
Technical Aspects of Multimodal System
 Dept. Informatics, Faculty of Mathematics, Informatics and Natural Sciences
 University of Hamburg


Praktikum: 5 & 6

Telebot sensors and actuators


Lecturers

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Manfred Grove


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Praktikum: 5

Telebot sensors


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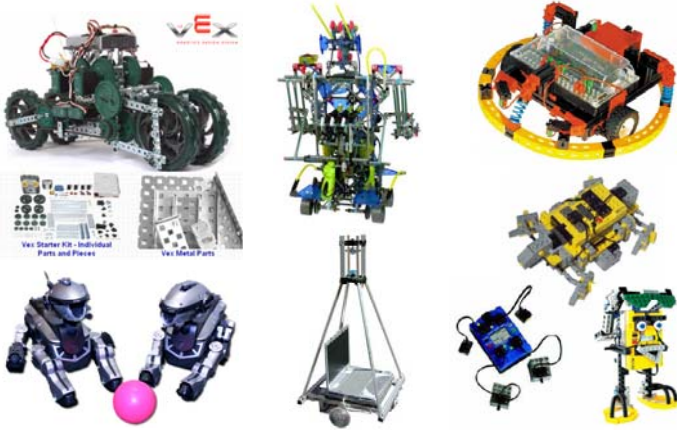



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Content of today's lecture

- Telebot sensors
 - Introduction
 - Simple test
 - Your tasks

- Telebot actuators
 - Introduction
 - Simple test
 - Your tasks


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Web links for today's lecture

- **Telebot project**
 - <http://tams-www.informatik.uni-hamburg.de/people/hzhang/projects/index.php?content=Telerobot>

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Content of today's lecture

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Sensors

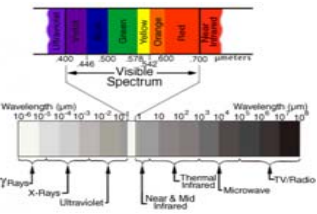
| Kinds | Purposes | Number | Photo |
|---------------|--|--------|---|
| Color sensor | Detect black and white | 2 |  |
| Object sensor | Detect objects in front | 2 |  |
| Light sensor | Detect an illuminant object such as a candle or a lamp | 2 |  |
| Touch sensor | Switch | 2 |  |

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What is the infrared radiation?

- It is an electromagnetic radiation of a wavelength longer than that of visible light, but shorter than that of microwaves.
- Infrared radiation has wavelengths between about 750 nm and 1 mm, spanning five orders of magnitude.



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Infrared sensor

| Radiation | Wavelength (Angstroms) | Wavelength (centimeters) | Frequency (Hz) | Energy (eV) |
|-------------|------------------------|---------------------------------------|---|------------------|
| Radio | $> 10^9$ | > 10 | $< 3 \times 10^9$ | $< 10^{-5}$ |
| Microwave | $10^9 - 10^6$ | $10 - 0.01$ | $3 \times 10^9 - 3 \times 10^{12}$ | $10^{-5} - 0.01$ |
| Infrared | $10^6 - 7000$ | $0.01 - 7 \times 10^{-5}$ | $3 \times 10^{12} - 4.3 \times 10^{14}$ | $0.01 - 2$ |
| Visible | $7000 - 4000$ | $7 \times 10^{-5} - 4 \times 10^{-5}$ | $4.3 \times 10^{14} - 7.5 \times 10^{14}$ | $2 - 3$ |
| Ultraviolet | $4000 - 10$ | $4 \times 10^{-5} - 10^{-7}$ | $7.5 \times 10^{14} - 3 \times 10^{17}$ | $3 - 10^8$ |
| X-Rays | $10 - 0.1$ | $10^{-7} - 10^{-9}$ | $3 \times 10^{17} - 3 \times 10^{19}$ | $10^3 - 10^5$ |
| Gamma Rays | < 0.1 | $< 10^9$ | $> 3 \times 10^{19}$ | $> 10^4$ |

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Infrared sensor

- Sensing range: 0.5-150 cm
- 1.5 degree measurement angle
- Affected by light
- Relative cheap
- Can be used to detect color

| Color | Reflectivity |
|-------|--------------|
| Dark | 90% |
| White | 18% |
| Gray | |

Our sensors' specifications

| | |
|------------------|------------|
| Working voltage | 4-6V |
| Working current | 10-20mA |
| Measure distance | 0.5-3cm |
| Output | On and off |
| Response time | <1ms |

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Black and white tracker principle

Tracker or liner following sensors

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Light sensor


- A light sensor is a sensor that measures the amount of light that it sees.
- This sensor has many uses, from a simple detector telling if someone has turned on the lights to enabling your robot to follow a black line on a white surface.

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Touch sensor

- Also called button or limit switch
- In principle, this kind of sensor must physically touch an object before the sensor is activated.
- When the switch is depressed, the circuit is closed and current flows; and when it is released again, the circuit is open and no current flows. As a result, the output of the sensor is a binary value.
- In a simple sentence, the touch sensor acts like a light switch in your house. When the button is pressed, this closes an electrical circuit and lets electricity flow through the sensor.



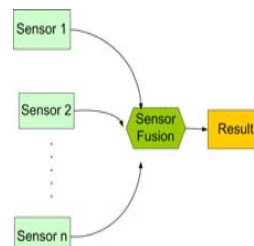
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Sensor fusion

- **Sensor fusion** is the combination of sensory data or data derived from sensory data from disparate sources such that the resulting information is in some sense better than would be possible if these sources were used individually.



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Sensor fusion depends on ...

- The quality of the sensors
 - *Is the designer's responsibility.*
- The positions of the sensors
 - *Is the user's responsibility.*
- The fusion algorithm
 - *Is the user's responsibility.*

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Some problems

- The sensor used in our telebot is relatively simple and cheap according to our financial situation.
- The sensors for the future version will possible be better.
 - More accurate
 - More complete
 - More reliable

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Praktikum: 6

Telebot actuators

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Actuators

- Relay
- Motor
- Lamp
- Beeper




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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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PWM

- The PWM uses the controller to create a high frequency pulse signal to drive on the 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 the above figure, where T is PWM period, To is On time.

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

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

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Your tasks for today

- Please build your own movement platform and let it move in a square in the scenario.
- Problem:**
 - Maybe the robot does not move so perfectly.
- Why?**
 - We are not using the sensor to adjust the movement on time.

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Your tasks for today

- Please build your own movement platform and let it move in an “8” in the scenario.

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It is time for your task now...

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Praktikum: 7 & 8

Telebot system integration

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Thanks for your attention!

Any questions?

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