

Utilizing Lego Mindstorms nxt(tm) as Teaching and Training Platform for IEC 61499

4DIAC Users' Workshop
ETFA, Bilbao, Spain
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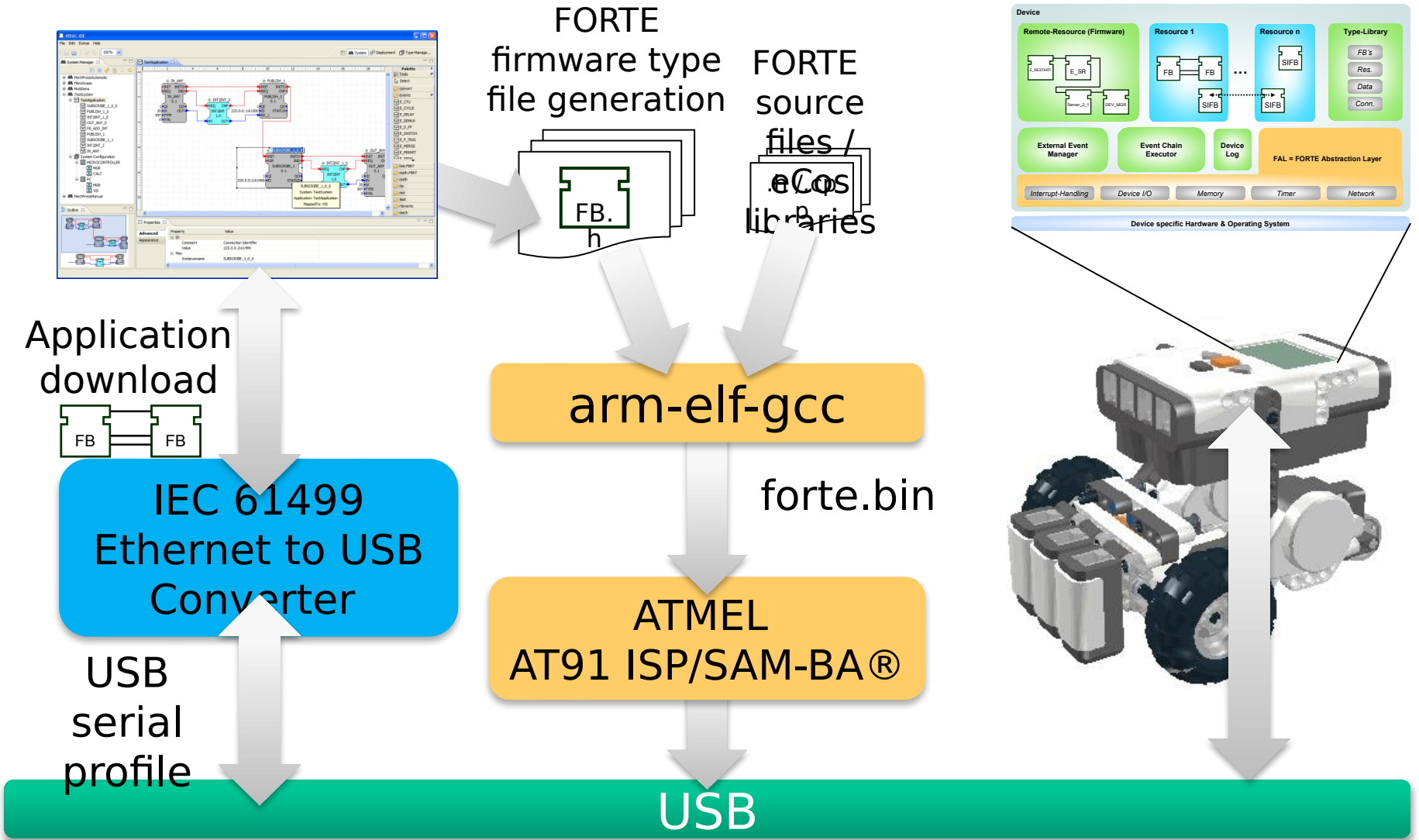
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Motivation

- Inexpensive starting kits (~300€):
 - Processor (Arm 7)
 - 64kB Ram, 256kB Flash
 - 3 Motors
 - Sensors (color, 2 push-button, ultrasonic)
 - ~600 Lego-Blocks
- ECOS port available (open source real-time operating system)
- FORTE port included on SourceForge

