Virtual Optical Comparator

Federal Manufacturing & Technologies

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Abstract

The Virtual Optical Comparator, VOC, was conceived as a result of the limitations of conventional optical comparators and vision systems. Piece part designs for mechanisms have started to include precision features on the face of parts that must be viewed using a reflected image rather than a profile shadow. The VOC concept uses a computer generated overlay and a digital camera to measure features on a video screen. The advantage of this system is superior edge detection compared to traditional systems. No vinyl charts are procured or inspected. The part size and expensive fixtures are no longer a concern because of the range of the X-Y table of the Virtual Optical Comparator. Product redesigns require only changes to the CAD image overlays; new vinyl charts are not required. The inspection process is more ergonomic by allowing the operator to view the part sitting at a desk rather than standing over a 30 inch screen. The procurement cost for the VOC will be less than a traditional comparator with a much smaller footprint with less maintenance and energy requirements.

Summary

The Virtual Optical Comparator was conceived during the procurement of design gages for the W76-1 mechanisms. The WR-1 Dual Stronglink Mechanism has similar features. Piece part designs included many critical features that are machined on the face of a part. Traditionally these features are checked on optical comparators using reflected light to illuminate the part surfaces. The part tolerance required the use of at least 50 X magnification. At this magnification the light intensity of the best comparators are marginal to see reflected part features. The edge breaks can be confused with the part edge. The 50X magnification makes many part images too large for a 30 inch comparator. This required the use of expensive fixtures so the part could be shifted to check portions of the part separately. This is a slow and tedious process.

The Virtual Optical Comparator uses a CCD camera to obtain the image of the part feature. This allows part surfaces to be more easily illuminated and viewed. Parts would be mounted on a precision X-Y stage so that the part image can be viewed in one set up. A CAD image of a traditional comparator chart would be overlaid over the part image on the monitor. It could be set and rotated to fit it to the part similar to traditional comparator charts. The part features can then be checked within the CAD image lines the same way traditional charts are used. Two advantages of this system are superior edge detection, and no vinyl charts procurement or inspection. Furthermore, the part size and expensive fixtures are no longer a concern because of the long range of the X-Y table; as the table moves the CAD image will move precisely in synch. Product redesigns require only changes to the CAD image. Additionally, the inspection process will become more ergonomically efficient by allowing the operator to view the part sitting at a desk rather than standing over a 30 inch screen. The procurement cost for the VOC will be less than a traditional comparator with a much smaller footprint with less maintenance and energy requirements.

Discussion

Scope and Purpose

The purpose of this project is to determine the feasibility of using CAD created overlays with a CCD camera, a Virtual Optical Comparator, to measure product limits. The current use of optical comparators is not suitable for use with many current W76 Stronglink parts and development WR1 stronglink parts. The scope of this project is to develop software, design, and build a Virtual Optical Comparator. The system will be evaluated to determine its suitability for use and ability to replace the optical comparators currently in use.

Prior Work

The first instance of Honeywell FM&T using a CCD display with a digital overlay was for contact inspection for an MC4713. The contacts needed to be adjusted within $\pm .001$ inch. The contacts for a previous similar product (MC3600) used an optical comparator and an overlay. The contact adjustment and acceptance was very difficult and tedious. The MC4713 uses a flat screen monitor and a computer generated overlay to inspect the contacts. The overlay used was fixed and the part was manipulated to check multiple contacts. The contacts are easily visible and the contacts can be seen as they are manually adjusted.

From this concept, it was conceived that if the digital overlay could be moved with the part it would be possible to inspect parts in a similar manner as an optical comparator but with the advantages of better optical resolution and greater range.

Activity

After the Virtual Optical Comparator was determined to be a suitable project an order was placed with Industrial Products Group, Inc in Minneapolis. They had already built the video equipment to inspect some electrical contacts using a digital overlay and were well suited to develop this project. The concept was to build a low cost chassis and concentrate on developing the software and hardware to create a moveable digital overlay. The pattern wheel for the WR1 DSSL stronglink was used as a test part. The TSL Pattern Wheel was a good candidate because it contains most of the difficult to measure features we expect to see in the future.

The chassis consists of a 6" X 6" x-y table and a fixed camera mount. The table uses Sony glass scale encoders accurate to $\pm .0001$ ". The camera is a 1 megapixel Hitachi with a 1" x 1 1/8" chip. It uses a Computar TEC-55 telecentric lens. A Samsung Synchmaster 243T LCD monitor is used for a display. It is a 24" unit with 1920 x 1200 lines of resolution.

The digital overlays are created from the PRO E model drawings of the part. The drawings are modified as required to add contour and positional limits. This file is saved in a DXF format then converted to a TIF image. The two overlays for the Pattern Wheel were created in one hour. For calibration purposes a similar overlay was created to match a calibrated glass grid. A 1 or 2 inch square is drawn around the part image. The square is used by the software to locate and orient the digital image. The appropriate part datum must be located at the center of the square. The resultant TIF images are 12MB in size.

Below is an image of the test system.

Figure 1. Picture of System

Figure 2. Traditional Optical Comparator

Figure 3. Sample Part Drawing

This is the digital overlay that was created from the Pro-E model of the part. This file is loaded into the program memory. It takes approximately 30 minutes to create the overlay.

Figure 4. Digital Overlay

First align the center circle of digital overlay with the part datum B using the X-Y adjustment tools.

Figure 5. Screen Shot of System Use I

Then move the image with the joystick to observe part datum C. You can see the digital overlay is not aligned.

Figure 6. Screen Shot of System Use II

Using the rotation tool you can rotate the image about the center circle and align it with part datum C. The center circle will remain balanced on part datum B.

Figure 7. Screen Shot of System Use III

The joystick is used to position the image along the part contours. The part image should remain inside the two overlay lines. The part we are using did not conform to the drawing.

Figure 8. Screen Shot of System Use IV

Another view of the contour.

Figure 9. Screen Shot of System Use V

The inspection results seen here correlated with the CMM data that had been taken on the part.

System Calibration

The concept of a visual, on-screen "overlay" that represents the calibration standard (or, in the practical sense, a part to be measured) makes the calibration process much more intuitive and thus, simpler to implement.

The current system could be expected to achieve a certification in the range of ± 0.0002 to ± 0.00025 inch (XY Planar). The current system was examined only over a range of approximately 1 square inch. Optical Comparators are currently calibrated to ± 0.0003 inch at 100 X magnification.

To aid calibration, additional software tools were requested for setting up the measurement origin and alignment (rotation of skew), such that the calibrator could set relative (part coordinate system) zero at a point of his/her choosing. Also requested was a crosshair-type mechanism that would be available on-screen. This mechanism would be used as a sort of datum to make measurements of deviations from nominal geometry (i.e. to quantify the amount that a part feature deviates from the nominal or allowable).

Accomplishments

This project validated the Virtual Optical Comparator concept. It showed that a digital image can be created through the PRO-E part model. The image can be modified to add acceptance limits for the part. The image can be stored in Matrix for documentation and SQA. The digital image can be overlaid and dimensionally reference a live video image of a part.

The live part image is superior to traditional optical comparators and will allow simpler and more robust inspection of a stronglink product. The footprint of the system allows its use on a desktop, and it can be used by an inspector seated in a chair. Vinyl overlays will not be required to be designed, fabricated, or calibrated. The flow time for overlays can be reduced from several months to several days. The costs for overlay fabrication and calibration will be eliminated.

Future Work

The activity will involve identifying and procuring an existing commercial chassis for the system, and investigating CCD cameras that will provide greater depth of field and resolution along with newer monitors. Additionally, the software will be modified for easier calibration and basic operation. This system will be formally calibrated and used on existing products. The goal is to be able to produce a system costing \$40K or less that can replace traditional optical comparators.

Appendix 1
Operating Manual

Video Comparator
Users Manual

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1. Introduction

1-A System Overview

The Video Comparator is designed to import native CAD drawings, in DXF format, to create an overlay which then can be used to compare with a live image of the object to be inspected. The primary hardware components consist of:

- A high-resolution monochrome video camera
- An X-Y motorized stage, controlled by a joystick
- A polarizing ringlight and analyzer
- Large screen color monitor
- Computer with image capture and processing capabilities.

Utilizing custom software, the Video Comparator will display an overlay on top of a live image with a combined resolution up to .0001". The joystick can then be used to traverse the stage and compare features anywhere within the limits of the 6" x 6" travel. Once the overlay is positioned correctly over the live image, the overlay will "pan" with the stage travel. The polarizing fiber optic ringlight and analyzer provides the sharpest, most glare-free image possible on a wide range of materials and finishes.

1-B Specifications

Camera:

Hitachi KP-F200CL-S1

Effective Picture Element:	1/1.8" CCD 1628(H) x 1236(V)
Frame rate	30 frames per second
Video output	Digital or analog for image checking
Sync system:	Internal
Aspect ration	4:3
Digital output	Camera-Link
Lens mount	C-mount
Electronic Shutter:	1/30 to 1/50,000 sec
Power Supply:	12V DC

Lens:

Computer TEC-55 telecentric lens, 2/3" format, 55.0mm focal length, F2.8, manual iris and manual focus. C-Mount

Monitor:

The Samsung SyncMaster 243T is a pivoting 24.0" analog/digital LCD display that offers a 500:1 contrast ratio, 1920 x 1200 resolution, pixel pitch of 0.270mm H/V, Xtrawide viewing angle, scanning frequency of 30-81kHz horizontal and 56-75 vertical, and dual inputs to accommodate either an analog or digital signal.

Panel Size: 24"

Brightness (Typical): 300 cd/m²
Contrast Ratio: 500:1
Viewing Angle (H/V): 170/170 (degrees)
Interface: Analog/Digital
Horiz. Frequency: 30-81 (kHz)
Max/Native Resolution: 1920x1200
Pivot Technology: Yes
Special Features: Narrow Bezel Design, Pivot Technology, Ergonomics, Height Adjustment and Swivel, Dual CPU Input

Linear Encoders:

Manufacturer: Sony
Model: SR118 Magnetic miniature scale for small-size linear stages
Travel: 15mm up to 260mm
Accuracy: +/- 2µm, +/- 2.5µm, +/- 3µm
Resolution: 0.5µm
Reference points: Optional external
Measuring system: Magnetic
Max response speed: 60m/min
Protection design grade: To IP44
Air purge: No
Output cable (connector): Hirose M2-7P
Cable length: 300mm braided cable, cables 3,5,10,15m.
Output type: Requires Sony interface for A/B phase signal

Computer and Login:

Manufacturer: Dell
Model: Precision 690
Login: Mike Beauchene, no password

2. System Setup

2-A Camera Calibration

Camera calibration consists of two steps, first calibrating optical magnification, second calibrating of camera bracket alignment. In order to calibrate the optical magnification, an NIST certified reference standard is recommended. The ideal reference standard should consist of a rectangular target slightly smaller than the camera field of view (FOV). Since the FOV is fixed at $\approx .070''$ (horizontal) x $.053''$ (vertical), a reference standard with marks about .063 apart horizontally and .048 apart vertically (or about 90% of the field of view) will give maximum accuracy. For the purposes of this manual, a reference standard with a dot pattern was used to show the procedure.

Camera Calibration Procedure:

1. Launch the Video Comparator software by either selecting the Start → All Programs → IPG → VideoComparatorProject, or by double-clicking the icon on the desktop.

Figure 1

2. Once the program opens, select “Begin Process” in the Mode Selection dialog box.

Figure 2

3. Place the reference standard on the stage surface. Adjust the illumination and focus height of the camera to give the sharpest image. Align the standard with the edges of the field of view, and

Figure 3

4. From the Menu bar, select "User" → Login, Figure 4.

Figure 4

5. **Enter the default login name: "Joe" and the default Password: "Joe"**. In the Setting Dialog box that opens, Figure 5, you may change the user name and password. On the CalibrationX and the CalibrationY lines, enter the respective distances between the reference marks on the standard you are using to calibrate the optics, Figure 5.

