

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


Proseminar Roboter und Aktivmedien

Mobile Service Robot "TASER"

Lecturer

Houxiang Zhang

TAMS, Department of Informatics
 University of Hamburg, Germany




©Tams

TAMS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 1

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Control PC
 - Actuators
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions




TAMS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 2

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

Outline of today's lecture


- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Control PC
 - Actuators
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions



TAMS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 3

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

Our TAMS group




TAMS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 4

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Control PC
 - Actuators
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions




TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 5

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Control PC
 - Actuators
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions




TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 6

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

Review of TASER platform

- Taser
 - Service-robot of the University of Hamburg
 - Mobile platform with differential drive
 - Two Mitsubishi PA10-6C manipulators
 - Two 3-finger robotic hands
 - Stereovision camera head
 - Omni-directional vision system
 - Two SICK laser range finders
 - Pentium 4 control PC
 - Wireless LAN communication

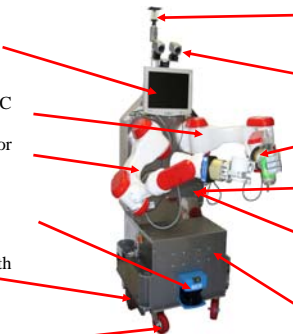


@TAMS

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 7

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

Hardware devices



- Screen mounting
- Mitsubishi PA10-6C
- Second manipulator
- Sick laser scanner
- Active wheels with encoders
- Passive wheels
- Omnidirectional vision system
- Stereo camera head with PTU
- BarrettHand and hand camera
- Controller for BarrettHand
- Controller for PA10
- Power electronics for PA10, controller for hand camera and PTU

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 8

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

Mobile Base

15" TFT-screen
 PCIMG-PC (2.4 GHz, 1 GB RAM, 1 ISA, 5 PCI, USB, VGA, sound, 100 Mbit LAN)
 8x lead-gel batteries
 Sick-laser range finder
 3x carrying wheels
 space for additional power electronics and hardware controllers
 power electronics, CAN-Bus-controller für battery voltage, joystick und gyroscope
 differential drive

@ Neobotix – GPS GmbH Stuttgart

Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

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

Research prototypes – old platform

stationary PC connected to other laboratory equipment and to a database
 TCP/IP IEEE 802.11b, 11 Mbps
 PA-10 Minolta Heavy Industries
 PA-10 arm controller
 ARCONET
 control PC with Linux and software for mobile robot and arm
 RS232 38400bps
 RS422 500000bps
 controller C167
 left and right drive
 camera
 gyroscope
 laser range finder front and back

Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Actuators
 - Control PC
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions

Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

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

Upper Body

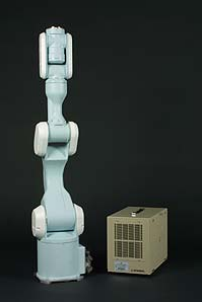
- Structure for two robot arms
- MHI - PA10-6C
- BarrettHand with hand camera
- Camera head with PTU
- Omnidirectional vision system

Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

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

Mitsubishi PA10

- Mitsubishi Heavy Industry
- 6 degrees of freedom, individually controllable
- Maximum range about 137cm
- Payload about 6 kg
- Controlled via ARCnet
 - Modified PCI-board
 - Control loop 2ms possible



TIA MIS Dr. ZHANG, Houxiang Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de http://tams-www.informatik.uni-hamburg.de/hzhang 13

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

PA10(2)


- Control software RCCL bzw. RCCL++
 - Supports control loop 10ms (RCI)
- Current work:
 - Adapt to RCCL to control two manipulators
- Problems:
 - Collision avoidance
 - Interaction/collaboration
 - Timing

TIA MIS Dr. ZHANG, Houxiang Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de http://tams-www.informatik.uni-hamburg.de/hzhang 14

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

BarrettHand BH-262

- Controlled by serial RS-232
- 4 degrees of freedom:
 - Open/close each finger individually
 - Spread angle between finger 1 and 3
- Force sensors in each finger (strain gauges)




TIA MIS Dr. ZHANG, Houxiang Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de http://tams-www.informatik.uni-hamburg.de/hzhang 15

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Actuators
 - Control PC
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions



TIA MIS Dr. ZHANG, Houxiang Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de http://tams-www.informatik.uni-hamburg.de/hzhang 16

