

UNIVERSITÉ DE GENÈVE

Communication Multimédia

SES 4406 CR

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Multimedia Technologies (cont.)

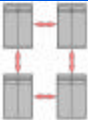
Professional systems

Information systems for multimedia applications
professional multimedia systems

Professional multimedia systems

Dominant technologies

- High-end x86 (some GHz) with Windows NT/XP
- Sparc (Scalable Performance ARChitecture, 32 bits RISC) with Unix (Sun)
- MIPS (Million Instructions Per Second, 32/64 bits RISC) with SGI Unix
(Silicon Graphics, high-performance computing + visualization, industrial / military use)
- MIPS * (# of CPU cycles/instruction) = GHz
- Cray SV (floating point operations' processor) with Unix (Silicon Graphics)
- Cluster computers - multiple servers linked together to handle variable workloads / fault tolerance



Information systems for multimedia applications
professional multimedia systems

High-end professional systems are, in general, composed from many computers and additional equipment, with total cost in order of millions of chf

Example: Virtual Studio consists of

- 2, 3 computers (out of which one is SGI for e.g. real-time video – generation/scene calculation)
- Video Synchronisation and switching equipment
- Cameras, tracking equipment



Information systems for multimedia applications
professional multimedia systems

Each system has its own advantages and disadvantages and targets a specific range of applications

- SGI systems target on real-time graphics and processing
- Sun targets on real-time servers (also video)
- High-end PCs are in general highly personalized and incorporated into complete system (for example multi-computer system for video-studio applications)

Information systems for multimedia applications
Hardware/Software for Home Multimedia Applications

Application example – home use & studio use


- Capture the video sentence, edit it, add graphics and subtitles, add audio comments, store the result on a video tape

Hardware

- PC : at least 3 GHz, 1 GB RAM
- Hard disc - 4GB / per hour (80 GB)
- Life Audio/Video capture card – analogue & digital
? ex. Fast AV-master card (700 CHF)
- Analogue/digital camcorder

Software

- Video editing application (improvements, add effects)
(ex. Ulead Media Studio)



Information systems for multimedia applications

Hardware/Software for Home Multimedia Applications



Practical problems

- If your PC is not strong enough, you will have a slow response from the applications (time for video editing operations)
- If other applications are running, the video card with drop frames (should capture 25 frames/sec) on capture and/or playback
- System might crash right at the moment you try to save the result of a 3 h work !
- Disk overflow due to multiple copies of video stream
- Medium video quality (for home viewing)

Information systems for multimedia applications

Hardware/Software for Professional Multimedia Applications



The same application in studio

- hardware
 - Digital camera and video recorder – set of monitors
 - High-end computer
 - ? PC with some GHz , GBs RAM, Win NT/XP, professional digital video capture card
 - ? Silicon Graphics Octane or Onyx workstations
 - fast disk array of at least 500GB of storage capacity
 - Hardware for video/audio synchronization
 - audio mixer console
- software
 - Video editing software – special effects generation

Information systems for multimedia applications


Hardware/Software for Professional Multimedia Applications



Characteristics of professional studio system

- Video is in digital format from capture to reproduction
- Computers are connected with fast network
- Operating systems are tuned for video




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Multimedia Technologies

Information systems for MM applications

Information systems for multimedia applications

Multimedia sensors and interfaces

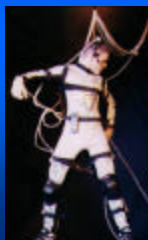
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Devices that capture a physical event generated by a person (/object) and convert it to computer-understandable form

Example: position of person in room, touch screen, data glove

➤ In multimedia virtual/augmented (mixed) reality we have two types of sensors

- Intrusive: sensor is physically attached to the person
 - ? movement & precision/price
- Non-Intrusive: sensor is not physically connected to the person (ex. Infrared sensor for locating the position of a person in a room)



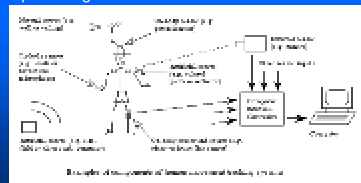
Information systems for multimedia applications

Multimedia sensors and interfaces – tracking of human movement

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➤ To get real-time data representing measured movement we need:

- Human (or object to track)
- Sensor(s) and/or marker(s) or source(s) + interface-electronics (on body)
- Source(s) or marker(s) and/or sensor(s) + interface-electronics (external)
- Computer interface-electronics + Computer
- Data representing the human movement



Information systems for multimedia applications

Multimedia sensors and interfaces – tracking of human movement

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- Classification of human movement tracking systems
 - Descriptive measures – *what + where is used to describe movement*
 - Medium between sensor and source (acoustical, electromagnetic, optical, mechanical)
 - Locations of sensor and source
 - Inside-in: sensor(s) and source(s) are both worn on the body
 - Inside-out: sensor(s) on body sense(s) external artificial / natural source(s)
 - Outside-in: external sensor(s) sense(s) artificial / natural source(s) on body
 - Type of source (artificial, natural)
 - Bodypart (finger, hand, arm, shoulder, head, eye, leg, etc)

Information systems for multimedia applications

Multimedia sensors and interfaces – tracking of human movement

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- Classification of human movement tracking systems
 - Static measures – *how system describes movement in space*
 - Spatial resolution XYZ, range
 - Static (spatial) accuracy
 - Additionally accuracy by means of - Linearity, hysteresis, calibration

Information systems for multimedia applications

Multimedia sensors and interfaces – tracking of human movement

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- Classification of human movement tracking systems
 - Dynamic measures – *how system describes dynamics of movement in space*
 - Dynamic accuracy (= static accuracy if system is linear)
 - Bandwidth, frequency range or temporal resolution
 - Latency, phase lag, update rate or temporal accuracy
 - Precision measures – *how precise system describes movement in space*
 - Repeatability, stability (drift, artifacts), durability
 - Noise, EM interference (RF, 60 Hz, ferromagnetic materials, occlusions), filtering, smoothing

Information systems for multimedia applications

Multimedia sensors and interfaces – tracking of human movement

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- Classification of human movement tracking systems
 - Interfacing measures – *how to access system describing movement in space*
 - Sensor interfacing and measurement (AC/DC voltage, resistance, ...)
 - Power supply
 - User interface and operating modes
 - Host communication interface (RS232, RS422, IEEE488, ..)
 - Wiring / wireless

Information systems for multimedia applications

Multimedia sensors and interfaces – tracking of human movement

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- Classification of human movement tracking systems
 - Computational measures – *how to get / interpret data from system*
 - Reference data frame
 - Data format
 - binary or ASCII format, headers and trailers, ..
 - Data representation
 - angle and muscle tension as a scalar
 - position as a 3-vector
 - orientation as euler angles
 - direction cosines
 - 3x3 rotation matrices or quaternions
 - derivatives ...

Information systems for multimedia applications

Multimedia sensors and interfaces – tracking of human movement

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- Classification of human movement tracking systems
 - Operational measures – *how to use system describing movement in space*
 - Form factor (size and weight of on-body sensor/cables and additional circuitry)
 - Workspace size
 - Comfortability, obtrusiveness
 - Setup time
 - Interoperability, compatibility with other systems
 - Temperature/humidity range
 - Economic measures – *how to get system describing movement in space*
 - Price
 - Customer support

Information systems for multimedia applications Movements Tracking

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Devices that allow to capture the position and movement of objects

General purpose tracker

- Can be attached to a person / object and measure the position, movements

Ex. Flock of Birds (<http://www.ascension-tech.com>) – position / orientation tracking of 1-4 sensors, provides six degrees-of-freedom (6DOF) tracking – X,Y,Z +Pitch (up/down) + Yaw (left/right) + Roll (rotation)

- Head Tracker specially designed for measurements of a head movements

- Ex. The Sony head tracker



Information systems for multimedia applications Movements Tracking

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Optical trackers

based on a video processing, they trace the position of specific points (anchors) on the body of a person- these points may be objects or reflecting colours / stripes attached to the person



Line-of-sight needed !!!



Information systems for multimedia applications Movements Tracking

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Characteristics of tracking devices

Technology

- Mechanic tracking
- Magnetic tracking (magnetic source needed, precise)
- Inertial tracking (low resolution, xyz)
- Optical tracking (require computer processing)
- Ultrasound – high precision, based on reflections

- Resolution of 6mm/15 deg to 2cm/2 deg

- Measurement frequency 30 to 500 Hz

- delay 2 to 20 ms (long!)

