The SmartImage Sensor Specialists

Training Sample Book

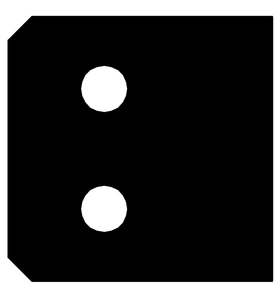
Key concepts: Use separate SoftSensors to isolate a failure mode. Setting Passing Parameters for the Intensity SoftSensors.
Intensity: On this part, you must verify using three separate Intensity SoftSensors that there are three holes in this metal plate. The following page shows a flawed version of this part.
Hint: To save time, create one SoftSensor then right-click on the sensor name & choose "Duplicate" to copy the sensor. Use the Reshape Tool to position the duplicated SoftSensors.

Note to instructors: This book is designed to be used in conjunction with a two day FrameWork training course. These samples are to be used with the *Workbook* where a series of worksheets asks questions about the samples presented here.

The average student should be able to complete all of the Introductory-level samples in the alotted time. More advanced students may have time to completed the Intermediate and Advancedsamples.

After the students have had their alotted time to work on samples, the instructor should review the solution(s) with the class. This includes the Intermediate and Advanced samples that may not have been solved by many students.

The goal with this book and the *Workbook* is to give students a good working knowledge of the functionality of all FrameWork SoftSensors.



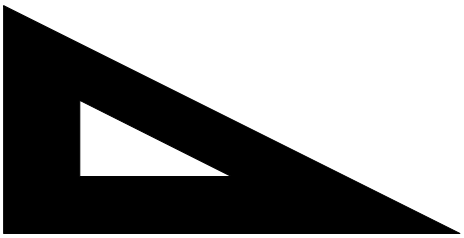
Measure distance between two hole centers
Verify that line running through holes is parallel to left edge of part
Check angle of both chamfered corners

Instructions

This book is designed to teach the basic operating principles of the FrameWork SoftSensor tools. Each page represents a sample part, complete with instructions for setup and use. In some cases, a sample part is shown in two forms: acceptable and unacceptable. Also found in this book are the samples covered in training class. They are spaced in between the major sections listed below.

Contents

Intensity: This is the flawed version of the part shown on the previous page. Use three Intensity SoftSensors to verify the presence of each hole. Using separate SoftSensors helps the user isolate modes of failure.



Use Measurement Area Edge Lines and the Angle Math Tool to measure the angle of the horizontal and sloped sides relative to the vertical one
Verify that the white triangle in the center is parallel to the black triangle
Measure distance from left edge of larger triangle to left edge of the white triangle

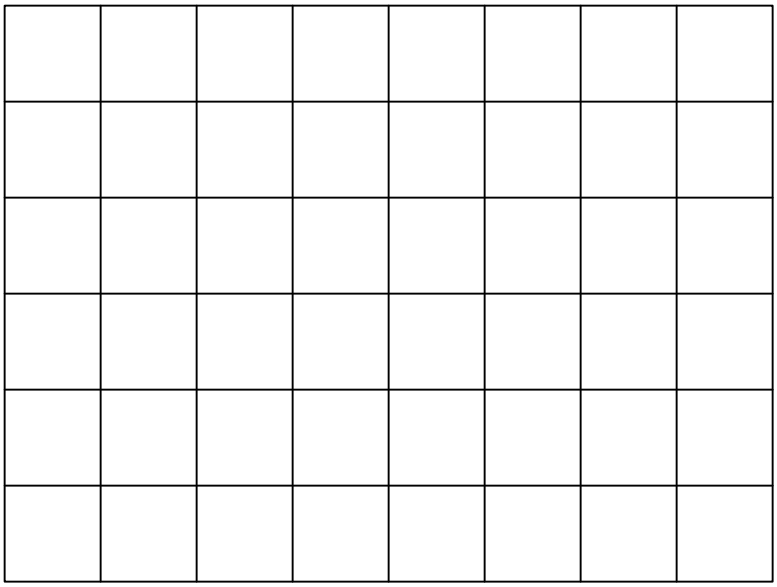
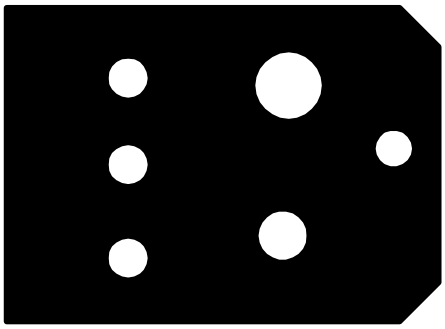


Image setup: place this grid so that it fills your field of view and is roughly aligned with the image with horizontal and vertical lines.

Key concept: Using the Bright Area parameter as a condition to Pass a SoftSensor.
Intensity: A common application is the verification of text printed as a date or lot code. At left is a dark "quiet zone" with a date code imprinted. Use an Intensity SoftSensor to verify print presence. The following page is a flawed version of this part.

In-class training sample

The image at left is a continuation of an example started on the previous page. The lot code shown here is considered a reject and that on the prior page is the currently acceptable code.
When done with this example, please delete the SoftSensor.



Measurement & Math Tools:
Verify several dimensions on this machined metal part.
On the previous page, you'll find the dimensions you are to verify with the Measurement and Math Tools.

EdgeCount: An Introduction

Now that you've set up your image with appropriate illumination and proper focusing, we're ready to move into the first SoftSensor category: EdgeCount. The EdgeCount tools are the simplest FrameWork has to offer.

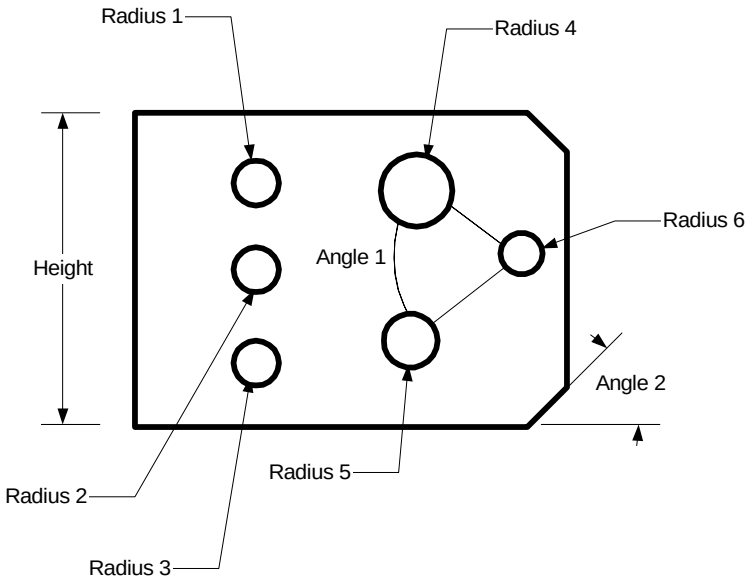
The primary topics you should understand before moving on from EdgeCount are outlined below:

Intensity: A measure of the brightness of a given pixel. This value is represented as a percentage from 0-100%.
Contrast: The difference between maximum intensity and minimum intensity. Contrast is a measure of image quality where more contrast means better images.
Threshold: EdgeCount considers all pixels as either bright or dark, relative to the threshold value.
Pixel Graph: Representation of pixel Intensity versus Position with the Threshold shown in red.
Edge: The ocurrence of a transition between bright and dark pixels along the SoftSensor path.

