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Research and technology

The user interface as a "mechatronic integrated device" (MID)

Transfer project for monitoring damp inside medical device controls

Fig. 1: Due to the high levels of hygiene required, wireless controls for medical equipment must have protection class IPX8 and be accordingly well sealed.

As part of a transfer project of the "it´s OWL" cluster of excellence, steute is investigating the integration of sensors in medical device control enclosures. More specifically, sensors for monitoring any penetration of damp. Two innovative manufacturing techniques are being combined in this investigation: laser direct structuring (LDS) and additive manufacturing (AM). The results are very promising – and will turn the user interface into a "mechatronic integrated device" (MID).

Completely sealed

Foot switches in the OR are cleaned often and thoroughly in order to meet strict hygiene requirements. Bearing this in mind, the user interfaces developed and produced by steute Meditec (Fig. 1) are very well sealed, typically to protection class IPX8. In addition, every single switch is meticulously inspected at the end of the production process to leakage. However, should the foot switch be opened in the field for a battery change, it is impossible to rule out the possibility that damp could penetrate the control. In such cases, the corresponding medical device could no longer be operated.

Integrated damp monitoring in OR foot switches

How can this risk be avoided – as simply and reliably as possible, and yet at a reasonable price? This was one of the questions addressed by a transfer project within the "Intelligent

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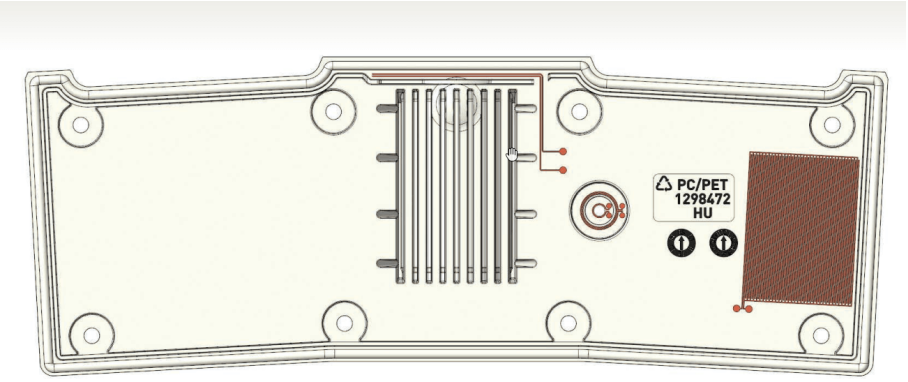

Fig. 2: Damp monitoring integrated inside the enclosure is a good option for foot switches in the OR – and an object of investigation within the it´s OWL MERLIN project.

technical systems – it´s OWL" cluster of excellence. Two research partners (Fraunhofer IEM, Paderborn, and TH OWL, Lemgo) worked here together with four industrial companies (Berg Spannsysteme, Contech, Lenze and steute). The project "Smart wireless MID sensor systems for IO applications" (MERLIN) was supported by the German state of NRW, with funding from the Ministry of Economic Affairs, Innovation, Digitalisation and Energy. It has now been completed, with some very practical results for steute Meditec.

Combination of LDS and additive manufacturing

A solution to the challenge "integration of damp monitoring inside a user interface enclosure" is provisionally provided by the laser direct structuring (LDS) technique. Here, three-dimensional conductive paths, sensors or antennas are integrated directly in the injection moulded part, using a special synthetic granulate enriched with metallic additives. A laser then "writes" the electrical layout onto the plastic component. This activates the additives which then bond to copper in a subsequent chemical bath. In the activated regions, three-dimensional conductive paths form on the surface and are then preserved by a layer of nickel or gold.

Depending on the application – i.e. whether the conductive layer should remain on the surface or be protected – this layer is then additionally lacquered over.

Additive synthetic powder

This technique is usually deployed for larger series, however, e.g. when integrating antennas in smartphone enclosures. It becomes viable for smaller series – and thus for application in user interfaces – thanks to a procedure which was developed and patented by the Fraunhofer Institut IEM and which combines LDS with additive manufacturing, in other words 3D printing. Here, an additive synthetic powder is first used to "print" the three-dimensional component. Then – very similarly to LDS for injection moulded parts – the layout is "burnt" by laser onto the surface of the component and metallised with copper ions. This conductive layer is then covered with a protective lacquer.

An alternative:

The second research partner in the MERLIN project, the Technische Hochschule OWL (Lemgo), uses a powder paint which facilitates the creation of circuits on all metallic bases. In such cases, the LDS technique can also be used.

Resistive and capacitive

Two strategies for measuring damp inside a switch enclosure. In the MERLIN project, steute – together with its two research partners – tested two different ways of measuring damp inside a switch enclosure. Using a demonstrator, conductive paths running in

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parallel, but not touching, were applied inside the body of the enclosure.

A penetrating drop of water – according to the principle of resistive measurement – creates a link between parallel conductive paths and generates a short circuit which can be measured as a drop in voltage: a clear signal that moisture has entered.

Capacitive damp measuring

In a second demonstrator, the capacitive technique for measuring damp was applied. Here, conclusions about the penetration of moisture can be drawn from changes in the dielectric constant. In comparison to the resistive measuring technique, this method proved less reliable. This is assumed to be because individual drops of moisture have only a very minor measurable impact on large-scale capacities. A solution could be to use an absorbent fleece, laid over the capacitive sensor surface.

The user interface as a "mechatronic integrated device"

According to the findings of this sub-project, the combination of LDS and AM is fundamentally very promising and could very well be integrated in the serial production of steute medical device controls in the future. User interfaces would then become "MID". This abbreviation stands for moulded integrated devices or mechatronic integrated devices. In this context, such devices are understood as being devices or components with selectively metallised surfaces.

New perspectives for functional integration

In general terms, steute Meditec is able to conclude that the excellent collaboration with these two research institutes and the other industrial partners within the MERLIN project has opened up new perspectives, is very helpful for tapping into new technologies, and will also speed up their implementation.

This manufacturing technology could also be used to solve other problems. First and foremost, potential exists for the integration of antennas – e.g. on protective guards over foot switches. After all, the majority of user interfaces from steute Meditec communicate with their corresponding medical devices wirelessly. And independently of the it´s OWL

Fig. 3: One possibility is integration of printed circuit boards in the 3D printed enclosure.

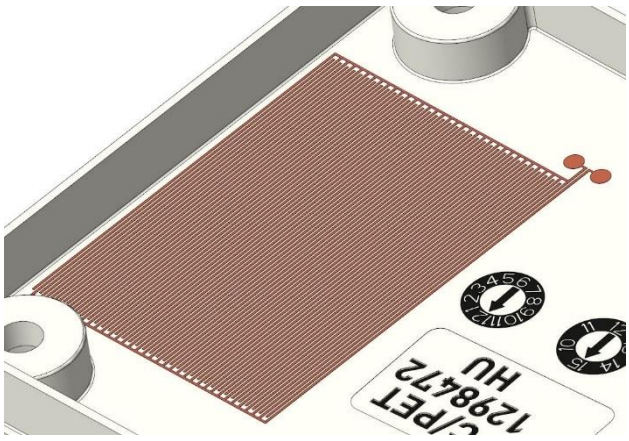

Fig. 4: A capacitive damp sensor integrated in and "printed" onto the surface was also investigated.

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project, the steute Meditec developers have also addressed ways of monitoring fluid or moisture penetration in the user interface using other (small-scale) procedures. ◄

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