

# Automated at-home wound monitoring system design and prototype



## Topic

Designing and developing a prototype of an at-home chronic wound monitoring device.

## Background Information

The client for this project was dr. ir. J. Pep Canyelles Pericàs, a researcher from the RAM group at the University of Twente and a Design Lab research fellow. This assignment was part of an ongoing research project that involved other graduation projects (BSc Biomedical Technology, BSc Creative Technology).

## Relevance

Chronic wounds are a large burden on the Dutch healthcare system taking up 2% to 3% of their annual expenses and are a serious health risk to patients as they can be the cause of life-threatening infections. Current methods for monitoring the healing progress of these wounds are inaccurate, time-consuming, and can be invasive. This thesis aims to develop a concept to improve

the quality, ease, and cost of wound care in the Netherlands.

## Research question

The objective of the assignment is the research, design, and production of a chronic wound monitoring device prototype for chronic wounds on the feet. This prototype must reflect the true design requirements of the users as closely as possible.

“How might one design an at-home wound monitoring device prototype for chronic wounds of the feet, using rapid prototyping methods with existing end user feedback and context-of-use analysis?”

## Approach

End user feedback research was previously conducted to determine the interest and feasibility of such a device. A context-of-use analysis with stakeholder interviews was conducted with a chronic wound expert and home-care nurses throughout the conceptualization phase to define users needs, product requirements, and collect detailed user feedback. Both the previous research and the research that happened parallel to part of this assignment collected feedback from Twente hospitals and the nationwide at-home wound care organization. Additionally a review of existing literature was done that looked into chronic wounds in general, their causes, who suffers from them, how are they assessed, and what existing technologies are there currently that aim to improve the monitoring of chronic wounds. With all of this research done a suitable concept for this device was

developed, electrical components were selected for the wound data collection and robotic arm actuation and control. Independent parts of the device were designed, prototyped, and tested before making the full prototype. With the selected parts and a validated concept a prototype was designed in SolidWorks for 3D printing and laser cutting production methods.

### Results & Limitations

As a result of this project a design of a portable robotic wound monitoring device was developed. Two functional prototypes of this device were made, the first met the most important functional requirements and crucial requirements for further development of the wound monitoring system and the follow up prototype improved existing features and added new ones. Renders of both prototypes and technical drawings of the final prototype were also made. Code for an Arduino UNO was written for positioning of the arm at the desired location. The prototypes were built in Design Lab and in the RAM labs. The final prototype that was made serves as a testing bed for further development of the robotic arm control as well as software for the data collection and processing. The report shows a potential approach for designing a such a device with the already pre-existing end-user feedback, and context-of-use analysis.

The limitations of this assignment are that since the prototype has been made no additional feedback collection or user testing has been done. Because of time limitations some features are still missing and some requirements are not yet met and not all problems in the design have been addressed.

### Conclusions & Recommendations

This thesis documented the process of designing and developing of an at-home wound monitoring device prototype for chronic wounds of the feet. The design and research process used in this assignment is quite specific to the project as previous research was already done and the timeline of the assignment parallel to this one was fixed. The results of this assignment will be crucial for the further development of this system. This project completed the first functioning prototype, with that in mind there are several recommendations that could be made for future work such as:

- Follow up prototypes that meet all the stakeholder requirements
- Further development of the robotic arm technology
- Development of the UX and UI of a mobile device app for using the wound monitoring system
- Integration of the device with existing health procedures