Intensity: This is the flawed version of the part shown on the previous page. Note that the date code was misprinted in this image.

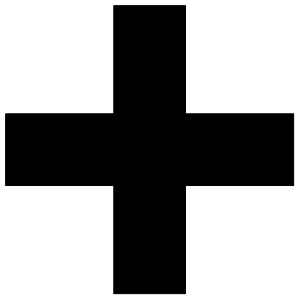
123456

At left is a lot code printed on paper labels for consumer products.
Apply a Template Match SoftSensor to verify a particular lot code (use the one at left as the current lot code).
The following page shows a different lot code that should be rejected.

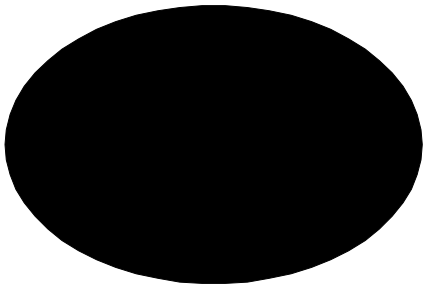


Measurement & Math Tools:
Verify several dimensions on this machined metal part.
Dimensions are shown on this page, turn to the following page to practice with the SoftSensors.

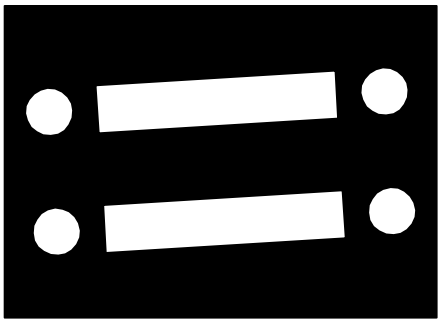
Instructor's Example



The widget example shown here, will be explained by the instructor. Please refer to the *Workbook*, chapter 2 for details on the inspection for this widget.

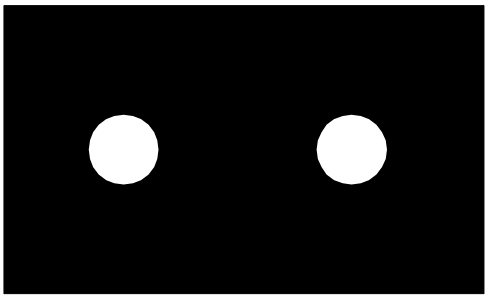


Key concept: Using the contrast and/or bright area parameter to Pass the Intensity SoftSensor.
Intensity: With proper illumination, a flat surface can be inspected for scratches. With this example, verify that this surface is scratch-free. The following page is an example of a flawed part.



This page is a continuation of an example started on the previous page.
At left is a representative flawed part.
The acceptable version appears on the previous page.
This image should produce a fail result in your Template Match SoftSensor.
You are finished with this SoftSensor and may now delete it.

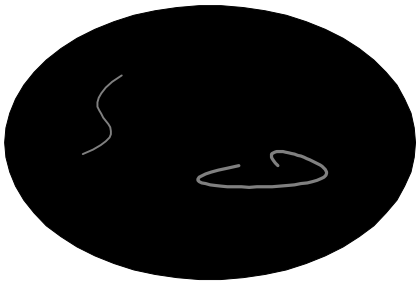
Measurement & Math Tools: Exercise



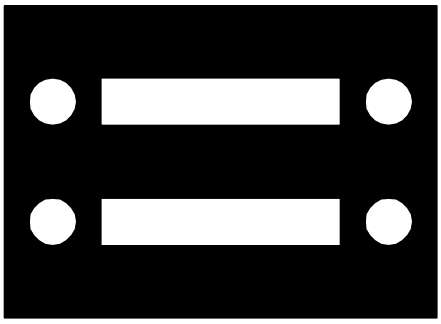
The image at left must be verified for proper dimensions.
Please refer to the *Workbook* for specific instructions
Measure the radii of the two holes.
Measure the height and width of the part.
Measure the distance between the holes.
After the Workbook exercise is complete for this sample, delete the SoftSensors and turn to the following page for more practice with the Measurement and Math Tools.

Instructor's Example

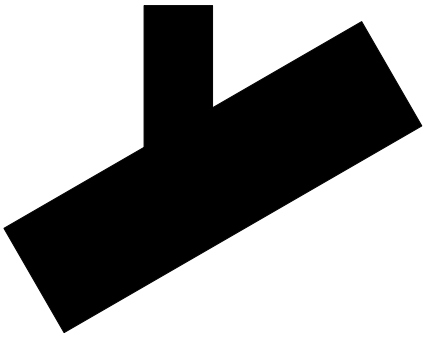
The widget example shown here, will be explained by the instructor. Please refer to the *Workbook*, chapter 2 for details on the inspection for this widget.



Intensity: This page shows a flat surface marked with scratches. Use an Intensity SoftSensors to reject this part and accept the one on the previous page.



This drawing simulates a metal stamping with holes and slots. Use the Fixed Template Match SoftSensor to verify the pattern has been properly stamped on the blank. Draw the SoftSensor, name it, and click on the Warn / Pass tab. Set the pass criteria (Max Error) to 5% and click Ok. Turn the page for a representative flawed part.



Rotational Find Edge: This image shows the flawed version of a part. The previous page shows the acceptable version.

EdgeCount: Exercise

This exercise is designed to get the user comfortable with the basic operation of the EdgeCount SoftSensor. More samples follow that are designed to further familiarize users with more complex aspects of EdgeCount.

Open the EdgeCount toolbox and draw an EdgeCount Horizontal Line from left to right through the middle of this sample.

