1.- Introduction

1.1.- Goals

Many developers around the world choose leJOS, Java for Lego Mindstorm, as the main platform to develop robots with NXT Lego Mindstorm. I consider that this eBook will help leJOS community, Lego Mindstorm community, Robot's developers and Java fans to develop better software.

Robotics will be very important for the humanity in the next 10 years and this eBook is an effort to help in this way.

Many people spend several hours in their robotics projects with problems with wires & electronics, protocols and problems with programming languages, Lego Mindstorm is easy and Java/leJOS is an excellent platform to demonstrate your software engineering skills to develop better robots. NXT Brick is the easiest way to enter in the robotics world and leJOS the best platform in the moment to use software engineering ideas.

Enjoy, Learn, Contact with me to improve the eBook and share your ideas.

Juan Antonio Breña Moral.
www.juanantonio.info

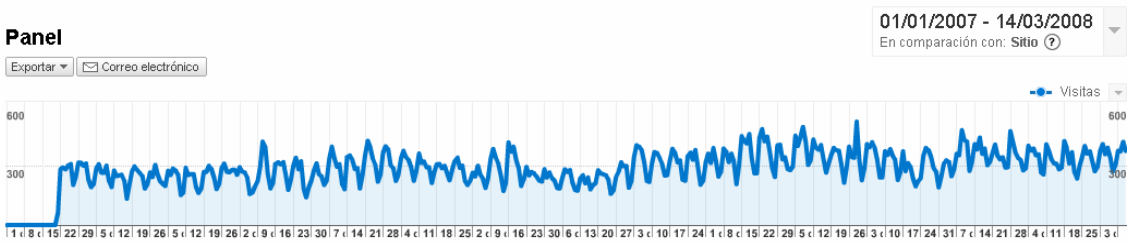
1.2.- LeJOS Project

LeJOS is Sourceforge project created to develop a technological infrastructure to develop software into Lego Mindstorm Products using Java technology.

Currently leJOS has opened the following research lines:

1. NXT Technology
    a. NXJ
    b. iCommand
2. RCX Technology
    a. leJOS for RCX

LeJOS project's audience has increased. Currently more than 500 people visit the website every day.



This eBook will focus in NXT technology with NXJ using a Windows Environment to develop software.

1.3.- NXT Brick

The NXT is the brain of a MINDSTORMS robot. It's an intelligent, computer-controlled LEGO brick that lets a MINDSTORMS robot come alive and perform different operations.

Motor ports
The NXT has three output ports for attaching motors - Ports A, B and C

Sensor ports
The NXT has four input ports for attaching sensors - Ports 1, 2, 3 and 4.

USB port
Connect a USB cable to the USB port and download programs from your computer to the NXT (or upload data from the robot to your computer). You can also use the wireless Bluetooth connection for uploading and downloading.

Loudspeaker
Make a program with real sounds and listen to them when you run the program

NXT Buttons
Orange button: On/Enter /Run
Light grey arrows: Used for moving left and right in the NXT menu
Dark grey button: Clear/Go back

NXT Display
Your NXT comes with many display features - see the MINDSTORMS NXT Users Guide that comes with your NXT kit for specific information on display icons and options

Technical specifications

- 32-bit ARM7 microcontroller
- 256 Kbytes FLASH, 64 Kbytes RAM
- 8-bit AVR microcontroller

- 4 Kbytes FLASH, 512 Byte RAM
- Bluetooth wireless communication (Bluetooth Class II V2.0 compliant)
- USB full speed port
- 4 input ports, 6-wire cable digital platform (One port includes a IEC 61158 Type 4/EN 50 170 compliant expansion port for future use)
- 3 output ports, 6-wire cable digital platform
- 100 x 64 pixel LCD graphical display
- Loudspeaker - 8 kHz sound quality. Sound channel with 8-bit resolution and 2-16 KHz sample rate.
- Power source: 6 AA batteries

1.3.1.- NXT Sensors used in the eBook

NXT Sensors used in the document are the following:

- NXT Motor
- Ultrasonic Sensor
- Compass Sensor
- NXTCam
- Tilt Sensor
- NXTCam
- RFID Sensor

NXT Motor

Ultrasonic Sensor

Compass Sensor

Tilt Sensor

NXTCam

RFID Sensor

Lattebox NXTe

1.4.- About the author

Juan Antonio Breña Moral collaborates in leJOS Research team since 2006. He works in Europe leading Marketing, Engineering and IT projects for middle and large customers in several markets as Defence, Telecommunications, Pharmaceutics, Energy, Automobile, Construction, Insurance and Internet.

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1.5.- About the collaborators

Frank Zimmermann is a Doctor in Mathematics and Professor for CIS at the University of Applied Sciences Nordakademie since 1996. Frank teaches Java, Software Engineering and Information Systems at the university. He discovered leJOS and NXT Technology in 2007.

Further information:
http://fermat.nordakademie.de/
http://www.nordakademie.de/

2.- Develop NXJ with Eclipse

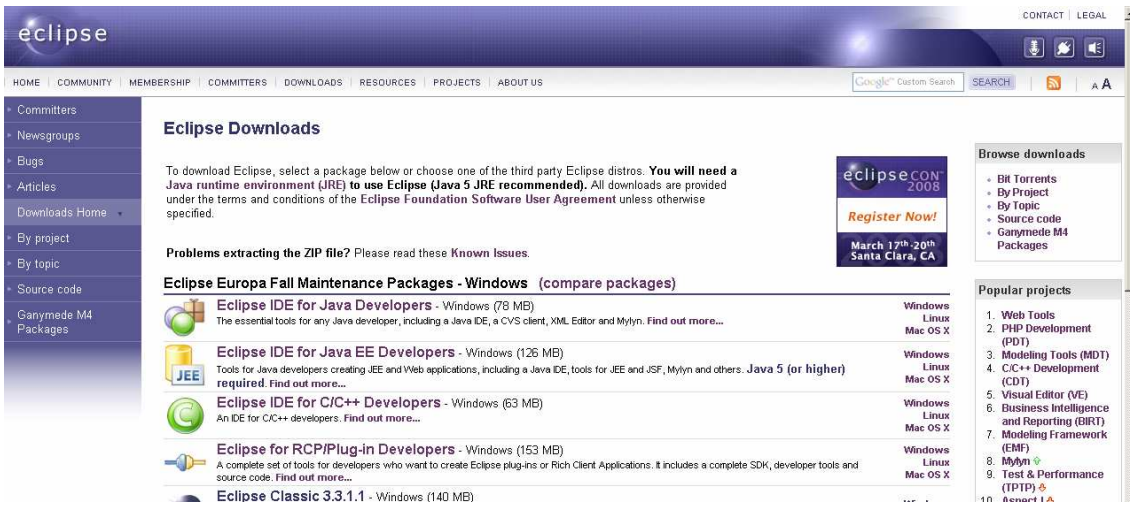
2.1.- Introduction

Eclipse is an extensible, open source IDE (integrated development environment). The project was originally launched in November 2001, when IBM donated $40 million worth of source code from Websphere Studio Workbench and formed the Eclipse Consortium to manage the continued development of the tool.

