HandPad: Enabling On-the-Go Writing on Your Hand via Human Capacitance

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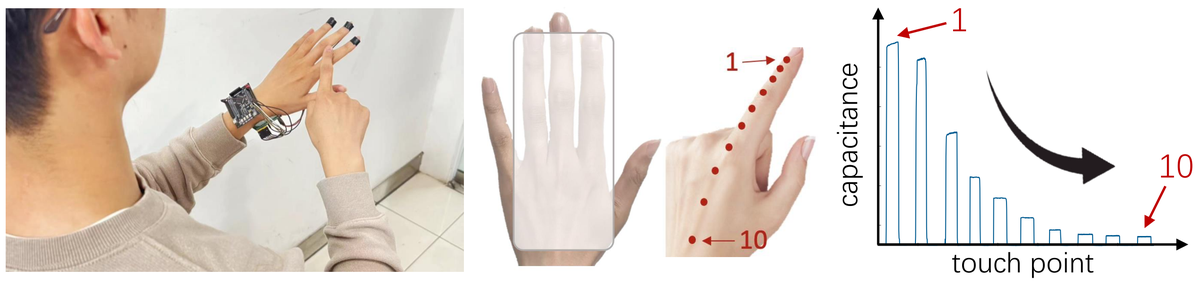
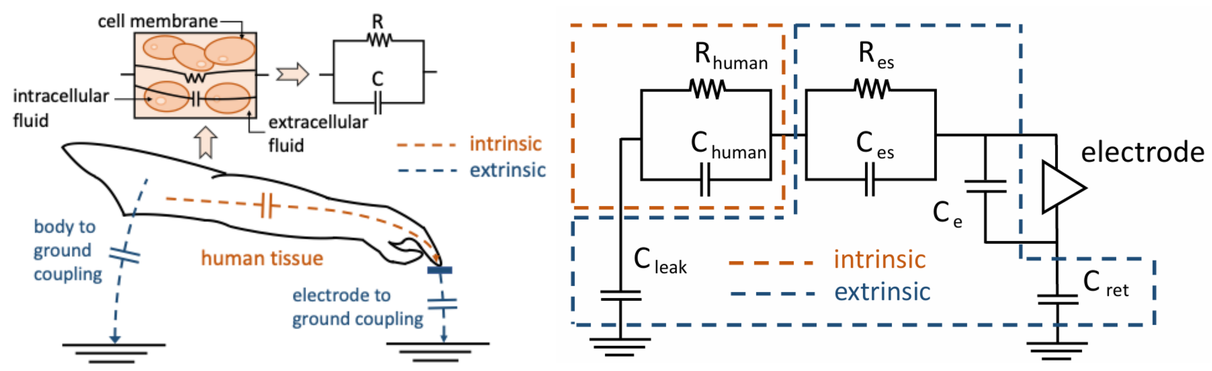
Objective and Observation



- **Objective:** Make hand be a portable touchscreen, supporting keystroke and handwriting input modes.
- **Observation:** Touching different spots on one hand with the other finger alters the arm's intrinsic capacitance.

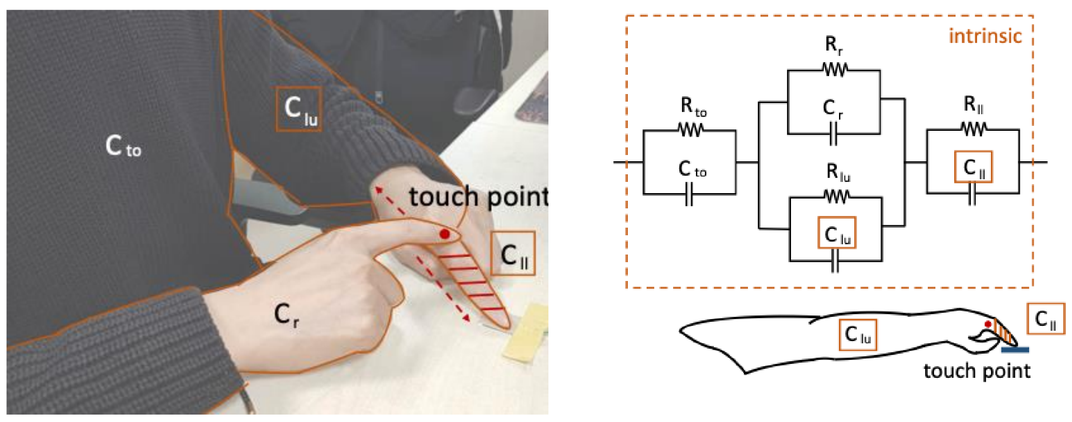
Human Capacitance



- Human tissues possess electrical properties and can be modelled as capacitive C_{tissue} and resistive R_{tissue} :