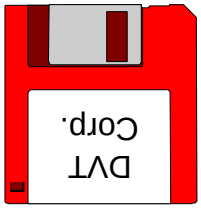
Key concept: Understand the **Key words** of Intensity, Contrast, Threshold, Pixel Graph, Edge

Click on the "Pixel Graph" tab.
How many edges are there?
(You should count 14)

The two marks on either end of this sample are not quite as dark as the others. **About how much higher is the intensity level for the two end marks than for the others?**

This sample is printed again on the following page, please turn now and continue with the instructions.

Instructor's Example



The diskette example shown here, will be explained by the instructor. Please refer to the *Workbook*, chapter 4 for details on the inspection for this floppy disk.

The sample at left is for practicing with with Template Match SoftSensors. Please refer to the exercise instructions in your Workbook for details on inspecting this image and that on the next page.

Key concept: Use of the Rotational Find Edge SoftSensor as a Position Reference for an EdgeCount SoftSensor.
Here is a part with a small tab sticking straight up. On the following page is the same part that has the tab bent several degrees to the right.
Apply an EdgeCount Polyline to verify tab presence in this image, then draw a Rotational Find Edge tool and reference the EdgeCount to the Rotational sensor.

This is a continuation from the previous page.

EdgeCount: Exercise

Refer to the Pixel Graph for these questions: **What is the maximum intensity along your SoftSensor line? What is the contrast? What could be done to improve contrast?**

The gray mark(s) on this sample and the page before is background noise (and is unimportant). **Is there a threshold level that would allow you to not count edges for the gray mark?**

Click on the "Warn/Pass" tab, check "Minimum Edges" and set the value to 10 (repeat for "Maximum Features". **Does the SoftSensor PASS or FAIL when the previous page is inspected? What is the result when this page is inspected?**

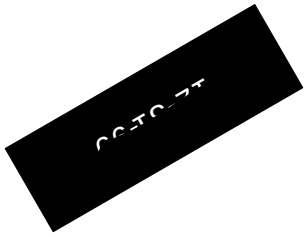
After you have answered all questions, delete this SoftSensor by selecting "Delete Sensor" from the SoftSensors Menu.

Instructor's Example

The diskette example shown here, will be explained by the instructor. Please refer to the *Workbook*, chapter 4 for details on the inspection for this floppy disk.

The sample at left is for practicing with with Template Match SoftSensors. Please refer to the exercise instructions in your Workbook for details on inspecting this image and that on the next page.

On this page is the same sample as shown on the previous page, except that the part has been skewed. Your task is to inspect the date code with an Intensity SoftSensor while the code and background are in this rotated orientation.



Key concept: The same SoftSensor tool (EdgeCount) can be applied in a variety of shapes and the threshold location can be calculated using more than one method.

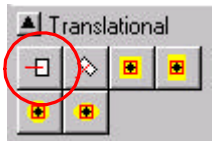
EdgeCount: Draw the polyline shape so that it just surrounds the upright tab on this sample. The SoftSensor should look like an upside-down U drawn in only the white space around the tab.

The idea with this approach is to draw the SoftSensor so that the ideal pass condition is zero edges and a failure occurs anytime the SoftSensor path is "broken" by a skewed tab. Click on the "Warn/Pass" tab and set the min. & max. number of edges to zero. Click the Apply button.

Many inspection SoftSensors calculate a dynamic threshold based on the contrast along the SoftSensor path. In this case, the "percent of path contrast" type of threshold causes false edge readings when the SoftSensor is drawn in a region of low contrast (like this all white area).

Turn the page to continue the example.

Translational Lines: Exercise

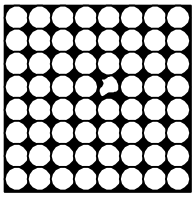


Key concept: Understand the terms edge and learned position.

Draw a Horizontal Translational Line from left to right through this sample.

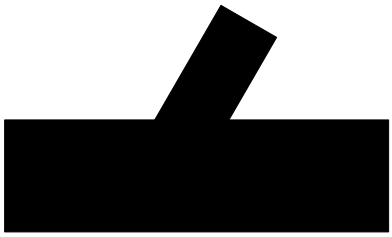
Look at the image and note the red or green hash mark along the SoftSensor path. This mark shows the position of the first edge crossing along the path (from beginning to end, in the direction of the arrow).

Turn the page and continue with the exercise.



At left is the flawed version of a filter part. On the previous page, you'll find the acceptable part.
After configuring the necessary Blob Tools SoftSensors, this image should cause a fail condition.
What criterion/criteria did you find helpful in this inspection?
You many now delete the SoftSensors used for this example.

When covering the Intensity SoftSensors, we saw this problem: verification of a date code printed on a dark background. The Rotational Find Edge SoftSensor comes in when the background and code are skewed at some angle. After applying the Rotational SoftSensor, draw an Intensity Rectangular Area around the date code and reference it to the Rotational tool. Turn the page and watch the result.



Look at the Pixel Graph and note both the contrast and how many edges are counted. Now, turn back to the previous page and note contrast and number of edges.

The first example probably showed some extremely high number of edges. That's because the threshold defaults to "percent of path contrast". When contrast is really low, this calculation method can give false edge readings.

To protect against this low contrast-false edges problem, click on the "Warn/Pass" tab and check the "Minimum Contrast to Count Edges" and click the Apply button.

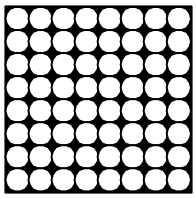
Finally, to set the passing condition for this SoftSensor, click on the "Warn/Pass" tab, check the maximum edges checkbox, and set the value to zero. Click the Apply button.

Flip back to the previous page. **Does the SoftSensor PASS or FAIL?** Return to this page. **Does the SoftSensor PASS or FAIL?**

When you're done this example, delete the SoftSensor.

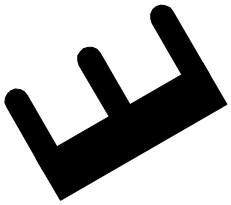
Translational Lines: Exercise

This image shows the same part displaced to the left by 1/2".
Now, draw a vertical FeatureCount line through the large rectangle. After naming the FeatureCount SoftSensor, click "Enable Position Reference" and choose the Translational Line form the drop-down list. Click Ok. (At Ok, the FeatureCount takes as its Learned Position the x & y coordinates of the Translational Line's edge crossing.)
Turn the page and continue with the exercise.