The stated goals of Eclipse are "to develop a robust, full-featured, commercial-quality industry platform for the development of highly integrated tools." To that end, the Eclipse Consortium has been focused on three major projects:

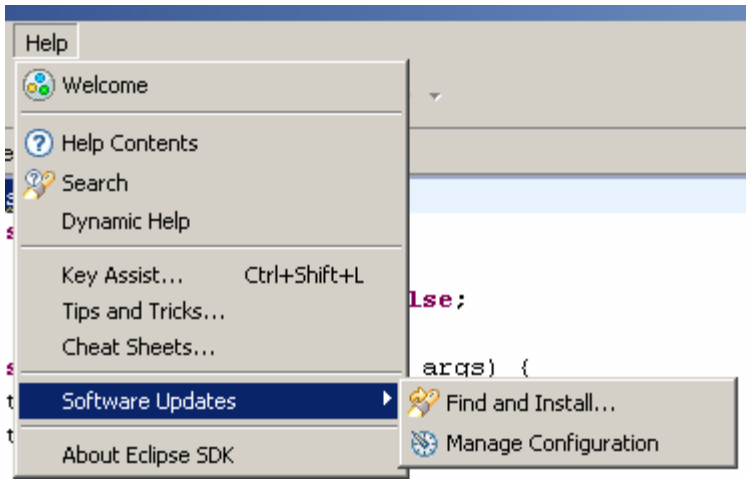
1. The Eclipse Project is responsible for developing the Eclipse IDE workbench (the "platform" for hosting Eclipse tools), the Java Development Tools (JDT), and the Plug-In Development Environment (PDE) used to extend the platform.
2. The Eclipse Tools Project is focused on creating best-of-breed tools for the Eclipse platform. Current subprojects include a Cobol IDE, a C/C++ IDE, and an EMF modeling tool.
3. The Eclipse Technology Project focuses on technology research, incubation, and education using the Eclipse platform.

Download Eclipse Europa 3.3 Classic from eclipse's website. Use the following URL: http://www.eclipse.org/downloads/

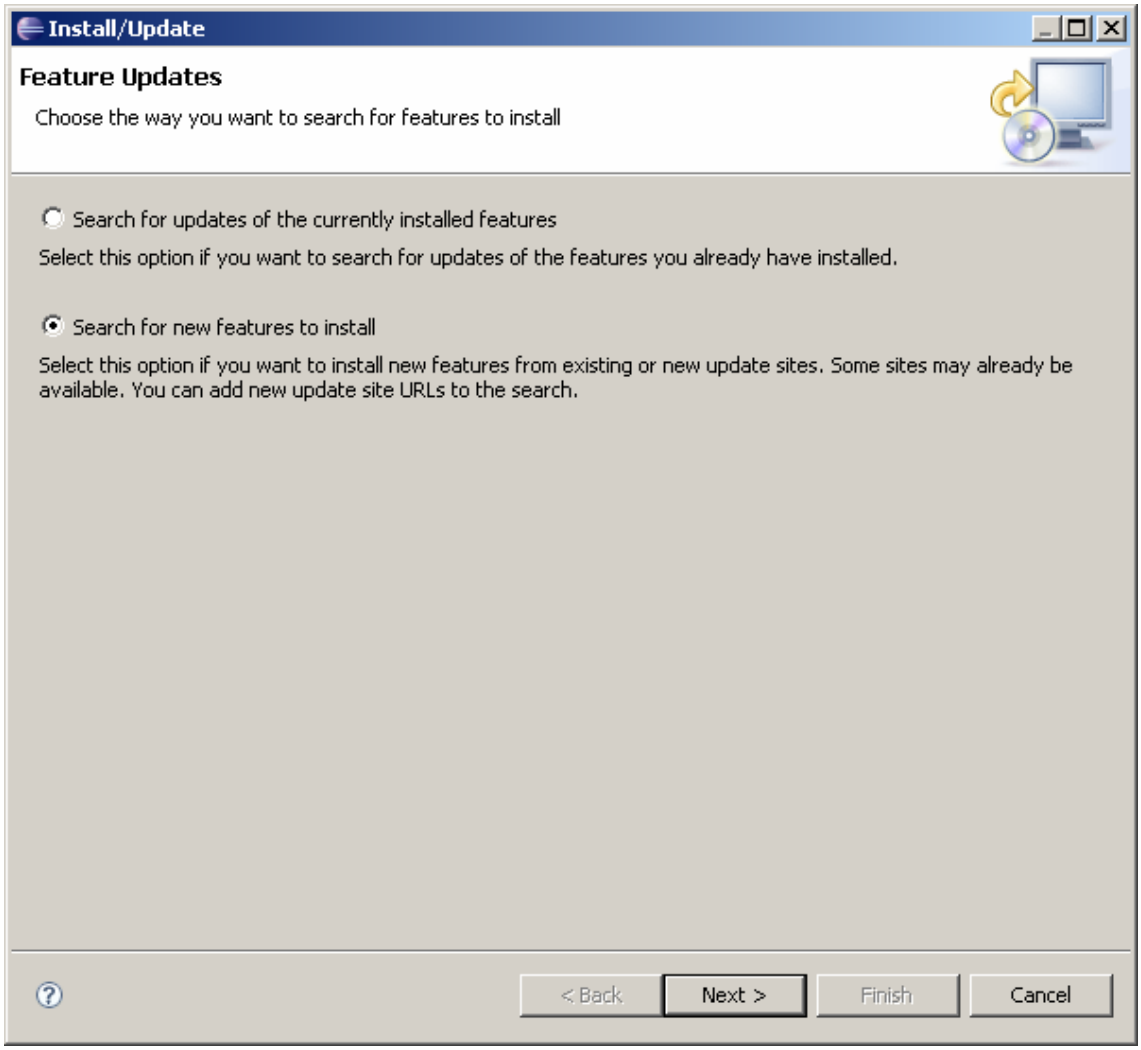


2.2.- Install NXJ Plug-in

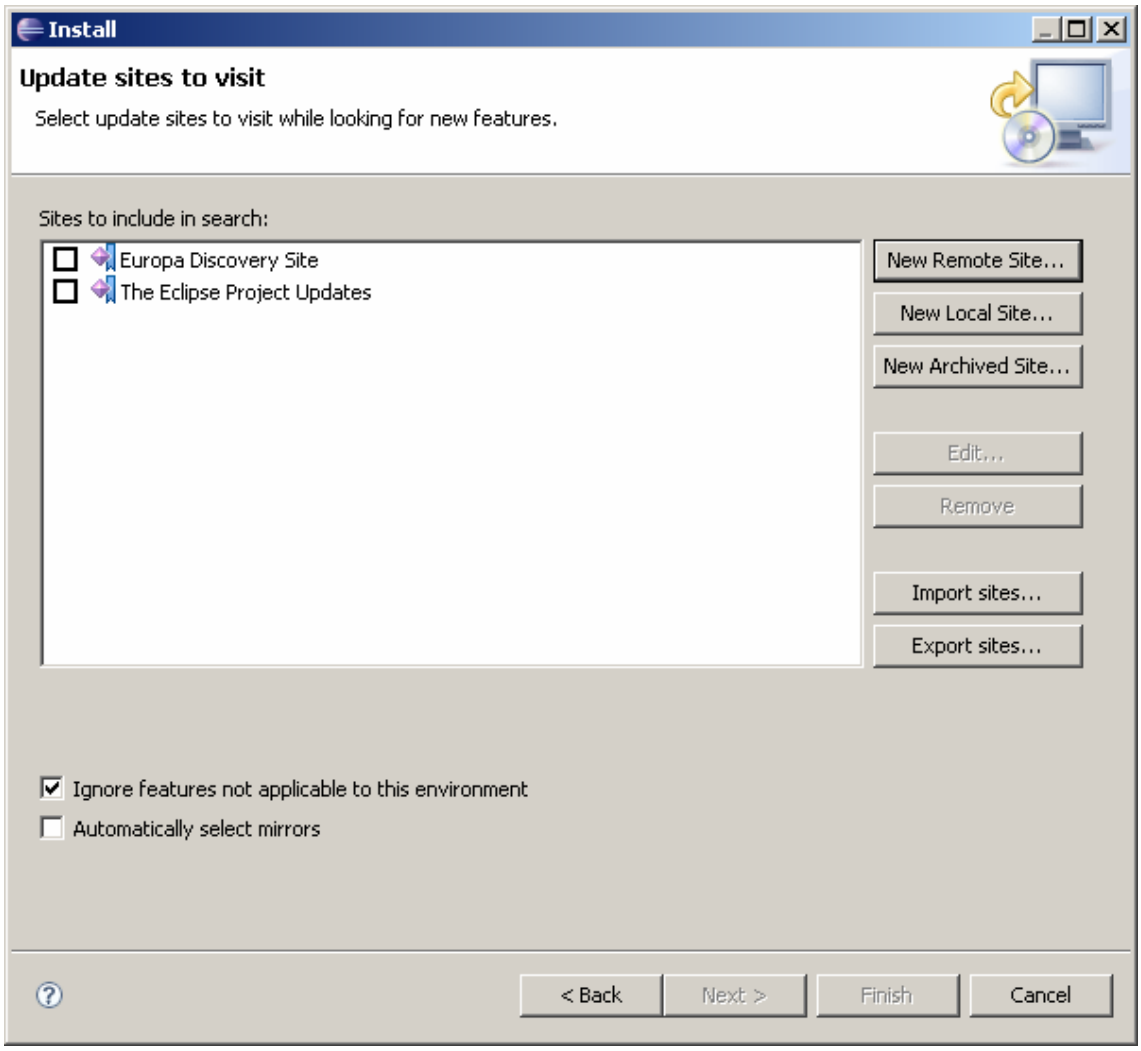
When you execute Eclipse and you want to install any Eclipse plug-in, in this case NXJ Plug-in, you have to go to *help > software updates > find and install:*



