MagIK: A Hand-Tracking Magnetic Positioning System Based on a Kinematic Model of the Hand

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In this paper we present a hand tracking system based on magnetic positioning. A single magnetic node is mounted on each fingertip, and two magnetic nodes on the back side of the hand. A fixed array of receiving coils is used to detect the magnetic field, from which it is possible to infer position and orientation of each magnetic node. A kinematic model of the whole hand has been developed.

Magnetic active nodes are small solenoids coupled with a capacitor (resonant LC circuits), and supplied with an alternating voltage, thus generating an oscillating magnetic field. Also receivers are solenoids coupled with capacitors. The varying magnetic field of the active nodes induces a measurable voltage on receivers. By measuring the induced voltage on each receiver, and inverting a mathematical model [40], it is possible to infer the position and the orientation of each active node, where the orientation is defined as the direction of the solenoid symmetry axis. Receivers are mounted on a stable wooden structure, shown in Figure 1 with its reference frame. There are 24 receivers inserted into carved slots. 16 sensors are mounted under the horizontal plane, arranged on a regular 4×4 grid, the distance between sensors being 8 cm; 4 sensors are mounted at the center of each one of the vertical planes, positioned on the vertices of an 8 cm side square.

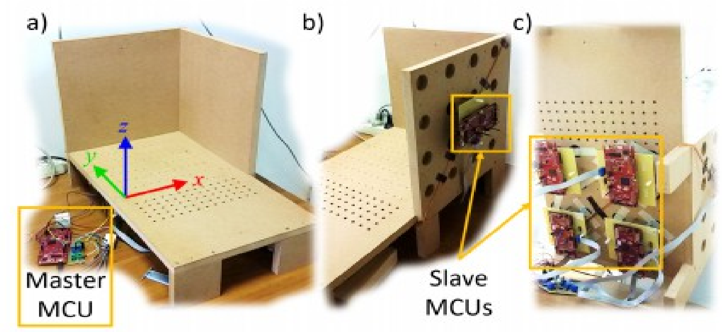


Fig. 1. A picture of the magnetic positioning system. a) Front view. The reference frame is shown. The grid carved on the xy plane is used for the calibration procedure described in [41]. Receivers are not visible from the front. b) Side view of the yz plane; receivers are inserted into round carved slots; only four receivers are mounted at the center of each vertical plane; signals on the receivers are acquired by microcontroller units equipped with four ADCs each. c) Bottom view. Sixteen receivers are mounted under the xy plane with four microcontrollers.

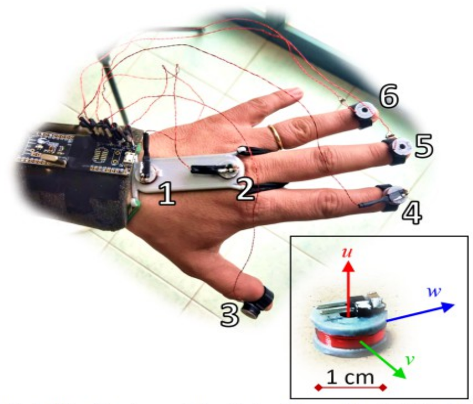


Fig. 2. Magnetic nodes mounted on the hand. The supply unit is tied to the wrist. Two magnetic nodes are mounted on the hand's back; they are used to measure the position and orientation of the hand in space. One node is mounted on each fingertip (the pinkie excepted) in order to measure finger position and flexion with respect to metacarpus. A single magnetic node is shown in the inset; rotations around its u axis cannot be measured by the MPS because of the cylindrical symmetry of the node.

IoT Based Sign Language Interpretation System

Golda Jeyasheeli P and Annapoorani K Miss 2019 *J. Phys.: Conf. Ser.* **1362** 012034

https://iopscience.iop.org/article/10.1088/1742-6596/1362/1/012034/pdf

Fig. 2: A wearable smart device for both left and right hand using the hardware component in the wearable glove.

