Preliminary Studies to Develop a Ubiquitous Computing and Health-monitoring System for Wheelchair Users

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**Vision - Ubiquitous**

Mini computer, UMPC, iPhone, Blackberry

convenient for general customer

**worse** for persons with manipulation impairment

Ubiquitous PC for people with disability

usable whenever & wherever it is needed

classroom, meeting, airports, and Starbucks
Vision - Wearable

Wearable Computer
special-purpose applications of wearable systems
No PC-level Wearable Computing System

Wearable PC for people with mobility impairments
Mobility Aid Devices (MAD) is an extension of their body
MAD can be a good platform to wear the PC
Vision – Quality of Life

Health-monitoring system
Telehealth seems particularly appropriate for vulnerable populations
Many health-monitoring devices and PC-based systems are available

Health-monitoring system on the wheelchair-worn PC
Power wheelchair users are a subgroup of that kind of vulnerable population
Measuring devices and monitoring systems are ready for the wheelchair-worn PC
We envision a wearable PC system, worn on the power wheelchair, which provides a ubiquitous computing and health-monitoring environment to people with mobility and manipulation.
A pathway to develop a new class of wearable PCs for real world settings

for heaviest mobility aid users

the most physically disabled

the most supportive environment

for lightest mobility aid users

the least physically disabled

the least supportive environment
Survey of Needs and Usage

Aims:
• to fully identify and understand the design requirements for the u-CHS
• to find out how they will use the system and for what tasks they plan to use the system
• to determine the needs of wheelchair users who will use the u-CHS on a daily basis
Survey of Needs and Usage

Methodology:
• Online-survey (SurveyMonkey.com)
  – Population: wheelchair users
  – Target Population: online users of population
  – Sampling frame:
    • Quad-List,
    • SCI Network,
    • WheelchairJuck.com,
    • CareCure Forum and
    • Korea Spinal Cord Injury Cybercenter
  – Sample: 97 responses
Survey of Needs and Usage

Methodology:
• Questionnaire: 50 questions
  – current physical condition;
  – work status;
  – Educational background;
  – type of wheelchair;
  – health service related questions;
  – computer usage;
  – recommendation about the design
Survey of Needs and Usage

Diagnosis

- SCI: 84%
- Others: 16%

Wheelchair Type

- Power Wheelchair: 74%
- Manual Wheelchair: 41%
- Both: 15%
Survey of Needs and Usage

Obstacles on using the laptop from your wheelchair

- To turn on the computer: 79%
- To adjust the monitor angle and position: 71%
- To use the keyboard: 63%
- To plug in the internet connection: 58%
- To use the pointing device: 56%
- To deploy and open the computer: 45%
- To access the table: 40%
- To take out the laptop from backpack: 34%
- To plug in the power connection: 29%
Survey of Needs and Usage

Top priority features to be included in the system

- Environmental protection: 69%
- Convenient Output device: 73%
- Powerful computing ability: 65%
- Ease to hide: 53%
- Outdoor usage: 52%
- Price: 51%
- Durableness/Toughness: 45%
- Convinient input device: 41%
- Ease to retrieve: 31%
Survey of Needs and Usage

See a doctor

- 81% more than once a year
- 51% at least every three months
- 27% more than once a month

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Survey of Needs and Usage

Medical Index preferred to monitor

- Blood Pressure
- Weight
- Blood Sugar
- Pulse
- Temperature
- Blood Oxygen
- Peak Flow
- Fluid Status
- ECG
Survey of Needs and Usage

Conclusion:
Five critical design features of the system

1) Ease of retrieving and hiding the input/output unit
2) Durable and weather protective
3) Outdoor usage
4) Powerful computing ability
5) Embedded weight scale
Design of The System

A monitor and keyboard hiding and swivel tray unit

Four alternative input device options

Health monitoring devices
- Web-based and/or PC-based health management program
- Universal connectivity tool

A lightweight, low-power control processing unit

Load cell for weight measurement

RST
Design of The System

CPU Unit

Power:
- receive power from the wheelchair battery
- supplementary power supply, optional battery,

Main board:
- CPU, memory, I/O bridge chips and various RF transceivers

HDD

Cable connection bays for the I/O unit

Wireless standards
- Bluetooth, Wireless LAN (WLAN, 802.11 a/b/g), GPS, and Wireless WAN (WWAN).
Design of The System

Tray-incorporated Input/Output Unit
Design of The System

Armrest Pocket-retrieval Input/Output Unit
Design of The System

Health-monitoring Unit

• Power wheelchair users typically must pay more attention to their health care (51% go see a doctor at least every three month, and 27% more than once a month)
  • Many health-monitoring devices and PC-based systems are currently available in the market
• Great demand to easily measure their weight (65% of responders)
  • A possible solution is to put load cells under the seat pan of the wheelchair and integrate a body weight monitor into the wheelchair-worn computer system
Thank you!