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(以论文、报告等形式考核专用)

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题目： On-Skin Interaction

On-Skin Interaction

Abstract

With the rapid development of technology, all mobile phones, tablets and watches have realized the screen control by touching and sliding, instead of the traditional key control. In order to keep up with the development speed of the information technology era, people began to pursue more convenient and comfortable control methods and equipment. The appearance of infrared sensors made scientists think that skin is the next effective information input tool. In this paper, how to use skin to realize information transmission and related technologies at present are briefly introduced.

Keywords

Interface, skin put, finger input.

1. Introduction

Why choose the skin as the next input device? The transformation of the mobile phone, watch and tablet touch screen does not mean the end of the input device. The flat surface and rigid design of the touch screen actually does not conform to the soft structure of the human body surface, and makes the gesture control instructions based on the touch screen design very limited. The skin is a soft surface with highly sensitive sensitivity that can distinguish different forms of touch and produce different mechanical vibration on different parts. The stretchability of the skin also makes the skin add additional input mode, and the external pressure on the skin will make the skin produce different degrees of deformation. These factors all make the skin an input device that can support more different forms of interaction.

The pursuit of portability leads to a growing number of smaller devices with powerful computing power, but small screens mean fewer buttons on the current screen, limiting people's operating space, and achieving convenience while sacrificing operability. Biologically speaking, skin, as the largest organ in the human body, has a wide range of operations. We can use every inch of skin accessible to our fingers as an information input tool, and according to daily experience, we know that fingers can accurately touch the designated parts without sight tracking, making it more convenient for users to operate. The skinput is a way that allows the body to achieve finger input using a new, wearable bioacoustic sensor.

2. Skinput

2.1. Theoretical basis

The flexibility of the skin is shown in that we can not only touch the skin, but also pull, squeeze and twist it. The skin can sense different degrees of contact. In addition to simple touch, pressing, pushing, you can scratch with your nails, and even wrap a place of the body with your hands.

Figure1 shows the eight patterns. It originates from established patterns of traditional touch interfaces and findings of skin biomechanics. These patterns range from surface interactions to strong skin deformation. More complex gestures, such as friction or shaking, can be performed by using these basic input patterns. These operable gestures to the skin make the information input not limited to the current click and swipe of the touch screen.

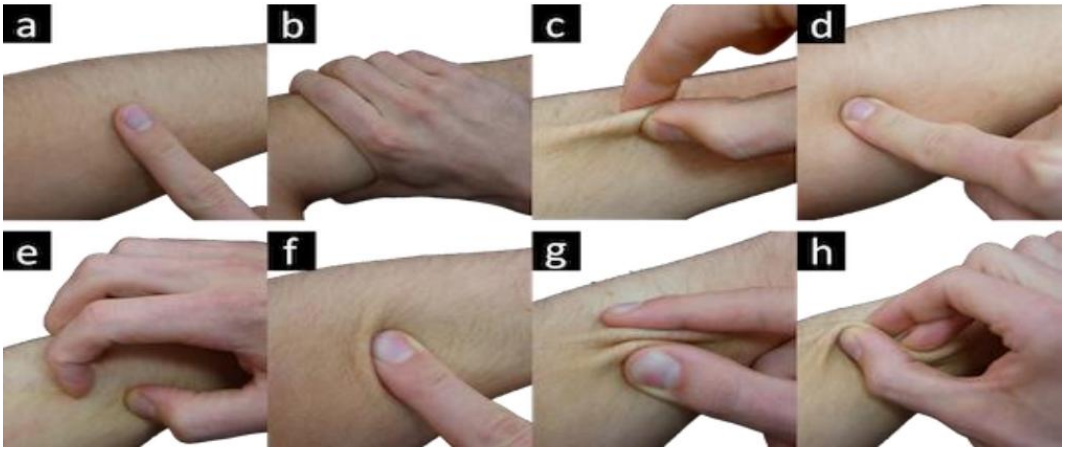

Figure1

The principle of the Skinput technique is the bioacoustics. Whenever a finger strikes on the skin, impact produces sound signals that can be captured by bioacoustic sensing devices. Some energy is lost into the external environment as acoustic waves. The remaining energy travels along the skin surface of the skin, and the remaining energy is passed inward until it is reflected from the bone. Depending on the type of surface producing the disturbance, the amplitude of the wave changes.

