

Design of a Flexible User Interface Demonstrator, Control Software and Sensors

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Overview

Motivation & Purpose

User Interface Demonstrator

Sensors

Control Software

Findings and Conclusion

Why UI, Sensors and Control Software?

The FRR concept aims at a toilet which automatically adjusts to the individual needs of elderly persons with functional limitations and/or persons with disabilities.

Adjustability of many elements requires an appropriate user interface

Automatic Adjustability requires

- means to recognise current status and current activities and intentions of the user (---> sensors)
- an intelligent unit which can interpret different input signals and can steer the whole system (---> control software)

Don't forget

It is not about finding out how much technology can be packed into a laboratory toilet system

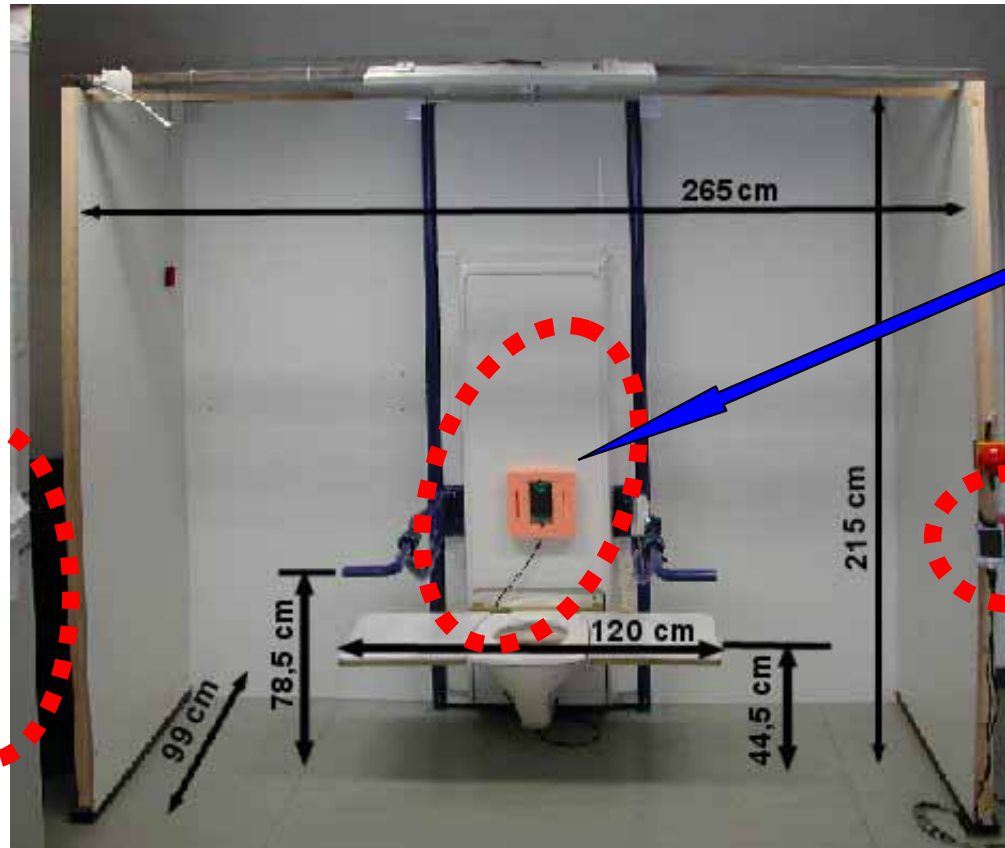
It is about investigating which new approaches are useful and promising from the users' point of view

in order to contribute to the main objective of the project: to allow the users to gain greater autonomy, independence, self-esteem, dignity, safety, improved self-care, to enjoy a better quality of life

UI, Sensors and Control SW provide means to contribute to this

Where is it located?

