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农牧业信息化专题

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1．无人农机作业环境感知技术综述

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前沿资讯

1．Entrepreneurship Awards for modular vertical farms and AI clothing sorter（模块化垂直农场和人工智能服装分拣机获创业奖）

简介：Three young entrepreneurs won prizes at the finals of the Wageningen Entrepreneurship Grant last Wednesday 22 May. The prize is awarded annually by University Fund Wageningen in cooperation with StartHub and helps young innovative entrepreneurs take the first steps with their initiative. The Future Resources Award of 25,000 euros went to Bart van Gorcum of Valuesort.ai, who is developing an AI tool to effectively sort out second-hand clothes for value. The Future Planet Award of 25,000 euros was won by Nikolaos Alfieris of FarmVent, which develops modular vertical farms with fresh vegetables for chefs. Tom Kloosterman won the audience prize, the Get Unstuck Award worth 7,500 euros, with his initiative Blue Bagger.

Saving second-hand clothes

"It takes an employee an average of six months of training to properly sort second-hand clothes," Bart van Gorcum pitched during the battle for the Future Resources Award. He competed against finalists Matthew Halley of Soualigas, which converts waste on Sint Maarten into valuable raw materials, and Tom Kloosterman of Blauwe Bagger, which separates dredge into valuable resources. Van Gorcum of Valuesort.ai won over the jury with its AI tool to analyse clothes by brand, size and quality via a camera and robotic system, estimating the true market value of a garment. This allows sorting companies of second-hand clothes to work faster and resell the valuable clothes for a better market price. A much-needed innovation, as some 7.5 billion kilos of second-hand clothes are collected in Europe every year. The prize was very welcome for the entrepreneur: "Our current prototype is made of materials from the hardware store. With this prize money, we can make our next prototype a lot better."

Growing vegetables on-site

"Impressively small, impossibly big" is the slogan of FarmVent, the initiative of Nikolaos Alfieris. His modular vertical farms are reminiscent of a cake display case next to the checkout, but instead of sweetness, they promise the freshest vegetables and herbs that the cook prepares directly for you. The cook chooses which and how many microgreens to grow, and as an important side benefit: it hardly taxes the environment. The vegetables are grown via aeroponics, without pesticides and directly on-site. No Food miles are driven, saving CO2, fewer vegetables are thrown away by matching them to local demand, and it is cheaper for the user. Alfieris competed in the finals against Emiel Smits of Aeroponics Outdoors, who makes a tube system to grow potatoes up to five times faster, and Evelien Bos, whose initiative PetPanel offers pet food testing to producers, with pet owners testing at home with their pets.

Alfieris managed to convince the jury in several areas. Chairman of the jury and co-founder of the award Heleen van Poecke praised Alfieris for the narrative around their business model, the established partnerships, and his team. That Alfieris was competing for the second time was impressive to the jury. Van Poecke: "The jury likes perseverance. It is

the mark of an entrepreneur, because progression is not linear."

Dredge is not waste

During the interludes, finalists could ask for help from the audience to fill gaps in knowledge, expertise, or contacts. For example, they asked for experts on thermodynamics, quantifying biodiversity, voluntary carbon credits and robotics. The finalists were also allowed to list a problem for which they could use the Get Unstuck Award money, €7,500. The public then voted on who they thought was most deserving of the award, with most votes for Tom Kloosterman. With the money, his team from Blauwe Bagger (Blue Dredge) will build an oven to bake PFAS-contaminated clay at a temperature where the PFAS disintegrates.

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2．WUR spin-offs at F&A Next: Scope Biosciences and Rival Foods（WUR的子公司在F&A Next：Scope Biosciences和Rival Foods）

简介：During F&A Next 2024 on 22 and 23 May, startups in the agri-food sector will have the opportunity to present themselves to potential investors or strategic partners. WUR spin-offs Scope Biosciences and Rival Foods will be on the podium. Five years after their establishment, how are both companies doing?

