ISSN : 2248-9622, Vol. 4, Issue 2(Version 1), February 2014, pp.725-728

RESEARCH ARTICLE OPEN ACCESS

Arm as a Touch-Screen

Abhijeet S. Kapse[1], Sunil B. Somani[2]
[1] (Department of Electronics and Telecommunication, Pune University, Pune-38)
[2](Department of Electronics and Telecommunication, Pune University, Pune-38)

Abstract
Popularity of mobiles devices increasing day by day due to the advantages like portability, mobility and flexibility.There are many advantages of small size mainly we can carry it with comfort, but the limited size gives very less interactive surface area. So we need a large interactive area to use but we want to easily carry it in our pocket. We cannot just make the device large without losing benefit of small size. A novel approach is presented in this paper which solves the size problem. We can use our skin which is largest part of our body as an input surface. Human body produces different vibrations when individual tap on different body parts. With the help of this unique property of human body, this technology uses different locations as different functions of small devices like mobile phones or music players. When user tap on itsbody part, some mechanical vibrations propagates through the body, those vibrations are captured by sensor array. The sensor array is mounted on armband which is interfaced with microcontroller. Microcontroller processes the data and finds the tapped location. Microcontroller is interfaced with mobile phone with the help of Bluetooth module. So according to the tapped location, desired operation is performed. This approach provides an always available, naturally portable, large, and on-body finger input system.
Keyword-Acoustic, Human Computer Interface, Mobile Phones, Skin Input, SVM.

I. Introduction

The world is going crazy over an invention, which is known as mobile phones. The Mobile devices became popular in less time due to some advantages they came up with, like portability, flexibility, mobility and responsiveness. These devices easily get fit in our pocket that means we don't need to carry any extra surface area with us. 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. very small screens, buttons) and consequently diminishes their usability and functionality. Since, we cannot simply make buttons and screens larger without losing the primary benefit of small size. Users don't want to carry large surfaces with them.So there is no meaning in increasing the size of device. Any user required an input system that does not require to carry or pick up a device. A number of alternative approaches have been proposed and invented now a days. The SixthSense project by Pranav Mistry [1] proposes a mobile, always-available input/output capability by combining projectorwith a color-marker-based vision tracking sys-tem. This approach is feasible, but its accuracy is limited. For example, determiningwhether, e.g., a finger has tapped a button, or above it, is extraordinarily difficult.Wearable computing is one of the approach in which a physical input device built inpart of one's clothing. For example, glove-based input systems [2]butare uncomfortable, and disruptive to tactilesensation. Speech input [3] is also a good approach for interaction, but it isn't feasible to use in public places, and suffers from privacy issues in shared environments. Post and Orth [4] present a "smart fabric" system that embeds sensors and conductors into fabric, but it becomes complex and expensive if as it required to implement on each cloth. However, there is one surface that has been previously overlooked as an input canvas and one that happens to always travel with us: our skin.

When any human being taps on its body part, some distinct ripples are propagates through that body part. Means on different body parts different type of frequency [5],[6] signals are created. So in this paper we have presented an approach in which any individual can use its body part (especially hand) as an input surface for mobile devices or mp3 players. Appropriating the human body as an input device is appealing not only because any person 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, and torso).This technology can be used without any visual contact.Anybodycan accurately interact with its body part in an eyes-free manner. For example, we can easily touch each of our fingers, touch the tip of our nose, and clap our hands together without visual assistance. We can use any part of our body as an input surface but for comfortable operation we need to use our arm as an input. This paper presentsnew approach:Skin as a touch screen– a method that allows the body to be appropriated for finger input using a novel, non-invasive, wearable bio-acoustic sensor.

This system is a combination of three parts which are microcontroller, bioacoustics sensors and Bluetooth. According to the needi.e. consider person wearing armband wants to use music application of mobile and there are four different input positions on his hand for play, pause, forward and reverse operation,then he just need to tap on hisbody. After tapping, some acoustic energy prorogates to airand through body also. These acoustic waves are different in amplitude and frequency in different locations. Frequency of vibrations produced due to tapping are in range of 25Hz to 78Hz [5],[7] i.e. lower frequency range. Those ripples are captured by bioacoustics sensors which are mounted on armband.This armband is connected to the micro-controller which has the Bluetooth module interface with it. With the help of Bluetooth module the controller is connected with mobile devices (android phone). So if individual taps on first location, play operation of music player gets activated in mobile. Similarly for second, third and fourth locations pause, forward and reverse operation will be executed.

