete the measurement.

-  Pitch measurement is to measure distance between 2 center points of circle.
- When this feature is enabled, a movable and sizable circle will appear on the image. Move and adjust the circle to fit on the first object and finally double click the circle to find the first center. Then, repeat the same on the second object and double click to complete that measurement.

Measurement Results Window

When a measurement task is performed, the measurement results shall be recorded in the measurement table. User may opt not to log the measurement result automatically by uncheck the “Log Measurement Data” option.



| No. | Tool Type | Distance | Width | Height | Angle | Radius | Area | Perimeter | Unit |
|-----|-----------|----------|-------|--------|-------|--------|------|-----------|------|
| 1 | Pn to Pn | 0.71 | 0.48 | 0.52 | | | | | mm |
| 2 | Pn to Pn | 0.74 | 0.45 | 0.59 | | | | | mm |
| 3 | Pn to Pn | 0.62 | 0.32 | 0.54 | | | | | mm |
| 4 | Radius | | | | | 0.62 | | | mm |
| 5 | Angle | | | | 41.83 | | | | ° |

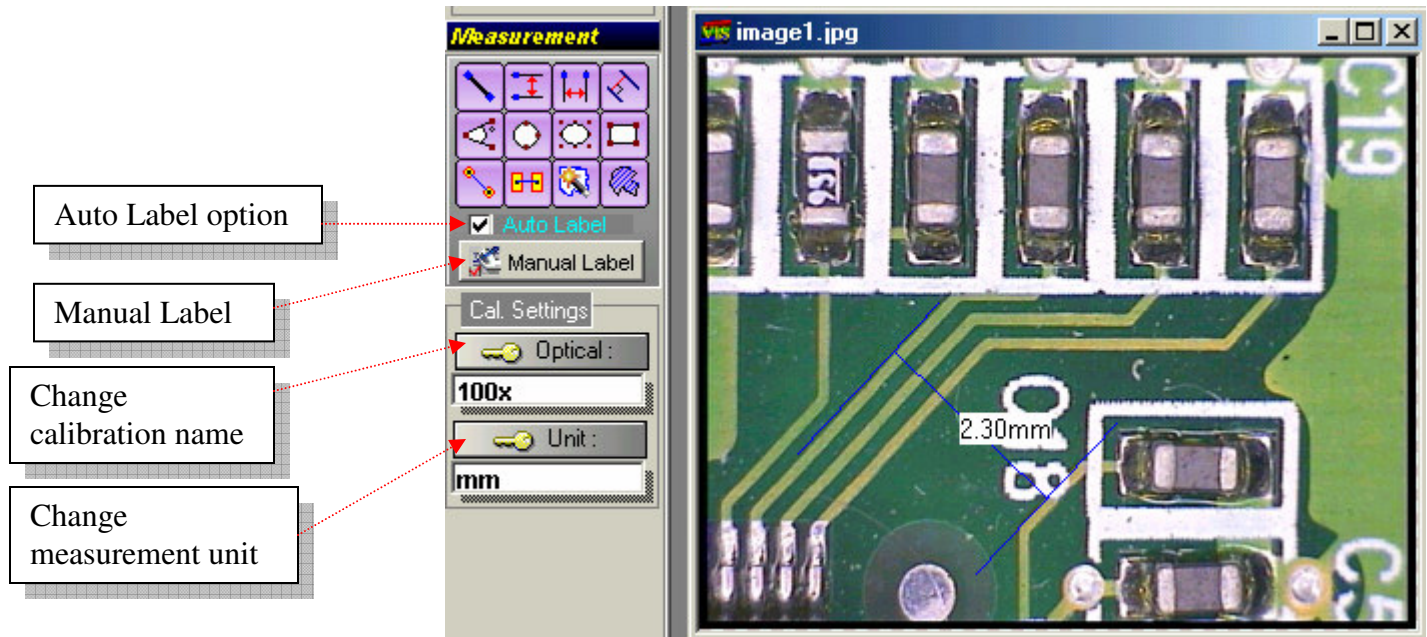
Measurement results can be saved and loaded from a file in VIS file format. Anyway, VIS also allow user to export the data to other formats for viewing or saving, e.g. Excel, Word, HTML etc..