Foods makes plant-based meat alternatives in Amersfoort and a production location in Geldrop in the province of Brabant. However, what both companies have in common is that they started in 2019 as a spin-off from Wageningen University & Research. Over the past two years, they have been awarded millions in investments to further grow their business. What challenges do they face in scaling up their production?

For both companies, we start by discussing how it all began. For Niek Savelkoul from Scope Biosciences, this was when he and professor of microbiology John van der Oost applied a new CRISPR-Cas technology for the on-site detection of pathogens in agrifood and health care. With Intellectual Property - developed with WUR - he then acquired funds to set up a laboratory and recruit staff. The product name was scopeDx.

F&A Next: Next Heroes in Food & Agtech 2024

At the F&A Next conference on May 22 and 23, start-ups in the agrifood sector will present themselves during the Next Heroes in Food & Agtech 2024 session. Among other activities, there will be a short Q&A with a panel of investors.

Scaling up in small lab

Scope Biosciences has a laboratory which they found at startup incubator Plus Ultra I. ‘We specialise in making reagents, in other words test tubes with liquid,’ Savekoul explains. ‘You can use them in handy devices, for a plant breeder in a growing location, for example. Or in large equipment in a hospital. We make all those reagents ourselves, but not the equipment. For now, that means we still have space to scale up.’

Moving from a lab in a university to a site of its own did prove a challenge. Savekoul:

‘You think you can get going almost immediately but it takes a long time until you have everything you need and the lab is operating. It’s all about pioneering and keeping going until everything works.’ Since then, he and a team of currently around ten staff have been focusing on an increasingly wider range of tests. ‘Whether you’re making a test for COVID or for a tomato virus, the process is 99 percent the same. That makes a huge difference when scaling up.’

Products and building machines

Rival Foods’ chicken breasts have already landed on the first gourmet plates. However, this was preceded by quite a journey. It started with Birgit Dekkers’ PhD research at WUR in which she developed new technology to make meat alternatives. ‘None of those unhealthy vegetarian hamburgers, but a plant-based beef steak or tuna steak that mimics the structure of muscle tissue. They are also much healthier, containing minimum salt and fat.’

Initially, Rival Foods was based on Wageningen Campus. They even shared an office for a while with Scope Biosciences. Dekkers: ‘We soon needed more room, because we develop both the products and the machines to make them.’ Thanks to investments, Rival Foods was able to move into a building in Amersfoort and the company recently started converting an old meat factory for large-scale production. ‘This is where we’re going to make between 100 and 400 tons of meat alternatives every year,’ Dekkers expects.

Tasting is believing

The products will go first to restaurants, later to supermarkets. According to Dekkers, a challenge will be selling something totally new: a plant-based muscle product. ‘Many consumers want to eat more plant-based products but are not satisfied with the structure or flavour of existing meat alternatives. Another factor is how healthy the product is. People are therefore initially sceptical, something I also notice in conversations with restaurants. But once they’ve tasted them, they’re converted. And cooks are enthusiastic because they can be much more creative with it than with a standard meat replacement.’

Working with researchers

Both companies work together with researchers. Savekoul uses the new knowledge that emerges from that collaboration for validation and for more fundamental knowledge. ‘At WUR, there is an incredible amount of knowledge about CRISPR-Cas, and pathogens in agrifood. So, we continue to work together with various sciences groups at WUR.’ Eventually, he wants to further expand the number of applications in diagnostics.

Dekkers also maintains contacts with WUR to further develop the products and machines of Rival Foods. Moreover, along with researchers and suppliers, she is looking for plant-based proteins from Europe to minimise the distance travelled by the soy used by the company. ‘Broad beans don’t go well with a chicken product due to the aftertaste, but I expect this will change.’

For Scope Biosciences and Rival Foods, F&A Next is a place to share experiences and extend their network. During the event, visitors can also sample a piece of plant-based chicken.