2.2. Bio-Acoustics

When one finger hits the skin, several different forms of acoustic energy are generated. Some energy radiates into the air in sound waves; this energy is not captured by the skin system. Of the acoustic energy transmitted through the arm, the most easily visible is the transverse wave, which is generated by the skin displacement caused by the finger impact, as shown in Figure 2. When photographed with a high-speed camera, they can ripple and propagate outward from the point of contact. The amplitude of these ripples is related to the tapping force and the volume and compliance of the soft tissue under the impact region. In general, the soft areas of the arm produce higher horizontal waves than the waveform areas (e. g., wrist, palm, fingers), where compliance is negligible. In addition to the energy transmitted on the arm surface, some energy is transferred inward towards the skeleton, as shown in Figure 3. These longitudinal (compressed) waves pass through the soft tissue of the arm and stimulate the bone, which is much less deformed than the soft tissue, but can respond to mechanical excitation by rotating and translating as a rigid body.

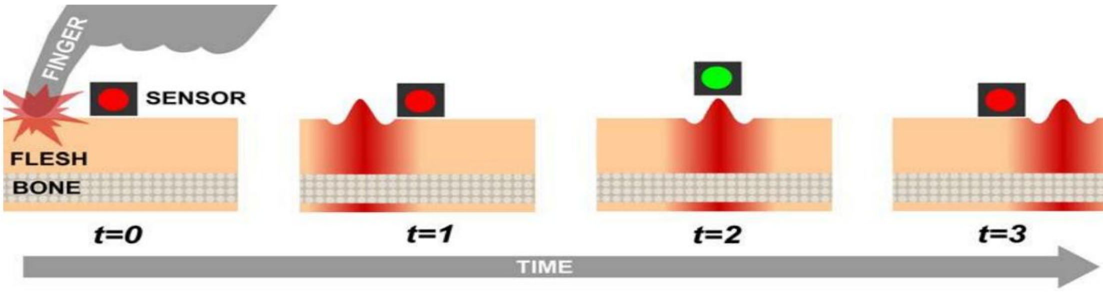

Figure2

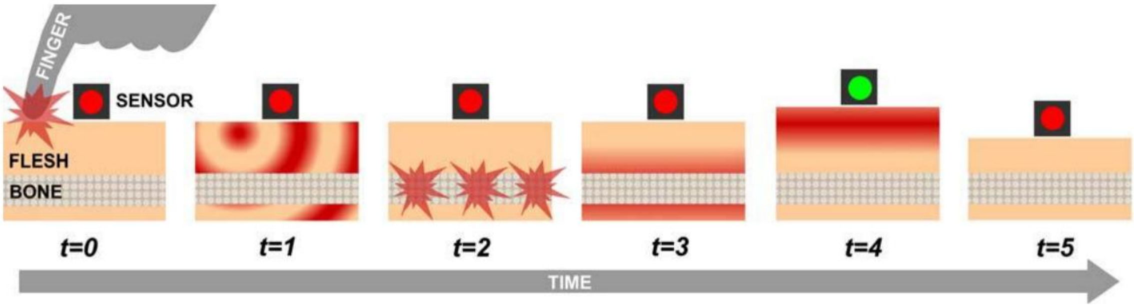

Figure3

Figure 4 and Figure5 illustrates a wearable, built-in bioacoustic sensing array. The sensing element detects vibrations transmitted through the body.The two sensor packages shown above, each containing five specially weighted cantilever piezoelectric films, respond to a specific frequency range.

We apply different pressure strength to the skin, percussion strength, can produce a specific pressure and vibration, as the input information transmitted to this sensor, is a simple, intuitive information input through the skin product.

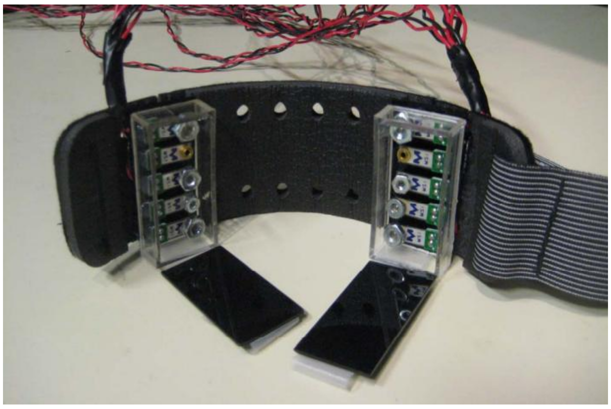

Figure4

Figure5

2.3. Related Experiments

Carnegie Mellon University has experimented with the arms and forearm.

