

Ecava IntegraXor HMI/SCADA

Version 6.1

Tutorial for Beginners

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Chapter 1: Introduction

"THE INTERNET HAS BEEN THE MOST FUNDAMENTAL CHANGE DURING MY LIFETIME AND FOR HUNDREDS OF YEARS. SOMEONE THE OTHER DAY SAID, "IT'S THE BIGGEST THING SINCE GUTENBERG," AND THEN SOMEONE ELSE SAID "NO, IT'S THE BIGGEST THING SINCE THE INVENTION OF WRITING." - RUPERT MURDOCH

Product

Ecava IntegraXor (IGX) is HMI/SCADA software with graphic animation, real time device connectivity, alarm functions, database logging, trending and reporting as basic functions. It is designed from ground up using web technologies to create a complete tool for building sophisticated and intelligent real-time control and monitoring systems.

Purpose

The purpose of this document is to give you some instructions on how to get started with Ecava IGX. Various tools in Ecava IGX will be utilized to create a simulated candy factory. The examples in this tutorial are meant to give initial guidance on how to use Ecava IGX and to assist you to quickly create and implement projects based on their own requirements.

Dependencies

Before we begin, ensure you have the following applications installed.

- 1) Ecava IGX SCADA
- 2) Graphic Editor Inkscape SAGE

If you do not have any of the above programs, go to <https://www.integraxor.com/download-scada/> to download them for FREE and install them on your PC.

System Requirements

Operating System	Microsoft Windows 7 or above.
Processor	Intel © Core ™ 2 @ 1.66GHz
Disk Space	~25MB for Runtime ~200MB for Development
Memory	4GB
Runtime (web browser)	Mozilla Firefox 3.5+, Google Chrome 3.0+, or Microsoft Internet Explorer 8+ (with Adobe SVG Viewer* plugin)

*If you must use IE 8 or below, please download Adobe SVG Viewer plugin at:
<http://download.adobe.com/pub/adobe/magic/svgviewer/win/3.x/3.03/en/SVGView.exe>



Also, as a truly web based product, Ecava IGX utilizes HTML and JavaScript as the programming languages. If you are not familiar with any one of the languages, do not worry. We will show you the basics. Have confidence that many people know these two programming languages and resources are widely available on the Internet.

Industrial Automation Basics

If you have used a HMI/SCADA application or a PLC before, you may skip the next chapter. If you are new to SCADA or industrial automation, you will need some basic knowledge of industrial automation, communication protocols and the concept of tags/points which you will learn in the next chapter.

Chapter 2: Basic Knowledge

Programmable Logic Controllers (PLC)

A programmable logic controller (PLC) is a microprocessor based device used for automation processes, such as control of machinery on a factory assembly line, or control of boxing machines and conveyor lines. A key feature of a PLC is the facility for input/output (I/O) which connects to sensors and actuators. Through these I/Os, a PLC can read limit switches, analog process variables (such as temperature and pressure), and the positions of complex positioning systems. A PLC can also operate electric motors, magnetic relays or solenoids, pneumatic or hydraulic cylinders or analog outputs.

They are one of the most versatile and common devices used for industrial automation. They monitor the inputs, solve logic of a user program and control the outputs.

Data & Communications

There is a wealth of information inside a PLC. Information such as math calculations or the input state of a device is stored in PLC's data areas. Data areas are internal memory registers of a PLC, each with its own memory address. These data are accessible from external systems via communication ports built in a PLC. Usually, a PLC will have a 9-Pin serial RS232 port with Modbus included as one of the communications protocols. Optionally, there may be Ethernet ports or various field buses for protocols such as DeviceNet or Profinet. For example, the running state of a motor is available to the PLC via input 1. Depending on the make of the PLC, the register address for input 1 may be mapped to the Modbus address 10001.

PLC & Ecava IGX

Ecava IGX is a tool to develop HMI/SCADA applications. Ecava IGX provides common communication drivers to exchange data directly with a PLC via its communication port. In the above example, in order to read the motor running state into Ecava IGX, we need to create a port, provide the PLC configuration in Ecava IGX Project Editor and create a digital I/O tag which corresponds to the Modbus address 10001. Ecava IGX Server will poll the PLC via the communication port and update the tag with real-time information.

Apart from PLCs, Ecava IGX can also communicate with various other devices such as robots and drives that support commonly used industrial communication protocols.

Ecava IGX also provides tools to draw graphical user interface for the user. For example, a simple tank can be represented by a rectangle and animated with the rising and falling of its water level. Alarms can be configured using Ecava IGX for early detection and warning. Database logging, trends and many other tools are also available in Ecava IGX. The flexibility of Ecava IGX and the use of modern web technologies allow limitless possibilities for your automation system on a global level.

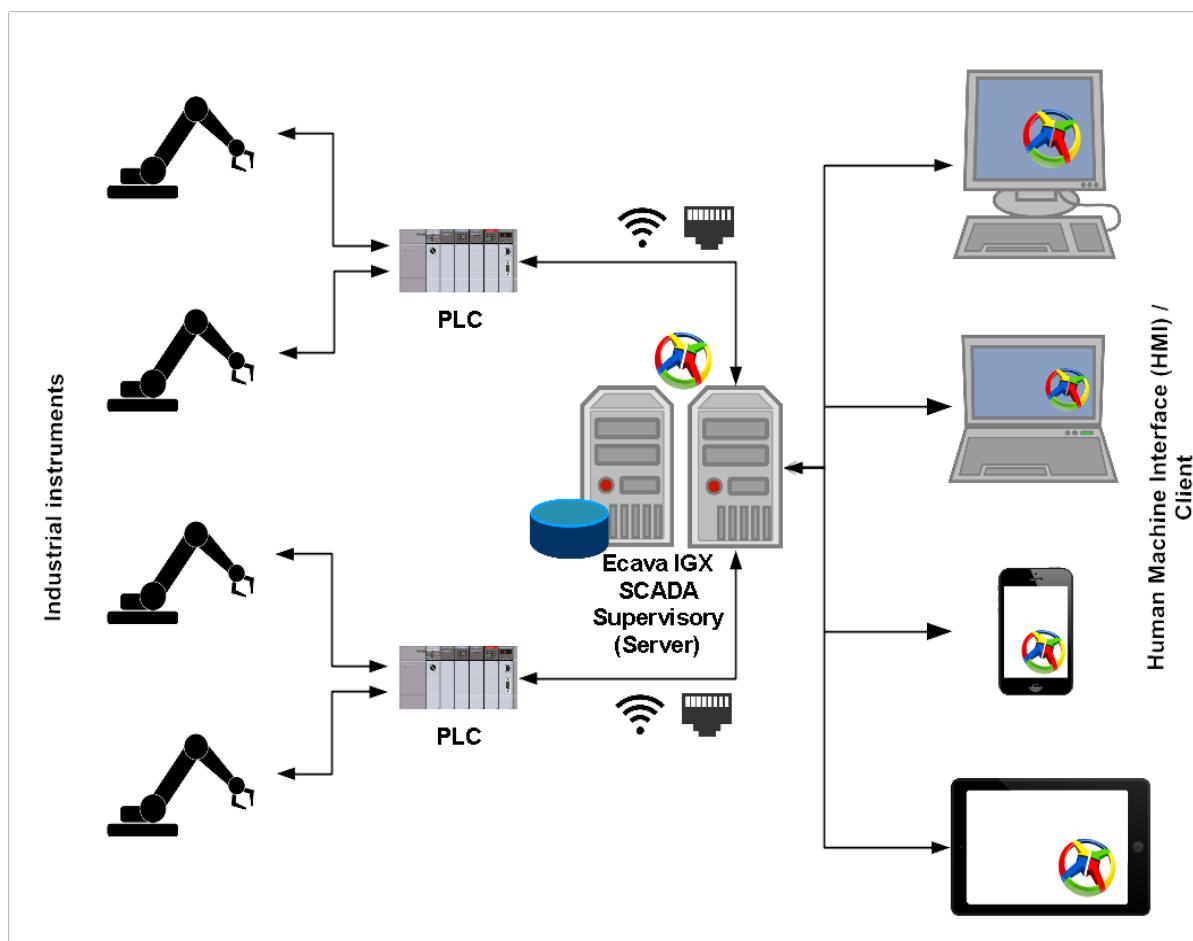


Figure 2.1 : Ecava IGX basic network architecture

The screenshot below shows a project homepage developed with Ecava IGX.

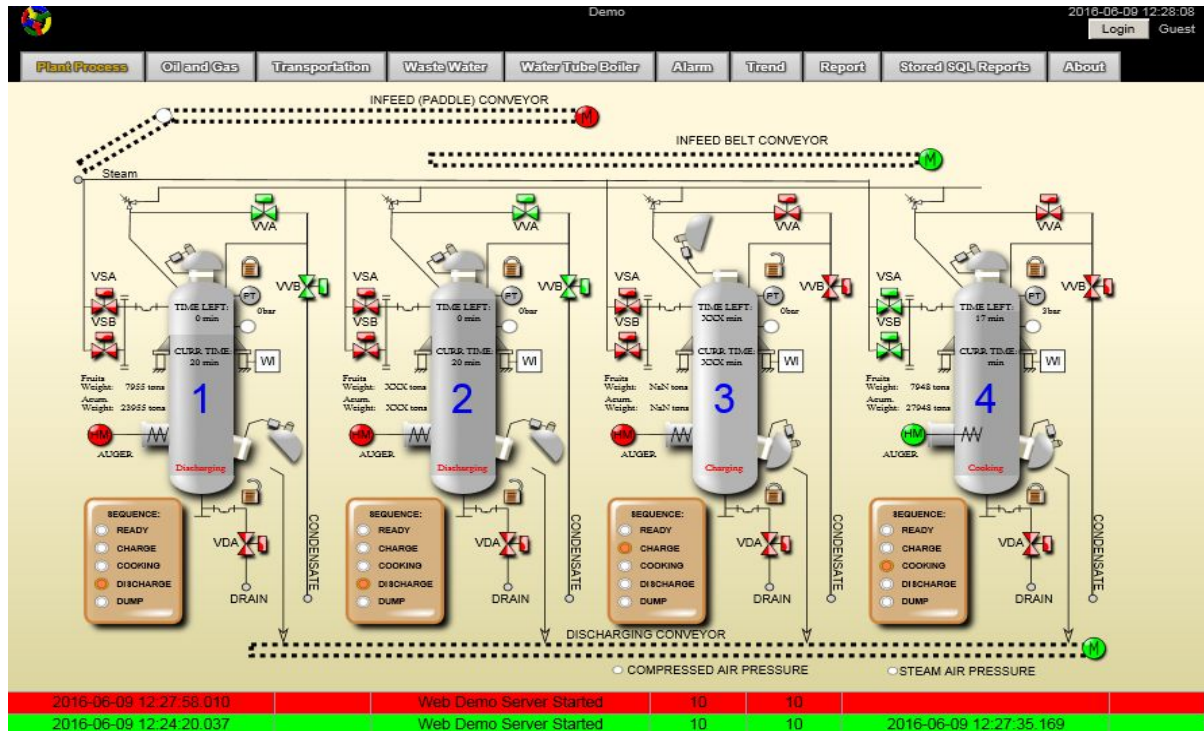


Figure 2.2 : Ecava IGX project screenshot (for a plant process)

Chapter 3: Project Overview

Candy Factory

In this tutorial, we will create a new Ecava IGX project to monitor and control a simple candy factory.

New Project

Click Start > Programs > Ecava IGX > IntegraXor Editor. This will open Ecava IGX Project Editor or in short, PE, where you will configure the SCADA project.

On the PE, click File > New Project to create a new project.

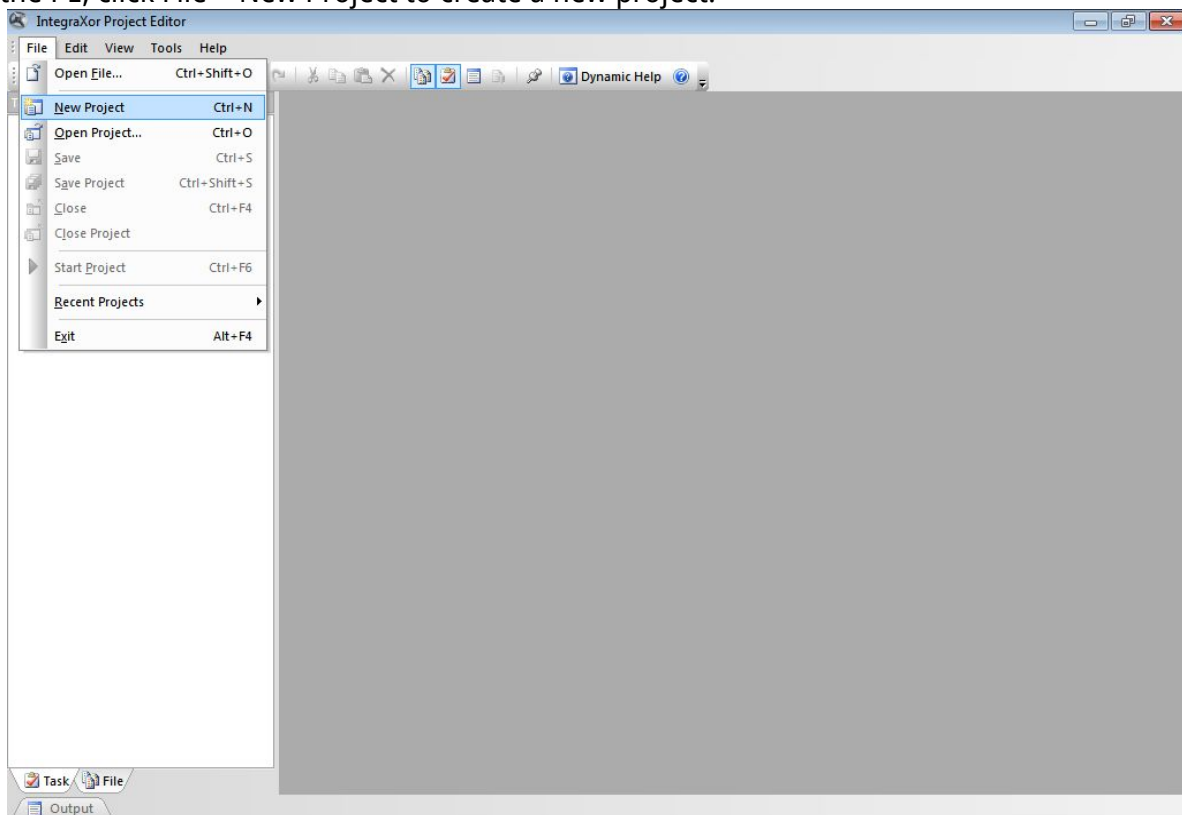


Figure 3.1 : Creating a new project with Ecava IntegraXor Project Editor

Name the project 'Candy'. You may create it in any directory. For this tutorial, we will create the Candy project in a directory called "C:\Documents\IntegraXor Projects". You need to create the directory first before you can select it in the 'Create New Project' dialog box.

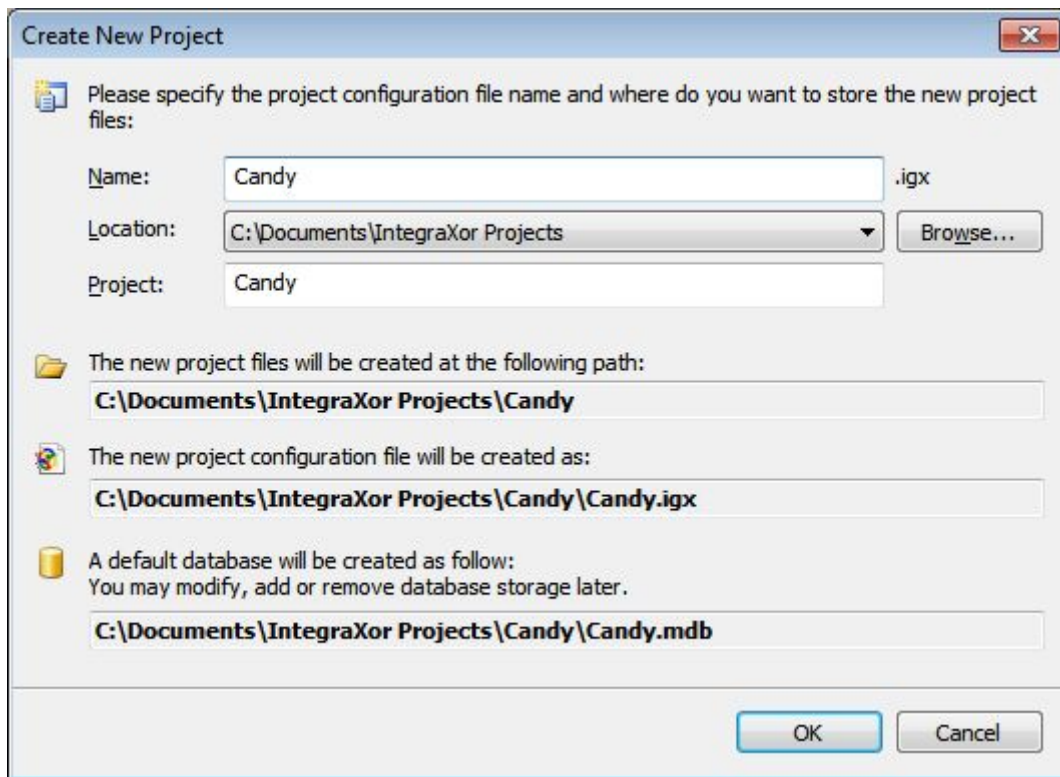


Figure 3.2 : Create New Project dialog box

Project Management

In the project location, a new folder with the project name 'Candy' will be created. The project file 'Candy.igx' will be created inside this folder along with several other files and directories. This 'Candy' folder will be your project folder. You may copy this folder to another location for backup or to distribute the project.

