

Human-Computer Interaction using Smartphones

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Abstract—We propose a system to make the Human-Computer Interaction more user friendly by using a Smartphone as a medium for interaction. This paper discusses how different Smartphone sensors can be used to interact with the computer from a finite distance. We also discuss the literature survey, design, advantages and disadvantages of the proposed system.

Keywords—Human-Computer Interaction, accelerometer, gestures, speech recognition

I. INTRODUCTION

Human-Computer Interaction (HCI) is study of how human beings interact with the computer [1]. Generally we interact with the computer using mouse and keyboard. But these peripherals need the user to be in close proximity with the computer which acts as a constraint for the interaction. Using Smartphone as a medium to interact we can overcome this constraint. Other methods of providing such interaction include using wearable devices. Such methods need the user to have special sensors attached to their body or have a separate device specially meant for interaction. Today with the widespread use of Smartphones by people and its ease of availability a Smartphone is apt to use as a medium for HCI. In the proposed system major modules include Face detection and Image processing, Interaction using Gestures, Speech recognition.

II. LITERATURE SURVEY

A. Face Detection and Image Processing

Detecting a presence of human face in a given image is a tough job to do, because of the possible variations of the face. There are number of techniques that can determine frontal upright faces. The process of face detection can be made easy by making use of face detection frame work. The Viola-Jones framework can detect faces regardless of pose reliability and in real time. The framework is also capable of detecting rotated and profile faces [2]. Face detection is followed by the process of emotion detection and feature extraction which is relied on image processing. Image processing is used to classify the universal emotions: Happiness, Sadness, Anger, Disgust, Surprise and Fear. After the face is detected, image processing based feature point extraction method is used to extract a set of selected feature points. Finally those extracted features recognize the emotion. The luminance, chrominance, facial geometry and symmetry based approaches, template

based approaches, Principal Component Analysis (PCA) based approaches are the main categories of the feature extraction approaches available [3].

B. Interaction using Gestures

Gesture based interaction has a wide range of applications in ubiquitous computing environment. The gestures can be recorded by a 3D accelerometer embedded in a hand held device. Smartphones are the most portable and wide available device which is embedded with 3D accelerometer. The recognition system makes use of Hidden Markov Models (HMMs) as a classifier. In addition to this a preprocessing step can also be included which can remove the effect of device orientation from the data [4]. This intermediate step can enhance the performance of the recognizer in both user dependent and independent cases. An alternative way is to use the FDSVM (Frame-based descriptor and multicast SVM) system which needs only a 3-dimensional accelerometer [5].

Once gestures are classified they can be mapped onto pre-specified commands or gestures using Dynamic Time Warping (DTW) algorithm. A similar system is discussed in [6].

C. Speech Recognition

Speech Recognition is the process of converting a speech signal to a sequence of words. Speech is the most natural form of human communication and has been the topic of research for many decades. The goal is have a speech recognition system that can be used to perform operations on a distant machine. The basic operations of a speech recognition system would be Signal Processing, Phonetic Recognition, Word Recognition and Task Recognition [7]. The approaches used for speech recognition are Acoustic Phonetic Approach, Pattern Recognition Approach and Artificial Intelligence Approach. The feature extraction methods used in speech recognition are Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Independent Component Analysis (ICA) [8].

III. PROPOSED SYSTEM

A. Problem Statement

To make the Human-Computer Interaction more user friendly using Smartphones.