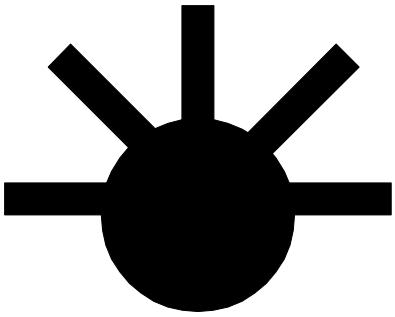


The image at left is another example for the Blob Tools.
Use the Blob Tools to inspect this part, which is a filter with round holes.
You should verify that the filter holes are not clogged, blocked, or otherwise damaged.
This application presents an interesting problem -- due to the accuracy of placing the SoftSensor on the image and the density of holes in the filter, you'll never be assured of having an exact number of blobs counted by the SoftSensor.
This application is prime for inverting the inspection criteria. Instead of searching for exactly n blobs, try setting up for zero blobs of the inverse criteria.
This example is continued on the following page with a flawed part.

Rotational Find Edge: Exercise



This sample is a continuation from the previous page.
How has the red line (marking the found edge of the part) changed since the last image?
Add a FeatureCount line sensor that runs through the three tabs on the example (roughly parallel to the red line fit in the rotation sensor). After naming the FeatureCount, click on the checkbox labeled "Enable Position Reference" and choose the rotation sensor from the drop-down list. Click Ok.
Now, flip between this page and the previous page to compare how the FeatureCount sensor "follows" along with the found edge from the Rotational SoftSensor.



Key concept: EdgeCount can even be applied in an arc shape.
New FrameWork users often report the Circular Arc SoftSensor shape is the most difficult to draw. This example shows you how.

To draw a Circular Arc, first select the tool from the EdgeCount toolbox.

Next, place your mouse cursor in the center of the prong at 12 o'clock.

Click and hold your mouse button. Drag the mouse to the 6 o'clock position so that you see a circle outline concentric with the part.

Release the mouse button. You've now established the diameter for the arc, now let's set the arc length.

Re-position your pointer at about the 8 o'clock position and click-and-hold your mouse button. Drag the mouse clockwise from 8 o'clock to 4 o'clock. You should see the arc length as you drag.

Release the mouse button when you arrive at the 4 o'clock position.

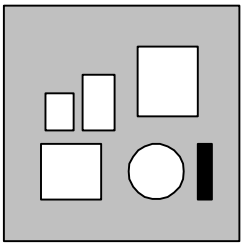
This example is continued on the following page.

Translational Lines: Exercise

This image shows the same part from the previous page, displaced to the right by 1/2".

What happened to the FeatureCount tool?

In Position Referencing, a SoftSensor (in this case FeatureCount) "learns" the offset position from the SoftSensor it is referencing (in this case the Transl. Line). In subsequent images, if that offset position changes, the referenced sensor (FeatureCount) repositions itself to remain constantly offset from its reference.



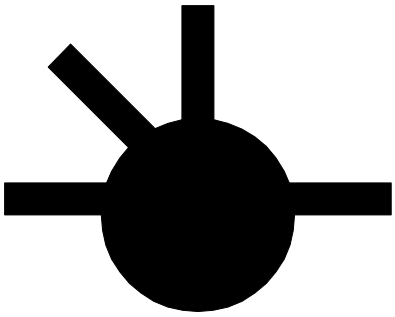
This is the fourth part of a four-part example. Here, the circuit board has been assembled properly, but appears 180 degrees out of rotation compared to the original image.
Your task with this part is to signal a passed inspection (all components are in place) but flag the fact that the board is rotated 180 degrees.
Apply some other SoftSensor you've studied up to this point. This SoftSensor may be Intensity, FeatureCount, or EdgeCount but must be set to pass on the unrotated version of this board and fail on this orientation of the board.
This is the final part of the example -- please delete the Blob Tools created here.

Rotational Find Edge: Exercise

Draw a Rotational Find Edge in Parallelogram SoftSensor across the bottom edge of this sample. (Hint: Drawing tips appear in the lower left of FrameWork after selecting the tool.)

Look at the Sampled Image Display and make a note of the red line in the sensor tool.

Turn the page and continue with the instructions.



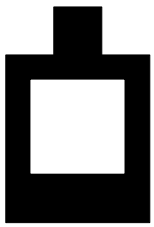
This is a continuation from the previous page. You should show an EdgeCount Circular Arc SoftSensor running clockwise from 8 o'clock to 4 o'clock (approximately 270 degrees around). Click on the SoftSensor Parameters "Warn/Pass" tab and set the Minimum and Maximum Edges to 10. Click the Ok button.

To test the passing condition, flip back to the previous page (considered acceptable) and verify a pass result.

Your goal with this example was to learn how to correctly draw a Circular Arc SoftSensor. Several other toolboxes in addition to EdgeCount make use of this shape.

With the Circular Arc shape, the beginning point is always the place where you first held down the mouse button to start drawing the arc length. In this example, that's the 8 o'clock position. This is important when reading graphs associated with this shape -- Pixel Graphs always start at the beginning point of the SoftSensor.

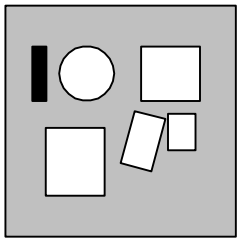
After you have completed this example, delete the SoftSensor.



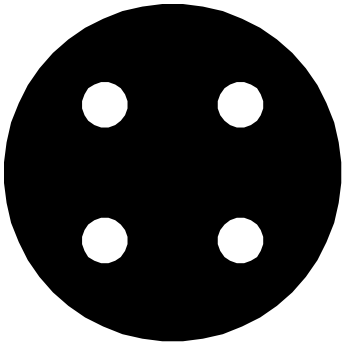
Key concept: Apply the concept of Position Referencing & understand the role of Inspection SoftSensor.

Draw a vertical Translational Line up through the bottom of this bottle.

For this bottling application, you must check the position of the white label (use a horizontal FeatureCount line to check for 2 dark features surrounding the label). Reference the Feature count to a Vertical Line Translational SoftSensor. The following page shows the flawed version of this part.



This is the third part of a four-part example. In this image, a simplified circuit board is shown with a skewed component.
For the second Blob Selector SoftSensor created earlier (to find the four rectangular components), open the Parameters dialog, Parameters Tab. Check "Calculate Blob Angles" FrameWork finds angles for rectangular shapes best when the "Maximum Point" option is chosen from the drop-down list to the right of the "Calculate Blob Angles" checkbox. Choose this option and click Apply.
Set the min and max angles for "Selection Criteria" so that the skewed component (and presumably, all misplaced componenets) cause a failure on this SoftSensor.
This example continues on the following page.



This is page two of a two part sample. Here, the plate has been turned 45 degrees before being imaged. At this point, you should have a FeatureCount Line SoftSensor referenced to the Rotational tool. The FeatureCount should have rotated around to "follow" the turned part.

