

 Technical Aspects of Multimodal System  
 Dept. Informatics, Faculty of Mathematics, Informatics and Natural Sciences  
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## Praktikum: 4

### Telebot system environment

**Lecturers**

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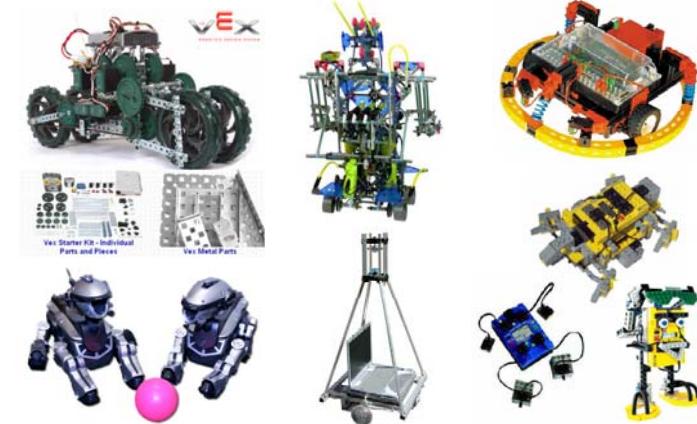


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## Content of today's lecture

- Program introduction
- Telebot program environment
  - Overview
  - Example
- Your task

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## C++ Introduction

- Structure of a program
- Variables, data types
- Constants
- Operators
- You can get more help in
  - <http://www.cplusplus.com/doc/tutorial/>
- More online documents.
  - <http://tams-www.informatik.uni-hamburg.de/people/hzhang/projects/TelerobotDocument/index.htm>

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## Structure of a program

```
#include <iostream>
using namespace std;

int main ()
{ cout << "Hello World!" << endl;
  return 0;
}
```

Hello World!

Please use **g++** compiler.

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## Variables & data types

- Global variables
- Local variables
- Constants
- Operators

```
// operating with variables
#include <iostream>
using namespace std;
int main ()
{
  // declaring variables:
  int a, b;
  int result;
  // process:
  a = 5;
  b = 2;
  a = a + 1;
  result = a - b;
  // print out the result:
  cout << result << endl;
  // terminate the program:
  return 0;
}
```

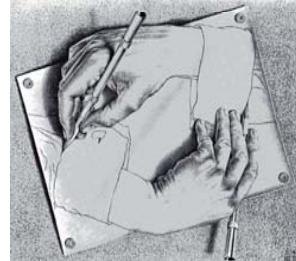
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## Control Structures

- **If and else**
- Iteration structures (Loops)
  - **while** loop
  - **do-while** loop
  - **for** loop
- The selective structure: **switch**



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## Functions

- Defining functions and methods
- Calling functions and methods

```
// function example
#include <iostream>
using namespace std;
int addition (int a, int b)
{
    int r; r=a+b; return (r);
}

int main ()
{ int z;
z = addition (5,3);
cout << "The result is " << z << endl;
return 0;
}
```

The result is 8

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## Object-oriented Programming (OOP)

- Class
- Object

```
#include <iostream>
using namespace std;
class CLrect {
float x,y;
public:
CLrect(void);
CLrect(float, float);
void set_values(float, float);
float area() { return(x*y); }
};

CLrect::CLrect(void)// Konstruktor 1
{} // besser z.B.: x= 0; y= 0;
CLrect::CLrect(float a, float b) // Konstruktor 2
{ x= a; y= b; }

void CLrect::set_values(float a, float b)
{ x= a; y= b; }
```

```
int main()
{ CLrect R;
CLrect *R2 = new CLrect(3.0, 8.0);
R.set_values(3.0, 4.0);
cout << "Fläche: " << R.area() << endl;
cout << "Fläche2= " << R2->area() << endl;
return 0;
}
```

Fläche: 12  
Fläche2:24

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## How to program the Telebot?

- First build your telebot
- Task description:
  - If there is an object in front of the telebot, it moves. If not, it stops. The Robot works without connecting to the GUI.

install the infrared sensor on sensor 1 channel

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## Building the mechanical system

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## Programming the robot

```
#include "Telerobot.h" //import the Telerobot head file
int main(int argc, char *argv[])
{
    Telerobot *t=new Telerobot; //create a telerobot object
    t->robotConnect(); // connect the telerobot and your PC
    t->initial(); //initialization the telerobot
    t->ask(); //gets the sensor feedback
    while (!t->Stop_flag) //check if mission shoud be canceled
    {
        if (!t->Pause_flag) //check if mission should be paused
            { if (t->getSensor1()) t->moveForward(90); //if sensor1 is true robot moves forward with 90% speed
              else t->stop(); //else robot stops
            };
        t->checkGuiCommand();
    };
    t->missionOver(); //mission over, buzzer pipes.
    t->robotDisconnect(); //disconnect the telerobot
}
```

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## Compiling the program

- Compile your code with **g++**
  - **g++ -L. -o destination\_file\_name code\_file\_name.cpp -lTelerobotLibrary**
  - or
  - **g++ -L. -o destination\_file\_name code\_file\_name.cpp Telerobot.cpp**
- The API library can be found on the TAMS web page.
  - <http://tams-www.informatik.uni-hamburg.de/people/hzhang/projects/TelerobotDocument/index-Dateien/Page751.htm>

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## Correct use of sensors in your program

