TAMPERE UNIVERSITY OF TECHNOLOGY
Institute of Electronics

Pervasive Mobile Interaction Devices

PERMID 2005

A Mobile Device as User Interface for Wearable Applications

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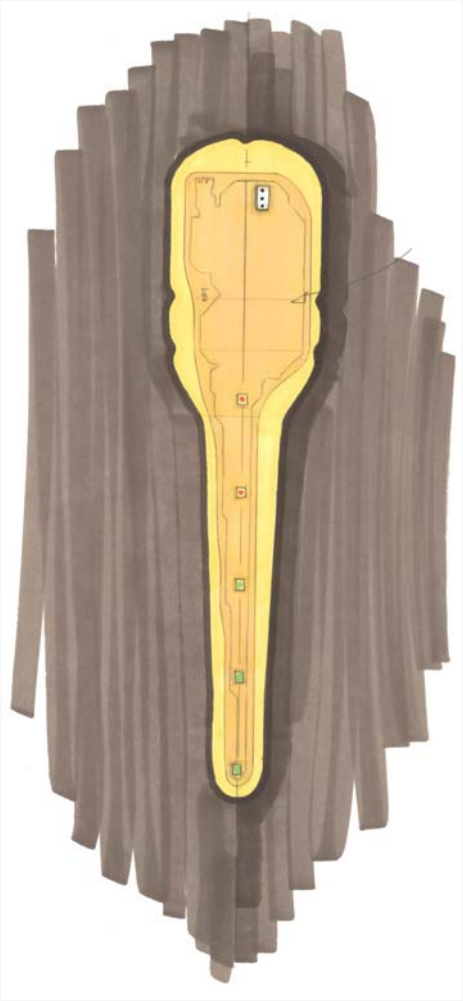

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II. THE CHALLENGE

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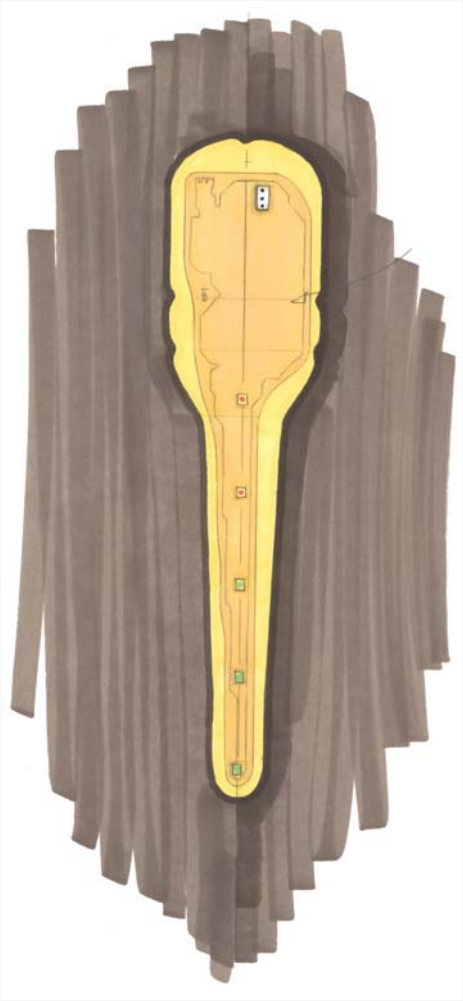
IV. THE RESEARCH

V. THE FUTURE



The Prediction

In the late 1990's

- Wearable technology will soon make mass market
- Wearable applications will overthrow the mobile handset
- Electronics will move closer to the user's body

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- Wearable technology will soon make mass market
- Wearable applications will overthrow the mobile handset
- Electronics will move closer to the user's body

Year 2005

- Wearable electronics haven't still made mass market
- Mobile handset market is flourishing