Hint: When looking at repetitive patterns such as this, keep in mind that by default the Rotational SoftSensors look only for the first edge crossing (dark to bright of vice-versa). Depending on the amount of rotation on a part, you might fool the SoftSensor. Try setting the Rotational tool up to look for the first dark to bright edge and you'll see more consistent results.

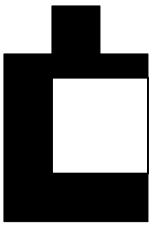
FeatureCount: An Introduction

At this point, you should have just completed the EdgeCount section. With a solid feel for how thresholds work and what edge counting is all about, you are ready to move on to a slightly more complicated tool.

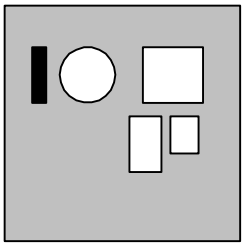
Basically, FeatureCount tools perform the same task as EdgeCount in that both are looking for **edges** along the SoftSensor path. FeatureCount, however, adds a parameter for Feature Size. A **feature** is defined as a series of pixels that can be limited by size.

The major topic you should understand before moving on from FeatureCount is outlined below:

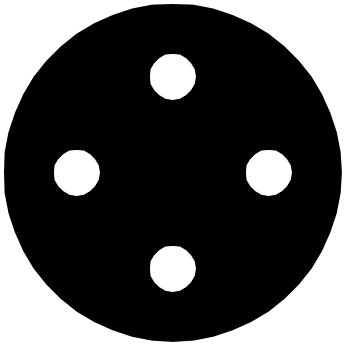
Feature: A series of either bright or dark pixels that meet a size requirement as set under the "Features" tab for a given SoftSensor.



Translational: This image is a continuation of the previous page. Note that the label on this bottle is off-center. This part should be rejected.



This is the second part of a four-part example. In this image, a simplified circuit board is shown with a missing component.
Because of the passing conditions set while working on the previous page, the second Blob Selector SoftSensor should be failing now. That's because there are no longer four rectangular blobs in the image.
Blob Tools are ideal for checking for the presence of objects in the image, much like Intensity and FeatureCount SoftSensors. However, the simplicity in setup (as compared to Intensity and FeatureCount) comes at a loss of processing speed.
This example continues on the following page with another example of how the Blob Tools can be used.



Often, when applying Rotational Arc SoftSensors a repeating pattern will appear which must be oriented. In this case, a plate with four holes provides a pattern which repeats every 90 degrees. Use the Rotational Circular Arc in approximately a 90 degree arc length to find the orientation any of these holes.

For testing purposes, reference a FeatureCount Line to the Circular Arc. Draw the FeatureCount Line so that it passes through the diameter of one of the holes. Turn the page to see the result of this Position Reference.

FeatureCount: Exercise

This exercise is designed to get the user comfortable with the basic operation of the FeatureCount SoftSensor. More samples follow that are designed to further familiarize users with more complex aspects of FeatureCount.

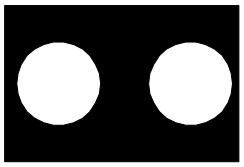
Key concept: Understand the idea of "feature"

Draw a FeatureCount Horizontal Line through this sample.

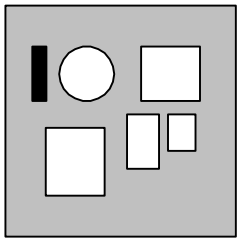
Click on the "Threshold" tab & look to the bottom of the tab. Press the "Dark Features Only" button under the "Feature Types to Count" setting. Click the OK button. **How many features are found?** (There should be 2)

Click on the "Features" tab & look in the "Dark Feature Size" section. Set the "Minimum" to 120 and "Maximium" to 200 (pixels). Click the OK button. **How many features are found?** (There should be 1)

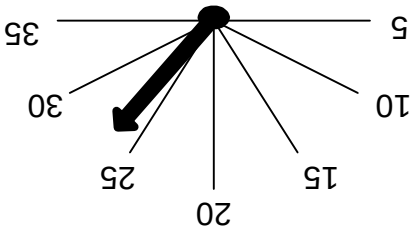
Click on the "Warn/Pass" tab, check "Minimum Features" and set the value to 1 (repeat for "Maximum Features". **What is the result?** (It should read PASS)



Key concept: Understand how to track the position of an object that might vary in both the x and y axes.
Translational: Now, with this sample, we'll take Position Referencing a step further. This part will be displaced in x and y axes in the following image. Draw one horizontal and one vertical Translational Line on this part. Reference the vertical line to the horizontal. Finally, draw a horizontal FeatureCount Line (to verify presence) & reference them to the vertical line. Turn the page to see the result.

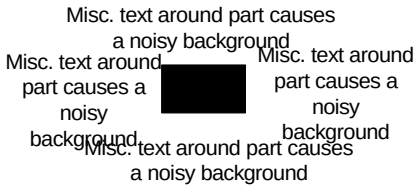


At left is a new example using the Blob Tools. Imagine this simple drawing is a circuit board on which various electronic components are placed.
Draw a Blob Rectangle for Generation around this "circuit board." Click on the PreProcessing Tab and choose to look for light blobs.
Select a good threshold location and minimum blob size so the SoftSensor result is five blobs.
Add a Blob Selector SoftSensor and use the Selection Criteria to select out the circular component (Hint: eccentricity can indicate the roundness of a blob).
Add another Blob Selector SoftSensor to confirm the presence of the four other components.
For both Blob Selector SoftSensors, set min and max passing criteria for the number of blobs.
This example continues on the following page.

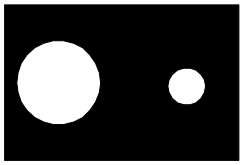


This is the "reject" part continued from the sample shown on the previous page. With these samples, you should gain a feel for how the Rotational Arc SoftSensors can be configured to look for the position of a feature instead of an edge (the default for both Translational Lines and Rotational SoftSensors).

