

Flyware Gauge3d - A 3D library for drawing round gauges using DirectX

The gauge definition

The Gauge3D library is an ActiveX OCX designed to draw a gauge in 3D space using DirectX.

Although the gauge is in 3D, it has a flat appearance because the elements drawn in different layers will be viewed in perpendicular direction to the layer.

A gauge is defined as any combination of scales divided by tics, rotating along a sitting pointer or covered by a rotating pointer, with any number of indicators, graphical or text based to be activated by the supply of certain parameter values.

Gauges are defined in Gauge3D as a combination of gauge specific elements that are mutually independent and can appear anywhere on the gauge (even outside the gauge).

The character of the elements is fully determined by a structured description in an .ini file. The file's sections are made up of the element name and the ID together: [Needle0]

The entries control properties like size, resolution, font, colour, shape and behaviour. *The integrity of the .ini file is the responsibility of the builder; for the sake of performance, there will be no checks for the actual presence of elements indicated by invalid ID's.*

Gauges are constructed from a combination of elements, some supported optionally by a bitmap. The gauge itself can have a background bitmap, a mask bitmap and a frame bitmap.

An element is a repeatable part of a gauge that can be uniquely defined by a set of properties. There is only one frame, one background, one mask, but there can be any number of Tics, Needles, Icons etc. only limited by the video card memory.

The gauge area is addressed using coordinates x and y. Zero is the center of the gauge, whereas the visible part of the coordinate system has a range from -20 to +20 gauge units.

The Z coordinate runs from front (-) to back (+).

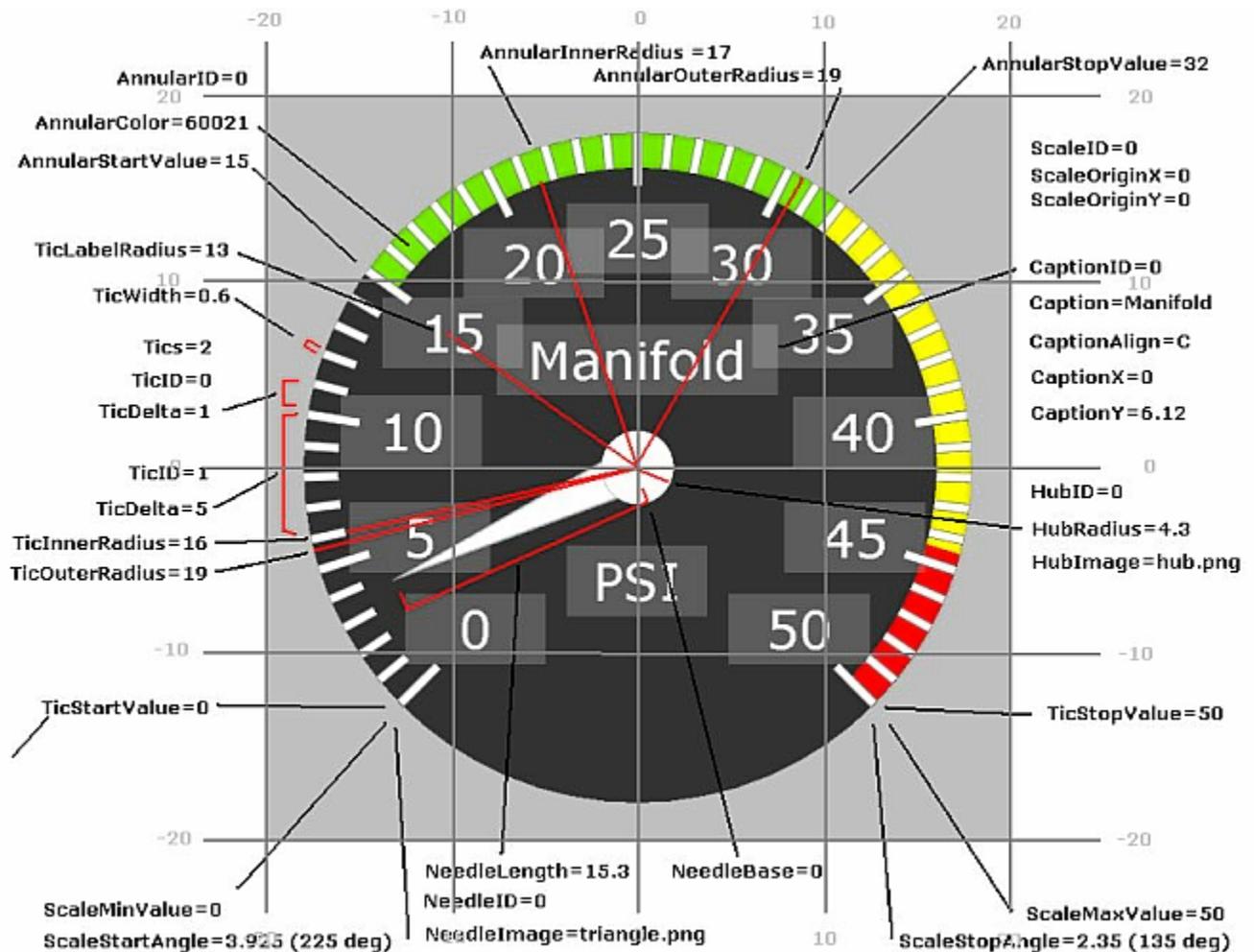
On the initialisation of the gauge, each element is scaled, translated, rotated, and drawn in the 3D world based upon the initial properties. After that, the calling application can change them at will, and will be able to call the render subroutine with each change in gauge values.