User Interface, Sensors, Control SW at the FRR prototype located in Vienna



Sensors

User Interface on hand held computer

Control Software running on a PC located in a control room very next to toilet room

Flexible User Interface Demonstrator

Hand held computer was used as an input device, as it is the size of a conventional handheld device

Overview mode (providing an overview, but showing fairly small icons)

Large mode (showing only a few icons, but allowing for the use of big icons)

Scanning mode, acoustic feedback in Greek, Italian, Swedish, German, English

XML based control interface to FRR control unit



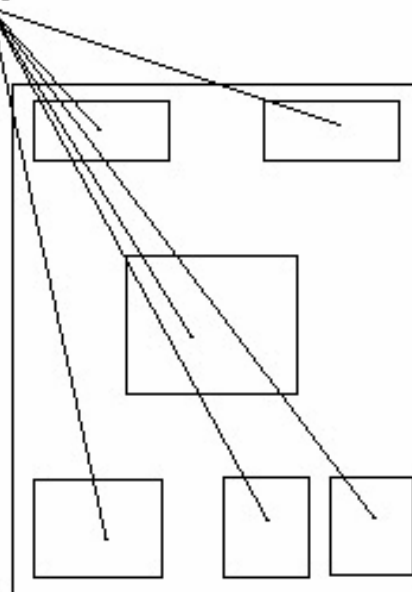
Screen Shots from user interface demonstrator

Left picture shows the static
conventional remote control
right pictures show dynamic layers of
FRR demonstrator

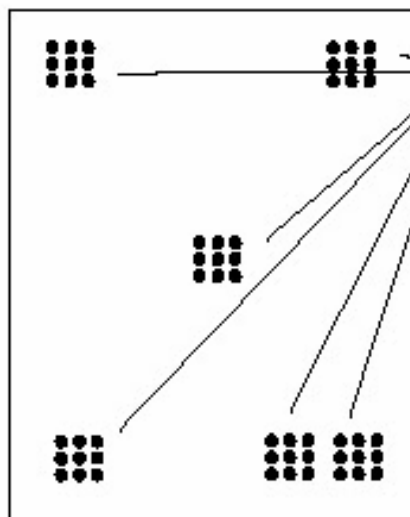
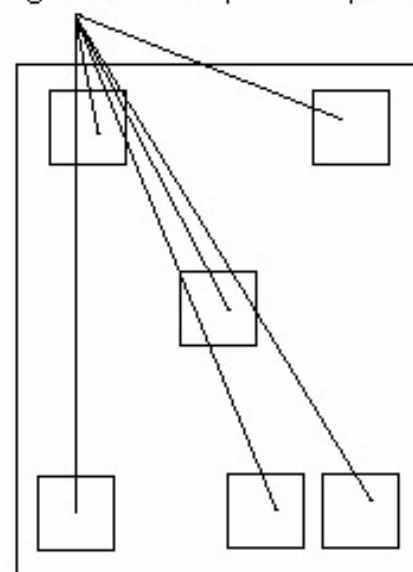


Tactile Overlay for Users with Visual Impairments

holes



glued on transparent squares



raised dots made by pressing the iPAQ stylus into a sheet of transparency plastic (placed on top of a mouse mat to get something soft to press into)

Sensors

What do we need sensors for?

- to find out the toilet's current position,
- to identify the user (and his/her preferences)
- to recognise his/her intentions (e.g. to sit down / to stand up)
- to recognise emergency situations