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3．How to make sustainable food systems with AI（如何利用人工智能制造可持续的食品系统）

简介：Startups use artificial intelligence (AI) to make food systems more sustainable. For example, Orbisk reduces food waste with a smart monitor. Professor Ioannis Athanasiadis wants to support these types of companies with a European testing and demonstration facility. They both present their views at F&A Next.

The startup Orbisk has developed a food waste monitoring system that catering companies and restaurants can place around their waste bin. A smart camera, in combination with a weighing scale, provides insight into their food waste. As a result, these companies can optimize procurement and processes in their kitchens and doing so increase sustainability and profitability.

'AI can take over labour-intensive tasks of us', says Orbisk founder Olaf van der Veen. 'We use image recognition equipment above the waste bin to determine what goes wasted. Research shows that an average restaurant throws away 10,000 kilos of edible waste every year and that is also what we find in our data. On average, 70 percent of our food waste is overproduction and over-stocking and only 30 percent comes from oversized portions. Restaurants and caterers usually purchase too much because they are afraid of coming up short. Our monitor gives them insight into the surplus and allows them to purchase much more efficiently.'

Neuraal network

Orbisks waste scanner works with a neural network that has learned what food looks like, for instance sandwiches, peppers and pasta remains. Orbisks main work was training the neural network to recognise all kinds of food, says Van der Veen. The company also uses other data sources. For example, they predict the number of guests, but also do research on what they eat. 'What people eat depends enormously on the weather, so the weather forecast is important. These are very complex datasets, so we need AI to recognise patterns in consumer behaviour.

Orbisk is growing like crazy. The startup, founded in 2018, has now sold six hundred food monitors in 33 countries and is growing by over 10% per month, says Van der Veen. About sixty people work there now.

"I want businesses to share their datasets and algorithms, so they can learn from each other." Ioannis Athanasiadis

70% savings

The food waste scanner can prevent 30% to 70% of food waste, says Orbisk. Its oldest customer, the Leiden University Medical Center, has had the food scanner for more than four years and structurally achieved 70% savings. Van der Veen also thinks he can make big savings in the catering industry. 'A lot of food is offered for free. This degrades the value of food, causing a lot of food to be thrown away. There is a lot to be gained in such an environment.' The waste scanner has recently also been installed on a cruise ship. 'There is a lot to be gained there. The food on cruise ships is plentiful, but food waste is also

becoming an issue there because of the negative perception and the costs.'

Facilities

Wageningen AI professor Ioannis Athanasiadis thinks he can support startups like Orbisk in the development of their business. 'Developments in AI are moving very quickly. Startups need support and facilities to test their prototypes and products in different conditions, so that they can develop and scale up their innovations. The EU has recognised the importance of this and has funded one of our programmes, called 'Testing and Experimentation Facilities for Agrifood Innovation'. This is a European network of facilities to test AI solutions.'

When considering AI solutions for agriculture and horticulture, Athanasiadis is thinking of weeding and picking robots that do their work under different conditions in, for instance, The Netherlands, Austria and Spain, but he also thinks about datasets and digital products that allow these facilities to better perform their tests. 'We aim to set up a digital infrastructure with other knowledge institutes in which we can pre-competitively test AI solutions, so that these innovations will become ready for practice more quickly and can scale up faster.'

Weeding robots

Companies that apply AI can learn a lot from each other, the professor thinks. 'For instance, there are already various systems in use in the field of weeding robots. Most are focussed on a specific crop and specific environmental conditions. They use different data streams, algorithms and protocols that are often not interoperable. I would like companies to share their datasets and algorithms so that they can learn from each other. Sharing data in such a public facility for startups and small companies can accelerate their development process.' This facility, AgrifoodTEF, is now developed.

