Skinput Technology- A Technique to act Skin as an Input Device

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***Abstract*—We present skinput , a technology that appropriates the human body for acoustic transmission, allowing the skin to be used as an input surface. In particular, we resolve the location of finger taps on the arm and hand by analyzing mechanical vibrations that propagate through the body. We collect these signals using a novel array of sensors worn as an armband. This approach provides an always available, naturally portable, and on-body finger input system. We assess the capabilities, accuracy and limitations of our technique through a two-part, twenty-participant user study. To further illustrate the utility of our approach, we conclude with several proofs of concept applications we developed.**

Keywords—skinput technology; bio-acoustic sensing; sixth sense technology/device;

I. INTRODUCTION

Devices with significant computational power and capabilities can now be easily carried on our bodies. However, their small size typically leads to limited interaction space (e.g. diminutive screens, buttons, and jog wheels) and consequently diminishes their usability and functionality. Since it cannot simply make buttons and screens larger without losing the primary benefit of small size, consider alternative approaches that enhance interactions with small mobile systems. One option is to opportunistically appropriate surface area from the environment for interactive purposes. For example, describes a technique that allows a small mobile device to turn tables on which it rests into a gestural finger input canvas. However, tables are not always present, and in a mobile context, users are unlikely to want to

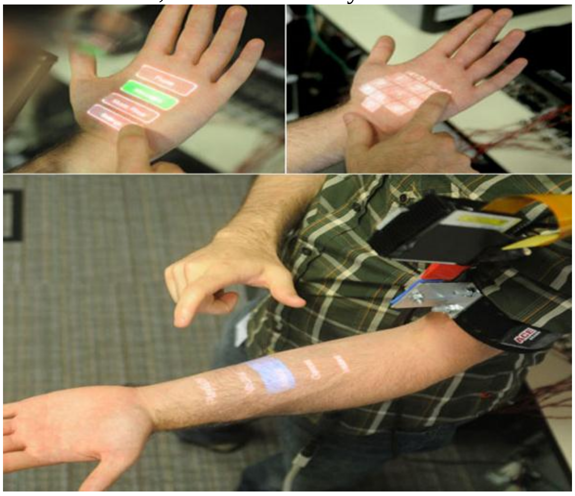

Figure 1: Skinput Technology.

carry appropriated surfaces with them (at this point, one might as well just have a larger device). However, there is one surface that has been previous overlooked as an input canvas, and one that happens to always travel with us: our skin. Appropriating the human body as an input device is appealing not only because we have roughly two square meters of external surface area, but also because much of it is easily accessible by our hands (e.g., arms, upper legs, torso). Furthermore, proprioception – our sense of how our body is configured in three-dimensional space – allows us to accurately interact with our bodies in an eyes-free manner. For example, we can readily flick each of our fingers, touch the tip of our nose, and clap our hands together without visual assistance. Few external input devices can claim this accurate, eyes-free input characteristic and provide such a large interaction area. In this paper, we present our work on Skinput – a method that allows the body to be appropriated for finger input using a novel ,non-invasive ,wearable bio-acoustic sensor .

II. PRINCIPLE

The principle on which this technology works is bio-acoustic. Whenever there is a finger taps on the skin, the impact creates acoustic signals, which can be captured by a bio-acoustic sensing device. Some amount of energy is lost to the external environment in the form of sound waves. Apart of the rest energy travels along the surface of the skin and the rest is transmitted inward till it's get reflected from the bone. Depending on the type of surface on which the disturbance is created, the amplitude of the wave varies. For example, on a soft surface (forearm) the amplitude is larger as compared to a hard surface (elbow) where the amplitude is smaller. In addition to the underneath surface, the amplitude of the wave also varies with the force of disturbance. Variations in bone density, size and the different filtering effects created by soft tissues and joints create distinct acoustic locations of signals, which are sensed, processed and classified by software. Interactive capabilities can be linked to different locations on the body. The average body surface area of an adult is 1.73 m^2, is 400 times greater than a touch-screen phone 0.004 m^2. Sailors and tattoo parlors have long seen opportunities for the body as a display. Skinput adds interactivity via a Pico-projector and vibration sensing tap an image projected on your arm, and the resulting arm vibrations control an application.