Figure 5

Click OK to close the dialog box.

6. Press the “Perform Calibration” button in the Mode Selection dialog box, Figure 6

Figure 6

A flashing reticle will appear in the center of the FOV. Use the arrow buttons in the Setting pane on the far right-hand side of the screen to move the reticle to the lower left-hand target on the reference standard. The amount the reticle moves for each click of the arrow button can be adjusted from “Small Moves” to “Large Moves” in the Manual Motion area of the Settings Pane: Figure 7

Figure 7

Adjust the size of the reticle circle by moving the adjusting slider, Figure 8.

Figure 8

7. Once the reticle is positioned as close as possible over the lower left-hand target, click the "Set 0-0" button.
8. Move the reticle using the arrow buttons to the upper right-hand target. Once the reticle is positioned as close as possible over the right hand target, click the "Set XY" button.
9. The camera and optics are now calibrated.
10. Now after calibrating the magnification, the camera adjustment bracket must be calibrated. **(The bracket has been calibrated before shipping)** There are 3 axis about which the camera must be calibrated:
 - a. Roll
 - b. Pitch
 - c. And Yaw.

The Roll adjustment will rotate the camera about the axis of the lens. This must be aligned with the X-Axis of the stage motion. Place a straight edge on the stage surface aligned with the X-Axis. Traverse the stage in the X direction and watch the image from the camera to check for edge creep. If the edge creeps as the stage travels in the X direction, adjust the alignment of the straight edge until it remains stationary in Y as the stage traverses in X. Use the straight edge to check the alignment of the camera by carefully moving the stage in the Y-axis until the straight edge is aligned with the edge of the Field of View. If the camera Field of View is not aligned with the straight edge, loosen the screws in Figure 9, and adjust the Roll until they are aligned.

Tighten the screws.

Figure 9

The Pitch and Yaw adjustment will be done by using a flat reference with marks that reach to the edges of the Field of View. Place the reference on the stage surface. Adjust the focus height of the camera for the sharpest image. Carefully inspect the left and right sides of the image for sharpness. If the left and right edges of the image are not both in focus, the Yaw needs to be adjusted. Loosen the screws for the Yaw adjustment, Figure 10, and adjust the Yaw until the image is equally focused on the left and right side of the image.

Figure 10

Repeat the same procedure using the top and bottom of the image for the Pitch adjustment. If the top and bottom of the image are not equally in focus, loosen the 3 Pitch Locking screws in Figure 11. Carefully adjust the Pitch Adjustment screw to make changes in the Pitch of the camera. When the image is equally in focus from top to bottom, tighten the Pitch Locking screws.

Figure 11

The Camera and Optics are now calibrated.

2-B Stage Calibration

Stage Calibration requires the use of a glass standard or precision ground square or rectangular gage block. Then loading a DXF overlay of the standard (as covered in section 4-C) then using the overlay you will be able to study the status of the stage alignment. If adjustment is needed the stage may be adjusted.

The X and Y axes of the stage pivot about each other from a center pin. Located out from the center you will find four 1/4-20 socket head cap screws that lock the two axes in alignment. To adjust, these screws must be loosened, Figure 12.

Figure 12

2-C Windows® Settings

The Windows® settings are optimized for performance. These settings must be maintained for the consistent operation of the video comparator software. The video comparator software is very resource hungry especially when it comes to system memory. All other programs should be terminated before starting the video comparator software program. No other programs should be run at the same time as the Video comparator to avoid memory conflicts.

3. DXF Conversion

3-A Concept

In this section we will cover the basic concepts for DXF conversion for the Video Comparator. The requirements for all DXF files will be:

1. All DXFs will be created with a scale of 1:1
2. The DXF file will need to have a 1 pixel boarder.
3. The part to be inspected may have a reference origin which will be centered in X and Y and not exceed the boarders.
4. Line color is black, background is white

Figure 13

3-B DXF conversion procedure

Procedure for converting DXF files.

1. Launch the program “Any DWG to Image Converter Pro” from the Start menu or by double-clicking the icon on the desktop. The interface looks like Figure 14.

Figure 14

Insure that the Output Format in “Options” area is set to TIFF, the Compression is “None” and the Output Folder is where you can find it again (the default is C:\Program Files, Industrial Products Group).

Figure 15

2. Click on the “Options” button. The Options dialog box opens, Figure 15. Under “Output Sizes and Colors” select “Custom” for Sizes. Enter the size of the final image in pixels. Remember to make the pixels the same proportion as the original DXF file size, I.E. if the DXF was a square, enter the same number of pixels for both Width and Height. In general, the higher the number of pixels, the greater the resolution of the resulting image. However, the image must be greater than 1,600 x 1,600 pixels and less than 24,000 x 24,000 pixels.
3. The “Margin” must be “0” pixels.
4. The “Output color” must be “Black/White”
5. The “Background color” must be Black.
6. Select “Rename (automatically increment the filename)”
7. On the left-hand frame under “Options Catalog:” choose “Output Layout”
8. Under “Output layout”, select “Model space Figure 16

Figure 16

9. On the left-hand frame under “Options catalog” select “Line Width (Pen Width)”, Figure 17.

Figure 17

Under “Line width (Pen width)” select “Default width” and enter “0”.

10. Under “Curve precision setting” both “Arc interpolation quality” and “Clip boundary quality” may be set as high as “50”. The larger the number, the greater the resolution of the converted image.
11. Select “OK” to close the Options dialog box.
12. Select “Add a File” and navigate to the DXF file you wish to convert.
13. Click “Convert Now”. A window will open with the new TIFF file in it.
14. You may want to convert a batch of individual DXF files at a time. The program will allow such batch processing.
15. Once you have successfully completed converting a DXF file to a TIFF file, click “Exit” to close the program.

4. Operation

4-A Powering on the system

Turn the power on the system by turning on the power supply for the stage and camera. Turn on the fiber optic light source. Turn on the computer. At the login screen, click the single icon. Once you have logged in, launch the Video Comparator program, Figure 18.

Figure 18
Click the “Begin Process” button in the Mode Selection box to turn on the live image. Watch the prompts in the Status window.

4-B Loading Parts For Inspection

Place the part to be inspected anywhere on the stage surface. If you are planning to do multiple inspections on identical parts, we recommend using a fixture to repeatedly position the parts accurately. Use the manual Joystick to move the stage so that the origin of the part is within the Field of View of the camera.

4-C Loading Image For Overlay

This section assumes that an image file has been created following the concepts presented in section 3-A.

After fixturing the part to be inspected as described in section 4-B you are ready to load an image for overlay.

1. The first step is to select a size format from the drop-down menu under “Settings”, Figure 19. Select “Overlay Size X” and enter the actual size in inches of the converted DXF image. Repeat for “Overlay Size Y”.

Figure 19

2. In the Mode Selection box, select “Load New Overlay”. Navigate to the image file for the part being inspected. Select the tiff file and click OK. To confirm that the file is the correct size, check

Figure 20

In the example above, the size of the image is 1 x 1 Inches. If this does not correspond to the actual size, go back to Step 1 above and change the “Overlay Size X” and “Overlay Size Y”. If the information in this box is correct, click the “Overlay Load Complete” button. Click the “Perform Inspection” button.

3. The overlay image always opens with the lower left-hand corner of the original DXF in the center of the screen, Figure 21.

Figure 21

4. To move the center (or origin) of the overlay to the center of the screen, click “Reset Encoders” in the Mode Selection dialog box, Figure 22.

Figure 22

4-D Aligning Part With DXF Overlay

The procedure for aligning the overlay with the part is as follows:

1. Move the overlay using the arrow buttons on the Manual Motion palette, not the Joystick for the stage, Figure 23.

Figure 23

You may select between small or large moves to adjust how fine or coarse the overlay image moves for each click of the arrow buttons.

2. The overlay image can be rotated using the “CW” (clockwise) and “CCW” (counter-clockwise) buttons. It may be easier to center origin of the overlay image over the origin of the live image of the part before rotating the overlay. Once the overlay is positioned in X and Y over the origin of the part, you can move the stage using the joystick so that the feature furthest from the origin is in the field of view. It is now easier to rotate the overlay accurately over the part being inspected.
3. Double check the alignment of the overlay by traversing the stage to different positions on the part. Once you are satisfied the overlay is positioned adequately, your inspection can proceed.

4-E Inspection

In this section we will go over the general practices for using the video comparator. For general inspections the operator will maneuver the part under the camera using the Joystick while making a visual inspection of the part. If there is a problem seeing the overlay, you have the option to change the overlay tint. Use the slide control on the Settings palette to adjust the overlay tint. Inspection procedure:

1. Use the Joystick to manually traverse the stage to all points of interest of the part under inspection. The speed of the stage can be controlled using the knob directly above the Joystick control. Turn the knob clockwise for faster stage travel
2. You may hide the Mode Selection dialog box by choosing View from the menu and clicking Mode Selection.
3. It is a good practice to return the stage to the origin of the part before completing the inspection.
4. After you are finished inspecting the part, click the “Inspection Complete” button on the Mode Selection dialog box.
5. If you are repeating an inspection of an identical part, click “Use Current Overlay from the Mode Selection dialog box. This will reload the same overlay.

4-F Measurements

The video comparator has the added capacity to make some basic measurements. As you see on the right hand side of the program window there are X and Y position Readouts. These readouts will automatically set the part origin at zero but you have the ability to set the zero and measure incrementally.

5. Maintenance

5-A Cleaning

Stage:

The video comparator stage is equipped with stepper motors that direct drive a lead screw. The lead screw may require an occasional film of high quality grease. There are covers for both the X-axis and Y-axis the stage. Removing these covers will provide access for lubricating the lead screws and bearings.

Lens:

The telecentric lens that the video comparator is equipped with has special lens coatings applied that can be damaged by strong cleaners and oils from exposed skin. To clean use a specially formulated lens cleaner and a lint free cloth.

Monitor:

Use a soft dry cotton cloth to remove fingerprints and smudges from the screen. If this does not completely remove the dirt and splotches, use a small amount of isopropyl alcohol on the cleaning cloth that has been dampened with water. (A small amount of vinegar can be substituted for the isopropyl alcohol.) Again, spray the liquid on the cloth and never directly onto the screen. Do not use paper towels on an LCD screen as they can scratch the screen. Never use ammonia, ammonia-based cleaners, or strong cleaners, which can cause the surface to yellow and become brittle.

It is good to have a special clean cloth that is dedicated to use on the LCD screen. Don't pick up any old rag, as dirt particles in the rag can scratch the surface of the screen. Special LCD cleaning cloths are available and can be an excellent investment.

5-B Lubrication

Stage:

The stage rails require a light coating of thin oil this can be applied with a lint free cloth or a Q-tip works great. Be careful not to leave any debris on the rails such as lint. This can reduce performance of stage.

Camera Bracket:

The camera bracket requires a light film of oil applied to the linear rail, this can be applied with a lint free cloth or a Q-tip works great. Do not apply oil to the guide shaft part of the camera bracket.

