Microsoft Robotics Studio Simulation Environment

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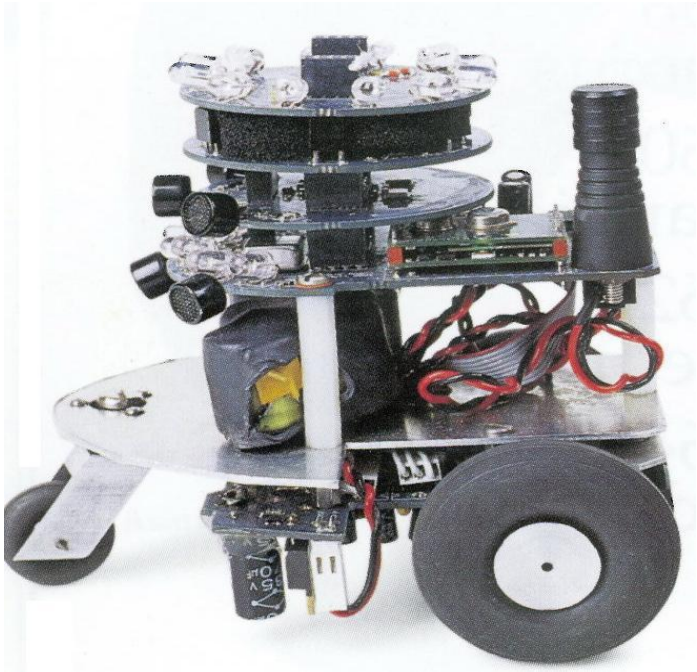
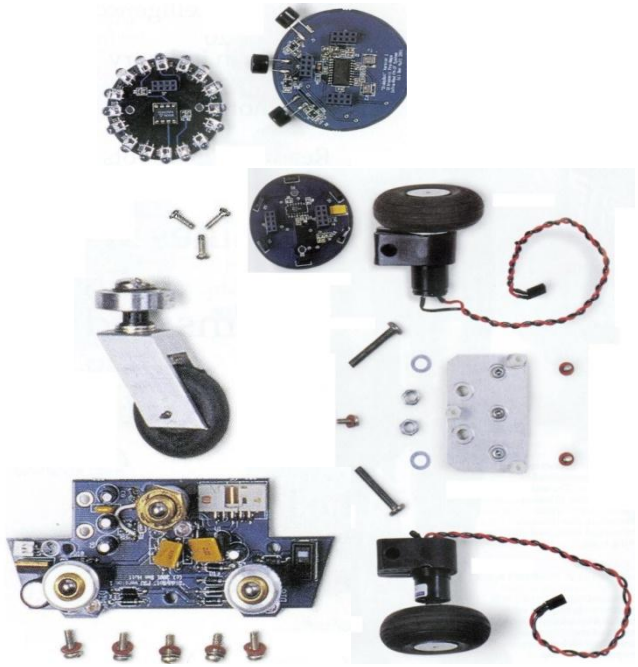
(I) Overview

Challenges Posed by Robotics Development

- **Difficulty of concurrent use**
- **Difficulty of hardware troubleshooting**
- **Robotics hardware can be expensive and hard to find**

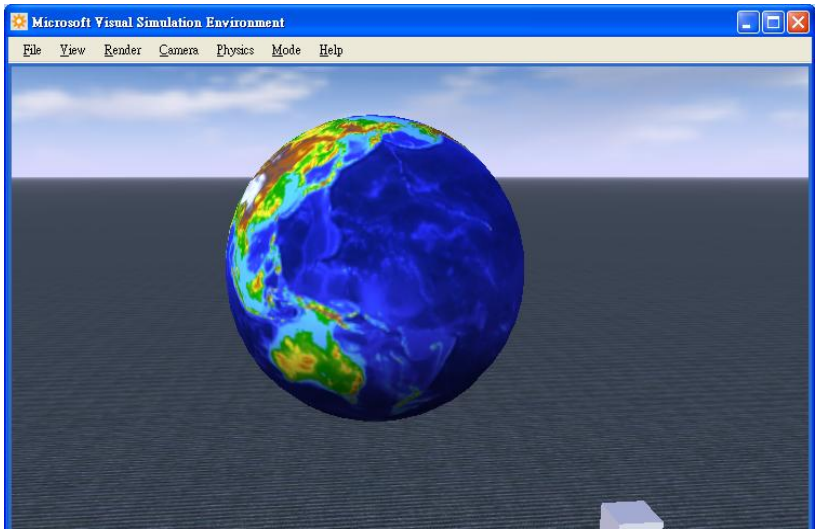


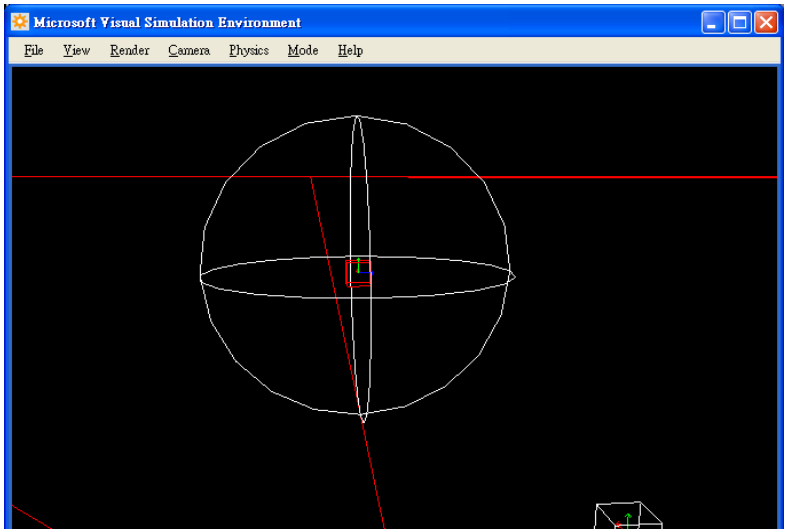


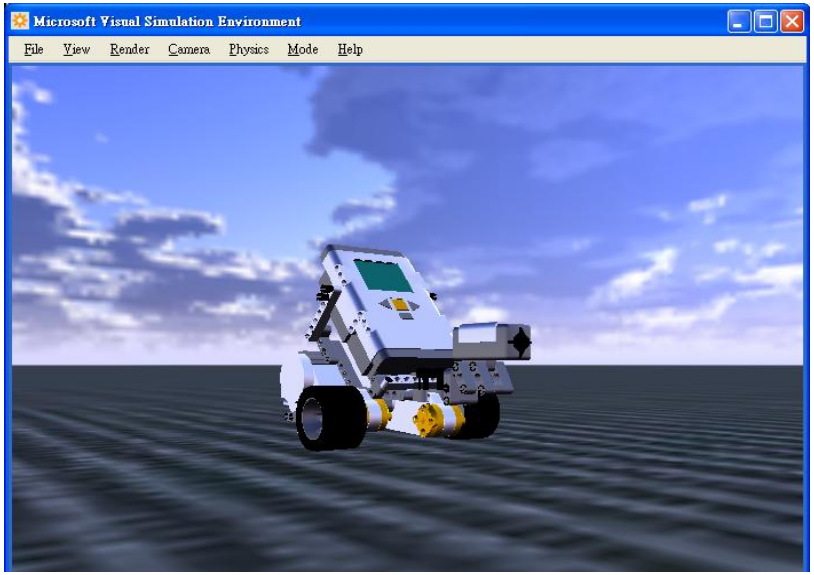
Benefits of Simulation

- **Low barrier to entry**
- **Staged approach**
- **Prototyping**
- **Education**
- **Learning system**

Snapshots


Microsoft Visual Simulation Environment
File View Render Camera Physics Mode Help