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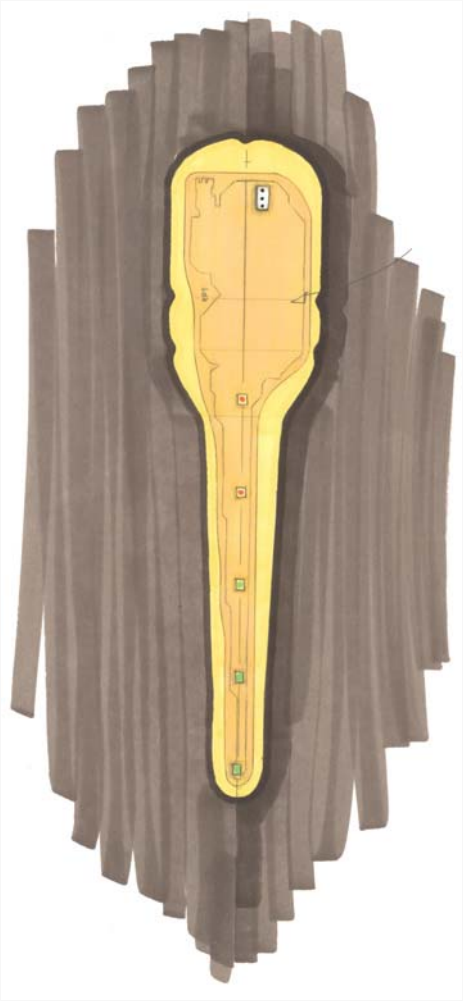

The Challenge

Maintenance of the garment

- Machine washing
- Recharging
- Customer service

The Challenge

- Maintenance of the garment
  - Machine washing
  - Recharging
  - Customer service
- Integrated wearable user interface
  - Soft washable keypad
  - Rigid surfaces on the body
  - Flexible display
  - Energy consumption
  - Interfacing with multiple layers of clothing

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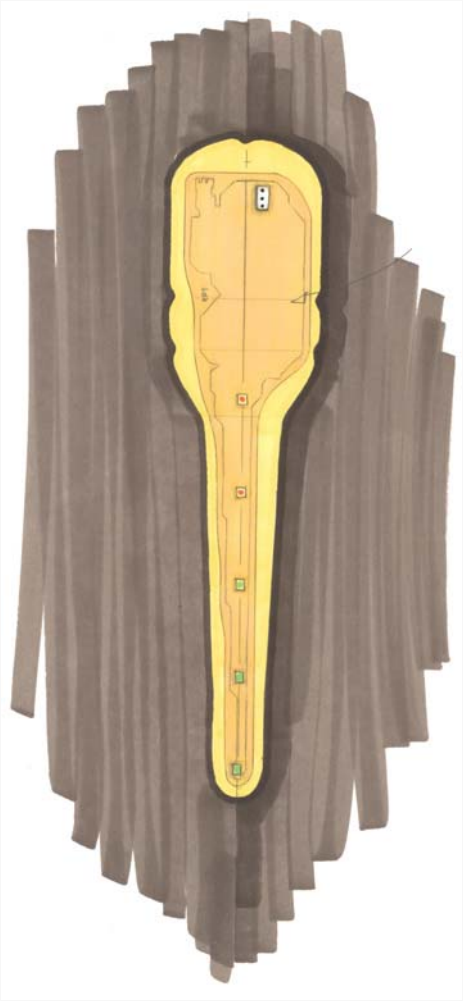