Notes:

Appendix 2

Computer Code

D:\VideoComparatorProject-
3\VideoComparatorProject\UserInterface\VideoComparator.vb

```
Public Class VideoComparator
```

```
Private Enum eModes
Startup
StartupComplete
Homing
HomingComplete
PreparingOverlay
PreparingOverlayComplete
LiveImage
Calibration
CalibrationComplete
Inspection
InspectionComplete
ErrorOccurred
```

```
End Enum
```

```
Private Enum eManualMoves
Stopped
MovingDown
MovingUp
MovingLeft
MovingRight
RotatingCW
RotatingCCW
```

```
End Enum
```

```
' Settings ToolStrip variables
```

```
Dim bMovingSettingsToolStrip As Boolean
Dim iSettingsLastX As Integer
Dim iSettingsDeltaX As Integer
Dim iSettingsLastY As Integer
Dim iSettingsDeltaY As Integer
Dim iOverlayTintTrackBarTopOffset As Integer
Dim iOverlayPathTextboxTopOffset As Integer
Dim iReticleSizeTrackbarTopOffset As Integer
Dim iStatusTextboxTopOffset As Integer
```

```
' Status ToolStrip variables
```

```

Dim bMovingStatusToolStrip As Boolean
Dim iStatuslastX As Integer
Dim iStatusdeltaX As Integer
Dim iStatuslastY As Integer
Dim iStatusdeltaY As Integer

' Overlay Rotate/Translate variables

Dim iTranslateNumberOfPixels As Integer
Dim ManualMove As eManualMoves

Private CurrentMode As eModes

Dim Reticle As clsReticle = New clsReticle
Dim Overlay As clsOverlay = New clsOverlay
Dim Camera As clsCamera = New clsCamera
Dim Stepper As clsStepper = New clsStepper
Dim WithEvents QuadBoard As clsQuadBoard = New clsQuadBoard

Private Sub VideoComparator_Disposed(ByVal sender As Object, ByVal e As
System.
EventArgs) Handles Me.Disposed

My.Settings.Save()

End Sub

Private Sub VideoComparator_Load(ByVal sender As Object, ByVal e As
System.EventArgs)
Handles Me.Load

```

```

D:\VideoComparatorProject-
3\VideoComparatorProject\UserInterface\VideoComparator.vb

'
' Sequence of events:
' QuadBoard must be zero'd before loading an overlay.
' An overlay must be loaded before allocating the MILOverlaySized Image

iReticleSizeTrackbarTopOffset = 150
iOverlayTintTrackBarTopOffset = 280
iOverlayPathTextboxTopOffset = 350

iStatusTextboxTopOffset = 30

VCPSettingsStrip.Left = Me.Width - VCPSettingsStrip.Width - 10
VCPSettingsStrip.Height = Me.Height - 40
VCPStatusStrip.Left = VCPSettingsStrip.Left - VCPStatusStrip.Width - 10
VCPStatusStrip.Height = Me.Height - 40

OverlayTintTrackBar.Left = VCPSettingsStrip.Left + 17
OverlayTintTrackBar.Top = VCPSettingsStrip.Top + iOverlayTintTrackBarTopOffset
OverlayPathTextBox.Left = VCPSettingsStrip.Left + 17
OverlayPathTextBox.Top = VCPSettingsStrip.Top + iOverlayPathTextboxTopOffset

ManualMotionGroupBox.Left = VCPSettingsStrip.Left + 17
ManualMotionGroupBox.Top = OverlayPathTextBox.Top + 2
OverlayPathTextBox.Height = 2
ReticleSizeTrackBar.Left = VCPSettingsStrip.Left + 17
ReticleSizeTrackBar.Top = VCPSettingsStrip.Top + iReticleSizeTrackbarTopOffset

StatusTextBox.Left = VCPStatusStrip.Left + 17
StatusTextBox.Top = VCPStatusStrip.Top + iStatusTextboxTopOffset

VCPStatusStrip.Visible = True
VCPSettingsStrip.Visible = True
ToDoGroupBox.Visible = True
StatusToolStripMenuItem.Checked = True
SettingsToolStripMenuItem.Checked = True
ModeSelectionToolStripMenuItem.Checked = True

ReticleSizeTrackBar.Minimum = My.Settings.ReticleMinimumSize
ReticleSizeTrackBar.Maximum = My.Settings.ReticleMaximumSize
ReticleSizeTrackBar.Value = My.Settings.ReticleWidth
ReticleSizeLabel.Text = "Reticle Size : " & ReticleSizeTrackBar.Value
ReticleColorLabel.BackColor = My.Settings.ReticleColor
ReticlePenWidthComboBox.Text = Reticle.ReticlePenWidth
Select Case Reticle.ReticleShape

Case clsReticle.enumReticleShape.Circle
ReticleShapeComboBox.Text = "Circle"
Case clsReticle.enumReticleShape.Square

```



```
ReticleShapeComboBox.Text = "Square"
```

```
End Select
```

```
Reticle.ReticlePenWidth = My.Settings.ReticlePenWidth  
Reticle.ReticleColor = My.Settings.ReticleColor  
Reticle.ReticleShape = My.Settings.ReticleShape  
Reticle.ReticleWidth = My.Settings.ReticleWidth  
Reticle.ReticleHeight = My.Settings.ReticleHeight
```

```
QualPinDiameterTextBox.Text = My.Settings.QualificationPinDiameter
```

```
CameraSizeXTextBox.Text = My.Settings.CameraSizeX  
Camera.CameraSizeX = My.Settings.CameraSizeX  
CameraSizeYTextBox.Text = My.Settings.CameraSizeY  
Camera.CameraSizeY = My.Settings.CameraSizeY  
If Camera.CameraSizeX <= Camera.CameraSizeY Then
```

```
Camera.CameraZoom = Math.Round(Me.Width / Camera.CameraSizeX, 1)  
Else
```

```
Camera.CameraZoom = Math.Round(Me.Height / Camera.CameraSizeY, 1)  
End If  
Camera.CameraResolutionX = My.Settings.CameraResolutionX
```

```

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Camera.CameraResolutionY = My.Settings.CameraResolutionY
ToolStripResolutionX.Text = Format(Camera.CameraResolutionX, "X 0000.00 DPI")
ToolStripResolutionY.Text = Format(Camera.CameraResolutionY, "Y 0000.00 DPI")

Overlay.OverlayXInches = My.Settings.OverlayInchX
Overlay.OverlayYInches =
My.Settings.OverlayInchXOverlay.OverlayRotateSourceScale =
My.Settings.OverlayRotateSourceScale

OverlaySizeComboBox.Text = My.Settings.OverlayInchX

QuadBoard.EncoderInchesPerPulseX = My.Settings.QuadBoardInchesPerCount

QuadBoard.EncoderInchesPerPulseY = My.Settings.QuadBoardInchesPerCount

MILDisplay.Left = 0
MILDisplay.Top = 0
MILDisplay.Width = Camera.CameraSizeX * Camera.CameraZoom
MILDisplay.Height = Camera.CameraSizeY * Camera.CameraZoom
MILDisplay.ZoomX = Camera.CameraZoom
MILDisplay.ZoomY = Camera.CameraZoom
MILDisplay.SendToBack()
Dim pointTemp As New Point
pointTemp.X = MILDisplay.Width / 2
pointTemp.Y = MILDisplay.Height / 2
Reticle.ReticleCenter = pointTemp
Reticle.ReticleCanvas = MILDisplay.Handle

MILImage.SizeX = Me.Width
MILImage.SizeY = Me.Height
MILImage.Allocate()

MILOverlayImage.SizeX = My.Settings.MaxOverlaySizePixels
MILOverlayImage.SizeY = My.Settings.MaxOverlaySizePixels
MILOverlayImage.Allocate()

MILOverlayChunkImage.SizeX = MILImage.SizeX
MILOverlayChunkImage.SizeY = MILImage.SizeY
MILOverlayChunkImage.Allocate()

MILOverlayColorImage.SizeX = MILImage.SizeX
MILOverlayColorImage.SizeY = MILImage.SizeY
MILOverlayColorImage.Allocate()
MILOverlayColorImage.Clear(100)

CurrentMode = eModes.Startup

ManualMove = eManualMoves.Stopped

```

```

UpdateUI()

MILDisplay.Free()

MILDisplay.Allocate()

End Sub

Private Sub VCPSettingsStrip_MouseDown(ByVal sender As Object, ByVal e As
System.
Windows.Forms.MouseEventArgs) Handles VCPSettingsStrip.MouseDown

iSettingsLastX = e.X
iSettingsLastY = e.Y
bMovingSettingsToolStrip = True

VCPSettingsStrip.BringToFront()
OverlayTintTrackBar.BringToFront()
OverlayPathTextBox.BringToFront()
ReticleSizeTrackBar.BringToFront()
ManualMotionGroupBox.BringToFront()

```

```

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End Sub
Private Sub VCPSettingsStrip_MouseLeave(ByVal sender As Object, ByVal e As
System.
EventArgs) Handles VCPSettingsStrip.MouseLeave

bMovingSettingsToolStrip = False
End Sub
Private Sub VCPSettingsStrip_MouseMove(ByVal sender As Object, ByVal e As
System.
Windows.Forms.MouseEventArgs) Handles VCPSettingsStrip.MouseMove
If bMovingSettingsToolStrip Then

iSettingsDeltaX = iSettingsLastX - e.XiSettingsDeltaY = iSettingsLastY - e.Y
VCPSettingsStrip.Left = VCPSettingsStrip.Left - iSettingsDeltaX

VCPSettingsStrip.Top = VCPSettingsStrip.Top - iSettingsDeltaY
OverlayTintTrackBar.Left = VCPSettingsStrip.Left + 17OverlayTintTrackBar.Top
= VCPSettingsStrip.Top + iOverlayTintTrackBarTopOffset

OverlayPathTextBox.Left = VCPSettingsStrip.Left + 17
OverlayPathTextBox.Top = VCPSettingsStrip.Top + iOverlayPathTextboxTopOffset
ManualMotionGroupBox.Left = VCPSettingsStrip.Left + 17

ManualMotionGroupBox.Top = OverlayPathTextBox.Top + OverlayPathTextBox.Height
+ 2
ReticleSizeTrackBar.Left = VCPSettingsStrip.Left + 17ReticleSizeTrackBar.Top
= VCPSettingsStrip.Top + iReticleSizeTrackbarTopOffset
End If
End Sub
Private Sub VCPSettingsStrip_MouseUp(ByVal sender As Object, ByVal e As
System.Windows
.Forms.MouseEventArgs) Handles VCPSettingsStrip.MouseUp

bMovingSettingsToolStrip = False
End Sub
Private Sub VCPStatusStrip_MouseDown(ByVal sender As Object, ByVal e As
System.Windows
.Forms.MouseEventArgs) Handles VCPStatusStrip.MouseDown
iStatuslastX = e.X

iStatuslastY = e.Y
bMovingStatusToolStrip = True
VCPStatusStrip.BringToFront()

StatusTextBox.BringToFront()

```

```

End Sub
Private Sub VCPStatusStrip_MouseLeave(ByVal sender As Object, ByVal e As
System.
EventArgs) Handles VCPStatusStrip.MouseLeave

bMovingStatusToolStrip = False
End Sub
Private Sub VCPStatusStrip_MouseMove(ByVal sender As Object, ByVal e As
System.Windows

.Forms.MouseEventArgs) Handles VCPStatusStrip.MouseMove
If bMovingStatusToolStrip Then
iStatusdeltaX = iStatuslastX - e.X