Microsoft Visual Simulation Environment
File View Render Camera Physics Mode Help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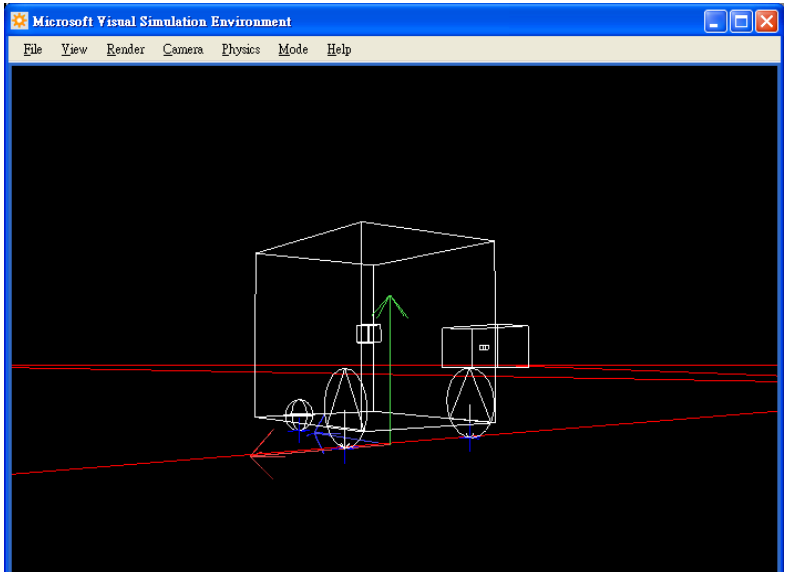
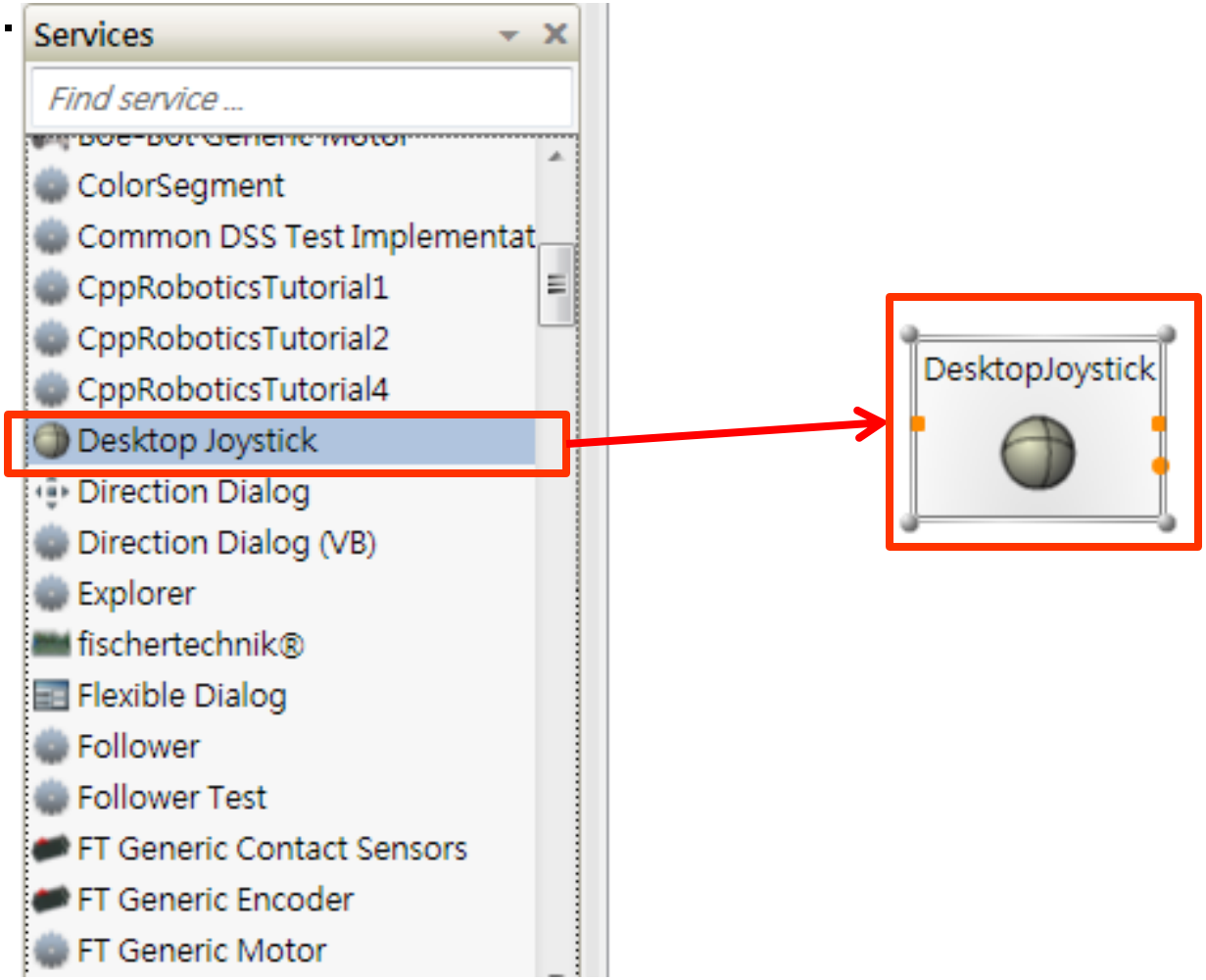

Microsoft Visual Simulation Environment
File View Render Camera Physics Mode Help

Demo

(II) Joystick a Robot in Simulation

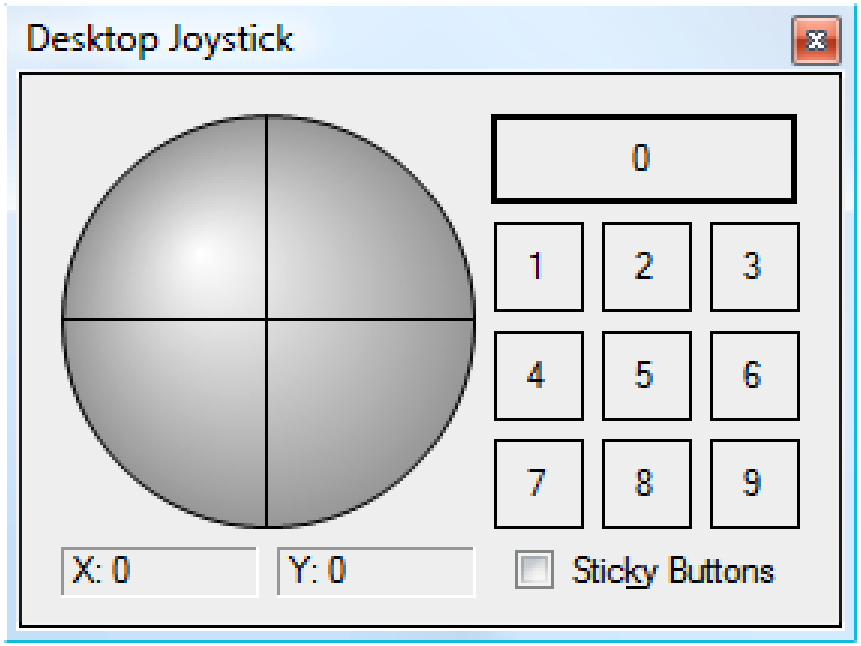
Step 1 Start the Program

- Drag the **Desktop Joystick** service onto your workspace.



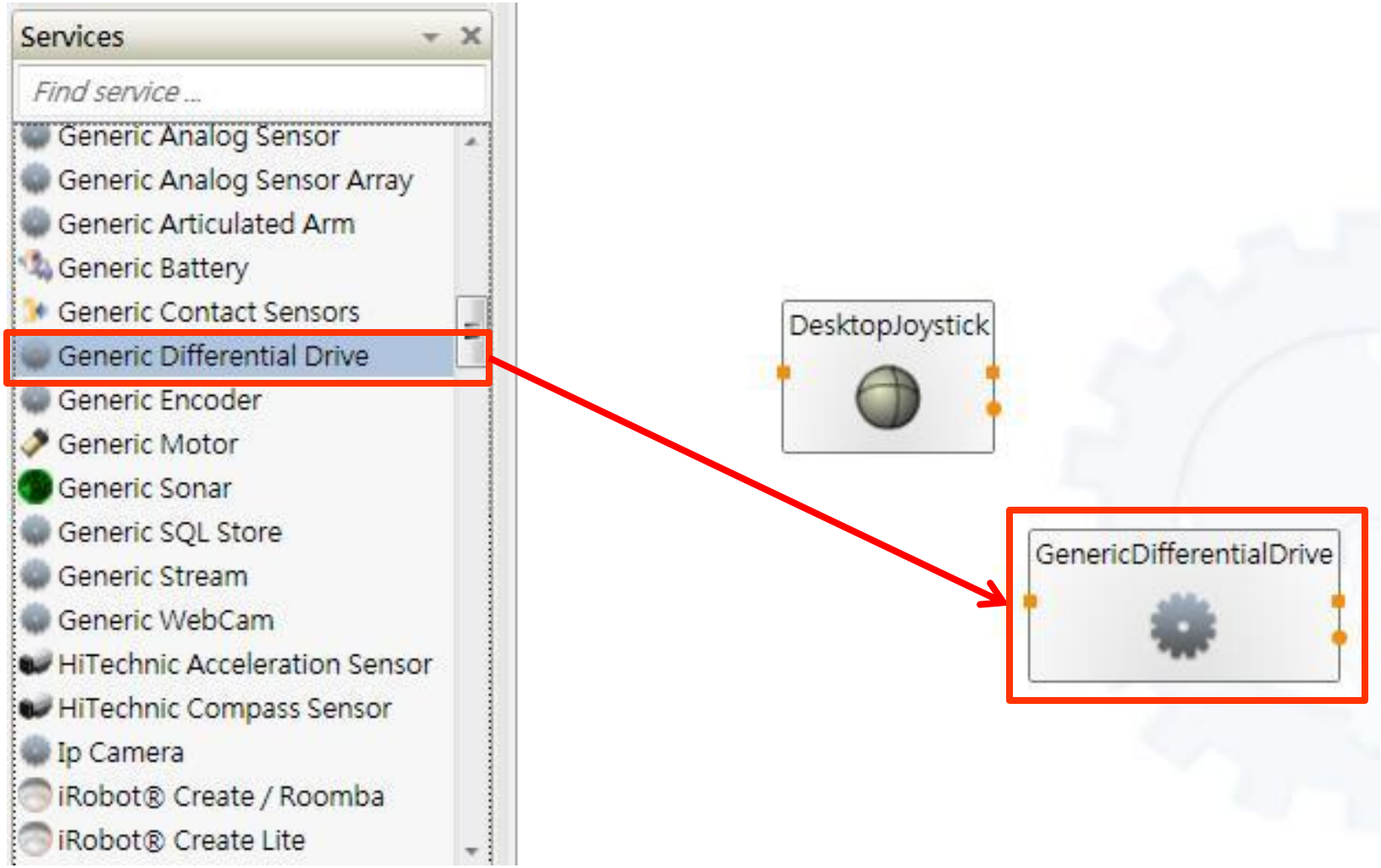
Step 2 Test

- Try it out !



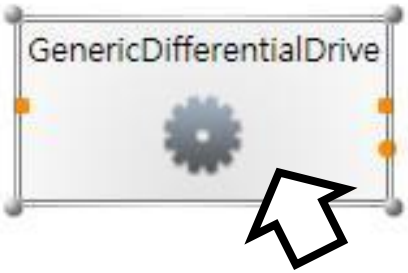
Step 3 Add a Service

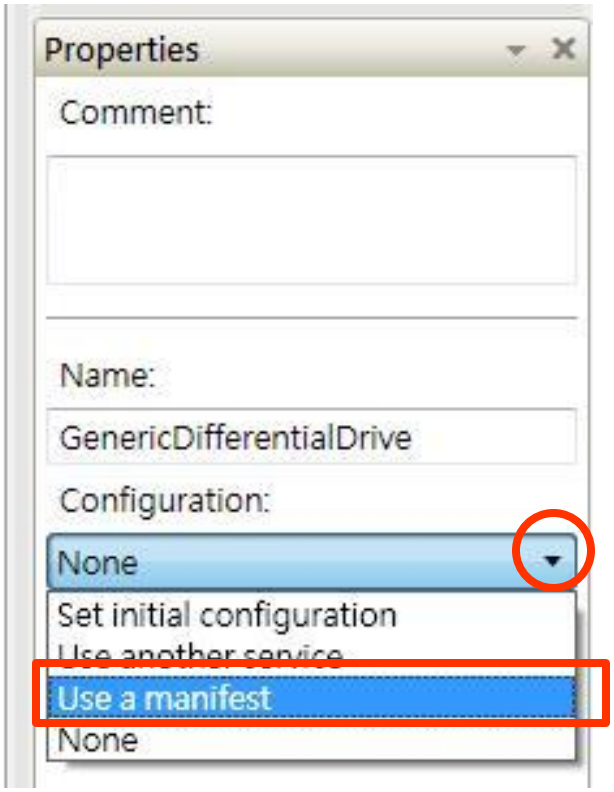
- Add a **Generic Differential Drive** service.



