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SKINPUT TECHNOLOGY USING PICO PROJECTOR

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Abstract: Skinput represents a groundbreaking technology leveraging. The human body can transmit sounds, which allows our skin to work like a touchscreen. This innovative method lets us use our arms and hands as interactive surfaces by detecting unique, low-frequency sounds when we tap different areas. It's a highly useful way to input commands and interact with devices, turning our skin into a natural interface.

Researchers clarify that alterations in bone density, mass, and size, coupled with the filtering effects caused by joints and soft tissues, result in distinct acoustic properties across different areas of the skin. The software correlates sound frequencies with specific skin locations, enabling the system to determine which skin area the user has pressed. Subsequently, the prototype system employs wireless technology, such as Bluetooth, to transmit commands to the controlled device (e.g., iPod, phone, or computer).

Keywords: Bio-Acoustic, Buttons, Acoustic Detector, Body Interaction, Pico Projector, Armband Prototype, Bluetooth.

I. INTRODUCTION

Skinput is a revolutionary technology that utilizes the skin's surface as the input interface. Unlike conventional touch surfaces, the skin produces unique mechanical vibrations when tapped at different points. However, skin differs fundamentally due to its stretchable nature, allowing for additional input methods such as pulling, pressing, and squeezing.

This expanded input capability broadens the scope for on- skin interactions, facilitating a wide range of gestures and interactions. This exploration of new interaction possibilities represents a largely untapped domain. Our objective is to contribute to a systematic comprehension of skin as an input medium and its specific functionalities. Initially, our focus is on input areas upper limb, including the upper arm, forearm, hand, and fingers, as these are most commonly used locations.

1.2 SKINPUT TECHNOLOGY

Microsoft has developed a groundbreaking technology called Skinput, which uses the human body to transmit sounds, allowing our skin to function as an interactive surface. By analyzing the vibrations from finger taps on the arm and hand, Skinput can detect precise tap locations. This is made possible by a special array of sensors built into an armband, capturing these signals effectively.

This innovative approach offers an always-available, inherently portable on-body finger input of the solution. To evaluate the capabilities, accuracy, and limitations of our method, we conducted a two-part user study involving twenty participants. Additionally, we showcase the practicality of approach through several proof-of-concept applications developed.

1.3 WORKING WITH SIXTH SENSE DEVICE

The Sixth Sense project introduces a mobile input/output feature that is constantly accessible, achieved by merging projected data with a reliant on color markers. While this concept is viable, it encounters significant challenges related to occlusion and accuracy. For instance, distinguishing between a finger actually tapping a button and merely hovering above it poses considerable difficulty. Emerging skinput interfaces incorporate technology capable of identifying and detecting finger taps directly on skin, presenting a promising alternative.

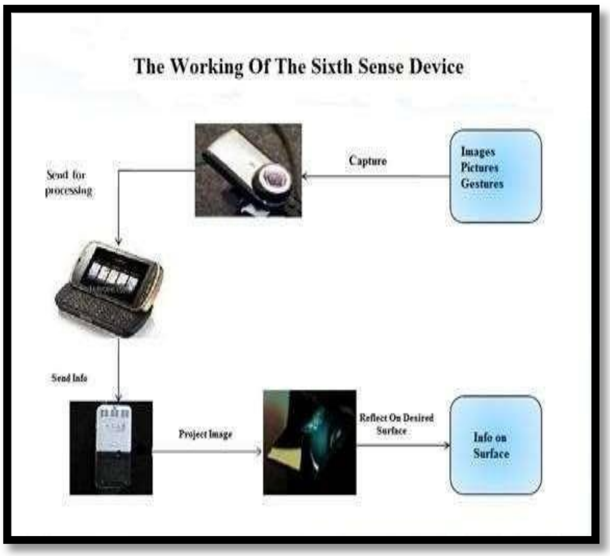


Figure 1. Working of Sixth Sense Device

The Sixth Sense technology holds significant relevance in contemporary society, finding numerous applications. These devices serve as a link between the digital and physical realms, enabling users interact with information seamlessly, without the need for traditional machine interfaces. Prototypes of Sixth Sense devices have showcased the practicality, utility, and adaptability of this innovative technology.