```

```

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iStatusdeltaY = iStatuslastY - e.Y
VCPStatusStrip.Left = VCPStatusStrip.Left - iStatusdeltaXVCPStatusStrip.Top =
VCPStatusStrip.Top - iStatusdeltaY
StatusTextBox.Left = VCPStatusStrip.Left + 17StatusTextBox.Top =
VCPStatusStrip.Top + iStatusTextboxTopOffset

End If
End Sub
Private Sub VCPStatusStrip_MouseUp(ByVal sender As Object, ByVal e As
System.Windows.

Forms.MouseEventHandler) Handles VCPStatusStrip.MouseUp

bMovingStatusToolStrip = False
End Sub
Private Sub ReticleColorMenuItem_Click(ByVal sender As System.Object, ByVal e
As
System.EventArgs) Handles ReticleColorMenuItem.Click
If VCPColorDialog.ShowDialog() = Windows.Forms.DialogResult.OK Then
ReticleColorLabel.BackColor = VCPColorDialog.Color
Reticle.ReticleColor = VCPColorDialog.Color

End If

End Sub

Private Sub SettingsToolStripMenuItem_Click(ByVal sender As System.Object,
ByVal e As
System.EventArgs) Handles SettingsToolStripMenuItem.Click

VCPSettingsStrip.Visible = SettingsToolStripMenuItem.Checked
OverlayPathTextBox.Visible = SettingsToolStripMenuItem.Checked
ReticleSizeTrackBar.Visible = SettingsToolStripMenuItem.Checked

End Sub

Private Sub SettingsCloseButton_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles SettingsCloseButton.Click

VCPSettingsStrip.Visible = False
OverlayPathTextBox.Visible = False
ReticleSizeTrackBar.Visible = False
SettingsToolStripMenuItem.Checked = False

End Sub

Private Sub StatusToolStripMenuItem_Click(ByVal sender As System.Object,
ByVal e As
System.EventArgs) Handles StatusToolStripMenuItem.Click

```

```

VCPStatusStrip.Visible = StatusToolStripMenuItem.Checked

End Sub
Private Sub StatusCloseButton_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles StatusCloseButton.Click
VCPStatusStrip.Visible = False

StatusToolStripMenuItem.Checked = False
End Sub
Private Sub ReticleColorLabel_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles ReticleColorLabel.Click
If VCPColorDialog.ShowDialog() = Windows.Forms.DialogResult.OK Then

```

```

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ReticleColorLabel.BackColor = VCPCColorDialog.Color
Reticle.ReticleColor = VCPCColorDialog.Color

End If

End Sub

Private Sub ReticleShapeComboBox_TextChanged(ByVal sender As Object, ByVal e
As System.EventArgs) Handles ReticleShapeComboBox.TextChanged

Select Case ReticleShapeComboBox.Text
Case "Circle"

Reticle.ReticleShape = clsReticle.enumReticleShape.Circle

Case "Square"

Reticle.ReticleShape = clsReticle.enumReticleShape.Square

End Select

End Sub

Private Sub ReticlePenWidthComboBox_TextChanged(ByVal sender As Object, ByVal
e As
System.EventArgs) Handles ReticlePenWidthComboBox.TextChanged

Reticle.ReticlePenWidth = CInt(ReticlePenWidthComboBox.Text)

End Sub

Private Sub ReticleSizeTrackBar_Scroll(ByVal sender As System.Object, ByVal e
As
System.EventArgs) Handles ReticleSizeTrackBar.Scroll

ReticleSizeLabel.Text = "Reticle Size : " & ReticleSizeTrackBar.Value
Reticle.ReticleHeight = ReticleSizeTrackBar.ValueReticle.ReticleWidth =
ReticleSizeTrackBar.Value

End Sub

Private Sub QualPinDiameterTextBox_TextChanged(ByVal sender As Object, ByVal
e As
System.EventArgs) Handles QualPinDiameterTextBox.TextChanged

If IsNumeric(QualPinDiameterTextBox.Text) Then
Reticle.ReticlePinDiameter = QualPinDiameterTextBox.Text

Else
QualPinDiameterTextBox.Text = My.Settings.QualificationPinDiameter

```



```

End If

End Sub

Private Sub UpdateCameraResolution()

Camera.CameraResolutionX = Reticle.ReticleWidth / Reticle.ReticlePinDiameter
/
Camera.CameraZoom
Camera.CameraResolutionY = Reticle.ReticleWidth / Reticle.ReticlePinDiameter
/

Camera.CameraZoom
ToolStripResolutionX.Text = Format(Camera.CameraResolutionX, "X 0000.00 DPI")
ToolStripResolutionY.Text = Format(Camera.CameraResolutionY, "Y 0000.00 DPI")

End Sub

Private Sub CameraSizeXTextBox_TextChanged(ByVal sender As Object, ByVal e As
System.
EventArgs) Handles CameraSizeXTextBox.TextChanged

If IsNumeric(CameraSizeXTextBox.Text) Then
Camera.CameraSizeX = CameraSizeXTextBox.Text

Else
CameraSizeXTextBox.Text = My.Settings.CameraSizeX
End If

End Sub

```

```

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Private Sub CameraSizeYTextBox_TextChanged(ByVal sender As Object, ByVal e As
System.
EventArgs) Handles CameraSizeYTextBox.TextChanged

If IsNumeric(CameraSizeYTextBox.Text) Then

Camera.CameraSizeY = CameraSizeYTextBox.Text

Else

CameraSizeYTextBox.Text = My.Settings.CameraSizeY

End If

End Sub

Private Sub QuadBoard_Counter1Changed() Handles QuadBoard.Counter1Changed

ToolStripAbsoluteY.Text = Format(QuadBoard.Counter1Inches, "Y 00.0000")
If CurrentMode = eModes.Inspection Then Overlay.MoveToInches(QuadBoard.
Counter2Inches, QuadBoard.Counter1Inches)

End Sub

Private Sub QuadBoard_Counter2Changed() Handles QuadBoard.Counter2Changed

ToolStripAbsoluteX.Text = Format(QuadBoard.Counter2Inches, "X 00.0000")
If CurrentMode = eModes.Inspection Then Overlay.MoveToInches(QuadBoard.
Counter2Inches, QuadBoard.Counter1Inches)

End Sub

Private Sub UpdateMILOverlayChunk()

MILOverlayColorImage.Clear(Overlay.OverlayColor)

MILOverlaySizedImage.CopyRegion(MILOverlayImage,
Matrox.ActiveMIL.ImBandConstants.
imAllBands, _
Overlay.OverlayRotateRect.X, Overlay.
OverlayRotateRect.Y, _
Matrox.ActiveMIL.ImBandConstants.imAllBands, 0
, 0, _
Overlay.OverlayRotateRect.Width, Overlay.
OverlayRotateRect.Height)

MILOverlayRotateImageProcessing.Rotate(Overlay.OverlayAngle)

MILOverlayReSizedImage.CopyRegion(MILOverlaySizedAndRotatedImage,
Matrox.ActiveMIL
.ImBandConstants.imAllBands, _

```

```

Overlay.OverlayRotateSourceXBorder - 1, Overlay.
OverlayRotateSourceYBorder - 1, _
Matrox.ActiveMIL.ImBandConstants.imAllBands, 0,
0, _
Overlay.OverlaySourceRect.Width, Overlay.
OverlaySourceRect.Height)

MILOverlayScaleImageProcessing.Resize(Overlay.ImageToOverlayScaleX, Overlay.
ImageToOverlayScaleY, _
Matrox.ActiveMIL.ImageProcessing.
ImpInterpolationModeConstants.impInterpolatedResize, _
Matrox.ActiveMIL.ImageProcessing.
ImpOverscanModeConstants.impOverscanDisable)

End Sub

Private Sub ReallocateMILOverlayChunk()

If MILOverlayReSizedImage.IsAllocated Then

MILOverlayReSizedImage.Free()

MILOverlayReSizedImage.SizeX = (Camera.CameraSizeX * Overlay.
OverlayToImageScaleX) + 1

```

```

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MILOverlayReSizedImage.SizeY = (Camera.CameraSizeY * Overlay.
OverlayToImageScaleY) + 1
MILOverlayReSizedImage.Allocate()

End If

If MILOverlaySizedAndRotatedImage.IsAllocated Then
MILOverlaySizedAndRotatedImage.Free()
MILOverlaySizedAndRotatedImage.SizeX = Overlay.OverlayRotateSourceScale *
(Camera.CameraSizeX * Overlay.OverlayToImageScaleX) + 1
MILOverlaySizedAndRotatedImage.SizeY = Overlay.OverlayRotateSourceScale *
(Camera.CameraSizeY * Overlay.OverlayToImageScaleY) + 1
MILOverlaySizedAndRotatedImage.Allocate()

End If

If MILOverlaySizedImage.IsAllocated Then
MILOverlaySizedImage.Free()
MILOverlaySizedImage.SizeX = Overlay.OverlayRotateSourceScale * (Camera.
CameraSizeX * Overlay.OverlayToImageScaleX) + 1
MILOverlaySizedImage.SizeY = Overlay.OverlayRotateSourceScale * (Camera.
CameraSizeY * Overlay.OverlayToImageScaleY) + 1
MILOverlaySizedImage.Allocate()

End If

End Sub

Private Sub MILDigitizer_GrabFrameEnd(ByVal sender As Object, ByVal e As
System.
EventArgs) Handles MILDigitizer.GrabFrameEnd

Select Case CurrentMode

Case eModes.Calibration
Reticle.Draw()
UpdateCameraResolution()

Try

MILDigitizer.Grab()
Catch ex As ExceptionStatusTextBox.Text = "Digitizer Failed. Please confirm
camera is
powered on and all cables are correctly connected."

CurrentMode = eModes.ErrorOccurred
UpdateUI()

Finally

```

```

End Try
Case eModes.LiveImage
Try

MILDigitizer.Grab()
Catch ex As ExceptionStatusTextBox.Text = "Digitizer Failed. Please confirm
camera is
powered on and all cables are correctly connected."

CurrentMode = eModes.ErrorOccurred
UpdateUI()

Finally

End Try

Case eModes.Inspection
UpdateMILOverlayChunk()
MILImage.CopyConditional(MILOverlayColorImage, _

MILOverlayChunkImage, _
Matrox.ActiveMIL.ImConditionConstants.imNotEqual,
_
0)

Try

MILDigitizer.Grab()
Catch ex As ExceptionStatusTextBox.Text = "Digitizer Failed. Please confirm
camera is
powered on and all cables are correctly connected."

CurrentMode = eModes.ErrorOccurred

```

```

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UpdateUI()

Finally

End Try

End Select

End Sub

Private Sub ResetQuadBoardButton_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles ResetQuadBoardButton.Click

    CurrentMode = eModes.Homing
    UpdateUI()
    QuadBoard.Initialize()
    CurrentMode = eModes.HomingComplete
    UpdateUI()

End Sub

Private Sub LoadOverlayButton_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles LoadOverlayButton.Click

    If CurrentMode = eModes.PreparingOverlay Then

        SaveSettings()
        CurrentMode = eModes.PreparingOverlayComplete
        UpdateUI()

    Else

        CurrentMode = eModes.PreparingOverlay
        UpdateUI()
        VCPOpenDialog.Filter = "image files|*.bmp;*.tif;*.jpg"
        VCPOpenDialog.ShowDialog()
        If VCPOpenDialog.FileName <> "" Then

            Overlay.OverlayPath = VCPOpenDialog.FileNameOverlayPathTextBox.Text =
            Overlay.OverlayPathMILOverlayImage.Clear()
            MILOverlayImage.Load(Overlay.OverlayPath, True)
            OverlayUpdate()

        End If

    End If

End Sub

```

```

Private Sub UseExistingOverlayButton_Click(ByVal sender As System.Object,
ByVal e As
System.EventArgs) Handles UseExistingOverlayButton.Click

SaveSettings()
CurrentMode = eModes.PreparingOverlayComplete
UpdateUI()

End Sub

Private Sub LiveImageButton_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles LiveImageButton.Click

If CurrentMode = eModes.LiveImage Then

CurrentMode = eModes.StartupComplete
UpdateUI()

Else

CurrentMode = eModes.LiveImage