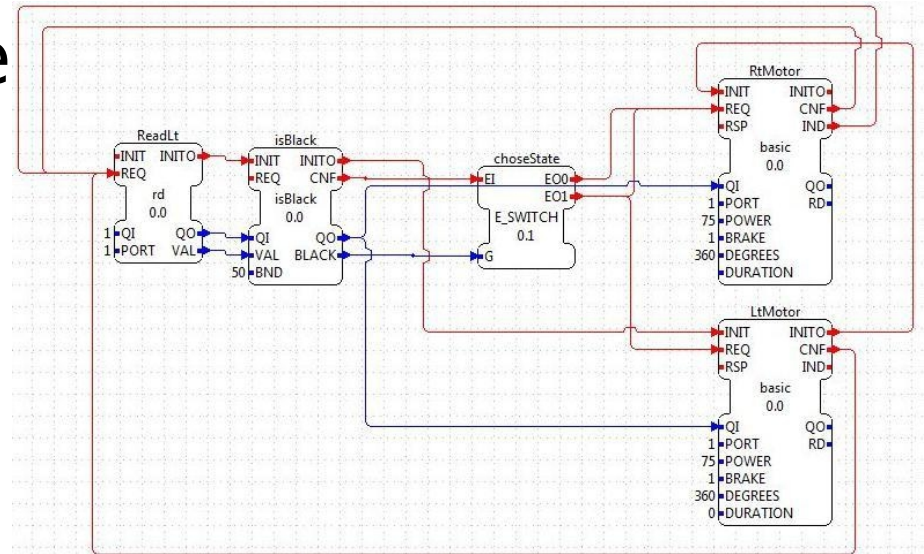


Vision



Planned Training Scenarios

- Typical applications in industrial automation
- Built on each other
- Increasing difficulty
- Deepening main IEC 61499 concepts
- Currently tutorials are being developed