The contents of this paper are: The description of the design of a novel, wearable sensor for bio-acoustic signal acquisition. Also the description of an analysis approach that enables the system to resolve the location of finger taps on the body. In this paper,a method that allows the body to be appropriated for finger input is described.

II. Functional Blocks

Main functional blocks of the system are: Acoustic Sensors (catches the vibrations produced after tapping), Microcontroller (Processes the data), Bluetooth module (transmit the data to phone) and an Android phone (figure 1). First block which is acoustic sensor array, mounted on armband. User has to wear this armband for capturing the signal produces after tapping on hand. HereMinisense 100 vibration sensor array can be used which is sensitive to low frequency range and produces analog output after vibrations are produced. After converting the analog output into digital, it should get store in microcontroller.
Support Vector Machine classifies the data and put into specific category. So this classification gives idea about, on which location the tapping is done. Now as shown in diagram the microcontroller is connected with the cell phone using Bluetooth module. So just tapping on hand, user can control any mobile application (in this case music application). If we tap on 1st location of arm, the play operation is performed in mobile. Similarly for 2nd, 3rd and 4th locations we have given pause, forward and reverse operations respectively. For interfacing cell phone with the microcontroller, an android application in the cell phone is necessary.

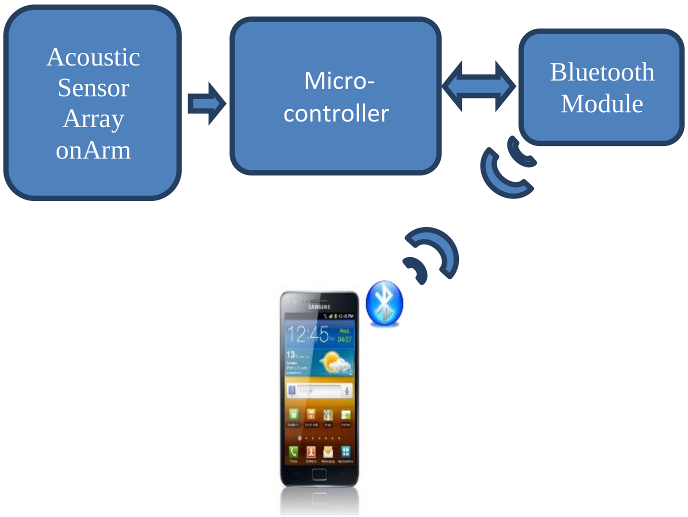

Figure 1: Block Diagram

Here, four different locations of arm is used. So after getting sufficient accuracy in it we can extend these locations up to ten.

III. Working

Acoustics is the interdisciplinary science that deals with the study of all mechanical waves in gases, liquids, and solids including vibration, sound, ultrasound and infrasound.When a finger taps the skin, several distinct forms of acoustic energy are produced [5].

These vibrations are captured with the help of piezoelectric sensors-Minisense 100. The Minisense 100is a low-cost cantilever-type vibration sensor loaded by a mass to offer high sensitivity at low frequencies. The cantilevered sensors were naturally insensitive to forces parallel to the skin (e.g., shearing motions caused by stretching). Thus, the skin stretch induced by many routine movements (e.g., reaching for a doorknob) tends to be attenuated. However, the sensors are highly responsive to motion perpendicular to the skin plane – perfect for capturing transverse surface waves.

