UNICORE NXT

Controlling a Lego NXT robot through UNICORE

May 29, 2012 | Sandra Bergmann & Matthias Richerzhagen

Overview

- What is a NXT robot
- How to control the NXT robot
- Integration in UNICORE
- Current implementation
- Future

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Part I: What is a NXT robot

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What is a NXT robot

Hardware

Quelle: educatec.ch

What is a NXT robot

Hardware specifications

processor	Flash memory	Ram	MHz
Atmel-ARM-processor[1]	256 kB	64 KB	48
coprocessor[2]	4 KB	512 Byte	8

- Bluetooth
- USB-2.0
- 3 Motor-(Output)-Ports
- 4 Sensor-(Input)-Ports
- 100x64px LC-Display
- Speaker(8-bit, 2-16 kHz)

[1] AT91SAM7S256

[2] Atmel 8-Bit AVR, ATmega48

Source: http://de.wikipedia.org/wiki/NXT

What is a NXT robot

Software

- Access with USB or Bluetooth
- Programming:
  - Standard Firmware: Drag&Drop
  - Custom firmwares offer other programming languages for example: Java (lejos_nxj) (Much more available)

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Part II: How to control the NXT robot

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How to control the NXT robot

Overview

Local

A NXT program is compiled and uploaded to the NXT and then executed on the NXT-Brick.

Remote

A program running on a host device connects to the NXT and controls motors/sensors remotely.

How to control the NXT robot

Differences

Local

- Good interfaces
- Unknown when or if a program has been finished
- Job is finished, when the program has been uploaded

NO SCHEDULING!

Remote

- Very tricky access to sensors
- Job finishes, when job is done

Scheduling!

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Part III: Integration in UNICORE

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Integration in UNICORE

Overview

Script Job

- Uploading and running a compiled .class file on the NXT
- Running a remote-program

simpleidb

Creating predefined jobs by using the simpleidb file that can be either local or remote-programs

Uploading a robot program

- Bluetooth and Lejos-NXJ commands must be available on target machine!
- Job finishes when the program has been uploaded
- Source or class files must be uploaded with the job
- Robot is not available when program is running
- Results need to be fetched by a remote-program

Example Code

```
nxjc LocalTest.java
nxj -r LocalTest
```

Running a remote program

- Bluetooth and Lejos-NXJ libraries must be available on target machine!
- Job finishes when program finishes
- Source or class files must be uploaded with the job
- Remote API is tricky
- Only one remote program at a time

Example Code

```
nxjpcc RemoteTest.java
nxjpc RemotetTest
```

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Part IV: Our Use Case

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Our Use Case

Follow the path

Idea:
Find and follow a path from A to B on a given map avoiding obstacles.

Prerequisites:

- Map
- Position and rotation of the robot

Tasks:

- Robot programs such as "Travel x" or "Rotate α"

Our Use Case

Follow the path - instruction queue

Process:

- Find a path from A to B $\Rightarrow$ waypoints

Our Use Case

Follow the path - instruction queue

Process:

- Find a path from A to B $\Rightarrow$ waypoints
- Convert this waypoints to travel and rotate commands

Our Use Case

Follow the path - instruction queue

Process:

- Find a path from A to B $\Rightarrow$ waypoints
- Convert this waypoints to travel and rotate commands
- Send these commands to the NXT robot

Current implementation

What we got

Components:

- Server that holds the bluetooth connection

Current implementation

What we got

Components:

- Server that holds the bluetooth connection
- Client, that submits travel and rotate jobs to the Server

Current implementation

What we got

Components:

- Server that holds the bluetooth connection
- Client, that submits travel and rotate jobs to the Server
- Tool for map $\Rightarrow$ waypoints
- Tool for waypoints $\Rightarrow$ travel/rotate commands