```

```

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UpdateUI()

Try

MILDigitizer.Grab()
Catch ex As ExceptionStatusTextBox.Text = "Digitizer Failed. Please confirm
camera is poweredon and all cables are correctly connected."

CurrentMode = eModes.ErrorOccurred
UpdateUI()

Finally

End Try

End If

End Sub

Private Sub OverlayUpdate()

OverlayParametersTextBox.Clear()
OverlayParametersTextBox.Text = Overlay.OverlayPath & vbCrLf
OverlayParametersTextBox.Text = OverlayParametersTextBox.Text &
MILOverlayImage.

SizeX & " x " & MILOverlayImage.SizeY & " Pixels" & vbCrLf
OverlayParametersTextBox.Text = OverlayParametersTextBox.Text &
OverlaySizeComboBox.Text & " x " & OverlaySizeComboBox.Text & " Inches" &
vbCrLf

End Sub

Private Sub UpdateUI()

CameraToolStripButton.Enabled = False
ReticleToolStripButton.Enabled = False
ReticleColorLabel.Enabled = False
ReticleSizeTrackBar.Enabled = False
OverlayToolStripButton.Enabled = False
OverlayColorLabel.Enabled = False
OverlayTintTrackBar.Enabled = False
ManualMotionGroupBox.Enabled = False
ModePanelHideButton.Enabled = False
ResetModeButton.Enabled = False
UseExistingOverlayButton.Enabled = False
ResetQuadBoardButton.Enabled = False
ResetQuadBoardButton.Text = "Reset/Home Encoders"
LoadOverlayButton.Enabled = False
LoadOverlayButton.Text = "Load Overlay"
LiveImageButton.Enabled = False

```



```

LiveImageButton.Text = "Begin Live Image Capture"
CalibrateButton.Enabled = False
CalibrateButton.Text = "Perform Calibration"
InspectButton.Enabled = False
InspectButton.Text = "Perform Inspection"

Select Case CurrentMode
Case eModes.Calibration
StatusTextBox.Text = "Locate the calibration pin on the stage and proceed
to calibrate. " & _
"Calibration settings may be adjusted using the Camera
and Reticle pull-downs in the Settings Toolbar. " & _
"When the Calibration is complete, select the
'Calibration Complete' button."

StatusTextBox.BackColor = Color.DarkGreen
CalibrateButton.Text = "Calibration Complete"
CalibrateButton.Enabled = True
CameraToolStripButton.Enabled = True
ReticleToolStripButton.Enabled = True
ReticleColorLabel.Enabled = True
ReticleSizeTrackBar.Enabled = True

```

```
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```

```
Case eModes.CalibrationComplete
```

```
StatusTextBox.Text = "Please select 'Reset/Home Encoders', 'Load New  
Overlay', 'Use Current Overlay' (if available), 'View Live Image', or  
'Calibrate  
Camera' "
```

```
StatusTextBox.BackColor = Color.DarkGreen  
ResetQuadBoardButton.Enabled = True  
LoadOverlayButton.Enabled = True  
LiveImageButton.Enabled = True  
CalibrateButton.Enabled = True  
If Overlay.OverlayPath <> "" Then
```

```
UseExistingOverlayButton.Enabled = True  
End If
```

```
Case eModes.Homing
```

```
Case eModes.HomingComplete
```

```
StatusTextBox.Text = "Please select 'Reset/Home Encoders', 'Load New  
Overlay', 'Use Current Overlay' (if available), 'View Live Image', or  
'Calibrate  
Camera' "
```

```
StatusTextBox.BackColor = Color.DarkGreen  
ResetQuadBoardButton.Enabled = True  
LoadOverlayButton.Enabled = True  
LiveImageButton.Enabled = True  
CalibrateButton.Enabled = True  
If Overlay.OverlayPath <> "" Then
```

```
UseExistingOverlayButton.Enabled = True  
End If
```

```
Case eModes.InspectionStatusTextBox.Text = "Locate the part on the stage and  
proceed to inspect.
```

```
"& _  
"The overlay tint may be adjusted during inspection  
using the Overlay Tint slider in the Settings Toolbar. " & _  
"When the inspection is complete, select the  
'Inspection Complete' button."
```

```
StatusTextBox.BackColor = Color.DarkGreen  
InspectButton.Text = "Inspection Complete"  
InspectButton.Enabled = True  
ManualMotionGroupBox.Enabled = True  
ManualMoveRepeatTimer.Enabled = True  
OverlayTintTrackBar.Enabled = True  
ModePanelHideButton.Enabled = True
```

```
Case eModes.InspectionComplete
```

```
StatusTextBox.Text = "Please select 'Reset/Home Encoders', 'Load New  
Overlay', 'Use Current Overlay' (if available), 'View Live Image', or  
'Calibrate  
Camera' "
```

```
StatusTextBox.BackColor = Color.DarkGreen  
ResetQuadBoardButton.Enabled = True  
LoadOverlayButton.Enabled = True  
LiveImageButton.Enabled = True  
ManualMoveRepeatTimer.Enabled = False  
CalibrateButton.Enabled = True  
If Overlay.OverlayPath <> "" Then
```

```
UseExistingOverlayButton.Enabled = True  
End If
```

```
Case eModes.LiveImageStatusTextBox.Text = "Please select 'Stop Live Image  
Capture' to stop  
image capturing."
```

```
StatusTextBox.BackColor = Color.DarkGreen  
LiveImageButton.Text = "Stop Live Image Capture"  
LiveImageButton.Enabled = True
```

```
Case eModes.PreparingOverlayStatusTextBox.Text = "Please select an overlay  
file. Additional overlayparameters may be set " & _
```

```

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"using the Overlay pull-down in the Settings Toolbar.
"& _
"When the settings are correct, select the 'Overlay
Load Complete' button."

StatusTextBox.BackColor = Color.DarkGreen
LoadOverlayButton.Text = "Overlay Load Complete"
LoadOverlayButton.Enabled = True
OverlayToolStripButton.Enabled = True
OverlayTintTrackBar.Enabled = True

Case eModes.PreparingOverlayCompleteStatusTextBox.Text = "Please select the
'Perform Inspection' button"
StatusTextBox.BackColor = Color.DarkGreen
InspectButton.Enabled = True

Case eModes.StartupStatusTextBox.Text = "Please Home the stage. When
complete, click the
'Reset/Home Encoders' button"

StatusTextBox.BackColor = Color.DarkGreen
ResetQuadBoardButton.Enabled = True

Case eModes.StartupComplete

StatusTextBox.Text = "Please select 'Reset/Home Encoders', 'Load New
Overlay', 'Use Current Overlay' (if available), 'View Live Image', or
'Calibrate
Camera'"

StatusTextBox.BackColor = Color.DarkGreen
ResetQuadBoardButton.Enabled = True
LoadOverlayButton.Enabled = True
LiveImageButton.Enabled = True
CalibrateButton.Enabled = True
If Overlay.OverlayPath <> "" Then

UseExistingOverlayButton.Enabled = True
End If

Case eModes.ErrorOccurred
StatusTextBox.BackColor = Color.Yellow
ManualMoveRepeatTimer.Enabled = False
ResetQuadBoardButton.Enabled = True
ResetModeButton.Enabled = True

End Select
End Sub

```

```

Private Sub ModeSelectionToolStripMenuItem_Click(ByVal sender As
System.Object, ByVal e As System.EventArgs) Handles
ModeSelectionToolStripMenuItem.Click

ToDoGroupBox.Visible = ModeSelectionToolStripMenuItem.Checked

End Sub

Private Sub ResetModeButton_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles ResetModeButton.Click

Overlay.OverlaySourceOffsetXInches = 0
Overlay.OverlaySourceOffsetYInches = 0
Overlay.OverlayAngle = 0
Overlay.OverlayPath = ""
OverlayPathTextBox.Text = Overlay.OverlayPath
CurrentMode = eModes.StartupComplete
UpdateUI()

End Sub

Private Sub CalibrateButton_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles CalibrateButton.Click

If CurrentMode = eModes.Calibration Then

```

```

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SaveSettings()
CurrentMode = eModes.CalibrationComplete
UpdateUI()

Else

CurrentMode = eModes.Calibration
UpdateUI()

Try

MILDigitizer.Grab()
Catch ex As Exception StatusTextBox.Text = "Digitizer Failed. Please confirm
camera is powered on and all cables are correctly connected."

CurrentMode = eModes.ErrorOccurred
UpdateUI()

Finally

End Try

End If

End Sub

Private Sub InspectButton_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles InspectButton.Click

If CurrentMode = eModes.Inspection Then
CurrentMode = eModes.InspectionComplete
UpdateUI()

Else

CurrentMode = eModes.Inspection
UpdateUI()
Overlay.OverlayXPixels = MILOverlayImage.SizeX
Overlay.OverlayYPixels = MILOverlayImage.SizeY
Overlay.OverlayXInches = OverlaySizeComboBox.Text
Overlay.OverlayYInches = OverlaySizeComboBox.Text
Overlay.ImageDPIX = Camera.CameraResolutionX
Overlay.ImageDPIY = Camera.CameraResolutionY
Overlay.ImageXPixels = Camera.CameraSizeX
Overlay.ImageYPixels = Camera.CameraSizeY
Overlay.OverlayColor = OverlayTintTrackBar.Value
Overlay.UpdateOverlayParameters()
ReallocateMILOverlayChunk()

```

```

MILDigitizer.Grab()

End If

End Sub

Private Sub SaveSettings()

My.Settings.CameraSizeX = Camera.CameraSizeX
My.Settings.CameraSizeY = Camera.CameraSizeY
My.Settings.OverlayInchX = Overlay.OverlayXInches
My.Settings.OverlayColor = Overlay.OverlayColor
My.Settings.CameraResolutionX = Camera.CameraResolutionX
My.Settings.CameraResolutionY = Camera.CameraResolutionY
My.Settings.QualificationPinDiameter = Reticle.ReticlePinDiameter
My.Settings.ReticleWidth = Reticle.ReticleWidth
My.Settings.ReticleHeight = Reticle.ReticleHeight
My.Settings.ReticlePenWidth = Reticle.ReticlePenWidth
My.Settings.ReticleShape = Reticle.ReticleShape
My.Settings.ReticleColor = Reticle.ReticleColor

My.Settings.Save()

End Sub

```

```

D:\VideoComparatorProject-
3\VideoComparatorProject\UserInterface\VideoComparator.vb

Private Sub LoadSettings()

    '

End Sub

Private Sub UpdateOverlayOffsetDisplay()
ToolStripRelativeX.Text = Format(Overlay.OverlaySourceOffsetXInches, "X
00.000")
ToolStripRelativeY.Text = Format(Overlay.OverlaySourceOffsetYInches, "Y
00.000")
ToolStripOverlayAngle.Text = Format(Overlay.OverlayAngle, "000.000")

End Sub

Private Sub OverlaySizeComboBox_TextChanged(ByVal sender As Object, ByVal e
As System.
EventArgs) Handles OverlaySizeComboBox.TextChanged

If CurrentMode = eModes.PreparingOverlay Then
Overlay.OverlayXInches = OverlaySizeComboBox.Text
Overlay.OverlayYInches = OverlaySizeComboBox.Text
OverlayUpdate()

End If
End Sub

Private Sub UpButton_MouseDown(ByVal sender As Object, ByVal e As
System.Windows.Forms

.MouseEventArgs) Handles UpButton.MouseDown
ManualMove = eManualMoves.MovingUp
UpdateOverlayOffsetDisplay()

End Sub

Private Sub UpButton_MouseUp(ByVal sender As Object, ByVal e As
System.Windows.Forms.
MouseEventArgs) Handles UpButton.MouseUpManualMove = eManualMoves.Stopped