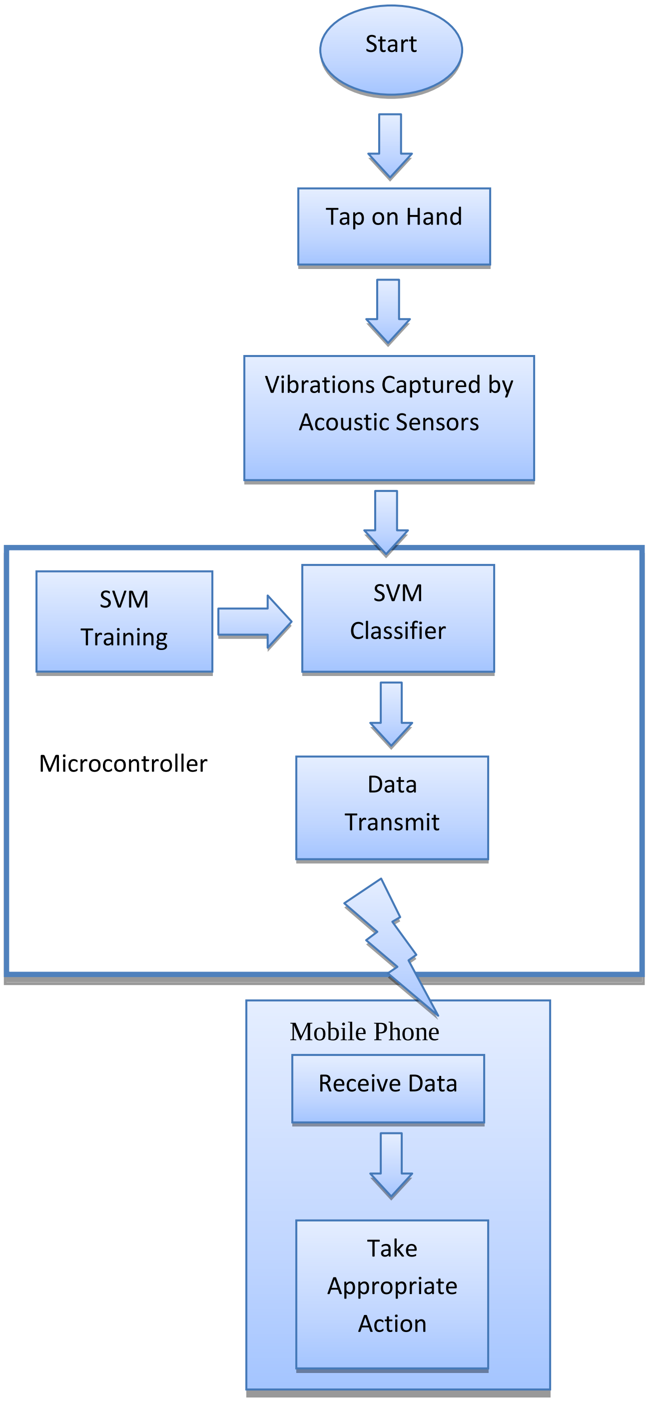

Figure 2:Flowchart

Sensor array consists of collection of sensors where each sensor consist of different weight on its end. Each sensor is having different resonant frequency, which is ranges from 25Hz to 78Hz [5].Piezoelectric sensor gives maximum output at its resonance frequency. So when user tap on each location, one of the sensors will produce maximum output.

Step by step process of whole system is shown in fig.2

IV. SVM

An SVM classifies data by finding the best hyperplane that separates all data points of one class from those of the other class. The best hyper-plane [9] for an SVM means the one with the largest margin between the two classes. Margin means the maximal width of the slab parallel to the hyperplane that has no interior data points. The support vectors are the data points that are closest to the separating hyperplane; these points are on the boundary. The following figure illustrates these definitions, with + indicating data points of type 1 and – indicating data points of type 1[9] (fig. 3).

