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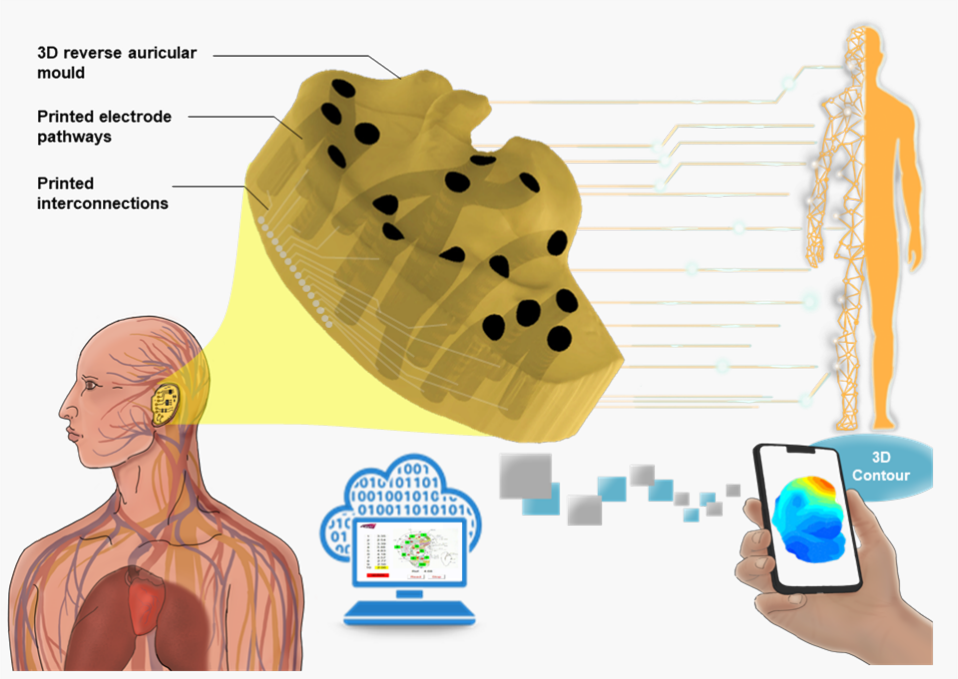
Wearable Three-dimensional Auricular Multi-point Acquisition, Health Status Monitoring, And Bio-stimulation Device

Health & Wellness

Biomedical and Genetic Engineering



IP Status
Patent filed

Technology Readiness Level (TRL) ? 6

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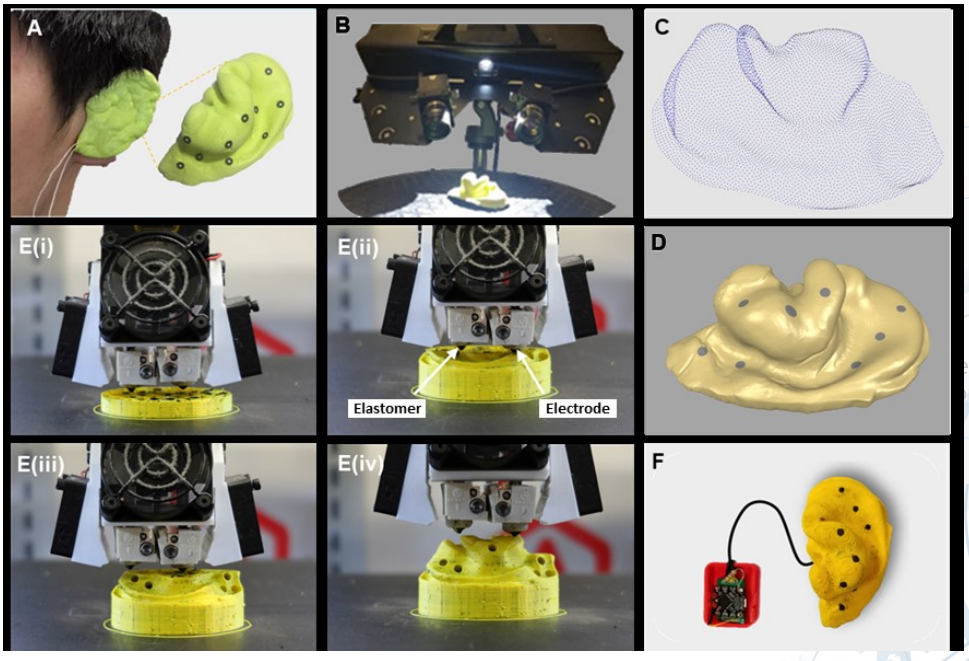
3D-printed personalized auricular sensor (3D-PAS) for simultaneously real-time bio-signal monitoring of multiple points across entire ear auricle.