- Task: Move forward until an obstacle is found

*Wrong !!*

```
.....
t->moveForward(50);
while (!getSensor1())
    ;
t->stop();
.....
```

*Correct*

```
.....
t->moveForward(50);
while (!getSensor1())
    t->ask();
// or t->moveForward(50);
// t->stop();
.....
```

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## Using analogue sensors (1)

- Sensorchannels 6 and 7 can supply analogue values, when you connect one of the optical sensors to them (8 Bit)
- For every method using digital sensors there is a corresponding method using analogue sensors on channel 6 and 7
- For example:

Digital: `ask()`

`moveRight(50)`

Analogue: `ask_Asensor()`

`moveRight_Asensor(50)`



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## Using analogue sensors (2)

- You can get the analogue values by calling the methods

`getAnalogueSensor6()`

and/or

`getAnalogueSensor7()`

Both return an (unsigned) char (1 byte)



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## Writing standalone programs

- You don't need MCGUI to run a program using the Telebot.
- If you are writing a standalone program you should

! Delete all calls to

`checkGuiCommand()` (important !)

! After creating the telebot-object call the method

`setmyoutput(true)`



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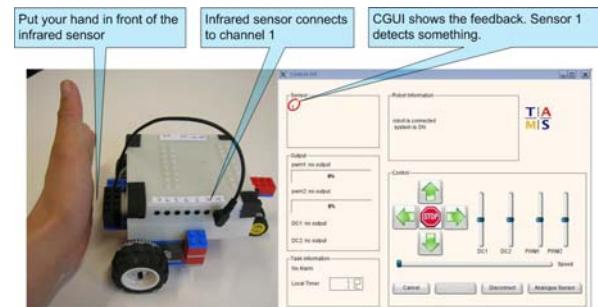
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## Testing your soft code with the Telebot

- First check your hardware with CGUI application



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# Testing your soft code with the Telebot

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.

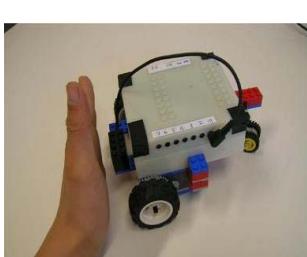
Progress bar shows the duty of PWM

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# Testing your soft code with the Telebot

- Execute your program on a Linux console



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# Your task ( after a 15-min-break)

- Following a line

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Execute your code on a Linux console

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Execute your code on the MCGUI(Monitor and Control GUI)

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The MCGUI interface shows a 'Monitor and Control' window. It includes fields for 'Task information' (Sensor, Actuator, Local Timer), 'Mission control' (Process path, Mission), and 'Robot information' (PWM output to DFI, PWM output to DFI, DC motor to DFI, DC motor to DFI). A 'Load' button is highlighted with the instruction 'Here type the path of your task process.' Below it, two buttons are labeled: '1. Click this button to load your task process' and '2. Click Mission Start button to start your task process.'

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## How to use MCGUI?

- Type in the execute code path
- Load
- Start the mission
- Terminate the mission

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The MCGUI interface is shown again, but with many more components annotated with green callouts. Labels include: 'Sensor field: show the sensor's status', 'Alarm label: show the alarm status', 'Mission label: show the mission status of task process', 'Timer: show the system period', 'Line editor: user can give the process path here', 'Load button: load the task program', 'Start button: start the task process', 'Cancel button: terminates the task process', 'Continue button: release the task process', 'Pause button: hang up the task process', 'DC label: show the output status of relay DC outputs', 'PWM1 duty: show the PWM rotate direction', 'PWM1 label: show the PWM rotate direction', 'Pwm value: show the PWM value', 'DC value: show the DC value', and 'Robot information field: show the robot movement information'.

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## Implementation

- Building the mechanical system
- Programming
- Testing

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A 3D CAD model of a mobile robot is shown. The model is labeled with various components: Controller, Supporting wheel, Mobile robot, Driving wheel, Optical sensor (left), Optical sensor (right), and Black line. Dimensions are indicated: a front wheel is 50mm wide, the distance between the front wheels is >25mm, and the distance between the rear wheels is 25mm. The model also shows internal gears and a motor.

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## Building the mechanical system

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Photographs and 3D models illustrate the assembly of the mobile robot. The top row shows the robot's internal structure with various gears and a motor. The bottom row shows the assembled robot with a red base plate and a black controller connected via a cable.

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## Programming the robot

```

graph TD
    Start([Start]) --> SensorInputs[Sensor inputs]
    SensorInputs --> V0[V0= Input 0(L)]
    SensorInputs --> V1[V1= Input 1(R)]
    V0 --> V0_1{V0=1?}
    V1 --> V1_I{V1=I?}
    V1 --> V1_1{V1=1?}
    V0_1 -- Y --> V1_I
    V0_1 -- N --> V1_1
    V1_I -- Y --> MotorL1[Motor(L) = -50% & Motor(R) = +50%]
    V1_I -- N --> MotorL2[Motor(L) = -80% & Motor(R) = +10%]
    V1_1 -- Y --> MotorL3[Motor(L) = -10% & Motor(R) = +80%]
    V1_1 -- N --> MotorL4[Motor(L) = 0% & Motor(R) = 0%]
    MotorL1 --> End([End])
    MotorL2 --> End
    MotorL3 --> End
    MotorL4 --> End
  
```

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Do it on your own...

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## Praktikum: 5 & 6

*Telebot sensors and actuators*

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Thanks for your attention!

Any questions?

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