Then you will see the following assistant. Select the second option: "Search for new features to install"

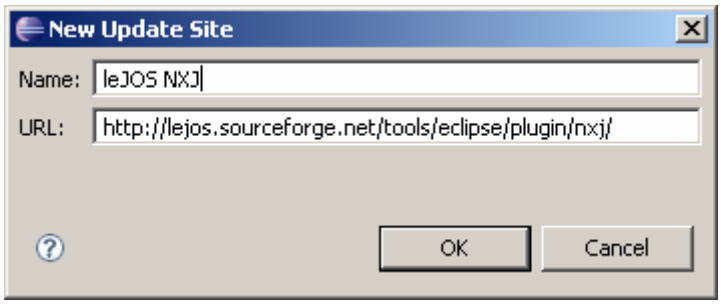


Click in the button next to indicate where is NXT Plug-in. Click in New remote Site:

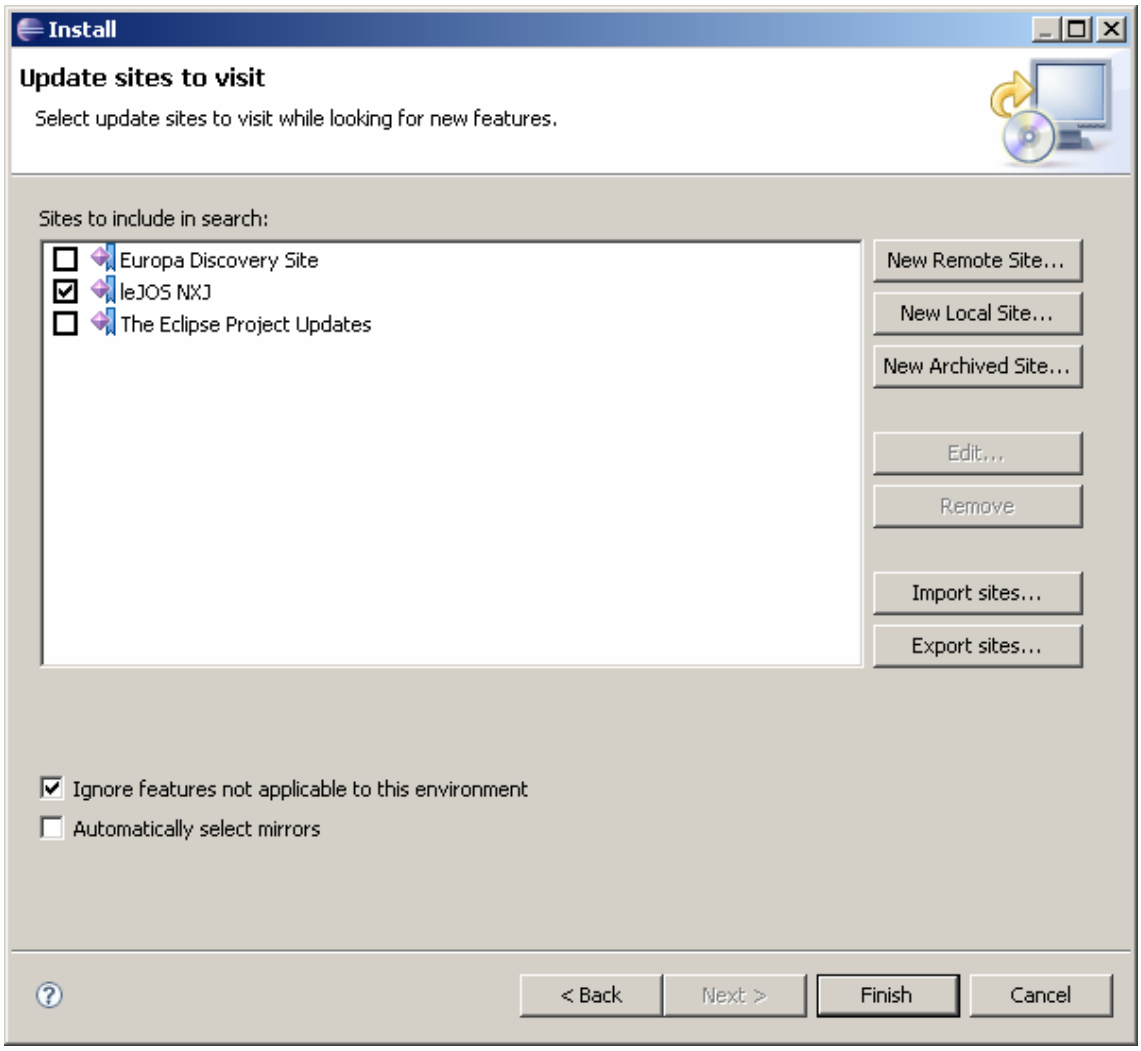


The parameters to write in the next window are:

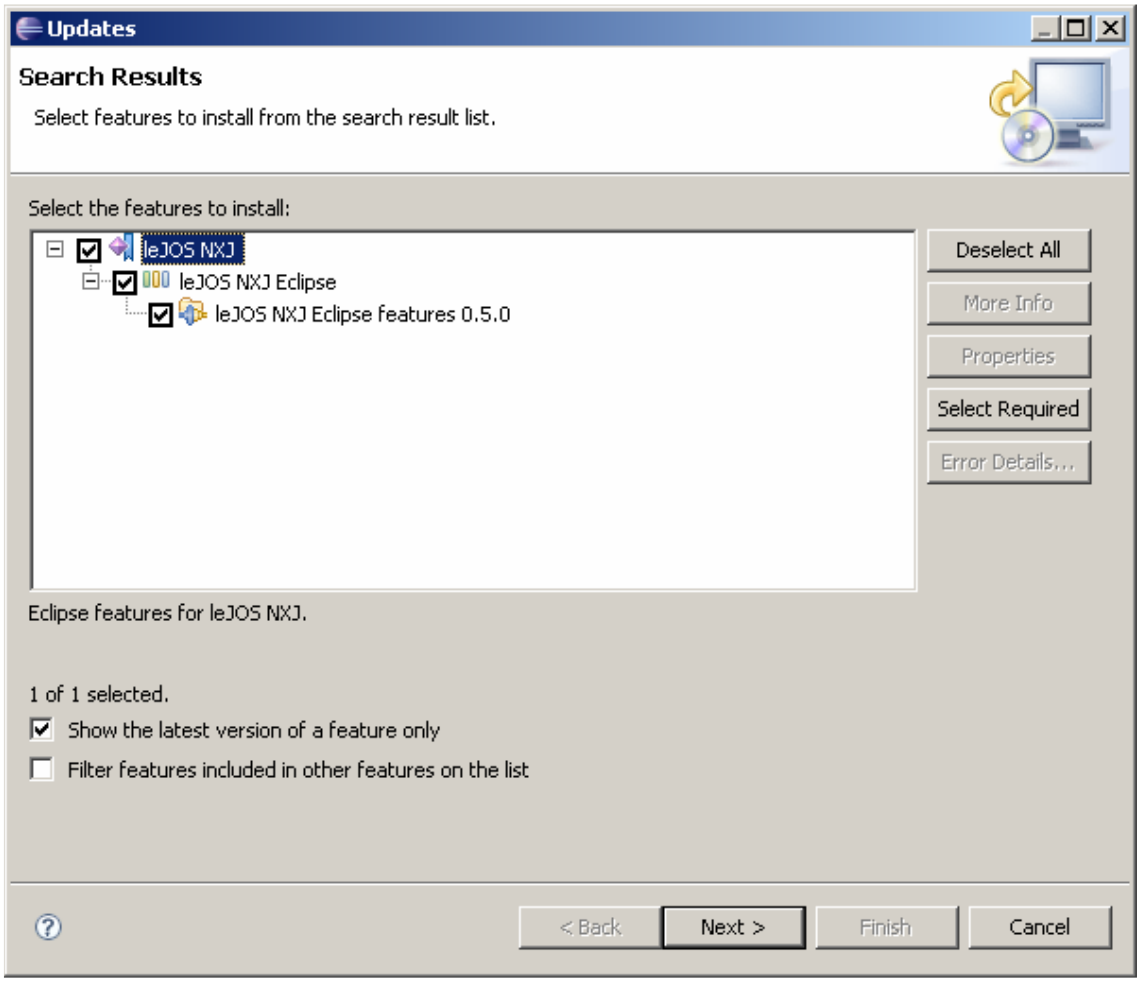
Name: leJOS NXJ
URL: http://lejos.sourceforge.net/tools/eclipse/plugin/nxj/

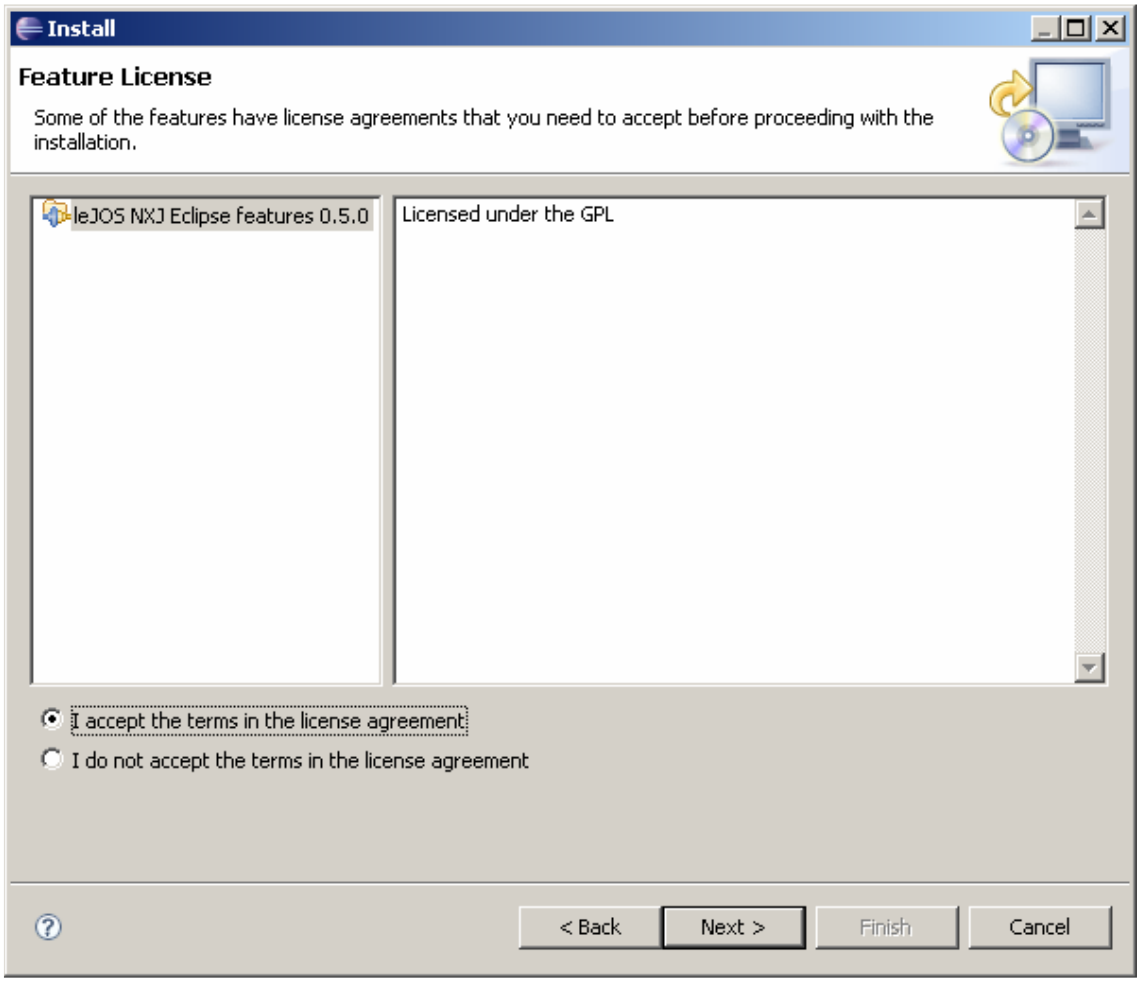


Then, select the site leJOS NXJ:

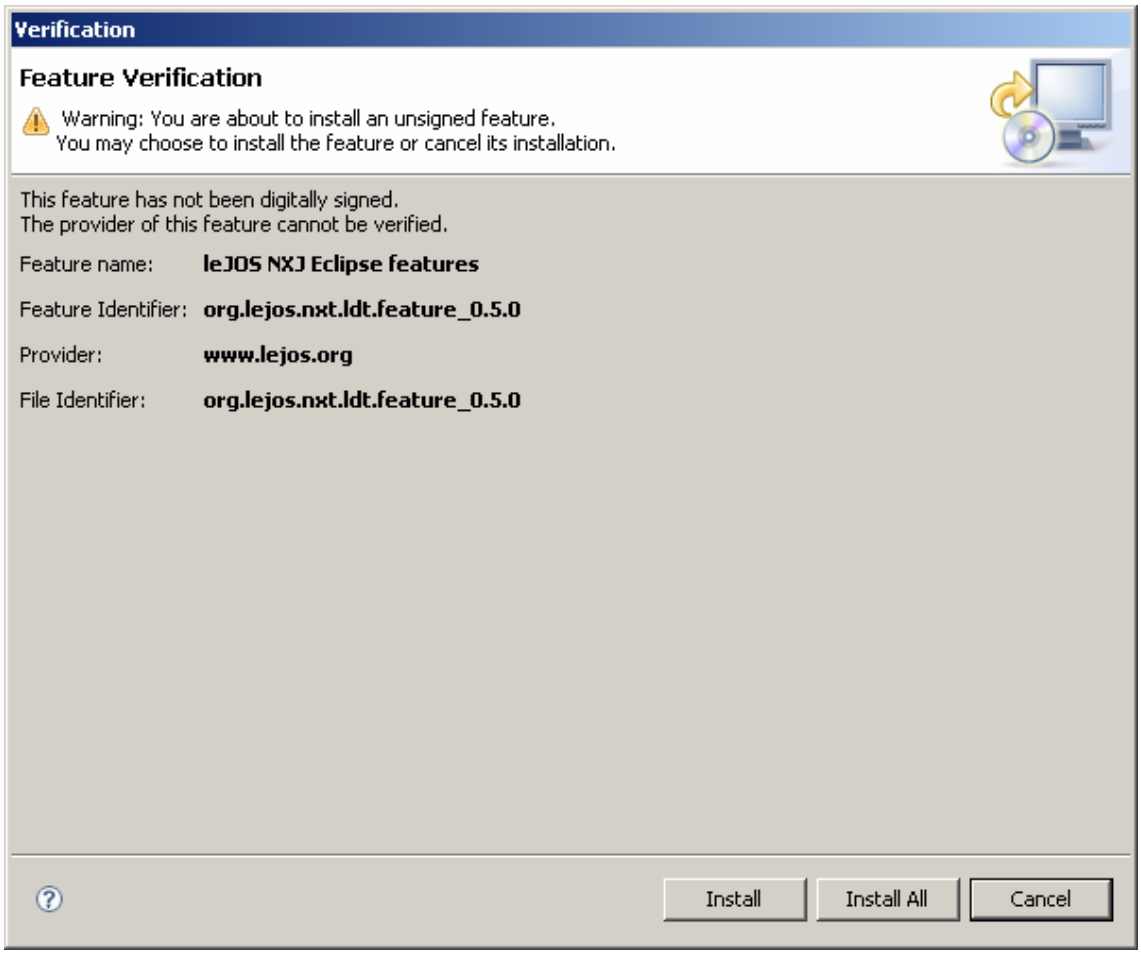


And click in Finish button. In next window, Check all options and click in next button.


Updates
Search Results
Select features to install from the search result list.
Select the features to install:
leJOS NXJ
leJOS NXJ Eclipse
leJOS NXJ Eclipse features 0.5.0
Deselect All
More Info
Properties
Select Required
Error Details...
Eclipse features for leJOS NXJ.
1 of 1 selected.
Show the latest version of a feature only
Filter features included in other features on the list
< Back
Next >
Finish
Cancel



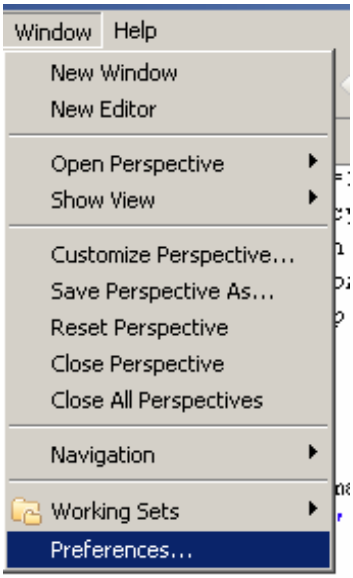
Then you have to accept the terms in the licence agreement and click in next button to install the NXJ plug-in.



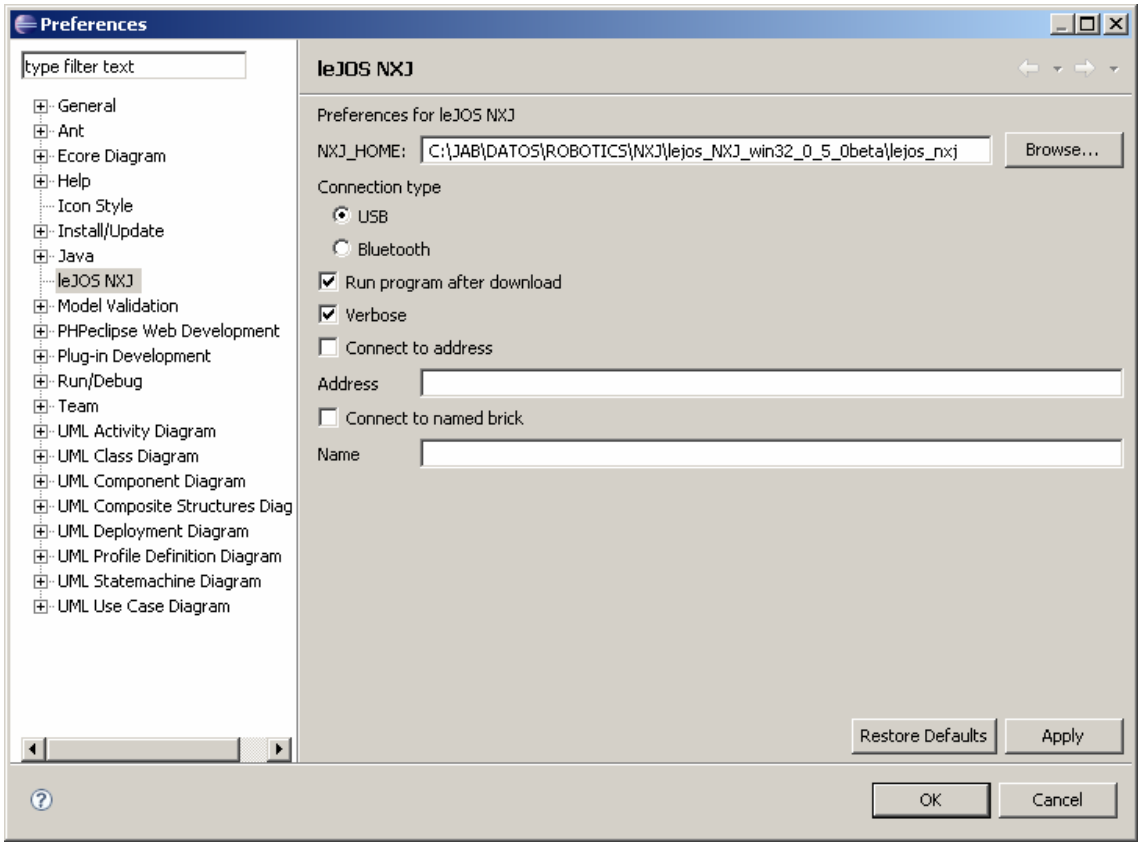
If you have reached to this window, you have finished installing the NXJ plug-in.

2.3.- Configure Eclipse IDE to use NXJ Plug-in

Once you have installed NXJ Plug-in, you have to set NXJ_HOME variable in preference area in Eclipse.