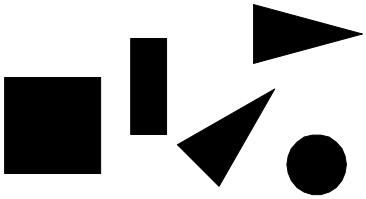
** Note: SmartImage Sensor images are "upside down". When the image is viewed in FrameWork, the image will be flipped.*



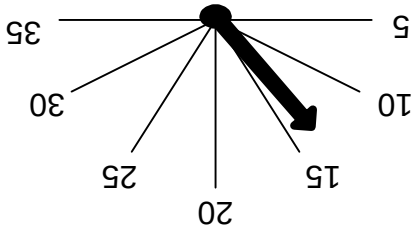
Key concept: FeatureCount can act to filter "noise" and find only objects of a specific size.
FeatureCount: Draw a vertical FeatureCount line through the text and dark block.
This image simulates a common problem: a noisy background (the text) in which falls an important image feature.
After drawing the line, set the minimum dark feature size to 10 pixels and the maximum to 200 (these settings are made on the Features Tab).
Click on the Threshold Tab and opt to count dark features only. This forces the SoftSensor to ignore any bright-colored features and focus only on the dark.
Finally, on the Warn / Pass tab, set the minimum and maximum number of features to one. This setting gets the FeatureCount tool to fail if the dark block is not present.
Turn the page for an example of a flawed part.



Translational: This part is a continuation of the sample on the previous page. In this image, the part has been displaced below and to the right of the original. With proper Position Referencing, your FeatureCount SoftSensor should have "moved" down and to the right of its drawn position to inspect the image.



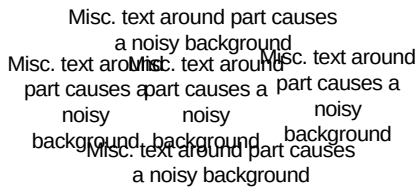
At left are the same "blobs" from the previous page, except that they've been rearranged for position.
Now, add a Blob Selector SoftSensor. Name it and click the Apply button. Click on the Parameters Tab and check off "Calculate Blob Positions." Now, click Apply again and finally click on the Blob Info Tab. FrameWork now reports the blobs by their index numbers and gives their x & y coordinates.
Selection Criteria on the Parameters Tab are configured to show calculated values under Blob Info only when checked. Practice with several parameters such as area and perimeter.
Blob index numbers increase as the software locates blobs from the top of the image towards the bottom. So, if you turn to the previous page, the blobs may seem to rearrange themselves on the index list.
Please delete these SoftSensors.



With this sample, we throw in a small twist from a previous sample. Here you have an indicator on a gauge, but instead of a white background, you see the markings. Apply the Rotational Circular Arc and use the Edges/ Features tab to force the SoftSensor to locate the first instance of a particular feature size (the needle).

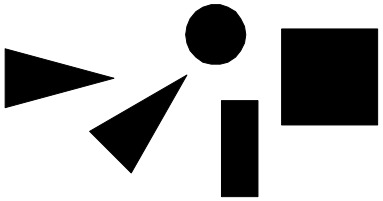
The "reject" part is shown on the following page.

** Note: SmartImage Sensor images are "upside down". When the image is viewed in FrameWork, the image will be flipped.*

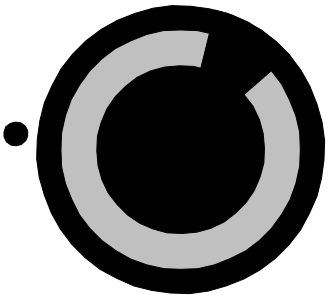


FeatureCount: This is an example of a flawed part for which the acceptable part is shown on the previous page.
Since you set Warn / Pass conditions earlier (looking for one feature), this image should cause your SoftSensor to fail inspection.
Even though there are a great deal of edges along your SoftSensor path, the FeatureCount tool is set up to only count objects when they reach a certain size (in this case, between 10 and 200 pixels).

Key concept: Understand that in Position Referencing, the order in which SoftSensors execute inspection is important.
Translational: With the sample on this page and the next, you'll need to apply horizontal and vertical Translational SoftSensors to locate this part then draw three vertical FeatureCount SoftSensors to verify the height of the three tabs.
Position Referencing can get tricky, as in this example. Look at the following page to see how far this part has been displaced. **What happens if the horizontal Transl. Line inspects first?**



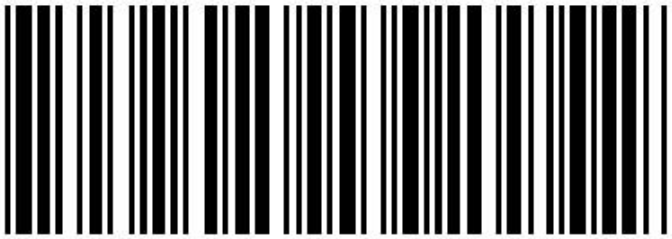
This and the following pages are geared towards using the Blob Tools SoftSensors.
Draw a Blob Rectangle for Generation SoftSensor around the shapes here, name the tool, and click Ok.
Blobs are defined as regions of interconnected pixels inside the SoftSensor. (Hint: think of the old "B" movie, The Blob - a large mass of connected goo) Blobs can be as small as a single pixel and as large as the image. Blobs are marked with gray pixels on a green background.
How many blobs are counted, according to the Result Table?
Please refer to your Workbook for instructions on applying the Blob Tools to this image and that on the following page.



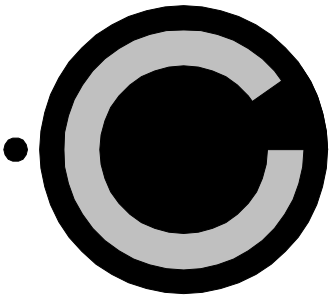
This is the same part as on the previous page, presented here in a rotated orientation with the dark circle out of position. Verify that the dark circle is basically opposite the gap in the gray "C" shape.

Key concept: Further develop an understanding of how FeatureCount can filter background noise. This is a variation on the previous problem. Your goal here is to apply a horizontal line FeatureCount to verify the presence of the dark mark on the noisy background.
The flawed version is shown on the following page.
You must set passing conditions so that the SoftSensor fails when the following page is presented to the image sensor.

Translational: When Position Referencing, the order of the references is important. In this example, if the horizontal Transl. Line inspects first, it will "miss" the base of the sample part because of how far it has been displaced vertically. Try referencing so that the vertical line inspects first, then the horizontal.



BarCode Reader: Line for 1D Codes.
This is a "USS 39" type of bar code (also known as Code 39).
Create a SoftSensor to read this code and determine what is encoded within this Code 39 symbol.



Your task with this sample is to verify the presence of the dark circle relative to the open section of the "C" shape. Remember, the EdgeCount or FeatureCount tools are perfect for determining presence (try a short line running through the circle).

In reality, this is very similar to a number of timing chan/belt applications seen in the automotive industry.

On the following page is an example of this same part in a rotated orientation with the dark circle out of position.