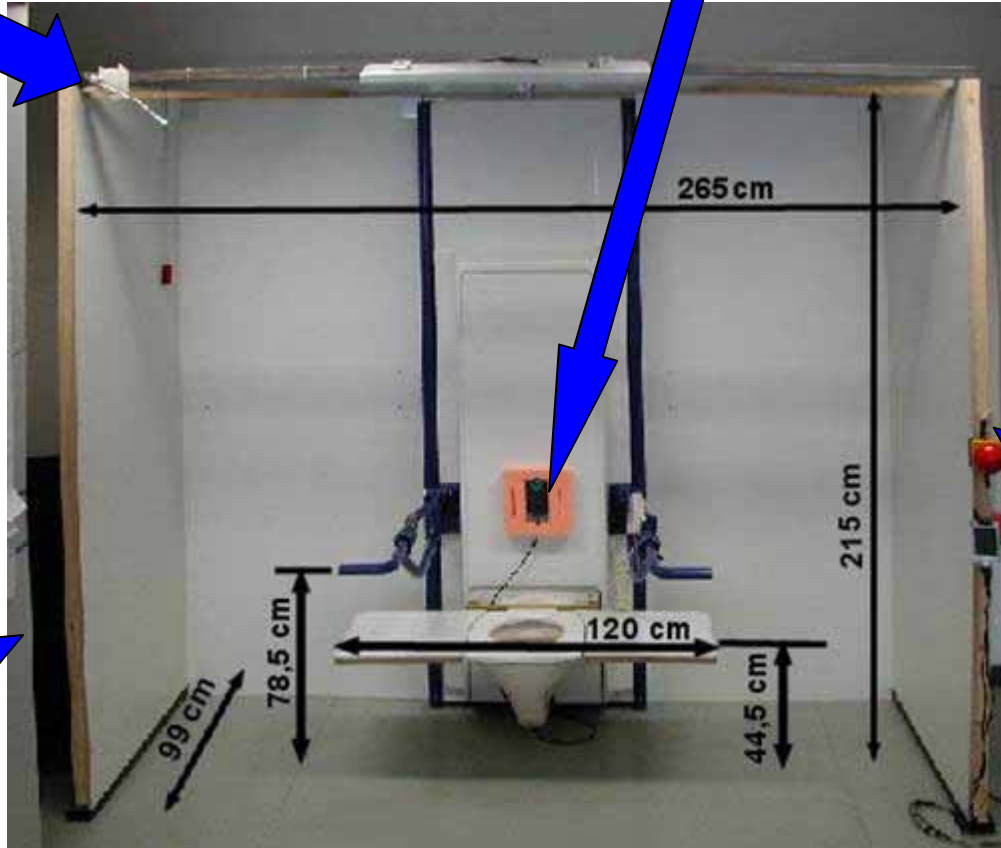
Examples of used sensors:

- 2 Position Sensor (height and tilt of bowl)
- Load cells, force sensitive resistors = pressure sensors, Force strain gauge sensors
- Ultra Sonic Distance Sensor
- Optical Fall Sensor
- Volume Level Sensor (Microphone) for triggering emergency call

Sensors at prototype in Vienna

Microphone

Ultra Sonic Sensor behind user's back



Reader for FRR Smart Card

Fall Sensor (not visible)

Touch Screen User Interface

Sensors for User Identification

There are various technologies for user identification available. We are using contactless smart cards based on RFID (Radio Frequency Identification)

RFID technology allows to store and recall users' preferences in a contact less way (up to 70 cm)

The FRR smart cards currently do have credit card format, but also can be integrated in mobile phones, watches, keys, pieces of jewellery

The smart cards enables the FRR system to gain a significant ability of self adaptation to the individual user's needs and preferences



Sensors for monitoring user's activities

Can we detect what the user is doing?