Embedded Measurement Data

There is a special feature of VIS which allow user to embed the measurement data directly into the image itself with creating any external file. To do that, right-click on the image and a pop-up menu shall appear and then select the “Attache Measurement Data” to store the data into the image. And to recall the data from the image, select the “Retrieve Measurement Data” from the same menu again. This feature is useful to retain the measurement data for further calculation, processing, SPC charting etc. purposes later. But, this feature is only applicable to image file saved in “.BMP” format only.

Measurement Tools

When a measurement task is performed, the measurement results shall be recorded in the measurement table. Besides, when the measurement dimension result labeling is needed, ViS provides auto dimension result labeling (by checking the “Auto Label” shown below) or manual labeling by clicking the “Manual Label” button shown below,



Optical Settings Changed

Important -- user must take note that when the optical setting is changed (e.g. Zoom factor), the current calibration or conversions factors are no longer valid. In this case, user can either re-calibrate the system following the calibration steps mentioned in the earlier topic or use/change the calibration setting to the pre-calibrated setting, and this can be done by clicking on the “optical” button shown above or choose the appropriate pre-calibrated name.

Change Measurement Unit

Besides, when the measurement unit other than the calibrated unit is needed, ViS provides an option for user to change to other measurement units (e.g. mm, cm, mil, micron and so on). Click on the “unit” button (as shown above), user can select their preferred measurement unit in a dialog box and ViS shall automatically convert all the conversion factors according to the new measurement unit.

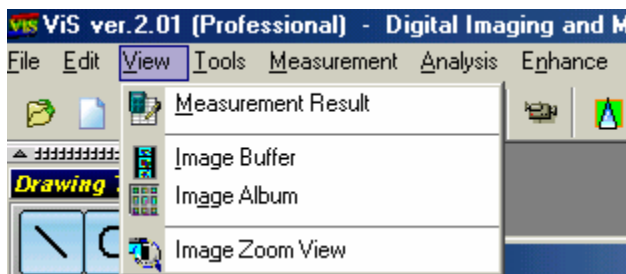
Change Decimal Point

To change the decimal point format for the measurement results, users don't need to re-calibrate or go to the calibration dialog for doing so. From the menu -> Measurement -> Change Decimal Point Format, user may do the changing here easily.