The Solution

A mobile device

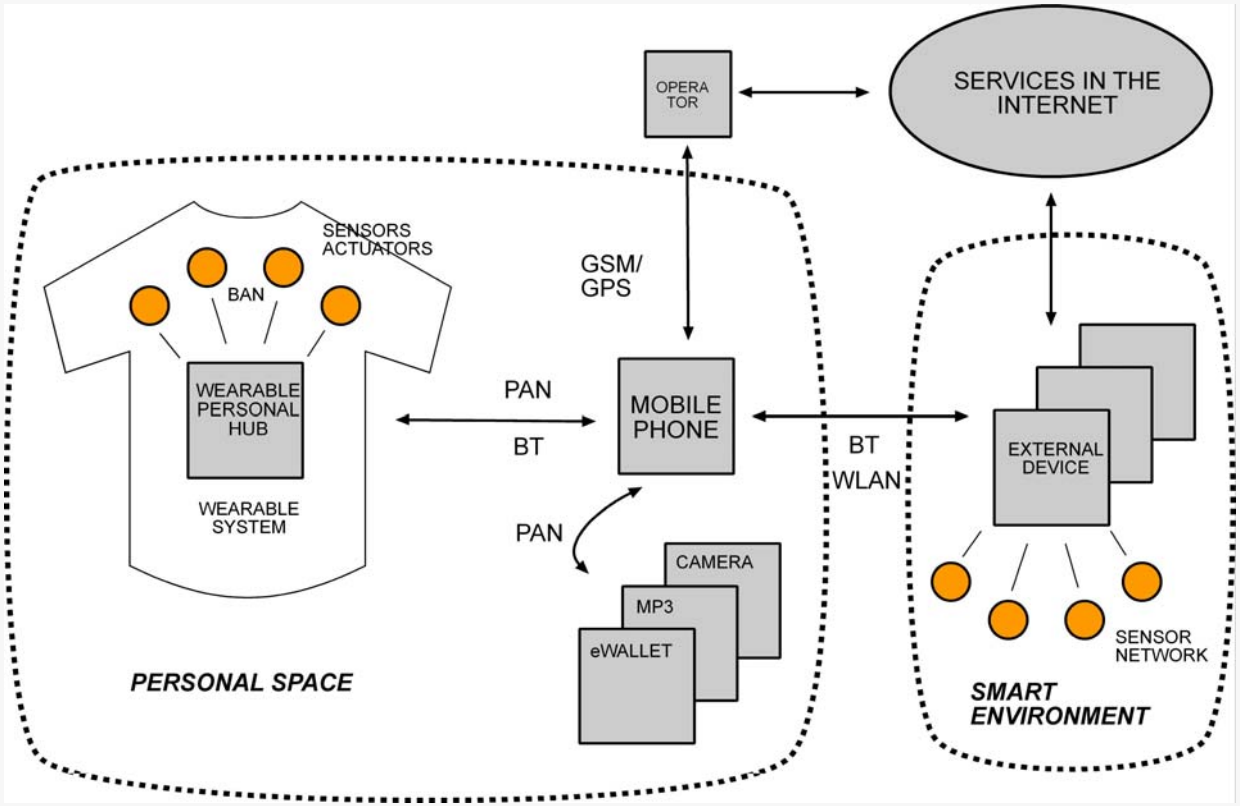
- User interface for wearable applications
  - Wireless connection
  - Good input/output capability
  - Customizable for different applications
  - Widely available and familiar to use
  - No added manufacturing costs

The Solution

- A mobile device
  - User interface for wearable applications
    - Wireless connection
    - Good input/output capability
    - Customizable for different applications
    - Widely available and familiar to use
    - No added manufacturing costs
  - Communication hub
    - Communication between the personal space and the environment
    - Bluetooth, GPRS, WLAN,…
    - Capability to run third party applications

The Solution

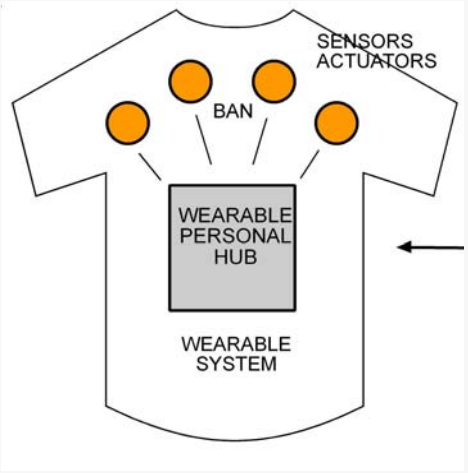
A Mobile Device as User Interface for Wearable Applications



The Solution

Body Area Network

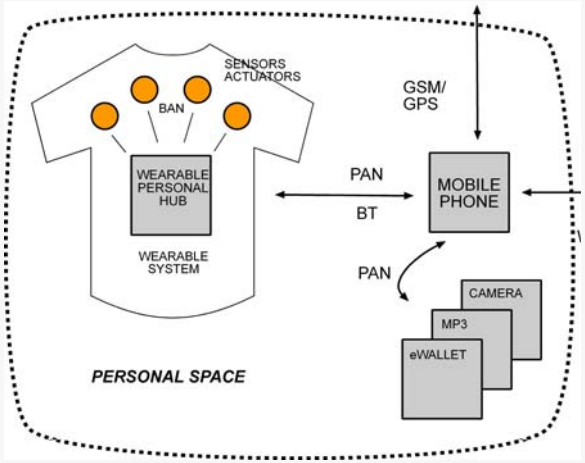
- Includes all parts of the wearable system located in the garment
- The wearable personal hub communicates with sensors and actuators
- Data transfer methods for BAN
  - Wiring inside the garment
  - Capacitive communication using body's skin surface
  - Wireless data transfer