End Sub

Private Sub LeftButton_MouseDown(ByVal sender As Object, ByVal e As
System.Windows.
Forms.MouseEventArgs) Handles LeftButton.MouseDown
ManualMove = eManualMoves.MovingLeft
UpdateOverlayOffsetDisplay()

```


End Sub

```
Private Sub LeftButton_MouseUp(ByVal sender As Object, ByVal e As
System.Windows.Forms
.MouseEventArgs) Handles LeftButton.MouseUp
ManualMove = eManualMoves.Stopped
```

End Sub

```
Private Sub DownButton_MouseDown(ByVal sender As Object, ByVal e As
System.Windows.
```

```
Forms.MouseEventArgs) Handles DownButton.MouseDown
ManualMove = eManualMoves.MovingDown
UpdateOverlayOffsetDisplay()
```

End Sub

```
Private Sub DownButton_MouseUp(ByVal sender As Object, ByVal e As
System.Windows.Forms
.MouseEventArgs) Handles DownButton.MouseUp
ManualMove = eManualMoves.Stopped
```

End Sub

```
Private Sub RightButton_MouseDown(ByVal sender As Object, ByVal e As
System.Windows.
```

```
Forms.MouseEventArgs) Handles RightButton.MouseDown
ManualMove = eManualMoves.MovingRight
UpdateOverlayOffsetDisplay()
```

End Sub

```
Private Sub RightButton_MouseUp(ByVal sender As Object, ByVal e As
System.Windows.
Forms.MouseEventArgs) Handles RightButton.MouseUpManualMove =
eManualMoves.Stopped
```

End Sub

```
Private Sub SmallMovesRadioButton_CheckedChanged(ByVal sender As
System.Object, ByVale As System.EventArgs) Handles
SmallMovesRadioButton.CheckedChangediTranslateNumberOfPixels =
My.Settings.OverlayTranslateSmallMoveEnd Sub
```

```

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3\VideoComparatorProject\UserInterface\VideoComparator.vb

Private Sub LargeMovesRadioButton_CheckedChanged(ByVal sender As
System.Object, ByVal e As System.EventArgs) Handles
LargeMovesRadioButton.CheckedChanged
iTranslateNumberOfPixels =
My.Settings.OverlayTranslateLargeMoveEnd
Sub

Private Sub ResetButton_Click(ByVal sender As System.Object, ByVal e As
System.
EventArgs) Handles ResetButton.Click

Overlay.OverlaySourceOffsetXInches = 0
Overlay.OverlaySourceOffsetYInches = 0
UpdateOverlayOffsetDisplay()

End Sub

Private Sub ManualMoveRepeatTimer_Tick(ByVal sender As Object, ByVal e As
System.
EventArgs) Handles ManualMoveRepeatTimer.Tick

Select Case ManualMove

Case eManualMoves.MovingDownOverlay.MoveDeltaPixels(0,
iTranslateNumberOfPixels)
UpdateOverlayOffsetDisplay()

Case eManualMoves.MovingLeftOverlay.MoveDeltaPixels(iTranslateNumberOfPixels,
0)
UpdateOverlayOffsetDisplay()

Case eManualMoves.MovingRightOverlay.MoveDeltaPixels(-
iTranslateNumberOfPixels, 0)
UpdateOverlayOffsetDisplay()

Case eManualMoves.MovingUpOverlay.MoveDeltaPixels(0, -
iTranslateNumberOfPixels)
UpdateOverlayOffsetDisplay()

Case eManualMoves.RotatingCCWOverlay.OverlayAngle = Overlay.OverlayAngle +
0.1
If Overlay.OverlayAngle >= 360 Then Overlay.OverlayAngle = 0
Overlay.MoveDeltaPixels(0, 0)
UpdateOverlayOffsetDisplay()

Case eManualMoves.RotatingCWOverlay.OverlayAngle = Overlay.OverlayAngle - 0.1
If Overlay.OverlayAngle <= 0 Then Overlay.OverlayAngle = 360
Overlay.MoveDeltaPixels(0, 0)
UpdateOverlayOffsetDisplay()

End Select

End Sub

```

```

Private Sub RotateCCWButton_MouseDown(ByVal sender As Object, ByVal e As
System.
Windows.Forms.MouseEventHandler) Handles RotateCCWButton.MouseDown
ManualMove = eManualMoves.RotatingCCW

End Sub

Private Sub RotateCCWButton_MouseUp(ByVal sender As Object, ByVal e As
System.Windows.
Forms.MouseEventHandler) Handles RotateCCWButton.MouseUpManualMove =
eManualMoves.Stopped

End Sub

Private Sub RotateCWButton_MouseDown(ByVal sender As Object, ByVal e As
System.Windows
.Forms.MouseEventHandler) Handles RotateCWButton.MouseDown
ManualMove = eManualMoves.RotatingCW

End Sub

```

```

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3\VideoComparatorProject\UserInterface\VideoComparator.vb

Private Sub RotateCWButton_MouseUp(ByVal sender As Object, ByVal e As
System.Windows.

Forms.MouseEventHandler) Handles RotateCWButton.MouseUp

ManualMove = eManualMoves.Stopped

End Sub

Private Sub OverlayTintTrackBar_ValueChanged(ByVal sender As Object, ByVal e
As System.EventArgs) Handles OverlayTintTrackBar.ValueChanged

OverlayColorLabel.BackColor = Color.FromArgb(OverlayTintTrackBar.Value,
OverlayTintTrackBar.Value, OverlayTintTrackBar.Value)
Overlay.OverlayColor = OverlayTintTrackBar.Value

End Sub

Private Sub ModePanelHideButton_Click(ByVal sender As System.Object, ByVal e
As System

.EventArgs) Handles ModePanelHideButton.Click

ToDoGroupBox.Visible = False

ModeSelectionToolStripMenuItem.Checked = False
End Sub
Private Sub ResetMILDisplay_Click(ByVal sender As System.Object, ByVal e As
System.

EventArgs) Handles ResetMILDisplay.Click
MILImage.Free()
MILImage.Allocate()

End Sub
End Class

```

D:\VideoComparatorProject-3\VideoComparatorProject\app.config

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
<configSections>
<sectionGroup name="userSettings"
type="System.Configuration.UserSettingsGroup,
System, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089" >

<section name="WindowsApplication1.My.MySettings" type="System.Configuration.
ClientSettingsSection, System, Version=2.0.0.0, Culture=neutral,
PublicKeyToken=
b77a5c561934e089" allowExeDefinition="MachineToLocalUser"
requirePermission="false" />

</sectionGroup>
</configSections>
<system.diagnostics>

<sources>
<!--This section defines the logging configuration for My.Application.Log -->
<source name="DefaultSource" switchName="DefaultSwitch">

<listeners>
<add name="FileLog"/>
<!--Uncomment the below section to write to the Application Event Log
-->
<!--<add name="EventLog"/>-->
</listeners>

</source>
</sources>
<switches>

<add name="DefaultSwitch" value="Information" />
</switches>
<sharedListeners>

<add name="FileLog"

type="Microsoft.VisualBasic.Logging.FileLogTraceListener, Microsoft.
VisualBasic, Version=8.0.0.0, Culture=neutral,
PublicKeyToken=b03f5f7f11d50a3a,
processorArchitecture=MSIL"

initializeData="FileLogWriter"/>
<!--Uncomment the below section and replace APPLICATION_NAME with the name
of your application to write to the Application Event Log -->
<!--<add name="EventLog" type="System.Diagnostics.EventLogTraceListener"
initializeData="APPLICATION_NAME"/> -->
```

```

</sharedListeners>
</system.diagnostics>
<userSettings>

<WindowsApplication1.My.MySettings>
<setting name="ReticleShape" serializeAs="String">

<value>1</value>
</setting>
<setting name="ReticleColor" serializeAs="String">

<value>Green</value>
</setting>
<setting name="ReticlePenWidth" serializeAs="String">

<value>5</value>
</setting>
<setting name="ReticleWidth" serializeAs="String">

<value>100</value>
</setting>
<setting name="ReticleHeight" serializeAs="String">

<value>100</value>
</setting>
<setting name="ReticleMinimumSize" serializeAs="String">

<value>10</value>
</setting>
<setting name="ReticleMaximumSize" serializeAs="String">

<value>1000</value>
</setting>
<setting name="QualificationPinDiameter" serializeAs="String">

<value>0.125</value>
</setting>
<setting name="CameraSizeX" serializeAs="String">

<value>640</value>
</setting>
<setting name="CameraSizeY" serializeAs="String">

```

```
D:\VideoComparatorProject-3\VideoComparatorProject\app.config

<value>480</value>

</setting>

<setting name="MaxOverlaySizePixels" serializeAs="String">

<value>24000</value>

</setting>

<setting name="QuadBoardInchesPerCount" serializeAs="String">

<value>3.9370079E-05</value>

</setting>

<setting name="OverlayInchX" serializeAs="String">

<value>2</value>

</setting>

<setting name="CameraResolutionX" serializeAs="String">

<value>1400</value>

</setting>

<setting name="CameraResolutionY" serializeAs="String">

<value>1400</value>

</setting>

<setting name="OverlayTranslateSmallMove" serializeAs="String">

<value>1</value>

</setting>

<setting name="OverlayTranslateLargeMove" serializeAs="String">

<value>10</value>

</setting>

<setting name="OverlayRotateSourceScale" serializeAs="String">

<value>1.5</value>

</setting>

<setting name="OverlayColor" serializeAs="String">
```

```
<value>125</value>  
</setting>  
</WindowsApplication1.My.MySettings>  
</userSettings>  
</configuration>
```


D:\VideoComparatorProject-3\VideoComparatorProject\Settings.vb

Namespace My

'This class allows you to handle specific events on the settings class:
' The SettingChanging event is raised before a setting's value is changed.
' The PropertyChanged event is raised after a setting's value is changed.
' The SettingsLoaded event is raised after the setting values are loaded.
' The SettingsSaving event is raised before the setting values are saved.

Partial Friend NotInheritable Class MySettingsEnd Class
End Namespace

```
D:\VideoComparatorProject-  
3\VideoComparatorProject\WorkingClasses\clsStepper.vb  
Public Class clsStepper  
  
Public Sub New()  
  
End Sub  
End Class
```

```

D:\VideoComparatorProject-
3\VideoComparatorProject\WorkingClasses\clsReticle.vb

Imports System.Windows.Forms
Imports System.Windows
Imports System.Drawing

Public Class clsReticle

Public Enum enumReticleShape
Square
Circle

End Enum

Private _ReticlePen As Pen
Private _ReticleBoundary As Rectangle
Private _ReticlePinDiameter As Double
Private _ReticleCenterPoint As Point
Private _ReticleShape As enumReticleShape
Private _ReticleCanvasHandle As IntPtr
Private _ReticleGraphic As Graphics

Public Sub New()

_ReticlePen = New Pen(Color.AntiqueWhite)

End Sub

Public Sub Draw()

Select Case _ReticleShape

Case enumReticleShape.Circle
_ReticleGraphic.DrawArc(_ReticlePen, _ReticleBoundary, 0, 360)
Case enumReticleShape.Square
_ReticleGraphic.DrawRectangle(_ReticlePen, _ReticleBoundary)

End Select

End Sub

Public Property ReticleCanvas() As IntPtr

Get

Return _ReticleCanvasHandle
End Get

Set(ByVal value As IntPtr)

_ReticleCanvasHandle = value
_ReticleGraphic = Graphics.FromHwnd(_ReticleCanvasHandle)

```

```

End Set

End Property

Public Property ReticlePenWidth() As Single

Get

Return _ReticlePen.Width
End Get
Set(ByVal value As Single)

_ReticlePen.Width = value

End Set

End Property

Public Property ReticlePinDiameter() As Double

Get

Return _ReticlePinDiameter
End Get
Set(ByVal value As Double)

