Wearable Gestural Interface

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Outline

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- State of the art
- Demonstration application
- Gestures
- Hardware
- Software architecture
- Integration into InterFace
- Developed applications
- Conclusion and future works
- Demo
Idea of the project - 1

- Develop a wearable gestural interface for smart living room & smart meeting room
- Device should be able to communicate with other devices
- The design includes 2 parts: hardware & application
Idea of the project - 2

- **Goal of the project:**
  - Wearable tool
    - small, pervasive
  - Hand gestures for the communication
    - simple to use
  - Augment physical world with information
    - no need to open a notebook
  - Communication with other devices
    - multi-user applications
Idea of the project - 3

- Application
  - Gesture recognition can be divided in the following 3 parts:
    - Image acquisition and preprocessing
    - Tracking
    - Gesture recognition
  - Integration into other applications
State of the art - 1

- Augmented Reality
  - Augmented the environment of the user by additional information (mostly visual)

- Wearable Computing
  - Worn by the user
  - Challenges:
    - Power use
    - Heat dissipation
State of the art - 2

• Gesture Recognition
  ◦ Preprocessing
    • Color segmentation
  ◦ Tracking
    • Condensation
  ◦ Gesture recognition
    • Hidden Markov Model
State of the art - 3

- Gesture Recognition
  - Projects
    - sixthsense (WUU – Wear Ur World)
      - MIT
      - Inspiration
    - Inter-Face
      - EIA-FR
      - Integration of WGI in Inter-Face
Demonstration application

- Tasks of the Application
  - Open PowerPoint Files
  - Switch to presentation mode
  - Navigate into the slides
  - Close presentation mode
  - Send file to another tool
Gestures - I

- Gesture for clicking and scrolling

Left hand

Right hand

Select a point/object

Click

Release
Gestures - 3

- Gesture for opening presentation in full screen (F5)

The hands are at the beginning in the middle and go further out of the camera range.
Gestures - 4

- Gesture to close the presentation (ESC)

The hands are at the beginning out of the camera range and go than into the middle
Gestures - 5

- Gesture for the next slide

Left hand

next

Right hand
Gestures - 6

- Gesture for the previous slide
Gestures - 7

- Gesture to send a file to another person

Left hand  Right hand

The hand is at the beginning in the middle or on the left side and go further out of the camera range on the right side.
Hardware

- Comparison has been done
- Following products will be used.

  - **Beamer**
    - 3M MPro 110

  - **Camera**
    - QuickCam Pro for Notebooks

  - **Ultra mobile PC**
    - Sony Vaio UX micro PC
Hardware – Fixation - 1

- Beamer
  - Fixation at the belt
  - Arm can be moved in almost every direction
Hardware – Fixation - 2

- Camera
  - Fixed on a plastic panel
  - Band around the neck
Hardware – Fixation - 3

- UMPC
  - Fixed at the belt
  - (cable goes in the pocket because of the length of the cable)
Hardware – Fixation - 4

- Finger markers
  - Foxglove with parts of air balloons
Software architecture (WGI) - 1
Software architecture (WGI) - 2

- **GesureRecognition**
  - Controller for the gesture recognition
  - Contains a timer
  - Stocks the common objects for the whole gesture recognition
  - Uses the library Emgu CV
Software architecture (WGI) – 3

- Preprocessing
  - Input: image (webcam)
  - Image segmented in different colors (finger markers)
  - Cleaning image (morphology operator: opening and closing)
  - Rectangle color creation (one per color with center)
  - Output: coordinates of the color rectangles
  - Uses the library Emgu CV
Software architecture (WGI) – 4

• Tracking
  ◦ Input: coordinates of the color rectangles
  ◦ Permits to track the different color rectangles and prediction of the locations
  ◦ Output: prediction of the coordinates

  ◦ Emgu CV don’t support the condensation algorithm
  ◦ Tracking made in C++ with OpenCV
  ◦ Wrapping from C++ to C#

  ◦ Library: OpenCV
**GestureIdentification**

- **Input:** coordinates of the color rectangles
- **Permits to train different gestures**
- **Detect gestures**
- **Output:** gesture

- **Uses HTK library (voice recognition)**
- **Uses HTK extension GART (mouse gesture recognition)**
Software architecture (WGI) – 6

- **GestureExecution**
  - Permits to inform the interesting components
  - Contains the interface WGIListener
Integration of WGI

• Necessary steps to include WGI into another applications:
  ◦ Include the DLL WGI
  ◦ Create a class which includes the interface WGIListener
  ◦ Create an object of GestureRecognition
  ◦ Add the class with the interface WGIListener to the eventDistributor of GestureRecognition
Some additional explications

- WGI has two modes
  - Touch mode: like two mice
  - Gesture mode: permits to detect the gestures
- To switch between the two modes, the voice is used
- To train the gestures video files has to be placed in the folder for the gestures and the newTraining boolean has to be changed to true
- The raised gestures or mice activities are send to all WGIListeners
Developed applications - 1
Developed applications - 2
Developed applications - 3
Optimization and current problems

- Cutting the movies that every training movie has the same length
  - 92% of success rate

- Problems with differencing
  - F5 – ESC
  - Next – Prev
Conclusion and future work - I

- Occurred problems
  - HMM of OpenCV
    - In the auxiliary package
    - No documentation aside from the method descriptions
    - Bad error output
  - Some gestures not possible with GART
  - GART beta
    - Sometimes training was not possible
Conclusion and future work - 2

- Improvements and Future work
  - Application for the training
  - More extensive training
  - Brighter portable beamer
  - Extend to 3 dimensional gestures
  - Put camera nearer to the eyes of the user
Conclusion and future work - 3

- Improvements and Future work
  - Use of a IPhone or Android phone instead of a UMPC
  - Beamer integrated in the phone

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Conclusion and future work - 4

- Personal impressions
  - Complex project
  - Big challenge
  - Very interesting
  - Enriching project
Demo
References – 1

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