Step 4 Set Up the Property

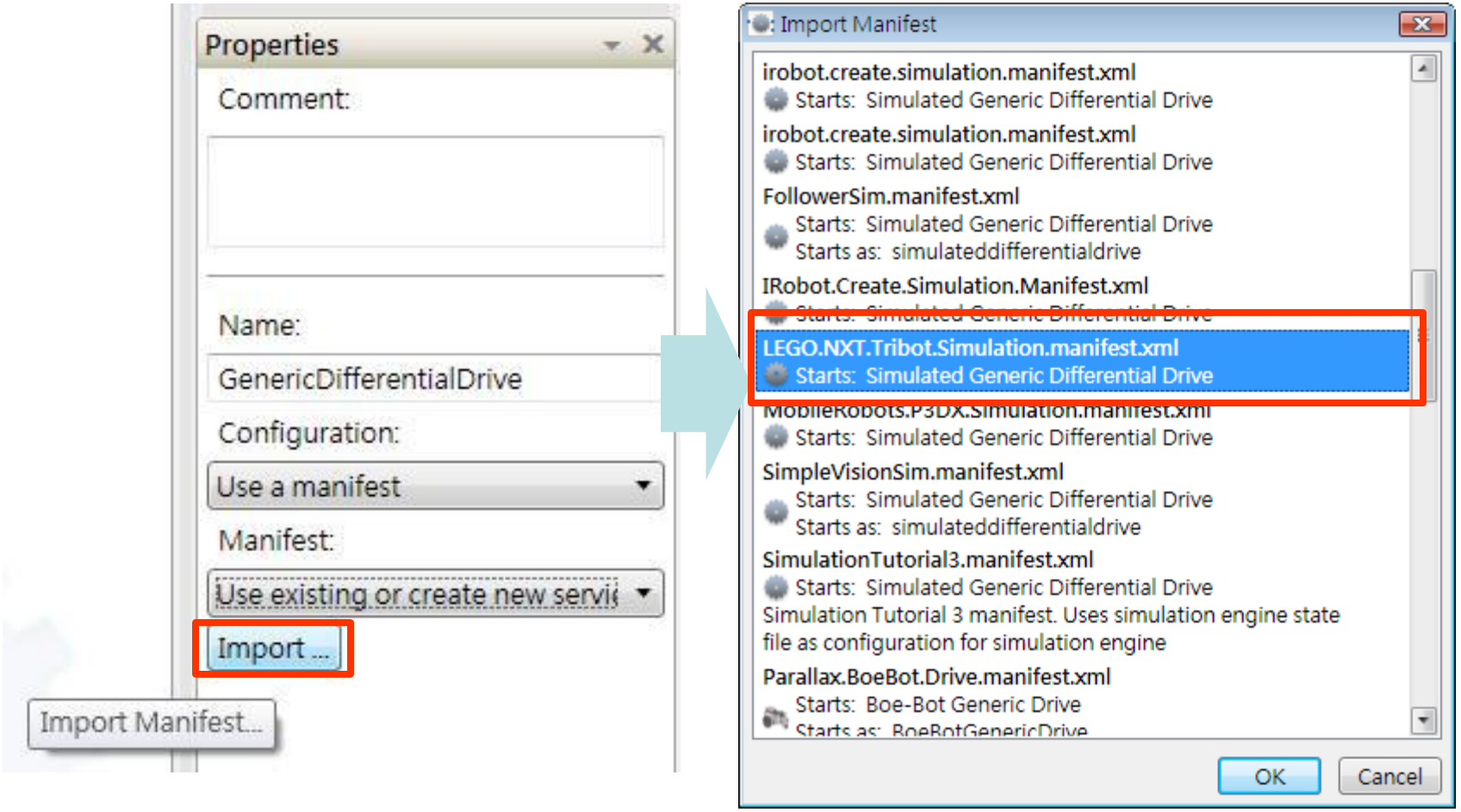
- First click on the **GenericDifferentialDrive** box; Then, in the **Properties** on the right, for **Configuration**, select the **Use a Manifest** entry.





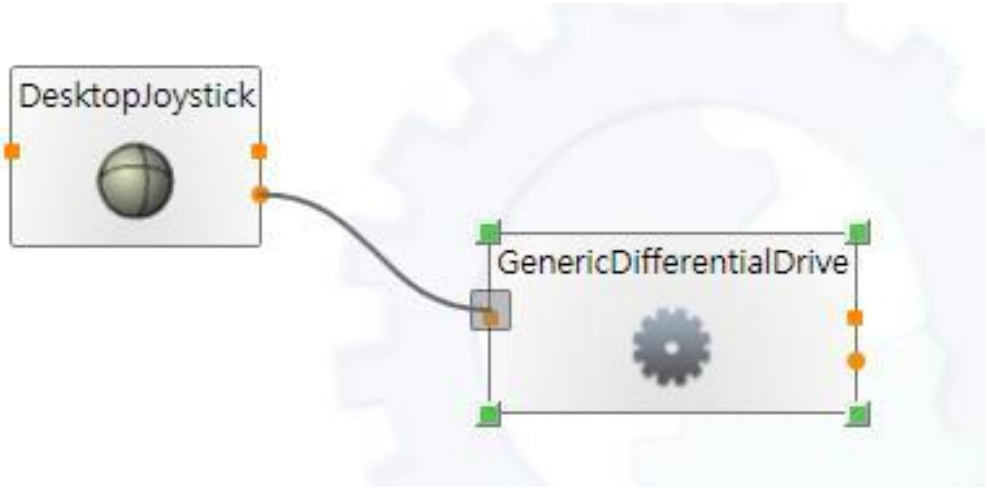
Step 5 Using a Manifest File

- Select the entry for **LEGO.NXT.Tribot.Simulation.Manifest.xml**.



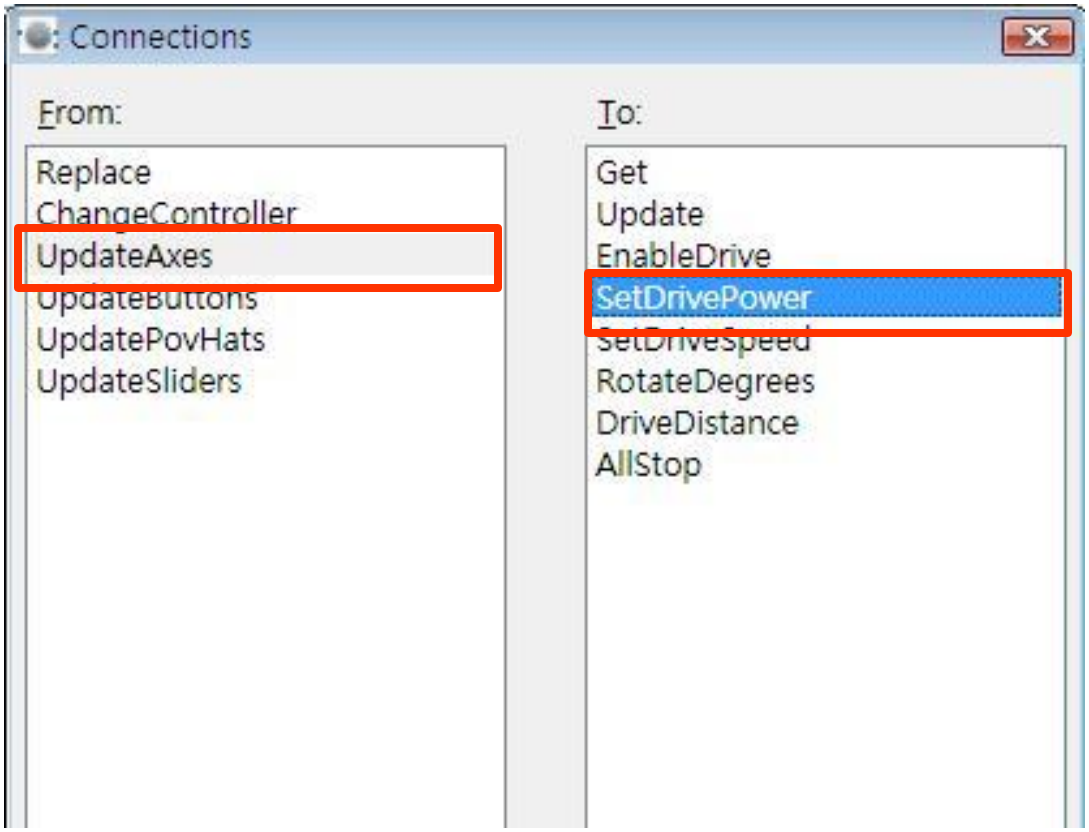
Step 6 Connect

- Connect the notification port (the small red circle on the right) of the **DesktopJoystick** to the input port (the small red square on the left) of the **GenericDifferentialDrive**.



Step 7 Set Up the Connection Type

- In the **Connections** dialog box, select **UpdateAxes** from the left column and **SetDrivePower** in the right column, then click **OK**.



Step 8 (1/3) Transformation Rule

- The **DesktopJoystick** service is sending notifications when the joystick axes change (in this case the X and Y values change), as you may have noticed when trying out the diagram earlier, These values vary between -1000 and 1000.
- The **GenericDifferentialDrive** service is expecting **LeftWheelPower** and **RightWheelPower** values between -1 and 1, where these values are indicative of the amount of power to be fed to the Left and Right wheels respectively.
- You now need to create a data transformation that will convert the X and Y values from the **DesktopJoystick** into **Left-** and **RightWheelPower**.

