PRoF Award abstract – Call 2016

GTUP

1. Research Outline

Acronym	GTUP
Project name in English	Ghent Toolkit Upper extremity Prosthesis
Pitch (1 sentence)	Developing a toolkit for prosthesis upper limb by using digital manufacturing techniques.
Executive summary (max. 10 lines)	
The purpose of this project is to create a toolbox for occupational therapists. With this toolbox it will be possible to shorten the prototyping phase in the development of a final prosthesis for the upper limb. In the prototyping phase the therapist needs to explore which activities the patient wants to perform with his final prosthesis. With the current way of development it's a process of trial and error which takes a lot of time. By creating a toolbox with all different kind of "fittings" that are individually adaptable to the wishes of our patients we'll try to shorten the phase of prototyping. By using digital manufacturing techniques the tools will be easily reproducible even for therapist who don't have a technical background. The digitalization will also secure the expertise of the team itself.	

2. Cause and context of the research

At the moment if a patient with an amputation of the upper limb needs a prosthesis a process between the occupational therapist, the rehabilitation specialist and the certified prosthetist/orthotist (CPO) goes in interaction. In order to make the prosthesis a cast mold has to be made of the stump on which a case can be molded. Making the plaster cast ready for the liner takes several weeks because a lot of manual labor is needed. Once we have a case the making of the individual attachments/tools and fittings can begin. This process is guided by a therapist with 40 years of experience in combination with the technician of the rehabilitation center. It takes 2 to 3 weeks to come up with a prototype of which the patient is satisfied. Then we can go back to the CPO who will make the final adaptations and

attachments to the case. This process can takes up to four weeks depending on the difficulty of the attachment.

By using current techniques like grinding and welding it takes a lot of time and special expertise to make the adaptations.

If we could make a toolkit with the most currently used adaptations and fittings to the final cast it would be possible to come quicker to a final attachment even for therapists with less expertise in metal work.

By using digital manufacturing techniques like 3D scanning and printing, lasercutting and Computer Numerical Control (CNC) milling the expertise of the therapists will be digitalized and so will be secured in the rehabilitation practice of our facility.

These techniques however require skills and equipment which we don't have in our rehabilitation center. Therefore we sought several external partners who can support us in developing the toolkit and securing our expertise.

If we would be granted by PRoF Award we would use the funds to create a digital library of attachments and to develop the toolkit which can also be used in other rehabilitation settings than in the University Hospital Ghent.

3. Innovation results achieved

- Our first patient, a mechanic who lost his right arm, has to be able to use two wrenches bimanually in order to continue his job. His own idea was to attach all wrenches to his passive prosthesis individually. This could be done by drilling holes in all of his wrenches and connect them with a pin and hole system. It would however be labor intensive to switch a wrench each time he needed another size of wrench.

- In a co creation process between the patient, the occupational therapist and technician a new solution was created. Using another type of wrench and but also another type of connection system (see figure 1). Now the patient was able to switch tools fast and one-handed. While experimenting with this tool, the patient learned a lot. The outcome of this process was that the patient needed various angles in which the wrenches needed to be positioned. Given the way the tool was made, with conventional techniques, this requires a lot of (manual) labor.

Image 1: Solution made with current machinery

- As rehabilitation time is limited it would be interesting to be able to test various configurations in one therapeutic session. A new tool is needed to give the patient and the therapist the opportunity to experiment fast in limited time.
- So the designer and occupational therapist looked to mimic the articulations of the wrist joint artificially because at the moment passive prosthesis are static at this point. By using a modular connection piece it is possible to connect different tools in different angles. (see image 2).
- Tools can be wrenches, a knife, a fork, … depending on the need of the patient.

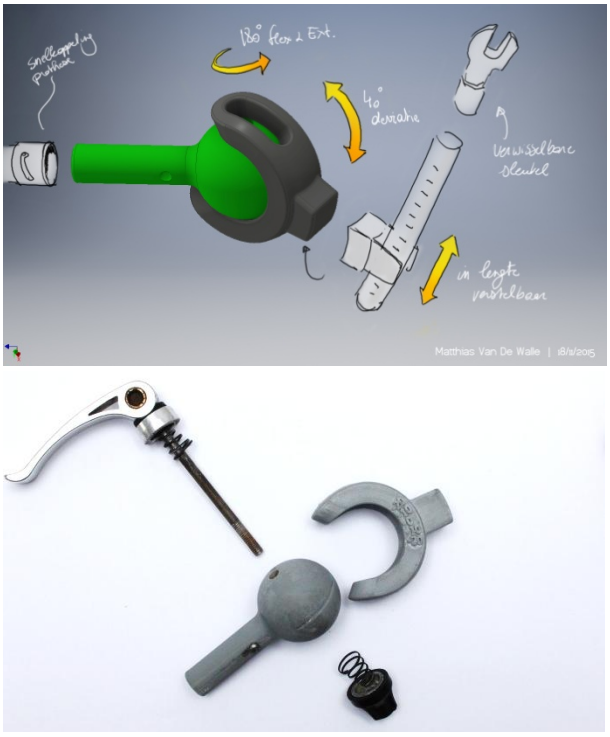

Image 2: above: the idea, under: the 3D-printed product

- Because we don't have the technical equipment to print 3D objects we used an external partner to print our first prototype (TRIAXIS – Ghent). This was done at our own expense (no financial contribution from our patient or society).

