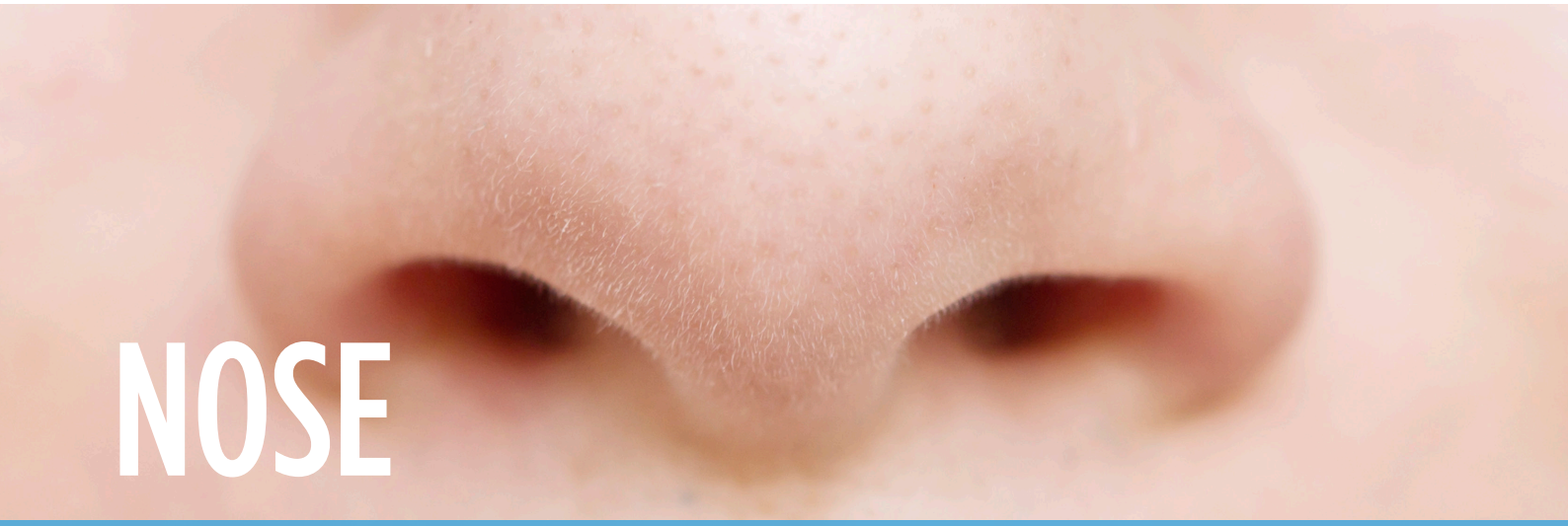

NOSE

Developing a 3D nose morphing tool that simulates the outcome of nose surgery based on easy-to-manipulate parameters; a tool increasing the interaction between surgeons and patients

The NOSE research project put rhinoplasty center stage – i.e. plastic surgery for correcting and reconstructing the form of the nose, or for restoring its functions.

Currently, rhinoplasty surgeons primarily make use of (2D) facial images to inform their patients of which corrections are required and what the projected outcome will be. Their suggestions are typically based on 2D measurements and years of hands-on experience.

The NOSE consortium partners investigated how science and mathematics can help surgeons obtain even better results, while increasing the interaction with their patients. The team combined facial modelling statistics with intelligent morphing algorithms in a 3D tool to accurately simulate the outcome of nose surgery – based on a number of easy-to-manipulate parameters.

"NOSE aimed at creating a 3D nose morphing tool that takes the 'average Caucasian nose' as a baseline; an 'average nose' that is computed based on the characteristics of a couple of hundreds of faces in the NOSE database," says Pieter Van Leemput (Nobel Biocare – Medicim), the project lead.

"Secondly, we wanted to integrate in our tool a number of predefined parameters – such as the shape of one's nose bridge, or specific nose dimple characteristics – and make those easy to manipulate. In other words, our ultimate objective was to provide surgeons with a user-friendly 3D tool that helps them to better visualize the outcome of a nose job."

