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(54) Title: HAND WORN INTERFACE DEVICE

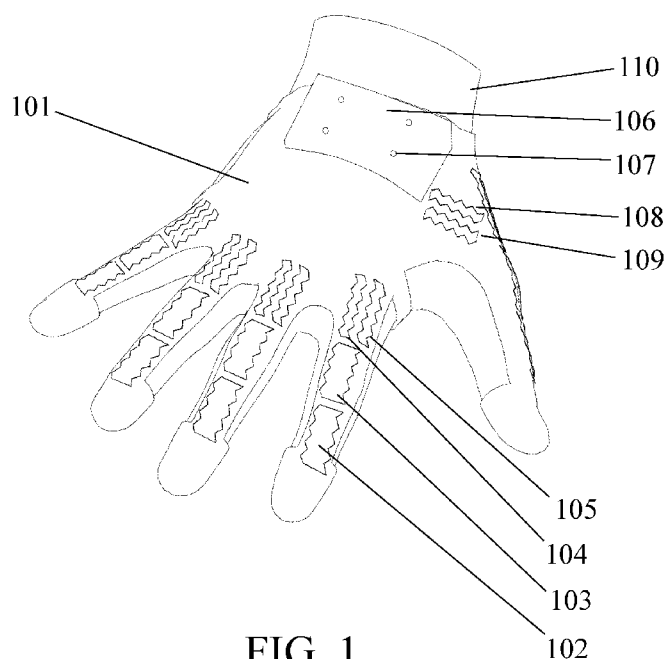


FIG. 1

(57) Abstract: A wearable device comprises a flexible substrate carrying multiple conducting loops which are formed into a zig zag pattern so as to be able to accommodate a stretching of the substrate. The substrate is formed into a glove and the loops positioned such that they are aligned with the anatomical joints. As the anatomical joints move, the loops change shape and accordingly change their inductance - this is measured by the electronics in the glove and used to calculate the joint angles in a processor which transmits the angles to an external computer system. Some of the loops are attached to current drivers in the electronics module, and a magnet positioned close to the loop, providing means for a force to be generated between magnet and loop when the current driver passes current through the loop, thereby providing tactile feedback to the user.



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- *with amended claims and statement (Art. 19(1))*

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Claims

- [Claim 1] A wearable device for measuring one or more joint angles of a body of a user comprising:
- a flexible, elastic substrate, the substrate attachable to the body;
 - a plurality of conductive loops attached to the substrate, each of the plurality of conductive loops positioned over a joint when the substrate is worn on the body, each of the plurality of conductive loops comprising a pattern of conductive material configured to stretch and increase inductance when the joint flexes and contract and decrease inductance when the joint extends;
 - a plurality of inductance measurement circuits attached to the plurality of conductive loops by conductive wires within or upon the substrate, the inductance measurement circuits configured to measure inductance in the corresponding conductive loops;
 - a processor attached to the inductance measuring circuits, the processor configured to receive inductance values from the inductance measuring circuits and compute a plurality of joint angles based on the inductance values.
- [Claim 2] The wearable device of claim 1, wherein said conductive loops comprise zigzag patterns.
- [Claim 3] The wearable device of claim 1, wherein said conductive loops comprise a plurality of turns, such that a circuit is formed from said inductance measuring circuits, through said conductive wires within or upon said substrate, through each loop in turn, and then back through said conductive wires to return to said inductance measuring circuit.
- [Claim 4] The wearable device of claim 1, wherein said conductive loops are positioned adjacent to the axis of flexion of the corresponding joint, when the substrate is worn on the body.
- [Claim 5] The wearable device of claim 2, wherein the wearable device is attached to the body.
- [Claim 6] The wearable device of claim 5, wherein the plurality of conductive loops are positioned over a plurality of joints, when the substrate is worn on the body.
- [Claim 7] The wearable device of claim 6, further comprising at least two extensible conductive loops positioned opposite the primary direction of joint flexion of the metacarpal phalangeal joints of the digits and configured to measure abduction and flexion.
- [Claim 8] The wearable device of claim 1, further comprising:

a plurality of permanent magnets in proximity to the plurality of conductive loops;
current driving circuitry attached to the conductive loops and configured to generate a current in the conductive loops and generate a force on the magnets.

- [Claim 9] The wearable device of claim 1, wherein each of the inductance measurement circuits comprise a capacitor, amplifier, feedback circuit, and frequency counter, the amplifier and feedback circuit connected to the corresponding conductive loop and capacitor and configured to generate an oscillatory signal.
- [Claim 10] The wearable device of claim 5, further comprising a device attached to the wearable device at the wrist, the device comprising a plurality of optical or magnetic transmitters or receivers, the device configured to interoperate with a body tracking system.
- [Claim 11] The wearable device of claim 1, wherein the wearable device comprises tubular structures configured to allow attachment to the body by allowing body parts to pass through the tubular structures.
- [Claim 12] The wearable device of claim 1, wherein the flexible, elastic substrate is a silicone or polyurethane elastomer or a woven elastic textile.
- [Claim 13] The wearable device of claim 1, wherein said processor is attached to a wireless transmitter configured to transmit information from said processor to a computer.
- [Claim 14] The wearable device of claim 9, wherein the amplifier, feedback circuit, and frequency counter are embodied in a field programmable gate array (FPGA).
- [Claim 15] The wearable device of claim 1, wherein each of the inductance measurement circuits comprises a means to generate an oscillatory current passing through said conductive loops and means to measure the frequency of the resulting oscillatory current.
- [Claim 16] The wearable device of claim 15, wherein said means to generate oscillatory current and measure the frequency of said oscillatory currents are embodied by digital logic gates.
- [Claim 17] The wearable device of claim 16, wherein said digital logic gates are embodied within a field programmable gate array (FPGA).

Statement under Article 19(1)

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Claims 2-3 and 5-14 have been amended to correct typographical errors and use clearer language. No new material has been added.

STATEMENT UNDER ARTICLE 19

Claim 1 has been amended to recite, inter alia: “a plurality of conductive loops attached to the substrate, each of the plurality of conductive loops positioned over a joint when the substrate is worn on the body, each of the plurality of conductive loops comprising a pattern of conductive material configured to stretch and change inductance when the joint flexes and contract and change inductance when the joint extends; a plurality of inductance measurement circuits attached to the plurality of conductive loops by conductive wires within or upon the substrate, the inductance measurement circuits configured to measure inductance in the corresponding conductive loops; a processor attached to the inductance measuring circuits, the processor configured to receive inductance values from the inductance measuring circuits and compute a plurality of joint angles based on the inductance values,” which is believed to distinguish over the prior art.