

A mobile application for heart failure management

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MOTIVATION AND PURPOSE

Self-management in congestive heart failure (CHF) is increasingly seen as critical for patients' health and quality of life. An appropriate and consistent self-management helps maintain clinical stability, and reduces mortality risk and hospital admission. However, it requires a big commitment from the patients as they are obliged to monitor their symptoms and physiological parameters, and adhere to their medication, diet and exercise regimes, etc. Mobile health technologies have emerged as a way to simplify this task and actively engage patients in self-management. The purpose of this study was to build a mobile application for the self-management of CHF, which includes several topics concerning the self-management of CHF and provides an appropriate guidance to the patients on how to cope with the disease.

METHODS

A systematic review was conducted regarding models predicting mortality/hospitalization and quality of life in CHF patients. This information was synthesized with existing guidelines for the treatment of CHF and expert opinions, and translated into decision models and content to be administered through a mobile application.

HeartMan APPLICATION

EXPERT MODELS

PHYSICAL ACTIVITY

The patients are provided with personalized exercise plans based on their physical capacity. The exercise plan consists of endurance (e.g. walk, cycling, etc.) and resistance (e.g. lifting light weights, etc.) types of exercises.

An exercise session consists out of three stages depending on when they happen (before, during, or after an exercise session).

- **Before exercise:** Before the start of each exercise session, the application checks if all prior-exercise requirements (e.g. heart rate and blood pressure within safety limits, no restriction due to medication, etc.) are met, and advises the patients about safety.
- **During exercise:** If the exercise is allowed the application provides appropriate exercises with detailed descriptions. During the exercise, the heart rate and the blood pressure are continuously measured by the wristband. In case dangerous values are present, an alarming signal is given and the patients are advised to stop the exercise.
- **After exercise:** After completing the exercise, the application assesses the adherence to the exercise and patients' improvement.

NUTRITION

The patients first answer a questionnaire, which both educates them and is used to assess their eating behaviour. Every week the patients receive advice related to different topics, (e.g. fluid, salt, etc.) for which the patients' habits or knowledge are poor.

ENVIRONMENT MANAGEMENT

In case that the poor feeling of health is related to ambient temperature (or humidity) the application informs the patient about the issue and suggests to reduce or increase the temperature (or humidity).

MEDICATION

The application provides reminders to take the medication and fill the pillbox, and assesses the patient's adherence to the medication scheme.

PSYCHOLOGICAL ADAPTATION

All the information are adapted according to patient's psychological status: normal, depressed, or anxious. This way we increase the patients' motivation and consequently the patients' adherence to advice as well.

GRAPHICAL USER INTERFACE

The user interface is designed in a user-friendly way and is suitable for the elderly (big buttons and letters, easy to use, etc.)

