
 Technical Aspects of Multimodal System
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Praktikum: 3

Telebot: first try


Lecturers

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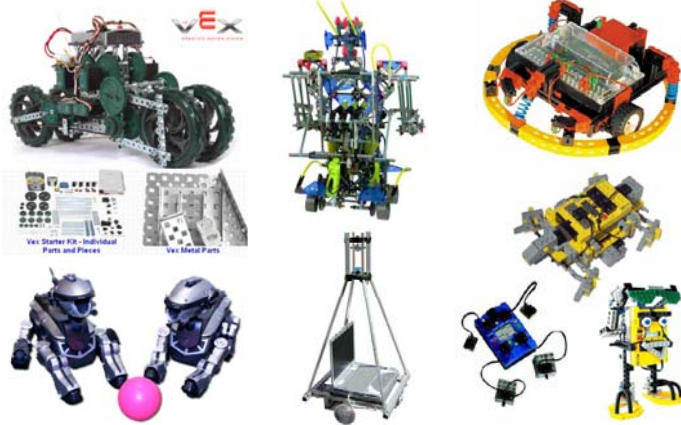



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Content of today's lecture

- [Introduction to Lego mindstorms](#)
- **Telebot system: first experiments**
 - Introduction
 - Components
 - Hardware realization
 - Integration
 - Possible tasks
 - Implementation: mechanical system, programming, testing
- [Final evaluation](#)


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Web links for today

- **Lego mindstorms**
 - <http://mindstorms.lego.com/default.aspx?domainredir=www.legomindstorms.com>
- **Telebot project**
 - <http://tams-www.informatik.uni-hamburg.de/people/hzhang/projects/index.php?content=Teleroobot>


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Overview of the Telebot

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Telebot system introduction

- Telebot (TAMS group based on cooperation with BUAA, 2006)
 - 9 channels for sensor inputs; 4 outputs for actuators
 - Communication interface
 - Java and C++ programming easy
 - More flexible and extended functions

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Components

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Components (cont')

- Lego 9640 set 1 set
- 1 battery 1 X 8 /set
- Wireless serial interface 1 X 2 /set
- Actuators 1 set
- Sensors 1 set
- Microcontroller 1 set
- A box for all components 1 set

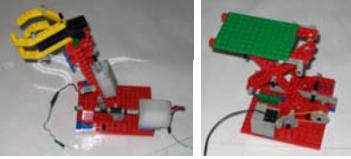

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Components (cont')

- Functionality
- Extensibility
- Easy handling
- Low cost


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Components (cont')

- Lego 9640 set
- 1 battery
- **Wireless serial interface**
- Actuators
- Sensors
- Microcontroller
- A box for all components




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Hardware realization: controller B

- ATmega16 microprocessor.
- The sensor channels from 0 to 6 can be used as digital or analog inputs; 7 and 8 can only be used in a digital way.
- Power supply should be 8.4V-24V
- Two communication interfaces on board: RS232 and TTL
- **ISP** for downloading the drivers
- Motor outputs 0 and 1 can be controlled by PWM signals; 2 and 3 are only under the on-off mode.







In-System Programming (abbreviated ISP) is the ability of some programmable logic devices, micro-controllers, and other programmable electronic chips to be programmed while installed in a complete system, rather than requiring the chip to be programmed prior to installing it into the system.

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Hardware realization: sensors

Kinds	Purposes	Number	Photo
Color sensor	Detect black and white	2	
Object sensor	Detect objects in front	2	
Light sensor	Detect an illuminant object such as a candle or a lamp	2	
Touch sensor	Switch	2	

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System integration

Mobile platform + Controller = Mobile robot + Manipulators + Sensors = Different robots

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Possible tasks for our practical course

- Moving along a line
- Detecting and moving around an obstacle
- Looking for an object
- Following a moving object
- Mapping the scenario
- ...

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Implementation

- Building mechanical system
- Programming
- Testing

Controller
 Supporting wheel
 Mobile robot
 Driving wheel
 Driving wheel
 Optical sensor (left)
 Optical sensor (right)
 Black line

50mm
 >2.5mm
 2.5mm

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Building the mechanical system

Controller

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GUI

Callouts for GUI components:

- PWM1 label: show the PWM rotate direction
- PWM1 duty
- Sensor field: show sensor's output
- Robot information field: show the robot status
- Relay output slider
- PWM DC output slider
- Speed slider: control the speed of the movement
- Analog/Digital button: change the sensor channel configuration
- Disconnect button: disconnect CGUI and telebot
- Start/Cancel button
- Timer: show the system period
- Alarm label: show the alarm status
- DC1 label: show the output status of relay dc output 1
- Movement button: control the movement of the telebot

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Testing the hardware

Callouts for hardware testing:

- Put your hand in front of the infrared sensor
- Infrared sensor connects to channel 1
- CGUI shows the feedback. Sensor 1 detects something.

