# *Creating a Speedometer in Excel – part 2.*

by George Lungu

-The previous tutorial (first half) explains how to download a speedometer picture from www.flickr.com and how to alter it (delete the needle) using a freeware called **Gimp** (similar to Photoshop).

- The model replaces the deleted needle from the picture with a moving one created from a chart line.
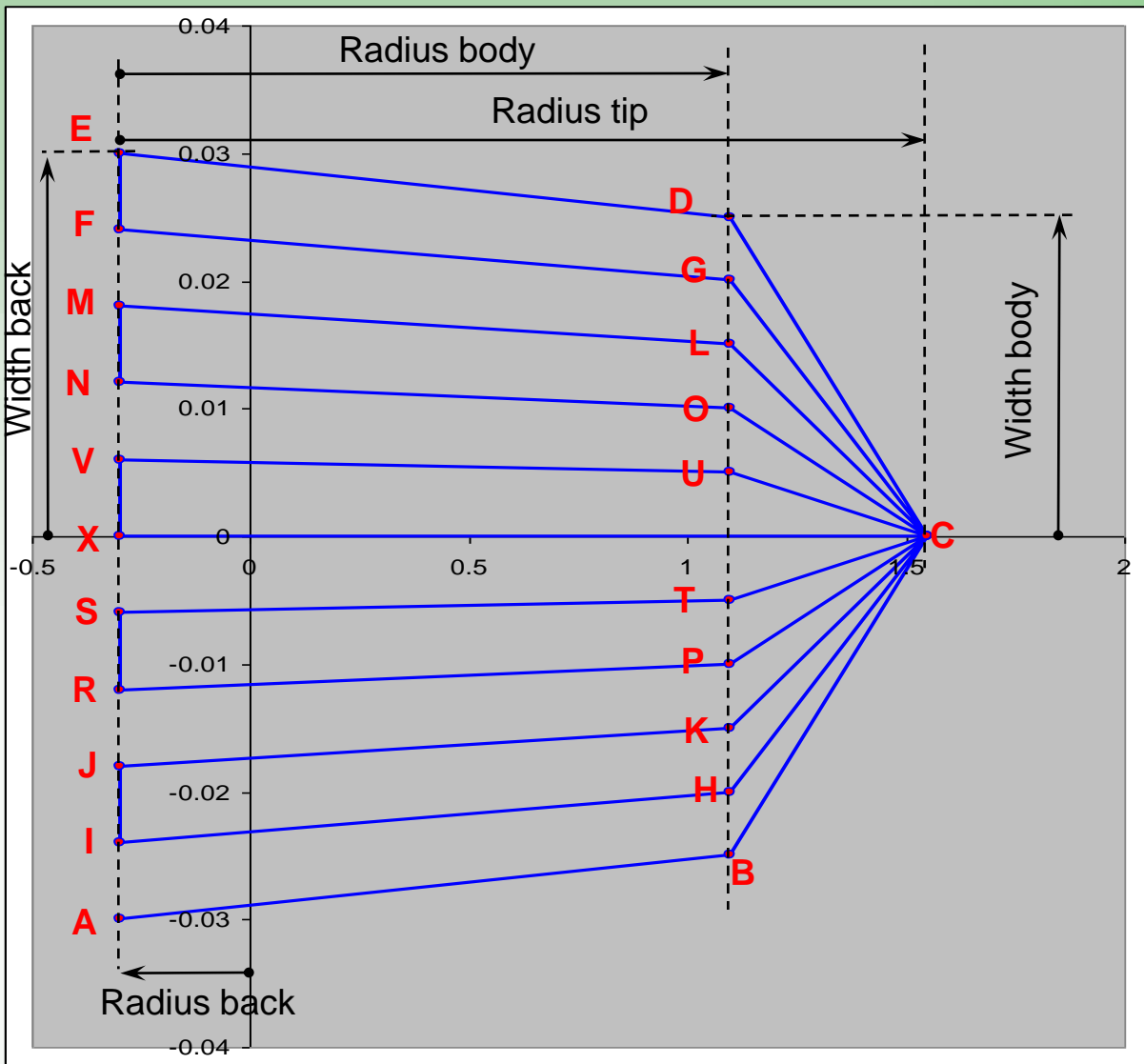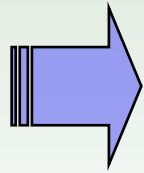
-This second half of the tutorial explains the geometry, trigonometry and VBA code used to build a new rotating speedometer needle to replace the static one deleted using **Gimp**.

