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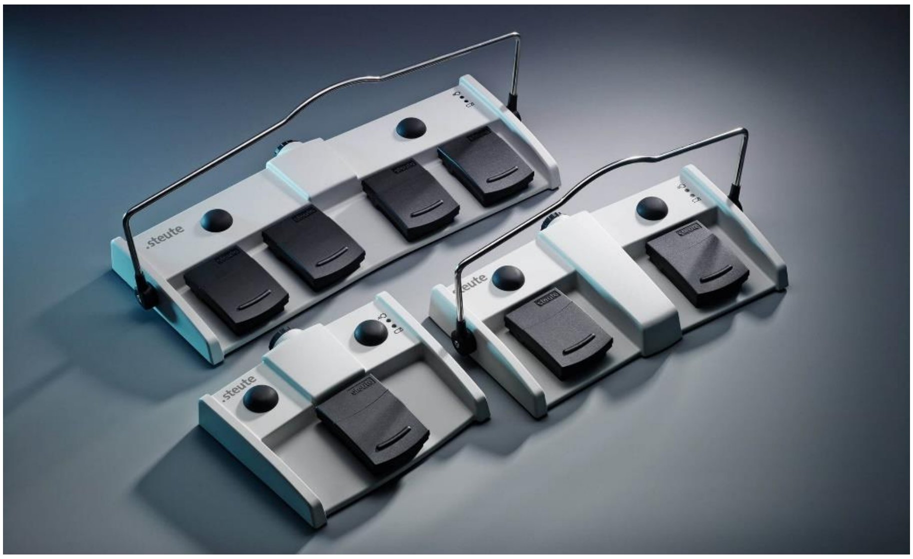
USER INTERFACE WITH INTEGRATED SENSORS

More functions for foot switches | The OR user interfaces of the future will be mechatronic integrated devices (MID) with special surfaces. Thanks to new production techniques, it is now possible to integrate conductive paths, sensors or antennas in the surfaces. Examples can be seen at the Medica.



Further development of foot switches using new technologies: steute Meditec wishes to approach this goal by collaborating in joint research projects. The initial results are promising.

If a foot switch is damaged during daily use in the OR, moisture could penetrate during cleaning, which in turn could impair the function of the medical device it is operating. The classical way to prevent this from happening is to have well-sealed user interfaces, typically to protection class IP X8. Each switch is also carefully inspected for leakage at the end of the production process. But how could the risk be avoided completely – with simple, reliable means and at an affordable cost? This is the question which the steute Meditec developers in Löhne asked themselves. And they found multiple answers.

The opportunity arose during a joint project on moulded integrated devices, also known as mechatronic integrated devices, or MID for short. These devices or components have selectively metallised surfaces – one example is plastic enclosures for smart phones. In these enclosures, three-dimensional conductive paths, sensors and antennas are integrated directly in the injection moulded part using laser direct structuring (LDS).

YOUR KEYWORD

- Mechatronic integrated devices (MID)
- Laser direct structuring, combined with 3D printing
- Moisture measurement inside the foot switch
- Foot switch enclosure: integrated antenna

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The process involves a plastic granulate containing metallic additives. A laser uses it to "write" the electrical layout onto the plastic component. The additives in the material are exposed to copper in a chemical bath and activated. In the activated regions, three-dimensional conductive paths emerge, preserved by a layer of nickel or gold. If necessary – depending on whether the conductive layer should remain on the surface or be protected – these paths can be painted over. The result is antennas for smart phones or other smart devices.

This process has been tried and tested, but relies on injection moulding, meaning that it is not economically efficient for smaller series. For companies which produce e.g. switching devices or drive elements in small to medium quantities, the question is then: is there another way to apply or integrate conductive paths in plastic enclosures in order to achieve MID? Can the advantages of LDS be combined with other technologies for use in smaller quantities?

These were the questions addressed by the project "Smart wireless MID sensor systems for IoT applications" (MERLIN) within the cluster of excellence "Intelligent technical systems – it´s OWL". The project group included Fraunhofer IEM, Paderborn, and TH OWL, Lemgo, as well as four companies, one of which was steute. The project received financial support from the state of NRW via the Ministry for Economic Affairs, Industry, Climate Action and Energy.

Further information

Aside from the it´s OWL project, the steute Meditec developers have also studied ways of monitoring the penetration of fluids or moisture in the user interface with other processes (suitable for smaller series). The results of these studies will be presented by steute Meditec at the Medica 2023.

At the Medica fair: Hall 10, Booth E39

Two parallel printed conductive paths facilitate resistive moisture measurement

Laser direct structuring combined with 3D printing

The results of this project have already shown that MID can be produced without injection moulding. A process developed and patented by Fraunhofer IEM combines LDS with additive manufacturing, in other words 3D printing. This facilitates manifold uses of LDS.

An additivised plastic powder is used to "print" the three-dimensional component. Then – very similarly to the familiar LDS for injection moulding – the layout is "burnt" onto the surface of the component by laser and metallised with copper ions. Here, too, the conductive layer can be painted over to protect it.

But that is only one of two possibilities which the project partners have been working on. The second: TH OWL (Lemgo) uses a powder paint which permits the creation of circuits on any metallic base. Here, too, the LDS process can be used.

For the project partner steute, one question within Merlin was of particular interest, namely the monitoring of moisture levels within a switch enclosure. In a demonstrator, parallel unconnected conductive paths were activated by laser within the base of the enclosure. As soon as a single water droplet penetrates the

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enclosure, it connects the conductive paths – in accordance with the resistance principle – and causes a short circuit. The consequent drop in voltage signals the penetration of moisture.

In a second demonstrator, capacitive moisture measurement was used and a sensor generated by laser. Here, too, moisture penetration can be measured because the dielectric constant changes. But compared to resistive measurement, this method is less reliable. One possible explanation is that single drops have only a small metrological impact on large-scale capacities. An absorbent fleece placed over the capacitive sensor surface can be helpful.

From the standpoint of steute Meditec, the project results can be successfully employed for other tasks. One example: the developers are currently working on the integration of antennas in the surfaces of wireless foot switch enclosures.

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