

Development Report:

GEWOS – A Mechatronic Personal Health & Fitness Assistance System

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GEWOS (Healthy Living in an Assisted Environment) is a BMBF-funded R&D-project (budget: 3.6 million €) in which a mechatronic chair for personal health and fitness assistance was developed and evaluated. Besides the chairs of the authors, several industrial partners joined the project team. The mechatronic chair is able to monitor a variety of the user's/patient's training activities and vital signs and assists with providing a customized exercise program.

Keywords: mechatronics, health & sports, smart chair

The system integrates advanced technology into a well-known object of daily living (a chair for the living room) in order to achieve enhanced functionality [a]. A major challenge throughout the project was the fusion of technologies such as high-performance medical sensors, i.e., for measuring the electrocardiogram (a 2-canal-EKG was integrated into the chair's arm rests), blood pressure and oxygen saturation of the blood (an infrared module was integrated into the right arm rest), weight (a weight measurement module was integrated under the seat plate) and activity (acceleration sensors were integrated into the arm rest and pressure sensors into the back rest), interfaces, mechanical systems (movable arm rests, backrest, footrest), sports and activity equipment (an foldable exercise and rowing device was embedded), and an underlying device control and data-management platform into a robust system. **Fig. 1** gives an overview over key system function and shows that the underlying device control and data-management platform connects the various devices and embedded systems of the chair with an ICT-infrastructure and relatives, physicians and physical therapists (as well as the user himself) access to measured vital signs, recorded exercise plans and exercise functions. In particular physical therapists can monitor the patient and their vital data and exercise status remotely and design on the basis of this data a customized exercise program for the patient. The exercise and rowing device integrated into the chair (**Fig. 2**) is equipped with acceleration sensors and allows for its motions to be visualized in real time on the TV set (see also **Fig. 1**) of the living room and thus to be used as the basis for playing fitness (e.g., rowing) games. When not needed, the mechanical exercise

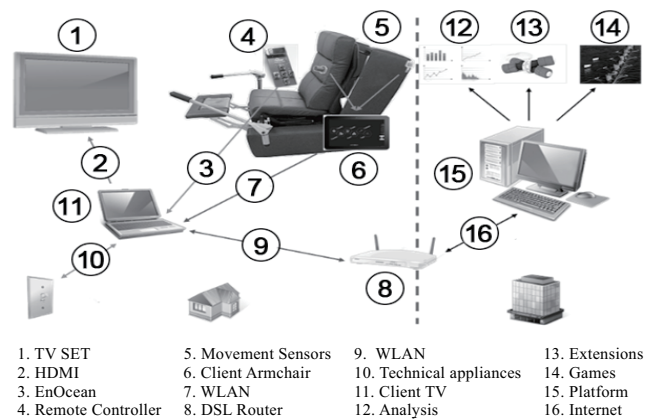


Fig. 1. System overview (Fraunhofer IIS).



Fig. 2. Prototype of integrated exercise function.



Fig. 3. Development of exercise manuals.

functions can be folded and hidden within the chair's arm rests as can be seen in **Fig. 3**. A set of professional exercise manuals that can be executed using the chair as basis was developed and tested with human subjects (**Fig. 3**).

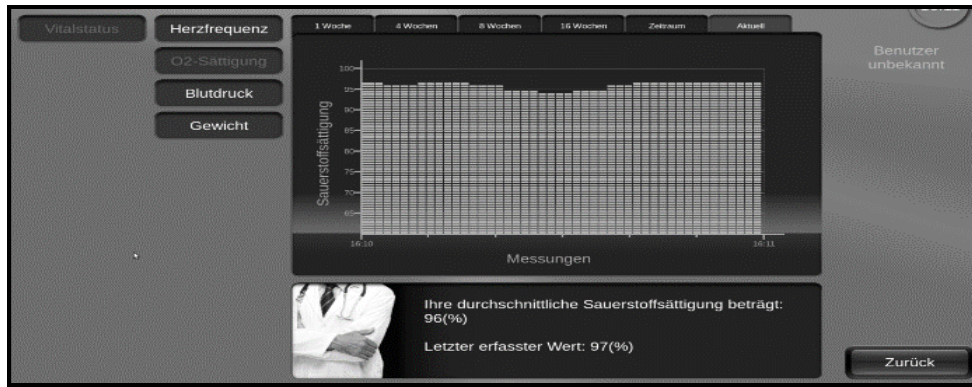


Fig. 4. Output of the system for measurement of oxygen saturation of the blood (ISA Information Systems GmbH).

Through the integrated pressure sensors also this motions can be detected, recorded and displayed for monitoring purposes. **Fig. 4** shows exemplarily the visualization of the human subject's oxygen saturation of the blood (measured by the infrared module integrated into the arm rest) on the TV screen of the patient (or accordingly on the computer of the physical therapist) after conducting some exercise activity.

Supporting Online Materials:

- [a] GEWOS (Gesund Wohnen mit Stil): <http://www.gewos.org/>
[Accessed June 28, 2014]