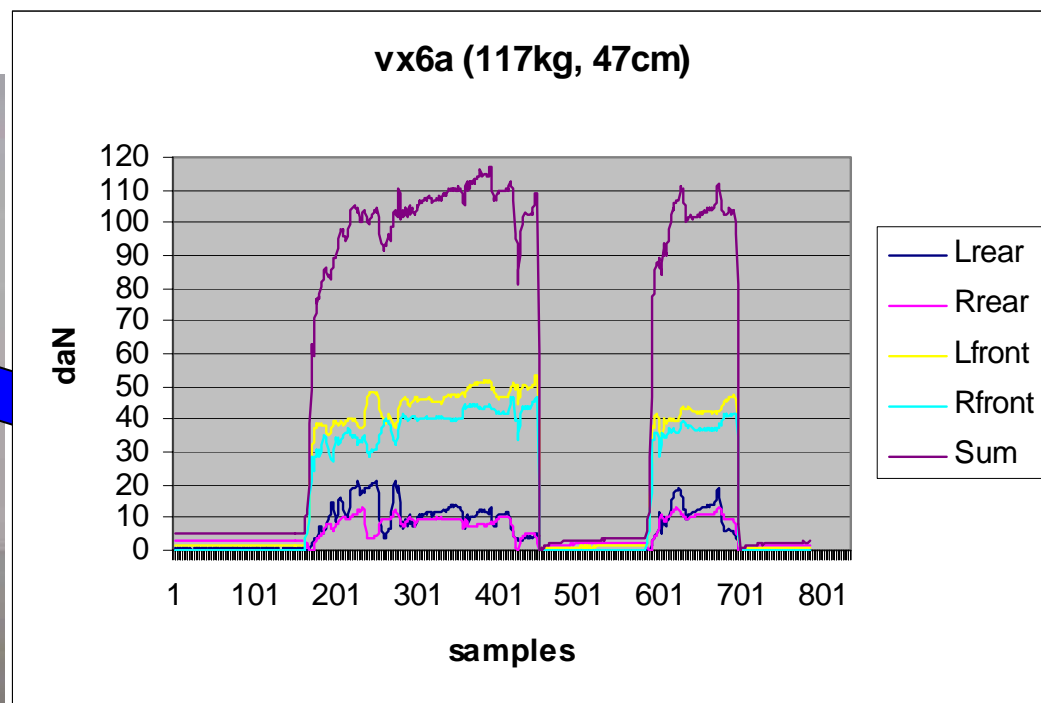
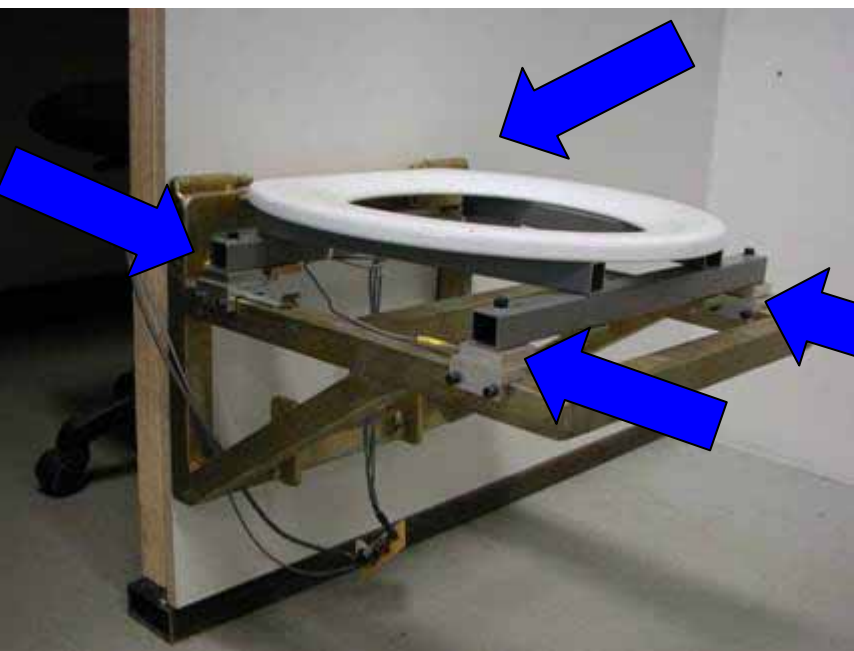
E.g. sitting down / Standing up

We can – e.g. by using side effects: if a user sits down – the tilt of bowl will increase

Sensors for sitting position

4 sensors (Force Sensitive Resistors) are measuring the distribution of weight. It can be recognised if a user wants to stand up (in this case the toilet might start to move in a higher position assisting the user to stand up)

In future it might be possible to detect if a user sits on a seat which is too high or too low.



