

A real modular DNA factory

DNA extraction on an industrial scale thanks to automation technology

Seeds are the new gold. Why is that? Plant-based foods can feed an ever-growing world population. But climate change, pests and diseases threaten plant breeding. To help develop resistant seeds and make them available to agriculture, plant breeders need vast amounts of DNA. That is precisely why Synchron Lab has developed the "DNA factory", which is automated with handling gantries, electric axes, pneumatic grippers and sensors from Festo.

The system can extract a tremendous 40,000 DNA samples in the space of 24 hours. It thus meets the increasing demands for high throughput in laboratory automation. The demand for DNA samples has long been so high that it would not be possible to employ enough laboratory assistants to supply these quantities. Not to mention staffing costs. Thanks to the system, highly qualified laboratory assistants can concentrate on their core competence, the analysis of results.

High throughput: 400 microwell plates per day

Experienced laboratory assistants are able to manually extract the DNA from two microwell plates per day. With small, automated bench-top systems, a total of eight microwell plates per day can be achieved. Synchron Lab's novel "DNA factory" can manage a throughput of 400 microwell plates per day. Only one operator is needed to load and unload the microwell plates.

"Laboratories are still quite sceptical about automation. That's why it is important that laboratory staff can always see what is going on in the system," explains Glenn Dukel, Project and Business Development Manager at Synchron Lab. So they involved plant breeders in the development phase and also made the operating software as intuitive as possible, for instance using drag and drop functions.

Automated sample preparation

The system extracts DNA from shredded plant material. The process begins with a microwell plate magazine that accommodates up to 400 plates – 200 for input and 200 for output. Bar code reader SBSI from Festo scans all the microwell plates at the start of a run. Electric axes type EGC in combination with semi-rotary drive DRRD and pneumatic gripper DHPS pick up the microwell plates and place them on workpiece carriers that move from one station to the next on a transport system.

Coded metallic microspheres, so-called magnetic beads, are added to the lysate samples in the first station. The DNA attaches itself to this and can then be separated, while the rest of the material floats in the microwell plates. To do this, a buffer solution of pure isopropanol is aspirated from rotary containers with a coated silica magnet and pipetted into the microwell plates. This is how the process of DNA washing starts.

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The pipetting heads are moved by a planar surface gantry EXCH along the X-axis and using an electric axis EGC-HD with the necessary rigidity along the Z-axis. Here, too, electric drives with servo motors type EMMT-AS ensure precise motion sequences. These servo motors are perfect for demanding and dynamic applications: They are characterised by very good controllability and path fidelity for positioning tasks. The space-saving one-cable plug solution reduces installation work.

Extensive washing process

The second and third stations are used for the washing process. At the second station, the binder buffer solution is aspirated. The magnet forms a ring with the buffer solution. The DNA remains in the microwell plate.

At the third station, the isopropanol buffer solution removes salts and ethanol from the DNA. Dispense head VTOI from Festo is used here. This is an efficiently controlled 8-channel dispense head for microwell plates equipped with only one valve for eight outlets. With VTOI, liquids in the smallest μl range can be dispensed and aspirated. The process is repeated four times.

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Automated handling modules

At the fourth station, the DNA is separated from the beads using a washout buffer solution. Four microwell plates are constantly subjected to this process at the same time, which enables the system to achieve economies of scale compared to other systems. Axes ELGC are used in the X direction and drives EGSC in the Y direction. Likewise, pneumatic grippers DHPS are used for lifting the microwell plates and semi-rotary drive DRRD for moving the plates.

"It was important for us to work on this project with an automation partner who stands for high quality and reliability as well as worldwide availability," adds Dukel. "That's why we decided on automation technology from Festo in line with the motto 'The best or nothing', as per the slogan of a renowned automotive brand."

In fact, the highly automated system has similar features to those of an automobile factory – with high productivity and modularity. Synchron Lab is therefore setting a gold standard in DNA extraction, enabling seed producers to respond to the enormous global demand in agriculture in the future.

About Synchron Lab

Synchron develops customised solutions for laboratory automation and specialises in the automated handling of liquids. Synchron is known in the industry as a progressive and innovative company. Since 1985, the company has been developing customised products thanks to the excellent relationships it has established with laboratory equipment manufacturers. Their products, both software and hardware, are now used in many

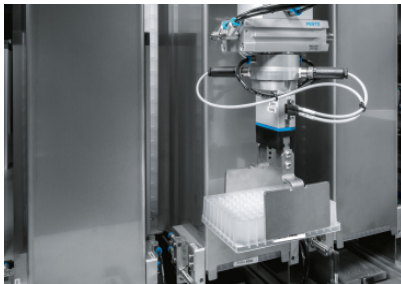
laboratories throughout Europe. Synchron offers expertise in all areas of automation and has a wealth of experience in the development and marketing of flexible robot automation.

Press Images



Synchron - modular DNA factory

With this system 40,000 DNA samples from plants can be extracted fully automatically per day.



Synchron - from station to station

From station to station: electric axes EGC combined with semi-rotary drive DRRD and a gripper DHPS place the microwell plates on the workpiece carriers of the transport system.



Synchron - washing the DNA

Washing the DNA: Here, the magnetic beads and a buffer solution are added to the samples.



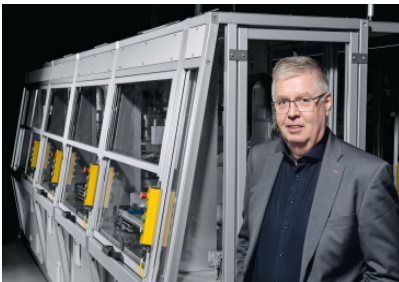
Synchron - intensive washing process

Intensive washing process: in this station, dispense head VTOI dispenses a buffer solution several times to remove salts and ethanol from the DNA.



Synchron - Glenn Dukel

Glenn Dukel, Project and Business Development Manager at Synchron Lab



Bert Baas, Festo

Bert Baas, Vertriebsingenieur bei Festo

About Festo

Festo is a global player and an independent family-owned company with headquarters in Esslingen am Neckar, Germany. Festo has set standards in industrial automation technology and technical education ever since its establishment, thereby making a contribution to sustainable development of the environment, the economy and society. The company supplies pneumatic and electrical automation technology to 300,000 customers of factory and process automation in over 35 industries. Digitalization, AI and the LifeTech sector with medical technology and laboratory automation are becoming increasingly important. The products and services are available in 176 countries. With about 20,600 employees in over 250 branch offices in around 60 countries worldwide, Festo achieved a turnover of around €3.45 billion in 2024. More than 8% of this turnover is invested in research and development. In this learning company, 1.5 % of turnover is invested in basic and further training. Festo Didactic SE is a leading provider of technical education and training and offers its customers worldwide comprehensive digital and physical learning solutions in the industrial environment.