The future of food

Are research robots and virtual food a reality? Researchers in the Food Research Programme at TEAGASC are investigating the latest digital and robotic technology to discover its impact on food research and beyond.

A byte is a unit of digital information, and is extremely simple compared to the complex sensory information we experience when we bite into our food. The simplicity of digital information means it can be manipulated and used to visualise biological structures in food matrices and this has intrigued researchers at both the Moorepark and Ashtown Food Research Centres of Teagasc.

The use of robotics and digital technology has increased dramatically over recent years and this translates to an exciting time for the food industry, as we begin to adapt to this new interactive world. Teagasc researchers are realising this potential and starting to align digital with real world research applications in a targeted way. Exciting new developments in augmented and virtual reality (AR and VR) can potentially connect physical attributes, e.g., sensory and food preparation, with consumer attitudes and preferences. This is currently one of the most exciting developments in food science, and has potential at a number of points along the food chain.

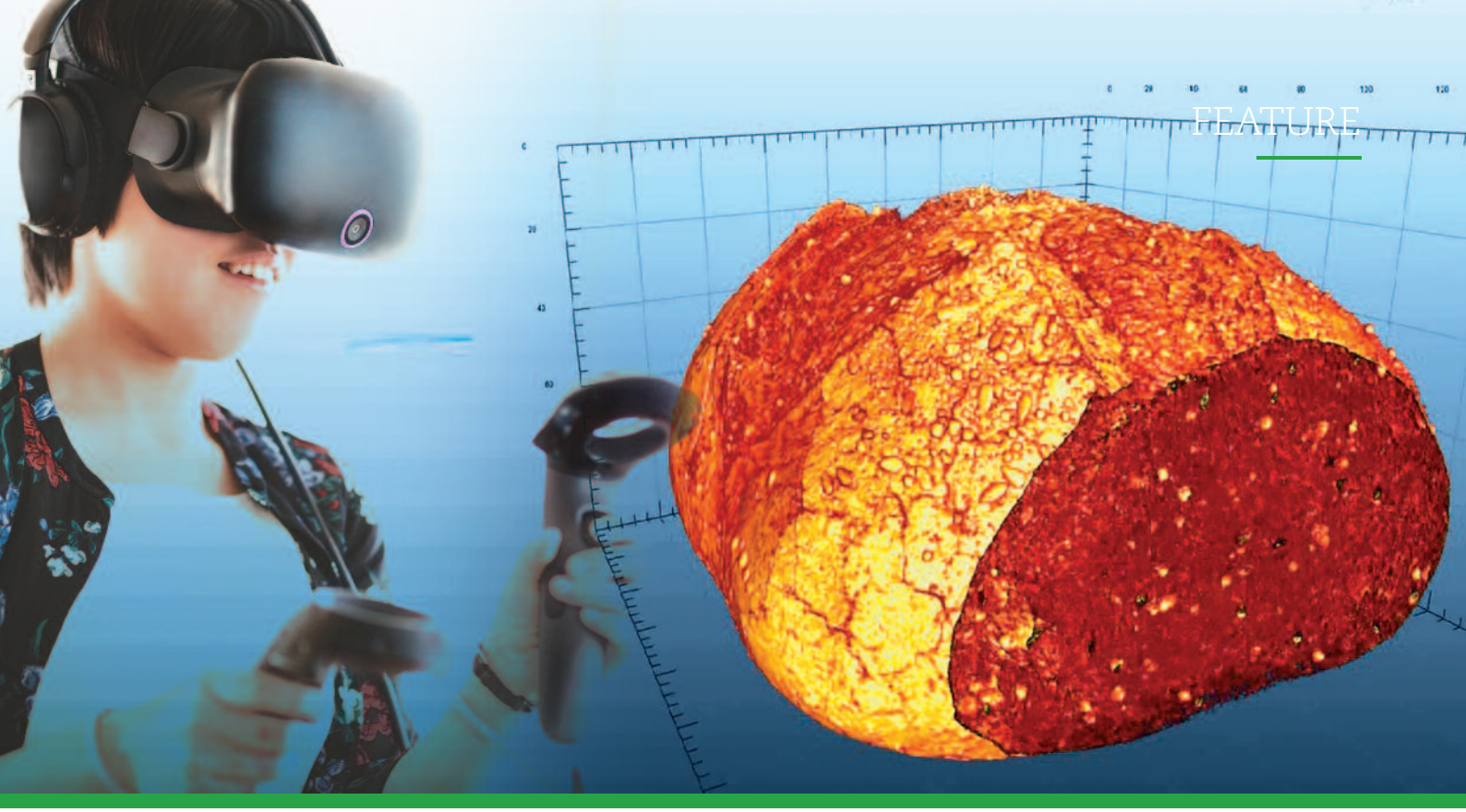
Food research robots

Teagasc Moorepark is pioneering the latest evolution in robotics, process analytical technology and image analysis tools to evaluate the rehydration performance of milk powders, for optimum reconstitution properties. Using the latest generation of collaborative robots, the research carried out by Norah O'Shea demonstrates that it is possible to consistently measure the rehydration properties of powder across batches, while reducing variability compared to testing performed by a human operator. Built-in vision sensors in the arms of the robot capture digital images of unhydrated powder particles post rehydration and these images are then used in combination with vision system analysis, which can translate the output from the image into numbers for objective interpretation of powder quality by the operator. The major benefit of using robotics is that it has the potential to replace current subjective lab tests prior to product release, with an automated objective quantitative test to ensure optimal finished powder quality.

Teagasc has developed collaboration with scientists from the Insight Centre for Data Analytics, Dublin City University, who are using biomechanical sensors to collect data that can accurately mimic the actions of people from different geographic locations around the world. This data will be used to programme arm movements of the robot to more accurately represent human movements involved in powder rehydration. This approach has potential for evaluating the functionality of many ingredients in real-world food applications.