The first is an experiment with finger information input: set up a set of gestures for participants to tap the fingertips of their five fingers. They provide clear discrete interaction points that have even been carefully named.Five fingertips, 14 knuckles, 5 large knots, and 9 sections of the fingers can provide a total of 19 easily identifiable positions for information input.In addition, the linear arrangement of the fingers may be of great use for digital input, size control (such as volume), and menu selection interfaces.At the same time, the fingers are one of the most uniform appendages on the body, and all except the thumb have similar skeletal and muscular structures. This greatly reduces the acoustic variation, and makes it difficult to distinguish between them.

The second experiment was with whole arm information input: Another gesture set investigated the use of —— arm, wrist, palm, thumb and middle finger at a total of five input positions in the forearm and hand.They experimented in two conditions, one with the sensor above the elbow and the other to measure the loss of accuracy at an important joint point (the elbow). In addition, participants repeated the lower placement condition without their eyes: participants were asked to close their eyes and face ahead for training and testing. This condition was tested to measure the accuracy of the user in targeting the body input position without the eyes.

Finally, the experiment of forearm information input: the experimenter set ten positions in the forearm, which is not only a very high input position density, but also depends on the input surface of the forearm, with a high degree of physical uniformity.

Figure 6 illustrates the three input location sets evaluated in the Carnegie Mellon study.

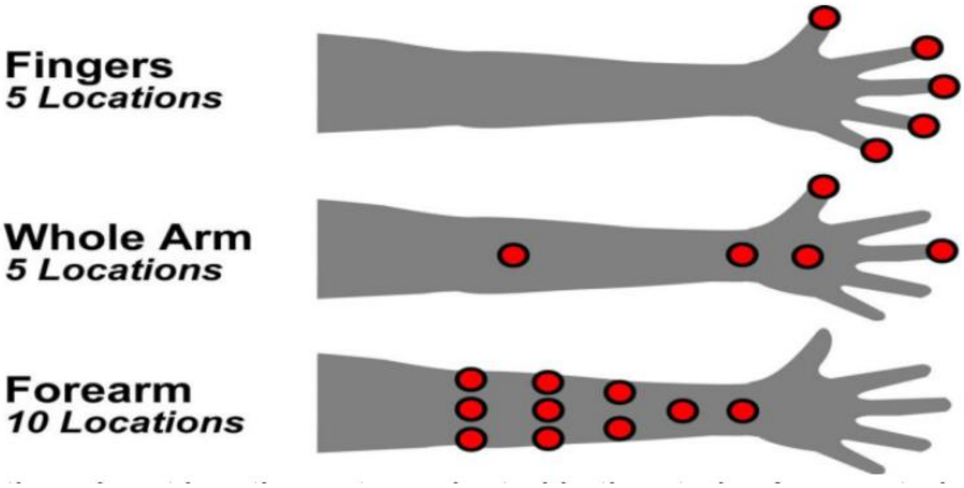

Figure6

Experimental results of Chris Harrison, Desnitan and Dan Morris show that despite multiple joint crossings between the input target and the sensor, the classification accuracy in the five-finger condition is still high, with an average of 87.7% (SD=10.0%, probability =20%). The errors tend to be distributed evenly over the other numbers.When the classification was incorrect, the system considered that it was because, at 60.5% of the time, the input was an adjacent finger, which was only slightly above the prior probability (40%).

3. Correlated technology

The realization of skin touch input can be achieved by optical and acoustic means, in this part of the existing related technologies are briefly introduced.

3.1. Optical field- -Application of infrared sensing technology realization

Both SenSkin and SkinWatch use infrared sensors to detect the skin deformation generated by the user after manipulating the skin, thus identifying different operations.

Figure 7 shows that senskin recognizes interactions by sensing skin deformation.