The PE interface consists of a tree view on the Task window on the left side, multiple tabs showing the project configuration on the right side and an Output window (which can be hidden) showing status, warning and error messages. The items in the Task window are General, Timer, Tag, Database, Security, Alarm, Script, Screen, Report, etc.

After creating a new project, look for 'General' on the left pane. Click on it, check to ensure that the new project name is configured in the Project ID entry, as well as other project properties.

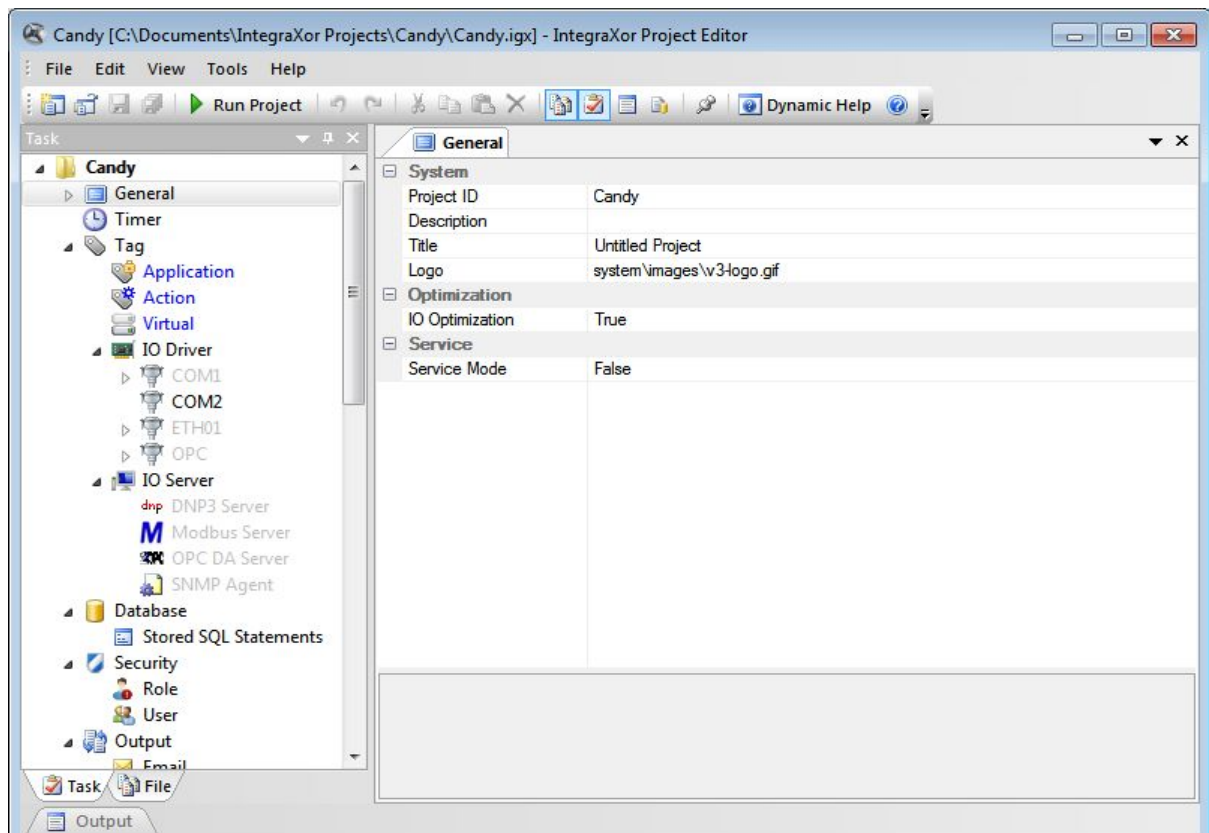


Figure 3.3 : Candy project General properties

Running the Project

From the PE, click 'Run Project' on the toolbar or hit the F5 key. Ecava IGX Server will run. It requires Administrator privilege to run. If you enable User Account Control (UAC) on your PC, a message asking for your permission to run Ecava IGX Server will pop up. You must choose 'Yes' in order to run the server.

The server shows the details of the tasks running behind Ecava IGX. This information is useful in monitoring the tasks as well as troubleshooting or diagnosing errors.

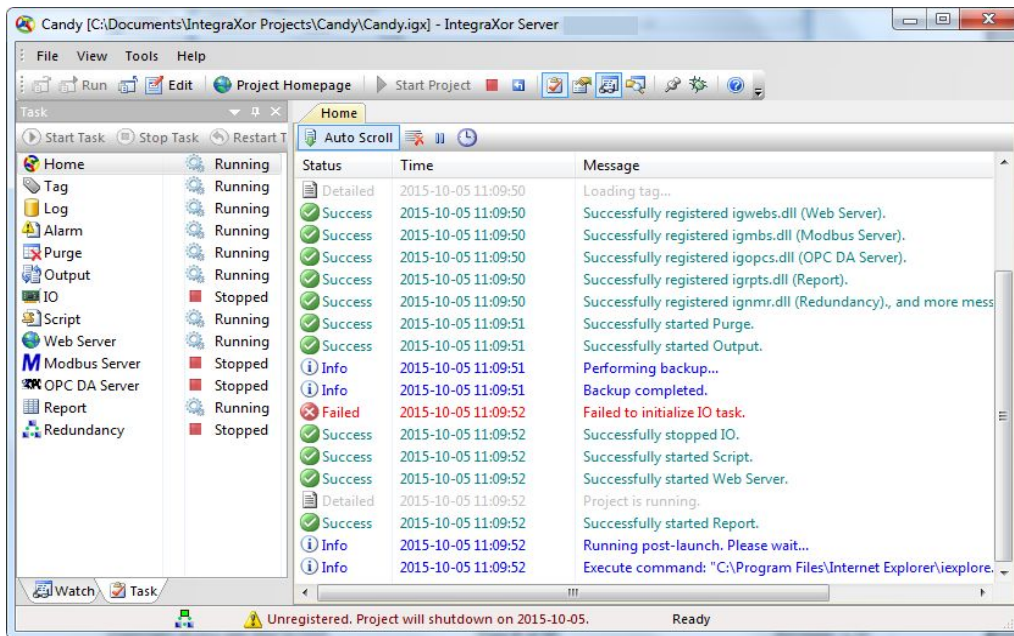


Figure 3.4 : Ecava IntegraXor server

Then, Internet Explorer will open the following page with the URL <http://localhost:7131/Candy/>. You might have noticed the automatic launch of the web browser is configured in the Post-launch under the General item.

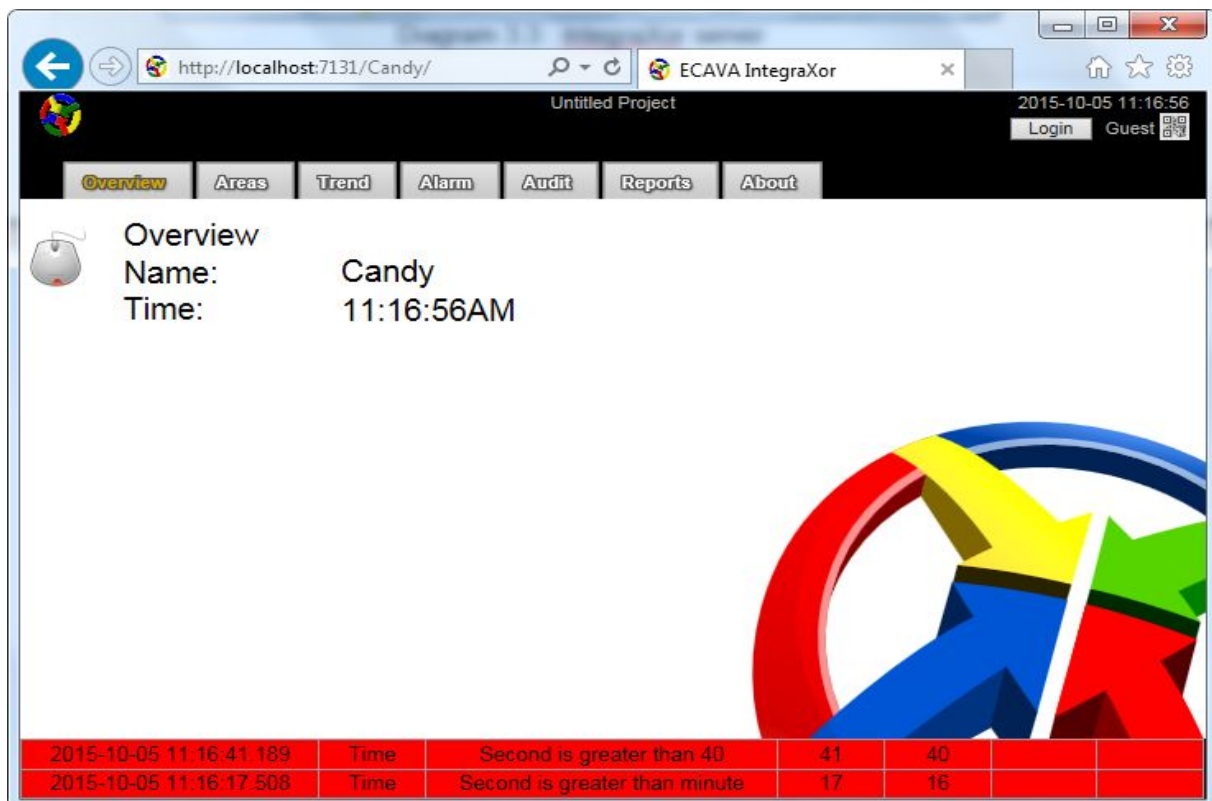


Figure 3.5 : IntegraXor project on Internet Explorer

There is a built-in web server that delivers pages such as index.html in Ecava IGX Server. It uses port 7131 by default. If there are more than one computing devices in your local network, go ahead and view your project with your browser on another computer or on a smartphone in the same network. Enter the appropriate project URL in your browser. For example, if Ecava IGX Server is running on a computer with an IP address of 192.168.1.100 and is listening to port 7131, the URL is <http://192.168.1.100:7131/Candy/>. You are now viewing the project as a remote client.

Quiz 1

1. Please create a new project named after your initials (e.g. Albert B. Colin as ABC) in My Documents > IntegraXor Projects folder. Run the project, print screen the Overview page and save the screenshot as 01Overview.png in My Documents > IntegraXor Projects > <your initials> > Quiz folder*.
2. In your local network, run your project in Ecava IGX Server on one of your PCs. This PC will be the server. Access the project URL with a browser on another PC, which is the remote client. On the client PC, print screen the Overview page and save the screenshot as 02Remote.png in My Documents > IntegraXor Projects > <your initials> > Quiz folder.

*Note: You must first create a new folder named Quiz in your project folder.

Chapter 4: Device Configuration

3 Steps

Ecava IGX reads data from a device by polling it through a communication port. The configuration in Ecava IGX PE is divided into 3 simple steps. First, assume we have a PLC controlling the whole candy factory. The PLC, which connects to a Modbus device, is also connected to a computer via a serial RS232 port (COM2). Ecava IGX Server runs on the computer and reads data from the PLC through COM2.

Step 1: Create a Port

Port is the first channel to determine in accessing external devices. A port can be a serial communication port, an Ethernet port, any physical connection to an external device or virtual connection to a simulator program.

Parameter	Description
Enable	Enabled (Checked) / Disabled (Unchecked)
Name	A unique name for the port
Description	Additional description
Address	Physical port address
Interval	Delay between devices in serial link or slow devices.

By default, COM1 and Ethernet localhost ports (ETH01 & OPC) are created for every new project. In this tutorial, we will create a new serial RS232 port called COM2. Expand the Tag item on the left and click the IO Driver to open the Port tab. Add a new port COM2, disable the other ports and save your changes.

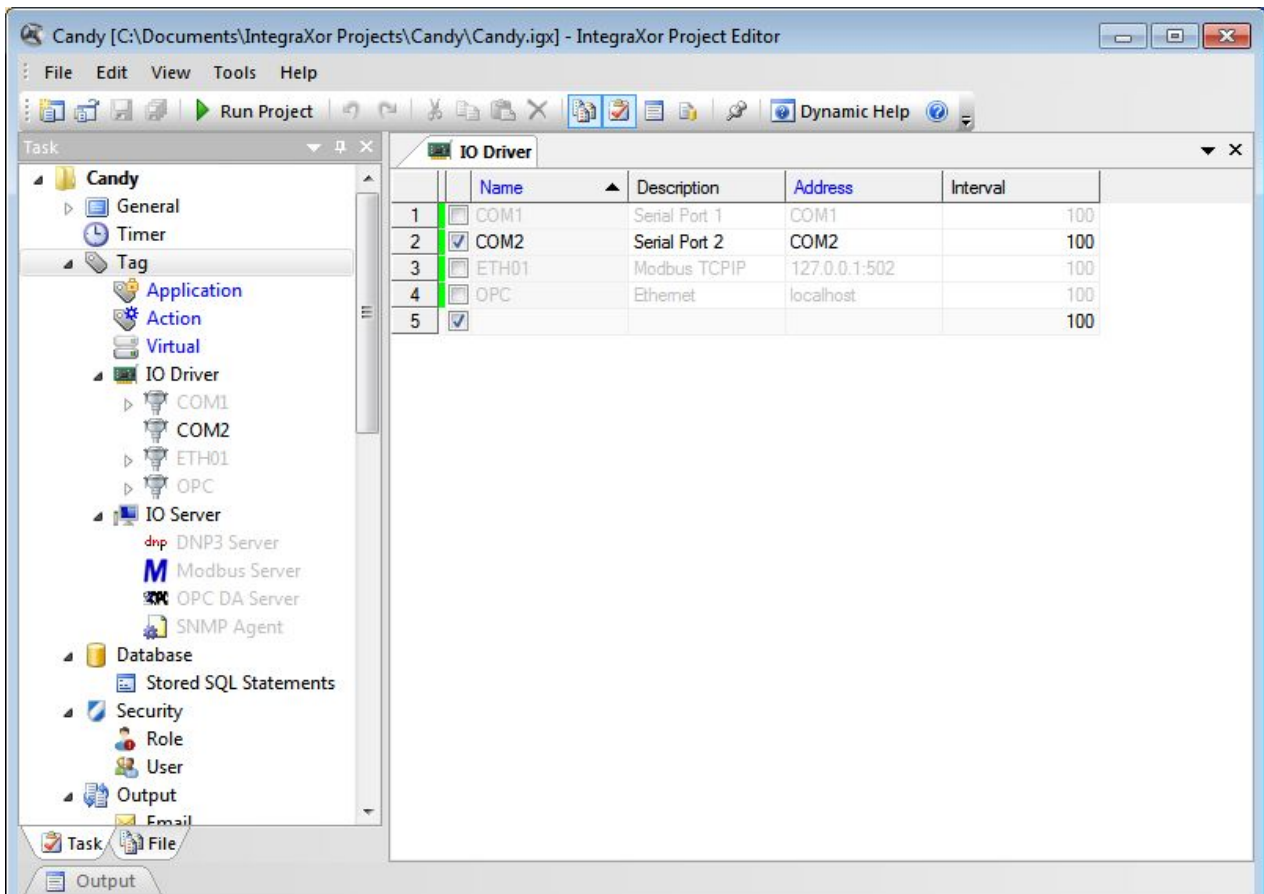


Figure 4.1 : Create New Port

Step 2: Create a Device

One or more devices can be connected to the HMI/SCADA system via one defined Port. The Device table defines the settings/behavior of the connected device(s).

Parameter	Description
Enable	Enabled (Checked) / Disabled (Unchecked)
Name	A unique name for the device
Description	Additional description
Timer	Define the polling interval to read data from the device
Driver	This column specifies the communication protocol used. Select a communication protocol from the drop-down menu.
Path	String type node address
Address	Numerical type node address
Maximum Connections	Maximum allowable connections per device

Click on COM2 on the left to open the Device table to add a new device. Give it a name, say “PLC02”. We will use Modbus RTU as the communication protocol with a Baud rate of 19200 and with even parity bit. Assign SEC01 as the timer so that the server will read data from the PLC every second. After completing the configuration, save the changes.