Each element has certain values that will be processed with each render to be reflected in the final 3D image. Only a few properties will be evaluated with each render. The rest is only used to initialise the gauge. If a change of these is necessary, the calling application needs to re-initialise that element.

Value, AnnularFloatoffset and TicFloatoffset are values processed with each render. Caption, Annular, Tic, Digital, Line, Icon, Maplabel and Symbol as a whole are processed only if a change has occurred compared to the last render, using a flag.

Strings are added without quotes. False and True (case sensitive) are valid, while 1 and -1 are True, and 0 is False.

Below you find an explanation of the most common gauge properties:



Elements

The following elements are present in the current Gauge3D library: Annulars, Bugs, Captions, Fonts, Hubs, Icons, Needles, Scales, Tics. Additionally, there are MapLabels, Symbols and Lines, only to be used by the calling application, used for drawing of the map and the aircraft track. All elements share a number of properties. These are the following:

Section: [Element#]
each Element has its own section.

ElementID=#
each Element has a unique ID.

ElementOn=True
is the element visible or not

ElementColor=60021
colour of the element, in standard RGB

ElementScaleID=0
to which scale is this element related

For each separate element, for the sake of brevity only non-shared properties will be discussed.

1. Annulars

Named after the rings in a tree cross section, an annular defines a part of a (or a complete) circle sector.

AnnularFloatOffset=0 [degrees]
additional rotation of the annular

AnnularInnerRadius=17
inner edge of annular

AnnularOuterRadius=18.999999
outer edge of annular

AnnularStartValue=0
actual value on the Scale where the annular starts

AnnularStopValue=0
actual value on the Scale where the annular stops

AnnularNormal=0
indication of the direction of the annular normal, being defined as the line perpendicular to the annular plane (usually 0 = z, optional 1 = x, optional 2 = y so the annular itself lies in the x-y plane, x-z plane, y-z plane)
optional 3 = y, with an additional rotation around the z-axis.
please note that the scale will not be affected, it is a virtual element and not to be drawn.

AnnularOffset=0
indication of a left or right shift of annulars' position (only has a meaning with AnnularNormal=1 or AnnularNormal=2)

2. Bugs

Like a needle, bugs indicate a value along a scale. Unlike a needle, a bug stays on that value when the scale rotates.

BugTicID=#
to which tic is this element related

BugValue=0
initial value the bug will point to when the gauge is loaded

BugLength=11.5
length of the bug in units

BugWidth=11.5
width of the bug in units

BugBase=4.709
position of the bug's base

BugImage=loch_pnt.png
the bitmap used for the bug; jpg, png, bmp

3. Captions

A caption indicates a numeric value or a text. The maximum text length depends on the font and is usually 14 characters. For large characters, it may be necessary to redefine the QuadSize.

