Demo: A Novel Finger-Assisted Touch-free Text Input System Without Training

Qiang Yang, Hongrui Fu, Yongpan Zou, Kaishun Wu
College of Computer Science and Software Engineering, Shenzhen University
{yangqiang2016,fuhongrui}@email.szu.edu.cn;{yongpan,wu}@szu.edu.cn

ABSTRACT

Recently, tiny smart devices have become increasingly popular in our lives because of their neat features and stylish appearance. However, their small form factors, especially screens, make it inconvenient for users to enter texts with conventional methods such as soft keyboards, which need a fairly large screen. To address this problem, we propose a novel texts-input system, called EchoType, with which users can enter texts with a finger writing in the air. EchoType makes use of acoustic sensors (*i.e.*, microphone and speaker) to sense finger gestures and infer texts based on mapping relation between gestures and basic letters. We take a step to enable users to input texts with acoustic signals. Compared with existing approaches, EchoType enjoys merits of low hardware requirements and high scalability to different mobile devices.

CCS CONCEPTS

• **Human-centered computing → Ubiquitous and mobile computing**; *Human computer interaction (HCI)*;

KEYWORDS

Texts input; Acoustic signals; Finger gestures

1 INTRODUCTION

It is known that the small form factors of mobile devices result in much inconvenience for users to interact with them. Although some novel touch-free approaches have been proposed based on speech recognition, vision[1], RF signals[3] and acoustic motion tracking[2], they possess different disadvantages of causing privacy leakage, requiring additional/special hardware.

In this work, we demonstrate a novel training-free text-input system, *i.e.*, EchoType, for commercial devices that does not require any additional hardware. The system architecture is illustrated as Fig 1. We firstly define six finger gestures which represent first strokes of letters. When users intend to enter texts to mobile devices, they can write a sequence of strokes (*i.e.*, the first stroke of each letter of the intended word) near the microphone. At the same time, the speaker emits inaudible sinusoidal acoustic signals at a frequency of 20 kHz and a microphone receives echoes simultaneously. Following that, we apply signal processing techniques to extract minute Doppler shift contours intrinsically related with strokes as their profiles. To recognize strokes, EchoType matches extracted Doppler shift profiles with stored templates using dynamic time warping (DTW). After that, the obtained stroke sequence is fed to linguistic model to infer corresponding texts. We also propose a Bayesian-based correction method to improve texts recognition performance. Finally, EchoType recommends five most probable words to user and automatically choose the first one if no selection is conducted for one second. To input a single letter, user can perform its first stroke and then choose this letter. As a result, EchoType relies on screen-touch scarcely except deleting or switching case of letters sometimes.

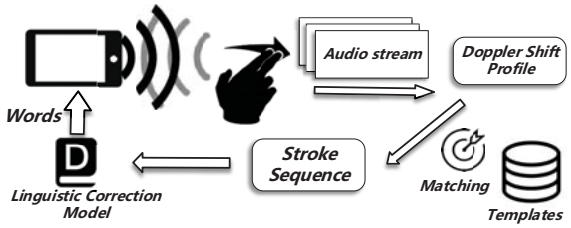

Figure 1: The system overview of EchoType.

We have implemented a prototype of EchoType on the Android platform with a Huawei Mate 9 smartphone. Theoretically, our system also can be applied on other mobile devices such as smart watches and smart glasses which are equipped with microphones and speakers. In this demo, we show clearly how EchoType works, and demonstrate its capability of recognizing texts input with auto-choosing, auto-association and stroke correction functions. The video clip is available at https://youtu.be/QKSdGWUXD8Y.

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REFERENCES

[1] Alexander Schick, Daniel Morlock, Christoph Amma, Tanja Schultz, and Rainer Stiefelhagen. 2012. Vision-based handwriting recognition for unrestricted text input in mid-air. In *ACM International Conference on Multimodal Interaction*. 217–220.
[2] Wei Wang, Alex X Liu, and Ke Sun. 2016. Device-free gesture tracking using acoustic signals. In *Proceedings of the ACM Mobicom*. 82–94.
[3] Ouyang Zhang and Kannan Srinivasan. 2016. Mudra: User-friendly Fine-grained Gesture Recognition using WiFi Signals. In *Proceedings of the ACM CoNEXT*. 83–96.

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