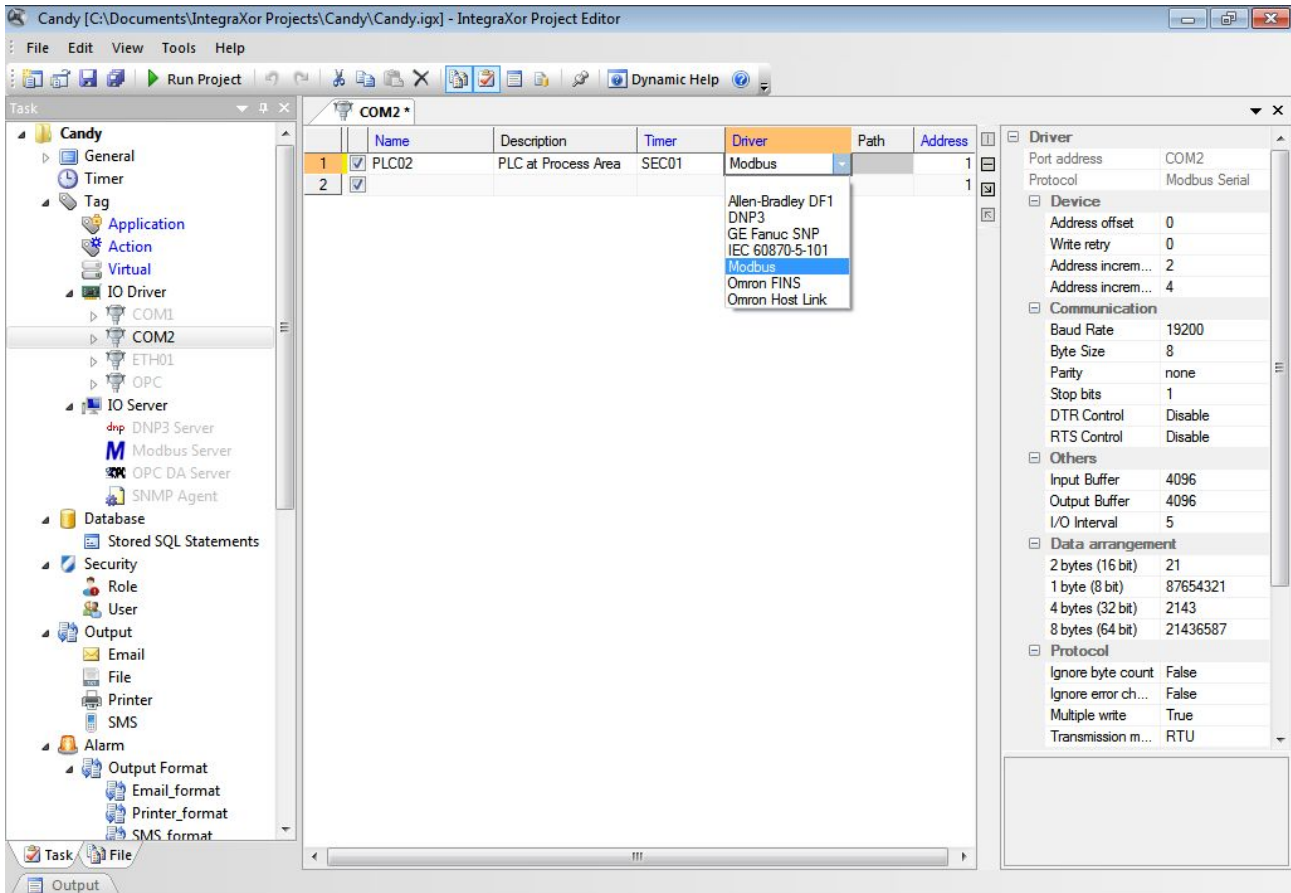


Figure 4.2 : Create New Device

Step 3: Create Tags

'Tag' is a common term in SCADA. A tag is similar to a variable in computer programming. A variable refers to a memory location in the computer, while a tag refers to a memory location in the PLC. There are three types of tags in Ecava IGX, which are external IO (xio), virtual IO (vir) and runtime (run). Both external IO and virtual IO tags must be entered into their corresponding Tag tables. A tag that is associated with a device is an external IO tag, otherwise it is a virtual IO tag. A tag used during runtime without being defined in the Tag table is called a runtime or system tag.

Parameters	Descriptions
Enable	Enabled (Checked) / Disabled (Unchecked)
Name	A unique name for each tag
Description	Additional description
Address	Address in numerical format, e.g. Modbus
Path	Address in string format, e.g. OPC
Batch	Batch number indicating a chunk of data for one device shall be read or written together if they are contiguous in data address arrangement. Enter -1 to automatically handle grouping based on protocol selected. Enter 0 to force the tag to be read separately. Enter any positive integer to group tags.
Type	The data type of the tag. The following are the available data types. <div style="display: flex; justify-content: space-between;"> <div>- boolean</div> <div>- int16</div> <div>- int32</div> </div> <div style="display: flex; justify-content: space-between;"> <div>- int64</div> <div>- int8</div> <div>- uint8</div> </div> <div style="display: flex; justify-content: space-between;"> <div>- real32</div> <div>- real64</div> <div>- string</div> </div> <div style="display: flex; justify-content: space-between;"> <div>- uint16</div> <div>- uint32</div> <div>- uint64</div> </div>
Length	The string length of the data, i.e. the number of characters in the string.
Default	The default tag value during server startup. If it is left blank, an uninitialized tag will have no value.
Input Expression	An expression that modifies the input data to the desired value before it is stored in the tag. The expression can be a scaling factor or a logical expression. If it is left blank, the input data will not be modified.
Output Expression	An expression that modifies the output tag value to the desired value before the modified value is written to an external device. The expression can be a scaling factor or a logical expression. If it is left blank, the output data will not be modified.
Read Level	The security level (0 to 1000) for reading the tag.
Write Level	The security level (0 to 1000) for writing the tag.
Log	Select a database to record the tag value . This setting is required for trending.
Retentive	Select a database to record the last known tag value. This value will be updated when the tag value changes. It will be assigned to the tag if the tag value cannot be read from the external device successfully.
Read Role	The security role for reading the tag.
Write Role	The security role for writing the tag.
Input Tag	Set true for Modbus 1x and 3x address and make a tag Read Only.
Attribute	The attributes for the tag behavior are as below:- <div style="margin-left: 20px;"> - Write-only tag - Log value on change (only applicable if Log parameters are defined) </div>

Click on 'PLC02' on the left menu to open its Tag table. We shall add a few tags to be mapped to the data areas in the PLC. The Modbus addresses may differ for each make of PLC. The typical address ranges are shown as follows.

Typical Modbus address ranges

Description	Modbus address
Coils Status (Digital Output)	00000-09999
Inputs Status (Digital Input)	10000-19999
Input Register (Analog Input)	30000-39999
Holding registers (Analog Output)	40000-49999

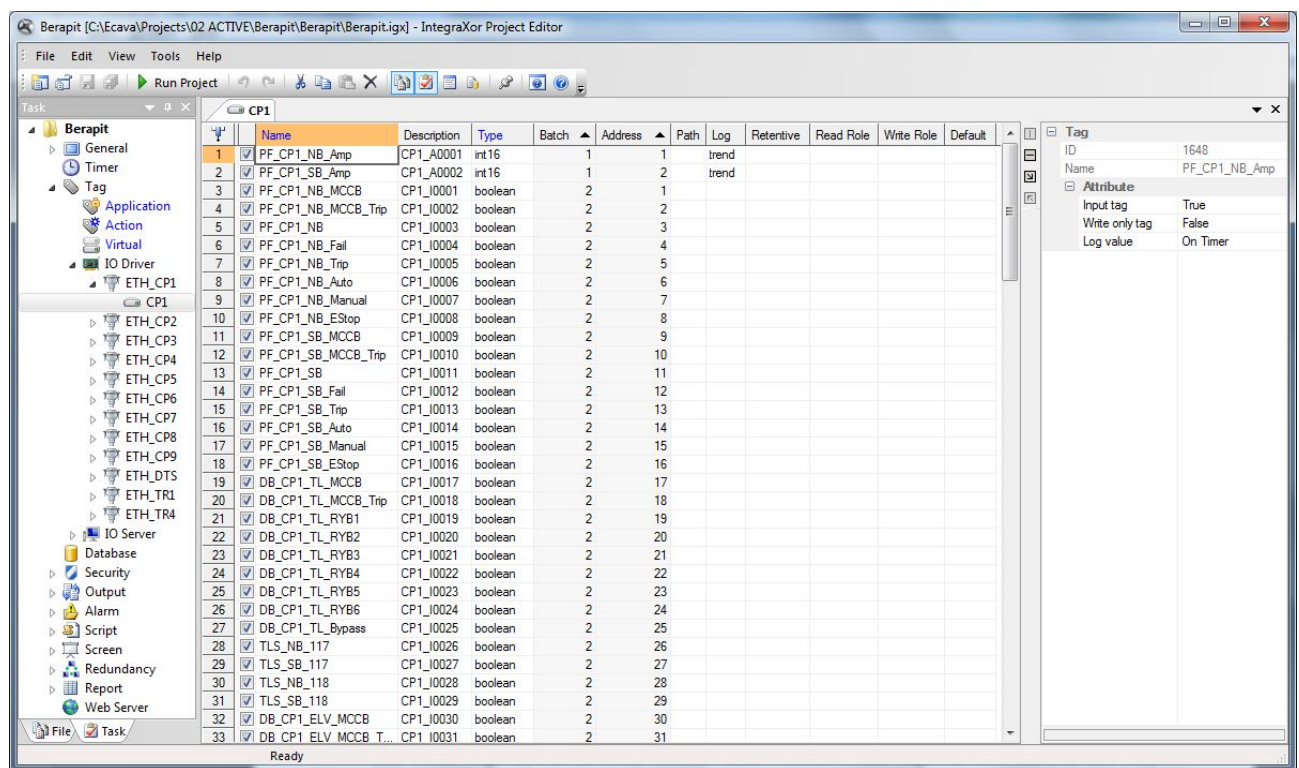


Figure 4.3 : Tag configuration

Since we will not be using an actual PLC in this tutorial, we will use virtual tags as a replacement. Virtual tags are internal tags that are not tied to any physical I/O. You can use these tags as variables to store data. These virtual tags are not included in the final licensed I/O count so you can create as many virtual tags as you want.

Open COM2 table to disable the device PLC02. Ecava IGX will not poll a device configured in a port if the device is disabled. You can also remove the device by deleting the whole row of device data.

Under the Tag item, click Virtual and create the following tags:

Tag name	Data type
level_chocolate	real32
level_syrup	real32
level_vanilla	real32
level_strawberry	real32

The other settings can remain as default.

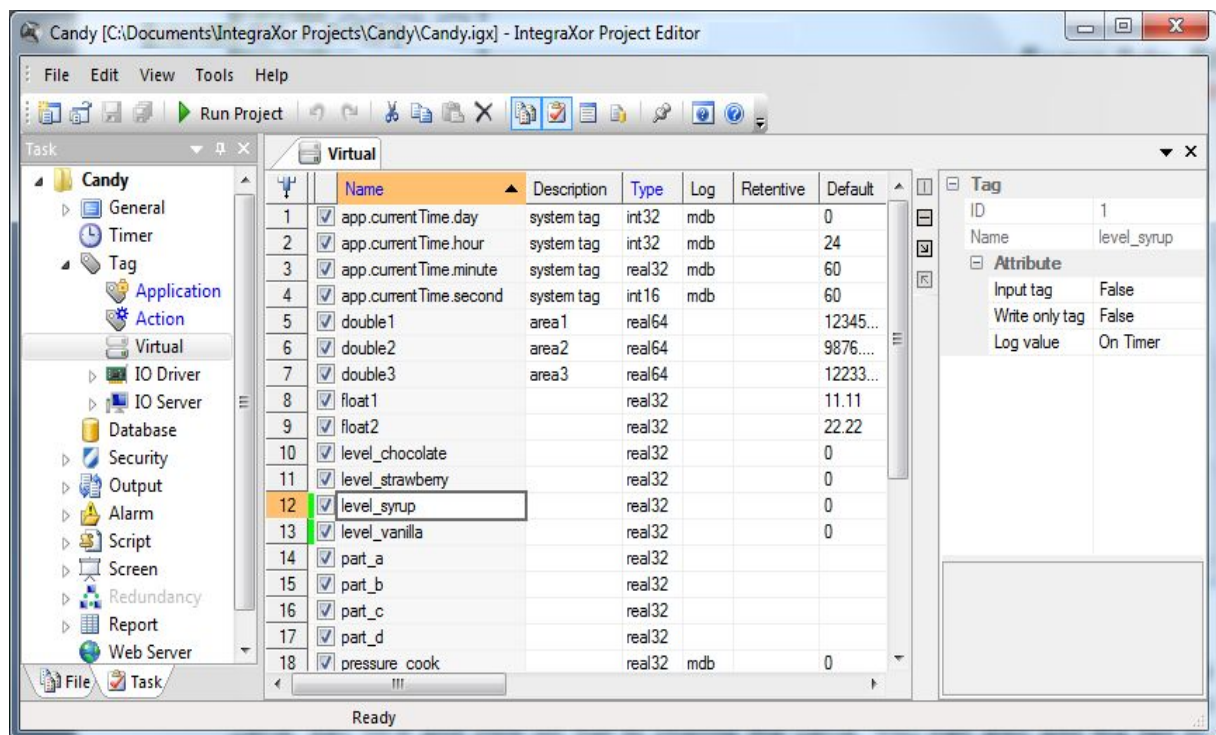


Figure 4.4 : Virtual Tags

Run your project in Ecava IGX Server. In the server, you can select one of the above tags in the Watch window. For example, to see the 'level_syrup' tag value, enter its name in the search bar on the Watch window. You can enter a new value, say 10.5 and press Enter to change the tag value. You can also add the tag to your watch list to monitor the value by clicking the star icon on the left side of the tag.

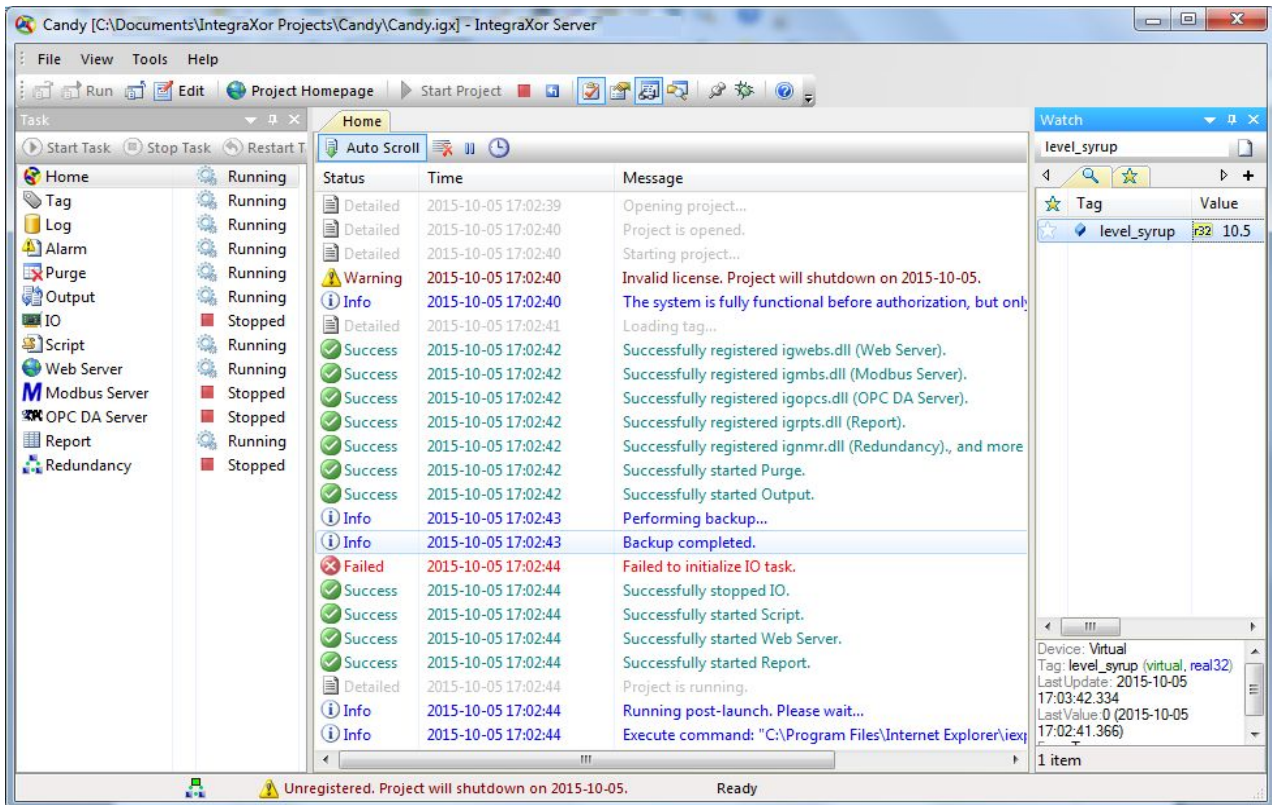


Figure 4.5 : Tags in the watch list

Quiz 2

1. Open PE. Create the Modbus IO tags based on the list below:

Configuration details:

IP and port number: 127.0.0.1:502

Protocol: Modbus TCP/IP

Timer: SEC01

IO List

Item	Description	Address*	Type	Input
A	<u>Operator Interface</u>			
1	System Fault Alarm Beacon	0	boolean	No
2	Auto/Manual Select Switch	3	boolean	Yes
B	<u>Pump Control</u>			
1	Pump Start/Stop Command	1	boolean	No
2	Pump Run/Stop	4	boolean	Yes
3	Pump Trip	5	boolean	Yes
C	<u>Valve Control</u>			
1	Valve Open/Close Command	3	boolean	No
2	Valve Fully Open	8	boolean	Yes
3	Valve Fully Close	9	boolean	Yes
D	<u>Instrument</u>			
1	Reservoir Tank Level (0 - 10000m ³)	0	int16	Yes
2	Reservoir Tank pH (pH 0 – 14)	1	int16	Yes
3	Reservoir Tank Outlet Flow Rate (0 - 1000m ³ /h)	2	int16	Yes
4	Reservoir Tank Outlet Flow Totalizer	3	int16	Yes

After you have finished entering all of the items above, print screen your PE and save the following: Port table as 03Port.png, Device table as 04Device.png and Tag table as 05Tag.png in My Documents > IntegraXor Project > <your initials> > Quiz folder.