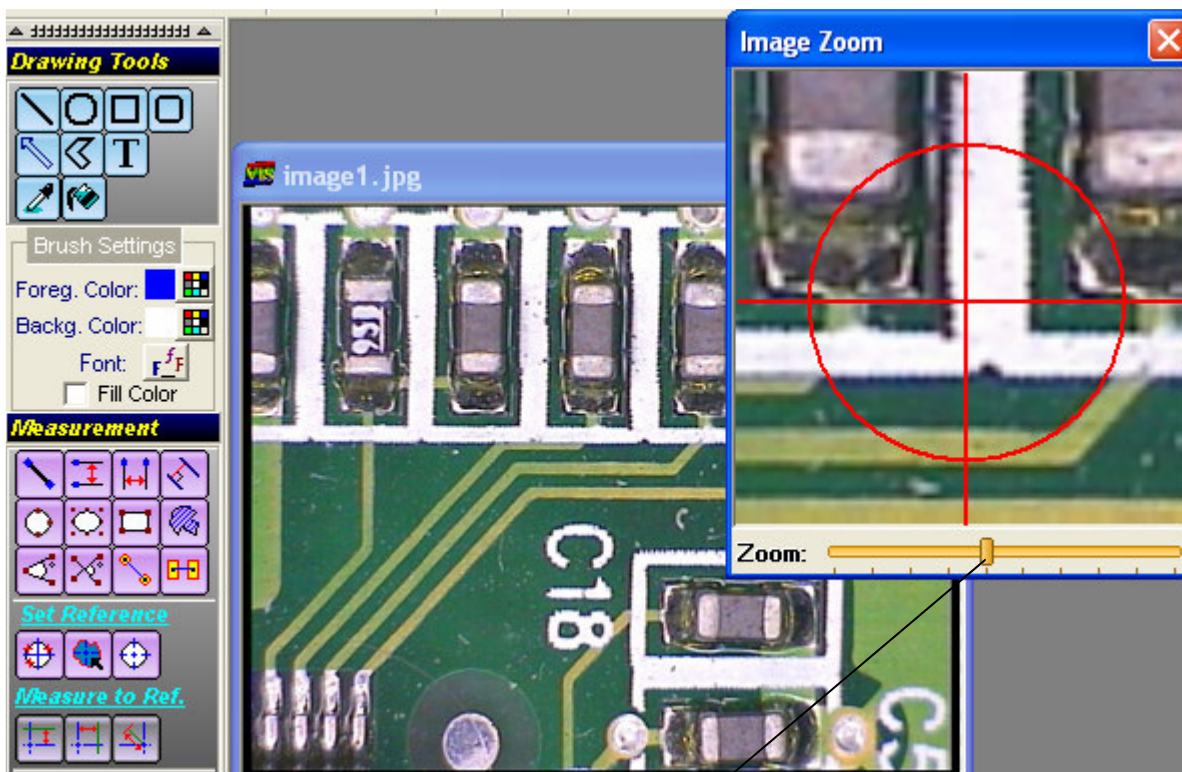
Image Zoom View

This tool is used for enhancing the image viewing or locating especially during measurement and analysis. It is basically a real time digital image zoom windows that showing the zoomed image of the region of image at the current mouse cursor position in the opened image. ViS eliminates the pixilation effect on the zoomed image using an advanced and fast digital zoom technique.

To activate it, simply select the “Image Zoom View” under the Pull-Down menu – View.



The Image Zoom Windows shall be displayed like below. Then, move the mouse cursor over any opened image (either in measurement or normal mode), and this windows will show the real time digital zoomed image of the image region of the mouse cursor position.



Adjust the view zoomi factor

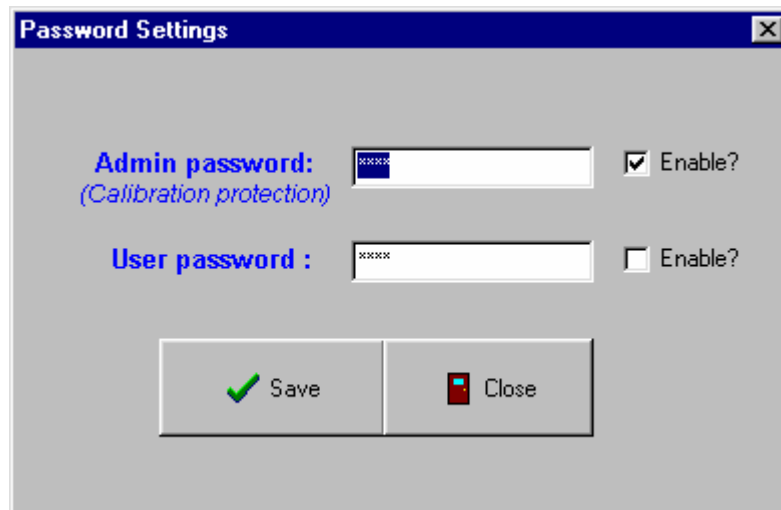
1.5 Password Protection Settings

ViS also provides basic security functions to protect ViS against unwanted access by the user without permission, and prevents unnecessary intervention to the calibration data. Anyway, these security features can be enabled or disabled anytime.

Basically, it has two levels of security password,

- 1.) **Admin Password** : Password to access and modify “Password Settings” menu and protect calibration data from any unnecessary intervention.
- 2.) **User Password** : Password for the normal users to run ViS software. When this feature is turned on, every execution of ViS is password needed!

To modify the “Password Settings”, click the pull-down menu “File” and “Password Setting”. For the first time, this setting is not protected as the Admin password is still blank. After Admin password is entered, the “Admin password” is needed to access this feature. Then, a dialog box like below is shown,



To turn on the protection for calibration, enter the Admin password and check the first “Enabled?” checkbox to enable it! And do the same to the “User Password” setting!

