MobiNetS Research Group

Position Free Keystroke Monitoring with Smartphones

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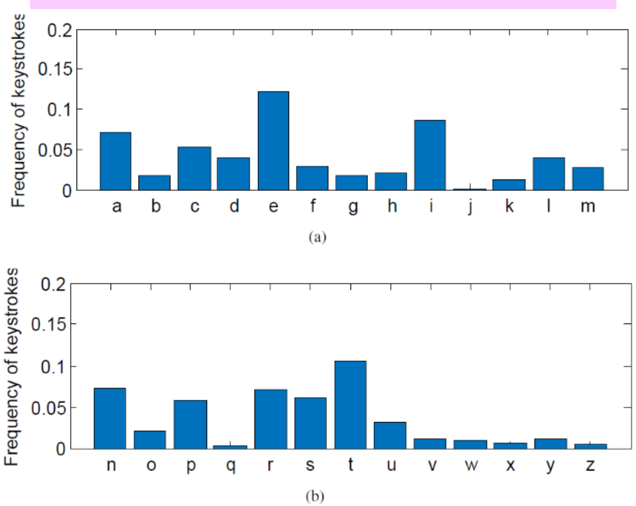
Introduction

In this paper, we investigate the problem of position free keystroke monitoring using smartphones. By exploiting the context of the background knowledge and the key positions of standard keyboards, we propose a mathematical model to estimate the relative positions and angles of the smartphone to the keyboard. The keystrokes can continuously test and calibrate the position estimation. After that, effective keystroke monitoring is established based on the relative position. we propose a Position free Keystroke Monitoring scheme (called PoKeMon), which does not require the prior knowledge of the phone-keyboard relative position.

Linguistic statistics

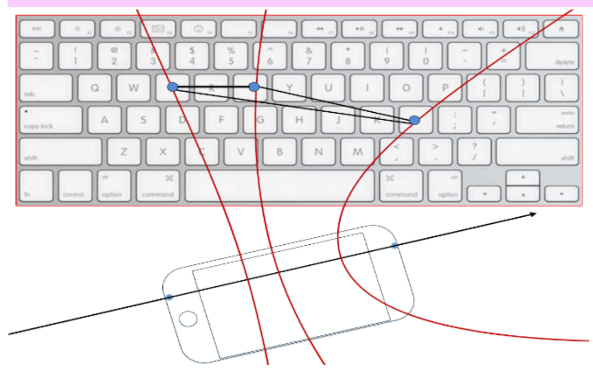


With figure 1 we can see that the typing frequency of some letters or characters are much higher than others. This allows us to infer the corresponding keys of keystrokes according to the frequency. For example, if the phone records a keystroke with the highest typing frequency and we know the context is C codes, it is most likely to be the letter "e" since "e" has the highest frequency.

TDoA-based approach

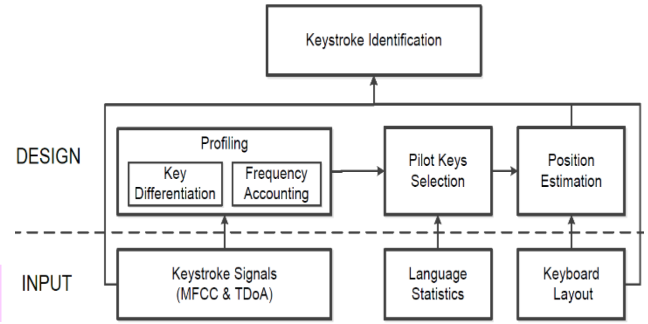
Consider our primary scenario as illustrated above the picture. Let's denote the distance between two microphones as d, and the distance between the sound source (i.e., the keystroke made on the keyboard) to that of two microphones as r1 and r2, respectively. Suppose $\triangle t$ is the TDoA measured at two microphones, the derived distance difference $\triangle r$ from the pressed key to two microphones can be represented as: $\triangle r = r1 - r2 = \triangle t * s0$.

Key Idea



The key idea is to combine the linguistic-based and the TDoA-based approaches. We first exploit the language limits to identify several "pilot keys", which are expected to be accurately recognized. Then we use these pilot keys as the anchor positions to further estimate the phone-keyboard relative position.Then based on the layout of the standard keyboard and the TDoA for each pilot keys, we can mathematically formulate the problem to find out the phone-keyboard relative position. To deal with the interference, we also propose a simple yet effective scheme to calibrate the positioning result. The calibration exploits the accelerator sensors and additional selective keys, improving the accuracy of the relative position estimation.Finally, based on the relative position, we can further recognize the keystrokes based on the state-of-the-art works.

PoKeMon Design



Our thought is to first distinguish different keys using acoustic features, and then employ the linguistic statistics to recognize some frequent letters (denoted as "pilot keys"). Now we have the TDoA from the phone to the pilot keys as well as the distance between any two pilot keys (since the layout of the standard keyboard is known). After that we can mathematically formulate the problem using the above information. Then the relative coordinates of the phone to the

Evaluation Results