*Note: The addresses are not absolute Modbus addresses. An address is entered as an offset from the first address of the register of a particular data type. For example, address 0 for read-only (input) boolean type is usually Modbus address 10001. Address 3 will be Modbus address 10004. To determine the address for a data type, use the following formula:

$$\text{address} = \text{actual Modbus address} - \text{first Modbus address} - \text{address offset}$$



The actual address and the first address must belong to the same data type. The address offset is a setting for a device. Its default value is 0. Refer to Figure 4.2 for the setting.

For more information about Modbus addresses, please refer to the Modbus specification document which can be downloaded online.

Chapter 5: Graphical Animation

Inkscape SAGE (SCADA Animation Graphic Editor)

Using Windows Explorer, go to “C:\Documents\IntegraXor Projects\Candy”. Right click on overview.svg and open it with an application called Inkscape SAGE. Inkscape SAGE is the tool for drawing graphics and configuring animation based on your tags.

In Inkscape SAGE, select the Rectangle tool (F4) by clicking on  icon. Drag to create a rectangle in overview.svg. Click on Select tool (F1) by clicking on  icon to return to selection mode.

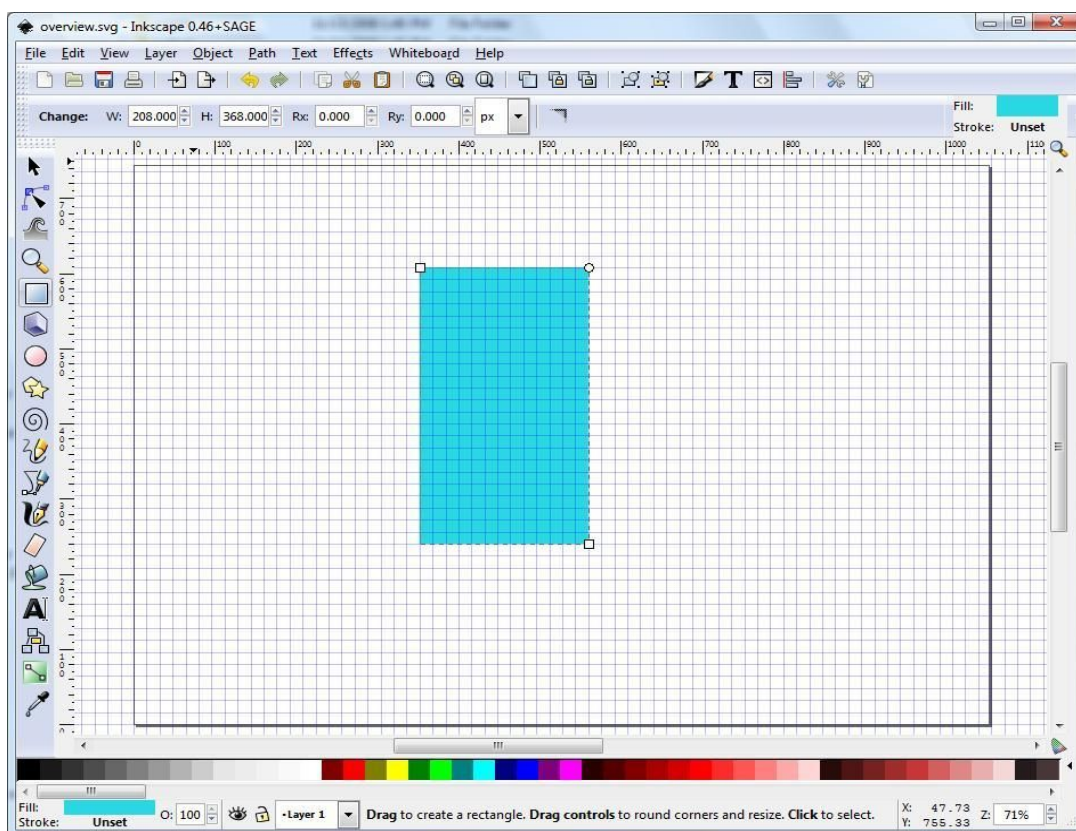


Figure 5.1 : Inkscape SAGE draw rectangle

This rectangle will be used to animate a tank fill level in your candy factory. You can change the color and border style of your tank level by selecting menu Object > Fill and Stroke (right click and select Fill and Stroke or press SHIFT+CTRL+F)

Next, right click on the tank and select Object Properties (select menu Object > Object Properties or press SHIFT+CTRL+O). Select 'Bar' animation, enter app.currentTime.second in Tag field. The tag called app.currentTime.second is an Application (server's internal) tag which contains the current time value of seconds. Enter 0 in the Min field and 59 in the Max field. Click OK. Select menu File > Save or press CTRL+S to save overview.svg.

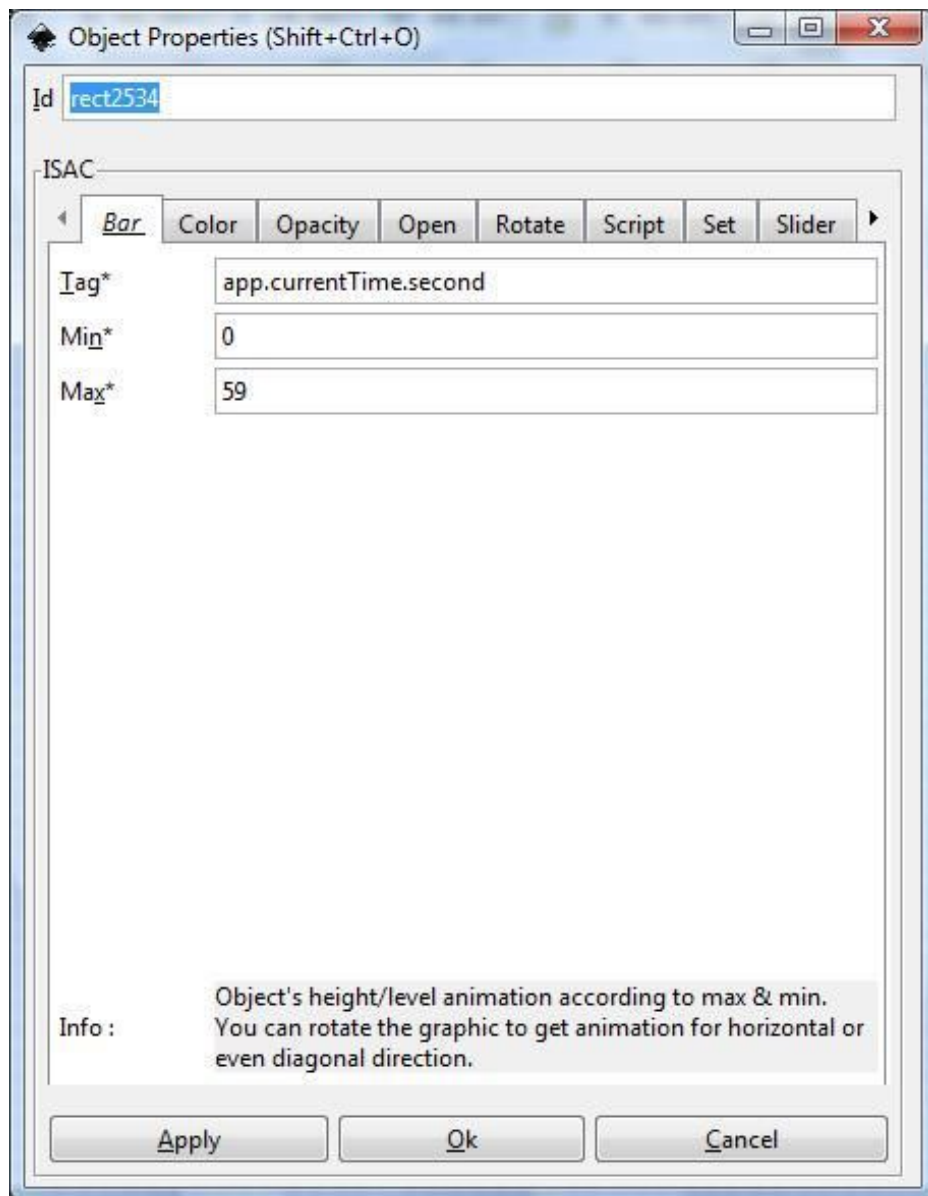


Figure 5.2 : Object Properties – Bar Animation

Return to Internet Explorer, press F5 to refresh (after running the Ecava IGX project). You will see the level of your tank changing every second. Congratulations! You have successfully created a basic graphic animation in Ecava IGX.

You can draw another rectangle to show the outline of the tank. Use gradients in the Fill and Stroke to create a 3D effect. Change the thickness and style of the object's outline or stroke. Try changing the opacity (visibility) and see the effects.

Now, create 4 tanks for chocolate, strawberry, vanilla and syrup. Use the tags you created earlier and configure Bar animation for each tank with Min 0 and Max 100.

Get Tag & Set Tag

Apart from graphic visualization of the level, we also need some text visualization. The Text tool is easy to find. On the left, select the Text tool (F8) with a Capital A as an icon. Click on an empty area in overview.svg and key in 'Vanilla'. Now, you can label the rest of your tanks.



Figure 5.3 : Adding Text

We also need to display the tank level in figures. Create another text box and enter `###` as text. Open Object Properties, select 'Get' animation and enter `level_vanilla` in the tag field. Click Apply.

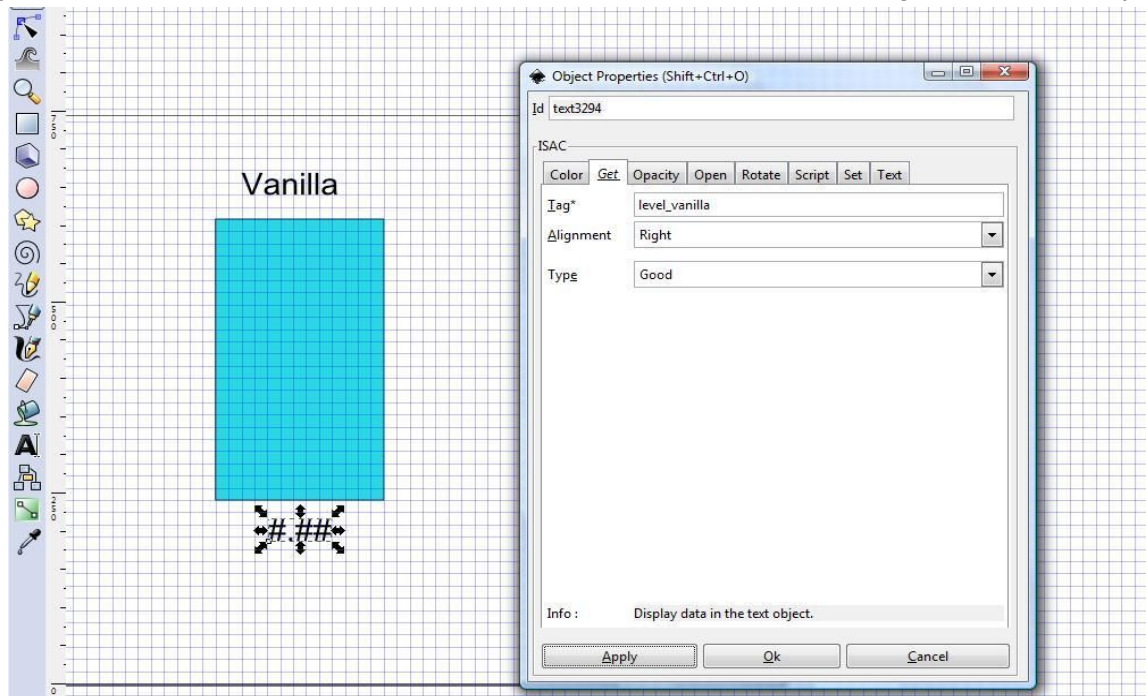


Figure 5.4 : Get Tag

Select 'Set' animation and enter `level_vanilla`. Click OK and save overview.svg. Refresh your Internet Explorer to see the changes. Try to click on the text and enter a real/float value.

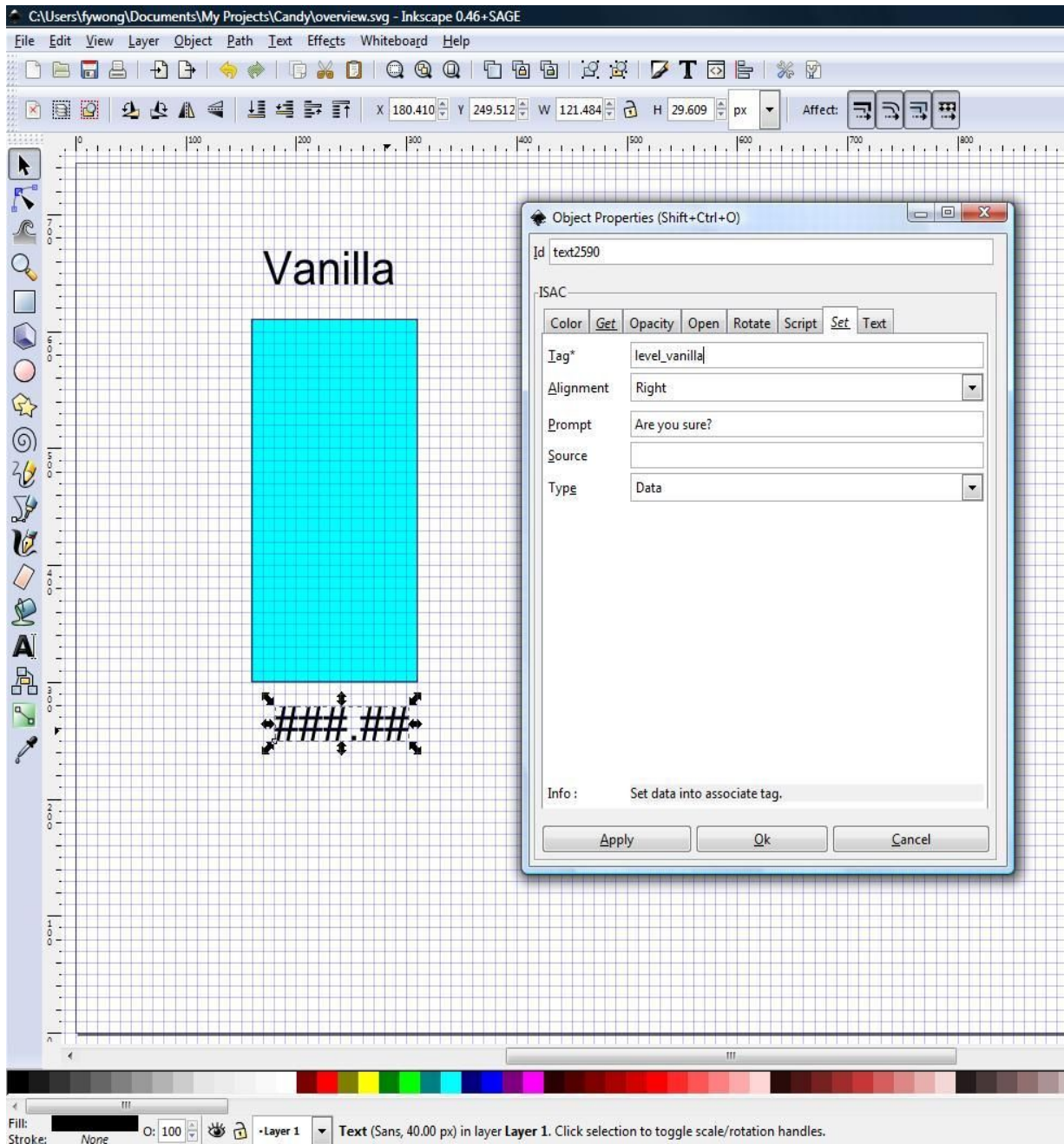


Figure 5.5 : Set Tag

Tip: `###` formats the display of your data. Click on the text to edit. Add '#' after the decimal point; `####`, refresh your Internet Explorer and you will see the difference. By adding '#' after decimal point in the text, you are specifying how many decimal places you want to display on your screen.