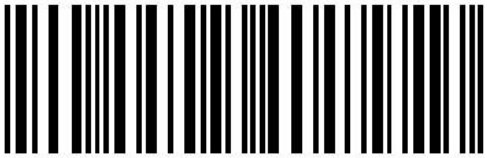
FeatureCount: This is the flawed part where the dark mark is undersized. The acceptable part is on the previous page. Use FeatureCount to distinguish between acceptable and unacceptable parts.

Translational Fiducials: An Introduction

By this point, you should be familiar with the Translational Lines SoftSensors. While these tools are extremely fast at exectuting, they are limited when presented with oddly shaped objects. The Translational Fiducials offer another method of object location within an image.

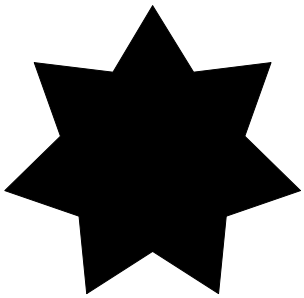
The primary topics you should understand before moving on from the Translational Fiducials are outlined below:

Fiducial: A target that is defined by contrast from a background. Fiducials may be either bright on a dark background or dark on a bright background.
Histogram: The histogram is a graph that charts intensity level versus percentage of pixels. This graph shows the distribution of various intensity levels throughout the SoftSensor inspection area.

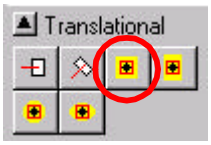


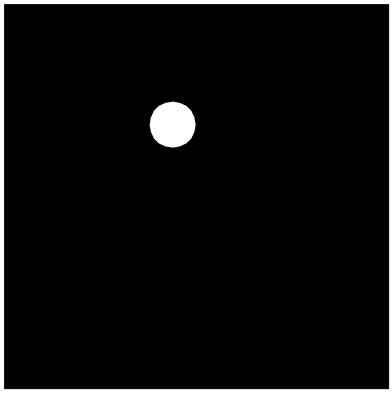
BarCode Reader: Line for 1D Codes.
This is an "Interleaved 2 of 5" type of bar code. The code incorporates the digits 0-9 only.
Draw a horizontal "Line for 1D Codes" SoftSensor to read this code.
Click on the Parameters Tab and set the radio button for "Code Type" to Interleaved 2 of 5.
What data is held in this bar code?

This is the second image of a needle on a gauge of some sort. On the previous page is the sample in the "acceptable" position. Use a Rotational Circular Arc SoftSensor to check the angle of the needle measured relative to horizontal.



Key concept: Use FeatureCount specifically to find background noise.
FeatureCount: Imagine this is a molded plastic part. Your job is to make sure no excess material (called flash) is present between the teeth of this star shaped part. An example of a flawed part is shown on the next page.
Use a FeatureCount circle SoftSensor that runs through the points on this part.
Hint: consider examining the white spaces between the teeth for excess material.





Draw a Translational Fiducial Square SoftSensor inside this dark area. Name the sensor and click OK.

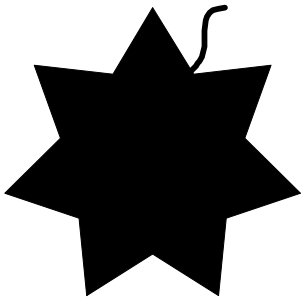
Look at the image and note the red mark at the center of the white circle. This marks where the SoftSensor found its target (or, fiducial).

Turn the page and continue following the instructions.

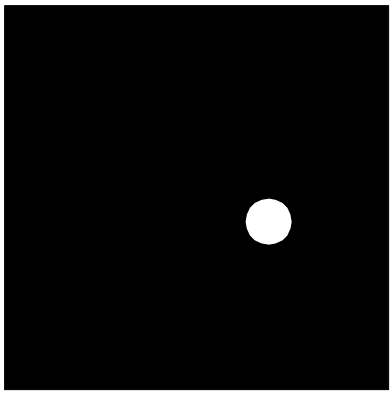
Here is a final DataMatrix code.
This is the same code as presented on the previous page.
The difference here, though, is that the code has been poorly printed. Note the large white section in the center of the code.
Despite this large amount of degredation in the printed code, FrameWork can still read it.
Take a look at the SoftSensor marking in the image. The red and green pixels should show you that FrameWork interprets the white section in the center of the code as bright cells (red pixel marks).
Delete the DataMatrix SoftSensor, as you are done with this example.

For ths part, imagine it is the needle on a gauge of some sort (perhaps a pressure gauge). Your task is to verify the angle from the needle measured relative to horizontal. The part shown on the following page is identical except the needle is out of position (and is a reject).

The Rotational Arc tools measure angles slightly differently than you might expect. Angles are represented as a percentage of total arc length. For example, a 180 degree angle on a 360 degree arc is 50% in the terms used here. (Don't let this representation alarm you, it is still an angle.)



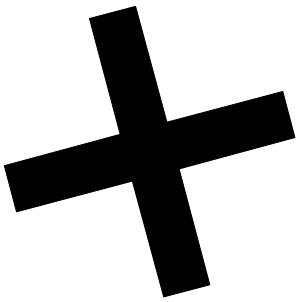
FeatureCount: An example of a flawed plastic part is shown here. The thin strand at about one o'clock is a flaw known as flash. See the previous page for the acceptable part.



Note in this image that the center of the fiducial (white circle) is marked with a red spot -- as in the last image.
This red mark shows the position found by the SoftSensor and is the point referenced by other sensors when Position Referencing.

Here is another DataMatrix code.
This code contains another string of text and is presented in a rotated orientation relative to your image sensor.
The Rectangle SoftSensor can read DataMatrix codes presented in any orientation.
Notice the SoftSensor marking in your image. Green and red are used to help you see how the SoftSensor is working. Red dots mark bright "cells" in the code and green mark dark cells. This marking will help you diagnose problems in the event of failed reads.

Rotational Arc: Exercise



This sample is a continuation from the previous page. In this image the part appears in a slightly rotated orientation.

How has the EdgeCount line (running through the leg) responded to this rotated version of the same part from the previous page?