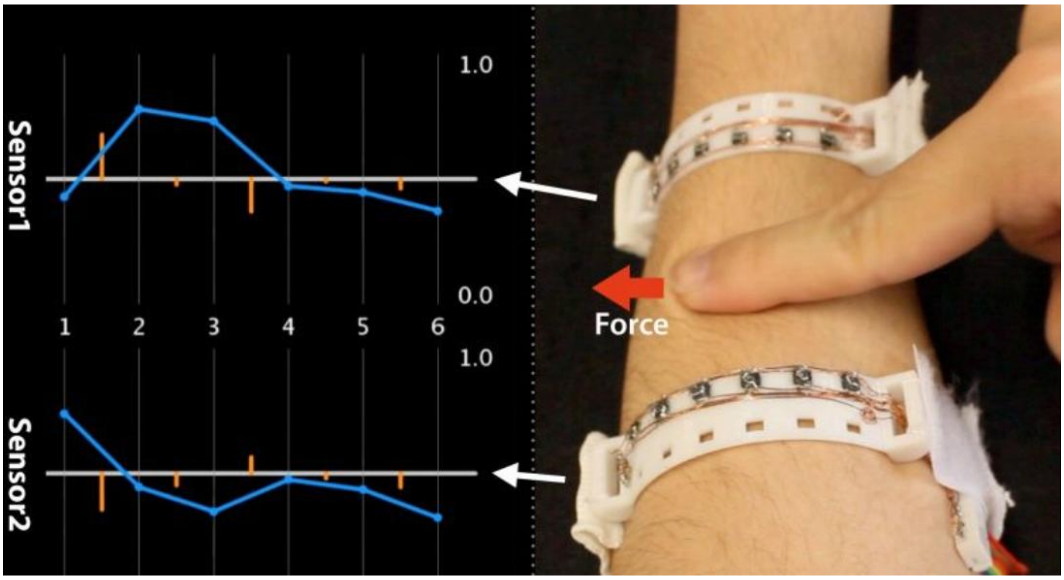

Figure7

Figure 8 shows that skinwatch accurately identifies the user's skin operation interaction on the edge of the watch.

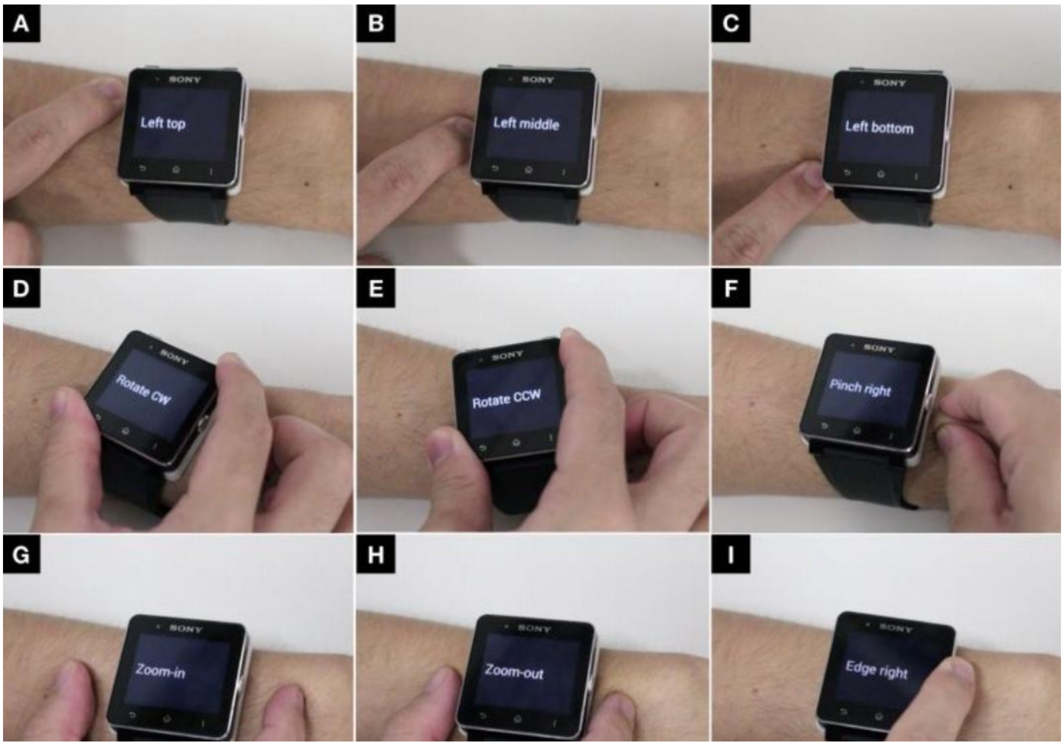

Figure8

3.2. Optical field- -Application of an array of infrared radiators and light-emitting diodes

Lumi Watch uses one-dimensional infrared sensors to detect the two-dimensional position of the skin interface, and can also recognize gestures such as sliding. WatchSense uses the camera to locate the user's gestures, enabling the user's operation above the skin can also be identified by the system.

Figure 9 shows the operational recognition achieved by WatchSense using a camera.

