Fitness game for the physically impaired

Modern IT can help to make working out more varied for people with physical disabilities. But what exactly is required? Fraunhofer researchers put this question to people disabled by the drug thalidomide. In close cooperation, an IT-based workout was developed that is intended to motivate users with elements that are typical of games.

One test subject rocks her upper body from left to right. She rotates her shoulders in little circles. Suddenly she cries out: “Did it! New record!” She has just beaten her personal best in a computer adventure. But this is no ordinary video game flickering on the tablet computer screen in front of her. Behind the development is a new kind of fitness tool for the physically impaired: the game’s required movements help the woman exercise motor functions, train concentration and coordination, and improve fitness and stamina. “She controlled her on-screen avatar with the movements of her upper body and the aid of our smart shoulder pad,” says Andreas Huber, scientist at the Fraunhofer Institute for Integrated Circuits IIS in Erlangen. Fitted inside the pad are small sensors that record each movement of the test subject and wirelessly transmit them via Bluetooth to the tablet on the table in front of her, where software processes all the data and relays it to her avatar.

Research in conjunction with users

“Our project is not just about developing innovative technology, but about starting with concrete needs. The prototypes were created in conjunction with people who know very well what it means to live with physical limitations: thalidomide victims,” says Karolina Mizer, who coordinates the project centrally from the Institute for Responsible Research and Innovation in Berlin, which belongs to the Stuttgart-based Fraunhofer Institute for Industrial Engineering IAO. These volunteers were willing to share their personal strategies for coping with the challenges of everyday life and to develop ideas for technical assistance systems together with Fraunhofer researchers on that basis. Some of them are missing limbs as a result of damage caused by the drug thalidomide, while others suffer from hearing impairments. “These specific disabilities led to concrete ideas,” explains Mizer. Three ideas were implemented by the researchers together with the volunteers, Heidelberg University, and physical therapists from Reha-Zentrum (rehab centre) Lübben: the “e-bag,” an application for tablet computers that makes it easy for users to show their tickets on buses and trains, a mobile signaler that enables communication with hearing-impaired people even when they are out of sight, and finally “akrobatik@home,” the largest of the three projects.

The smart shoulder pad

The pad adapts to every shoulder shape and contains some very clever electronics: researchers have fitted sensors for every conceivable movement –whether rotation, vertical, or horizontal. “While users play, they unconsciously do the exercises recommended by therapists. The playful approach is designed to motivate people to keep repeating the movements on their own initiative. After all, they’ll be looking to improve their scores,” says Huber, while the volunteer beside him rotates her torso as she makes her way through a warren of caves.

A look into the future

The research project comes to an end this spring. So what’s the next step? “What was unusual in this case was that there was no clearly defined technical goal at the outset. The focus was on closely integrating end users into the process and thereby developing technical solutions that are genuinely helpful and above all gain acceptance among them. The project has shown how important participation is in terms of involving users and stakeholders before starting the technical development stage. Recent research agendas have been emphasizing the very same thing, including the EU’s major Horizon 2020 framework program for research and innovation,” explains Mizer. Now the researchers want to explore other applications for their technical findings. This includes developing advanced control technology for commercial video games and testing how the sensor technology could be integrated directly into clothing.

Contact:
Thoralf Dietz
Phone: +49 9131 776-1630
thoralf.dietz@iis.fraunhofer.de

Contact:
Christian Hofmann
Phone: +49 9131 776-7140
christian.hofmann@iis.fraunhofer.de

Prepunched board

From the institutes

Inspection method detects cracks during collar forming

It can be rather costly if device defects such as cracks are not found in time. But for the deformation process known as “collar forming,” existing inspection methods for crack detection have proven to be less than effective in practice. Fraunhofer researchers have now developed a new method that allows defects to be determined in a process-capable manner.

Collar forming is part of the standard repertoire of metal forming: tension pressure is applied to sheet metal or pipes to produce punctures, known as collars. They are required in sheet metal as thread holes for screw connections, to run cables through, or as bearings for shafts. Given the trend towards lighter and more cost-efficient materials, as well as more and more complex part geometries, the production process has seen an increase in cracks, micro-cracks, and constrictions. If defective parts such as these are then used in assembly, significant subsequent costs can ensue. The problem, however, is that conventional inspection methods cannot reliably identify these “NOX parts” (not OK parts). At a cycle duration of 20 to 30 parts per minute, a visual inspection is hardly realistic. Optical inspection systems have also been shown to be less effective than in series production.

All good things come in threes

Scientists at the Fraunhofer Institute for Nondestructive Testing IZFP in Saarbrücken and the Institut für Umformtechnik und Umformmaschinen IUM (Institute for Metal Forming and Deformation Machines) in Hannover are therefore working on new non-destructive inspection methods to reliably detect cracks and micro-cracks before workplaces like these appear in the production hall. The inspection concept is divided into three stages that cover the entire value chain. The first step starts even before the manufacturing process itself in a pre-process monitoring stage, the engineers first take a close look at the material to evaluate whether it is even suitable for the collar forming process. For the production process itself, the engineers have integrated special sound-emission sensors directly into the collar forming tool. These work in a similar manner to a microphone and transmit any noises detected to a control station. The sound signals allow the engineers to determine precisely if and when a crack has started to form. In the post-process stage that follows, the parts can be checked for any cracks or constrictions after collar forming has taken place. To this end, special inspection systems based on electromagnetic ultrasound and induction thermography – developed at Fraunhofer IZFP – are used. The project is being funded by the German Federation of Industrial Research Associations "Otto von Guericke" and the European Research Association for Sheet Metal Working.

Contact:
Sabine Poltevin-Burkas
Phone: +49 681 9302-3680
sabine.poltevin-burkas@izfp.fraunhofer.de
Fraunhofer Institute for Integrated Circuits IIS
Am Wolfsmantel 33
91058 Erlangen
Germany
www.izfp.fraunhofer.de

Contact:
Christina Dietz
Phone: +49 9131 776-1630
christina.dietz@izfp.fraunhofer.de
Fraunhofer Institute for Nondestructive Testing IZFP
Am Wolfsmantel 33
91058 Erlangen
Germany
www.izfp.fraunhofer.de

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Cracks often form during collar forming.
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