B. Design

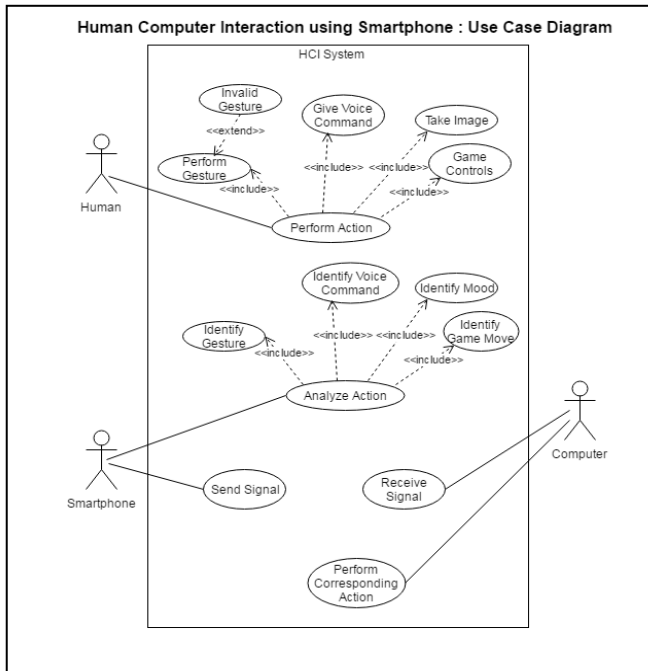


Fig. 1 Use Case Diagram of the System

As seen in Fig. 1 three actors are involved: Human, Smartphone and Computer. Human interacts with the HCI system by performing any one of the action. The Smartphone analyzes the action performed by the Human and identifies it. After identifying the valid action the Smartphone sends the signal to the computer. After receiving the signal the computer performs the corresponding action.

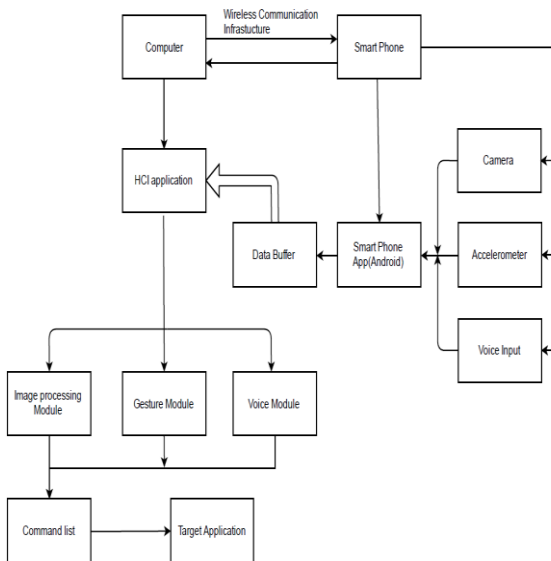


Fig. 2 Block Diagram of the System

The whole system can be visualized as an interaction between a Computer and a Smartphone. The block diagram in Fig. 2 shows two devices with a wireless communication media. The Smartphone has the HCI application used for taking input from the user using the sensors. The data gathered is then sent to the intermediate data buffer. The modules process the data to produce a command list. The command list is then used to perform the desired actions on the target application.

C. Advantages

1) Accessibility

Realization of the proposed system means a Computer can be accessed directly through a Smartphone thus making it very simple to access the Computer and perform desired operations.

2) Cost

The proposed system is very cheap as no additional expenses are needed to realize the system, with Smartphone and the integrated application being the only prerequisites.

3) Availability

Easy availability of Smartphones makes it possible for anyone to use the system.

D. Disadvantages

1) Slow execution due to buffer overflow

The input for the computer based application is passed on by the mobile based application. Hence some scenarios may arise wherein the user may have to wait for some period of time for the system to process the signals and exchange them. The user may experience a possible lag/delay due to the data buffer overflow.

2) Complex operations may not be possible

It may not be possible to fully replace the current existing system with the proposed system as there are few operations which may require complex data inputs and details. Thus the system may have few shortcomings in the form of non-executable operations

3) Wireless internet connectivity is mandatory

Wireless internet connection is required to exchange data between the Smartphone and the Computer. Hence it is necessary to have wireless internet connectivity on both the Computer and the Smartphone.

IV. CONCLUSION

Human-Computer Interaction is an important part of the systems. Quality of system depends on how it is represented with an effective GUI and used by users. Therefore, enormous amount of attention has been paid to design the HCI system.

The new direction of research is to replace common regular methods of interaction via keyboard and mouse with intelligent, adaptive, multimodal, natural methods using inputs from a Smartphone device. This paper attempted to give an overview and provide a survey of existing research through a comprehensive reference list with the new proposed system. As described above, the main aim for developing this system is to enable a human-computer interaction technology to control information by integrating the user input by gestures and other methods. When this technology is used, information can be displayed and operations can be carried on the desktop based systems through Smartphones. Inputs to perform these operations can be entered in the form of voice, gestures along with information passed through image processing which is controlled via the user's Smartphone. As a result, the proposed system is very much effective as it has a wide range of applications including usage in homes, offices, educational institutions and other organizations.

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