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In the digital indoor garden



Radishes, lettuce, and more from a test laboratory in Munich

As the world's population grows and land available for agricultural use shrinks, traditional agriculture is nearing its limits. Working with research and industry partners in the international EIT Food consortium, Siemens Corporate

Technology is looking for solutions to make foodstuff production more efficient and more sustainable.

Getting to the vegetable field below the Siemens buildings in Perlach, Munich, involves a journey through windowless concrete cellar corridors. Growing in this subterranean area are radishes, lettuce, and other types of vegetable. Blazing, slightly red-tinged LED light takes the place of sunlight – sunglasses are a must down here. What's different is that no-one sows any seed, applies fertilizer, or waters the plants. A robot looks after everything. For example, it uses a vacuum pipette to gather plant seeds and sows them at regular intervals in a new patch. Then it moves on to another point to water some seedlings. Each one gets a few drops, perfectly coordinated to its needs. "Our vision is that farmers using [our technologies](#) will only need to determine which plants they want to cultivate, and what properties the plants should have," says Siemens research scientist Rudolf Sollacher. "All other tasks, such as sowing, watering, fertilizing and harvesting, must be automated and run efficiently and transparently. In our model laboratory, we show in-house and external customers that this is how the future could look."

The farmer in the cloud

The gardening robot analyzes the current cultivation conditions, such as humidity or the nutrient content in the soil. These measurements are compared against recommendations from botany experts. Using simulation models – a digital twin of the garden – calculations are performed to determine what the robot has to do to ensure each plant gets exactly the right quantity of nutrients and water it needs for ideal growth.

The data used here, such as the digital twin of the garden, the algorithms, and the expert knowledge involved, is saved in the cloud so it can be easily shared with others and also re-used. “Our

approach is obviously not only suitable for our special model garden, but also for any other indoor farming area or outdoor set-up," comments Sollacher. "For different garden or agricultural areas we just need different digital twins, but otherwise the procedure is exactly the same. In an outdoor area, for example, we would need to accommodate additional sensor data in the digital twin to reflect the volume of natural precipitation."

The growing challenge ...

The food industry is facing growing challenges because of the constant increase in the world's population. There will probably

be ten billion people on the Earth by 2050 – and what will they eat? It isn't only cultivable land that is in short supply; water is also becoming scarcer. With traditional watering, most of the water doesn't reach the plant at all, but evaporates unused. Efficiency gains are being made in this area thanks to the project by Sollacher and his colleagues on behalf of [EIT-Food](#). By looking after the plants individually and giving them precisely what they need for ideal growth, far less water is wasted.

..... and the sophisticated consumer

In the industrialized nations, the foodstuffs industry faces different challenges. In these countries, people generally have no worries about basic food supplies, but they want greater transparency about where and how their foods are made, and demand reliable commitments regarding condition and quality – such as whether they contain particular allergens. “By constantly gathering data, we can get a very precise picture of the properties our foodstuffs will have, and we can deliver the transparency the consumers want,” says Sollacher. “Especially in indoor farming, with artificial light or watering, we can go further still and control the properties of foodstuffs with greater precision. For example, you can adjust the light – more red or blue – to determine whether radishes will subsequently have a mild or a sharp taste.”

Not only for vegetables but the entire food chain

As our platform we have opted for [the flexible IoT operating system MindSphere from Siemens,](#) Sollacher says. "One reason is that it gives us the possibility of expanding our approach to cover the entire foodstuff production chain to suit our requirements. For example, we could use only electricity from renewable sources for the watering process if the pumps were synchronized with data from a Smart Grid. Or agricultural machinery could be shared flexibly between several farms. And, of course, this approach can also be adapted to suit other foodstuffs like meat or dairy products. There will be more and more use cases we can continue working on. And when the

vegetables are ready for picking here in Perlach, it will be snack time for the entire department.”

Aenne Barnard

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