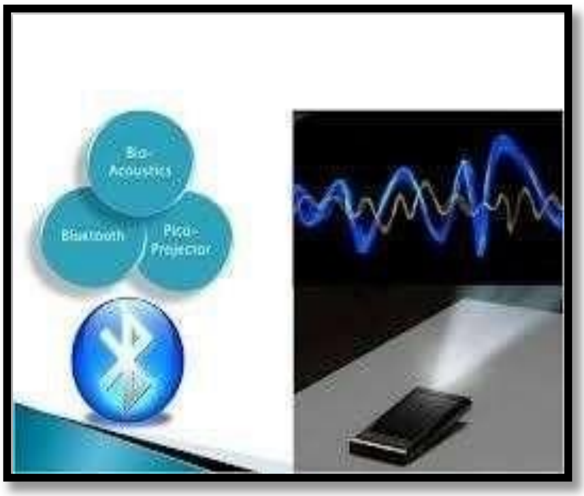


Figure 1.2 Skinput Parts

1.4 APPLICATION OF THE SKINPUT TECHNOLOGY

- **Bio-Acoustics and Sensors**: It’s the armband sensing element that captures the various sort of the vibrations once users faucet their fingers at the skin surface.

- **Bluetooth:** It’s used to connect theBio- Acoustic sensing element for mobile in order so that information will be transferred to many being controlled devices like mobile, iPod or laptop.

- **Pico-Projector:** Pico-Projector is employed as Output device that show menu. It’s employed in mobile and camera to show the project.

II. RELATED WORKS

2.1 ALWAYS AVAILABLE MOBILE INPUT

The main objective of Skinput is to offer a constantly accessible mobile input system, eliminating the need for users to carry or handle a separate device. Several alternative methods have been suggested to fulfill this purpose. While techniques relying on computer vision have gained popularity, they often computationally intensive and susceptible to errors

In mobile settings, especially those In situations where optical flow isn't utilized for input, speech input becomes a feasible choice for continuously accessible input. However, its precision can compromised in unpredictable surroundings, and it poses challenges related to privacy and scalability in shared environments. As alternatives, wearable computing solutions have been explored.

2.1 PICO-PROJECT

Figure 1.3 Pico Projector

Pico projectors are compact, battery-powered projection devices, some as small as mobile phones or even smaller, with the capability of being integrated into phones or digital cameras. Despite their small size, these projectors can produce large displays, sometimes reaching up to 100 inches. The MP180 stands out for its unconventional design among projectors, primarily because it incorporates an LCD display. This unique feature allows users to navigate through various options and access different settings directly from the screen located on the top of the projector.

III. WORKING SKINPUT TECHNOLOGY

3.1 WORKING WITH SKINPUT

Skinput is technology that utilizes human body for transmission.Utilizing acoustic transmission, Skinput lets our skin act as an input surface by detecting finger taps on the arm and hand. It does this by analyzing vibrations that travel through the body. An array of sensors in an armband captures these signals, offering a convenient, portable, and natural way to input commands using our own skin. In order to broaden the scope of sensing modalities for continuously available input systems, we are going to present Skinput, an innovative input method that utilizes the skin as a surface for finger input.

3.2 BIO-ACOUSTICS

Bio-acoustics encompasses the study of mechanical waves across various mediums, including gases, liquids, and solids, such as vibration, sound, ultrasound, and infrasound. It is an interdisciplinary field that integrates biology and acoustics, exploring aspects as production, propagation through elastic materials, and reception in animals, also humans.