Fall Sensor Laboratory Sensor System to recognise falls in the toilet room and to trigger an emergency call

Features

Optical sensor with motion detection

Binary output: fall has happened / has not happened

Needs information if somebody is in the room or not

Self adapting to the equipment mounted in the toilet

Control Software

Currently running on a PC with WindowsXP located near the toilet, later to be implemented as embedded system

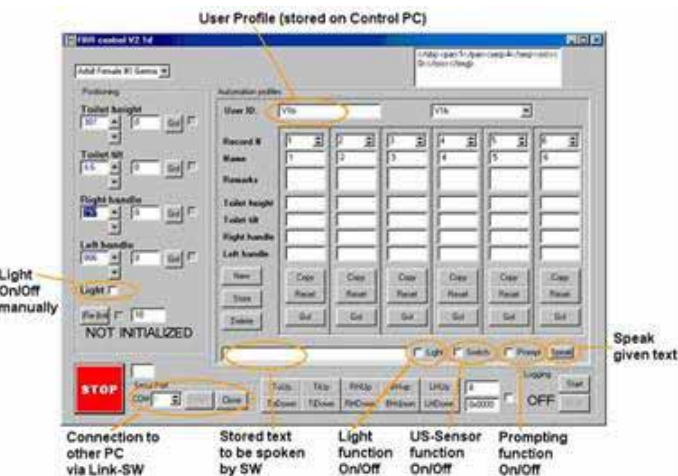
Gets data from other FRR modules (user interface module, sensors, smart cards, voice input module)

Interprets data and

Steers the toilet via link to embedded microprocessor board in toilet

Stores and recalls the users' preferred settings

Continuous logging functionality including synchronisation with the optional video recording



Control Software: Voice Output

Gives acoustic information to inform the users about current situation and future activities of the toilet.

Can also be used for prompting, for guiding the user

Control Software: Voice Control

Voice control (height, tilt, flush, light, alarm,...)

Speaker independent

command space

Reliability

Requirements to be fulfilled: loudness of user's voice, background noise, length of command words, cognitive load to remember words