NXJ_HOME = C:\JAB\DATOS\ROBOTICS\NXJ\lejos_NXJ_win32_0_5_0beta\lejos_nxj

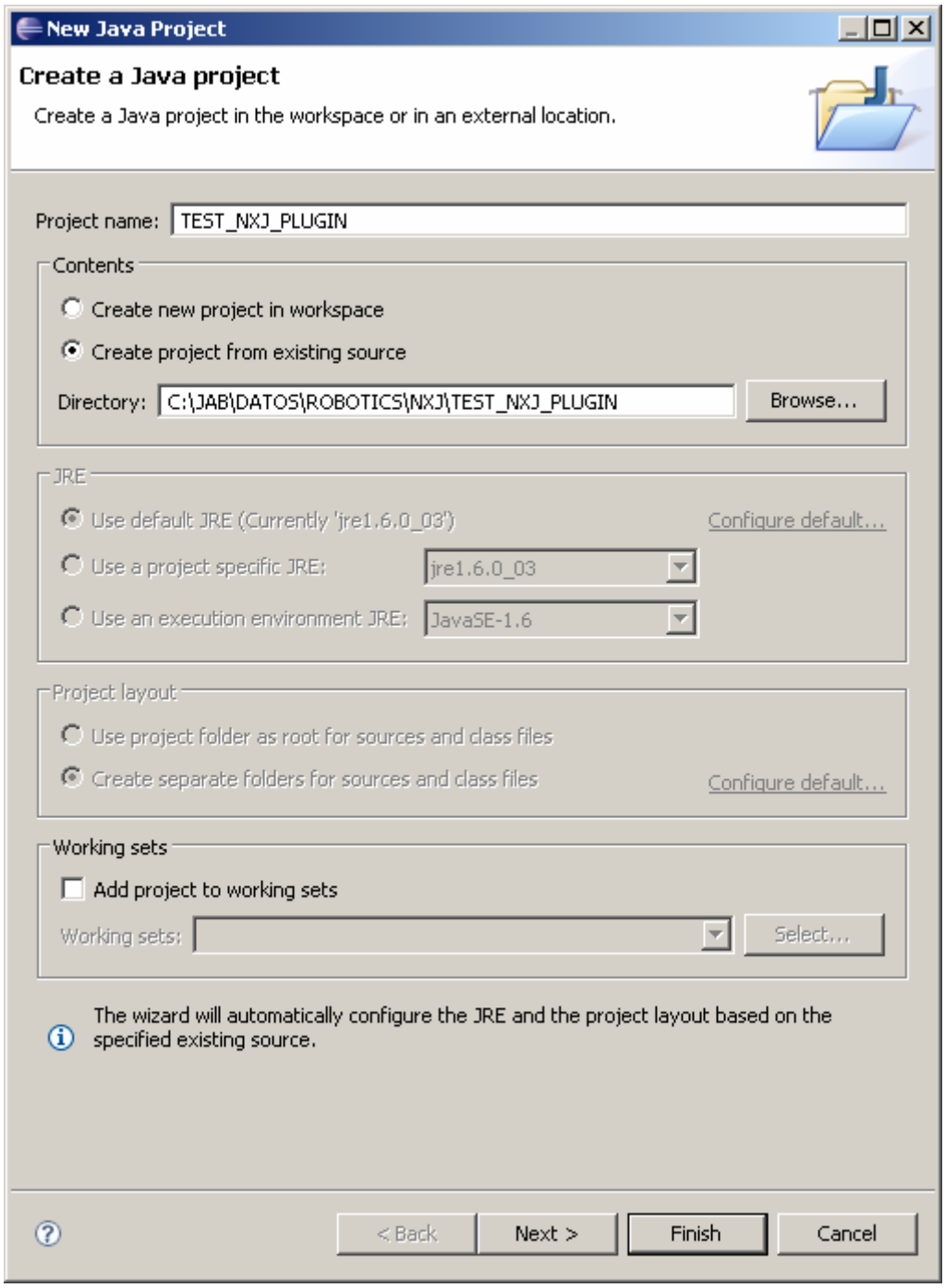


2.4.- Creating a NXJ Project in Eclipse IDE

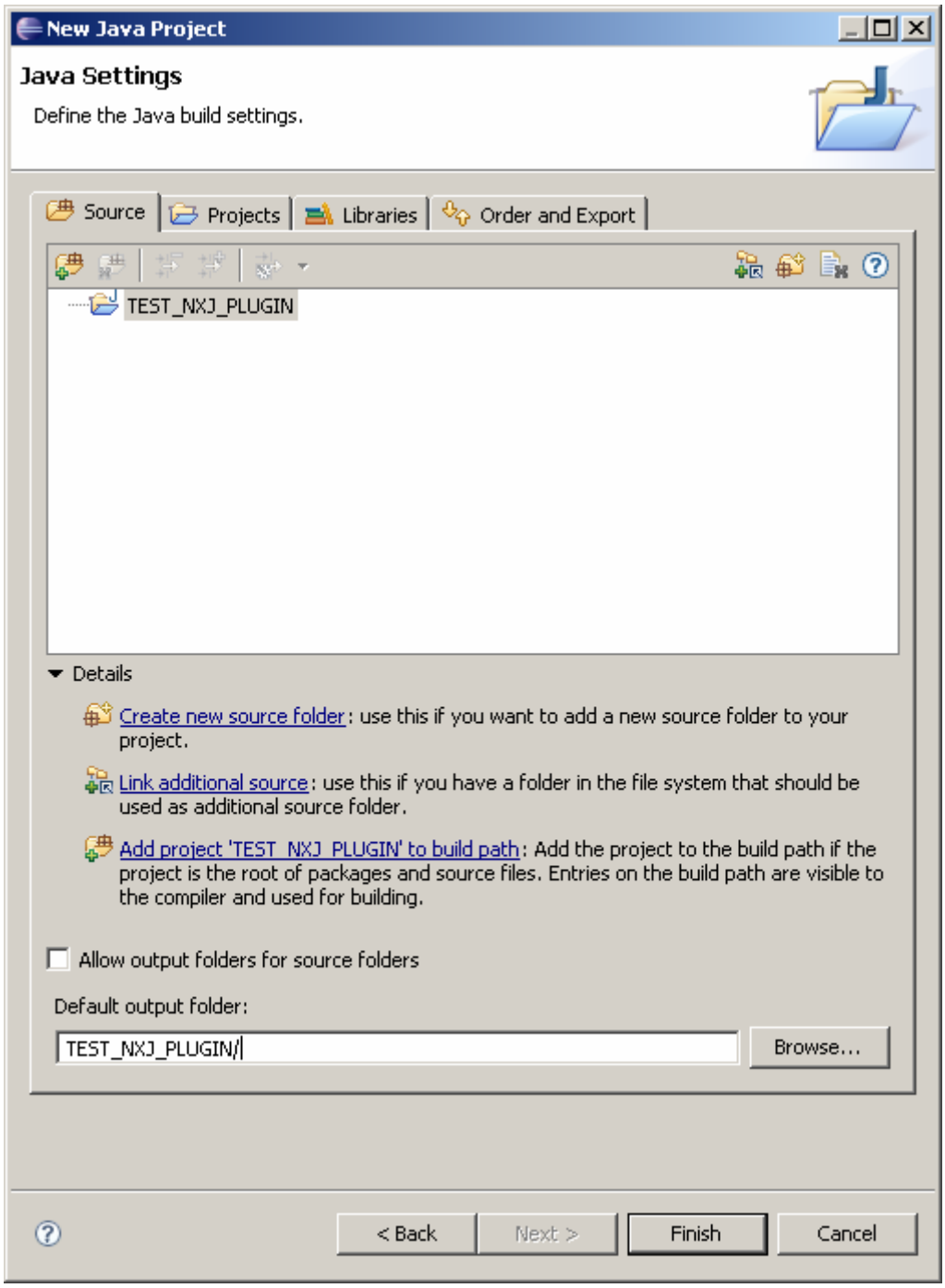
2.4.1.- Creating a Java Project

In Eclipse, you can create a Java Project. To create a Java project, go to *File* > *New* > *Java Project*:

Then you will see an assistant where you have to indicate the name of the Java Project and where you want to store your Java Classes and Byte codes:



Click in next button. In next window, you have to indicate where you want to store .class files. You have to indicate that class files have to store in the same path where you have java files.