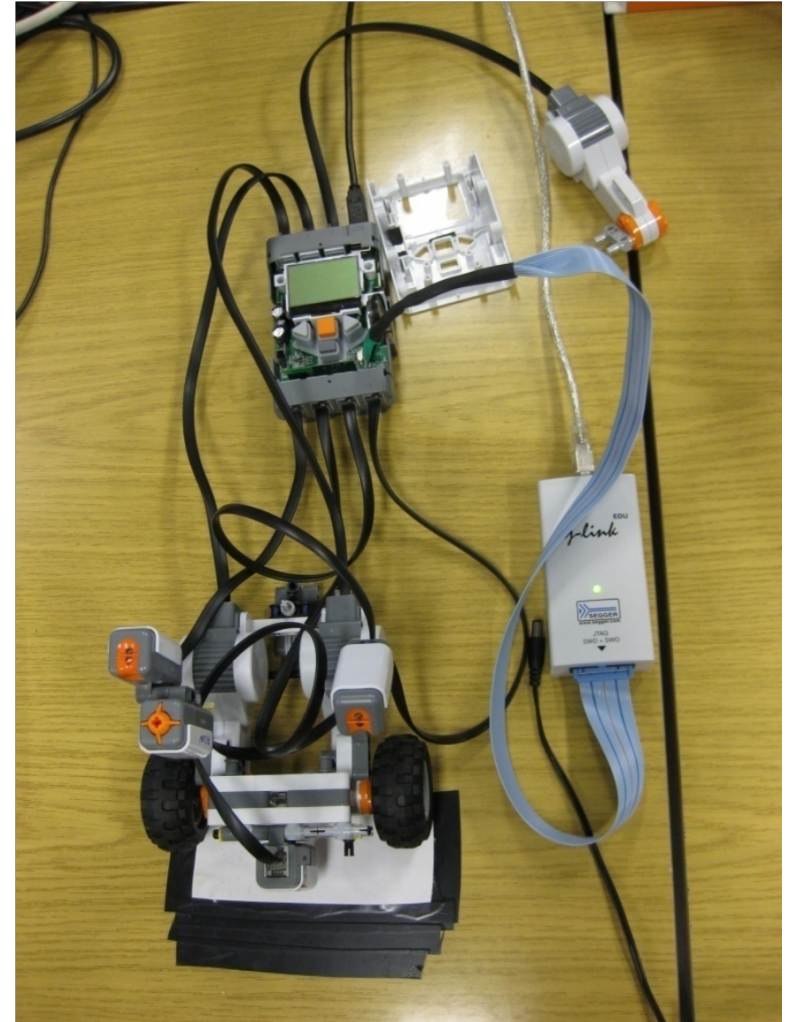


Tutorials Under Development

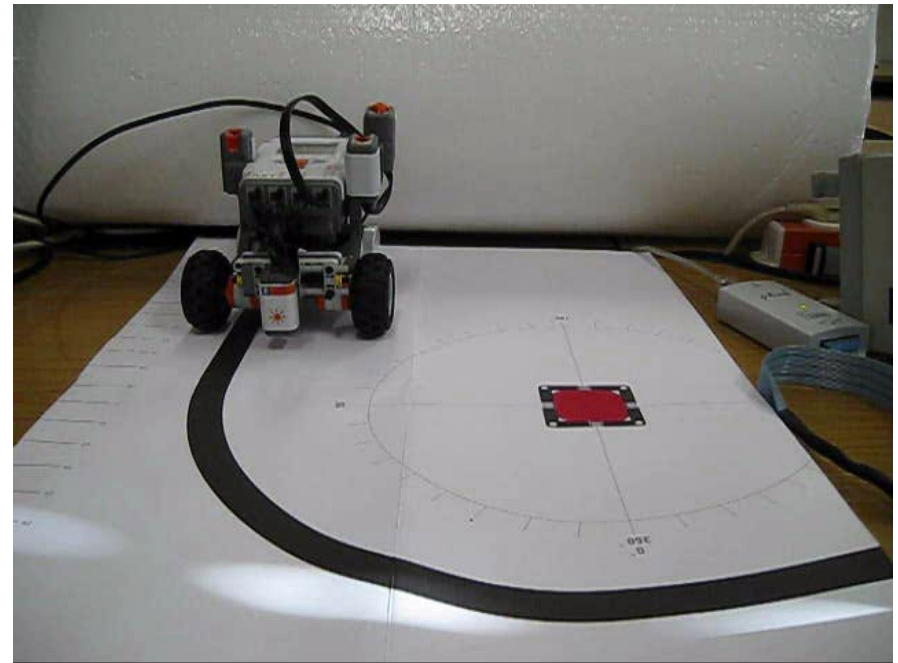
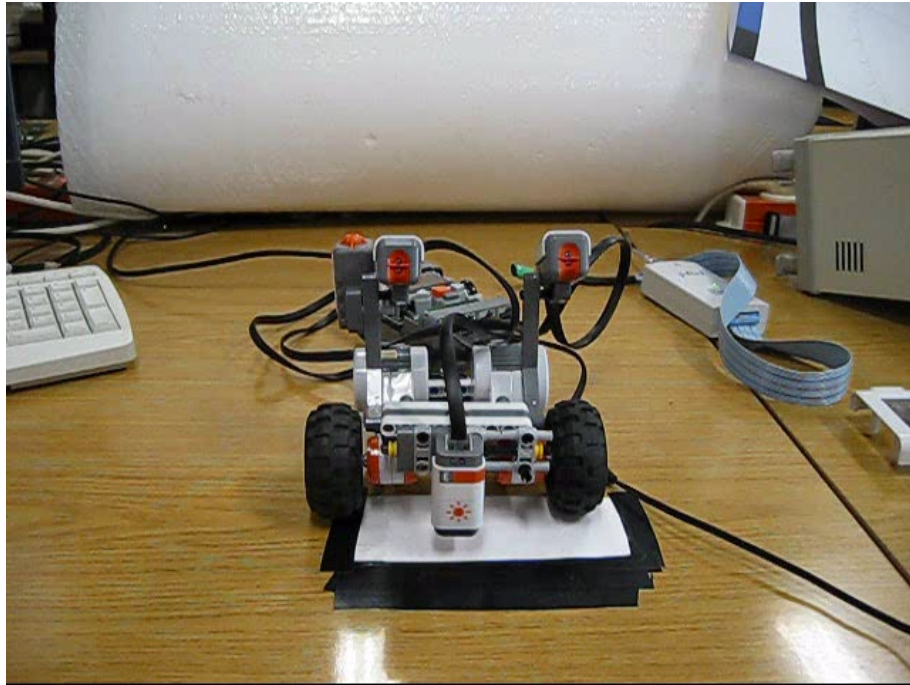
- Light blinking application
 - Goal: usage of sensors and actuators (light); understand application timing
- Line following robot
 - Goal: understand Basic Function Blocks; Closed Loop Control (Motors); Management of resources
- Car Wash
 - Goal: develop Service Interface Function Blocks; Improved Closed Loop Control (e.g., PID)
- Part Sorting and Packaging
 - Goal: timed buffers; Position control (Pick and Place); Monitoring of conveyor belt

Current State

- FORTE runs on Lego Controller
- 4DIAC-IDE can download via Java-proxy and USB
- FBs for
 - Push-Sensor
 - Buttons
 - LED / Light-Sensor
 - Sound Sensor
 - Motors
- Needs JTAG connector for debugging → voids guarantee



Example Line Following Robot



Next Steps

- Develop FBs for
 - Ultra-sonic sensor
 - Display
 - Sound
- Testing and improvements
 - Work without JTAG
 - Use binary XML for improving performance and memory usage
- Will be released to public via 4DIAC-Wiki:
<http://sourceforge.net/apps/mediawiki/fordiac>
- Additional tutorials, examples and suggestions are warmly welcome

Further Developments

- Utilizing Lego's Bluetooth for distributed applications
- Connecting 4DIAC with Virtual Lego