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

System architecture

Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

17

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

Control PC

- Pentium 4 2,4 Ghz, industrial PC
 - 1 GB RAM
 - 54 Mbit WLAN
- SuSE 9.0 Linux (Kernel 2.4.21-166)
 - Kernel patched for Real-Time
 - Driver-Modules for:
 - CAN-Bus
 - Arcnet
 - Videograbber
 - MOXA serial board (obsolete)

Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

18

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

Control PC (2)

- Planned Progression:
 - Upgrade to Kernel 2.6 (Driver for USB-Framegrabber)
 - integration of second 2nd manipulator in software
 - improved documentation of software modules

Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

19

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

Drive system/CAN-Bus

- Individually controllable drive wheels
- Getting data of wheel encoders
- Getting data of battery voltage
- Getting data of gyroscope
- Getting joystick commands


Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems
 hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang

20

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Actuators
 - Control PC
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions



TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 21

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

Sensors onboard

- Gyroscope
- Wheel encoders
- Force sensor on the hand
- Stereovision on the shoulder
- Omni-directional camera on the top
- Two laser range finders in the front and at the back

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 22

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

SICK-Laser Range Finders

- Robot is equipped with 2 LRF's
- Serial communication at 500 kBaud
- Distance measurement, fan-shaped
- Used for
 - Collision avoidance
 - Navigation
 - Person-tracking

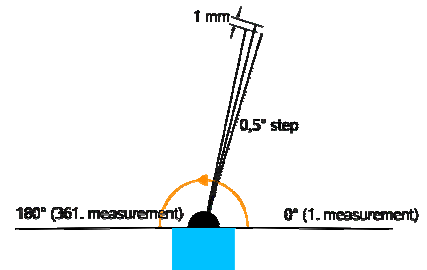


TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 23

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

LRF-measurement principle

- Rotary mirror
- Resolution: 1 mm
- 0,5° angular resolution



TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 24

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

SICK LMS 200 - integration

- Modified serial High-Speed-board from MOXA:
 - Quarth replaced to reach 500 kBd instead of 460 kBd
 - Linux-Kernel-module modified to this adjustment
 - Connection of 2 LRF's possible
- Problems:
 - high system load due to IRQ
 - loss of dataResolution: 1 mm

1 mm
 0.5° step
 180° (361. measurement)
 0° (1. measurement)

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 25

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

SMART-Interface for LMS-200

SICK LMS 200
 serial RS-422
 Rabbit Powercore 3800
 serial CMOS-level
 RS-422 transceiver
 ETHERNET
 HOST
 SICK LMS 200

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 26

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

Vision Systems

- Stereo camera head:
 - Two IEEE1394-cameras (640x480 pixel, 30 fps)
 - PTU serially controlled
- Omnidirectional Vision System:
 - IEEE1394-camera (1280x960 Pixel, 7.5 fps)
 - Hyperbolic mirror
- Hand-camera:
 - Analogue micro-camera with external electronics
 - Digitalized with USB-Grabber

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 27

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

Stereo-Head


- 3D – Image information by correlation of two images
- Depth information about the scene
- Visual serving

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 28

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

Omni-directional camera system


- Parabolic mirror
- 360° view
- Transformation to perspective image possible
- Used for coarse overview of the scene



T+I+M+S Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 29

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

Omni-directional camera system (2)




T+I+M+S Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 30

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

Hand-Camera

- Jai Microhead Camera
- Analogue, digitalize by USB-Framegrabber
- Controls approach to objects
- Fine-positioning




T+I+M+S Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 31

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Actuators
 - Control PC
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions

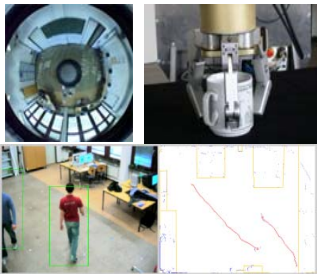


T+I+M+S Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 32

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

Research prototypes – TASER

- Taser
 - Mobile manipulation
 - Grasping
 - Mobile robot navigation
 - People tracking
 - 3D image processing
 - Man-machine interaction



@TAMS

TIAS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 33

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

Research Projects

- People Tracking
- Monocular 3D image reconstruction
- Navigation
- Learning by demonstration
- Grasping
- SMART-Camera-Systems

TIAS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 34

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


People Tracking

- Motion of people are recorded by cameras and laser range finders
- Detection of walking direction and speed
- Boost of Reliability due to multimodality
 - vision and laser range measurements
- Foreword looking path planning

TIAS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 35

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

People Tracking(2)