Immersing yourself in food

Combining AR and VR has the potential to revolutionise research methodologies for the visualisation of internal structures in food. Researchers within the Teagasc Food



Research Programme are using powerful new image analysis software, adapted from the medical sector, to enable interactive 3D visualisation of the inside of foods. When coupled with virtual reality hardware, the researchers can completely immerse themselves into the food and acquire measurement data of structures in real time. For example, using the new software and a VR headset, Eimear Gallagher, Head of Food Quality and Sensory Science at Teagasc, has been able to 'get inside her bread' to visualise internal structures in 4D. Eimear is currently working on ways of relating the structures that she sees inside the bread to sensory and texture attributes. In another application, Ciara McDonnell and Gonzalo Delgado-Pando have digitally recreated the carcass of a lamb from data generated using a CT scanner and examined it using VR. In both these applications, it is possible to take rapid measurements using hand controllers while immersed within the computer generated imagery-based VR food. Using 4D visualisation in this way is a world first and can enable researchers at Teagasc to continually re-analyse structures with unlimited observations and viewpoints within the same food. In fact, AR and VR can transform our understanding of the link between sensory parameters and the physics of food structure, potentially leading to new manufacturing practices, food products and customer experiences. The technology will enable food manufacturers to identify key structural components and benchmark them against existing high-quality foods. Deirdre Kennedy, Teagasc Moorepark, explains that the software works by interpreting a 3D image stack, for example, those obtained by a CT scanner or a suitable microscope. These layers of images are brought to life in 4D by a VR headset, such as the one used by Teagasc researchers. Measurements are then taken using hand controllers and powerful software tools. Emily Crofton (sensory scientist at Teagasc) is confident the AR and VR technology will grow beyond research to reach the consumer, and AR can potentially be used to provide nutritional data about the food we eat. This is something that is currently under evaluation at the sensory facility at Teagasc, Ashtown.

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