A tutorial
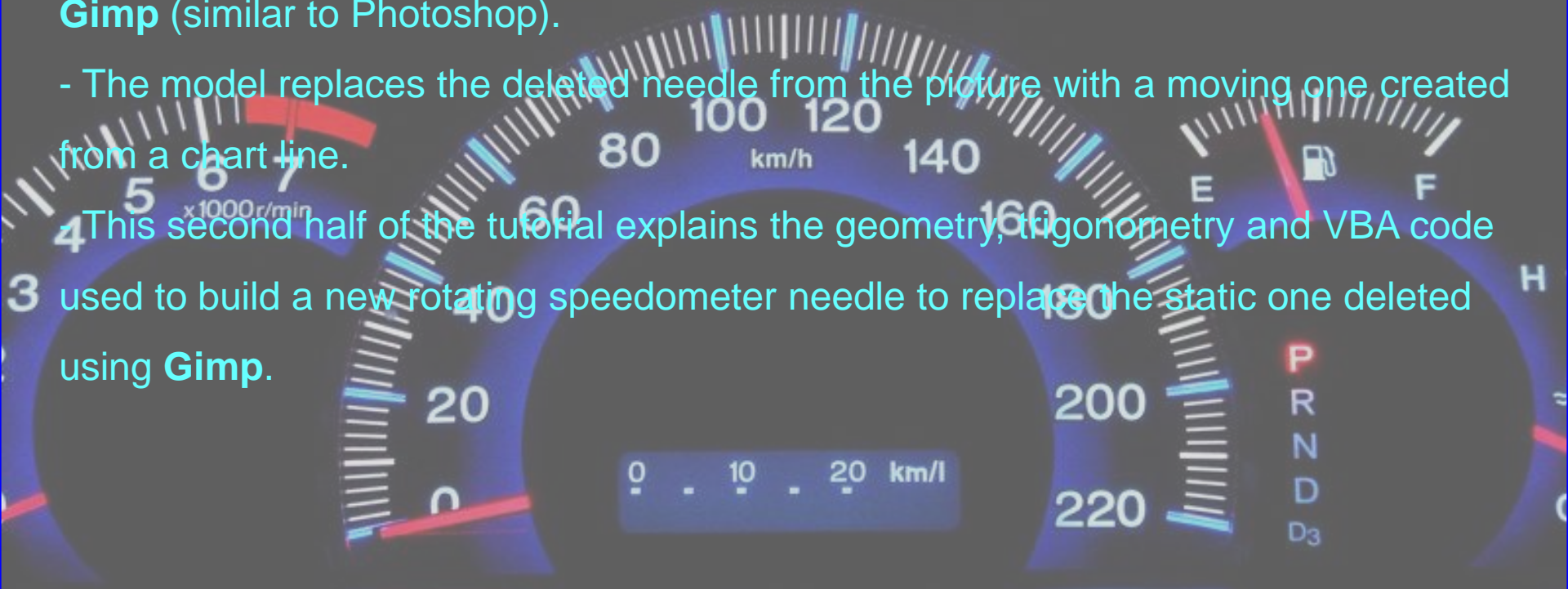
Creating the speedometer needle: The following two tables are used to create the speedometer needle. You can check out the formulas in the lower table to see how the speedometer needle is generated, just like a long snake. The upper table contains the geometrical parameters of the needle.
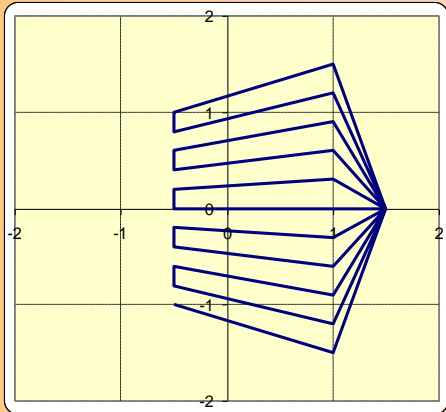
Radius_tip	1.55
Radius_body	1.1
Radius_back	-0.3
Width_back	0.03
Width_body	0.025