"In the course of the project, we saw that our approach raised a lot of interest in the domain of anaplastology too – a branch of medicine dealing with the prosthetic rehabilitation of absent body parts," adds professor Peter Claes (iMinds - KU Leuven), who oversaw the project's scientific research effort. "It appeared that our tool could be used in that field as well to 'predict' a whole new nose, and manipulate it afterwards."

THE OUTCOMES

1. Mathematical characterization of an average Caucasian face/nose, combined with algorithms that allow predefined nasal features to be changed on-the-fly

The NOSE research effort has resulted in novel ways to mathematically characterize what an average Caucasian face/nose looks like. NOSE has also managed to capture relevant nasal variations into concrete hands-on parameters.

In a second step, algorithms have been built that allow a set of six predefined nasal variations to be changed on-the-fly. Those algorithms lay the foundation for the NOSE tool, which enables surgeons to accurately illustrate what a more/less feminine, wide, straight, … nose looks like – in full 3D.

2. Anaplastology : an unforeseen – yet successful – use case

As mentioned before, the anaplastology use case has proved to generate pretty impressive results. A mathematical

approach has been developed that morphs 'the average Caucasian nose' with a patient's face in which the nose is missing. That result is then taken as a basis to continue to fine tune the patient's nose, using the rhinoplasty tool.

"And those results were pretty impressive," says Pieter Van Leemput. "In one specific case, the anaplastologist with whom we tested this technology was so happy with the tool's proposed solution that he took that suggestion as a basis for the creation of a nasal epithesis."

3. A 3D software demonstrator that brings all components together

Starting from a number of mock-ups that described what the ideal rhinoplasty tool should look like, and which features it should contain, a software demonstrator has been developed that enables surgeons to easily manipulate the six predefined nasal features in a 3D environment. Those 3D views can also be displayed on a second PC or tablet to stimulate the involvement of – and interaction with – the patient.

The latter proved to be an important outcome of NOSE's user experience study, which hinted at the hurdles that patients are confronted with when wanting to express their opinion on the planned surgery. And that's exactly one of the problems NOSE has tackled, resulting in a tool that allows patients to better understand what their nose (and face) will look like, and providing them with the opportunity to suggest changes too.

Uniquely, the NOSE tool was complemented with a module that allows the 'suggested nose' to be exported to a 3D printing environment. Again, in the domain of anaplastology this makes for an important breakthrough.

NEXT STEPS

"As far as we can see, it is the first time that scientific research and mathematical algorithms form the basis of a 3D nose morphing tool," concludes Pieter Van Leemput. "In principle, our demonstrator is fully functional and holds great potential. However, as this technology would be considered a medical device, it would need to go through a number of approval cycles before it can be used in clinical practice."

Also, more work is needed to improve functional features such as the tool's real-time rendering of 3D visualizations.

Finally, to really foster NOSE's further valorization, a party – or project spin-off – should now take the lead in the overall commercialization effort.

FACTS

NAME	**NOSE**
OBJECTIVE	Developing a 3D nose morphing tool that simulates the outcome of nose surgery based on easy-to-manipulate parameters; a tool increasing the interaction between surgeons and patients
TYPE	ICON project
DURATION	01/01/2014 – 31/12/2015
PROJECT LEAD	Pieter Van Leemput, Nobel Biocare – Medicim
RESEARCH LEAD	Peter Claes, iMinds - PSI-MIC - KU Leuven
BUDGET	2,030,000 euro
PROJECT PARTNERS	Centrum voor Cranio-Faciale Epithetiek, Nobel Biocare – Medicim, UZ Gasthuisberg, UZ Gent
IMINDS RESEARCH GROUPS	Mintlab - KU Leuven PSI-MIC - KU Leuven

WHAT IS AN ICON PROJECT?

iMinds is the digital research center and business incubator for Flanders, Belgium. Its ICON research projects are agile and demand-driven, combining academia and industry partners. ICON projects typically have a duration of two years, yet quickly adapt to the rapidly-evolving digital landscape. ICON partners intend to use the project results in their products or services.

NOSE project partners: Universitair Ziekenhuis Gent, UZ Leuven, Nobel Biocare, medicim MEDICAL IMAGE COMPUTING

AGENTSCHAP INNOVEREN & ONDERNEMEN Vlaanderen is ondernemen

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