



# PATRONUS

Personalized Anxiety Therapy Through Longitudinal & User-aware Services

Anxiety disorders are highly prevalent and disabling conditions. They cause feelings of incapacitating fear for individuals, and cost society 74.4 billion Euro per year in Europe alone.

Exposure therapy (ET) involves gradually exposing the patient to the object or situation that they fear. It is effective, but also time-consuming, expensive and difficult to control. Virtual reality exposure therapy (VRET) offers a safe, controlled, cost-effective and potent alternative. Using a computer-generated environment, VRET gradually immerses the patient in an emotional experience. However, current VRET solutions struggle to correctly assess the patient's real-time anxiety level during exposure and are difficult to personalize. Moreover, VRETs are often standalone, complex solutions, which complicates longitudinal, long-term follow-up based on blended self-care and therapist involvement. Mobile apps for anxiety do exist, but don't include the therapist in the daily follow-up and coaching loop.

PATRONUS sought to develop a portfolio of IT tools that provides personalized, blended, emotion-aware support to therapists and patients throughout the entire anxiety treatment process.

The PATRONUS consortium brought together experts in ET (The Human Link), VR & mobile development (PreviewLabs & Bazookas), scalable data processing (Van Roey), data analytics hardware and software (imec-CHS & IDLab), and patient-centered services (mict). They aimed to create a blended care solution that provides an accurate and continuous view of the patient's anxiety level (supported by physiological information from a wearable device and subjective values from the patient) throughout treatment. Easy to control and personalize, it would support longitudinal

follow-up between sessions through home-based VR therapy exercises and a motivational mobile coaching application.

## THE OUTCOMES

### 1. A blended care solution to support anxiety therapy

PATRONUS's cloud-based solution consists of four main components. The first is an immersive virtual reality environment for claustrophobia and panic disorders, which can be personalized to the patient's profile. The second is a low-cost mobile application enabling the patient to perform VR exercises at home and allowing therapists to conduct longitudinal follow-up. Third is a comprehensive dashboard, enabling therapists to easily configure the VR environment and mobile application. Fourth is a scalable data analytics cloud platform, enabling seamless integration of data collected from a wearable device and delivering real-time insights to the therapists about the patient's condition.

### 2. Data analytics for emotion-aware and personalized exposure therapy

A detailed study investigated how data collected through wearables such as the imec Chillband+ and Empatica E4 could be used to enhance the exposure therapy. An algorithm was designed to assess fear objectively, based on the data collected from the patient's wearable during therapy. The therapist can use this assessment as an extra tool to steer therapy - in addition to the subjective fear assessments provided by the patients themselves. Secondly, the project team created a data analytics algorithm that provides the therapist with suggestions on how to configure the VR environment for the therapy session. Suggestions are based on the patient's profile collected through clinically validated questionnaires, previous exercises and reported fear levels. This greatly simplifies configuration for the therapists, allowing them to focus on the therapy instead of the tools.

### 3. Clinically validated guidelines and protocols for blended care

The project also designed guidelines and protocols that show therapists how best to integrate the IT tools into the exposure therapy to enable optimal blended care. A user study revealed that the majority of therapists reacted positively to the user-friendliness of the dashboard. In addition, the blended care solution and guidelines were clinically validated by therapists from The Human Link, working with their patients, to assess their effectiveness.

## NEXT STEPS

For The Human Link, the project has been a fruitful exploration of the role of VR, mobile applications and data analytics in anxiety therapy. There are plans for further clinical validation, looking at how these assets can be incorporated in ET to ensure optimal benefits. Van Roey Automation has developed and adapted the technology for the mental healthcare market and to enable high performance, scalable data analytics and VR solutions. These building blocks are ready to be further developed in its product portfolio. Both PreviewLabs and Bazookas have learnt valuable lessons on the design of mobile applications and VR for the (mental) healthcare markets, enhancing their service offerings and value in this market. Van Roey Automation and The Human Link are exploring further funding opportunities to bring this solution to the market. Meanwhile, imec researchers are using PATRONUS as a stepping-stone for further investigation of emotion-aware steering of VR through wearable technology.

PATRONUS project partners:



The PATRONUS project was co-funded by imec, with project support from Agentschap Innoveren & Ondernemen.



## FACTS

NAME	PATRONUS
OBJECTIVE	Tools for a personalized, blended, emotion-aware VR-based exposure therapy
TECHNOLOGIES USED	Wearables (imec Chillband+ and Empatica E4), Data analytics (Gaussian Mixture Models, Semantic Web technologies and Markov Chain Logic), Virtual Reality (Unity), Mobile development (Java), Cloud technologies (Microsoft Azure, Docker, .Net Core and Signal R)
TYPE	imec.icon project
DURATION	01/10/2017 – 30/09/2019
PROJECT LEAD	Bernard François, PreviewLabs
RESEARCH LEAD	Femke Ongenae, IDLab, an imec research group at UGent
BUDGET	2,021,966 euro
PROJECT PARTNERS	The Human Link, PreviewLabs, Bazookas, Van Roey Automation
RESEARCH GROUPS	IDLab, an imec research group at Ghent University; mict, an imec research group at Ghent University; imec-CHS



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