A

Accuracy - The extent to which a machine vision system can correctly measure or obtain a true value of a feature. The closeness of the average value of the measurements to the actual dimension.

Area - Portion or area of the image to be analyzed. Area analysis measures the number of pixels which fall in a specified range of gray levels for the feature of interest.

B

Background - The part of a scene behind the object to be imaged.

Bandpass Filter - An absorbing filter which allows a known range of wavelengths to pass, blocking those of lower or higher frequency.

Binary - An image with pixel values either one or zero.

Binary image - A black and white image represented as a single bit containing either zeros and ones, in which objects appear as silhouettes. The result of backlighting or thresholding.

Bit Map - A representation of graphics or characters by individual pixels arranged in rows and columns. Black and white require one bit, while fancy high definition color up to 32.

Brightness - The total amount of light or incident illumination on a scene or object per unit area. Also called intensity.

C

Calibration - The act of relating X and Y pixel spacing to a known or predetermined pixels per unit length (ie inch, mm) factor. Often involves adjusting the imager position in setup.

CCD - Charge Coupled Device. A photo-sensitive image sensor implemented with large scale integration technology.

Centroid - The center of mass of an object having a constant density, or of an object having varying density, weighted by the gray scale value.

Closing - A dilation followed by an erosion. A morphological operator useful to close holes and boundaries.

Color - A visual object attribute which may be described by a "coordinate system" such as hue, saturation and intensity (HSI).

Composite Video - A television signal which is produced by combining both a video or picture signal with horizontal and vertical synch and blanking signals.

Contrast - The difference of light intensity between two adjacent regions in the image of an object. Often expressed as the difference between the lightest and darkest portion of an image. Contrast between a flaw or feature and its background is the goal of illumination.

Contrast Enhancement - Stretching of the gray level values between dark and light portions of an image to improve both visibility and feature detection.

Convolution - Superimposing a $m \times n$ operator (usually a 3x3 or 5x5 mask) over an area of the image, multiplying the points together, summing the results to replace the original pixel with the new value. This operation is often performed on the entire image to enhance edges, features, remove noise and other filtering operations.

D

Depth-of-field - The range of an imaging system in which objects are in focus.

Digital Camera - The newest generation of video cameras transform visual information into pixels, then translate each pixel's level of light into a number in the camera.

Digital-to-Analog Converter - A VLSI circuit used to convert digital computer processed images to analog for display on a monitor. DAC is the acronym.

Digital Image - A video image converted into pixels. The numeric value of each pixel's value can be stored in a computer memory for subsequent processing and analysis.

Dilation - A morphological operation which moves a probe or structuring element of a particular shape over the image, pixel by pixel. When an object boundary is contacted by the probe, a pixel is preserved in the output image. The effect is to "grow" the objects.

E

Edge - A change in pixel values exceeding some threshold amount. Edges represent borders between regions on an object or in a scene.

Edge Detection - The ability to determine the true edge of an object.

Edge Operator - Templates for finding edges in images.

Erosion - The converse of the morphology dilation operator. A morphological operation which moves a probe or structuring element of a particular shape over the image, pixel by pixel. When the probe fits inside an object boundary, a pixel is preserved in the output image. The effect is to "shrink or erode" objects as they appear in the output image. Any shape smaller than the probe (ie noise) disappears.

F

Field-of-view - The 2D area which can be seen through the optical imaging system. (FOV)

Filtering - The use of an optical filter for picture or color enhancement in front of the camera lens or light source. Also analog or digital image processing (IP) operations to enhance or modify an image. May be linear & non-linear.

Filter - A device or process that selectively transmits frequencies. In optics, the material either reflects or absorbs certain wavelengths of light, while passing others.

Focal Length - The distance from a lens' principal point to the corresponding focal point on the object.

Focus - The point at which rays of light converge for any given point on the object in the image. Also called the focal point.

Frame - The total area scanned in an image sensor while the video signal is not blanked. In interlaced scanning, two fields comprise one frame. Frame rate is typically 30 Hz.