Acoustics, as a broader discipline, encompasses the study of mechanical waves in various mediums and finds applications across numerous sectors of modern society. From audio technology to noise control industries, acoustics plays a pivotal role in enhancing our understanding and utilization of sound. Practitioners in this field may be referred to specialization.

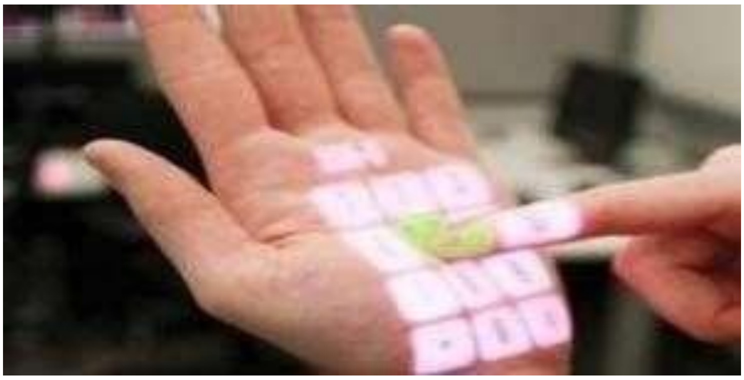


Figure 1.4 Skinput Uses Bio-Acoustic Sensor

Skinput uses a bio-acoustic sensor to detect when a finger taps the skin, generating acoustic energy. While some of this energy becomes sound waves in the air, Skinput focuses on the energy traveling through the arm. Specifically, it looks at the transverse waves caused by the finger's impact, which make the skin ripple. When viewed through a high-speed camera, these ripples spread out from the point of contact like waves.

3.3 TRANSVERSE WAVE PROPAGATION

When captured by a high-speed camera, these ripples are visible as they spread outward the point of contact. The magnitude of these ripples is associated with both the force of the the skin. tap and the volume and flexibility of soft tissues in the impacted region. Typically, tapping on of softer arm results in higher amplitude transverse waves compared to tapping on bony areas, arm which exhibit minimal compliance. carry Apart from the energy that travels along the surface of the some energy is also directed inward, towards the skeletal structure.

The sensor becomes active as wave passes beneath it.

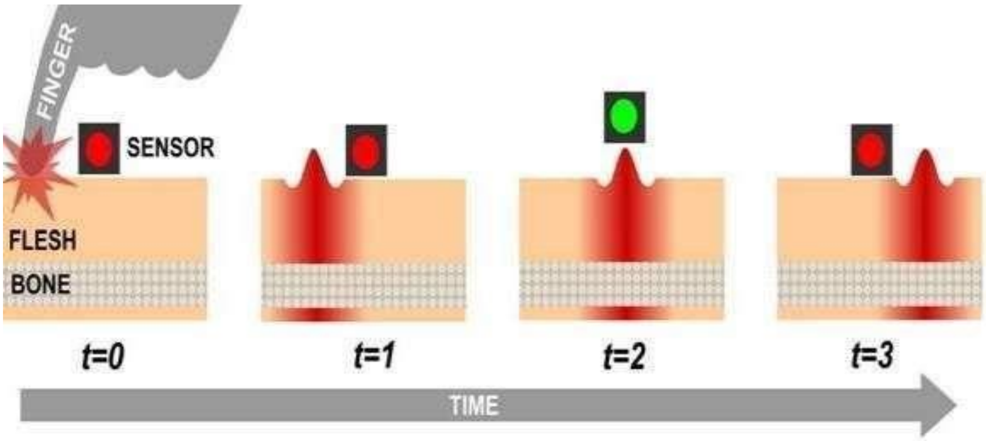


Figure 1.5 Transverse Wave Propagation

3.4 LONGITUDINAL WAVE PROPAGATION

The soft tissues of the arm transmit longitudinal (compressive) waves, which stimulate the bone. Although the bone is less flexible than soft tissue, it reacts to mechanical stimulation by rotating and translating as› rigid body. This stimulation causes the soft tissues surrounding the entire length of the bone to vibrate, creating new longitudinal waves that propagate outward to It's important to highlight these two distinct modes conduction—transverse waves traveling directly along the surface and longitudinal waves passing into and out of the bone through soft tissues—because they energy at different frequencies and over varying distances. arm,