Web Buttons

Buttons are used widely in industry. Start, Stop, Run, Open and Close are some of the more common uses of a button. Here, we would like to create a button to top-up our tank to 100. Draw a rectangle. Open Object Properties, select 'Set' animation and enter `level_vanilla`. In the Source field, enter 100. Use the text tool to name your button, 'Top-up'. Save and refresh. Click on the button to set it to 100.

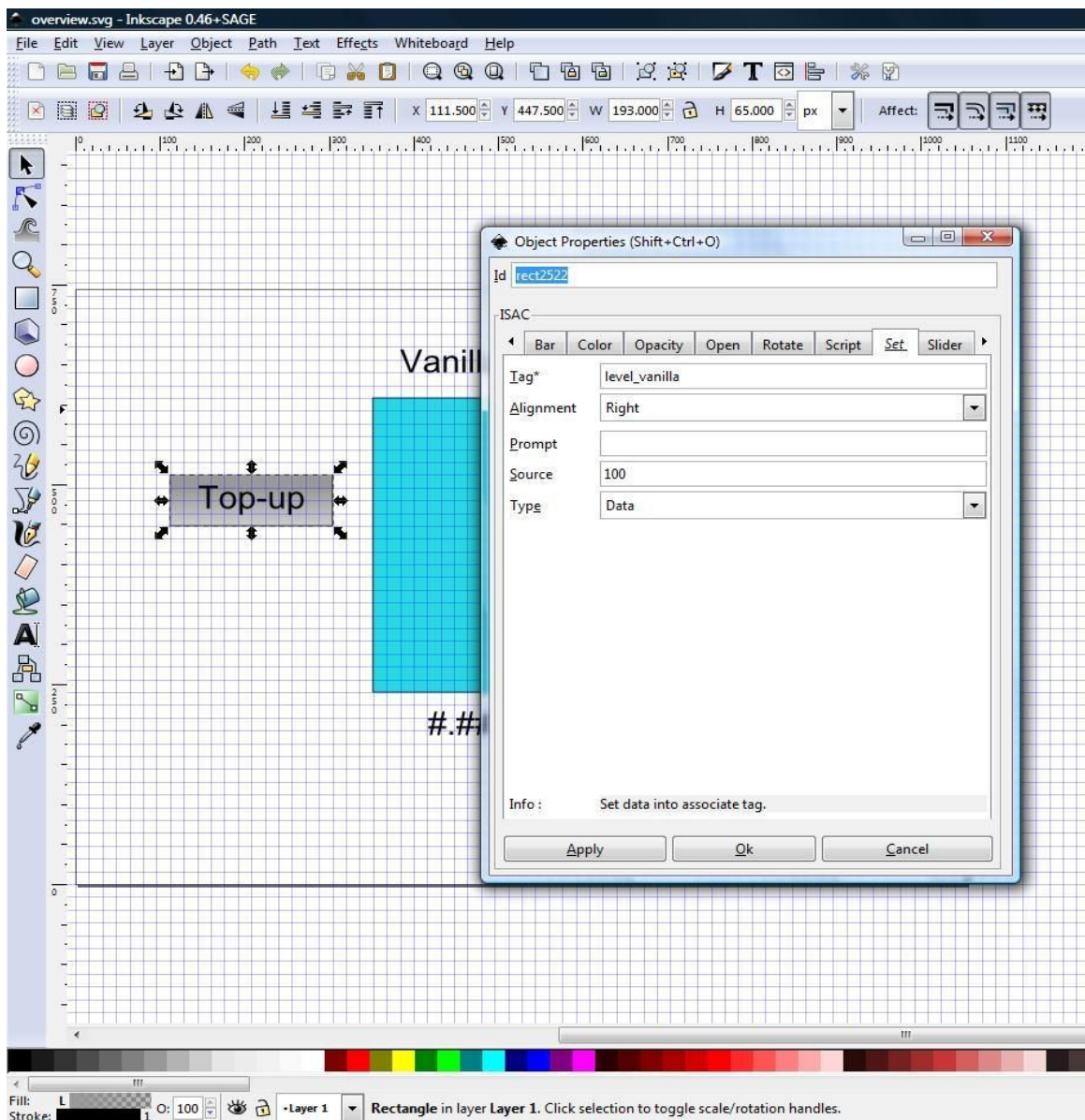




Figure 5.6 : Button Action

Tip: There are numerous tutorials on the Internet on how to draw Web 2.0 buttons with Inkscape. 3D, gel and shadow effects make the overall look of your graphics more pleasing. Do a search for "Inkscape button tutorial" online.

Slider Movement

For a straight line linear movement between 2 points, you can use the slider animation. First, create an object. Here we will draw a piece of candy using the Spiral tool ( icon / F9) and Straight line tool ( icon / SHIFT+F6). Press shift and click on both objects. Select menu Object > Group (or hit CTRL+G).

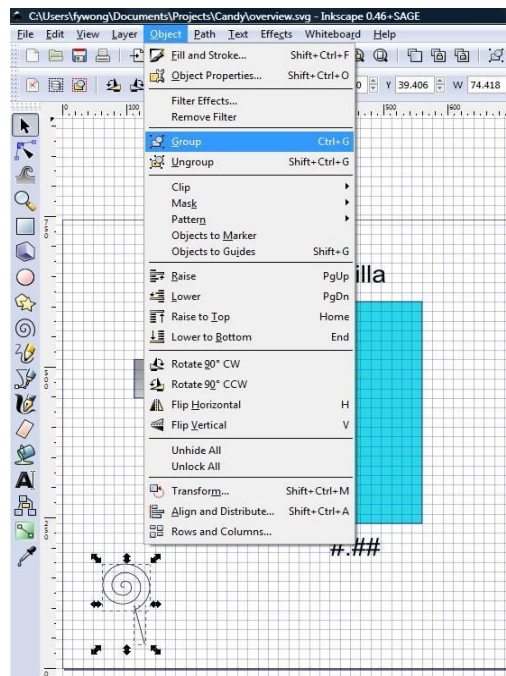


Figure 5.7 : Group objects

Next, right click on the grouped object and select Object Properties. In the Slider tab, enter `app.currentTime.second` in the tag field, Min 0 and Max 59. Click OK.

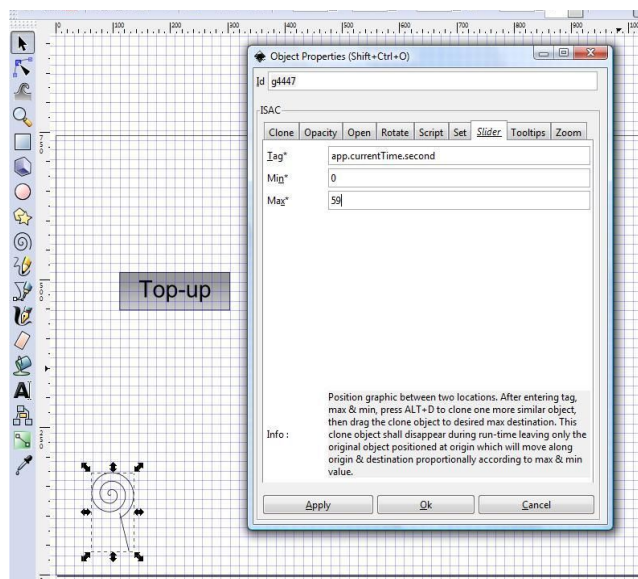


Figure 5.8 : Slider Animation

Click on the grouped object, select Edit > Clone > Create Clone (or hit ALT+D). A clone object will be created right on top of the original. Click on top (clone) object and place it at the Max destination. This piece of candy will travel from the original position to the Max position based on time in seconds. Save the SVG and refresh your Internet Explorer.

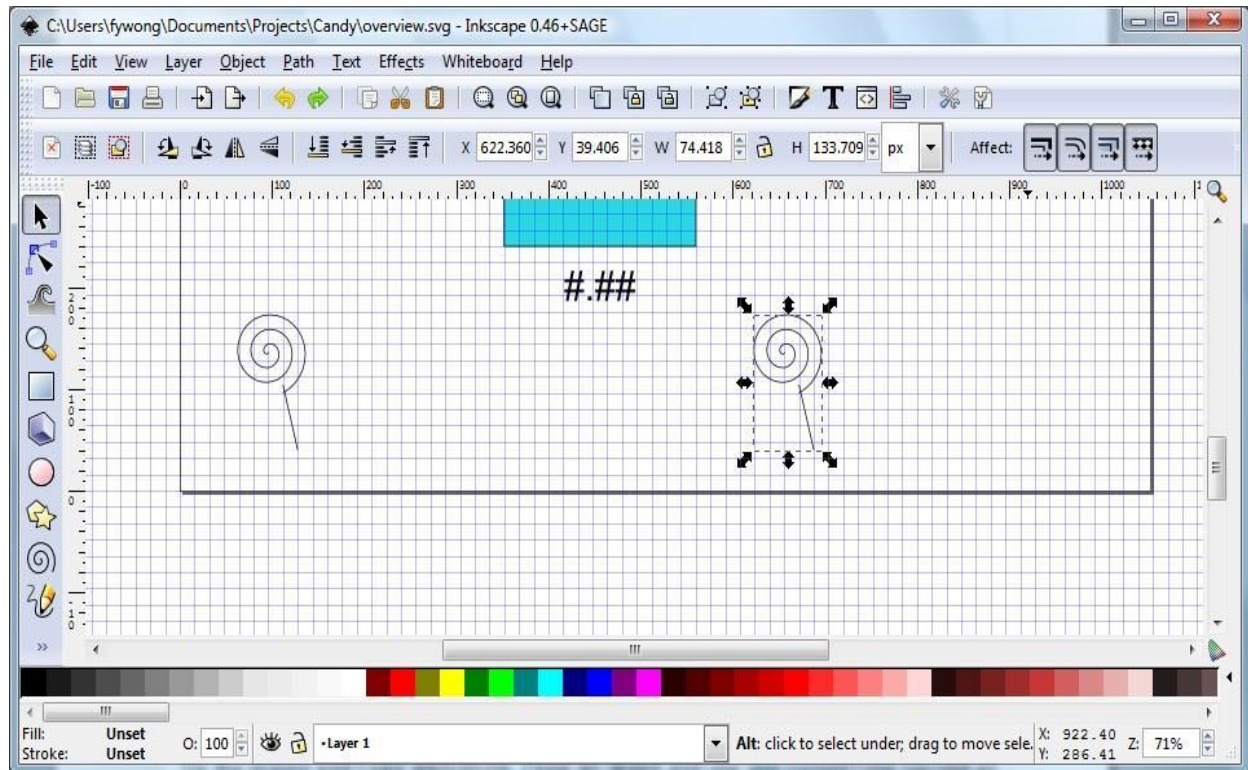


Figure 5.9 : Clone object

Tip: If you modify the original object, all cloned objects will be automatically modified as well. However, ungroup action (CTRL+U) will remove all group animation. In order to keep the group animation, right click on the group and select Enter Group. Now, you can select the individual items for modification.

Faceplate

Faceplate allows user to duplicate a grouped object while keeping the same tag name. This is useful when there are multiple identical objects such as pumps, valves, etc with the same animation but are associated with different tags. Faceplate is available only on the Object Properties dialog box for grouped objects. Before applying the Faceplate settings, the user must design the object and use the same pattern of tag names.

For example, a pump has an animation and the user wants to create two identical pumps animated by two tags: pump_1_state and pump_2_state. When assigning the animation tag, the user enters the tag name as pump_%n_state in the Tag field instead. After the pump drawing is completed, it should be grouped by pressing CTRL + G. Next, the user can duplicate the pump object by pressing CTRL + D. The Faceplate settings are in the Object Properties dialog box of each pump object.

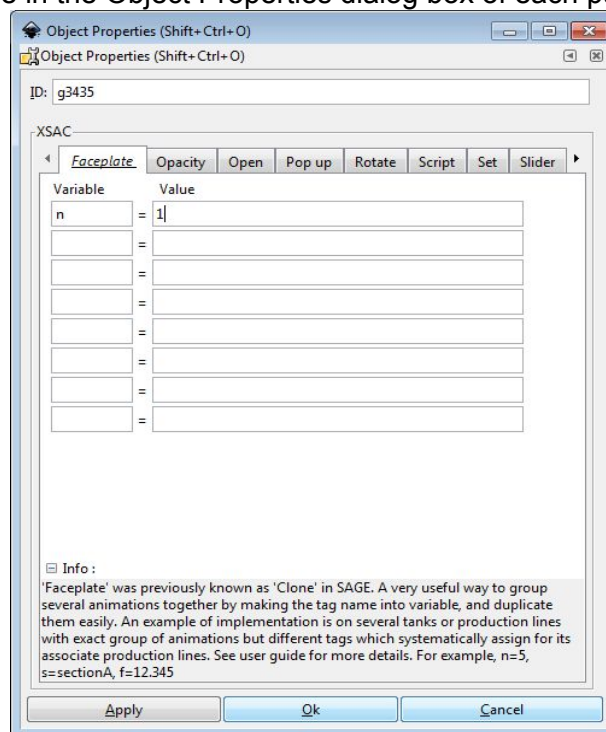


Figure 5.10 : Faceplate settings on Object Properties dialog box

The user needs to fill up the Variable and Value fields. Variable is the part of the tag name that is different, while Value is the value that replaces the Variable when the tag name is evaluated. In our case, the Variable is n and the Value should be 1 for the first pump or 2 for the second pump. The symbol % is an identifier of the animation system and is not required in the Variable field. During runtime, the front end script will convert the tag name from pump_%n_state to pump_1_state for the first pump or pump_2_state for the second pump.

Several variables can be entered in separate rows for use within a grouped object. For a tag name with a pattern like tag%n_%s_%d, there are three entries in the list, where the variables are n, s and d. The value field should contain characters that are valid for a tag name.

Visibility (Opacity)

Another way to make an object move is to make it appear in the path of the movement. Let's try this out by making a mixing tank. First, draw a tank. Then, we create 4 sets of graphics with the agitator arms in 4 different positions like this.

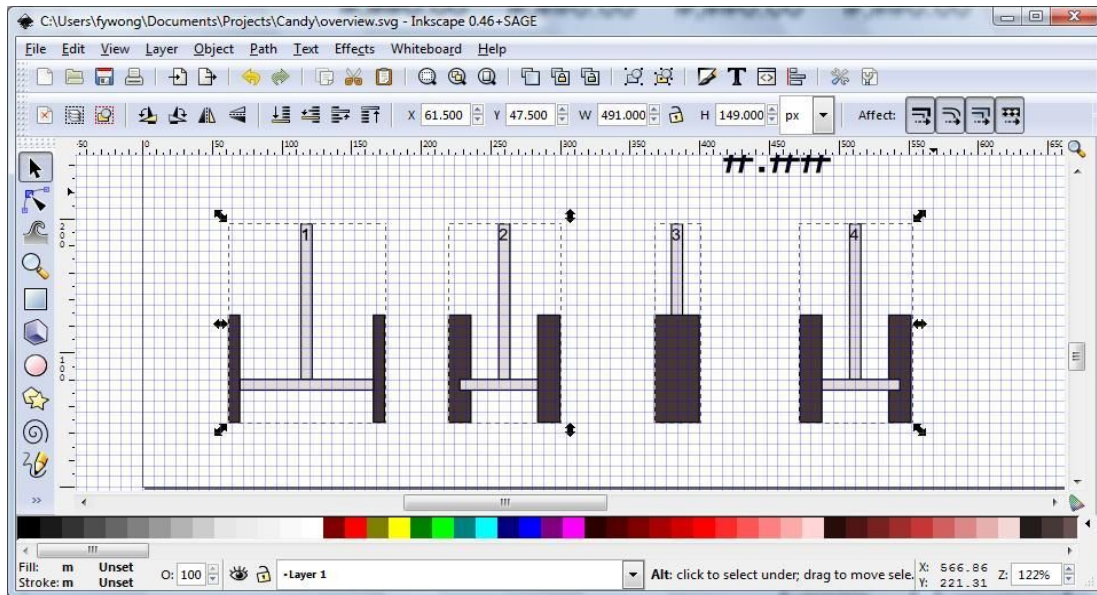


Figure 5.11 : Stirrer Movement by Opacity

Next, return to PE and create the following virtual tags.

Tag name	Data type
agitator_posA	boolean
agitator_posB	boolean
agitator_posC	boolean
agitator_posD	boolean

Return to overview.svg, right click on the first set of agitator arms and select Object Properties. Select Opacity animation and enter agitator_posA in the tag field. Set maximum to 1 and minimum to 0. Do the same with the other 3 sets of graphics with tags agitator_posB, agitator_posC and agitator_posD. Next, hold down the Shift key and click on all 4 set of agitator graphics. This selects all 4 sets together. Alternatively, you can click and drag your mouse across all 4 graphics. With all 4 sets selected, go to the Objects menu and select 'Align and Distribute' (or press CTRL+SHIFT+A). Align all 4 horizontally and vertically. This action overlaps the 4 graphics exactly on top of each other. The effect we want is agitator position A to appear first then disappear. As soon as agitator position A disappears, agitator position B appears and this is repeated for agitator position C and D. In order to do this, we need the tags to alternately set to 1. We will do this with a script in the next chapter.

