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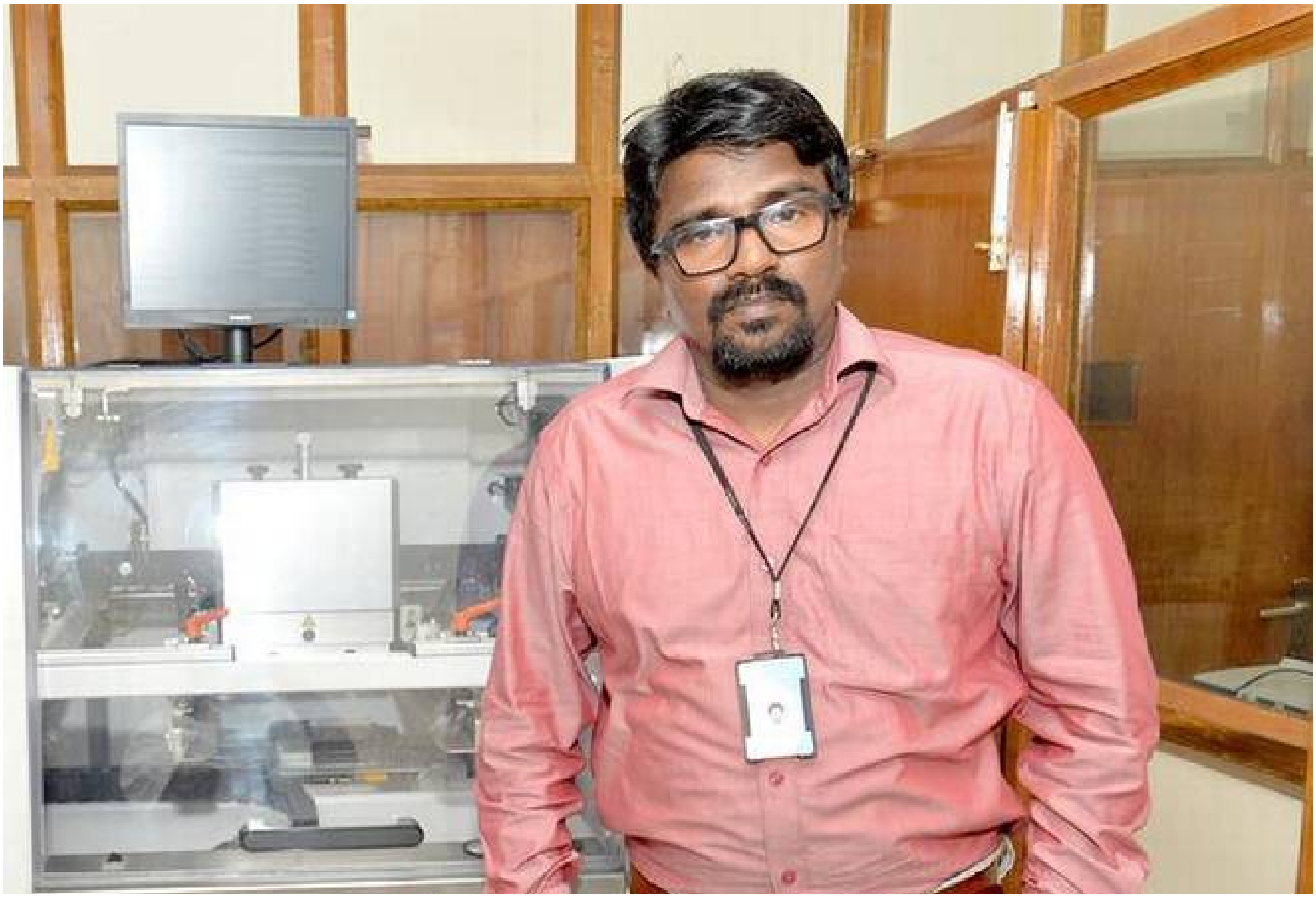
NIIST team fabricates a wearable antenna



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The prototype made may need more improvements

Wearable antenna embedded in a multilayered polyester fabric suitable for WiMAX (Worldwide Interoperability for Microwave Access) applications may soon become a reality, thanks to the work by researchers at the National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram. The wearable WiMAX antenna, which is about 3 cm in length and nearly 4 cm in width, is flexible, light weight and operates at around 3.37 GHertz. Wearable antenna has applications in telemedicine, defence and environmental monitoring, among others.

"Our goal is to make wearable antenna which can be embedded in the jacket worn by soldiers in remote locations. We can connect the antenna to different sensors such as temperature, pressure and ECG sensors and the data can be transmitted to a remote server. The antenna can sense and communicate data in a non-intrusive manner. This way we can monitor the health of soldiers," says Dr. P. Mohanan from Cochin University of Science and Technology, Kochi and one of the authors of the paper.

Silver choice

Conventionally, thin copper films cladded to glass reinforced epoxy substrates are used for making patch antennas and these antennas are not flexible.

The antenna fabrication can be dramatically simplified by printing technology using copper ink where the radiating patch as well as bottom electrode can be screen printed onto flexible substrates including fabrics. But the use of copper ink is fraught with problems as it gets oxidised easily thus compromising the performance of the antenna.

Dr. K.P. Surendran from the Materials Science and Technology Division at NIIST and Roshni S. Babu overcame this problem by using a silver ink for printing the bottom electrode on the polyester fabric as well as the E-shaped patch antenna. Screen printing on fabric is not new but the challenging arises from the roughness of the fabric. “To overcome the problem of surface roughness, we coated the fabric with a polymer (polyvinyl butyral or PVB) to make the surface smooth and hydrophobic,” says Dr. Surendran, who is the corresponding author of the paper published in the journal *Smart Materials and Structures*.

Coating the fabric with a PVC polymer reduced the surface roughness from 341 nanometre to about 15 nanometre. The polymer coating also made the surface water-repelling (hydrophobic). “We can increase the degree of hydrophobicity by coating another polymer that is more hydrophobic,” he says. It is essential to make the fabric hydrophobic as wetting of the fabric compromises the performance of the antenna.

Thicker fabric

A thicker fabric base is an essential requirement for making a wearable antenna. The researchers achieved this by hot pressing three layers of the fabric with polyacrylate sheets in between the fabric layers; the polyacrylate sheet acted as an efficient adhesive. A thicker fabric prevents the ink from permeating during screen printing. “We were able to achieve over 1 mm thick fabric by gluing three layers of the fabric,” he says.

A worn fabric undergoes a lot of flexing and bending and very often the performance of a wearable antenna gets affected after repeated bending and flexing. When the wearable antenna is bent, some of the electrical contacts between the metal ink particles on the patch and bottom electrode get disrupted thus reducing the radiation efficiency. The radiation efficiency becomes normal when the fabric is unbent.

“The radiation efficiency did not deteriorate even when bent for cycles of 10 up to 100 times,” Dr. Surendran says.

Since the antenna radiates microwave, it is necessary to protect the body from the microwaves emitted by wearable antennas. “The bottom electrode protects the body from radiation. So wearable antennas are safe,” assures Dr. Surendran.

The size of the antenna can be reduced by using an antenna array (many antenna printed in a symmetric fashion). “We have developed a prototype already but want to increase the hydrophobicity further,” he says.

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