

# Design Considerations for Novel Self-Adapting Toilets for Semi-Public Spaces

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**Abstract.** People with physical limitations face significant challenges when using existing toilets. User requirements work shows the wide range of user needs and confirms the high demand for innovative toilets, enabling people to leave home more often and participate more in societal life. The Toilet For Me too (T4ME2) project aims to implement and test a new ICT-based toilet system capable of physically supporting users, allowing autonomous and safe use outside the home.

**Keywords.** toilets, bathroom equipment, Ambient Assisted Living, AAL

## 1. Introduction

Contrary to other fields of daily living so far, there has been little progress in support by technology for easier use of toilets by disabled or older adults, despite this being a daily activity and problems being well known.

Some advances beyond the simple Western-type water closet can be found in the home area by basic stand-up support systems for home use and toilet shower (bidet) devices. Recently, the Changing Places initiative [1] has emerged to upgrade toilet rooms for the public area with changing benches and lifts for adults.

Current standard public toilets still offer only one fixed (raised) toilet seat height, which does not fit individual needs from body size, wheelchair use, and physical abilities for stand-up. The need to always have an accompanying attendant when going out of home or to ask other people for help in the toilet is undoubtedly unpleasant.

For the semi-public area, the usual method of individually adjusting the stand-up support for home use to every single user - often already before installation - is not possible, while a wide variety of users must be served with high robustness in this area.

## 2. Methods

In the current T4ME2 project [2], the research which had started with the iToilet project [3] [4] [5] was extended to the out-of-home semi-public area. As part of an awareness-raising activity, 61 Primary and 39 Secondary Users in 4 European countries were interviewed to rate the difficulties users face with the existing toilet infrastructure. Additionally, because of restrictions due to the COVID pandemic, 154 users answered an online questionnaire [6].

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### 3. Results

The participating users ranked current difficulties and suggested future functions. Lack of availability of suitable toilets, insufficient functionalities, and limited cleanliness were stated as major problems [6] with existing toilets. Primary Users rated hygiene (85%), emergency detection (80%), motorized height lift (74%), and toilet shower (63%) as the most important functions. A high number of people (69% in NL, 87% in AT, and 64% in BE) stated in the online poll [6] that a lack of appropriate toilets keeps them from visiting public spaces and thus limits their social activities.

### 4. Discussion and Outlook

The highly individual requirements, needs, and preferences of the users found from requirements research [4], [6] - and also their very different affinity to technology - call for a smart way to reduce complex manual control tasks and adapt to individual needs leading to the following design considerations:

First of all, autonomous use without a supporting person being present must not compromise the safety, so fall and emergency detection and automatic alarms are needed.

In the core, a motorized lift support should allow for arbitrary height and tilt combinations in a wide range and adaptive control capabilities in addition to manual control, which requires a special construction and smart ICT-enhanced control different from simple commercial devices for home use which are on the market since some years.

The system also should comprise sensors to get information about the status and behavior of users and to pre-estimate their needs, connected by a communication interface (ICT backbone) allowing to add optional components in a modular way making the system open for future enhancements also by third parties.

The project already evaluated a first prototype (a chair-like portable construction) implementing the envisaged core functions with a small number of Primary Users to get in-depth hands-on feedback on the advanced functions of tilting the seat for easier stand-up and automated seat adjustment of positions. Currently, the summarized findings directly steer the production of real-life trial prototypes, which will be tested in fall 2022 by ca. 100 users at 3 test sites in different European countries over several weeks.

### References

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