## Title

Designing Novel Mobile Systems By Exploiting Sensing, User Context, and Crowdsourcing

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## Abstract

With the proliferation of sensor-enabled smartphones, significant attention has been attracted to develop sensing-driven mobile systems. Current research on sensing-driven mobile systems can be classified into two categories, based on the purpose of sensing. In the first category, smartphones are used to sense personal context information, such as locations, activities, and daily habits to enable applications such as location-aware systems and virtual reality systems. In the second category, smartphones are exploited to collect sensing data of the physical world and enable applications including traffic monitoring, environmental monitoring, and others. As smartphones become blossomed in popularity and ubiquity, new problems have emerged in both categories of mobile sensing systems. In this thesis, we investigate three core challenges by answering the following fundamental questions: first, how can we utilize user context to improve the operating system performance? Second, how can we process sensing data, especially images, with high accuracy? Third, how can we enable distributed sensing while satisfy resource constraints of smartphones? The first part of this thesis studies how to exploit user context to improve the responsiveness of mobile operating systems. We propose a context-aware application-preloading engine named FALCON. The core of FALCON is a decision engine that learns application usage patterns of mobile users and preloads applications ahead of time to improve the responsiveness of mobile OS. Compared with other approaches such as caching schemes like Least Recently Used (LRU), Falcon improves the application responsiveness by two times. The second part of this thesis focuses on image search for mobile phones. We first explore how to improve image search accuracy on centralized servers, and propose an image search engine named CrowdSearch. The core idea of CrowdSearch is to incorporate crowdsourced human validation into the system for removing erroneous results from automated image search engines, while still provide realtime response for mobile users. Compared with existing automated image search engines, CrowdSearch achieves over 95% accuracy consistently across multiple categories of images with response time in a minute. We then extend image search to distributed mobile phones, and emphasis resource constraint problems, especially on energy and bandwidth. We propose a distributed image search system named SenSearch, which turns smartphones into micro image search engines. Images are collected, indexed, and transmitted using compact features that are two magnitudes smaller than their raw format. SenSearch improves the energy and bandwidth cost by five times compared with centralized image search engines.

## Recommended Citation