```

```

D:\VideoComparatorProject-
3\VideoComparatorProject\WorkingClasses\clsReticle.vb

_ReticlePinDiameter = value

End Set

End Property

Public Property ReticleColor() As Color

Get

Return _ReticlePen.Color
End Get
Set(ByVal value As Color)

_ReticlePen.Color = value

End Set

End Property

Public Property ReticleShape() As enumReticleShape

Get

Return _ReticleShape
End Get
Set(ByVal value As enumReticleShape)

_ReticleShape = value

End Set

End Property

Public Property ReticleWidth() As Integer

Get

Return _ReticleBoundary.Width
End Get
Set(ByVal value As Integer)

_ReticleBoundary.Width = value
_ReticleBoundary.X = _ReticleCenterPoint.X - _ReticleBoundary.Width / 2

End Set

End Property

Public Property ReticleHeight() As Integer

```

```

Get

Return _ReticleBoundary.Height
End Get
Set(ByVal value As Integer)

_ReticleBoundary.Height = value
_ReticleBoundary.Y = _ReticleCenterPoint.Y - _ReticleBoundary.Height / 2

End Set

End Property

Public Property ReticleCenter() As Point

Get

Return _ReticleCenterPoint
End Get
Set(ByVal value As Point)

_ReticleCenterPoint = value
_ReticleBoundary.X = _ReticleCenterPoint.X - _ReticleBoundary.Width / 2
_ReticleBoundary.Y = _ReticleCenterPoint.Y - _ReticleBoundary.Height / 2

End Set

End Property

End Class

```

```
D:\VideoComparatorProject-  
3\VideoComparatorProject\WorkingClasses\clsQuadBoard.vb
```

```
Imports System.Windows.Forms  
Imports System.Timers
```

```
Public Class clsQuadBoard
```

```
Private _Counter1PreviousCount As Integer  
Private _Counter2PreviousCount As Integer  
Private _Counter1Count As Integer  
Private _Counter2Count As Integer  
Private _CountersInitialized As Boolean  
Private _EncoderInchesPerPulseX As Double  
Private _EncoderInchesPerPulseY As Double  
Private _EncoderPulsesPerInchX As Double  
Private _EncoderPulsesPerInchY As Double  
Private _EncoderPixelsPerPulseX As Double  
Private _EncoderPixelsPerPulseY As Double  
Private _EncoderPulsesPerPixelX As Double  
Private _EncoderPulsesPerPixelY As Double  
Public Event Counter1Changed()  
Public Event Counter2Changed()  
Private WithEvents EncoderTimer As New System.Timers.Timer  
Private DaqBoard As MccDaq.MccBoard  
Private DaqError As MccDaq.ErrorInfo  
Private _CounterWrapPreventer As Integer
```

```
Public Sub New()
```

```
DaqBoard = New MccDaq.MccBoard(0)
```

```
DaqError = DaqBoard.C7266Config(1, MccDaq.Quadrature.X4Quad,  
MccDaq.CountingMode.  
NormalMode, MccDaq.DataEncoding.BinaryEncoding,  
MccDaq.IndexMode.IndexDisabled, MccDaq.OptionState.Disabled,  
MccDaq.FlagPins.CarryBorrow, MccDaq.OptionState.Disabled)
```

```
DaqError = DaqBoard.C7266Config(2, MccDaq.Quadrature.X4Quad,  
MccDaq.CountingMode.  
NormalMode, MccDaq.DataEncoding.BinaryEncoding,  
MccDaq.IndexMode.IndexDisabled, MccDaq.OptionState.Disabled,  
MccDaq.FlagPins.CarryBorrow, MccDaq.OptionState.Disabled)
```

```
_Counter1PreviousCount = 0  
_Counter2PreviousCount = 0
```

```
EncoderTimer.Interval = 100  
EncoderTimer.Enabled = True
```

```
End Sub
```

```
Public ReadOnly Property Counter1Inches() As Double
```

```
Get
Return CDbl(_Counter1Count * _EncoderInchesPerPulseY)
End Get
End Property
```

```
Public ReadOnly Property Counter2Inches() As Double
Get
Return CDbl(_Counter2Count * _EncoderInchesPerPulseX)
End Get
End Property
```

```
Public Property EncoderInchesPerPulseX() As Double
Get
```

```
Return _EncoderInchesPerPulseX
End Get
Set(ByVal value As Double)
```

```
_EncoderInchesPerPulseX = value
_EncoderPulsesPerInchX = 1.0 / value
```

```
End Set
End Property
```

```
Public Property EncoderInchesPerPulseY() As Double
Get
```



```

D:\VideoComparatorProject-
3\VideoComparatorProject\WorkingClasses\clsQuadBoard.vb

Return _EncoderInchesPerPulseY
End Get
Set(ByVal value As Double)

_EncoderInchesPerPulseY = value

_EncoderPulsesPerInchY = 1.0 / value

End Set
End Property

Public Property EncoderPixelsPerPulseX() As Double
Get

Return _EncoderPixelsPerPulseX
End Get
Set(ByVal value As Double)

_EncoderPixelsPerPulseX = value

_EncoderPulsesPerPixelX = 1.0 / value

End Set
End Property

Public Property EncoderPixelsPerPulseY() As Double
Get

Return _EncoderPixelsPerPulseY
End Get
Set(ByVal value As Double)

_EncoderPixelsPerPulseY = value

_EncoderPulsesPerPixelY = 1.0 / value

End Set
End Property

Public ReadOnly Property CountersInitialized() As Boolean
Get
Return _CountersInitialized
End Get

```

```

End Property

Public Sub Initialize()
    _CountersInitialized = False
    DaqBoard.CLoad32(MccDaq.CounterRegister.QuadCount1, 0)
    DaqBoard.CLoad32(MccDaq.CounterRegister.QuadCount2, 0)
    _CountersInitialized = True

End Sub

Private Sub EncoderTimer_Elapsed(ByVal sender As Object, ByVal e As
System.Timers.

ElapsedEventArgs) Handles EncoderTimer.Elapsed
    DaqError = DaqBoard.CIn32(1, _Counter1Count)
    If _Counter1Count <> _Counter1PreviousCount Then

        _Counter1PreviousCount = _Counter1Count
        RaiseEvent Counter1Changed()
    End If

    DaqError = DaqBoard.CIn32(2, _Counter2Count)

    If _Counter2Count <> _Counter2PreviousCount Then
        _Counter2PreviousCount = _Counter2Count
        RaiseEvent Counter2Changed()

    End If

End Sub
End Class

```

D:\VideoComparatorProject-
3\VideoComparatorProject\WorkingClasses\clsOverlay.vb

Imports System.Windows.Forms

Public Class clsOverlay

Private _OverlayAngleDegrees As Double
Private _OverlayAngleRadians As Double
Private _OverlayPath As String
Private _ImageXPixels As Integer
Private _ImageYPixels As Integer
Private _ImageDPIX As Double
Private _ImageDPIY As Double
Private _OverlayXPixels As Integer
Private _OverlayYPixels As Integer
Private _OverlayXInches As Double
Private _OverlayYInches As Double
Private _OverlayDPIX As Double
Private _OverlayDPIY As Double
Private _OverlayToImageScaleX As Double
Private _OverlayToImageScaleY As Double
Private _ImageToOverlayScaleX As Double
Private _ImageToOverlayScaleY As Double
Private _OverlaySourceRectangle As Rectangle
Private _OverlayRotateRectangle As Rectangle
Private _OverlayRotateSourceScale As Double
Private _OverlayRotateSourceXBorder As Integer
Private _OverlayRotateSourceYBorder As Integer
Private _OverlaySourceLowerLimit As Point
Private _OverlaySourceUpperLimit As Point
Private _OverlaySourceCenter As Point
Private _OverlaySourceOffsetX As Double
Private _OverlaySourceOffsetY As Double
Private _OverlayCurrentXInches As Double
Private _OverlayCurrentYInches As Double
Private _OverlayColor As Integer
Private _DeltaXMove As Double
Private _DeltaYMove As Double
Private _DeltaXAdjusted As Double
Private _DeltaYAdjusted As Double

Public Sub New()

End Sub

Public Property OverlayColor() As Integer

Get

Return _OverlayColor

End Get

Set(ByVal value As Integer)

```
_OverlayColor = value

End Set

End Property

Public Property OverlayPath() As String

Get

Return _OverlayPath
End Get
Set(ByVal value As String)

If Not IsNothing(value) Then
_OverlayPath = value

End If
End Set

End Property
```

```
D:\VideoComparatorProject-  
3\VideoComparatorProject\WorkingClasses\clsOverlay.vb
```

```
Public Property ImageXPixels() As Integer
```

```
Get
```

```
Return _ImageXPixels
```

```
End Get
```

```
Set(ByVal value As Integer)
```

```
If value > 0 Then
```

```
_ImageXPixels = value
```

```
End If
```

```
End Set
```

```
End Property
```

```
Public Property ImageYPixels() As Integer
```

```
Get
```

```
Return _ImageYPixels
```

```
End Get
```

```
Set(ByVal value As Integer)
```

```
If value > 0 Then
```

```
_ImageYPixels = value
```

```
End If
```

```
End Set
```

```
End Property
```

```
Public Property ImageDPIX() As Double
```

```
Get
```

```
Return _ImageDPIX
```

```
End Get
```

```
Set(ByVal value As Double)
```

```
If value > 0 Then
```

```
_ImageDPIX = value
```

```
End If
```

```
End Set
```

```

End Property

Public Property ImageDPIY() As Double

Get

Return _ImageDPIY
End Get
Set(ByVal value As Double)

If value > 0 Then
_ImageDPIY = value

End If
End Set

End Property

Public Property OverlayXPixels() As Long

Get

Return _OverlayXPixels
End Get
Set(ByVal value As Long)

_OverlayXPixels = value

End Set

End Property

Public Property OverlayYPixels() As Long

Get

```

```
D:\VideoComparatorProject-  
3\VideoComparatorProject\WorkingClasses\clsOverlay.vb
```

```
Return _OverlayYPixels  
End Get  
Set(ByVal value As Long)
```

```
_OverlayYPixels = value
```

```
End Set
```

```
End Property
```

```
Public Property OverlayXInches() As Double
```

```
Get
```

```
Return _OverlayXInches  
End Get  
Set(ByVal value As Double)
```

```
_OverlayXInches = value
```

```
End Set
```

```
End Property
```

```
Public Property OverlayYInches() As Double
```

```
Get
```

```
Return _OverlayYInches  
End Get  
Set(ByVal value As Double)
```

```
_OverlayYInches = value
```

```
End Set
```

```
End Property
```

```
Public Property OverlayDPIX() As Double
```

```
Get
```

```
Return _OverlayDPIX  
End Get  
Set(ByVal value As Double)
```

```
If value > 0 Then  
_OverlayDPIX = value
```

```
End If  
End Set
```

```
End Property
```

```
Public Property OverlayDPIY() As Double
```

```
Get
```

```
Return _OverlayDPIY
```

```
End Get
```

```
Set(ByVal value As Double)
```

```
If value > 0 Then
```

```
_OverlayDPIY = value
```

```
End If
```

```
End Set
```

```
End Property
```

```
Public Property OverlayToImageScaleX() As Double
```

```
Get
```

```
Return _OverlayToImageScaleX
```

```
End Get
```

```
Set(ByVal value As Double)
```

```
_OverlayToImageScaleX = value
```

```
End Set
```

```
End Property
```



```
D:\VideoComparatorProject-  
3\VideoComparatorProject\WorkingClasses\clsOverlay.vb
```

```
Public Property OverlayToImageScaleY() As Double
```

```
Get
```

```
Return _OverlayToImageScaleY
```

```
End Get
```

```
Set(ByVal value As Double)
```

```
_OverlayToImageScaleY = value
```

```
End Set
```

```
End Property
```

```
Public Property ImageToOverlayScaleX() As Double
```

```
Get
```

```
Return _ImageToOverlayScaleX
```

```
End Get
```

```
Set(ByVal value As Double)
```

```
_ImageToOverlayScaleX = value
```

```
End Set
```

```
End Property
```

```
Public Property ImageToOverlayScaleY() As Double
```

```
Get
```

```
Return _ImageToOverlayScaleY
```

```
End Get
```

```
Set(ByVal value As Double)
```

```
_ImageToOverlayScaleY = value
```

```
End Set
```

```
End Property
```

```
Public Property OverlayAngle() As Double
```

```
Get
```

```
Return _OverlayAngleDegrees
```

```
End Get
```

```
Set(ByVal value As Double)
```

```

_OverlayAngleDegrees = value
_OverlayAngleRadians = _OverlayAngleDegrees * Math.PI / 180.0

End Set

End Property

Public Property OverlaySourceRect() As Rectangle

Get

Return _OverlaySourceRectangle
End Get
Set(ByVal value As Rectangle)

_OverlaySourceRectangle = value

End Set

End Property

Public Property OverlayRotateRect() As Rectangle

Get

Return _OverlayRotateRectangle
End Get
Set(ByVal value As Rectangle)

_OverlayRotateRectangle = value

End Set

End Property