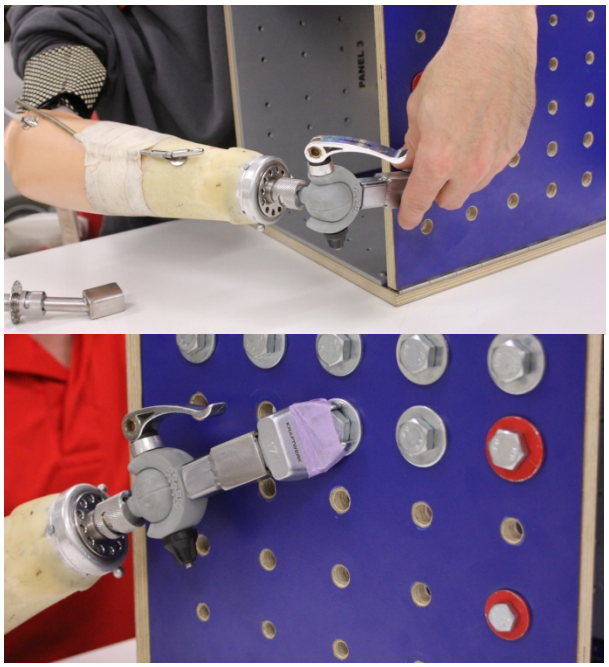

Image 3: the patient experiments with different positions

- Once our prototype was available we could experience what the weaknesses and strengths were of our "product" (see image 3).
    - Feedback from the patient after the test period: "the process of searching a solution together gave me more insight in what I'll be able to do. More than I thought. Not only the wrenching but also other activities".
    - Experience with other stakeholders during the first test:

      other patients with amputation, not involved in this test, responded positive to this project. Some patients came with questions of developing unique tools/aids because they can't find them on the consumer market.

      Only a few occupational therapist were involved in the design part of this project. But other therapists, even with a non-technically background, are in favour of the idea of creating a toolbox with which they can experiment together with the patient in order to determine the right position of every tool needed.

- As we moved on in the process of testing we became aware of the fact that maybe we should use other materials and techniques to develop the prototypes. Perhaps, as mentioned above, the development of a range of “standard” tools might be desirable. Our next objective is to develop a toolbox that can be used by therapists with less or no technical background.
- In this phase of our process are collaborating with TEN to evaluate which tools will be needed, which materials must be used, ….Also a cost-effectiveness study is being done at the moment.
- As we don’t want any cost for our clients nor society we would use the budget of this award to finalize a toolbox which can be used by other therapists in the field.

4. Link to the PRoF values

Awareness: By using DDM toolkit we can create unique prototypes for each individual patient. This is necessary because every patient has a different lifestyle, workactivities or hobby’s. The more we offer individualized solutions for a patient’s limitation(s) the more he or she will be able to pick up his role as a parent/husband or colleague. Being able to pick op these former rolls gives patients a tremendous boost in self-esteem.

Comfort: People with amputations of upper limb want to perform as many activities as they were used to. Current prosthesis are often made for one or two activities. Using prostheses in other activities than those they were designed for gives great discomfort. By creating fast and cheap different attachments for prostheses it must be possible to expand the range of activities without creating a greater discomfort for the patient.

Safety: Therapists can provide very fast prototypes to patients that meet general standards of safety and hygiene.

Privacy: The development of a personal individualized prosthesis is a process between the rehabilitation team and the patient. Especially the occupational therapist and the product designer try to create unique personalized tools for each individual patient.

Loneliness: If one can develop a tool with which a person with an amputation of the upper limb can return to work or engage in activities, this will create a social network. Without a prosthesis he or she might stay at home with a high risk of social deprivation.

Non-stigmatizing: By using DDM it is possible to “pimp” prostheses in shape and color. In that way the prosthesis can be personalized and can be seen as “something cool” instead of putting the emphasis on the disablement.

Intergenerational: If we can develop a toolkit with several standard attachments and adaptations it will be possible to provide other therapists in other rehabilitation settings the opportunity tot develop safe prototypes for their amputee patients.

Flexibility: By creating a database of all different tools that are created it becomes easy to adjust the size and shape of tools when needed in different circumstances/activities. This effect might be larger if we make this database open source. Then therapist all over the world can pick up or drop designs and print them in their own facilities.

5. Applicable IPR rules

There are non.

6. Information on the partners

- UZ Ghent – Physical Rehabilitation and Medicine
  - Lode Sabbe – head occupational therapist
  - Chris Rabaey – occupational therapist rehabilitation
- UZ Ghent – Orthopedic Service
  - Matthias Verstraete – post doctoral research engineer
- Ugent – Industrial Systems Engineering and Product Design
  - Francesca Ostuzzi - lecturer/researcher
  - Yannick Christiaens – lecturer/researcher
  - Robbe Terryn - student
- Howest - Department of Occupational Therapy
  - Anne Dejaeger – lecturer
  - Matthias Van de Walle – industrial product designer/student
  - Indy Lonnoy – student
- Howest - Department of Product Design
  - Lieven De Couvreur - lecturer/researcher
- TRIAXIS Ghent (http://www.triaxisprint.be)
- TEN Group – Mechanical Engineering & Product Development (http://www.tengroup.be)
  - Mike Matheeussen
  - Yvette Plaisier

Note:

If your project is selected as laureate for the Award Symposium, a powerpoint presentation that reflects the project as suggested will be required (in advance), including a future plan how the funding will be used.

If your project is selected as the winner of the Award, you will be invited to present the results achieved thanks to the award during the Award Symposium of the next year.

Addendum: Contact information

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