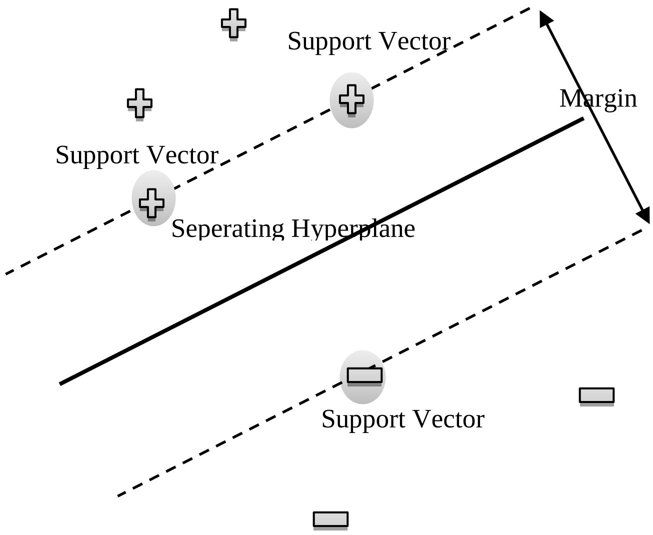

Figure 3: SVM Classifier which separates the data

Before the SVM can classify input instances, it must first be trained to the user and the sensor position. This stage requires the collection of several examples for each input location of interest.Means user needs to feed data to SVM for training i.e. minimum ten samples from each location required as a training set of SVM, which helps to find hyperplane equation. Then user give live input to SVM by tapping on skin, these are fed into the trained SVM for classification.

V. Android:

There are many mobile platforms on the market today, including Symbian, iPhone, Windows Mobile, BlackBerry, Java Mobile. But android is the first environment that has following important features: It has free development platform based on Linux and open source, automatic management of application life cycle, high quality graphics and sound, portability across a wide range of current and future hardware. So developing and sharing specific application in android is easy.

VI. Future Implementation

In this paper, four different tap locations has described. It means four different functions of mobile phone are managed. It can extend up to tenpoints i.e. ten different positions. Also interfacing a pico-projector with controller showsdisplay screen on arm. So it will be easy to handle mobile operations as we will be having total mobile screen on our hand.

VII. Conclusion

In this paper, the new approach to appropriating the human body as an input surface is presented. A novel, wearable bio-acoustic sensing array that mounted on an armband in order to detect and localize finger taps on the forearm and hand is shown. So this technology can use the human body part as an input surface for electronic devices.

REFERENCES

[1] Mistry, P., Maes, P., and Chang, L., WUW - wear Ur world: a wearable gestural interface. *CHI '09* Ext. Abst., 4111-4116.

[2] Sturman, D.J. and Zeltzer, D., A Survey of Glove-based Input. *IEEE Comp Graph and Appl*, 14.1, Jan 1994.

[3] Lakshmipathy, V., Schmandt, C., and Marmasse, N. Talk-Back: a conversational answering machine. In Proc. UIST '03, 41-50.

[4] Post, E.R. and Orth, M., Smart Fabric, or Wearable Clothing. In Proc. *ISWC '97*, 167.

[5] Chris Harrison, Desney Tan and Dan Morris, "Skinput: Appropriating the Skin as an Interactive Canvas*Communication of the ACM,August*2011, Vol.54, No.8, 111-118.

[6] Chris Harrison and Scott E. Hudson,Scratch Input:Creating, Large Inexpensive, Unpowered and Mobile Finger Input Surfaces, *UIST2008*.

[7] Amento, B.Hill andW.Terveen,The Sound of one Hand: A wrist- mounted bio-acoustic fingertip gesture-interface, *CHI'02*.

[8] Thomas Hahn, Future Human Computer Interaction with special focus on input and output techniques,*HCI* March 2006.

[9] Burges and C.J., "A Tutorial on Support Vector Machines for Pattern Recognition." *Data Mining and Knowledge Discovery*, 2.2, June 1998, 121-167.

[10] Deyle, T., Palinko, S., Poole, E.S. and Starner,ABio-Acoustic Gesture Interface,*ISWC2007*, 1-8.

[11] Erol A. Bebis, G. Nicolescu, M. Boyle, R.D. and Twombly, "Vision-based hand pose estimation: A review."*ComputerVision and Image Understanding*. Oct., 2007.

[12] D.-R. Chen, Q. Wu, Y. Ying and D.-X. Zhou, "Support vector machine soft margin classifiers: Error analysis", *J. Mach. Learn. Res.*, 5:1143–1175, 2004.

[13] Kasik, David J., "Advanced Graphics Technology," *Computer graphics and applications* , *IEEE* , vol.31, no.3, pp.96,96, May-June 2011