Current implementation

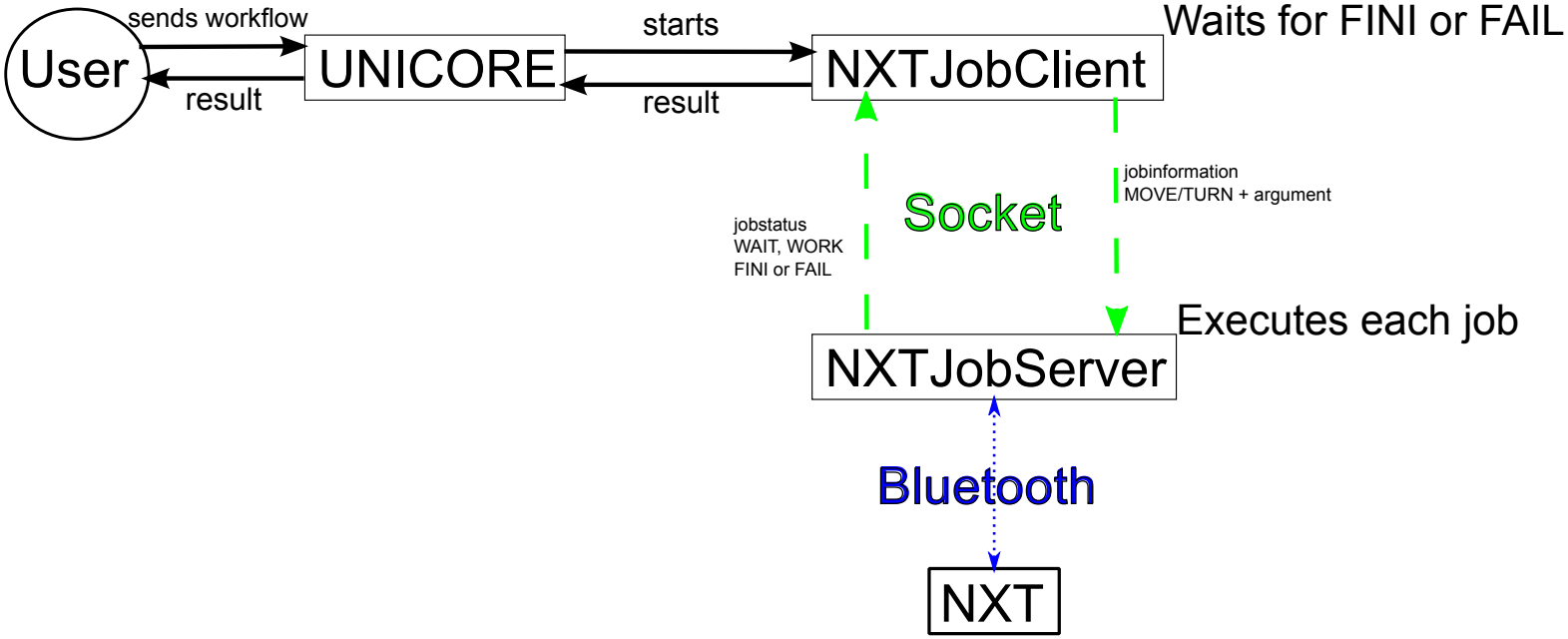
What we got

Components:

- Server that holds the bluetooth connection
- Client, that submits travel and rotate jobs to the Server
- Tool for map $\Rightarrow$ waypoints
- Tool for waypoints $\Rightarrow$ travel/rotate commands
- simpleidb entries for the application specification

Current Implementation

Architecture

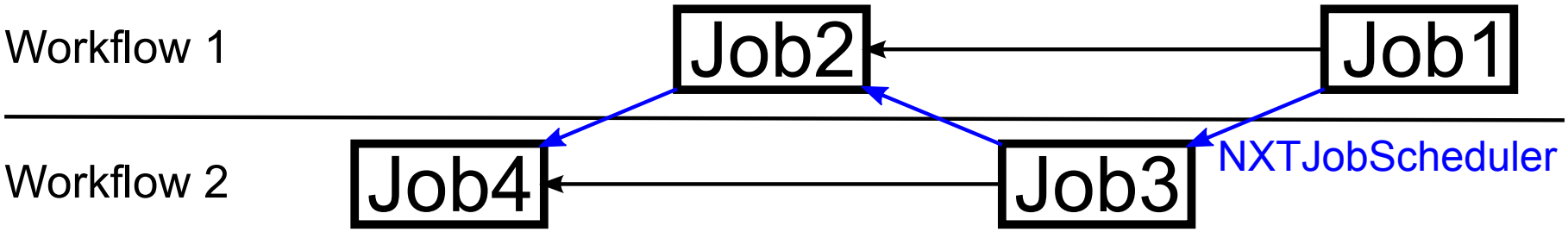


Demo

Current implementation

Problems

- Workflows interfere with each other



- Cannot associate job with owner
- Jobs are not independent from each other
- Long idle times, between 2 job executions

Future

- reduce the time between job executions $\rightarrow$ extension of the workflow system
- Association between job and owner $\rightarrow$ more security
- GridBeans

Thanks

Any Questions?