The Solution

Personal Area Network

- Includes everything in the user's close proximity
- The mobile phone is the mediating device



  - Provides data transfer between BAN, PAN, smart environment and the Internet
  - Communicates with the wearable personal hub
  - Processes the data received from the garment
  - Communicates with the smart environment
  - Provides access to services in the Internet

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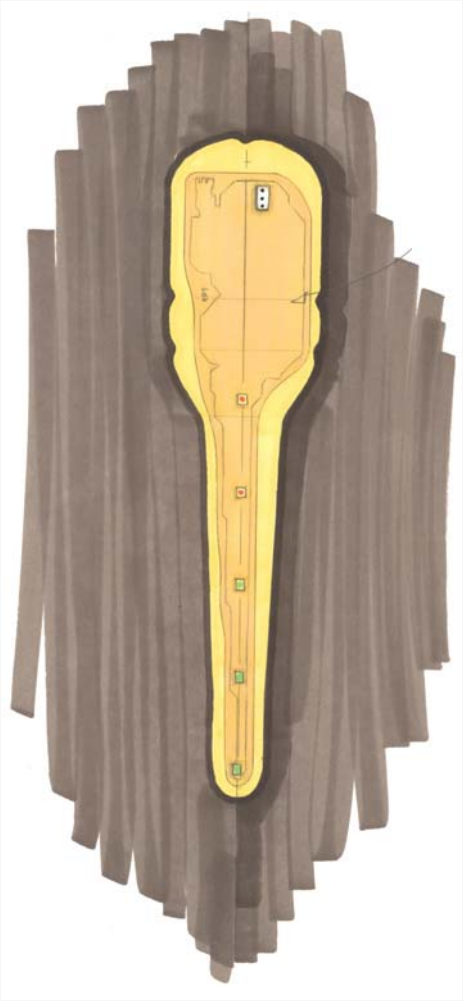


The Research

Wearable Electronics Maintenance Project

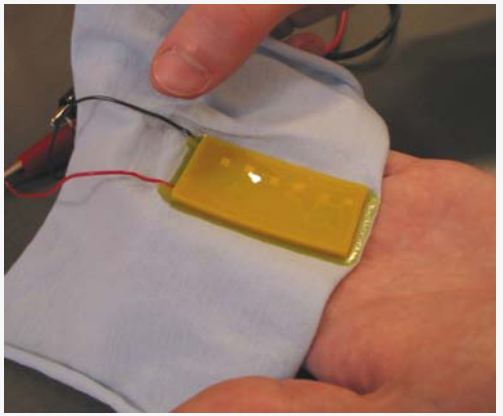
Polymer casting electronics

- Objective is to make machine washable and flexible electronics
- Unobtrusive and comfortable to wear
- Fully garment integrated
- Fits nicely with the concept of wireless external user interface

The Research

Testing the prototypes

- Regular household washing machine
  - 40°C with color detergent
  - Spin-dry at 900rpm
- Mechanical durability
  - Connections are critical with flexible circuit boards
- Waterproofing
  - Shielding against moisture and chemicals has proven to be sufficient



The Research

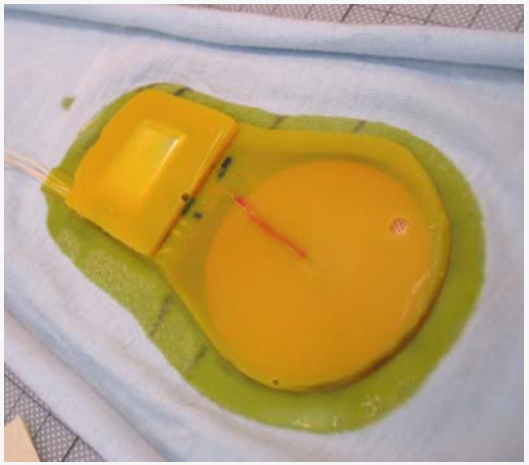
The Noise Shirt concept

- Prototype of a garment integrated electronic device
  - Flexible encasing
  - Wireless recharging
  - No wearable communication hub
- Built to test the maintenance solutions
- Measures the noise level of surrounding environment
  - Dynamic range from 65 to 100 dB
  - Indication with LEDs