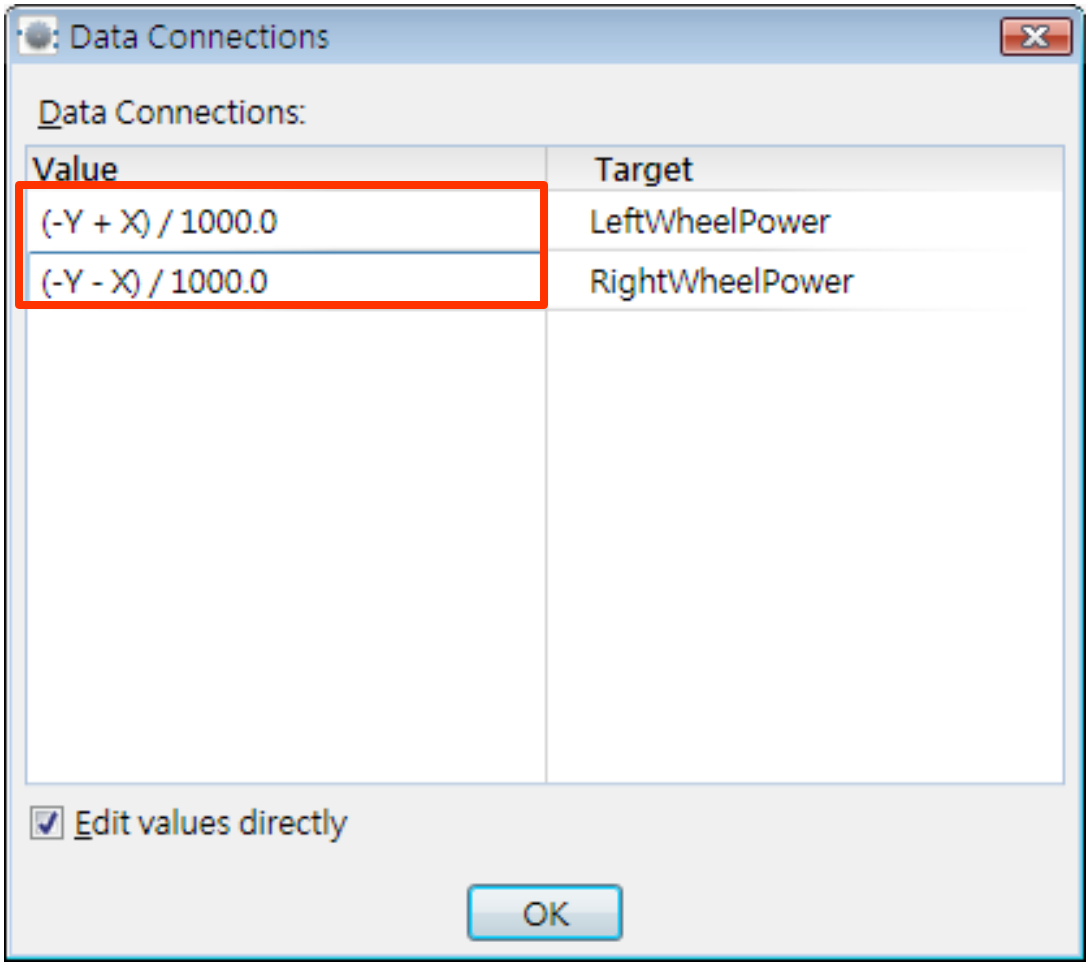
Step 8 (2/3)

- Select the **Edit values directly** check box in the **DataConnections** form. Then enter the following expressions into the value boxes for the **LeftWheelPower** and **RightWheelPower** targets.

(-Y + X) / 1000.0
(-Y – X) / 1000.0

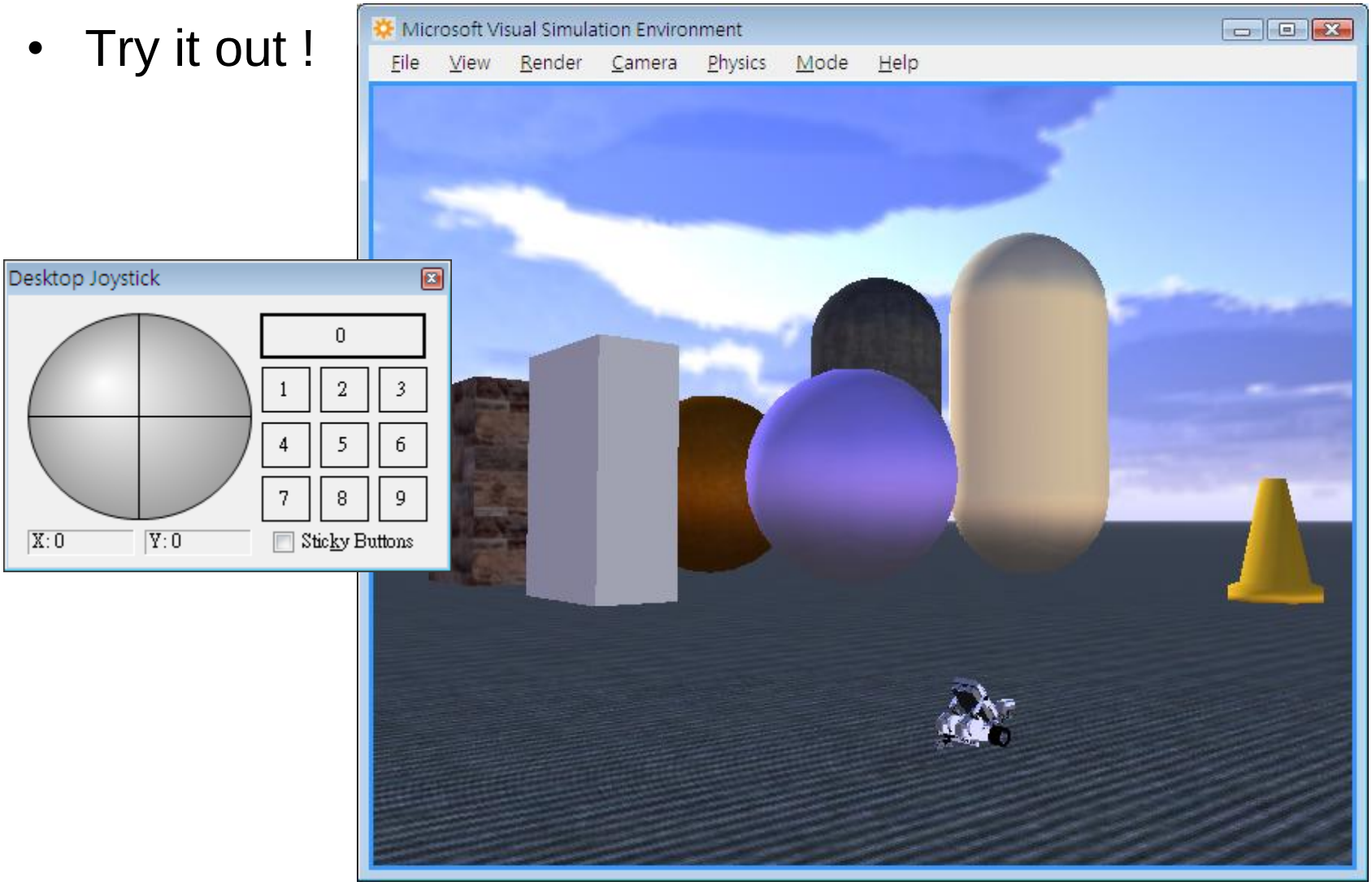
Step 8 (3/3)

- Like this !



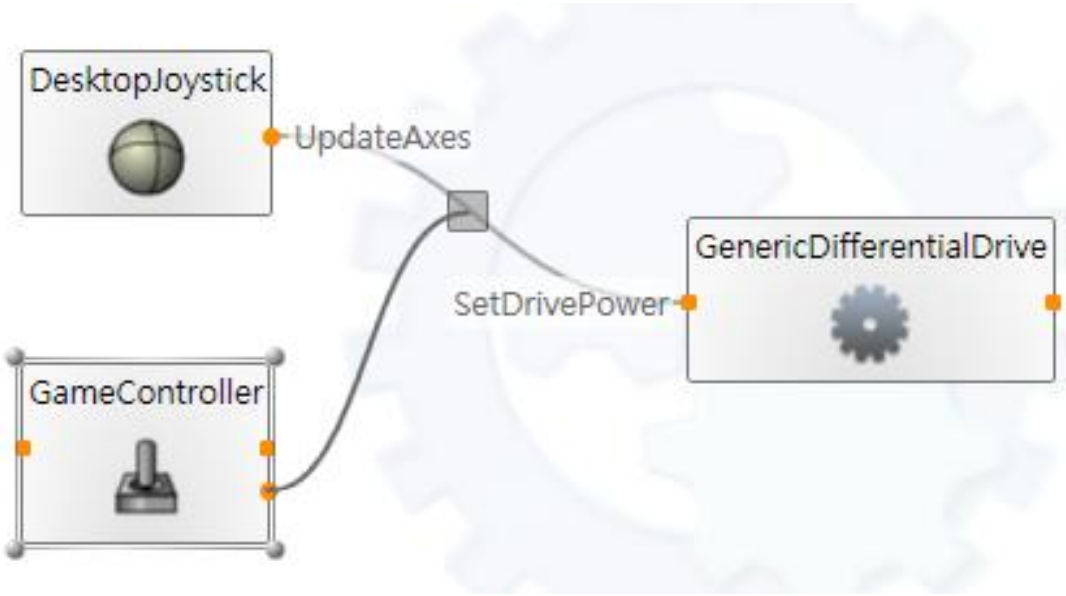
Step 9 Test

- Try it out !