TIAS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 36

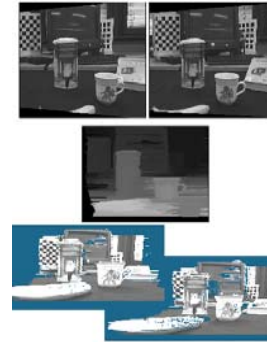


Monocular 3D image reconstruction

- Acquisition of two images with one camera
- Hand-camera is used
- Manipulator is moved between shots
- Calculation of depth information
- Control of grasps



Monocular 3D image reconstruction



Navigation

- Recognition of reflector marks with laser range finders
- Comparison with a map of all known reflector marks
- Calculation of robots' position
- Path planning




Learning by Demonstration

- 3D-recognition of human hand
- Use of Stereovision Camera Head
- Tracking of features
- Recognition of grasp types
- Transfer of grasps to manipulator

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

Grasping

- Development of a Reinforcement-Learning agent to calculate grasping strategies
- Shape of objects must be known
- Try- and Error-Learning, but actions that have lead to stable grasp are chosen more likely




TIA MIS Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang 41

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

SMART-Camera

- Camera-systems with integrated computing capabilities
- Connection via Ethernet
- Image (pre-)processing directly on the camera
- Image-information instead of raw image data
- Increase of image processing power/unload control PC of the service Robot



TIA MIS Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang 42

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

Specifications of the SMART-Camera

- Basler eXcite exA-1390
- Embedded Linux OS (2.6 Kernel)
- 1 Ghz MIPS processor
- 128 MB RAM, 128 MB ROM
- Gigabit Ethernet
- 1388 x 1038 resolution, 12 bit per pixel
- Bayer 8 colour-pattern

TIA MIS Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang 43

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

Plugin-based processing architecture

- Each processing step is done by a plug-in
- Processing functions are run consecutively on image-data
- Configuration at runtime
- Simple integration of new functions
- Reuse of code in different context
- Architecture uses Gstreamer Framework (Open Source)
 - Comparable with Direct Show (MS Windows)
 - Many existing plug-in (resizing, format conversion, network transfer)
 - Expandable

TIA MIS Dr. ZHANG, Houxiang
 Institute TAMS Technical Aspects of Multimodal Systems hzhang@informatik.uni-hamburg.de
 http://tams-www.informatik.uni-hamburg.de/hzhang 44

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

Example of a processing strategy

control

client on smart-camera
 -connection to Host
 -set up/control processing-chain

Gstreamer chain

data

TCP-Send → Feature Extraction → Low-Level-processing → Camera Driver Plugin

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 45

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

Outline of today's lecture

- Introduction to TAMS
- Review of TASER platform
 - Mobile platform
 - Actuators
 - Control PC
 - Sensors
- Research Project
 - Localization of mobile robot
 - Grasping
 - Learning
- Conclusions

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 46

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

Demonstration

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 47

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

Conclusions

- A mobile prototype with colourful devices
- Control system supports different onboard sensors to make the system full-functions
- Different high-level research implemented on this prototype
- Some open problems
 - Two arms integration
 - Hardware recourse limited
 - RCCL is not functional and easy-to-use.

TIA MIS Dr. ZHANG, Houxiang hzhang@informatik.uni-hamburg.de
 Institute TAMS Technical Aspects of Multimodal Systems http://tams-www.informatik.uni-hamburg.de/hzhang 48



Lecture material

- *Development of a Smart Laser Range Finder for an Autonomous Service Robot*, Hannes Bistry, Stephan Pöhlens, Daniel Westhoff, Jianwei Zhang "", Proceedings of the 2007 IEEE International Conference on Integration Technology (ICIT), Shenzhen, China, March 20-24, 2007
- *Three-Dimensional Monocular Scene Reconstruction for Service-Robots: An Application*, Sascha Jockel, Tim Baier-Löwenstein, Jianwei Zhang , In Proceedings of VISAPP 2007 - Second International Conference on Computer Vision Theory and Applications, Vol. Special Sessions, Barcelona, Spain, 2007 March 8-11, INSTICC Press, pp. 41-46.
- *Proactive Multimodal Perception for Feature Based Anchoring of Complex Objects*, Martin Weser, Jianwei Zhang, Proceedings of the 2007 IEEE International Conference on Robotics and Biomimetics (ROBIO), Sanya, China, December 15-18, 2007
- Many other publications on the webpage:
 - <http://tams-www.informatik.uni-hamburg.de/publications/>



Thanks for your attention!

Any questions?