The Research

Wireless recharging

- Inductive power transfer
  - A recharging interface in a clothes hanger
  - A neck-tab with induction coil and electronics
  - Recharging time 3 hours (3,7V 100mAh battery)
  - Run time from 2 to 4 hours (10 mA per LED)
- No bulky connectors
  - No need to plug in the shirt



The Research

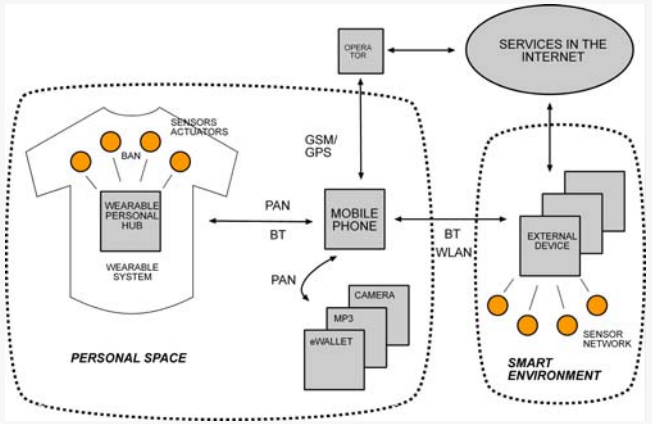
Interfacing wearable applications

- Typical application could be a body monitoring garment with sensors
- Input data to the garment
  - Low bit rate information
  - Device on/off, operation mode
- Output data from the garment
  - Mostly measurement data
  - Heart rate, respiration rate, EKG, EMG, perspiration, temperature, movement,…
  - Bit rate depends heavily on the application and the amount of pre-processing

The Research

Data processing

- In the garment
  - Real-time processing
  - Less data transfer
  - Limited data memory
  - Limited computing resources
- In the mobile phone
  - Reduced costs and complexity for the garment
  - Not real-time processing
- By a service provider
  - Data transfer costs (motion 24h 6 sensors ca. 40 MB)
  - Extensive resources for physical modelling



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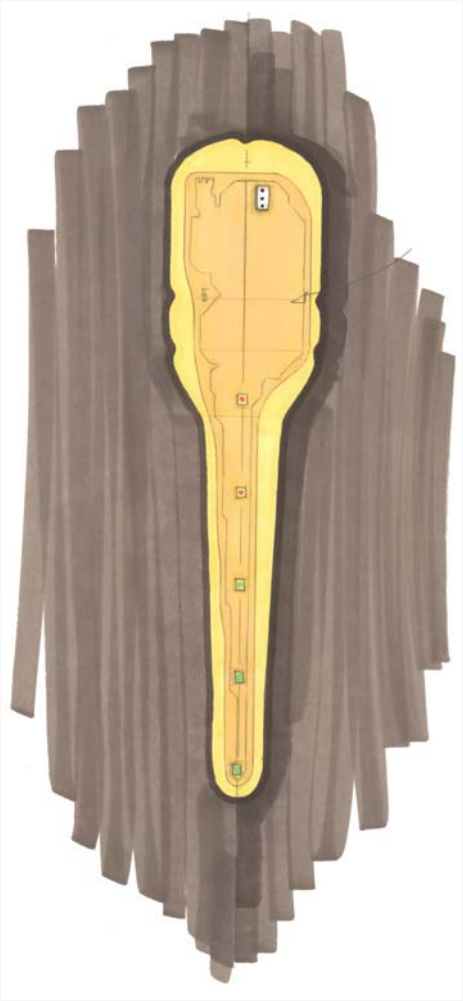

The Future

- A full featured implementation of the communication architecture will be done in the Wearable well-being project
- Research on the infrastructure around wearable electronics continues
- Our prediction
  - Fully garment integrated, machine washable electronics with a mobile device as user interface and communication hub will have a role in future wearable applications

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Thank you!