III. WORKING WITH SIX SENSE DEVICE

The Sixth Sense project proposes a mobile, always available input/output capability by combining projected information with a color-marker-based vision tracking system. This approach is feasible, but suffers from serious occlusion and accuracy limitations. For example, determining whether, e.g., a finger has tapped a button, or is merely hovering above it, is extraordinarily difficult new kinds of skinput interfaces involve technology that is able to locate and sense finger taps on the skin.

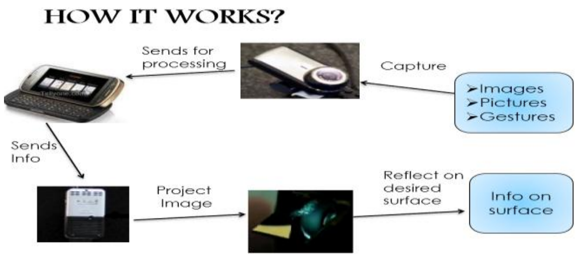

Figure 2: Working of the Sixth Sense Device .

The sixth sense technology finds a lot of application in the modern world. The sixth sense devices bridge the gap by bringing the digital world into the real world and in that process allowing the users to interact with the information without the help of any machine interfaces. Prototypes of the sixth sense device have demonstrated viability, usefulness and flexibility of this new technology.

IV. COMPONENTS OF SKINPUT TECHNOLOGY

There are three major components of Skinput Technology:

Figure 3: Major components of Skinput Technology

• **Bio-Acoustics and Sensors**: When a finger taps the skin, several distinct forms of acoustic energy is produced. Some energy is radiated into the air as sound waves; this energy is not captured by the *Skinput* system. Among the acoustic energy transmitted *through* the arm, the most readily visible are transverse waves, created by the displacement of the skin from a finger impact (Figure 2). When shot with a high-speed camera, these appear as ripples, which propagate outward from the point of contact. The amplitude of these ripples is correlated to both the tapping force and to the volume and compliance of soft tissues under the impact area. In general, tapping on soft regions of the arm creates higher amplitude transverse waves than tapping on boney areas (e.g., wrist, palm, fingers), which have negligible compliance. In addition to the energy that propagates on the surface of the arm, some energy is transmitted inward, toward the skeleton. These longitudinal (compressive) waves travel through the soft tissues of the arm, exciting the bone, which is much less deformable then the soft tissue but can respond to mechanical excitation by rotating and translating as a rigid body. This excitation vibrates soft tissues surrounding the entire length of the bone, resulting in new longitudinal waves that propagate outward to the skin. We highlight these two separate forms of conduction –transverse waves moving directly along the arm surface, and longitudinal waves moving into and out of the bone through soft tissues – because these mechanisms carry energy at different frequencies and over different distances. Roughly speaking, higher frequencies propagate more readily through bone than through soft tissue, and bone conduction

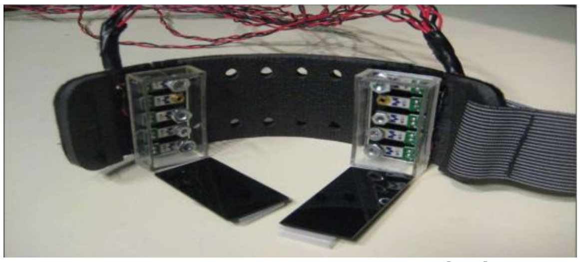

Figure 4: Bio-acoustic sensing armband

carries energy over larger distances than soft tissue conduction. While we do not explicitly model the specific mechanisms of conduction, or depend on these mechanisms for our analysis, we do believe the success of our technique depends on the complex acoustic patterns that result from mixtures of these modalities. Similarly, we also believe that joints play an important role in making tapped locations acoustically distinct. Bones are held together by ligaments, and joints often include additional biological structures such as fluid cavities. This makes joints behave as acoustic filters. In some cases, these may simply dampen acoustics; in other cases, these will selectively attenuate specific frequencies, creating location specific acoustic signatures.