$$C_{tissue} = \varepsilon A/L \quad R_{tissue} = L/\sigma A$$

- Human body capacitance consists of intrinsic tissue capacitance and extrinsic capacitance between the body, the ground, and the electrodes.

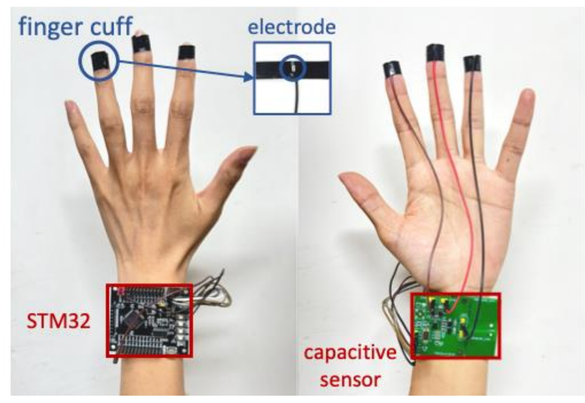


- Extrinsic capacitance remains constant, we can modulate measured capacitance value by changing the intrinsic capacitance (i.e., touch on human body):

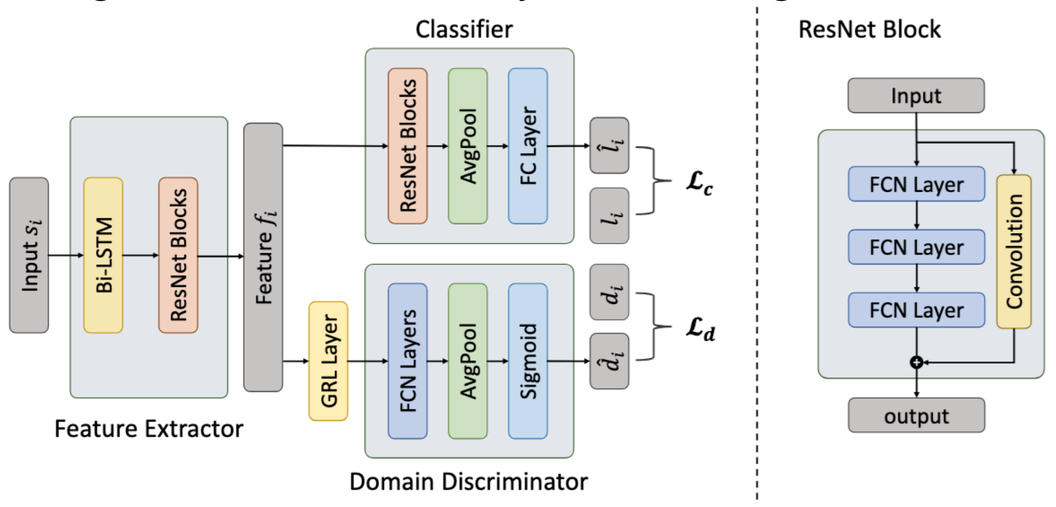
$$C_{human} = \frac{1}{\frac{1}{C_{to}} + \frac{1}{C_r + C_{lu}} + \frac{1}{C_{ll}}}$$

HandPad System Design

- HandPad only requires the deployment of electrode finger cuffs at the fingertips to capture body capacitance.



- **Keystroke Input :**
  - ✓ Users touch the specific locations on the back of the hand for finger modelling.
  - ✓ The system pre-processes, segment the capacitance signal, and achieve keystroke recognition.



- **Handwriting Input:**
  - ✓ Build the dataset for various language types of handwritten inputs.
  - ✓ The recognition process involves training the base model with the dataset, collecting 3 samples per input from the target user, training a user model via domain transfer, and performing Chinese character recognition through stroke sequence matching.

Evaluation Results

- *HandPad* achieves accuracies of 100%, 97.6%, 99.1%, and 97.9% for keystroke, number, letter, and Chinese character recognitions.