Then you will see in tree menu in Eclipse IDE a new Java Project named TEST_NXJ_PLUGIN. Select it and click in "Convert to leJOS NXJ project"

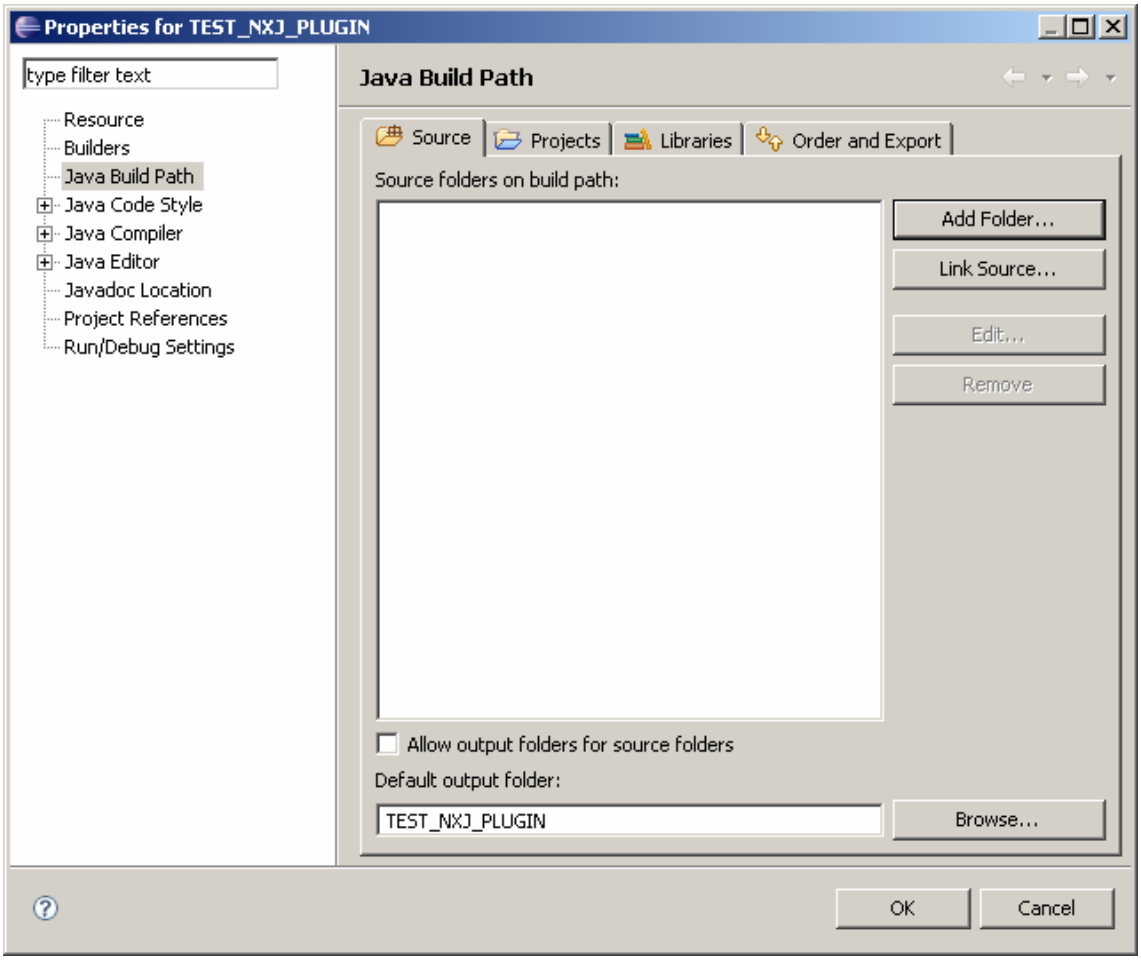
Then your project will be associated with lib path in your NXJ release.

Besides, in Eclipse console window, you will see the following message:

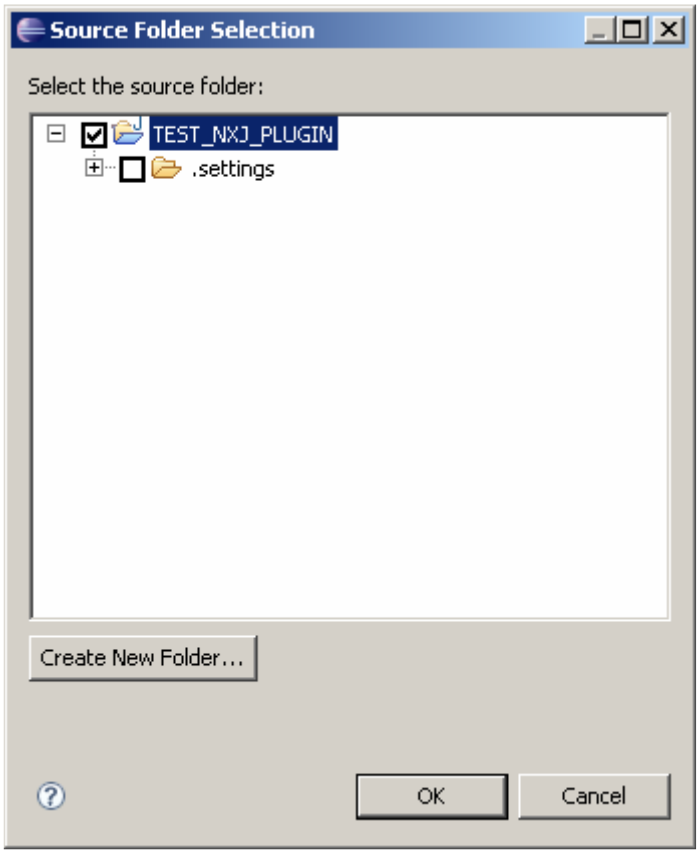
Project TESTING_NXJ_PLUGIN now is a leJOS NXJ project

Then, it is necessary to define Build path. Select your NXJ Project and click in Configure Build Path in context menu:

