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MEDIA RELEASE

UP's Engineering 4.0's 'smart avos' key to determining impact of transportation conditions on agricultural products

PRETORIA – Scientists at the University of Pretoria's (UP) Engineering 4.0 research facility are tracking the journey of 3-D-printed avocados on a ship from South Africa to the Netherlands. These avocados have microsensors and are part of a research project to determine damage to fresh produce that is being transported from producers to supermarkets.

According to Professor Wynand Steyn, Head of the Department of Civil Engineering in the Faculty of Engineering, Built Environment and Information Technology, "This is a flagship project of Engineering 4.0 which focuses on smart transport, infrastructure and cities. The researchers have made use of the Department's unique smAvo and smaTo sensor platforms, which are used to monitor the entire value chain, from farm to fork."

He said many producers in South Africa face the challenge of ensuring that their agricultural products intended for the export market arrive at their destination unblemished. Furthermore, the products need to be suitable for further distribution and sale. "But sometimes damage to products leads to a loss for the producer."

Prof Steyn said, "The department has experience in determining the impact of transportation conditions on agricultural products and optimising these conditions to ensure that products such as tomatoes and avocados arrive at the consumer in the best condition."

To determine the damage on avocados, the UP researchers developed a concept known as "civiltronics", which entails the combination of traditional civil engineering with electronics, the internet of things (IoT), programming, computer science and additive manufacturing (3D printing). The project involves monitoring the transportation by cargo ship of a consignment of avocados destined for Rotterdam in the Netherlands, from where it will be further distributed throughout the European Union.

"The avocados are 3D-printed with microsensors that send data back to UP's Engineering 4.0 research facility, tracking the effects of accelerations in speed, rotational movements of the ship and temperature, as well as other elements of the ship's behaviour, to determine whether this impacted on the produce itself and the condition in which it arrived at its destination."

To optimise the data recorded during the transportation of the avocados, the team developed a measuring instrument with microsensors embedded in a number of 3D-printed avocados with a soft water-resistant outer covering that would be exposed to the same conditions as the real produce surrounding them.

This instrument was developed from "off-the-shelf" components and microcontrollers. It was programmed and customised for the objectives of this particular project so that live, real-time data could be collected and stored for analysis.

“If you can’t measure the damage, you can’t manage it,” said André Broekman, a PhD student working on the project.

“Real-time data on the ship’s location in the Atlantic Ocean, as well as weather conditions throughout the trip, is being sent to the University’s researchers at Engineering 4.0, where all the data will be captured on the Department’s central platform for analysis, interpretation and the recommendation of future action,” he explained.

This data will later be linked to maritime data such as the height of the waves, wind speed and the direction in which the ship is travelling, which are obtained from satellite data. “This information is not just of value to producers to ensure that they can obtain top prices for South Africa’s best products, but also to avoid additional costs related to transporting products that have been damaged or are no longer suitable for trade in the export market back to South Africa,” he said. The data should assist in understanding where in the logistics chain damage potentially may occur, and therefore assist in eliminating events that may cause such damage.

“The University’s world-class research footprint entails focusing on digital information across a transdisciplinary platform,” said Prof Steyn. “The success of this project will therefore not be restricted to a single product or engineering discipline. Inherent in this innovative technology is the potential to apply it to other fields as well to promote the transdisciplinary research for which the University of Pretoria is so highly regarded.”

Caption 1: Prof Wynand Steyn and André Broekman holding the newest generation of instrumentation at the Engineering 4.0 research facility

Caption 2: smAvo prototypes undergoing testing in a packhouse

Caption 3: Digital rendering of the smAvo enclosures and electronic components

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ABOUT THE UNIVERSITY OF PRETORIA

The University of Pretoria (UP) is one of the largest contact and residential universities in South Africa, with its administration offices located on the Hatfield Campus, Pretoria. This 113-year-old institution is also the largest producer of research in South Africa.

Spread over seven campuses, it has nine faculties and a business school, the Gordon Institute of Business Science (GIBS). It is the only university in the country that has a Faculty of Veterinary Science which is ranked top in Africa, and overall has 120 academic departments, as well as 92 centres and institutes, accommodating more than 55 000 students and offering about 1 100 study programmes.

UP is one of the top five universities in South Africa, according to the 2019-2020 rankings by the Center for World University Rankings. It is also ranked among the top 100 universities worldwide in three fields of study (veterinary science, theology and law), and among the top 1% in eight fields of study (agricultural sciences, clinical medicine, engineering, environment/ecology, immunology, microbiology, plant and animal sciences and social sciences).

In May 2020, the annual UK Financial Times Executive Education Rankings once again ranked GIBS as the top South African and African business school. The University also has an extensive community engagement programme with approximately 33 000 students involved in community upliftment. Furthermore, UP is

building considerable capacities and strengths for the Fourth Industrial Revolution by preparing students for the world beyond university and offering work-readiness and entrepreneurship training to its students.

As one of South Africa's research-intensive universities, UP launched the Future Africa Campus in March 2019 as a hub for inter- and transdisciplinary research networks within UP and the global research community to maximise 4IR innovation and address the challenges and stresses our continent and world is facing. In addition UP also launched the Javett Art Centre in September 2019 as a driver of transdisciplinary research development between the Humanities and other faculties. In November 2020 UP launched Engineering 4.0. as a hub not only for Smart Cities and Transport, but also to link the vast resources in technology and data sciences to other faculties via Future Africa. These initiatives are stimulating new thinking at the frontier of 'science for transformation'.

For more information, go to www.up.ac.za