NoShake: Reducing Perceived Shake on Mobile Displays

Ahmad Rahmati*, Clayton Shepard*, and Lin Zhong

* With equal contribution
Department of Electrical & Computer Engineering
Rice University, Houston, TX 77005

{rahmati, cws, lzhong}@rice.edu

1. INTRODUCTION

Many consumer electronics and mobile devices, handheld and otherwise, are used in situations that subject them to shaking. This leads to an important usability problem, since the shaking makes their screens difficult to read. Examples include checking email or browsing the web on a bus, using a GPS navigation system mounted in a vehicle, and a phone held by a person with a shaking hand, such as the elderly or someone with Parkinson's disease.

While there has been extensive research using accelerometers and gyroscopes to counteract the effects of shaking on both video and image capturing, to the best of our knowledge NoShake is the first publicly demonstrated system to apply this idea to a mobile screen. We provide a prototype implementation of NoShake on the Apple iPhone; this prototype samples the embedded accelerometer at 60 Hz and dynamically shifts the displayed image in real time to reduce the perceived effects of shaking.

2. NOSHAKE: SCREEN CONTENT STABILIZATION

We used a simple yet effective physics-inspired model for the core of NoShake. The model represents the screen as a mass suspended to the mobile device with a spring and viscous damper independently in each direction, as shown in Figure 1. We adaptively compensate for the effect of gravity from the accelerometer readings using a simple high-pass filter; this allows us to analyze the model without considering gravity.

The mass-spring-damper model is particularly well suited for reducing display shaking since the spring causes the mass to move in the opposite direction of the motion (relative to the device), thus reducing the effects of shaking, especially higher frequency shaking. The dampers are necessary to prevent oscillation of the mass; oscillation would lengthen the time of perceived screen shaking, and thus would be counterproductive. These dampers are tuned to achieve critical dampening, which causes the mass to converge to the steady state point as fast as possible without oscillation.

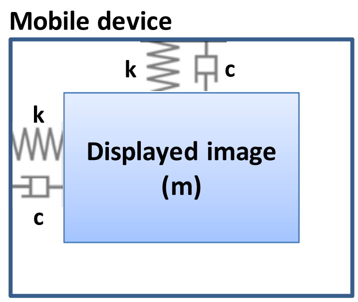

Figure 1: Spring - mass - damper physical model for NoShake screen stabilization

Figure 2: Photographs of the demo in action; the top text shifts according to the device displacement (NoShake) while the bottom text stays stationary

Furthermore, the mass-spring-damper system only requires device acceleration to compensate for shaking, rather than the actual device displacement. This allows us to use the simple accelerometer present in a growing number of consumer electronics and mobile devices to implement NoShake.

3. DEMONSTRATION

In the demo, we will display our NoShake prototype in action. Conference delegates will be able to see both stationary and NoShake stabilized text on the iPhone. They can also change the tuning parameters of NoShake on the fly and observe their effects. Our demo would benefit from Wi-Fi or Ethernet connectivity along with an electrical outlet for a laptop.