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4 . AI will unravel secrets of non-coding genes（人工智能将破解非编码基因的秘密）

简介：From smart chatbots to apps that can write entire articles, Artificial Intelligence (AI) is becoming an increasingly ubiquitous part of our lives. Michael Schon, a research associate at Wageningen University & Research, is designing an AI tool that can perform comparisons of non-coding RNA on plant genomes. The tool is expected to accelerate and simplify the future development of new plant varieties with greater resistance to drought or diseases, for example. Schon has received a Veni grant to support his research.

Proteins are the building blocks for cells in organisms. The instructions for making these proteins are issued (coded) by RNA from genes. Alongside these coding RNAs, some genes can produce non-coding RNAs: in other words, RNA that doesn't include instructions to make a protein. This type of RNA also plays an important role in the development of organisms, says Michael Schon. "For example, they can activate genes, or do the opposite

and switch them off. This will affect the appearance of a plant and the properties it has. Certain important non-coding RNAs also determine whether a plant reaches maturity at all."

Relatives within the same family

Non-coding RNA could also potentially reveal why a plant species belongs to a particular family yet has different characteristics. In previous research, Schon identified non-coding RNAs of Arabidopsis thaliana (thale cress). This plant is used by plant scientists as a model organism. "Arabidopsis belongs to the Brassicaceae family, along with important crops like broccoli, cauliflower and kohlrabi. This family is also known as the mustard or crucifer family. However, it's difficult to compare non-coding RNAs of Arabidopsis with that of other plants in the mustard family because previous work in these species has focused mainly on protein coding genes."

Limited annotation of non-coding RNA

This means that a comparison between plants requires separate gene annotation for the non-coding RNA for each crop. Through his Veni project, Schon is looking for new ways to identify non-coding RNAs by using knowledge from related species. "More than 200 genome sequences are available for plants within the mustard family. Each genome is stored as a large text file consisting of millions of letters that represent the bases of a DNA molecule (A, C, T and G). Because the non-coding bits aren't catalogued (annotated) properly in these genomes, it's impossible to compare all the non-coding genes scattered inside this mountain of data. We need new strategies and tools for that. I'm trying to develop those."

A small part of each genome

The first problem is knowing where in the genome to look. One of the tools Schon is developing is something he calls GeneSketch. To find the corresponding parts of different genomes, he's using a method called Minimizer Sketch. "The idea behind the Minimizer Sketch is that you only need to look at a small piece of DNA – a sketch – rather than the entire sequence," says Schon. "That means you only have to pay attention to a few thousand characters per genome to perform a comparison, rather than millions. The Minimizer Sketch was previously used to build a tree of primate evolution, which includes humans and their closest relatives. It turned out that a very accurate family tree of our ancestors can be made from sketches made of less than 1% of the whole genomes. A minimizer sketch therefore is a very efficient way to estimate how similar pieces of DNA are to each other, so it should also be useful for comparing genomes within the mustard family."

Same technology as ChatGPT

After you know where to look, then next step is to understand what you are looking at. The technology Schon plans to use in GeneSketch is the same as that which is currently used in other AI tools, such as ChatGPT. "It's something called 'transformer' technology," says Schon. "You can ask a transformer to fill in a missing word in a sentence, for example. Initially, the transformer gives you a random word because it has never seen words before. But if you train it on millions of example sentences, it slowly learns to guess the right words by paying attention to patterns in the text. After training, a large language model like ChatGPT becomes very good at certain tasks, like answering questions or translating from

one language to another. A transformer can be trained to learn not just human languages, but also the language of DNA, which has its own distinct patterns. I am working on a model to detect patterns in the DNA of many different species, and translate those patterns into a language that we as humans can understand."

Model must be trained

Schon will train the transformer for GeneSketch to pay attention to how genes change across different species, especially non-coding genes. But he expects to come up against some challenges along the way. "One important issue is reliability. The transformer is a relatively new technology, and it makes mistakes. ChatGPT, for example, was trained on many different sources of text, but if you ask it a topic it never saw during training, it needs to make something up. You hope that it makes up something reasonable based on the patterns it has seen, but this is never a guarantee. You obviously want to avoid nonsense output. The more you train a transformer, the less nonsense it produces, but training can cost a lot of time and money. Is it better to train the model completely from scratch or build off of existing models? I am trying both approaches."