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Testing the hardware (cont ')

Callouts for hardware testing (cont):

- PWM2 output connects to a PWM motor.
- CGUI shows the feedback. Sensor 1 detects something.
- PWM2 slider controls the PWM2 output
- PWM2 label shows the output direction of PWM2 channel.
- Progress bar shows the duty of PWM

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Programming the robot

```

graph TD
    Start([Start]) --> Sensor[Sensor inputs]
    subgraph Inputs
        V0[V0= Input 0(L)]
        V1[V1= Input 1(R)]
    end
    Sensor --> V0{V0=1?}
    V0 -- Y --> V1_1{V1=1?}
    V0 -- N --> V1_2{V1=1?}
    V1_1 -- Y --> M1["Motor(L)=-50% & Motor(R)=+50%"]
    V1_1 -- N --> M2["Motor(L)=-80% & Motor(R)=+10%"]
    V1_2 -- Y --> M3["Motor(L)=-10% & Motor(R)=+80%"]
    V1_2 -- N --> M4["Motor(L)= 0% & Motor(R)= 0%"]
    M1 --> Motor[Motor]
    M2 --> Motor
    M3 --> Motor
    M4 --> Motor
    Motor --> End([End])
  
```

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Hint: What is PWM?

- **PWM Motor.** This motor is connected to the PWM output channel of the low-level controller. The rotation speed and the rotation direction are adjustable.
- **Pulse-width modulation (PWM)** of a signal or power source involves the modulation of its duty cycle, to either convey information over a communications channel or control the amount of power sent to a load.

http://en.wikipedia.org/wiki/Pulse_width_modulation

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Hint: PWM

- The PWM uses controller to create a high frequency pulse signal to drive on and off of signal. The duty (percentage of On time to PWM period) on the motor will determine the output flow rate or speed to the motor.
- A typical PWM signal is shown in figure, where T is PWM period, To is On time.

$$\tau = \frac{T_o}{T} \times 100\%$$

- The relationship between the duty of actuator and its output speed is shown in other figure. The bigger the duty, the bigger the output.

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C and Java programming environments

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Now run a test on you own!

Discussion.....


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Testing: Mechanical experience


- Task 1. build a robot with a gripper
 - To grasp an object.
 - Please test your mechanical platform.



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Task 1: Build a robot with a gripper

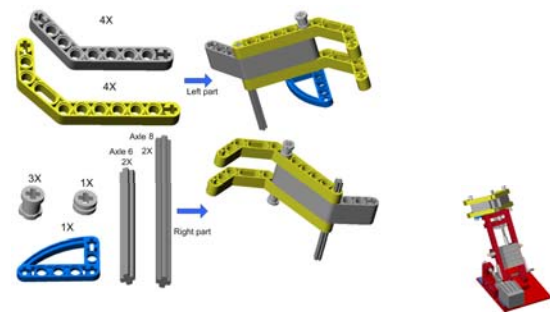


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Task 1: Build a robot with a gripper

- Step 1

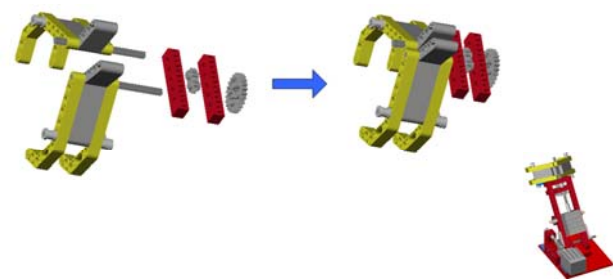


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Task 1: Build a robot with a gripper

- Step 2

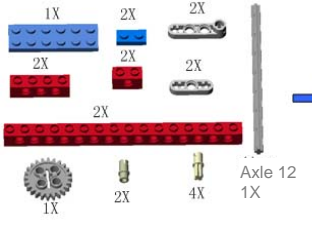




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Task 1: Build a robot with a gripper


- Step 3


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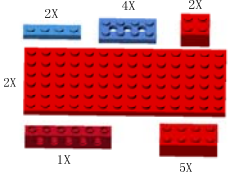
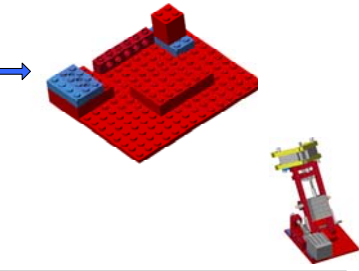
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Task 1: Build a robot with a gripper


- Step 4


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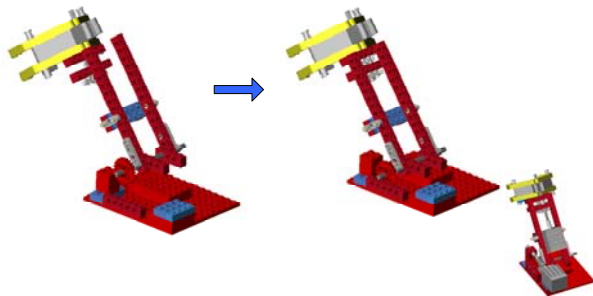
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Task 1: Build a robot with a gripper


- Step 5




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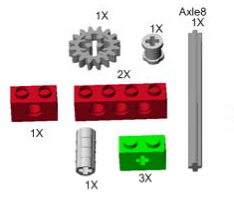
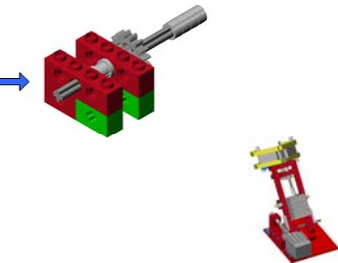
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Task 1: Build a robot with a gripper

- Step 6


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Task 1: Build a robot with a gripper

- Step 7

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Task 1: Build a robot with a gripper

- Step 8

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Do it by your own...

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18.272 Praktikum: 4

Telebot system environment

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Thanks for your attention!

Any questions?

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Praktikum: 5 & 6
Telebot sensors and actuators

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Praktikum: 7 & 8 & 9
Telebot system integration

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