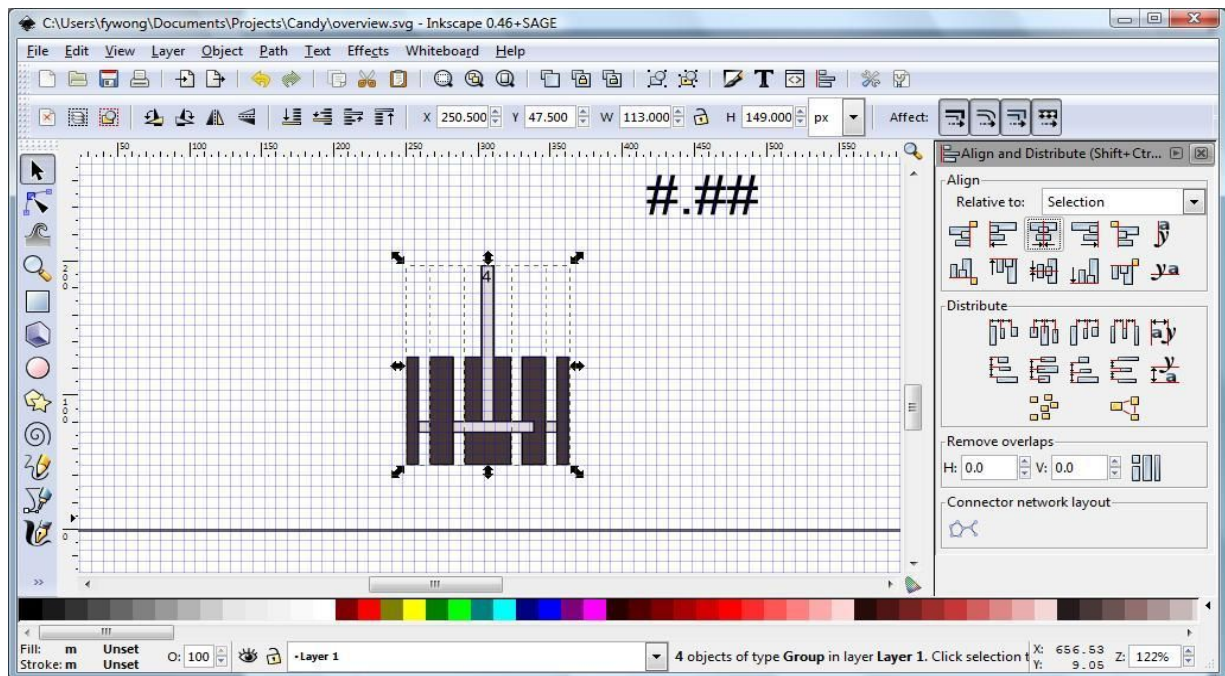


Figure 5.12 : Alignment of objects

More Animations

Try the Rotate and Color animations. Draw an object and use `app.currentTime.second` as the tag. You will be able to see the animation every second. Refer to Ecava IGX User Guide for the complete list of available animations.

Quiz 3

1. With your imagination and engineering knowledge, please draw in My Documents > IntegraXor Projects > <your initials> > overview.svg a simple reservoir tank system referring to IO list given in Quiz 2.

In the screen you must show at least the tank level animation, pump run/stop/trip status and valve fully open/fully close status. Run your server, print screen Overview screen and save the screenshot as 07Mimic.png in My Documents > IntegraXor Projects > <your initials> > Quiz folder.

Chapter 6: Server-side Scripting

JavaScript

One of the most popular scripting languages for the web is JavaScript. It is easy to find JavaScript tutorials and examples on the Internet. JavaScript is also a very easy, flexible and powerful language to learn. In this section of the tutorial, you will be writing your first JavaScript for Ecava IGX.

Your First JavaScript

In the PE, click on Script item on the left menu. Add a new script and enter the following details.

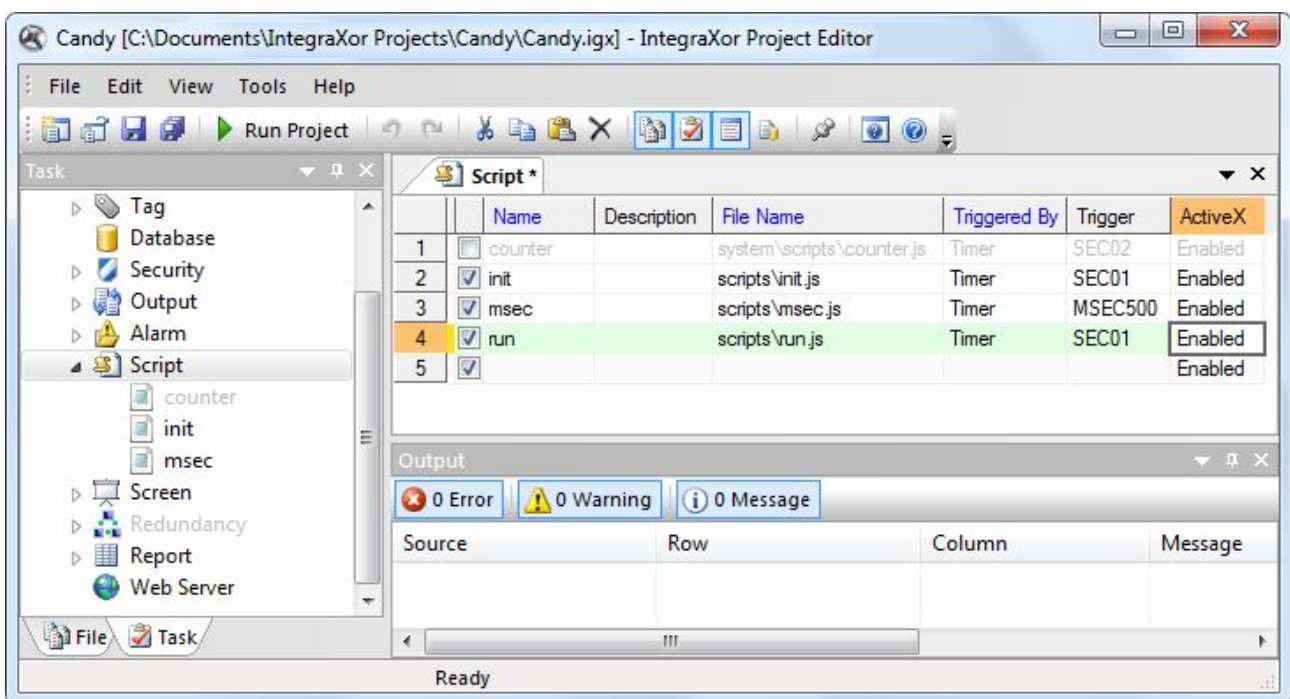


Figure 6.1 : Create Server-side Script

Save the changes you have made and a JavaScript file named run.js will be automatically created in your project folder.

Click on the newly created 'run' script to open it. Copy and paste the following into your run script. Save the script.

```
//agitator rotation animation
var ctr = getTag( 'agitator_pos');
if (ctr < 4) {
    ctr++;
}
else {
    ctr = 1;
}
setTag( 'agitator_pos', ctr);

switch (ctr) {
    case 1:
        setTag( 'agitator_posA', 1);
        setTag( 'agitator_posB', 0);
        setTag( 'agitator_posC', 0);
        setTag( 'agitator_posD', 0);
        break;
    case 2:
        setTag( 'agitator_posA', 0);
        setTag( 'agitator_posB', 1);
        setTag( 'agitator_posC', 0);
        setTag( 'agitator_posD', 0);
        break;
    case 3:
        setTag( 'agitator_posA', 0);
        setTag( 'agitator_posB', 0);
        setTag( 'agitator_posC', 1);
        setTag( 'agitator_posD', 0);
        break;
    case 4:
        setTag( 'agitator_posA', 0);
        setTag( 'agitator_posB', 0);
        setTag( 'agitator_posC', 0);
        setTag( 'agitator_posD', 1);
        break;
}
```

We will briefly explain the script. The first line is a remark or comment. A comment begins with // on a line. Anything after // on the same line will not be executed. The script then gets the value of tag agitator_pos and stores the value in a variable. Next, we add this value by 1. By calling this script every second, the variable will change from 1 to 4 with an increment of 1 every second. After the value changes to 4, it will be reset to 1 and the cycle repeats. The next part of the script sets the tag value of agitator_posA to 1 if value of agitator_pos is 1. The tag value of agitator_posB is set to 1 if the value of agitator_pos is 2. Similarly, agitator_posC is set to 1 if agitator_pos is 3 and agitator_posD is set to 1 if the agitator_pos is 4.

Ensure that the script is enabled or it will not run. In the Trigger field, select SEC01 to run this script every second.

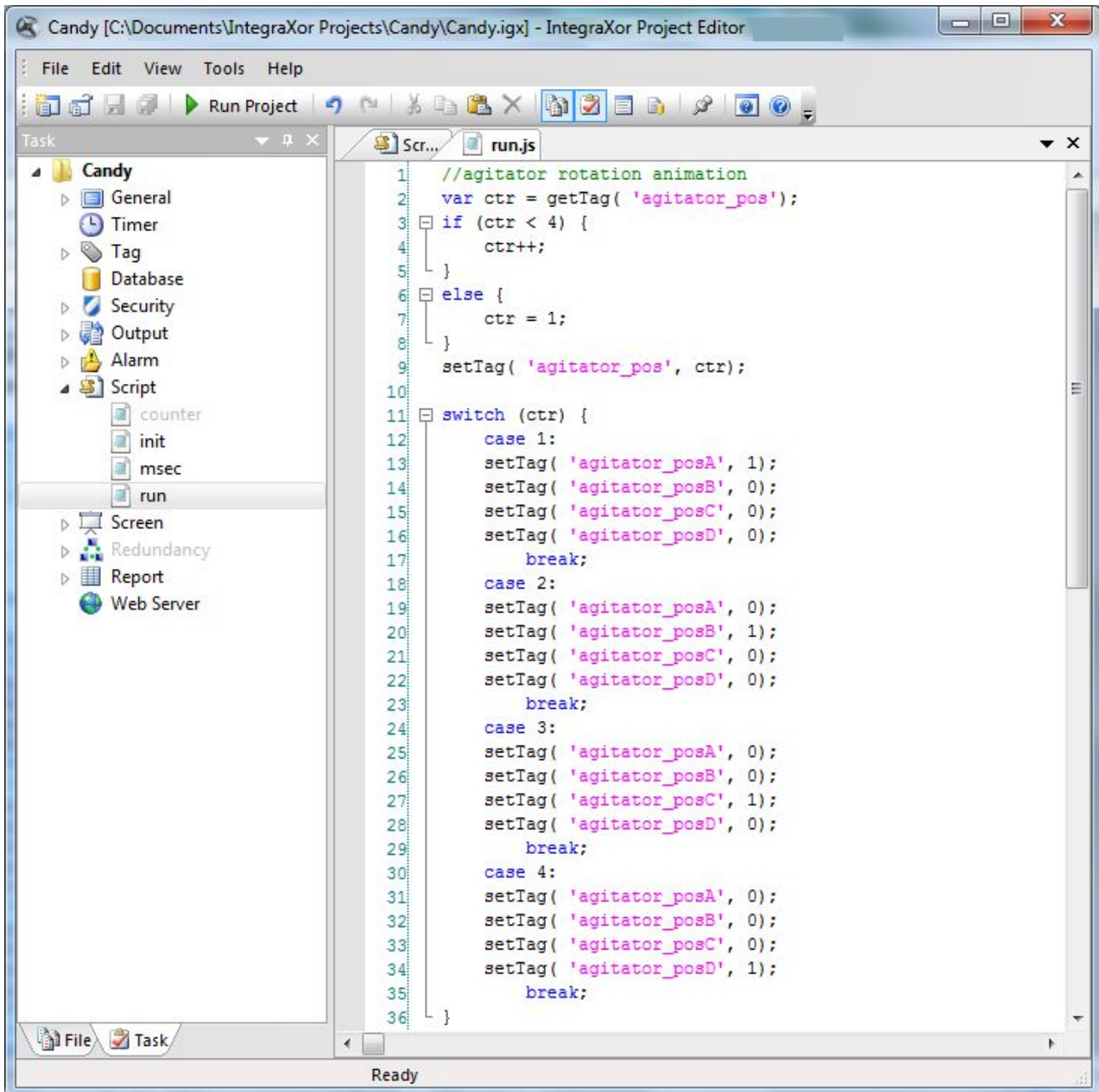


Figure 6.2 : Server-side Scripting

Finally, we restart the Script task in Ecava IGX Server. Highlight 'Script' task and select Tools > Restart Task (or hit F5). Refresh your Internet Explorer. Your candy factory is now mixing a batch of candy.

Quiz 4

1. From your previous Quiz, create a server-side script to activate System Fault Alarm Beacon for 'pump trip' or 'tank level above 8000m3'. Print screen your PE, show the newly added script and save its screen shot as 08ServerScript.png in your Quiz folder.

Chapter 7: Client-side Scripting

Client-side scripting

The web defines server-side scripts as programs that are performed by the server in client-server networking. Common operations such as scaling and logging are generally done at server side. An advantage is that this lightens the work of clients.

The client-side scripts generally refer to scripts running in the client's web browser. User input may be different or environmental conditions are different such as the time of day. An advantage is that this reduces unnecessary load on the server.

An important point to note is that client-side scripts will only run when they are activated in the web browser. For scripts that are required to run without a web browser, it is best they are configured at the server side in PE.

Inkscape SAGE Script

While server-side scripts are configured at the PE, client-side scripts are done by using Inkscape SAGE and HTML. In this tutorial, we will show you a simple script to top up all tanks with a click of a button.

Using Inkscape SAGE, open overview.svg in "C:\Documents\IntegraXor Projects\Candy" and add a button using the Rectangle tool. Label it as 'Top-up all'. Right click the button and select Object Properties. Select Script and enter the following script into the script field as shown below.

Figure 7.1 : Inkscape SAGE Script

Save the overview.svg file, refresh Internet Explorer and test your script.

More scripts

In addition to the extensive JavaScript resources on the Internet, you can refer to the Ecava IGX User Guide for a complete list of specific commands such as `getTag` and `setTag`.

Quiz 5

1. Then open My Documents > IntegraXor Projects > <your initials> > overview.svg, create two command buttons to command pump start/stop and valve open/close using client-side script method. Print screen the Object Properties of your two command buttons and save as 09Pump.png and 10Valve.png in your Quiz folder.

Chapter 8: HTML

HTML Basics

HTML (Hypertext Markup Language) describes how a web browser should display a document. To write a HTML file, start by composing the text you want to display, then insert suitable HTML tags in the right places. Do not confuse the HTML tags with the data tags that you created in PE. Every HTML tag begins with < and ends with >. Tags tell a browser to do something special, such as showing an image, linking to another web page or showing text in italic. HTML is also very easy to learn.

Your First HTML

Copy and paste the following into Notepad. Then, save the file as hello.htm.

```
<html>
  <head>
    <title>Hello, world</title>
  </head>
  <body>
    Hello, world.
  </body>
</html>
```

Open hello.htm in Internet Explorer. In the above example, the <html> </html>, <head> </head> and <body> </body> are called container tags. All displayed text, images, hyperlinks, SVG and so on are placed between <body> and </body> tags.

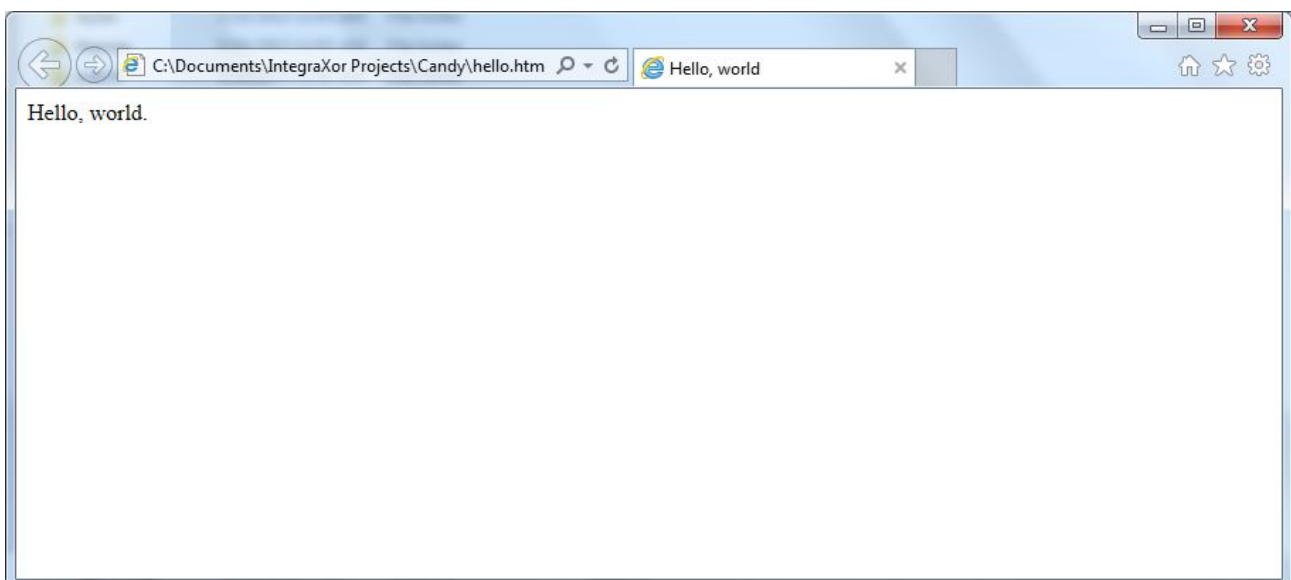


Figure 8.1 : First HTML

Unlike the above example, Ecava IGX cannot be run by directly opening the HTML file in Internet Explorer. An Ecava IGX project page must be viewed by connecting to the Ecava IGX server using a web browser. Previously, we set up a sample project called 'Candy' and opened a browser to view its page at <http://localhost:7131/Candy/index.html>.