- cost - 1000 to more than 15.000 CHF



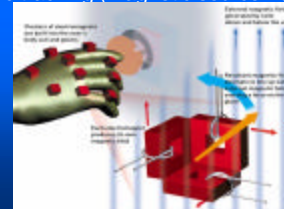
Information systems for multimedia applications Movements Tracking

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Characteristics of tracking devices

Technology

- Magnetic tracking (magnetic source needed, precise)



Information systems for multimedia applications Data Glove

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- An input device in the form of a glove which measures the movements of the wearer's fingers and gloves' position in space and transmits them to the computer

- Sophisticated data gloves also measure movement of the wrist and elbow

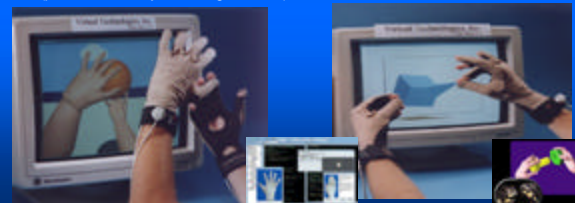
- Data glove may also contain control buttons or act as an output device, e.g. return force



Information systems for multimedia applications Data Glove – feedback force

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- The user usually sees a virtual image of data glove and can point or grasp and push objects (precision/latency of tracing matters!)



Information systems for multimedia applications Data Glove

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- ⚡ Characteristics of data gloves
- ⚡ Technologies for capturing
 - ⚡ Mechanic (direct)
 - ⚡ Optical fibre (based on light reflection)
 - ⚡ Sensitive bend (flexible material, sensors inside the glove)
- ⚡ Connection RS232 (relatively low speed)
- ⚡ Capture frequency: 30-300Hz (may be low for real-time!)
- ⚡ Sensors number: 10-20+ ? – e.g. finger, finger abduction thumb crossover, palm arch, wrist flexion and wrist abduction + flexion of the distal joints on the four fingers
- ⚡ Cost 500 - 20.000 CHF - ?



Information systems for multimedia applications Data Glove

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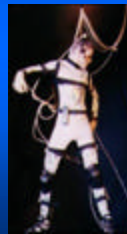
- ⚡ Characteristics of data gloves
- ⚡ Technologies for capturing
 - ⚡ Mechanic (direct)



Information systems for multimedia applications Body suit

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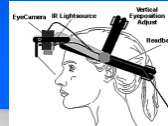
- ⚡ Technology similar to glove but for the whole body



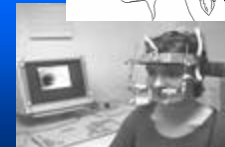
Information systems for multimedia applications Tracking of eyes

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- ⚡ Materials that allow for detection of eye position (where the person is looking at ?)
- ⚡ Ex. Helps understand learning process



pilots



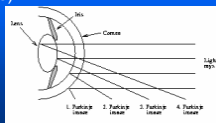
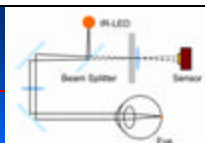
Medicine use

Information systems for multimedia Tracking of eyes

⚡ How eye-tracking works?

⚡ Different technologies available

- ? Image processing - a video camera system looks at the eye and the picture is processed by a computer system
- ? Techniques based on reflected light - Tracking of parts of the eye using light (mainly infrared light) reflected by the eye (on the cornea or further in in the eye)
 - ⚡ limbus tracking
 - ⚡ pupil tracking
 - ⚡ corneal and pupil reflection relationship
 - ⚡ corneal reflection and eye image using an artificial neural network and Purkinje image tracking



Information systems for multimedia Tracking of eyes

⚡ How eye-tracking works?

- ⚡ limbus tracking
- ⚡ track boundary between the white sclera and the dark iris of the eye
 - ⚡ easily optically detected and tracked
 - ⚡ technique based on the position and shape of the limbus *relative to the head*, so: head must be still or apparatus is fixed to the user's head
 - ⚡ eyelids cover top and bottom of the limbus – limbus tracking is suitable for precise horizontal tracking only



