Transforming service fields into laboratories
Virtualization of indoor environments and behavior of customers and employees

We have developed SDF (Sensor/Data Fusion) for human-behavior sensing and geometric-modeling techniques for indoor service fields. SDF can measure the position and orientation of customers and employees with wearable self-contained sensor modules which contain accelerometers, gyroscopes, magnetometers, and a barometer. The relative position and absolute orientation are estimated by PDR (Pedestrian Dead-Reckoning). Measuring the absolute position and correcting estimation errors accumulated by PDR are done with IMES/Wi-Fi/RFID/VLC (Visible Light Communication) and with 3D environmental maps. The massive cost for initial installation and maintenance is inevitable if we densely cover indoor environments only with positioning infrastructure. The combination of PDR, sparse positioning infrastructure, and map information realizes cost-effective and adaptive measurement. Also using interactive 3D indoor modeler makes it possible to create virtualized-reality models of service fields only from a set of photos while reducing the creation cost. Moreover, the indoor models have high re-usability since they can be used not only for maps in SDF, but behavior analysis, ethnography, navigation, etc.

Tomoya ISHIKAWA
Center for Service Research
tomoya-ishikawa@aist.go.jp
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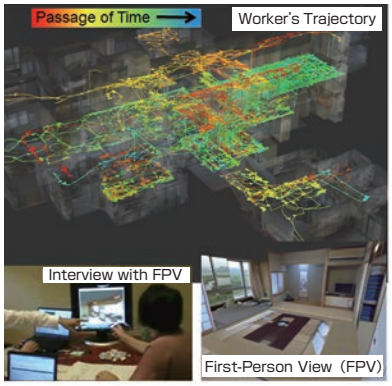

Retrospective interveiw support using virtual first-person views based on human-behavior measurement

Flexible, film-like thermoelectric devices fabricated through printing processes
Improvement in the usability of thermoelectric devices making possible the application to energy harvesting field

To innovate the usability of thermoelectric devices, we have developed a novel printable active material based on a carbon nanotube/polymer composite and fabricated film-like devices on flexible plastic substrates. The film-like thermoelectric devices offer technical advantages over the BiTe-based ordinary counterpart in terms of the characteristics in the fabrication and the usage; employing rare-metal-free materials, possible low-cost, large-area and high volume production by the use of printing technology, and a greater degree of freedom in installation due to mechanical flexibility. We succeeded in generating electric power from a prototype device in contact with low-temperature thermal sources such as the human body.

Kouji SUEMORI
Flexible Electronics Research Center
kouji-suemori@aist.go.jp
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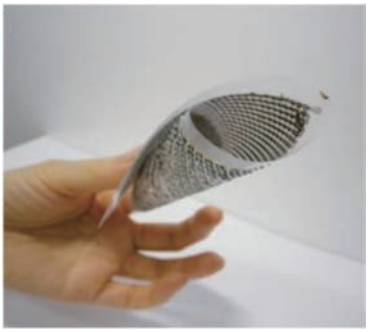

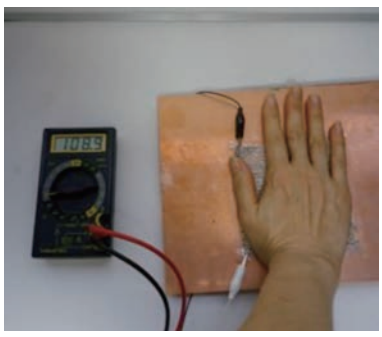

A flexible thermoelectric conversion film fabricated by using a printing process (left) and its electrical power-generation ability (right)
A temperature difference created by placing a hand on the film installed on the 10 °C plate generated voltage of 108.9 mV.