Now, take a look at your project's index.html. You can open it with a text editor such as Notepad. We have created this HTML file as a template to produce the interface frames for the project homepage.

Project HTML

In this tutorial, we will add one more tab on your web page that loads a new svg file called newadd.svg to monitor the new section of our factory. First, use Inkscape SAGE to create a new svg and save it as newadd.svg. Open a project with PE and click on Screen.

Right click on the pane and click New Menu to create a new tab called New Page on your web page. Enter newadd.svg on the New Page tab. Save and refresh your Internet Explorer (during project running). Try your modified web page. Click on New Page. Click on Overview to return.

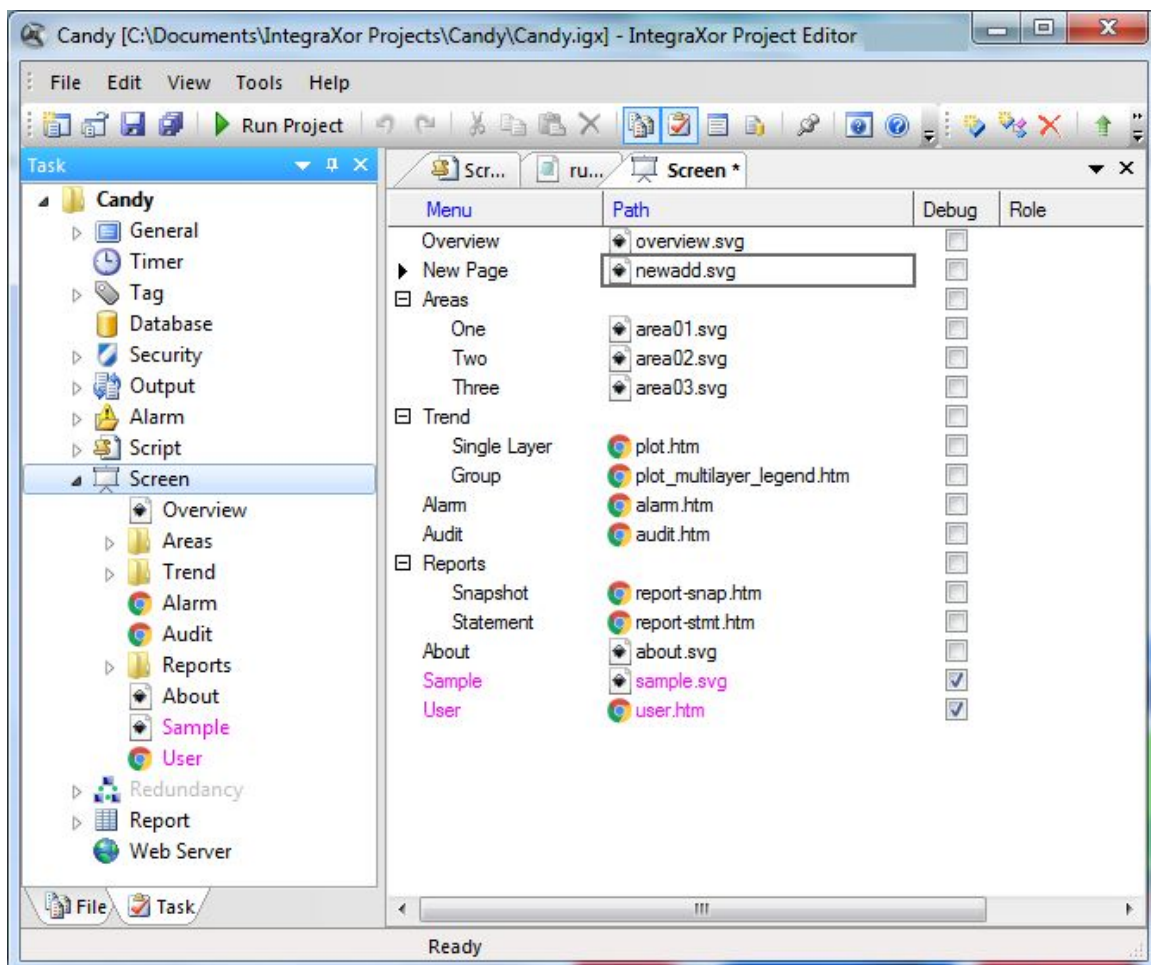


Figure 8.2 : New Page

Also you can add two or more sub-menu under same tab, you just need to right click on a created menu and select New Sub-menu.

Let's add hello.htm we created earlier under New Page tab along with newadd.svg as sub-menu. Also enter 'Candy Factory' in General-Title parameter.

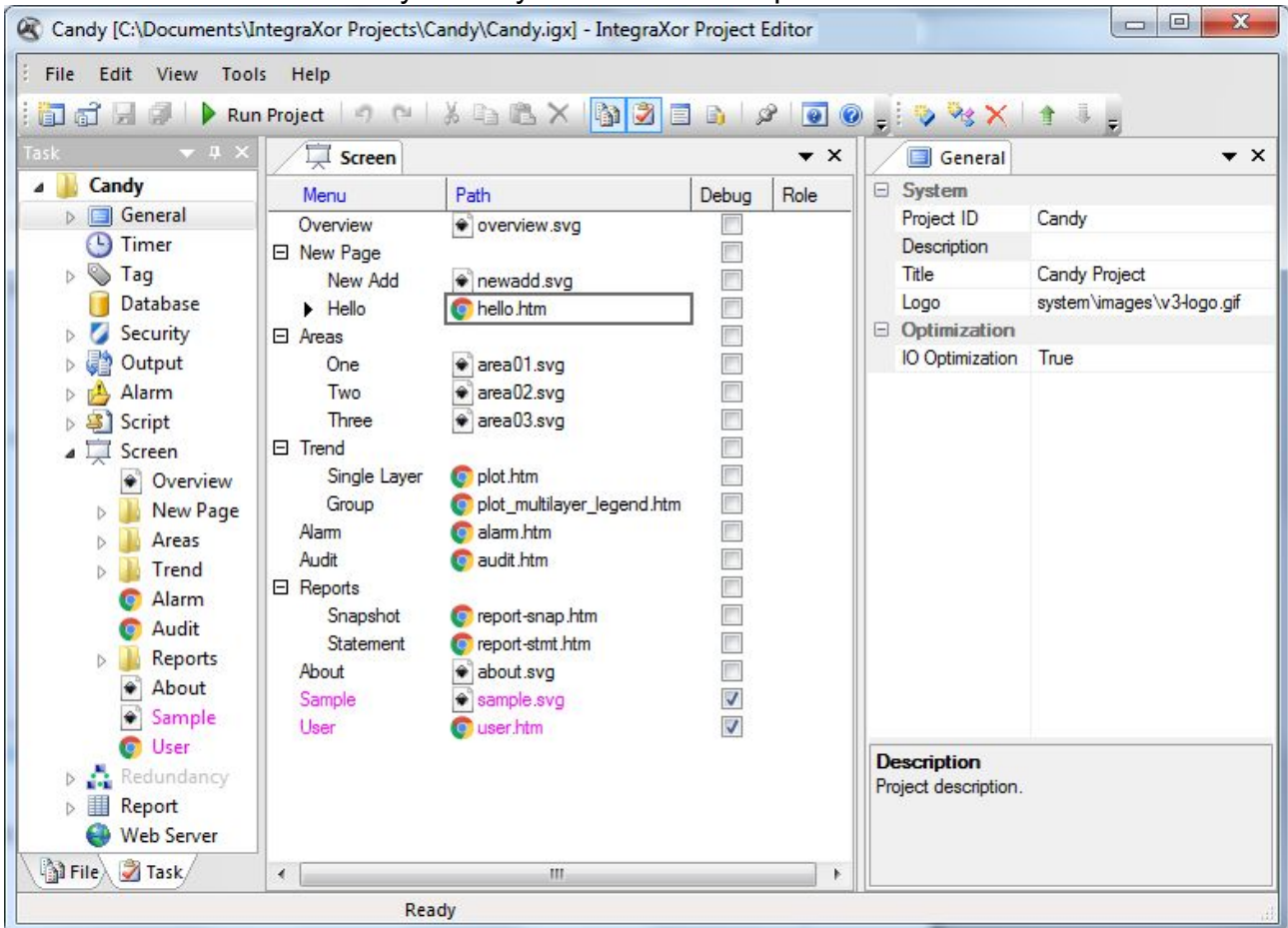


Figure 8.3 : New Sub-Menu

Then save and refresh your Internet Explorer again to see the difference.

Calling HTML from SVG

Try this. Create a new button in overview.svg. Label it as 'Go to Packaging'. Right click and select Object Properties. Select Open animation and enter package.svg in the source field. In the Source Type drop down, select URL. In the Dest. Type drop down, select Current Window. Add a page and svg file for this package.svg in PE. Save all and test your button.

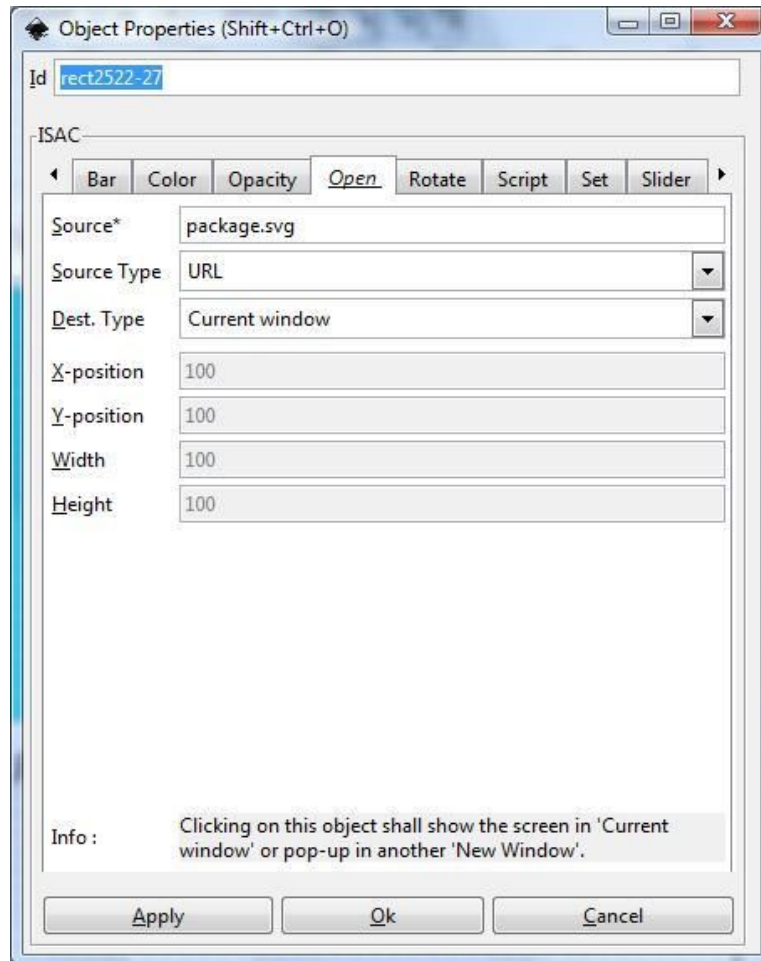


Figure 8.4 : Open Animation

More HTML

Have you ever seen a nice web page and wondered whether you can do the same for your HMI/SCADA system? The answer is YES. You can configure your HMI/SCADA system to play videos, view camera feeds, view pdf and autocad files and even do email. The possibilities are limitless. However, these are beyond the scope of this tutorial.

Quiz 6

1. Modify your previous Quiz's files so that when IntegraXor runs, it will contains project name as your name and four tab menu – shows;

- Main Menu - shortcut button/icon to Plant Overview, Alarm and Trending pages
- Plant Overview - the Reservoir Tank system mimic
- Alarm - alarm status page
- Trending - trending page

Print screen your Main Menu and Plant Overview page and save as 11Mainmenu.png and 12PlantOverview.png in your Quiz folder.

Chapter 9: Alarms

Alarm Management

Alarms are useful to inform the user that a condition has exceeded the design limit. Configuration of alarms is done in PE. The template project contains an alarm page with all the standard features included.

Alarm Configuration

Alarm configuration begins with a tag. Here, we will monitor the level_vanilla value. If our level_vanilla goes below 20, we want to generate an alarm. We will compose a message to alert the user of the condition. Our alarm message will be “Vanilla tank level LOW”.

In PE, select Process under Alarm tree. Add a new alarm and enter the following:

Enable	Yes
Name	va_lo
Message	Vanilla tank level LOW
Tag Name	level_vanilla
Trigger By	Compare Value
Condition	Less Than (<)
Limit 1	20

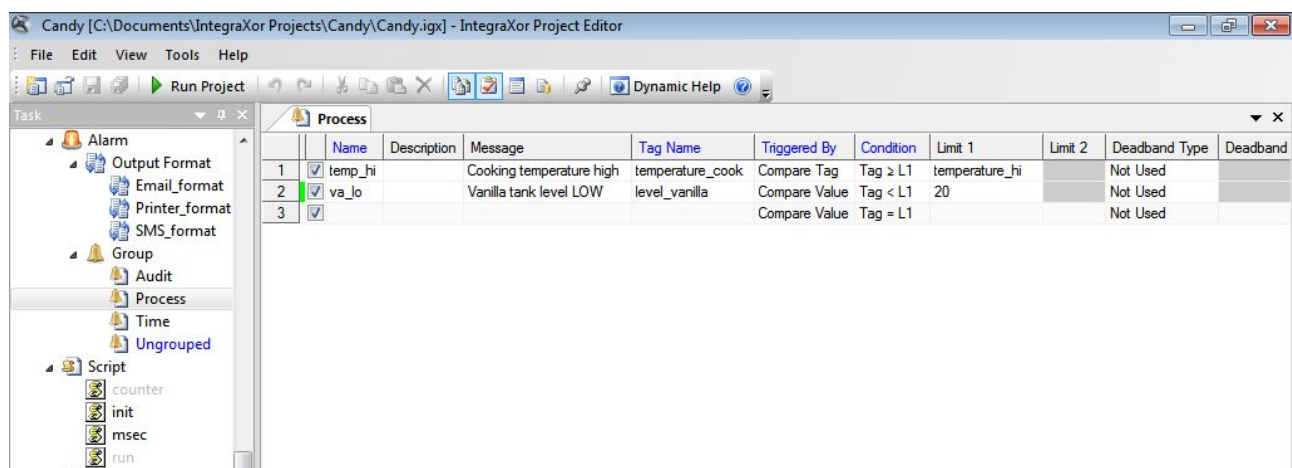
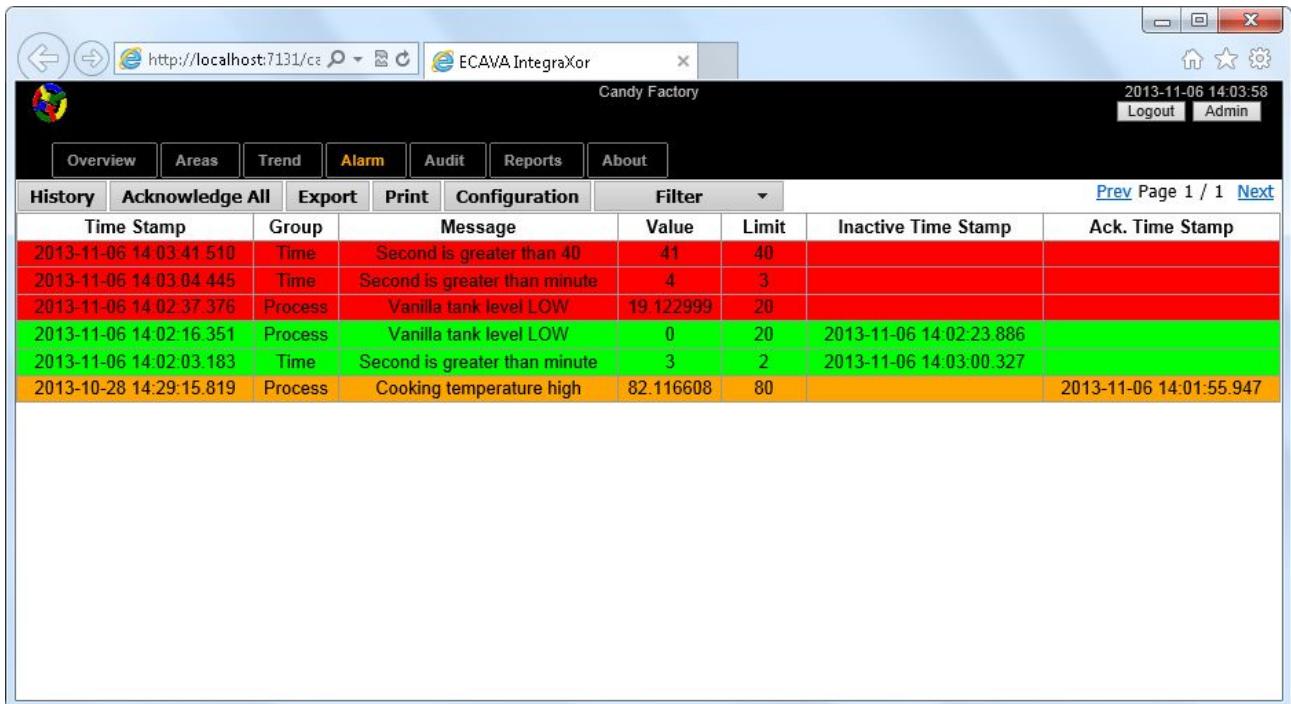


Figure 9.1 : Alarm Configuration

Go ahead and add the alarms for the other tanks as well.

