LEGO Mindstorm EV3 Robots

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LEGO Mindstorm EV3 Robot
LEGO Mindstorm EV3 Components
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- Motor
- 4 output ports (A, B, C, D)
- USB port for software upload
- Lego NXT control unit
- Ultra sonic Sensor
- Colour/Light sensor
- Gyro sensor
- Touch sensor
- 4 input ports (1, 2, 3, 4) for connecting sensors
Basic robot for lab

1 ultra sonic sensor

2 independently controlled wheels

The basic robot will be extended by additional sensors and actuators during the labs
Data flow programming using LabVIEW

- LabVIEW programs = Graphs
- Specification of operations and dependences
- Can be executed in arbitrary sequence as long as data dependences are met
- We don’t care about the precise sequential code needed for each of the nodes.

Example:
Virtual instruments

VI = virtual instrument
VIs represented in 2 windows:
- Front panel: user interface
- Block diagram: functionality of the system
LabVIEW NXT tool kit

Front panel irrelevant, since robots have no “user interface“

Mindstorm EV3 programming:

- Functions menu contains all required features for programming EV3

- Use **only** these functions

The other features are not available for the Mindstorms EV3
Input

**Menu:** Mindstorm Robotics => I/O => Sensor => Touch/Sound/Light/Ultrasonic/Rotation

**Touch sensor**
- reads in touch sensor data from designated input port
- Mode: pressed/released/bumped/count
- Output: yes/no

**Sound sensor**
- reads in sound sensor data from designated input port
- Output: volume in dB/dBA
**Input**

**Menu:** Mindstorm Robotics => I/O => Sensor => Touch/Sound/Light/Ultrasonic/Rotation

**Light sensor**
- reads in light sensor data from designated input port
- Output: intensity (0-100)

**Ultra sonic sensor:**
- reads ultrasonic sensor data from designated input port
- Output: distance (cm)
Comparison

Menu: Mindstorm Robotics => Programming => Comparison

Essentially self-explaining

- Result: Boolean
- Exception: Select

? 2 ? 1 Mux
Case-dependent data flow
(control elements present in LabView)

**Menu:** Mindstorm Robotics => Programming => Structures => Case Structure

Move from Functions-Palette into editing area using drag & drop

- Consists of several sub diagrams, only one of which can be active
- Click on the arrows next to the case label to display a particular sub diagram.
- The case selector serves as the input to the case structure;
  Possible data types: Bool, String, Integer.
- Action to be performed designated by additional elements within the case structure
- Right click opens context menu
Data flow loops

**Menu:** Mindstorm Robotics => Programming => Structures => While Loop

- Sub diagram will be repeated until Boolean condition is true
- Condition is represented by conditional terminal
- Right allows selecting whether iterations will stop or continue if condition is true
- The iteration terminal includes the number of the actually executed iteration
Output

**Menu** Mindstorm Robotics => I/O=> Move Motors

**Move Motors**

Moves DC motors with either constant power or constant speed

**Inputs**

*Motors* specifies which motor controller and port each motor is connected to.

*NXT* establishes the flow of the program. Wire the *NXT* output of the previous VI in the program to the *NXT* input of this VI.

*Power/Speed* specifies the amount of power, from -100 to 100, with which you want to move the motors or the speed, in seconds, at which you want to move the motors.
Outputs

**NXT** establishes the flow of the program. Wire the **NXT** output of this VI to the **NXT** input of the next VI in the program.
**Menu:** Mindstorm Robotics => I/O=> Stop Motors

**Stop Motors**
Stops DC motors immediately or slows to a stop, depending on **Brake** or **Coast**

**Inputs**
- **Motors** specifies which motor controller and port each motor is connected to.
- **NXT** establishes the flow of the program.

**Outputs**
- **NXT** establishes the flow of the program. Wire the NXT output of this VI to the NXT input of the next VI in the program.
Display

Menu: Mindstorm Robotics => I/O=> Display

Display
- Writes text on the NXT brick's screen given a line number (Line 1 = top of the screen, Line 8 = bottom of the screen)
- displays only strings.
- 16 characters on a line

This example writes "Hello World!" in the upper left-hand corner on the NXT brick's screen.
Downloading software

**Menu:** Tools => NXT/EV3 Terminal

- Download either via USB or Bluetooth
- Terminal window
- Find NXT/EV3
- File => Target to EV3 => Deploy
Small example

Goal: robot moves forward until ultrasonic sensor detects a obstacle 20 cm away from it.

Terminate loop if Comparison returns true