```

```

D:\VideoComparatorProject-
3\VideoComparatorProject\WorkingClasses\clsOverlay.vb

Public Property OverlaySourceCenter() As Point

Get

Return _OverlaySourceCenter
End Get
Set(ByVal value As Point)

_OverlaySourceCenter = value

End Set

End Property

Public Property OverlaySourceOffsetXInches() As Double

Get

Return _OverlaySourceOffsetX
End Get
Set(ByVal value As Double)

_OverlaySourceOffsetX = value

End Set

End Property

Public Property OverlaySourceOffsetYInches() As Double

Get

Return _OverlaysourceOffsetY
End Get
Set(ByVal value As Double)

_OverlaysourceOffsetY = value

End Set

End Property

Public Property OverlayRotateSourceScale() As Double

Get

Return _OverlayRotateSourceScale
End Get
Set(ByVal value As Double)

```

```

_OverlayRotateSourceScale = value

End Set

End Property

Public Property OverlayRotateSourceXBorder() As Integer

Get

Return _OverlayRotateSourceXBorder
End Get
Set(ByVal value As Integer)

_OverlayRotateSourceXBorder = value

End Set

End Property

Public Property OverlayRotateSourceYBorder() As Integer

Get

Return _OverlayRotateSourceYBorder
End Get
Set(ByVal value As Integer)

_OverlayRotateSourceYBorder = value

End Set

End Property

```

```

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3\VideoComparatorProject\WorkingClasses\clsOverlay.vb

Public Sub MoveDeltaPixels(ByVal deltaX As Integer, ByVal deltaY As Integer)

    _DeltaXMove = CDb1(deltaX) / _OverlayDPIX

    _DeltaYMove = CDb1(deltaY) / _OverlayDPIY

    _DeltaXAdjusted = _DeltaXMove * Math.Cos(_OverlayAngleRadians) + _DeltaYMove
    *
    Math.Sin(_OverlayAngleRadians)
    _DeltaYAdjusted = _DeltaYMove * Math.Cos(_OverlayAngleRadians) - _DeltaXMove
    *
    Math.Sin(_OverlayAngleRadians)

    _OverlaySourceRectangle.X = _OverlaySourceRectangle.X + CInt(_DeltaXAdjusted
    *
    _OverlayDPIX)
    If _OverlaySourceRectangle.X < _OverlaySourceLowerLimit.X Then
        _OverlaySourceRectangle.X = _OverlaySourceLowerLimit.X
    If _OverlaySourceRectangle.X > _OverlaySourceUpperLimit.X Then
        _OverlaySourceRectangle.X = _OverlaySourceUpperLimit.X
    _OverlaySourceRectangle.Y = _OverlaySourceRectangle.Y - CInt(_DeltaYAdjusted
    *
    _OverlayDPIY)
    If _OverlaySourceRectangle.Y < _OverlaySourceLowerLimit.Y Then
        _OverlaySourceRectangle.Y = _OverlaySourceLowerLimit.Y
    If _OverlaySourceRectangle.Y > _OverlaySourceUpperLimit.Y Then
        _OverlaySourceRectangle.Y = _OverlaySourceUpperLimit.Y

    _OverlaySourceOffsetX = _OverlaySourceOffsetX + CDb1(deltaX) / _OverlayDPIX

    _OverlaysourceOffsetY = _OverlaysourceOffsetY + CDb1(deltaY) / _OverlayDPIY

    _OverlayRotateRectangle.X = _OverlaySourceRectangle.X -
    _OverlayRotateSourceXBorder
    _OverlayRotateRectangle.Y = _OverlaySourceRectangle.Y -
    _OverlayRotateSourceYBorder

MoveToInches(_OverlayCurrentXInches, _OverlayCurrentYInches)

End Sub

Public Sub MoveToInches(ByVal ToX As Double, ByVal ToY As Double)

    _DeltaXMove = ToX - _OverlayCurrentXInches

    _DeltaYMove = ToY - _OverlayCurrentYInches

    _DeltaXAdjusted = _DeltaXMove * Math.Cos(_OverlayAngleRadians) + _DeltaYMove
    *
    Math.Sin(_OverlayAngleRadians)
    _DeltaYAdjusted = _DeltaYMove * Math.Cos(_OverlayAngleRadians) - _DeltaXMove
    *

```

```

Math.Sin(_OverlayAngleRadians)

_OverlaySourceRectangle.X = _OverlaySourceRectangle.X + CInt(_DeltaXAdjusted
*
_OverlayDPIX)
If _OverlaySourceRectangle.X < _OverlaySourceLowerLimit.X Then
_OverlaySourceRectangle.X = _OverlaySourceLowerLimit.X
If _OverlaySourceRectangle.X > _OverlaySourceUpperLimit.X Then
_OverlaySourceRectangle.X = _OverlaySourceUpperLimit.X
_OverlaySourceRectangle.Y = _OverlaySourceRectangle.Y - CInt(_DeltaYAdjusted
*
_OverlayDPIY)
If _OverlaySourceRectangle.Y < _OverlaySourceLowerLimit.Y Then
_OverlaySourceRectangle.Y = _OverlaySourceLowerLimit.Y
If _OverlaySourceRectangle.Y > _OverlaySourceUpperLimit.Y Then
_OverlaySourceRectangle.Y = _OverlaySourceUpperLimit.Y

_OverlayRotateRectangle.X = _OverlaySourceRectangle.X -
_OverlayRotateSourceXBorder
_OverlayRotateRectangle.Y = _OverlaySourceRectangle.Y -
_OverlayRotateSourceYBorder

_OverlayCurrentXInches = ToX

_OverlayCurrentYInches = ToY

End Sub

```

```

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3\VideoComparatorProject\WorkingClasses\clsOverlay.vb

Public Sub UpdateOverlayParameters()

    _OverlayDPIX = _OverlayXPixels / _OverlayXInches
    _OverlayDPIY = _OverlayYPixels / _OverlayYInches

    _OverlayToImageScaleX = _OverlayDPIX / _ImageDPIX
    _OverlayToImageScaleY = _OverlayDPIY / _ImageDPIY
    _ImageToOverlayScaleX = _ImageDPIX / _OverlayDPIX
    _ImageToOverlayScaleY = _ImageDPIY / _OverlayDPIY

    _OverlaySourceRectangle.Width = _ImageXPixels * _OverlayToImageScaleX
    _OverlaySourceRectangle.Height = _ImageYPixels * _OverlayToImageScaleY

    _OverlayRotateRectangle.Width = _OverlaySourceRectangle.Width *
    _OverlayRotateSourceScale
    _OverlayRotateRectangle.Height = _OverlaySourceRectangle.Height *
    _OverlayRotateSourceScale

    _OverlayRotateSourceXBorder = (_OverlayRotateRectangle.Width -
    _OverlaySourceRectangle.Width) / 2
    _OverlayRotateSourceYBorder = (_OverlayRotateRectangle.Height -
    _OverlaySourceRectangle.Height) / 2

    _OverlaySourceLowerLimit.X = 0 + _OverlayRotateSourceXBorder + 1
    _OverlaySourceLowerLimit.Y = 0 + _OverlayRotateSourceYBorder + 1
    _OverlaySourceUpperLimit.X = _OverlayXPixels - _OverlaySourceRectangle.Width -
    _OverlayRotateSourceXBorder - 1
    _OverlaySourceUpperLimit.Y = _OverlayYPixels - _OverlaySourceRectangle.Height -
    _OverlayRotateSourceYBorder - 1

    _OverlaySourceRectangle.X = _OverlaySourceLowerLimit.X
    _OverlaySourceRectangle.Y = _OverlaySourceUpperLimit.Y

    _OverlayAngleRadians = _OverlayAngleDegrees * Math.PI / 180.0

End Sub

End Class

```

```
D:\VideoComparatorProject-  
3\VideoComparatorProject\WorkingClasses\clsCamera.vb
```

```
Imports System.Windows.Forms
```

```
Public Class clsCamera
```

```
Private _CameraInitialized As Boolean  
Private _GrabbingImages As Boolean  
Private _CameraSizePixelsX As Long  
Private _CameraSizePixelsY As Long  
Private _CameraResolutionX As Double  
Private _CameraResolutionY As Double  
Private _CameraZoom As Double
```

```
Public Sub New()
```

```
End Sub
```

```
Public Property CameraInitialized() As Boolean
```

```
Get
```

```
Return _CameraInitialized  
End Get  
Set(ByVal value As Boolean)
```

```
_CameraInitialized = value
```

```
End Set
```

```
End Property
```

```
Public Property CameraSizeX() As Long
```

```
Get
```

```
Return _CameraSizePixelsX  
End Get  
Set(ByVal value As Long)
```

```
_CameraSizePixelsX = value
```

```
End Set
```

```
End Property
```

```
Public Property CameraSizeY() As Long
```

```
Get
```

```
Return _CameraSizePixelsY  
End Get
```



```

Set(ByVal value As Long)

_CameraSizePixelsY = value

End Set

End Property

Public Property CameraResolutionX() As Double

Get

Return _CameraResolutionX
End Get
Set(ByVal value As Double)

_CameraResolutionX = value

End Set

End Property

Public Property CameraResolutionY() As Double

Get

Return _CameraResolutionY
End Get
Set(ByVal value As Double)

_CameraResolutionY = value

```

```
D:\VideoComparatorProject-  
3\VideoComparatorProject\WorkingClasses\clsCamera.vb
```

```
End Set
```

```
End Property
```

```
Public Property CameraZoom() As Double
```

```
Get
```

```
Return _CameraZoom
```

```
End Get
```

```
Set(ByVal value As Double)
```

```
_CameraZoom = value
```

```
End Set
```

```
End Property
```

```
End Class
```

D:\VideoComparatorProject-3\VideoComparatorProject\Settings.vb

Namespace My

'This class allows you to handle specific events on the settings class:
' The SettingChanging event is raised before a setting's value is changed.
' The PropertyChanged event is raised after a setting's value is changed.
' The SettingsLoaded event is raised after the setting values are loaded.
' The SettingsSaving event is raised before the setting values are saved.

Partial Friend NotInheritable Class MySettingsEnd Class
End Namespace