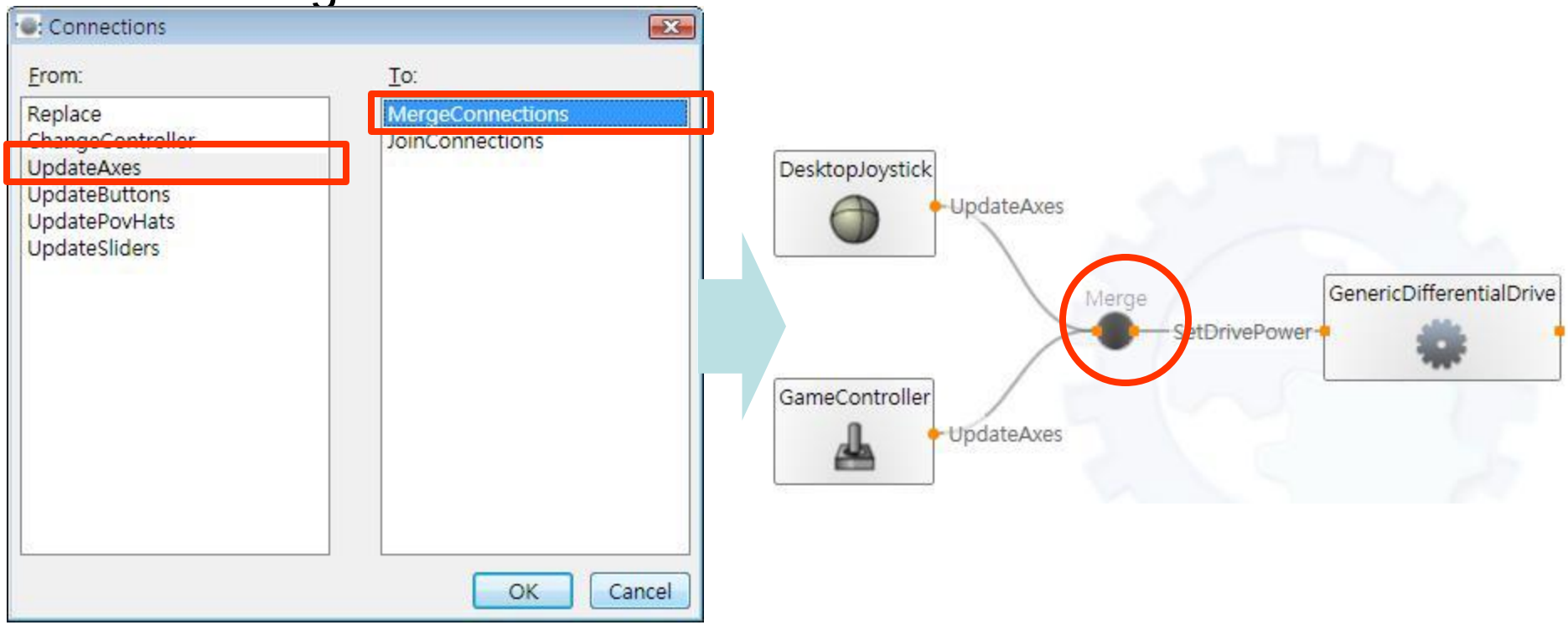
Step 10 Using a Joystick (1/2)

- Drag a **GameController** service from the **Services** toolbox. Then drag from the notification pin of the **GameController** service to the middle of the wire connecting the **DesktopJoystick** and **GenericDifferentialDrive** services.



Step 10 (2/2)

- Release it and on the left side, as before, choose **UpdateAxes**, on the right side choose **MergeConnection**.
- Run again !

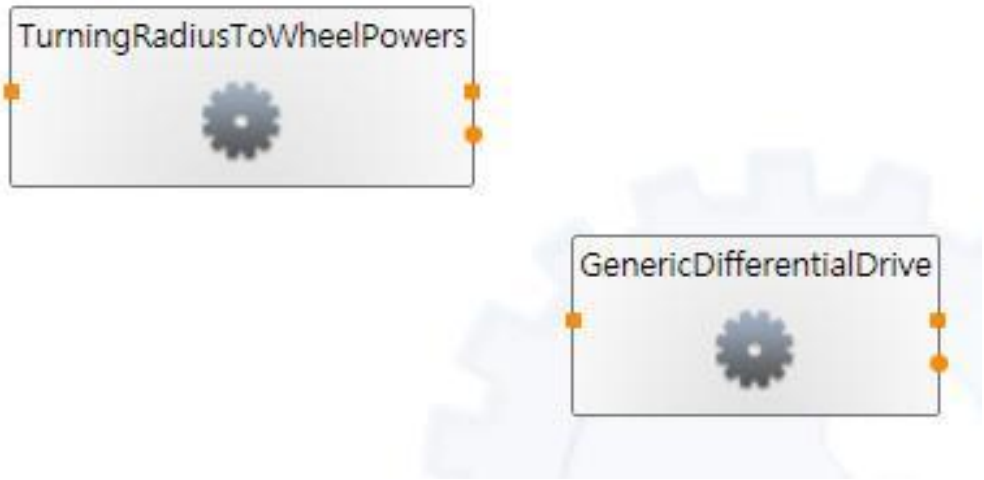


Result

(III) Drive in Circles

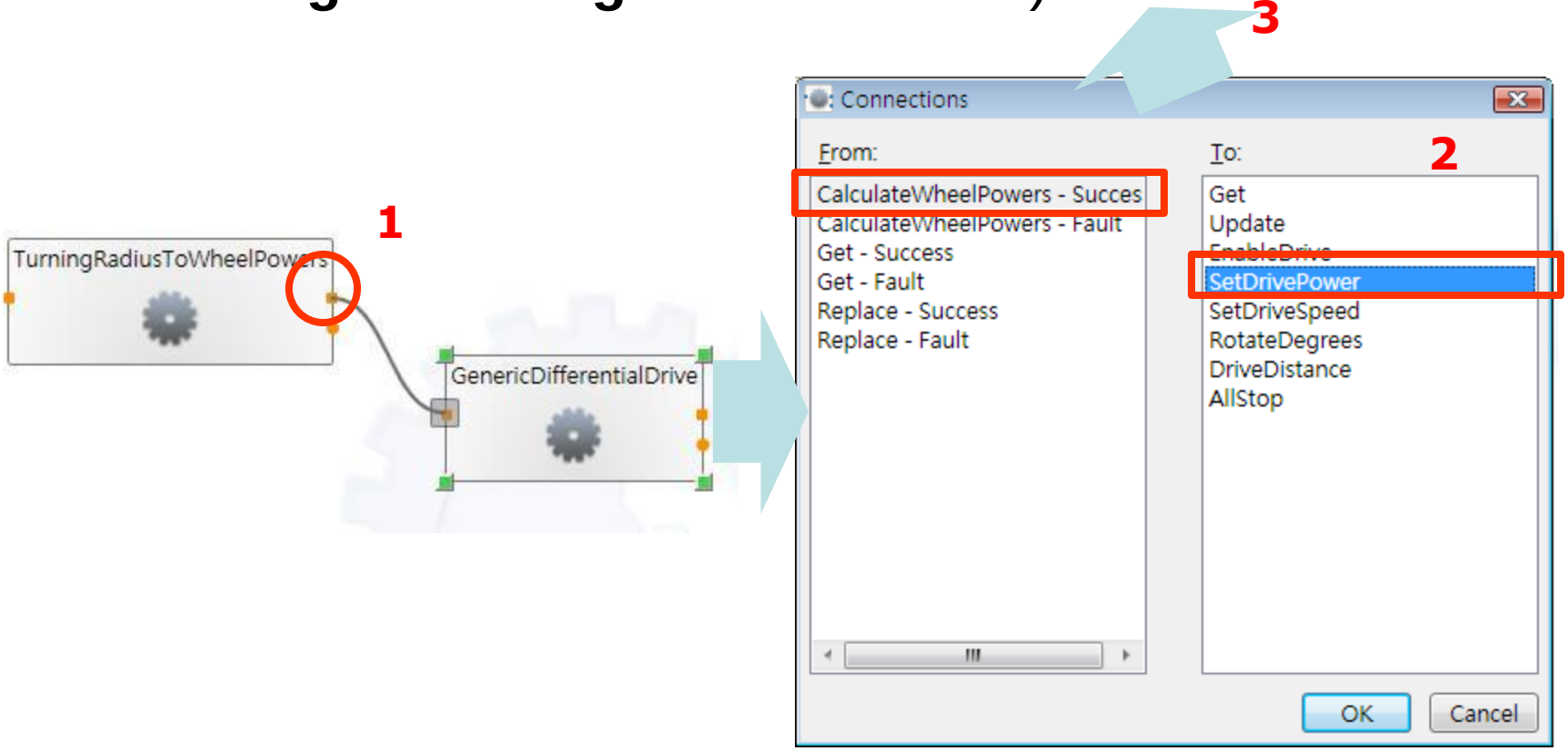
Step 1 Start the Program

- Start by adding a **TurningRadiusToWheelPowers** service and a **GenericDifferentialDrive** service.