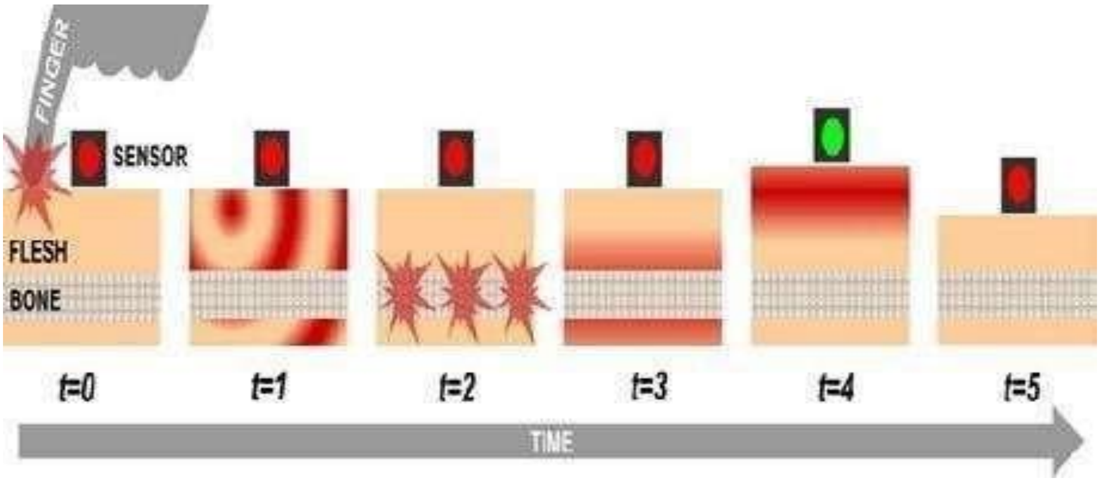


Figure 1.6 Longitudinal Wave Propagation

3.5 BIO-ACOUSTIC SENSOR

The Minisense 100 represents a budget-friendly cantilever-style vibration sensor, utilizing a mass- loading mechanism to provide heightened sensitivity, particularly at lower frequencies. Its pins are engineered for straightforward installation and can readily be soldered. Offering both horizontal also vertical mounting options, as well a variant withreduced height, it caters to diverse installation requirements.

Encased within shielded construction, the active sensor area is adept at mitigating interference from radio frequency and electromagnetic sources. The sensor boasts a durable, adaptable PVDF sensing element capable of withstanding significant shock overload. With exceptional linearity and dynamic range, it can effectively detect continuous vibrationas well as effect.

Some features of Minisense 100 are given below:

- High Voltage Sensitivity (1 V/g)
- Over 5 V/g at Resonance
- Horizontal or Vertical Mounting
- Shielded Construction

3.6 ARMBAND PROTOTYPE

The ultimate prototype showcases a design comprising two sets sensing elements, integrated into an handband/armband configuration. The rationale behind incorporating two sensor arrays stemmed from our emphasis on utilizing the arm as the primary input interface.

During the initial data collection, we tailored each sensor package to detect unique resonant frequencies. We specifically tuned the upper sensor package to be more sensitive to lower frequency signals, which are more common in areas with more flesh.

- Contained within the Skinput armband are two sets of sensor arrays, each comprising five sensors. Once the armband is secured around the arm, one array is positioned atop the arm while the other rests beneath it. This configuration ensures that the sensors capture a comprehensive range of valuable data.

Figure 1.7 Armband Prototype

3.7 BLUETOOTH

Bluetooth stands as a wireless technology standard facilitating the exchange of data across short distances. Employing short-wavelength radio transmissions within the ISM band spanning from 2400 to 2480 MHz, it enables communication between fixed and mobile devices, thereby establishing personal area networks (PANs) characterized by robust security measures.