Potential of the GeneSketch

Schon hopes to have a prototype of the GeneSketch after the first year of the project, which started in October 2023. He plans to use it to create gene annotations for the entire mustard family. The tool could be useful not just for the research sector but also for the agricultural industry, says Schon. "It could, for example, provide seed breeders with a quick way of understanding the DNA of a crop and its wild relatives. By learning more about how crops have been able to develop unique traits over the centuries, breeders could make more informed decisions for improving traits, such as making crops more resilient to climate change. So, the potential impact could be huge."

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5．Global Food Security Conference concludes: 'Broad view on food security and food systems important'（全球粮食安全会议总结："对粮食安全和粮食系统的广泛看法很重要"）

简介：Earlier this month, the fifth edition of the Global Food Security Conference took place in Leuven. Over 500 participants from 65 countries interacted to discuss food security and food systems. Professor Martin van Ittersum, Professor of Plant Production Systems at Wageningen University & Research, co-hosted the conference. He looks back on the conference with great satisfaction.

How do you see the importance of this Global Food Security Conference?

The conference is of great significance. It brought together scientists from all disciplines and areas of interest related to food security and food systems, ranging from agronomists to nutritionists, and from historians to economists and policy experts. We are all working on the same theme, albeit from different perspectives and using different

methods. The congress facilitated to provide a broader, integrated view of food systems, and that is crucial for solving problems.

What are the main lessons to be learned from the conference?

There was a strong consensus at the conference that we need to stop doing the bad things, such as overconsumption and overuse of inputs, but we should not lose sight of the positive aspects of current systems, such as land-saving production and the importance of realizing in many parts of the world a stable availability of healthy and safe food. It is too easily said that the entire food system needs to be 'transformed', and we must be careful not to throw out the baby with the bathwater, as echoed by several contributors.

Another important lesson that can be drawn is that as scientists, we should focus more on which goals we want to achieve and less on how we want to achieve them. We should talk less in terms of buzzwords such as ‘nature-inclusive’, ‘regenerative’ and ‘all plant-based’, and more about their effects on the goals, such as land use, emissions and health. There is no single farming method that works optimally everywhere, just as there is no one solution to achieve less consumerism (less animal protein, for example) with food policy.

Were all these aspects adequately covered during the conference?

With the presence of 65 nationalities and much diversity within those countries, I believe, the conference offered a rich and varied presentation of knowledge and discussion. Moreover, a large proportion of the attendees were relatively young, and almost 60 percent female.

How do you see the future of the conference?

Regarding the future of the Global Food Security Conference, we are considering shifting the focus from food security to food systems as a whole. This shift has already been visible in recent years. In 2013, the focus was still largely on production, but now it is already much more balanced. Therefore, we are considering changing the name of the conference to Global Food Systems Conference.

The next conference is expected to take place in late 2026 or early 2027. The organizing committee is currently exploring potential venues in South or Southeast Asia, or Latin America.

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学术文献

1．无人农机作业环境感知技术综述

简介：推进农业装备智能化能够有效解决农业劳动力短缺的问题。环境感知是农业装备智能化的首要条件。然而，农业环境的动态变化和非结构化特性限制了无人农机的环境感知能力。该文对无人农机的作业环境信息感知技术进行全面梳理，首先介绍了无人农机作业环境的典型要素和各类感知传感器，并分析了不同传感器的优缺点，然后分别从障碍物感知、作物行感知和农田边界及高程信息感知等方面，对无人农机作业环境信息

感知技术进行归纳总结，最后讨论了无人农机作业环境信息感知技术面临的挑战及发展趋势，旨在推动环境感知技术在农业领域的应用，促进农业机械的智能化转型。

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