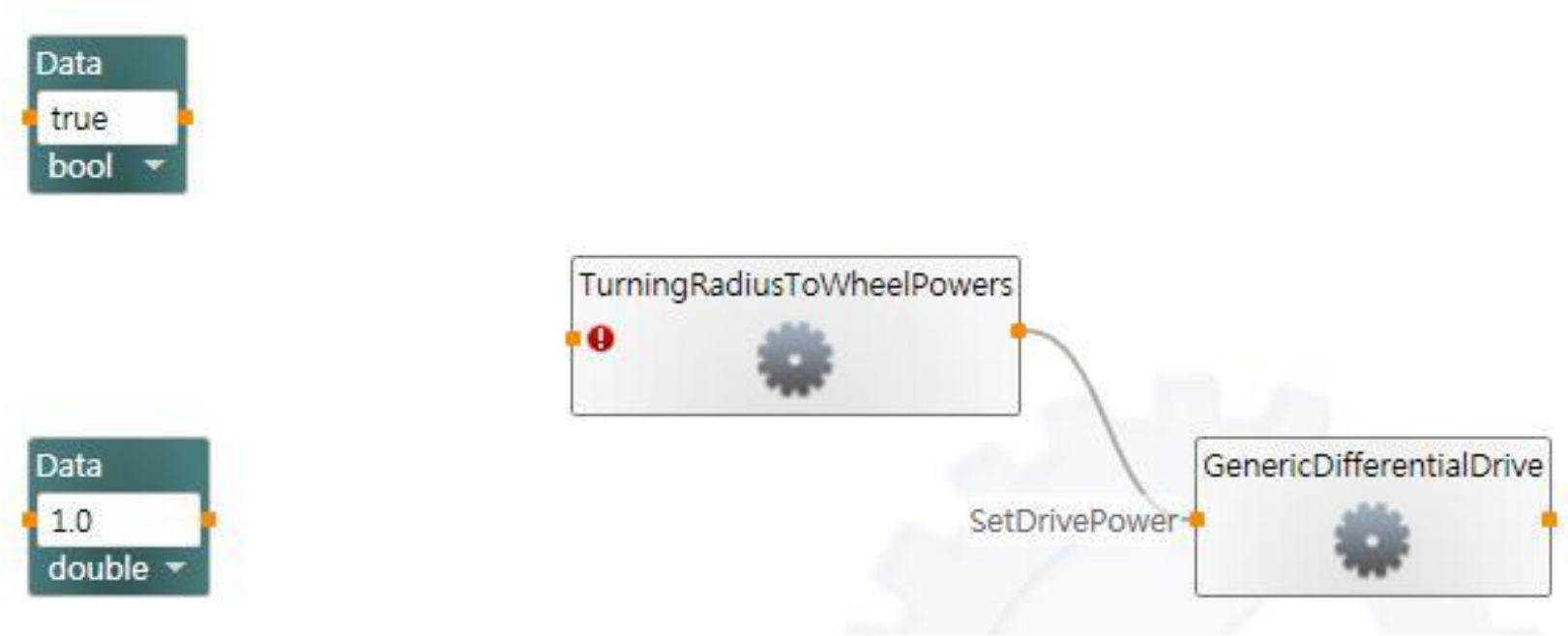
Step 2

- Connect the output port of the former to the input port of the latter (associating **Left** with **LeftWheelPower** and **Right** with **RightWheelPower**).



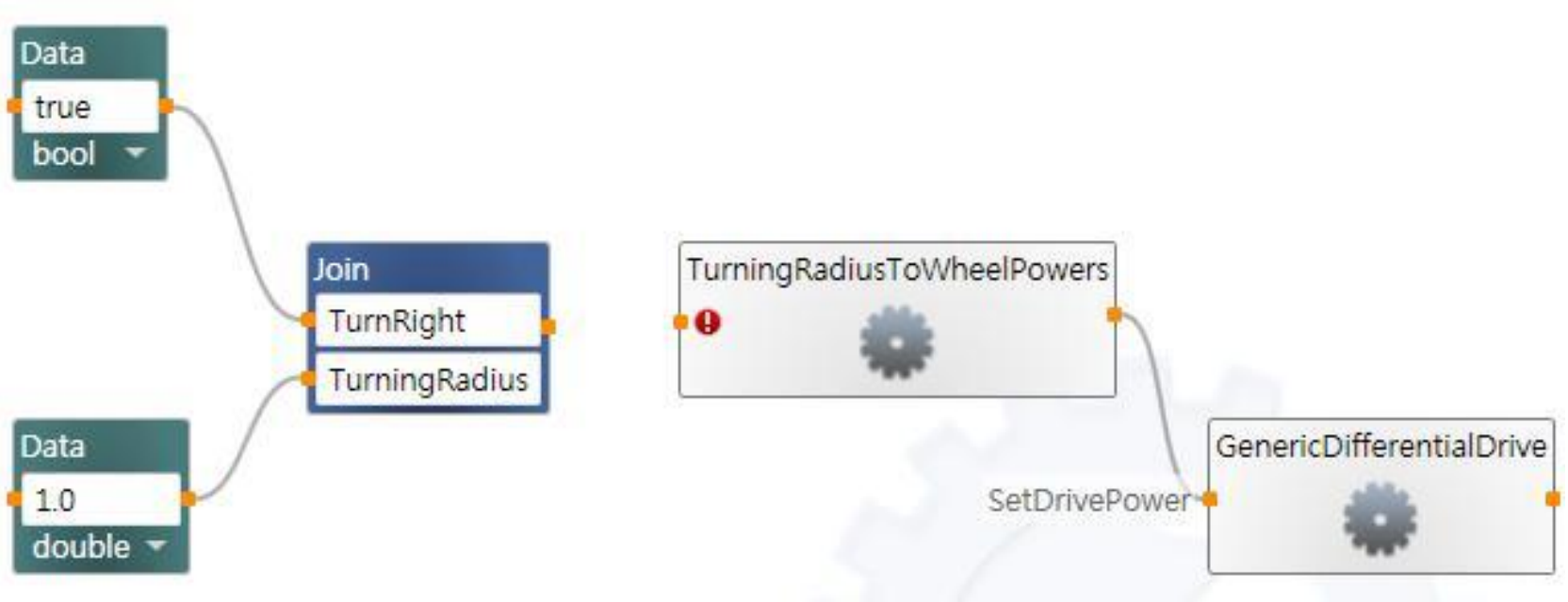
Step 3

- Drag over two **Data** and set one block to be of type **boolean** with value **true**, and the other to be of type **double** with value **1.0**.



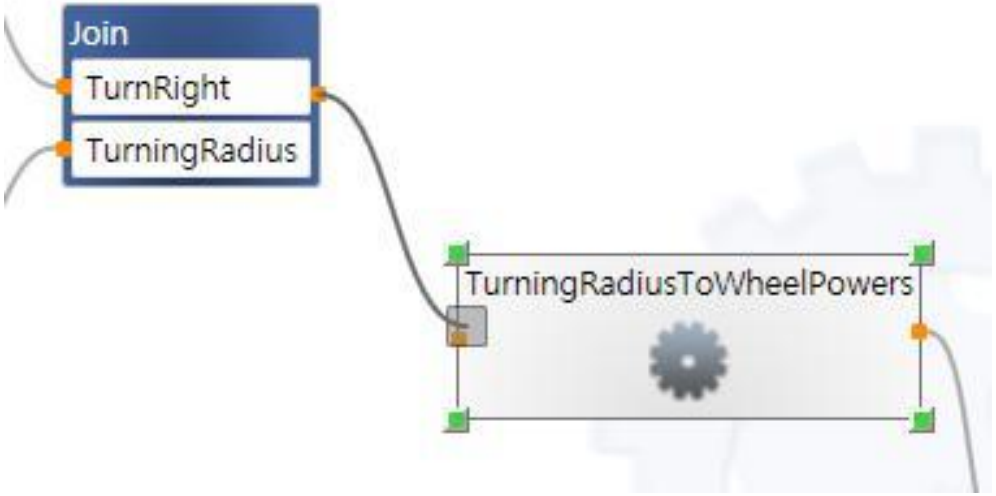
Step 4

- To aggregate the two pieces of data, we must add a **Join** block.
- Connect the **boolean** data to the **Join**, specifying the name **TurnRight**; also connect the **double** data to the **Join**, calling it **TurningRadius**.



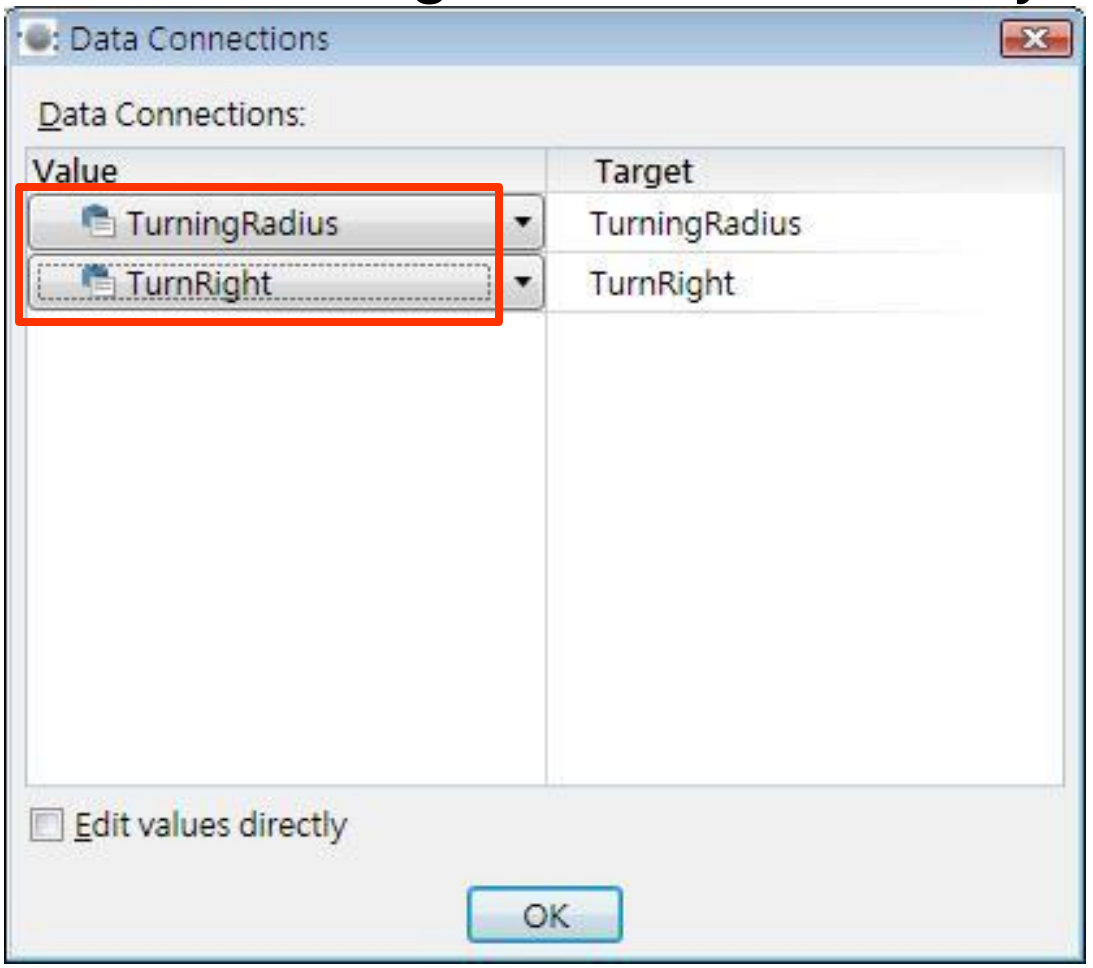
Step 5 (1/2)

- **TurningRadiusToWheelPower** takes in two arguments: the **TurningRadius** (a **double**) and a **boolean**, **TurnRight**, which encodes whether or not to turn to the right (otherwise, turn to the left).
- Connect **Join** and **TurningRadiusToWheelPower**.



