MAPS (IST-2000-27519)
Monitoring Amputee Progress with Sensor Socket

Project Coordinator
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Research area keywords
Amputees, Sensor socket, Telemedicine

Timescale
1.01.2001 - 31.10.2003 (34 months)

Budget
Total cost: 2,828,853 €
EC Contribution: 1,732,950 €

Project partners
Ossur hf - Iceland;
Kings College London - UK;
Tadiran Spectralink Ltd. - Israel
Univ College of Health Sciences - Sweden
RSscan International - Belgium
Katholic Univ Leuven - Belgium
Erasmus Univ Rotterdam – The Netherlands
The Electrode Company - UK
Univ of Strathclyde - UK
Medisch Centrum Rijnmond Zuid, Rotterdam – The Netherlands

Summary
MAPS has addressed an important issue in the care for amputees, i.e. how the amputees can be monitored in their daily activities and the information transmitted to a clinic and used to determine the health status of the residual limb and thus the patient.

The project has reviewed and prioritised different parameters according to their importance for amputee health, prototype sensors, communication unit and sensor socket have been made and finally the prototype has been tested.

Objectives
The objective of MAPS was to develop an interface for amputees, where physical data for the stump could be gathered over a period of time in normal activity. The data would be sent using telecommunication methods to the rehab doctor and/or CPO for evaluation. The concept was called the Sensor Socket (SES) and aimed to incorporate relevant sensors into sockets that were used as interface between the stump and the prosthesis. The system should include telecommunications equipment needed for sending data from the SES and receiving it remotely. The SES concept was a vehicle to assist amputees to integrate into the society and maximize the comfort and use of their prosthesis. Another objective was to gather medical information about amputees in a quantitative manner, thus giving possibilities for better treatment.

Description of work
To achieve the project goals the work was divided into three main phases:
1. SES specification
2. Design and prototyping of key parts of the SES
3. Validation of SES measurements and procedures

In the first phase, the necessary functions of SES were defined. That involved deciding which parameters were to be
measured, setting references, and defining how much information was needed from the SES.

The second phase of the project was the challenge of actually designing and fabricating the SES to meet the specified design criteria.

In the third phase the prototypes were tested and results compared with data obtained using conventional methods.

Approach

The approach taken in the project was aimed at including all the relevant players and gathering as comprehensive information as possible before deciding the strategy for measurements and monitoring. The first phase of the project work concentrated on gathering the information available on residual limb parameters and presenting that in a systematic way, interpreting the importance of each parameter based on the vast clinical experience available in the project group. After prioritizing the parameters, the technical feasibility of the parameters was reviewed and discussed. Based on this, a final selection of parameters was made and the technical partners started their development work.

The technical development was conducted in a modular approach in which partners developed their own part of the system. The interface units were predefined and then one partner was responsible for a certain interface. This setup made it possible for the technical partners to proceed with their work independently of each other for most of the development period after which the partners could sit down together to conduct integration tests to ensure compatibility between the different parts of the system.

Each of the partners developing sensors worked closely with one of the clinical partners. By doing so rapid feedback on the design was possible and the clinicians were also in a position to enhance features in the design and suggest alterations.

Results

Reviewing the different parameters, and analysing their importance, was a very intensive and important work. At the start of the project there were no reports on the relative importance of the different parameters, and in general the information about residual limb health was scarce. The clinical partners approached this in a systematic way in order to find out which combination of parameters could predict the health situation of the limb.

The project work has led to 4 patent applications that have been filed in three different areas of work. Three of these patent applications originate within SMEs.

Two new types of sensors have been developed: in pulse oximetry and in pressure measurement.

The data link unit solved the task of transferring huge amount of data in reasonable time and the silicone sensor socket solved the issue of getting the sensors into limited space.

Conclusions

The project has shown that the concept of monitoring amputee health remotely is viable if sensors are correctly chosen and correctly placed. The results offer interesting opportunities for further work on both the scientific and technological side.

The project objectives were reached to a very large extent.