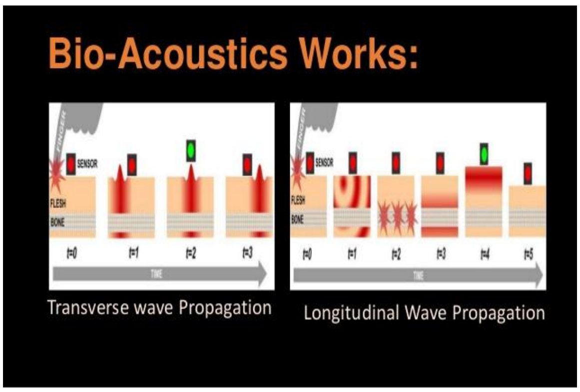

Figure 5: Transverse and Longitudinal wave propagation

.• Bluetooth: Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength radio transmissions in the ISM band from 2400–2480 MHz) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security. Bluetooth is essentially a networking standard that works at two levels:

• It provides agreement at the radio-frequency standard. physical level -- Bluetooth is a radio-frequency standards.

• It provides agreement at the protocol level, where products have to agree on when bits are sent, how many will be sent at a time, and how the parties in a conversation can be sure that the message received is the same as the message sent.

• Pico-Projector: Pico projectors are tiny battery powered projectors - as small as a mobile phone - or even smaller: these projectors can even be embedded inside phones or digital cameras. Pico-projectors are small, but they can show large displays (sometimes up to 100"). The MP180 features a design that is rather unconventional when it comes to projectors and this especially due to the fact that it features an LCD display. This screen on the top of the projector can be used to navigate though the different options as well as have the ability to access the different settings transmission, allowing the skin to be used as an input surface.

Figure 6: Pico-Projector

The location of finger taps on the arm and hand is resolved by analyzing mechanical vibrations that propagate through the body. These signals are collected using a novel array of sensors worn as an armband. This approach provides an always available, naturally portable and on-body finger input system.

To expand the range of sensing modalities for always available input systems, we introduce Skinput, a novel input technique that allows the skin to be used as a finger input surface.

V. ADVANTAGES AND DISADVNATAGES

A. Advantagesics

- Easy to work.
- No worry about keypad.
- No interaction with the gadget.
- Can be used without Visual Contact.
- Larger buttons to reduce the risk of pressing the wrong buttons.
- Through the use of a sense called pro-prioception.After user learns where the locations are on the skin.They will no longer have to look down to use Skinput reducing people looking down at their phone while driving.
- It can be used for a more interactive gaming experience.
- Always available.
- Naturally portable.
- Save space.

B. Disadvantages

- The easy accessibility will cause people to be more socially distracted.
- This technology only works on direct skin exposure. We cannot use full sleeves shirt when we are using this technology.
- The arm band is currently bulky.
- The visibility of the projection of the buttons on the skin can be reduced if the user has a tattoo located on their arm.
- If the user has more than a 30% BMI, accuracy is reduced to 80%.

VI. APPLICATIONS

The premise of the research was spurred from the conflicts between the miniaturization of portable devices and the remaining need for a comfortable way of interacting with said products. As the devices gets smaller, so does the area to control them, such as buttons and touch screens. The search for an external surface focused on the one thing every persons always carries around with them, their skin.

With the use of the sensors, one can control an electronic device simply by tapping their skin in predestinated places. The most obvious application of this technology is portable consumer electronics, such as mobile phones or music players

VII. CONCLUSION

In this paper, we have presented our approach to appropriating the human body as an input surface. It described a novel, wearable bio-acoustic sensing array built into an armband in order to detect and localize finger taps on the forearm and hand. Our research shows that the system performs very well for a series of gestures, even when the body is in motion. Additionally, it have presented initial results demonstrating other potential uses of our approach, which we hope to further explore in future work.

In this paper we also discussed the major components through which the Skinput Technology works that are: Bio-acoustic sensing, Pico-projector, Bluetooth.

This technology has a great future scope as it uses our body as the input devices.

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