Step 5 (2/2)

- Associating **TurningRadius** with **TurningRadius** and **TurnRight** with **TurnRight**. Click **OK**, then try it out !



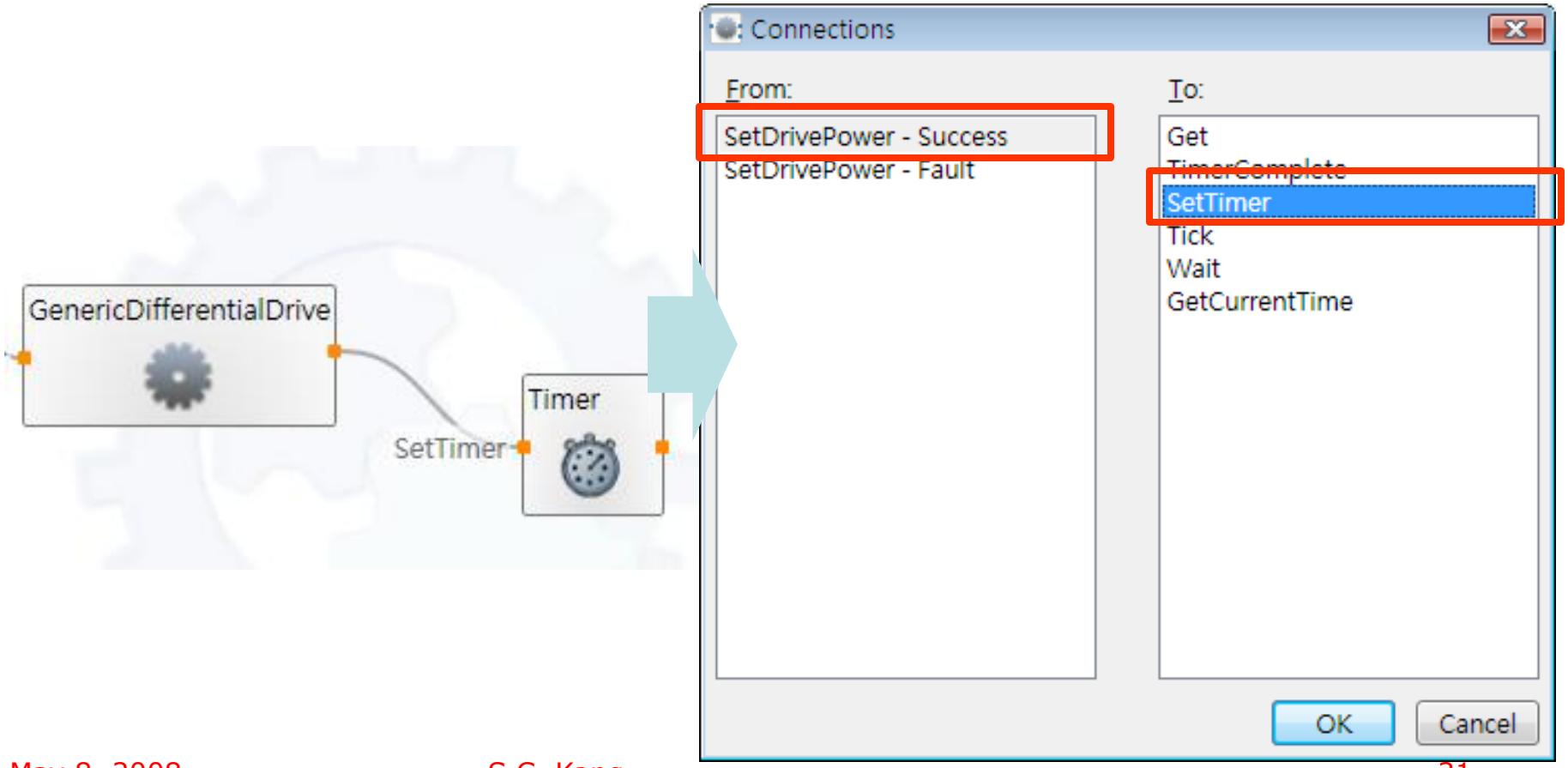
Result

- Your robot can now drive in circles. Vary the hard-coded values and watch its behavior.

(IV) Drive along an Arc

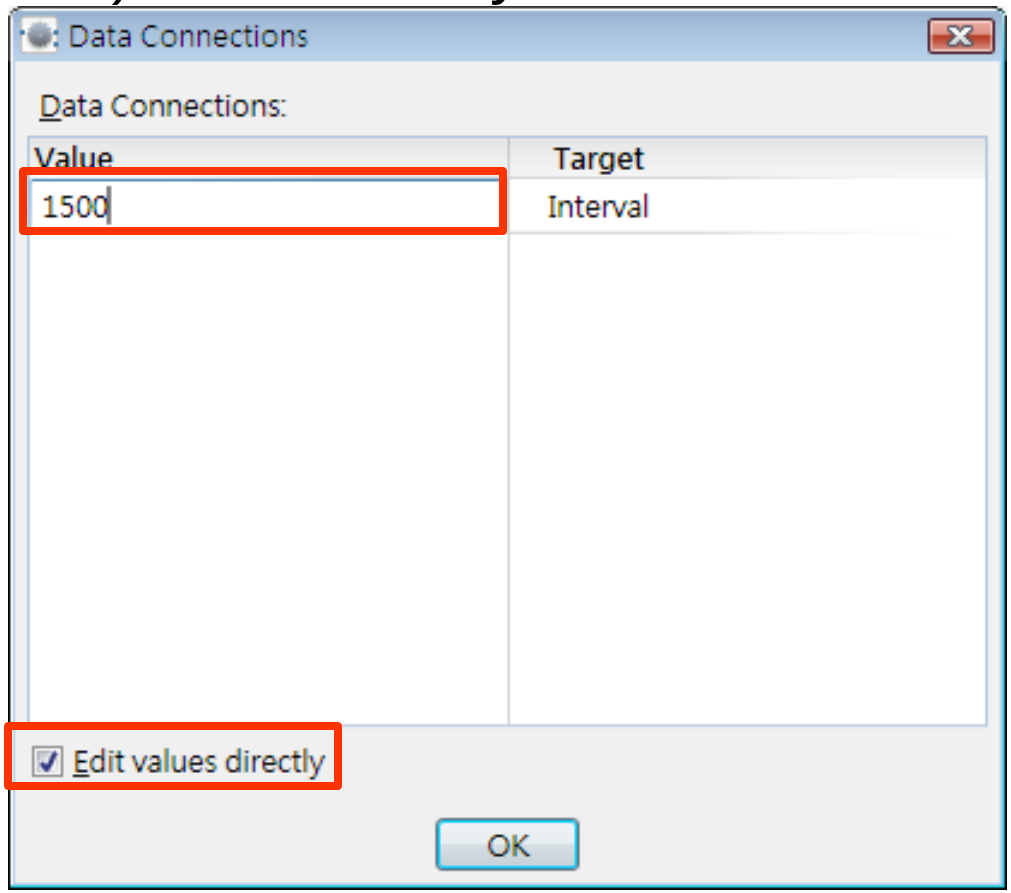
Step 1 Continues the Diagram (III)

- Add **Timer** service to your diagram and connect to **GenericDifferentialDrive** (associating the **SetDrivePowerSuccess** with the **SetTimer**).



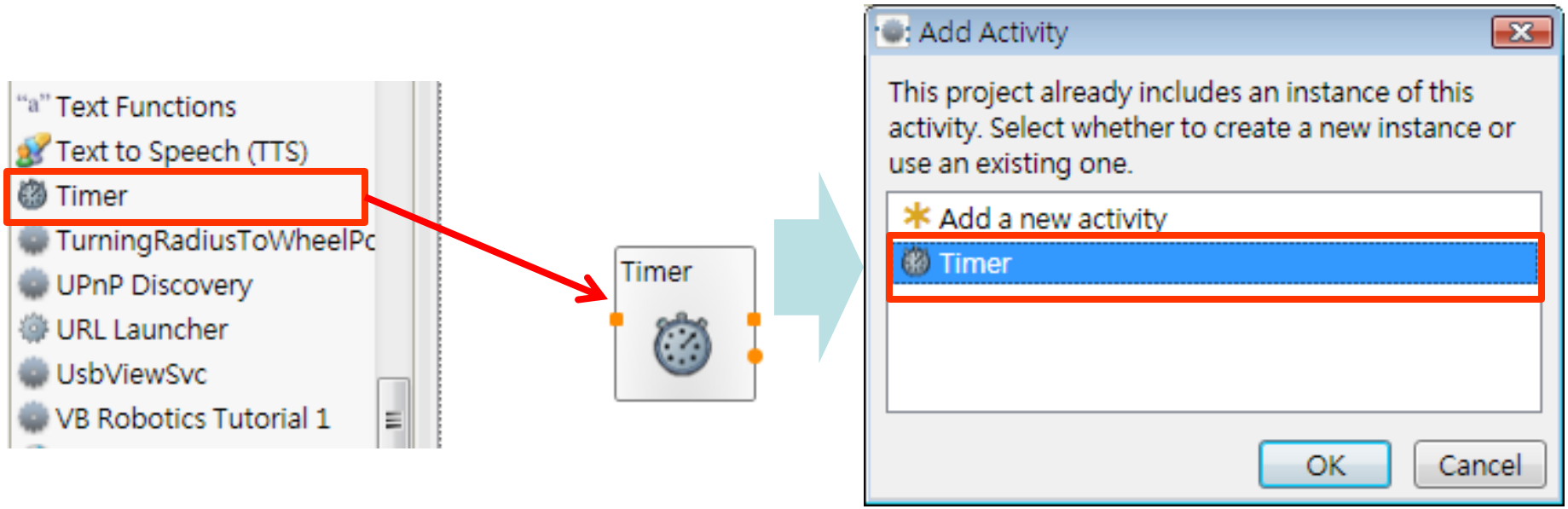
Step 2 Set Up Timer

- In the **Data Connections** window, check **Edit Values Directly** and type in **1500** for the value (the units are milliseconds).This link only indicates execution flow.