CaptionLength=1
length of the text, usually set by the application

Caption=text
readout of the caption

CaptionBackColor=-1
backcolour of the caption; -1 is transparent

CaptionCenter=True
obsolete; replaced by CaptionAlign

CaptionAlign=L
alignment of the caption, L, C or R only

CaptionFlag=0
will the caption be updated with the next render or not, usually set by the application

CaptionFontID=1
the font used by the caption

CaptionX=-11.95
when centered, this is the center position of the caption
when left-aligned (default) it is the leftmost position of the caption
when right-aligned, not used

CaptionXRight=19.5
right position of caption when right aligned, default value will be 20

CaptionY=11.65
y-coordinate of the caption field top

4. Hubs

A hub is the central disk covering the base of a needle. It is attached to the center of the scale.

HubRadius=4.3
the radius of the hub in units

HubImage=hub.png
the bitmap used for the hub; jpg, png, bmp

5. Icons

An icon represents an indicator in the form of a small picture. It is easily used as a flag.

icons can be rotated, not translated. Not related to a scale, and an icon will only rotate around itself (x,y)

IconOpacity=255
the icon will be transparent with value 0, fully opaque with value 255

IconHeight=10
height of the icon in units

IconWidth=10
width of the icon in units

IconX=0
x-coordinate of the icon in units

IconY=-13
y-coordinate fo the icon in units

IconImage=dig_box.png
the bitmap used for the icon; jpg, png, bmp

6. Needles

Needles (hands) indicate a value on a scale. They rotate around the associated scale x,y.

NeedleDigital=False
is there a digital readout present (similar as a Caption)

NeedleDigitalColor=65535
colour of the digital

NeedleDigitalBackColor=-1
background colour of the digital (-1 is transparent)

NeedleDigitalDecimals=0
how many decimals does the digital have

NeedleDigitalFontID=#
the font associated with the digital

NeedleDigitalX=0
x-coordinate of the digital within the gauge

NeedleDigitalY=0

y-coordinate of the digital within the gauge

NeedleLength=1.4
total length of the needle in units

NeedleShape=
not in use at the moment

NeedleStyle=
not used at the moment

NeedleValue=0
initial value the hand will point to when the gauge is loaded

NeedleWidth=1.9
width of the needle in units

NeedleBase=0.36
position of the needle's base

NeedleImage=ils_pnt.png
the bitmap used for the needle; jpg, png, bmp

NeedleScalar=1
value of needle will be multiplied by scalar

NeedleParameter=6
the FS parameter that is to be represented by the needle. Only for round engine gauges, Asi, Fuel gauges and Custom# gauge array.

7. Scales

A Scale is defined as the parent element that holds other related elements together. It is virtual in nature and not visible itself.

The ScaleID of an element points to its parent scale. This means for instance that the related elements are drawn with respect to the properties (like Position, StartAngle and StopAngle) of the scale.

For instance there is no needle X- or Y-coordinate, the needle will inherit that information from the associated scale. Annulars, Bugs, Needles, they will all be positioned relative to the associated Scale.

The Scale has its ScaleMinValue and ScaleMaxValue, and will start at its ScaleStartAngle and end at its ScaleStopAngle, though it is not visible as such. Only the associated Tics are visible and will show the actual values that are within the Tic definition.

Where Tics are merely used to adorn a scale with value positions, they do not define the actual values possible on the Scale. The Tic will always be positioned relative to the start value of the Scale, and be spread along the Scale accounting for the total value range of the Scale.

If a Tic runs from 0 to 50, and a Scale runs from 0 to 50, the Tic will be spread along the entire scale.

If the Scale maximum is changed to 100, the Tic will only cover half of the scale.

If a tic starts with 5, position 0 to 5 will be invisible on the gauge. Needles and bugs however still can point to a value not defined in the Tic. The needle position associated with the scale exists, but it is not shown on the gauge if it is outside the Tic range definition.

The Tics will be adorned with TicLabels displaying the right values automatically. Where custom labels are needed, it is possible to define a set of custom TicLabels setting TicLabels to a value > 0 and define them all subsequently. Both numerical and text values are allowed. This way it is even possible to use ASCII characters like dash and underscore.