Bluetooth operates as a networking standard functioning at two distinct levels:

- Physically, Bluetooth operates as a radio- frequency standard, facilitating communication between devices.
- At the protocol level, Bluetooth ensures agreement among products regarding the timing and quantity of transmitted bits. Additionally, it establishes protocols for verifying that the received message matches the sent message, ensuring reliable communication between parties involved in a conversation.

IV. DESIGN WITH SETUP OF ARM BAND USED IN THE SKINPUT

We used three different input locations, as shown in the figure, to evaluate the effectiveness of Skinput.

4.1 FINGERS (FIVE LOCATIONS) SKINPUT

i. We used Skinput with five finger locations, placing sensors above the elbow joint. The armband was positioned about 7cm above the elbow for accurate detection.
ii. We applied Skinput to five locations on the whole arm, placing sensors below the elbow. The armband was positioned approximately 3cm from the elbow for accurate detection.
iii. We used Skinput on the forearm with ten locations, positioning the sensors above the elbow. The armband was placed about 7cm above the elbow joint for accurate detection.

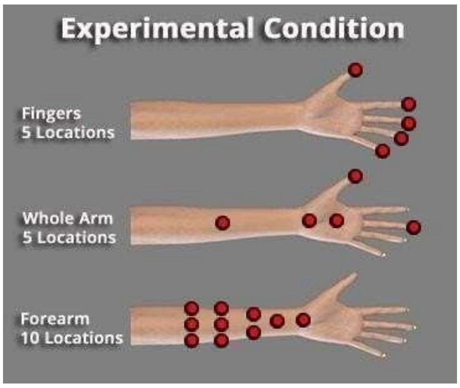


Figure 1.8 Fingers (In Five Locations) Skinput

- Five Fingers Skinput Locations: The accuracy for five finger locations is high and is approximately an average rate of 87.7% is obtained.
- Whole Arm Skinput Locations: The accuracy for Whole Arm locations is relatively high and is approximatelyan average rate of 95.5% is obtained.

4.2 FINGER TEN LOCATION SKINPUT

The figure shows that we can achieve high accuracy at six input points.

Research has revealed a reliable, though sometimes unpredictable, method with very high accuracy at six input points. Harrison and his team discovered that a tap on a fingertip, five points on the arm, or any of ten points on the forearm produces unique acoustic data. Machine learning programs, trained with this data, can learn and analyze these signals. These programs can identify the type of finger tap by examining 186 different features of the bio-acoustic input signals.

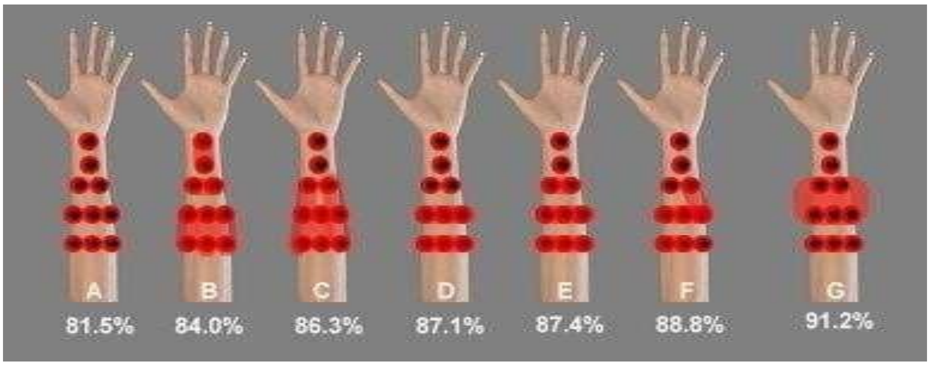


Figure 1.9 Finger Ten Location Skinput

V. IMPLEMENTATION AND EVALUATION RESULT

5.1 IMPLEMENTATION OF THE SKINPUT

In our implementation of Sk input, we differentiated between multi touch gestures and skin-specific gestures through a qualitative analysis. This involved manual classification of each user defined gesture based on various criteria including input modalities, body location, and gesture properties such as pressure, speed direction repetition and contact area.