Step 3

- Drag in a new **Timer**, and in the **Add Activity** dialog that pops up, select the **Timer** that already exists instead of adding a new one.

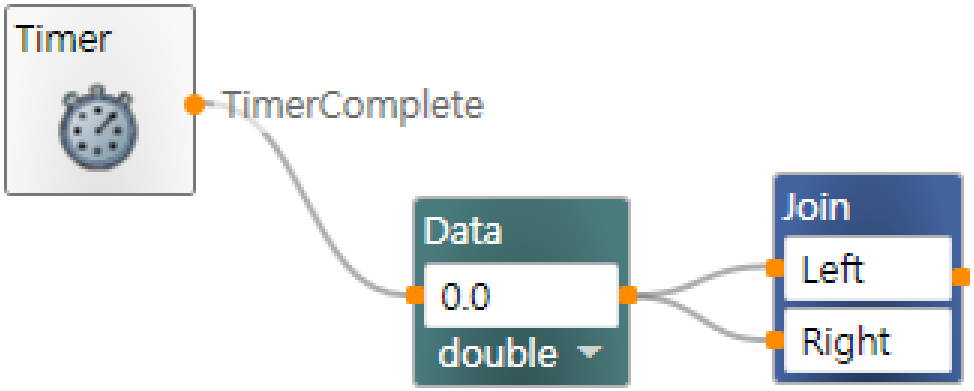


Step 4

- Connect the new **Timer**'s notification port to a new **Data** block with a **double** value of 0.0 (use the **TimerComplete** operation).
- This will set up the execution path so that when the timer completes (that was set on the right), execution will begin.

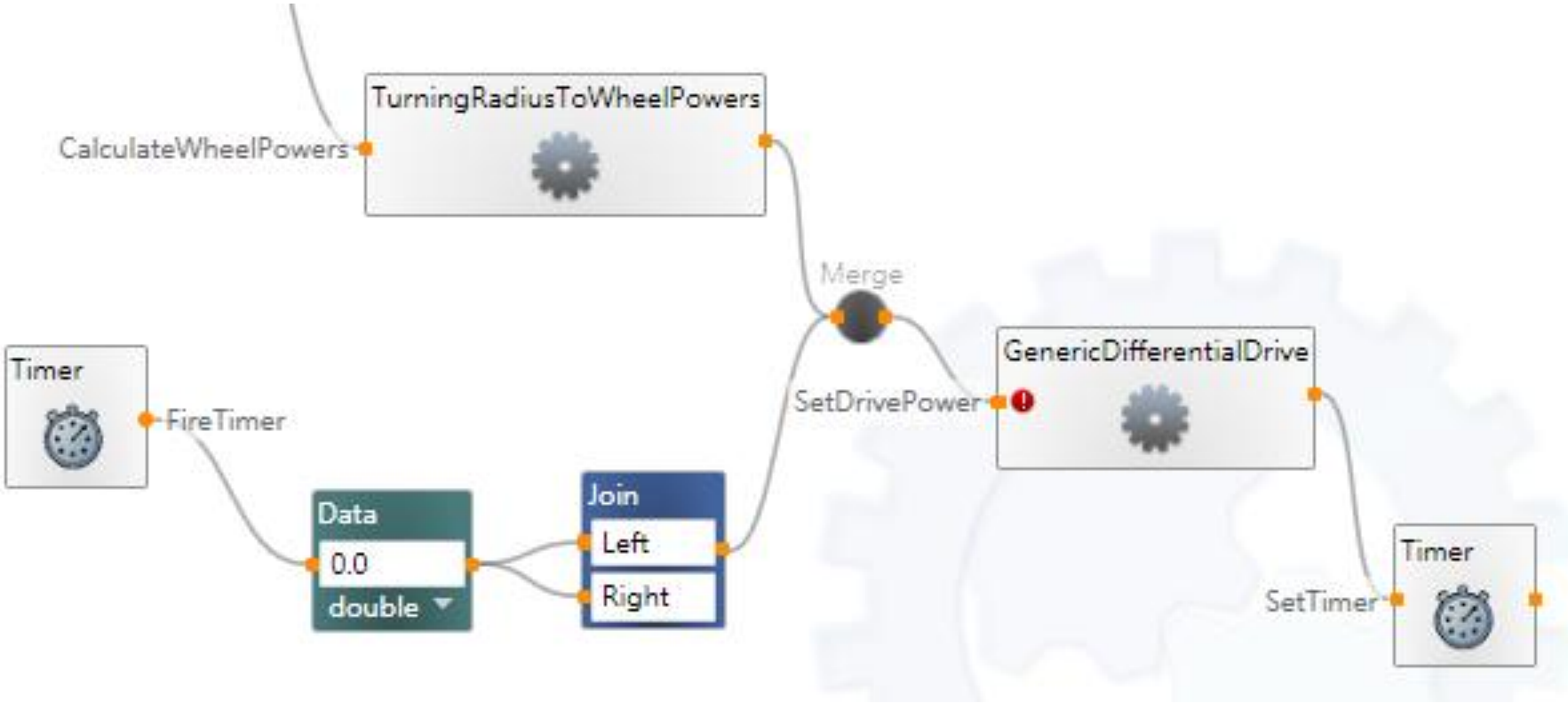
Step 5

- In order to stop, we must set both the left and right wheels to no power. Add a **Join** with names **Left** and **Right** and attach the output of the data value to both of them. They are the same as the names output by **TurningRadiusToWheelPowers**.



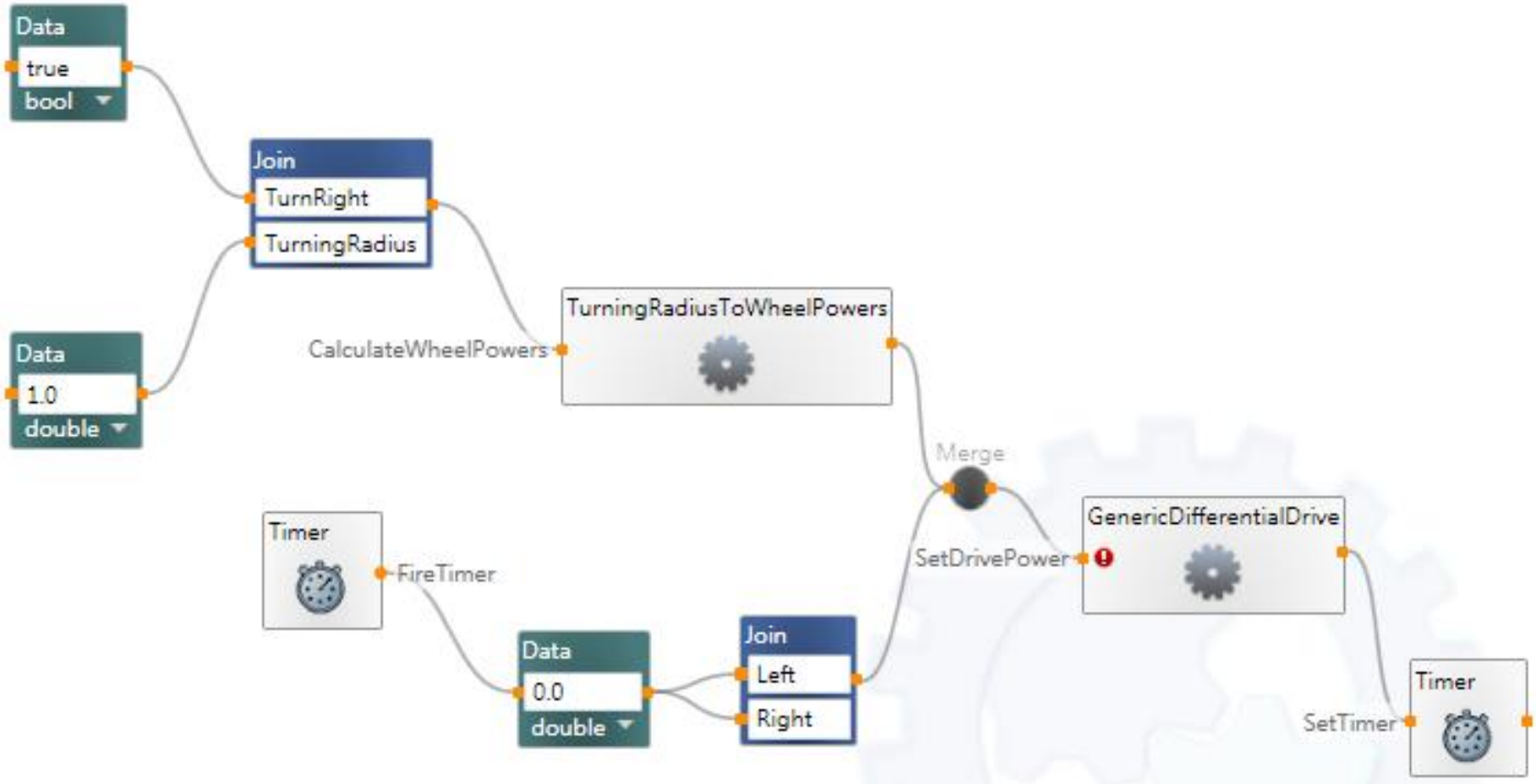
Step 6 Merge Connections

- Connect the output of the **Join** to the drive; This time, the middle man we need is **Merge**. It is necessary, however, for the inputs to **Merge** to match exactly, both in name and in type.



Step 7 Finish

- The overall diagram should be look like:



Result

- Your robot can now drive along an arc; again, vary the hard-coded values and watch its behavior.

Practice

- How about driving along the path like “8”?
- How about driving along rectangle path?

Question?

Course website

http://robot.caece.net