ScaleON=True

will the associated elements be visible or not

ScaleDirection=0

scale runs from left to right (clockwise), 1 for the reverse

ScaleMaxValue=8

the maximal value possible on the scale, used to adjust the Tics along the scale and to calculate the needle position

ScaleMinValue=0

the minimal value possible on the scale, used to adjust the Tics along the scale and to calculate the needle position

ScaleOriginX=0

the x-coordinate of the scale center in units

ScaleOriginY=0

the y-coordinate of the scale center in units

ScaleStartAngle=3.92873636209273

start position of the Scale relative to the top position in Radians

ScaleStopAngle=2.35619455575943

stop position of the Scale relative to the top position in Radians

ScaleRelSize=1

scale can be resized relatively, causing all related elements to be resized

ScaleDrawOrder=0

in what order is this scale drawn; this way scales can be drawn over each other. Essentially, Gauge3D will draw the scales one by one, starting with ID 0.

ScaleClipMin=30

distance along the z-axis; sets an x-y plane that cuts off the closer part of a scale's elements

only useful with element normal > 0

ScaleClipMax=50

distance along the z-axis; sets an x-y plane that cuts off the farther part of a scale's elements

only useful with element normal > 0

ScaleClipAnnular=True
cutoff for the annulars

ScaleClipTic=True
cutoff for the tics

ScaleClipNeedle=True
cutoff for the needles

8. Tics

Tics are the divisions that make up a scale. A Tic is any series of radial lines along the edge of a scale. They can rotate around the associated scale x,y.

TicOpacity=255
the Tic will be transparent with value 0, fully opaque with value 255

TicDelta=1
the distance in Scale units that the divisions are apart

TicFloatOffset=0
the startposition of the tic is augmented by this offset causing it to rotate around the Scale x,y

TicFontID=0
the associated font for the tic label

TicInnerRadius=16.0000005
inner edge of tic in units

TicLabel=True
will ticlabels be drawn

TicLabelRadius=13
inner edge of ticlabel

TicLabelRotated=False
will ticlabels be rotated along the related scale x,y

TicOuterRadius=18.999999
outer edge of tic

TicStartValue=0
actual value where tic starts on the related scale

TicStopValue=7.99999999999955
actual value where tic stops on the related scale

TicStyle=0
not used

TicWidth=0.6
the width of the tic in units

TicNormal=0

indication of the direction of the tic normal, being defined as the line perpendicular to the annular plane (usually 0 = z, optional 1 = x, optional 2 = y so the tic itself lies in the x-y plane, x-z plane, y-z plane)

optional 3 = y, with an additional rotation around the z-axis.

please note that the scale will not be affected, it is a virtual element and not to be drawn.

TicFactor=1

TicLabel value can be multiplied by a factor

TicOffset=0

sets right/left alignment of tics in linear scales

TicLabelOffset=0

sets right/left alignment of ticlabels in linear scales

TicLabelColor=16777215

colour of TicLabel

TicLabelBackColor=-1

backcolour of TicLabel, -1 is transparent

TicLabelInvert=False

puts TicLabel upside down

TicLabels=0

no custom TicLabels

Additional with custom TicLabels, i.e. if there are 5 ticlabels, replace the above by:

TicLabels=6

LabelValue0=0

LabelValue1=tt

LabelValue2=4

LabelValue3=Testvalue

LabelValue4=8

LabelValue5=10

Remaining Sections

The non-element sections describe the structure of the gauge wherein the elements are drawn, the relation between drawn parts, drawing order, behaviour of elements

1. Meta

Family=Generic

Indicates the manufacturer of a specific aircraft (if a gauge is type specific). If not, the word Generic is used.

The name points to a directory within the Gauge3D directory, for example given in the calling application: Gbmp\Generic

In this directory, a directory has to be present for each gauge to be displayed, containing all bitmaps specific for that gauge. The name of that directory is of the

format: *Gaugename_Mode_Disptype*

AircraftType=2-eng-prop

The name of the panel to which the gauge is known to belong. Not actively used at the moment, possibly later.

GaugeName=Fuel Flow Indicator

The name of the gauge to be used in the calling application.

Mode=1

Glass panels can appear in a certain mode. For modeless gauges, the value is 1.

DispType=1

Glass panels can appear with a certain type. For typeless gauges, the value is 1.

In the [Meta] section of the ini file, the amount of each element is indicated. Each element has an ID; ID's start with 0 and are consecutive. If there are n elements, the highest element has ID n-1.