Subsequently, two authors independently categorized each gesture as skin- specific if it involved any input modality other than multi-touch, or if the participant explicitly cited a skin-specific rationale while performing a multi-touch gesture. Gestures that did not meet We identified both standard commands and their variations during our analysis. Among these, some emerged as most frequently executed gestures for their respective commands, while others served as skin specific alternatives of most commonly performed multi-touch gestures.

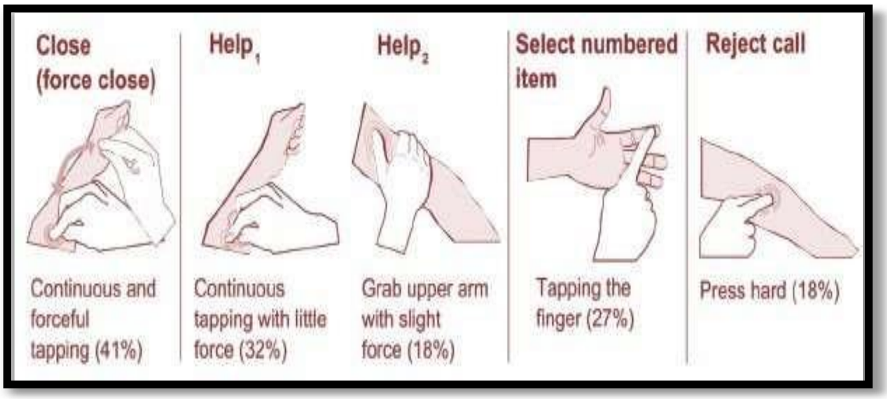


Figure 1.10 Variations Of Skin-Specific Gestures

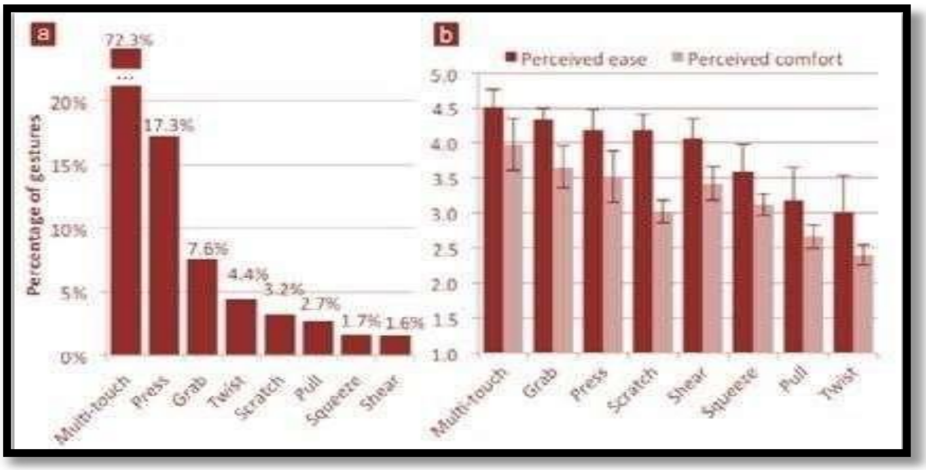


Figure 1.11 Input Modalities

For majority of emotional expressions, participants these criteria were classified as multi touch predominantly utilized skin-specific gestures. During the gestures.

5.2 ARIATIONS OF STANDARD COMMANDS

Participants demonstrated a higher frequency of skin-specific gestures across the variations. Among the ten referents, skin-specific gestures were the most frequently utilized for five of them. We identified several significant skin- specific gestures during our analysis.

semi-structured interviews, participants unanimously expressed their ability to convey emotions more effectively through skin-based interactions compared to touch screen interactions. They highlighted that this method enabled them to draw inspiration from conventional modes of expressing emotions when making physical contact with others. Notably, boredom were the only emotions found to be easier to convey via other means.