	x	y
A	-0.3	-0.03
B	1.1	-0.025
C	1.55	0
D	1.1	0.025
E	-0.3	0.03
F	-0.3	0.024
G	1.1	0.02
C	1.55	0
H	1.1	-0.02
I	-0.3	-0.024
J	-0.3	-0.018
K	1.1	-0.015
C	1.55	0
L	1.1	0.015
M	-0.3	0.018
N	-0.3	0.012
O	1.1	0.01
C	1.55	0
P	1.1	-0.01
R	-0.3	-0.012
S	-0.3	-0.006
T	1.1	-0.005
C	1.55	0
U	1.1	0.005
V	-0.3	0.006
X	-0.3	0
C	1.55	0

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Let's see the effects of changing the needle parameters:

Radius_tip	1.5
Radius_body	1
Radius_back	-0.5
Width_back	1
Width_body	1.5

Radius_tip	1.9
Radius_body	0
Radius_back	-1
Width_back	0.3
Width_body	1
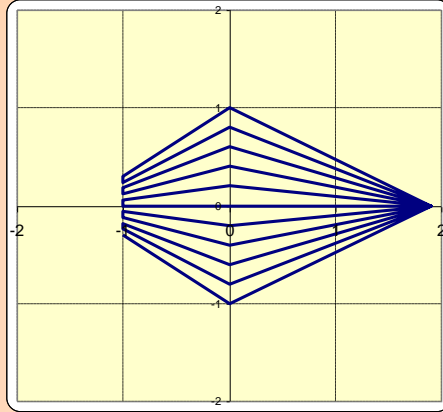
Radius_tip	1.3
Radius_body	1.2
Radius_back	-0.3
Width_back	0.1
Width_body	0.1
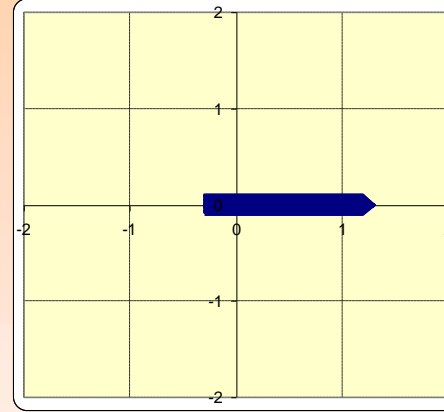
Radius_tip	1.55
Radius_body	1.5
Radius_back	-0.3
Width_back	0.03
Width_body	0.025
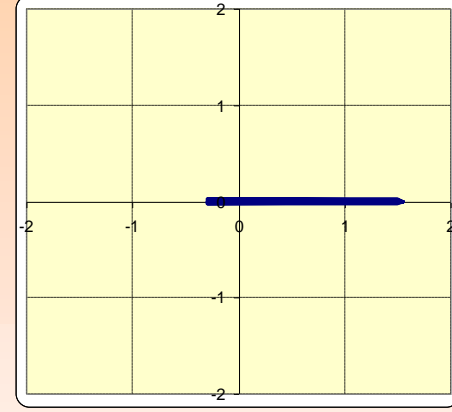
How do we change the angle in VBA? - In order to tackle any variety of speedometer

pictures we need to set adjustable start-limit and end-limit angles for the needle in the spreadsheet.
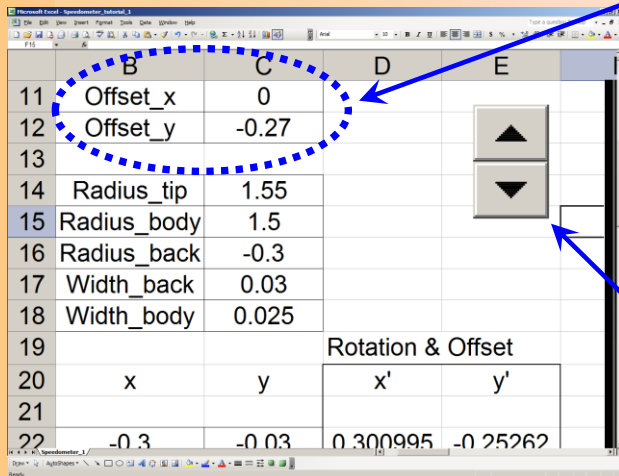
Private Sub Speed_Change()

*[E9] = [C8] - Speed * ([C8] - [C9]) / 200*

End Sub

The spinner button controlling this macro has a range of [0,200]. Looking at the above macro we can see that while on 0 the needle will have the custom angle typed in cell C9 and while on 200 the needle will be set at the angle in cell C8.