PREDICTIVE MODELS

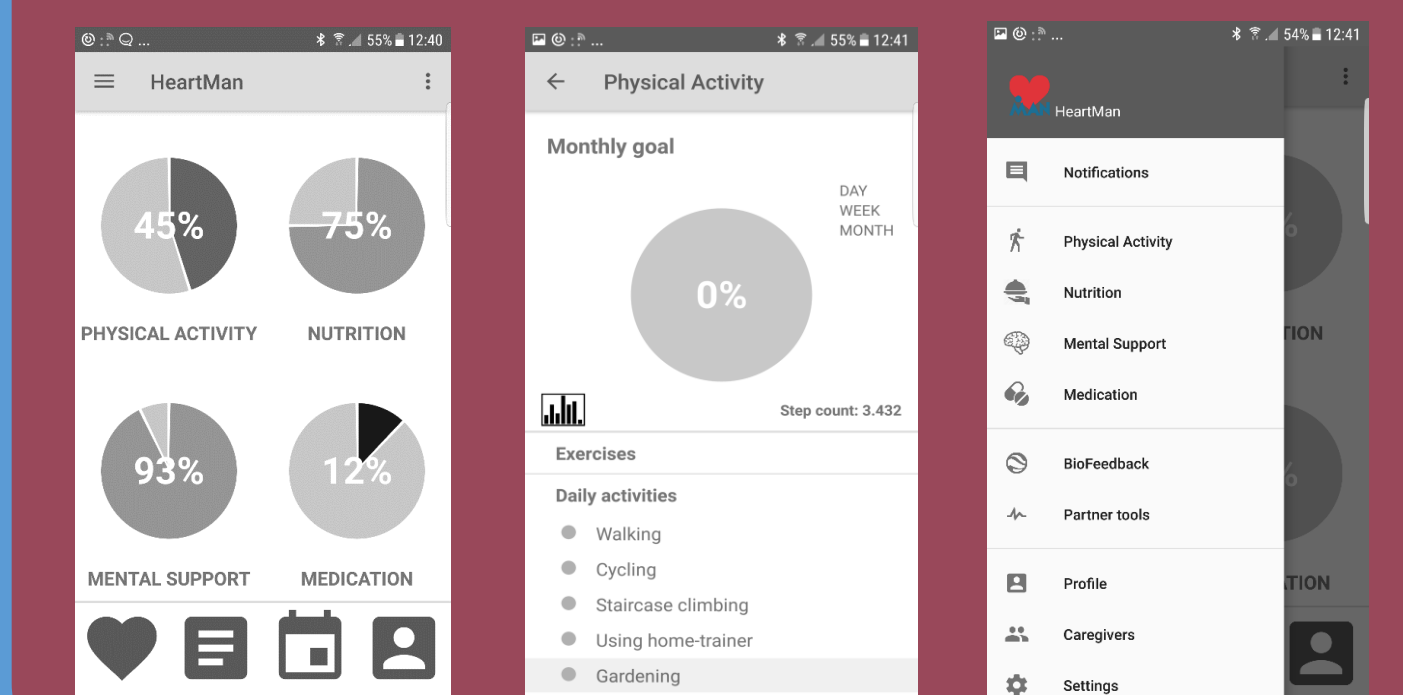
PREDICTION

By using machine learning methods (decision trees) based on physiological and environmental measurements the application is able to predict the patients' feeling of health.

GENERATING ADVICE

In case a bad feeling of health is predicted the application generates a possible solution to improve it. By using optimization methods the application finds an optimal solution, which minimizes the patients' effort.

PATIENT



SENSORS

To provide appropriate advice for the modules mentioned above the application requires several measurements as inputs. Beside measurements before and during an exercise sessions the patients are instructed to regularly perform different other measurements (e.g. weight, respiratory rate, etc.). This provides valuable information to their physicians. For this purpose the patients are given a set of devices and are instructed on how to properly perform the measurements:

- **wristband** (physiological signals, activity recognition, energy expenditure, etc.),
- **personal weather station** (ambient humidity and temperature),
- **phone sensors** (speech analysis),
- **blood pressure monitor**, and
- **scale**.

HeartMan WRISTBAND

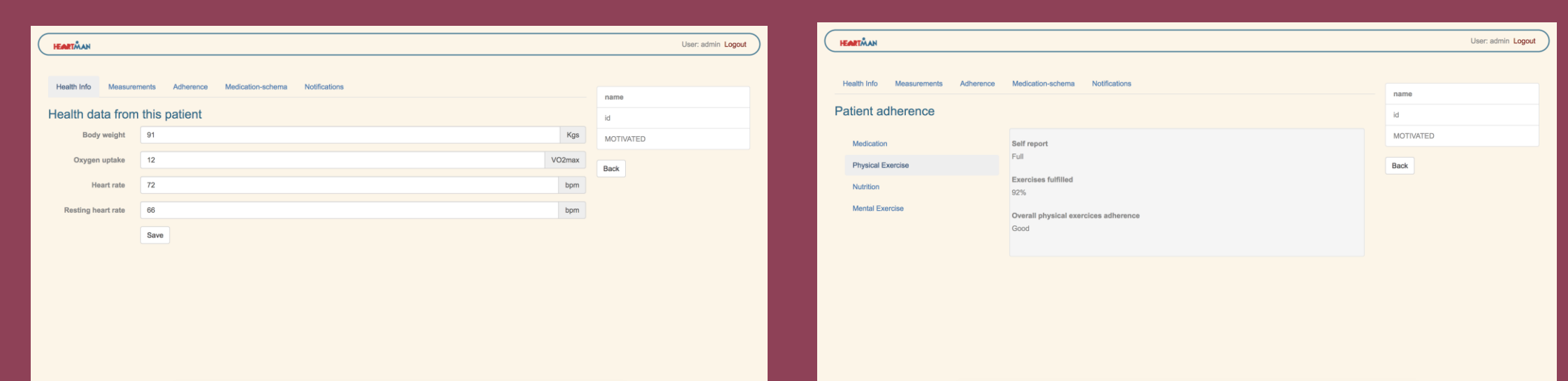


PERSONAL HEALTH SYSTEM

To provide personalized advice on exercise regime, diet, and medication the system requires medical information such as physical capacity, medication scheme, comorbidities, etc. These information are administered by physician through a dedicated web service.

On the same web service the physicians receives different measures that describe patients' conditions and adherence to the medication scheme and the exercise regime. This way the physicians have better insight into patients' status during regular meetings.

HeartMan WEB INTERFACE FOR PHYSICIAN



ACKNOWLEDGMENT

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