Frame Grabber - A device that interfaces with a camera and, on command, samples the video, converts the sample to a digital value and stores that number in a computer's memory.

G

Gamma - The numeric value for the degree of contrast in a television picture. The exponent in the power law relating output to input signal magnitude. Non-linear camera tube.

Gray level - A quantized measurement of image irradiance (brightness), or other pixel property typically in the range between pure white and black.

Grayscale Image - An image consisting of an array of pixels which can have more than two values. Typically, up to 256 levels (8 bits) are used for each pixel.

H

High Pass Filter - Passes detailed high frequency image information, while attenuating low frequency, slow changing data.

Histogram - A graphical representation of the frequency of occurrence of each intensity or range of intensities (gray levels) of pixels in an image. The height represents the number of observations occurring in each interval.

Histogram Equalization - Modification of the histogram to evenly distribute a narrow range of image gray scale values across the entire available range.

HSI Conversion - A mathematical conversion from the color RGB space to hue, saturation and intensity values.

HSI - An acronym for the Hue-Saturation-Intensity color representation. A mathematical conversion from RGB. Often used for machine vision analysis.

Hue - One of the three properties of HSI color perception. A color attribute used to express the amount of red, green, blue or yellow a certain color possesses. White, gray and black do not exhibit any hue.

I

Image Analysis - Evaluation of an image based on its features for decision making.

Image Capture - The process of acquiring an image of a part or scene, from sensor irradiation to acquisition of a digital image.

Image Enhancement - Image processing operations which improve the visibility of image detail and features. Usually performed for humans.

Image Processing - Digital manipulation of an image to aid feature visibility, make measurements or alter image contents.

L

Laplacian Operator - The sum of the second derivatives of the image intensity in both the x and y directions is called the Laplacian. The Laplacian operator is used to find edge elements by locating points where the Laplacian is zero.

Low Pass Filter - A digital or optical filter which passes slow changing, low frequency information, while attenuating high frequency, detailed edge information.

M

Morphology - Image algebra group of mathematical operations based on manipulation and recognition of shapes. Also called mathematical morphology. Operations may be performed on either binary or gray scale images. Parallel processors are useful to implement.

O

Orientation - The angle or degree of difference between the object coordinate system major axis relative to a reference axis as defined in a 3D measurement space.

P

Pixel - An acronym for "picture element." The smallest distinguishable and resolvable area in an image. The discrete location of an individual photo-sensor in a solid state camera.

Pixel Counting - A simple technique for object identification representing the number of pixels contained within its boundaries.

Precision - The degree of spread or deviation between each measurement of the same part or feature. Repeatability.

R

Region - Area of an image. Also called a region of interest for IP operations.

Repeatability - The ability of a system to reproduce or duplicate the same measurement. See precision. The total range of variation of a dimension is called the 6-sigma repeatability.

Resolution, Pixel Grayscale - The number of resolvable shades of gray (ie 256).

Resolution, Image - The number of rows and columns of pixels in an image.

Resolution, Spatial - A direct function of pixel spacing. Pixel size relative to the image FOV is key.

Resolution, Feature - The smallest object or feature in an image which may be sensed.

Resolution, Measurement - The smallest movement measurable by a vision system.

RGB - An acronym for the Red-Green-Blue color space. This three primary color system is used for video color representation.

ROI - Region of Interest.

S

Saturation - The degree to which a color is free of white. One of the three properties of color perception along with hue and intensity (HSI).

Shape - An object characteristic, often referring to its spatial contour.

Sharpening - An IP operation which enhances edges. An unsharp mask adds a low pass filtered image to the original, resulting in edge enhancement.

Sobel Transform - A 3x3 convolution used for edge enhancement and locating.

T

Thresholding - The process of converting gray scale image into a binary image. If the pixel's value is above the threshold, it is converted to white. If below the threshold, the pixel value is converted to black.

V

VGA - An acronym for Video Graphics Array. The IBM video display standard of 16 colors.

Video - Visual information encoded in a specific bandwidth and frequency spectrum location originally developed for television and radar imaging.

W

Window - A selected portion of an image or a narrow range of gray scale values.