Annulars=5

Bugs=0

Captions=2

Fonts=2

Hubs=1

Icons=1

Needles=2

Scales=1

Tics=2

GaugeFieldOfView=45

This is the field of view used by the camera in DirectX. 45 is the normal aspect, with a lower value a tele lens effect is achieved, which can be useful to flatten curved scales. Gauge3D does not yet allow linear scales to be drawn. The reason for this was the demand for simplicity and integrity; no logic would be required to determine whether the end of a scale had been reached in order to make the scale start at the start value again. The drawback is that linear scales implemented as round scales rotated around the X or Y axis will not be perfectly linear. The effect can be discarded when the FOV is properly set. The great asset is that true 3D scales can be drawn like in a wet compass and the combined altimeter-asi gauge.

Remark: Choosing a different FOV will cause all elements to shift to another X/Y position.

InflateLinScale=1

with linear scales, it is often desired to show only a small arc or range of values. By magnifying the Scale the useable portion of the scale will fit better into the gauge and not be too small.

CaptionDrawOrder=0

on what layer will the captions be drawn

IconDrawOrder=0

on what layer will the icons be drawn

MaskDrawOrder=1

on what layer will the mask image be drawn

HasMap=False

does the gauge have a map included (True with ND)

QuadSize=4

size of the field where Caption, TicLabel and NeedleDigital are written. Default value is 2. Affects performance and card memory use.

RelativeResolution=2

gauges are drawn with a resolution of 512 x 512 multiplied with this factor. Affects performance and card memory use. This is something different than gauge size.

CameraPositionX=0

position of the camera in horizontal sense. Will be different when a gauge is not a square, like a vertical strip.

CameraPositionY=0

position of the camera in vertical sense. Will be different when a gauge is not a square, like a horizontal strip, for instance the rudder trim indicator.

2. Panel

Top=0

top position of gauge on the panel

Left=0

left position of gauge on the panel

Height=164

height of gauge in pixels

Width=164

width of gauge in pixels

Scalar=1

obsolete, replaced by NeedleScalar

DirectionX=0

orientation of gauge, if 1, rotated -90 degrees, if -1, rotated +90 degrees

3. Back

Properties of the gauge background and mask

BackColor=0

background colour of gauge

BackPicture=0

background picture of gauge (.jpg, .png, .bmp), lowest draw order

BackPicScale=1

scales background picture relative to gauge

MaskColor=0
colour of mask picture

MaskPicture=0
mask picture of gauge (.jpg, .png, .bmp) 0 if no picture, the name if there is one (no path!)

MaskPicScale=1
scales mask picture relative to gauge

BorderWidth=0
not used

BevelInner=0
not used

BevelOuter=0
not used

BevelWidth=0
not used

4. Fonts

associated fonts for the elements Caption, Tic, NeedleDigital
Changing of fonts will cause relocation of elements. Caption and NeedleDigital will need new coordinates and all elements may outgrow their field area. In that case, change Quadsize in the [Meta] section.

Font=Tahoma
not used

FontBold=False
is the font bold or not

FontItalic=False
is the font italic or not

Fontname=Tahoma
name of the font to be used

FontSize=10
size of the font to be used

FontResolution=256
quality of the character to be drawn, possible values: 256, 128, 64, 32; affects performance

FontStrikeOut=False
is the font striked out or not

FontUnderline=False
is the font underlined or not

5. Frame

Gauge appears to be set in a frame if used, highest draw order

FrameBottom=0

not used; positioning of frame is always centered and scalable

FrameColor=12632256

colour of the frame; if frame image is white, otherwise result unpredictable

FrameLeft=0

not used; positioning of frame is always centered and scalable

FramePicture=gen_frame.png

frame picture of gauge (.jpg, .png, .bmp)

FramePicScale=0.75

scales frame picture relative to gauge

Frameright=

not used

FrameShape=

not used

FrameStyle=

not used

FrameTop=

not used

Application use

Additional elements are only to be used by the application if there is a map active. They will not be present in the ini file.

The use of the library by other applications is under consideration. Please apply if you would like to do that.

version 1.0 february 2009

Flyware simulation software

<http://www.flyware.nl>

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