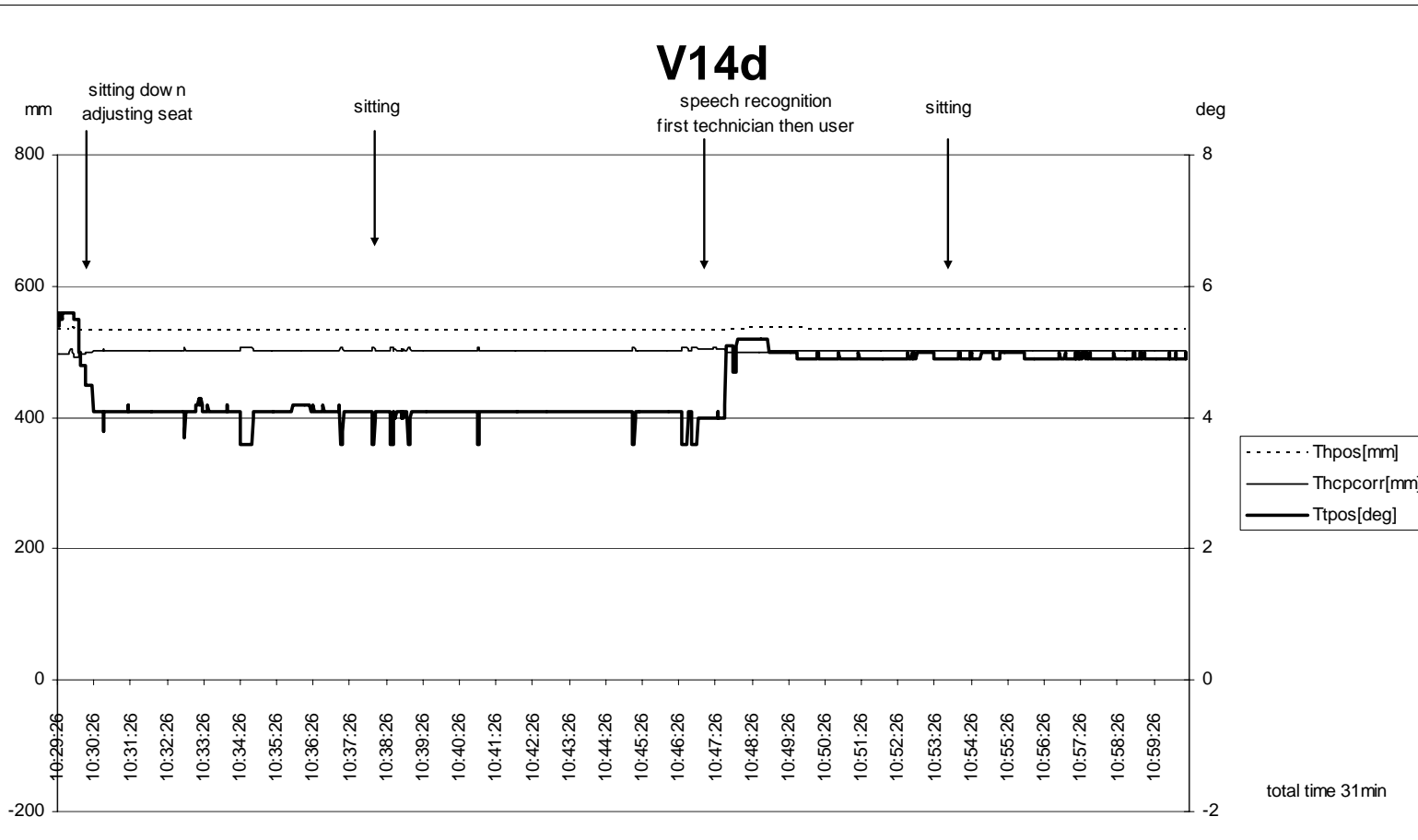
Control Software: Remote Access

Allows the maintaining agency to access the FRR control unit from remote via the internet

Was successfully used during the FRR real life test at Caritas Socialis (based on a protocol from a previous EU funded project FP4/TAP DE4208 RESORT)

Control Software: Logging

Automatic logging of events (changes in sensor data)



Use Case: FRR contact-less smart card

User finds the toilet already well adjusted to be his/her preferred toilet

Individually preferred height, tilt

Preferred language for voice control & voice output

Activation / deactivation of all settings, e.g.: fall sensor, alarm call, voice control, voice output, weight sensors etc



FRR Smart Cards used during laboratory tests

Use Case: FRR Voice Control

The toilet provides the missing “third hand” to the secondary user.

Typical: e.g. when using both hands for assisting during a transfer.



Microphone for Voice Control

Use Case: Voice Output

FRR Voice Output

The toilet provides a cognitive orthosis

Could enhance autonomy of persons with mild dementia

Findings & Discussion: Voice Control

Works better than expected

Is better accepted by older users than expected

Technology not mature but promising

Only laboratory tests

Knock out criteria: volume of voice, background noise, high learnability

Safety considerations

Findings & Discussion: Touch Screen User Interface Demonstrator

Works well

Audio feedback of great value

Scalability (including language settings)

Only demonstrator for laboratory
(hygiene)

Larger Touch sensitive area requested

Findings & Discussion: Contactless Smart Cards

Powerful tool for personalisation

Absolutely easy to be used

Authentication (like Euro key)

But could be forgotten (- - > integration in a watch, key, mobile phone)

Limited Range of detection

FRR Smart Cards used during real life test at Caritas Socialis day care centre



Findings & Discussion: Sensors

Fall sensor is very promising and needed

Some user activities (sitting down / standing up) can be derived from tilt position sensor

Low cost sensors (approx 1 Euro / unit) are promising and easy to be mounted

Sensors should be seen as an option

Conclusion

Several new approaches have been implemented and evaluated by users
Feasibility has been demonstrated and in most cases the usefulness was evaluated positively, especially regarding

- adjustability of height and tilt of toilet,
- flexible user interface,
- voice control,
- self adaptability of FRR system based on Smart Cards.

Still “some” work is left for future projects, e.g. regarding Reliability, Safety and Hygiene

Thank you