In the case of happiness and boredom, individuals predominantly utilized multi-touch gestures. For these emotions, individuals drew inspiration of facial expressions, such as a smiley, to convey happiness, and engaged in tapping motions on surface to convey boredom.

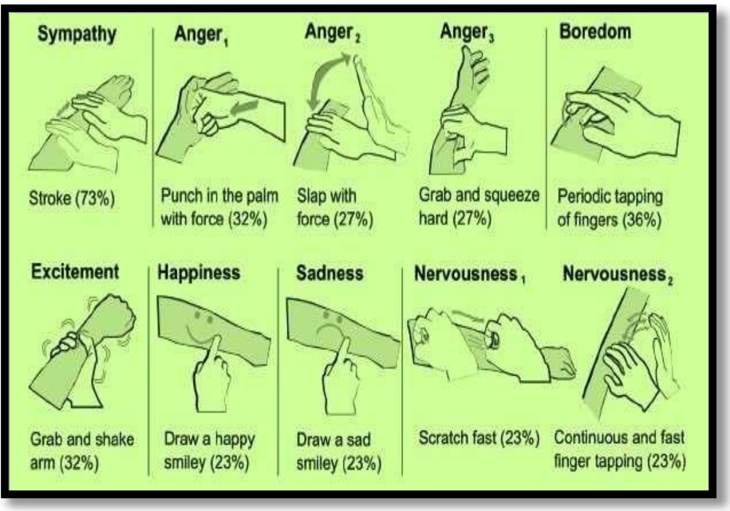


Figure 1.14 Locations Of User- Defined Gestures, Means And 95% Confidence Intervals Perceived EaseAnd Comfort.

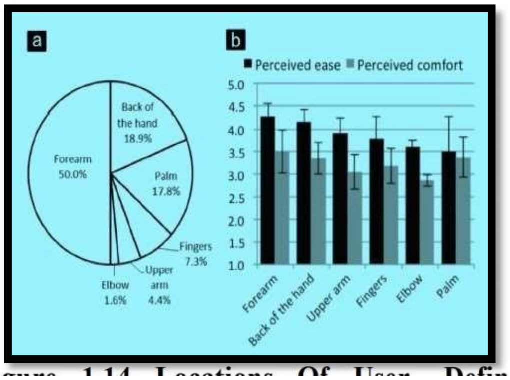
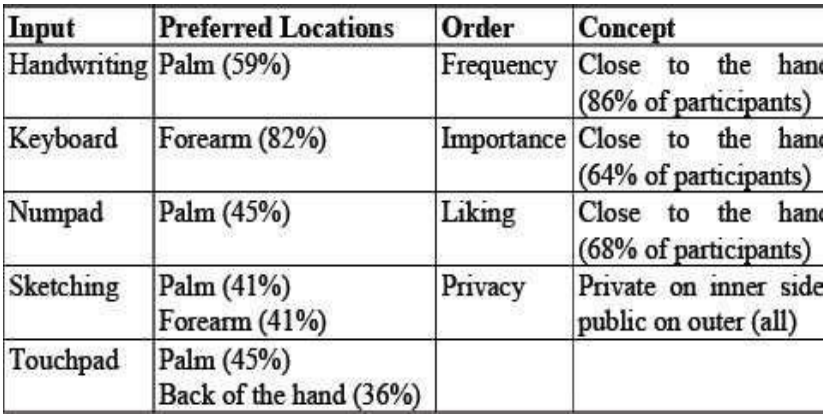


Figure 1.12 Most Frequent Skin Specific Gestures Emotional Expressions

Half of the gestures were performed on the forearm, with the back of the hand and the palm also being commonly used locations. In contrast, minimal usage was observed on the upper arm and elbow. We combined the average values for perceived ease and comfort of use for each location across all input modalities.