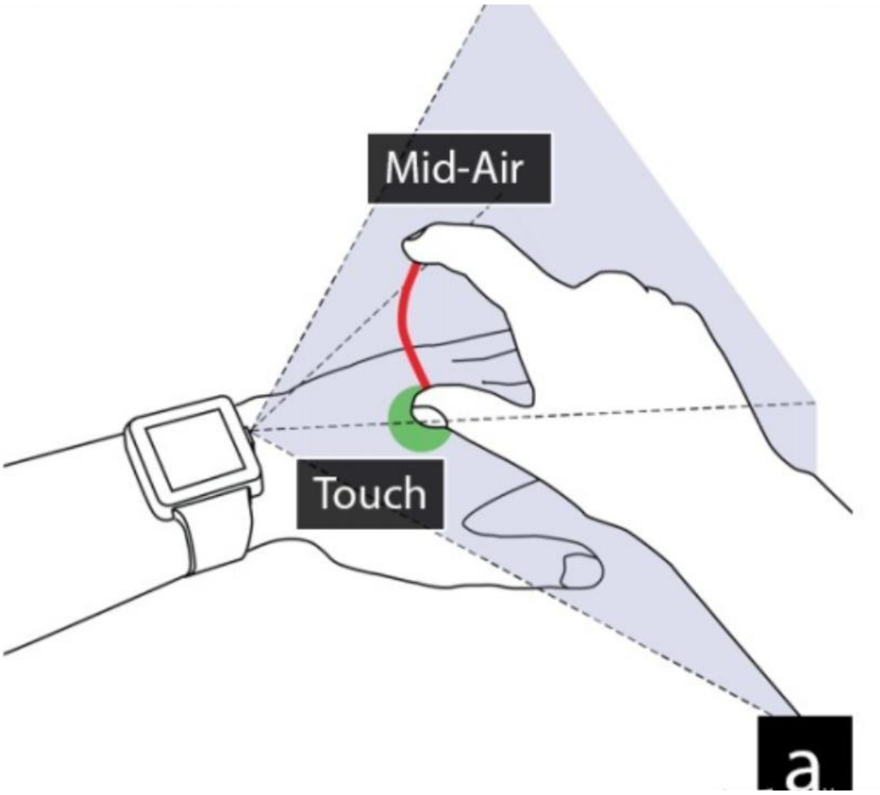

Figure9

3.3. Acoustic field- -Use of ultrasonic sensors

SonarWatch and PUB detect the user's simple interactive behavior on the arm through an ultrasonic sensor worn on the wrist. TapSkin is able to detect bioacoustic propagation caused by interaction vibration on the skin using inertial sensors and microphone devices, using algorithms to speculate on ongoing interaction events.

Figure 10 illustrates that the PUB utilizes ultrasound sensing for music control.

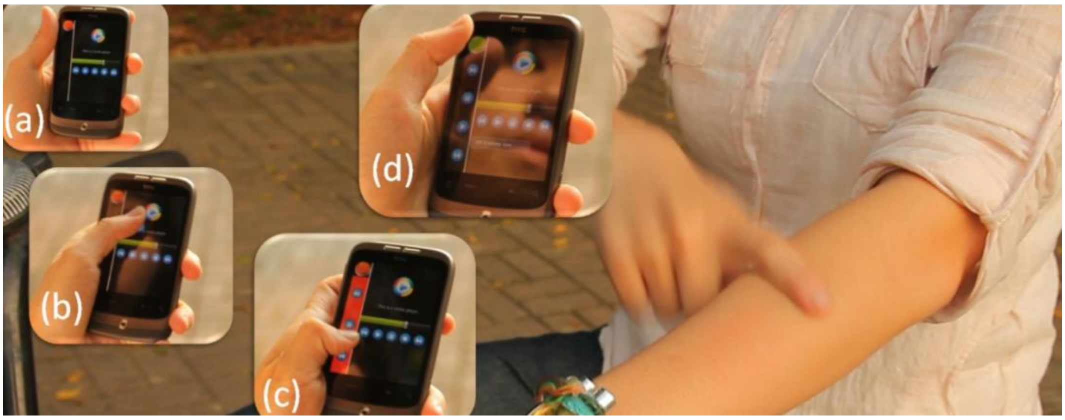

Figure10

4. Conclusions

In this paper, we propose the topic of skin as an information input and interactive interface.The analysis of the theoretical basis of skinput and the existing experiments, and the introduction of related techniques, are briefly presented. For the realization of skin interaction, there has not been a mature technological achievement. However, through the content elaborated in this paper, we can know that the skin has high sensitivity and interaction ability. If the loopholes and problems in the process of realizing the skin interaction can be well solved, the skin-based interactive computing can become the next user interface with unprecedented directness and expression.

5. Acknowledgements

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References

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