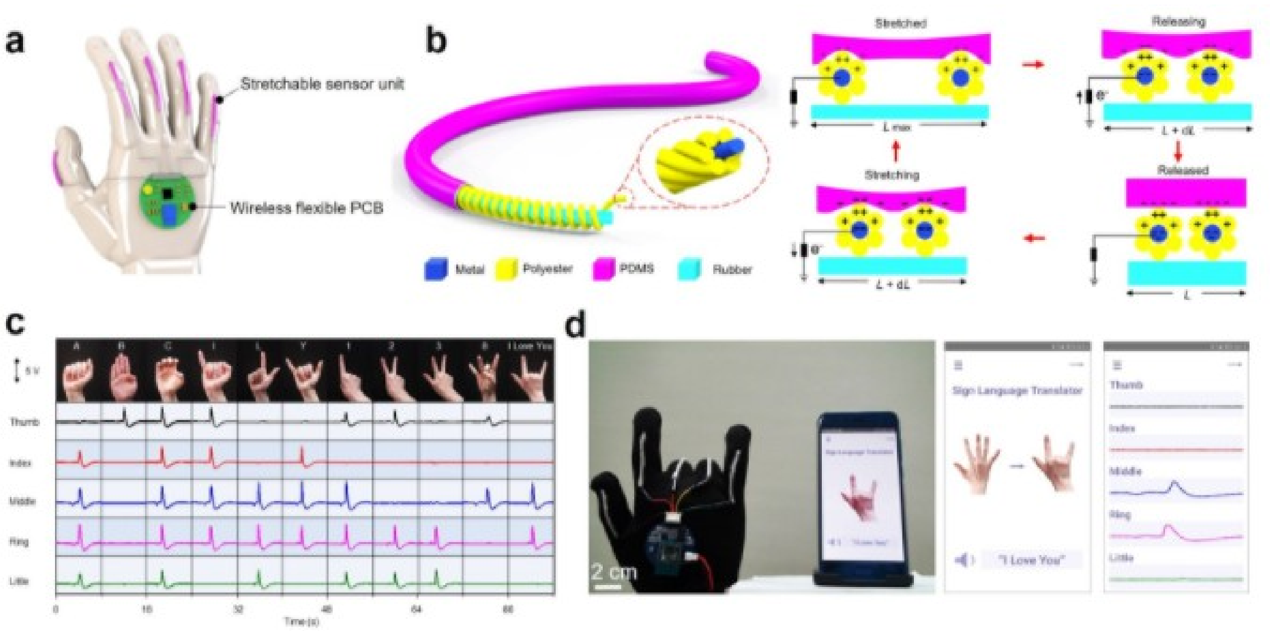
The 4.5inch flex sensor is used for pinky finger, ring finger, middle finger and forefinger for both right and left hand. The 2.2inch flex is used for thumb finger on both right and left finger. The flex sensor 4.5 inch is used for pinky finger because it is connected with the micro controller. The two-pressure senor is used on right hand and another two on left hand. The pressure sensor is placed at above and below the palm of the both hands. The omnidirectional flex sensor changes its resistance whenever the bend is made in downward and upward direction. Each flex sensor is connected with 10KΩ resistor to reduce the current flow in the flex sensor.

The pressure sensor is connected with 5KΩ resistor. They are interconnected to produce the accurate sensor values for the gesture produced by the deaf and mute peoples. The proposed system contains three different modules, they are, a sensor module, the processing module, and an application module. The sensor and the processing modules are implemented in the smart wearable device and the application module is implemented in android mobile phone. The sensor values of flex sensors and pressure sensor are collected in Arduino mega microcontroller. Two Arduino mega microcontroller are used for the wearable device. The overall system design is shown in Fig.3.

Sign-to-speech translation using machine-learning-assisted stretchable sensor arrays

https://www.nature.com/articles/s41928-020-0428-6

The wearable sign-to-speech translation system consists of yarn based stretchable sensor arrays (YSSA) and a wireless printed circuit board (PCB). Due to its unique structural design and use of soft materials, the yarn based stretchable sensor array can conform to the skin of a human finger under both releasing and stretching states. Analogue triboelectrification and electrostatic induction-based signals generated by sign language components — including hand configurations and motions, and facial expressions-are converted to the digital domain by the wearable sign-to-speech translation system to implement sign-to-speech translation.



A wearable sign-to-speech translation system. **a**, Schematic illustration of a subject's hand with the skin-attached YSSA and the wireless PCB. **b**, Schematic illustration to show the structural design of a yarn-based stretchable sensing unit and its working principle. Inset: enlarged view of the conductive yarn. **c**, Photographs of the sign language hand gestures according to American Sign Language and the corresponding generated voltage profiles as recognition patterns, which are capable of expressing letters, numbers, and short phrases. **d**, User-friendly interface for final speech expression, and the real-time electrical signals display as an intermediate state.