Fabrication process of 3D-PAS. (A) Human-specific auricular impression molding. (B) 3D-scanning of reverse auricular mold. (C) Points cloud generating. (D) Geometric designing and locating of embedded electrodes pathways. (E) 3D-printing of sensor with elastomer and functional material. (F) Prototype of

3D-PAS with electrical circuit.

Opportunity

This invention is a novel wearable 3D-shaped auricular points bio-signal healthcare device which can reliably measure or apply different real-time signals at multiple points of the auricle simultaneously. Such a commercial product does not exist today. This device is personalized for users and can be conformably shaped with the entire outer ear of human subjects, which varies significantly among subjects. The novel geometric design of this device provides a 3D human-machine interface and geometrically configurates multiple sensing or stimulating units which are spatially distributed in the 3D sensor. Functionally, this device can sense or stimulate different physical signals (such as skin impedance, temperature, hydration, pressure, etc.) in multiple auricular regions with each region also surrounded by multiple sub-sensing/stimulating points; then multi-functional signals can be collected or stimulated for further analysis. Users can wear this device on outer ear for medical diagnosis or therapy, and even for daily activities and bio-signal monitoring. Additionally, a friendly user interfere has also been set up to show the measurement results with a three-dimensional contour map that directly visualizes 3D-distribution of bio-signal strength across the auricle and helps users identify the variations of activities at specific regions of the subject's body. This device can greatly advance auricular points based diagnosis and therapy by delivering quantifiable and repeatable data.

Technology

A type of medical molding material (e.g., green eco, DETAX GmbH & Co. KG) is used to construct personalized ear impressions, which have complex 3D structure and varies significantly among human subjects. 3D-scanning-like technology is used to perform surface identification and obtain cloud points data of the ear impression. Surface modification and building are performed to generate 3D solid model of the device by 3D modeling software followed by locating the positions of regions to be sensed or stimulated. Multiple-functional sensing or stimulating elements are also geometrically embedded and designed into the specific locations. After that, 3D-printing-like technology is used to fabricate 3D ear-mold with multiple types of materials for sensing or stimulating elements, respectively. Additionally, on the top of sensing or stimulating "electrodes" is filled with softer functional materials which deliver mechanically stable skin-electrode contact.

Advantages

- Full-coverage: this invention can perform sensing or stimulating in multiple auricular regions across the whole ear auricles.
- More reliable: this invention provides 3D conformable human-machine interface resulting to more repeatable and stable measurement.
- Multi-functional: this invention can simultaneously sense or stimulate multiple real-time physical signals (such as skin impedance, temperature, hydration, pressure, etc.) in auricular skin.

- Visualized: user interface of the 3D contour map is used to directly identify signal distributions.
- Quantifiable data collection: justifiable data is collected for further analysis.

Applications

- Monitor different human physiological changes during daily activities like exercising, sleeping or working.
- Diagnose patient's health condition with different stages or track therapy effectiveness.
- Perform mechanical/electrical auricular treatment.
- Monitor human emotional and mental changes, or any other potential applications related.