Input	Preferred Locations	Order	Concept
Handwriting	Palm (59%)	Frequency	Close to the han (86% of participants)
Keyboard	Forearm (82%)	Importance	Close to the han (64% of participants)
Numpad	Palm (45%)	Liking	Close to the han (68% of participants)
Sketching	Palm (41%) Forearm (41%)	Privacy	Private on inner side public on outer (all)
Touchpad	Palm (45%) Back of the hand (36%)		

Figure 1.13 illustrates Non Gestural Input also the Order of Task three alongside their most preferred locations.

5.2 ON-SKIN SENSORS

Previous research has advanced non- invasive optical methods for detecting multi- touch gestures on skin. However, we are not aware of any existing sensors capable of capturing the specific set of skin-specific gestures identified in study. These gestures accounted for 87% of all skin-specific gestures observed and encompassed 18 out of the 23 gestures in consolidated set. Among these gestures are shearing, queuing, and twisting.

5.4 COMPLEMENTARY DEVICES FOR OUTPUT

In our experimental setup, we intentionally chose not to incorporate any system output to prevent biasing participants towards a particular form or location of output. In the subsequent sections, we analyze the implications of our findings for various promising categories of devices that can enhance on-skin input by delivering output to the user.

5.3 OFF-SKIN OUTPUT

All the identified gestures can perform without the need for visual input, thanks to proprioception and tactile feedback. Consequently, our findings are particularly relevant to scenarios where the skin serves solely The skin serves as the input interface, while an external device delivers visual, auditory, or haptic output. This includes situations such as controlling a mobile device remotely, which is either carried on to the body or kept in a pocket, providing auditory or haptic feedback (e.g., smartphones, music players, or imaginary interfaces). It also includes scenarios where a head-mounted display or an external screen offers visual output (e.g., public displays or TVs).

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5.3 HANDHELD MOBILE DEVICES

For handheld devices with a touch display, such as mobile phones or tablets, the lower arm, hand and fingers can provide complementary input space. This can be used for more expressive or more personal ways of input than possible on the touchdisplay.

VI. LIMITATIONS

It was conducted indoors during summertime. Most participants were short- sleeved or could easily uncover the skin of their upper limb. No participant mentioned clothing as an issue during the study. Clothes might lower the accessibility of some locations or make them inaccessible, e.g. in cold weather conditions.

VII. CONCLUSION

We have developed a new approach to using the human body as an input surface, creating a unique wearable bio-acoustic sensing array embedded in an armband. This system can detect and locate finger taps on the forearm and hand. Our experimental results show that our system is effective across a variety of gestures, even when the body is moving. We also presented initial findings that demonstrate other potential applications, such as single- handed gestures, taps using different parts of the finger, and the ability to distinguish between different materials and objects. Finally, we discussed several prototype applications that highlight the diverse design possibilities enabled by Skinput.

REFERENCES

[1]. Ahmad, F., and Musilek, P. A Keystroke and Pointer Control Input Interface for Wearable Computers. In *Proc. IEEE PERCOM '06*, 2-11.
[2]. Amento, B., Hill, W., and Terveen, L. The Sound of One Hand: A Wrist-mounted Bio- acoustic Fingertip Gesture Interface. In *CHI '02Ext. Abstracts, 724-725.*
[3]. Argyros, A.A., and Lourakis, M.I.A. Vision- based Interpretation of Hand Gestures for Remote Control of a Computer Mouse. In *Proc.ECCV 2006 Workshop on Computer Visionin HCI, LNCS 39 79, 40-51.*
[4]. Burges, C.J. A Tutorial on Support Vector Machines for Pattern Recognition. *Data Mining and Knowledge Discovery*, 2.2, June 1998, 121-167.
[5]. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. National Heart, Lung andBlood Institute. Jun. 17, 199