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"Lab-on-a-Chip": Design Automation Simplifies Production

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Conducting medical tests either in the lab or directly with a patient? So-called "labs-on-a-chip" can make it possible.



Professor Robert Wille

The Coronavirus pandemic was actually not the first example of conducting medical tests in the lab only but also directly where the patient happened to be at the time; so-called "labs-on-a-chip" make it possible. However, designing and manufacturing a small series of labs-on-chips still often involves a great deal of manual effort. A consortium that includes the Johannes Kepler University Linz, ESS Engineering Software Steyr GmbH, Ernst Wittner Gesellschaft m.b.H. and Software Competence Center Hagenberg (SCCH) is now working on automating the process. The Austrian Research Promotion Agency (FFG) is providing funding in the amount of €1.4 million.

Medical analyses and examinations today are still often carried out in state-of-the-art laboratories where experts analyze various substances using complex equipment, costly chemicals, and a high number of personnel. At the same time, however, so-called "labs-on-a-chip" are viable alternatives where professionals can, among other things, mix, heat and/or incubate samples at the micro level. The laboratory is "reduced" to a single chip and can provide corresponding analyses wherever the patient happens to be. Pregnancy tests and rapid antigen tests in lieu of the coronavirus pandemic are simple examples of this type of technology. There is also the potential to, for example, pursue point-of-care diagnostics, cancer research, and treat other infectious diseases - particularly in areas that have poor health care, such as in developing countries.

Complex Technology in Action

To date, this technology's potential, however, has hardly been tapped into. One of the reasons is that designing and manufacturing these "chip laboratories" is complex and requires a great deal of manual effort. For example, conduits to facilitate the flow of substances and chemicals must be scaled and connected. The liquids must be injected into the chip with the correct amount of pressure and any mixing, heating or incubation must be started at exactly the right time. As it all takes place on the microliter scale, even the smallest deviation can result in a faulty chip. Design and production is only successfully after a process of trial and error.

A consortium that includes the Johannes Kepler University Linz, ESS, Ernst Wittner Gesellschaft m.b.H., and Software Competence Center Hagenberg aims to solve the problem by creating special design automation methods. The inspiration stems from designing conventional computer chips which nowadays are also highly complex units containing sometimes millions or even trillions of components, such as transistors, that have to be correctly placed, connected, etc. In contrast to the "labs-on-a-chip", in the past a large number of automatic methods were created in which these chips can be designed "at the push of a button". Similar methods will now be developed for the "labs-on-a-chip".

Taking the Laboratory to the Patient

Prof. Dr. Robert Wille, head the project and consortium leader, explains: *"The methods we develop as part of the project will make it much easier to take additional medical analyses and examinations from the lab directly to the patient. Whereas previously months of detailed work delayed or even prevented implementing many "labs-on-a-chip", in the future, we can design and manufacture chips in just a few days."* This not only facilitates cost-effective use of the technology for many other applications, but also helps to respond quickly to any new challenges, such as testing for new virus variants.

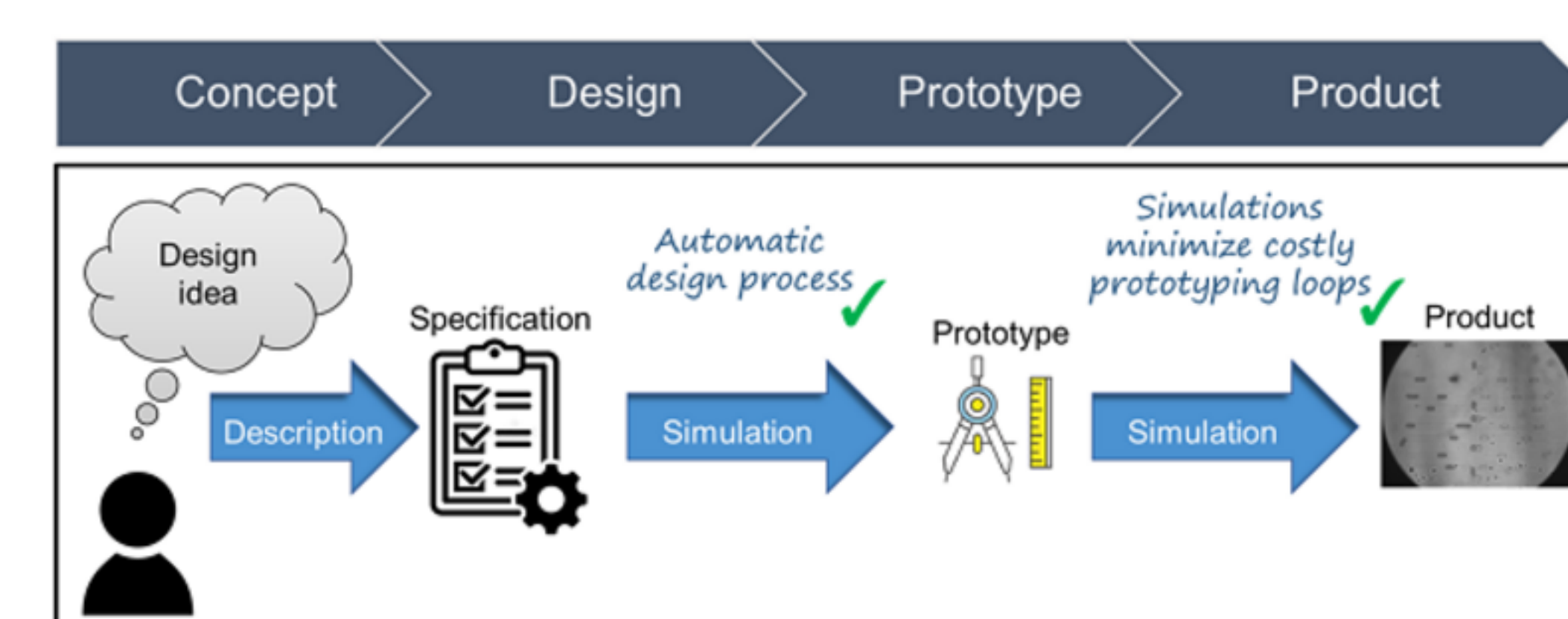
The project pools skills that ideally complement each other; the JKU will conduct base-knowledge research in design and production of chip laboratories while ESS and Ernst Wittner GmbH - established companies with decades of production experience and international marketing experience in automating design processes - focus on other areas. As an expert in the field of software science, SCCH will also ensure that all of the methods remain truly operational and applicable for the interdisciplinary target group.

The Austrian Research Promotion Agency (FFG) is providing over €1.4 million in funding.

[Prof. Wille](#)

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