Demo: Fusing Mobile Sensors for Paper Keyboard On-the-Go

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ABSTRACT

Using touchscreens has largely limited user inputs to small form-factor devices. To address this constraint, we explore a novel input mechanism, dubbed PaperKey, that enables users to interact with mobile devices by performing multi-finger typing gestures on a surface where the device is placed. Using acceleration signals on the device, PaperKey infers the user's type events and then leverages a vision-based technique for detecting the exact typing locations on a paper keyboard layout. Compared to single audio, image, or vibration sensing, this work accurately localizes keystrokes with faster processing speed. Additionally, this mechanism keeps the mobility of devices by working without external sensors.

Keywords

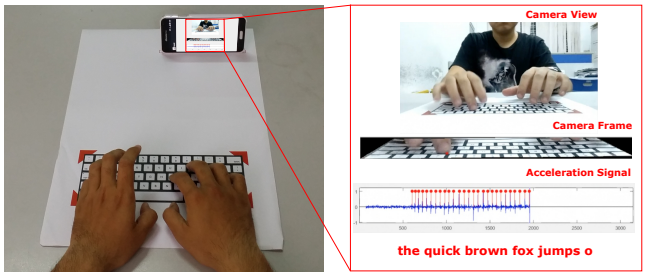
Multi-finger Typing; Touching Vibration; Vision-based Localization; Paper Keyboard

1. INTRODUCTION

Technology has led to the development of modern mobile and wearable devices. In contradiction with their ceaseless increases in efficiency and power, their shape and size are miniaturized so that their dominant form of inputting text today remains as small virtual on-screen keyboards. Although such keyboards are easily integrable and relatively easier to use, they have to adapt to different finger sizes and such adaptability is impractical in reality.

Together with a suite of sensors built in mobile devices, recent contributions have seen the growth of different user input techniques through sensing. However, some text-entry methods require carried piece of a bulky external hardware [1, 2], which is not convenient for mobile users. On the other hand, most of them leverage only the single sensor to detect keystrokes [3, 4]. Consequently, achieving high accuracy requires hacking device hardware to enable special ways of signal sensing and data collection.

In this work, we demonstrate a novel touch-free mechanism, dubbed *PaperKey* [1], that fuses an accelerometer and a smartphone forward camera to accurately detect keys pressed at natural typing speed. Specifically, when a user taps one key on the keyboard layout placed on the same surface as the phone is standing, it creates vibrations on the surface recorded by the accelerometer. Due to no constraint on the number of involved fingers in camera images, after determining a touch event of a finger on the surface, the actual typing finger is identified and the coordinate location of the pressed key is then determined, with respect to the keyboard, using image processing algorithms.



(a) Demo Setup (b) Smartphone Screenshot

Figure 1: A typical demonstration of PaperKey

2. DEMO

We will demonstrate our PaperKey system using various Android smartphone models with a self-designed keyboard layout. Specifically, the self-designed layout will be printed in color on a paper and be placed on a flat-surface table. The smartphone will then be stood horizontally on the layout at a location where its front camera can capture the whole keyboard in the closest distance. Figure 1 visualizes a setup of our demonstration along with the phone and the keyboard.

We will also demonstrate the capability of PaperKey to accurately detect actual keystrokes using the fusion of data from multiple sensors. Users will freely type their own sentences using the paper keyboard with natural typing speed. Moreover, there will be no limit of choosing their input ways in terms of different number of typing fingers and hands.

3. REFERENCES

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[1]Demo video is available at https://youtu.be/dZ1OEtj-laY

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