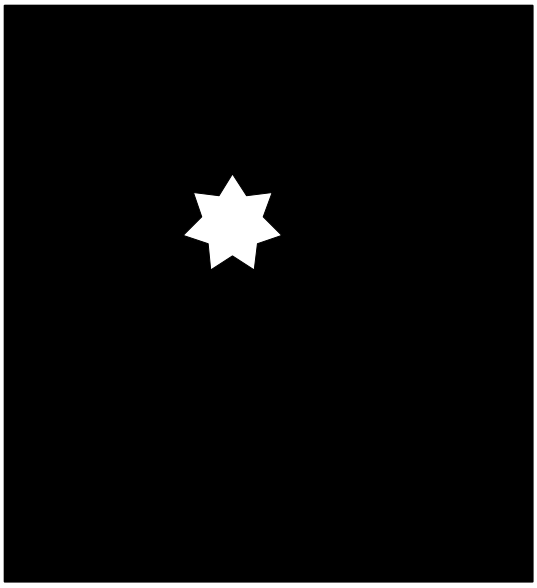
Intensity: An Introduction

At this point, you should have just completed the FeatureCount section. With a solid feel for how thresholds work and what edge detection and feature counting are all about, you are ready to move on to another tool.

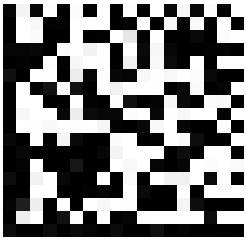
While EdgeCount and FeatureCount both are **edge detection** tools, Intensity is a **pixel counting** tool. That is to say that Intensity tools calculate the relative amounts of bright and dark pixels instead of look for the presence of edges.

The major topics you should understand before moving on from Intensity are outlined below:

Bright Area: The number of bright pixels divided by the total number of pixels inspected by the tool.
Histogram: A graphical representation of the Bright Area (see above) vesus Intensity values. A Histogram is basically a bar chart used to identify the major pixel intensities being inspected by a SoftSensor.

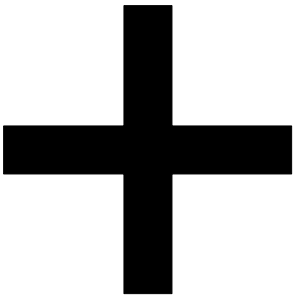


In this sample, the target shape is different from the previous one. The Translational Fiducial SoftSensors can locate targets of any shape without any change in the Parameters. Give this one a try to see how the tool behaves.



The black-and-white symbol at left is a code known as DataMatrix, which is similar to a bar code.
There is text encoded in the DataMatrix symbol at left.
Open the BarCode Reader Toolbox.
Draw the Rectangle DataMatrix SoftSensor around the image of this code. This SoftSensor can read the DataMatrix code in any orientation, as long as the code falls within the SoftSensor.
This is an ECC200 version of the DataMatrix code. ECC200 is the accepted standard for DataMatrix encoding. This version can be recognized by the even number of rows and columns in the code.
What text is held in this code?
This example continues on the following page.

Rotational Arc: Exercise



Draw a Rotational Circular Arc SoftSensor so that it is concentric with the cross shape and about 1/2 its diameter.

Next, draw an EdgeCount line so that it runs through one of the legs. On the EdgeCount General Tab, click "Enable Position Reference" and choose the rotational SoftSensor from the drop-down list. Click OK.

Turn the page and continue with the instructions.

Intensity: Exercise

This exercise is designed to get the user comfortable with the basic operation of the Intensity SoftSensor. More samples follow that are designed to further familiarize users with more complex aspects of Intensity.

Key concept: Understand the relationship between threshold and amount of bright area as well as contrast.

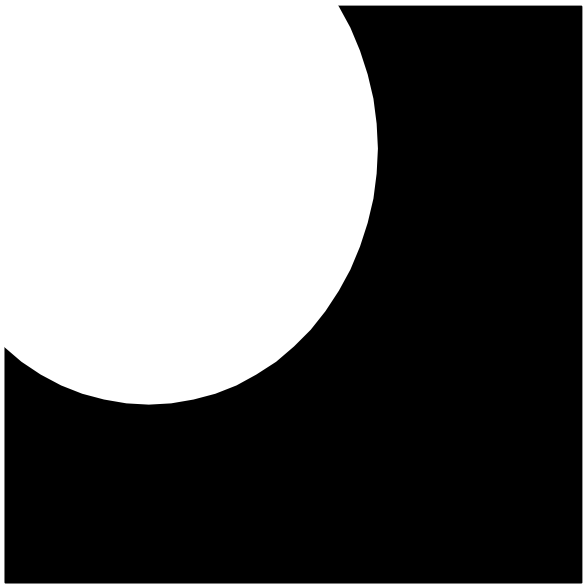
Draw a Horizontal Intensity Line SoftSensor through the center of this sample. Click on the "Threshold" tab & look at the threshold information.
What is the Threshold Type? (Fixed)
What is the Threshold Level? (50%)

Click on the Histogram Tab. **What is the Bright Area value?** (~75%) **What is the Contrast value?** (~80%)

Click Ok to close the Parameters dialog box. Click on the Images menu and choose "Show Inspection Results." Look at the image where the Horizontal Line has been drawn.
What color is the line in the very dark color block? In the medium-dark color block? In the lightest gray color block? (FrameWork marks the SoftSensor line with white pixels for bright and black pixels for dark.)

Change the Threshold Level to 90% intensity & click Apply.
What is the Bright Area value? (~90%) What is the Contrast value? (~80%)

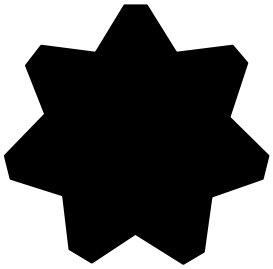
Look again at the image marking. **How has the image marking changed from the last case** (with the 10% threshold)?



This target represents a common "problem" encountered. By default, the Translational Fiducials can only locate target positions that are fully surrounded by a contrasting intensity level (i.e. white on black). Here, the target is the white elliptical shape that is larger than our field of view.

Try drawing the Translational Fiducial sensor, then use the settings on the "Sides" tab to force the sensor to look for the target only from the "left" and "top".

** Note: SmartImage Sensor images are "upside down". When the image is viewed in FrameWork, the image will be flipped.*



Rotational Arcs: An Introduction

The Rotational SoftSensors are another type of Positioning sensor, much like the Translational SoftSensors. The goal of the Rotational tools is to find the orientation of an object then report that orientation to any SoftSensor that may be Position Referencing the Rotational SoftSensor.

In this section, you should be sure to understand the following terms:

Edge: The ocurrence of a transition between bright and dark pixels along the SoftSensor path.
Featue: A feature is the region between two edges and can be either dark or bright. The Roatational SoftSensors allow user to locate the orientation of a feature in lieu of an edge.
Learned Position: The position (x & y coordinates) referenced by an Inspection SoftSensor. The Learned Position is always found by a Translational (or Rotational) SoftSensor and is referenced via the "Enable Position Reference" field in an Inspection SoftSensor's dialog box.