Restart the Alarm task at Ecava IGX Server. Test the alarm by varying the value of level_vanilla. Also, try to acknowledge the alarm and see the result.



Time Stamp	Group	Message	Value	Limit	Inactive Time Stamp	Ack. Time Stamp
2013-11-06 14:03:41.510	Time	Second is greater than 40	41	40		
2013-11-06 14:03:04.445	Time	Second is greater than minute	4	3		
2013-11-06 14:02:37.376	Process	Vanilla tank level LOW	19.122999	20		
2013-11-06 14:02:16.351	Process	Vanilla tank level LOW	0	20	2013-11-06 14:02:23.886	
2013-11-06 14:02:03.183	Time	Second is greater than minute	3	2	2013-11-06 14:03:00.327	
2013-10-28 14:29:15.819	Process	Cooking temperature high	82.116608	80		2013-11-06 14:01:55.947

Figure 9.2 : Alarm Viewer

Quiz 7

1. Modify your previous Quiz files so that when Ecava IGX Server runs, it will display an alarm message when the pump trip signal is active and when the tank level is above 8000m3. Print screen your alarm page and save the screenshot as 13Alarm.png in your Quiz folder.

Chapter 10: Trending

Process Trending

A trend chart displays the direction changes of a tag value over time. Not every SCADA project requires trending. We will configure a simple trend chart to monitor some new tags. The template project has a trend page with all the standard features included.

Trend Configuration

We will begin by creating 2 virtual tags to trend. Create the following tags in PE.

Name	Data type	Log
package_output	int16	mdb
package_defect	int16	mdb

We will need these values to be changing. Again, we use the time in seconds to simulate this. Copy the following script and paste it at the end of your run.js.

```
var myt = getTag( 'app.currentTime.second');
setTag( 'package_output', myt);
setTag( 'package_defect', 60-myT);
```

Next, go to Screen tab and edit plot.htm (Trend > Single Layer menu). Note that a Trending object can be expanded by clicking on the menu node. You may right click to create a group called Package, enter Unit as kg, and then set Min & Max range from 0 to 100 respectively.

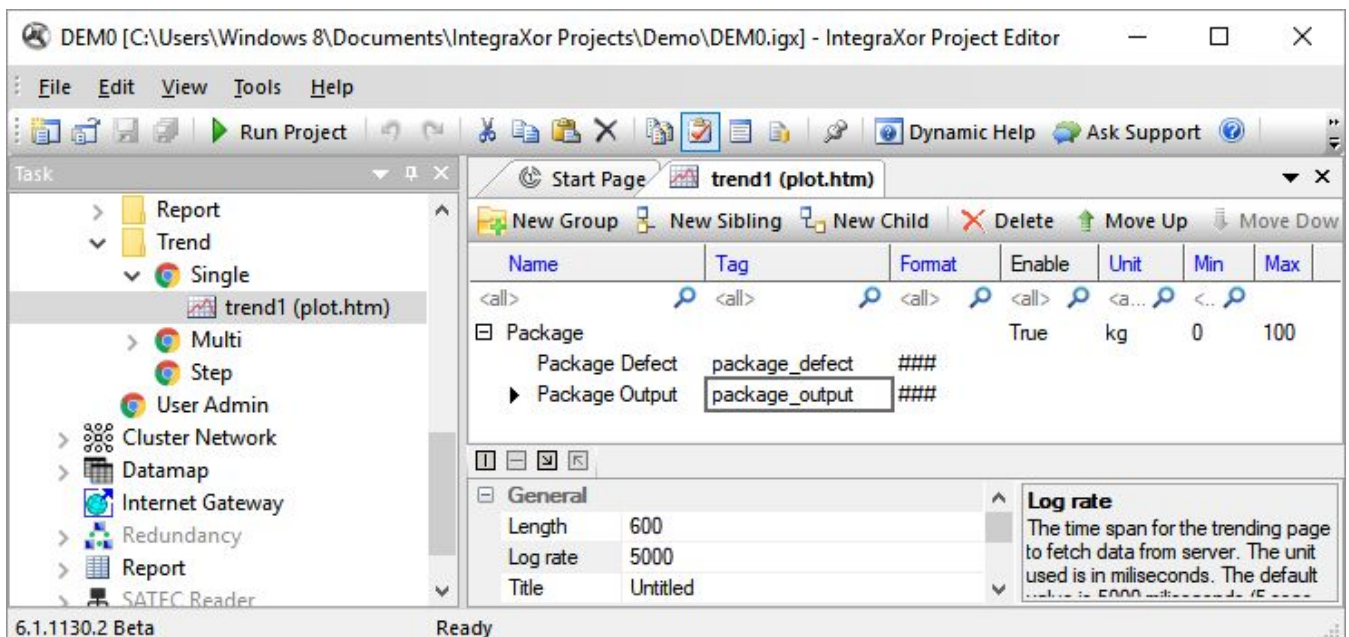


Figure 10.1 : Edit plot.htm

After that, right click to create new childs to associate with 2 tags. Save plot.htm and restart your project. Open a web browser and access the project page. Click on the Trend tab to view your trend chart.

You will find that the trend chart updates itself every 5 seconds. This is because the database mdb has been configured to log data every 5 seconds. You can scroll to view historical trends. Use the zoom function to zoom in and out. You can also click on the start time and end time to manually change the range.

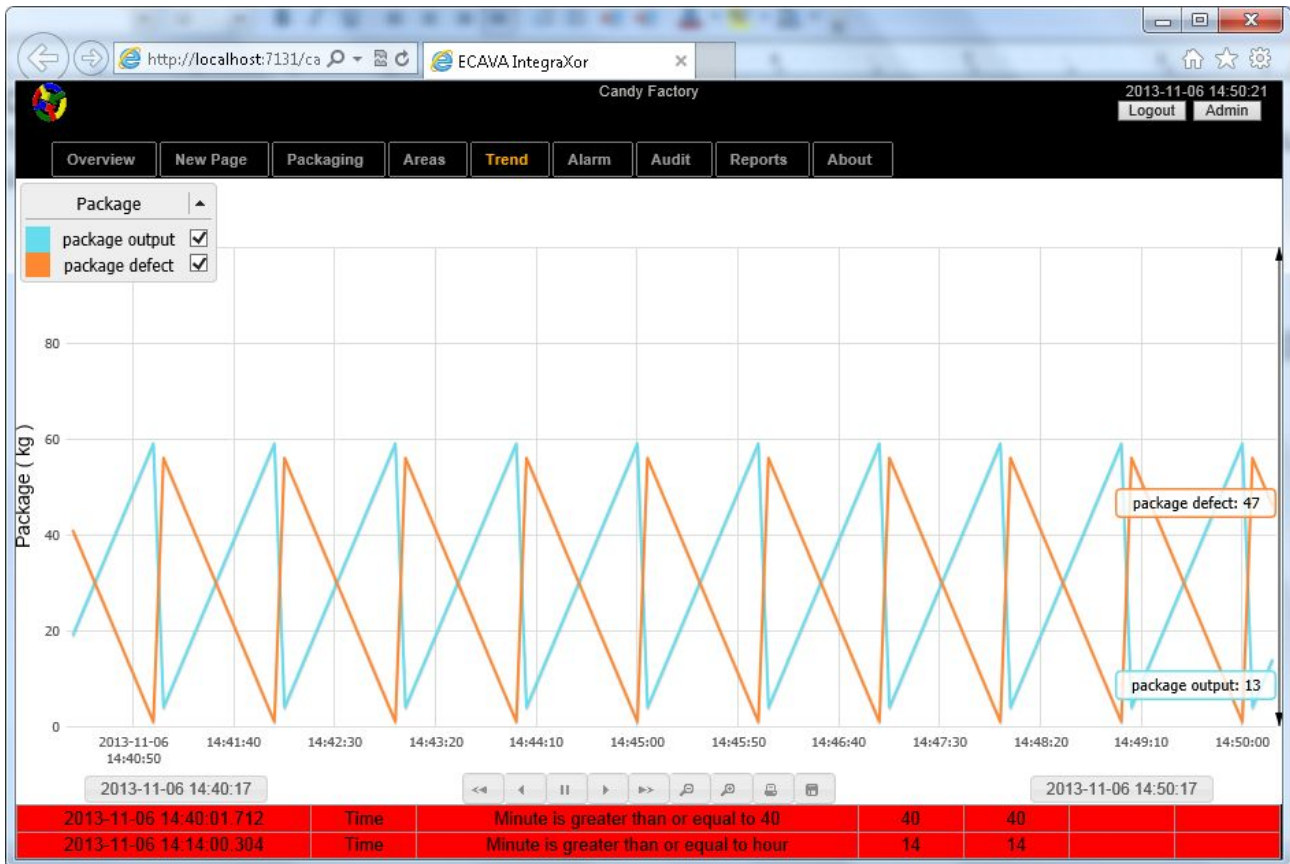


Figure 10.2 : Trending

Quiz 8

1. Modify your previous Quiz files so that when Ecava IGX Server runs, it will show 3 more trending graphs under Trend > Single Layer tab for:

- Level – Tank Level trending graph
- pH – Tank pH trending graph
- Flow rate – Outlet Flow rate trending graph

Save the trend page screenshot as 14Trend.png.

Chapter 11: Database & More

Database Management

Ecava IGX uses Open Database Connectivity (ODBC) to log data into different databases. This ensures compatibility with a wide range of databases from free Open Source databases to the large commercial databases such as Oracle and Microsoft SQL Server.

Microsoft Access

By default, the template project is configured to log user data to an Access database called dblog.mdb. In PE, select the Database tab. There is configuration called mdb which connects to the dblog.mdb in the project folder. It is configured to log every 5 seconds.

In other sections of PE, you might find a “Log” field. For example, in our Alarm configuration, we have selected the alarm data to be logged to mdb.

In our Tag configuration, if we select “Log”, the data will be logged to dblog.mdb every 5 seconds. Go ahead and select mdb in the “Log” field for the level tags.

NOTE: Microsoft Access is chosen for quick demo and education purpose only. You shall setup professional database like PostgreSQL for production purpose.

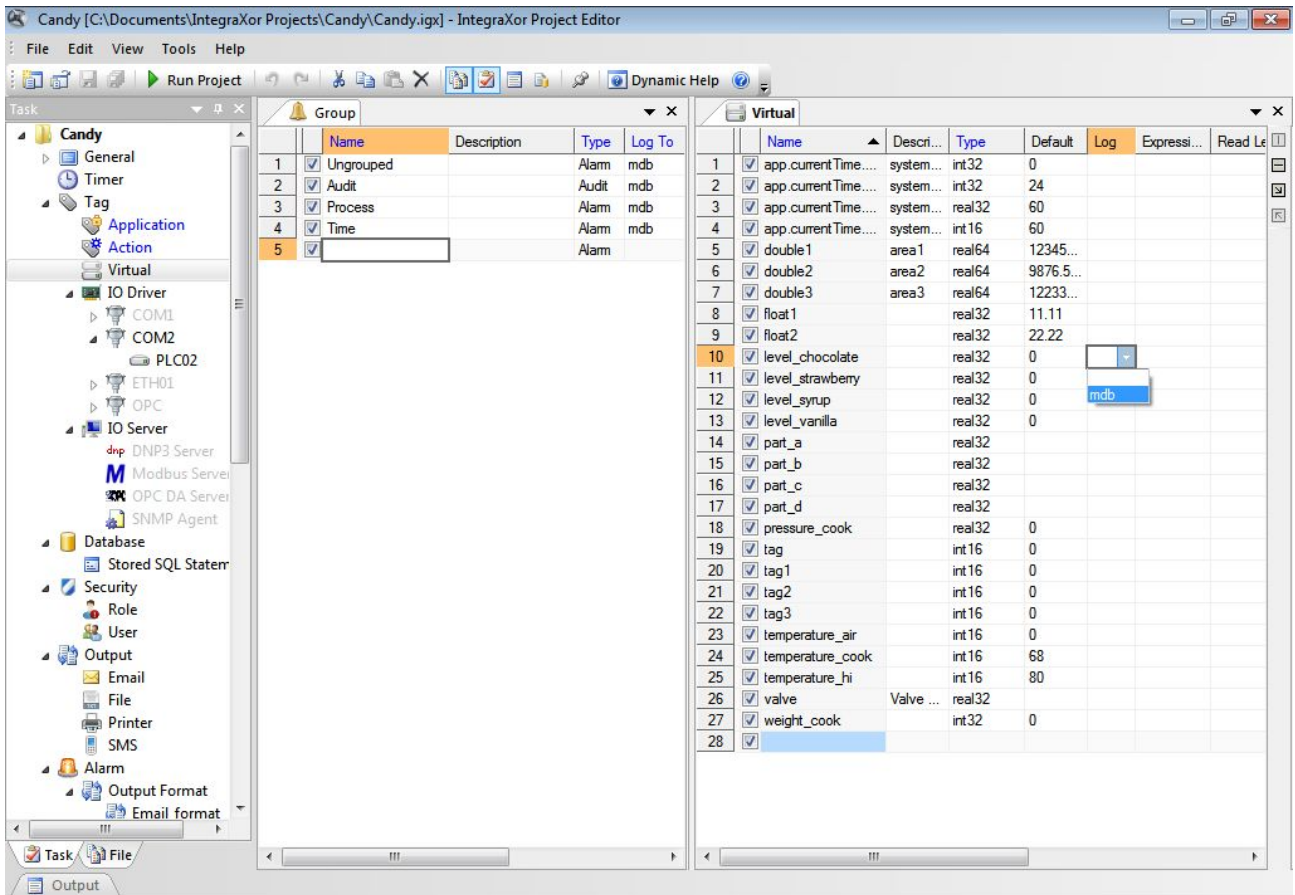


Figure 11.1 : Log data to database

Run the project and vary the level data once in awhile. If you have Microsoft Access, you can open the dblog.mdb and view the contents of 'log_xx' table (where 'xx' is the variable number written to the database) to verify that your data have been logged successfully. If you have OpenOffice, you can also connect to this database and view the contents.

Microsoft SQL Server

For those who are familiar with Microsoft SQL Server, you can try to log data to this database. First, create a new database for your Ecava IGX project in your SQL Server.

In PE, an MS SQL Server Express connection named '_mssql' has been configured as an example. Alternatively, you can create your own ODBC and enter the connection string details in PE.

Other Databases

Similar to Microsoft SQL Server, other databases can also be configured for logging data. We will continue to add SQL scripts for various databases. Check with us if you need assistance with any database.

End of Tutorial

This is the end of our tutorial. We will leave the user to explore the Security feature on his or her own. Tip: Refer to our User Guide in PE for details.

We are also working on further improvement to the product as well as adding more features and modules. Check with us from time to time to find out about these improvements. We also welcome suggestions on how to improve the product further.

Quiz 9

1. Make your final touch. Remove all unwanted files, device, tags and alarm in your previous Quiz folder. Also try to improve your graphic and SCADA function.

Chapter 12: Conclusion

"INFORMATION TECHNOLOGY AND BUSINESS ARE BECOMING INEXTRICABLY INTERWOVEN. I DON'T THINK ANYBODY CAN TALK MEANINGFULLY ABOUT ONE WITHOUT THE TALKING ABOUT THE OTHER." - BILL GATES

Future of Industrial Automation

Companies must keep innovating to compete in the globalized world. Industrial automation can no longer continue to play the role of guardians of machinery, production and safety without innovation. Automation systems must easily adapt to changes just like how the PLC is designed to be programmable for high adaptability.

A website on the Internet changes very quickly to meet the current business needs and requirements. Similarly, a HMI/SCADA system must also be able to adapt quickly to the same needs. With Ecava IGX, we hope to bring the HMI/SCADA technology closer to this goal.

Contact Us

We welcome any comments or suggestions. Reach us at:
<https://www.integraxor.com/support/>