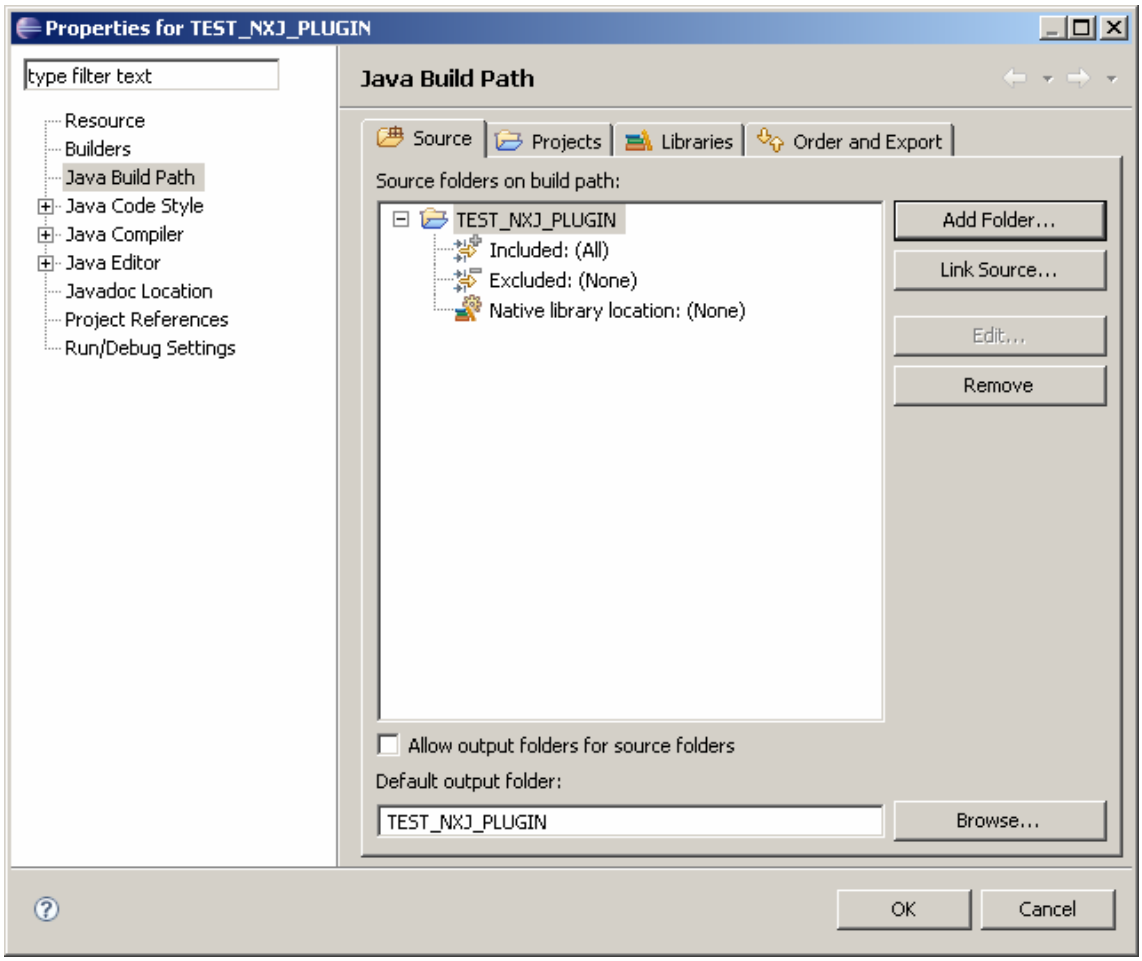
Add new folder:



And check the folder TEST_NXJ_PLUGIN:



Then, click in Ok button to see the changes in your project:



Then you have to click in Ok button to finish this step.

2.5.- Using NXJ Plug-in

2.5.1.- Features

NXJ Plug-in allow to NXJ developers to do the following actions:

1. Upload latest firmware into NXT Brick
2. Upload NXJ programs into your NXT Brick
3. Convert any Java project into NXJ project

In this section, we explain the first and second feature.

Besides, NXJ Plugin includes a excellent documentation.

2.5.2.- Upload firmware

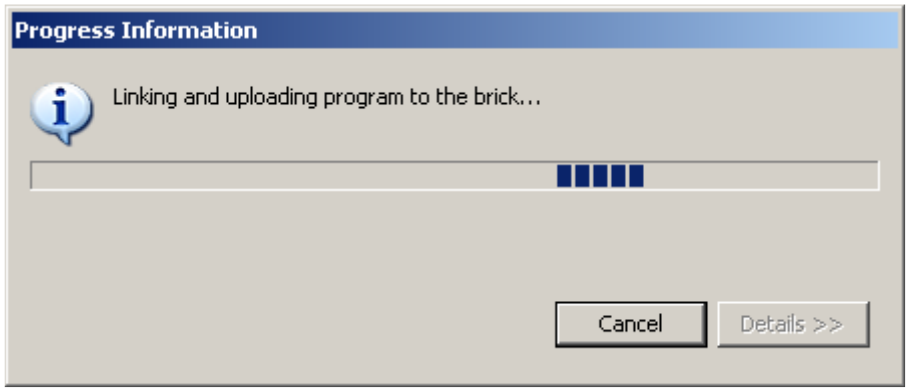
If you have to upload leJOS firmware to NXT brick, you can use this plug-in. Connect your NXT brick by USB wire to your computer and click in *Upload firmware*:

2.5.3.- Upload Program to the NXT brick

Normally you send programs to NXT brick using DOS console or using Eclipse manually or another IDE. With NXJ Plug-in the process to send NXJ programs is so easy.

When you finish developing your NXJ Program, simply selecting the class and with context menu, selecting the option *Upload Program to the NXT Brick*:

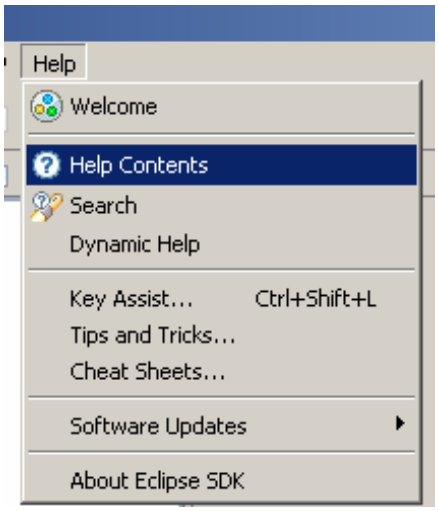
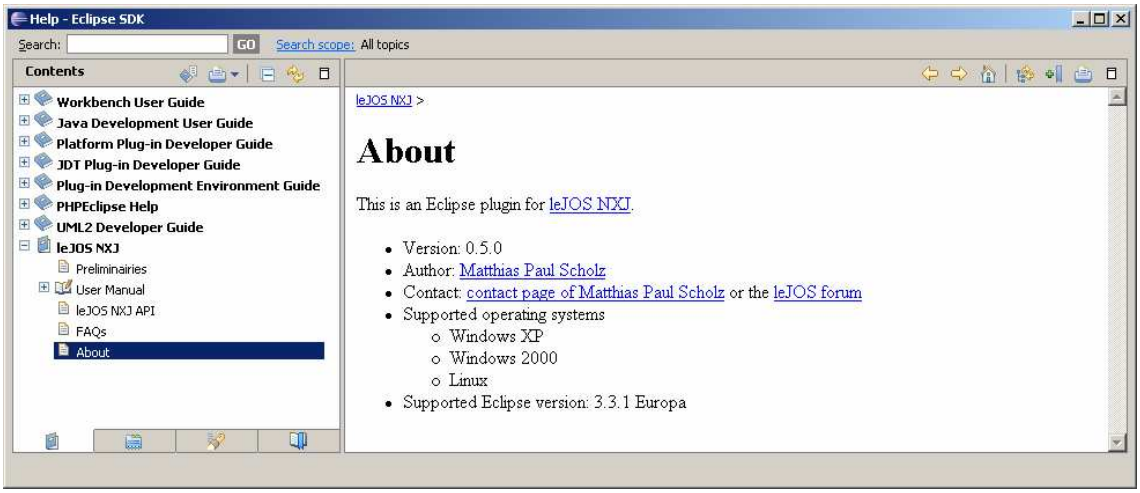
Then if your class doesn't have any syntactic error, connect your NXT brick and click in the option, then you will see the following window:



Then your program will be running in your brick!

2.5.4.- NXJ Plug-in documentation

The plug-in includes an excellent documentation integrated with eclipse. To read it, click in *Help* > *Help Contents*:



Then you will see a new section named leJOS NXJ.