

## PERSONAL DECISION SUPPORT SYSTEM FOR HEART FAILURE MANAGEMENT

### Fields of use

Artificial intelligence related software,  
Computer-aided diagnosis and therapy,  
Patient rehabilitation & training,  
Artificial Intelligence (AI), Computer  
Software, Applications for Health

### Current state of technology

Field tested/evaluated

### Type of cooperation

Research cooperation agreement,  
Technology cooperation agreement

### Intellectual property

Copyright, Secret Know-how

### Developed by

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More information about the  
invention



### Summary

Slovenian researchers have developed and clinically tested a mobile personal health application that provides accurate personalized advice for patients with congestive heart failure. They are seeking industry and academic institutions to create new or enhance existing heart disease treatment solutions, leveraging their technology under technical cooperation and research cooperation agreements.

### Description of the invention

Congestive heart failure (CHF) is a serious disease that requires complex management involving multiple medications, exercise, and lifestyle changes. It mainly affects older patients, many of whom also have depression and anxiety, so they find disease management difficult. Existing mobile apps supporting the self-management of CHF have limited features and are inadequately validated. For example, there is no existing solution which is taking into the account the psychological state of the CHF patient and offering accurate advice on disease management adapted to each patient.

The Slovenian research institute with partners have developed a state-of-the-art personal health system that helps patients manage CHF. It consists of a mobile application that coaches the patient; a wristband connected to the application that measures the heart rate, physical activity and respiration rate, as well as estimates the blood pressure; a backend that manages the patients' data and performs some of the reasoning about patient's condition; and a web application for medical professionals.

The application recognizes five important topics concerning self-management for these patients: physical activity, medication, nutrition, monitoring of symptoms and physiological parameters, and environment management. The application has access to patient's health records, it is connected to a monitoring wristband, and keeps a record of the user's past actions. Provided guidance is thus personalized and based on the patient's data. For example, the exercise programme depends on the patient's physical capacity and current heart rate, while the nutrition education is adapted to the patient's comorbidities (diabetes etc.) and focuses on topics the patient has difficulties with. Healthcare professionals have a key role in the CHF. Therefore, the solution includes also a web portal designed specifically for professionals. The portal provides fast access to patient data from multiple sources, and simplifies the interpretation of patient information to improve disease management.

The authors of the system are computer science researchers, with many successfully applied and won machine learning challenges in the health, Covid 19 response and industrial domains, such as Xprize competition.



The research institute is seeking academic institutions, hospitals and industry who would use the system to support their research (under a research cooperation agreement). The institute is also keen to cooperate with an industrial partner for the commercialization of the technology (under a technical cooperation agreement).

## Main Advantages

Several mobile applications for congestive heart failure management have been developed in last couple of years, but their main functionality is to track the information relevant for the patient's health, while their guidance is general and usually relatively simple. Most of them focus only on one or two problems (e.g. medication adherence, physical activity, etc.).

The proposed system has numerous advantages and innovations as opposed to congestive heart failure systems which are available on the market:

- It provides comprehensive guidance to all relevant self-management topics identified through the literature review (physical activity, medication, nutrition, monitoring of symptoms and physiological parameters, and environment management).
- It offers a significant degree of personalisation.
- It raises the patient's awareness of their health through monitoring and providing advice.
- It has a high degree of adjustability for adding new functionalities or changing the (visual) design of the application.
- As a complete solution reduces mortality risks and hospital admission.

## Stage of development

The system decision models and content have been validated by medical experts. The application was clinically tested in two groups of more than fifty patients in Italy and Belgium.

The results of clinical testing are:

- The system proved to be successful in improving self-care behaviour – and thus resulting in a higher quality of disease management
- Using the system significantly improved psychological outcomes, i.e. intervention patients decreased their level of depression and anxiety and these reductions were even higher in the patients who had used the mental exercise in the application more intensively.
- The system intervention also reduced the experience of sexual problems and stimulated their interest and expressed need to receive counselling and information about the topic.



The results also suggest that clinical outcomes were affected by the system as shown by the improvement in left ventricular ejection fraction (LVEF) and decrease in the predicted 1-year mortality risk in the intervention group.

The system (SW) modules are ready to:

- a) be used in further research (use of existing system)
- b) be further developed in an application with additional features

## Partner Sought

### Type

For research cooperation agreements:

Academic institutions, hospitals and companies with experience in participation in international research projects and other bilateral or in-house research projects. Partners with experience in project coordination is surplus. Companies with core expertise in e-health, wellbeing, wearable and other health related technologies are specifically sought.

For technology cooperation agreements:

Companies which develop, produce, sell wearable, wireless, medical, personal health monitoring and other health related and medical devices, solutions for remote patient monitoring, on-site professional healthcare monitoring and home/office/work environment monitoring are sought.

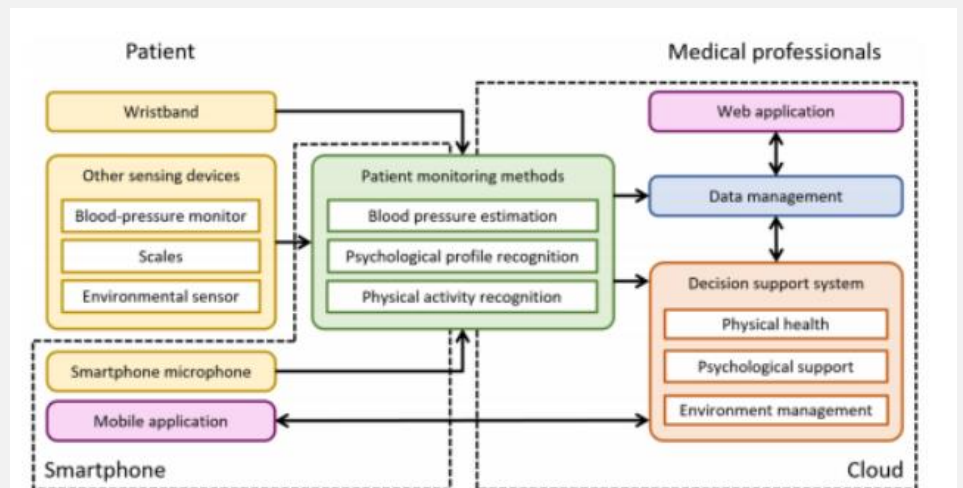
### Role

For research cooperation agreements:

Ideally, partners should prepare (in-house research) or be part of wider (typically international) consortia for new project proposals. Partners with experience in participation in international research projects and coordination of (bigger) research projects is surplus (e.g. Horizon Europe Programme).

For technology cooperation agreements:

Companies should develop and test e-health solutions with good established cooperation with hospitals and patients for establishment of extensive trials of the proposed system.



A diagram presenting an overview of the system.



Dashboards of the mobile app for physical activity, nutrition, mental support, and medication management.