How do we rotate the needle and set it at an adjustable offset?

Theoretical formulas
for rotation and offset:

$$x' = \cos(\alpha) \cdot x - \sin(\alpha) \cdot y + x_{offset}$$

$$y' = \sin(\alpha) \cdot x + \cos(\alpha) \cdot y + y_{offset}$$

Create a second table in the range D22:C48 with rotation and offset formulas. The master angle of rotation is placed in cell E9 and the offset data is located in the range C11:C12. The following formulas were used:

"D22": =B22*COS(RADIANS(E$9))-C22*SIN(RADIANS(E$9))+C$11

"E22": =B22*SIN(RADIANS(E$9))+C22*COS(RADIANS(E$9))+C$12

After typing the above formulas in the range
D22:E22, copy them down to row # 48.

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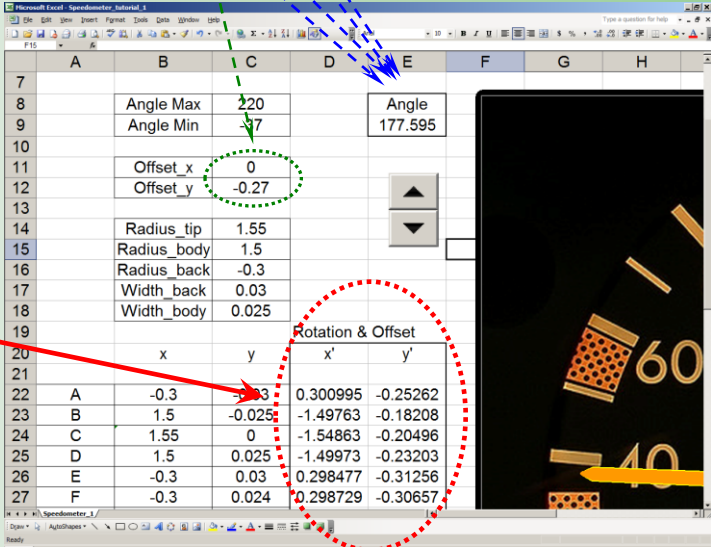
Creating and sizing the chart and final adjustments:

- Create a 2D scatter chart with the data from the range "D22:C48" (D as x and C as y)

- Size both axes to [-2, 2] to begin with

- Choose the processed picture (with the original needle removed) and open it in any program where you can see the width and height values (I used *MS Office Picture Manager*)

- Insert the picture as a chart background: Double click the plotting area => Fill Effects => Select picture => OK => OK

- While the horizontal axis is set at a size of [-2, 2] we'll calculate the vertical axis so that the ratio of the horizontal picture size to vertical picture size is equal to the ratio of the two axes

- In this particular case the picture size is: 640 x 479

- Let's calculate the vertical axis maximum: $y\_max = 479*2 / 640 = 1.4968$ (it's around 1.5)

- Let's set the vertical axis to [-1.5, 1.5]

- Select and delete both axes one at a time

- Make sure to size the chart by stretching it manually until it has the right proportions (640/479)

- And finally adjust the length of the needle and the needle offset so that the axis of rotation keeps the needle in the middle of the dial (for various angles the tip of the needle needs to be around half of the notches)

- All the above steps require some repeated trial and error work but they are not hard to do

Create a hub: Insert a new series in the chart called "Hub" whose coordinates are taken from the center of the needle (C11:C12)

- Using the "Draw" menu create a circle as a shape filled with dark blue or black
- Select the circle you created => shift + copy as picture then highlight the new point (hub) on the chart and paste the circle you have just created.

Different types of gauges created in Excel 2003 with pictures downloaded from Flickr:

Toyota Camry

r.p.m. meter

Ford Crown Victoria