

Demo Abstract: *Kitokito* - Supporting Impromptu Collaboration in Participatory Sensing Using Smart Camera Phones

Hiroki ISHIZUKA^{†#}, Shun FUKUMOTO[†], Tatsuhiko NISHIMOTO[†], Ryo FUKUHARA[†]
Tatsuya Morita[†], Keiji Sugo[†], Niwat Thepvilojanapong*, Shin'ichi KONOMI^{†#}
Kaoru SEZAKI[§], Ryosuke SHIBASAKI[§], Yoshito TOBE^{†#}

[†]Institute of Industrial Science, the University of Tokyo

[†]Department of Information Systems and Multimedia Design, Tokyo Denki University

[§]Centre for Spatial Information Science, the University of Tokyo

*Graduate School of Engineering, Mie University

#JST CREST

isi@mcl.iis.u-tokyo.ac.jp, {konomi,shun,tatsu,ryo}@u-netlab.jp,
{sezaki,shiba}@csis.u-tokyo.ac.jp, yoshito_tobe@osoite.jp

Abstract

To seek and collect useful sensor data in a participatory sensing environment, participants should be able to coordinate their activities in a timely manner. However, existing systems deal separately with the “preparation time” to define the goal and method of sensing, and the “sensing time” in the field. Therefore, participants cannot easily modify the sensing method, including the collaboration setting, once they are out in the field. In this demonstration, we will present a system called *Kitokito*, which allows participants to easily create small sensing tasks, and iteratively modify the collaboration and sensing method during the “sensing time.”

1. Introduction

Many people use mobile phones in their everyday lives, and sensor-enabled smartphones are increasingly commonplace. These pervasive devices can be exploited in participatory sensing, which has received a significant amount of attention in recent years. Existing research in this area has primarily focused on *goal-oriented information gathering*, in which independent data collection efforts can be coordinated during a preparation phase. Such coordination can be supported by mechanisms for recruiting appropriate participants [1], affixing a sensing request to a location [2], etc.

In contrast, *explorative information seeking* tends to be more open-ended and have no preset data-collection goals because it involves *in-situ* learning and contextual changes of the information seeker. A conference participant who initially has general interest in the atmosphere of the exhibition hall may

receive geo-tagged photographs from relevant data contributors to learn that there are attractive demos there, which can create a need to collect more detailed data at a few spots in the hall. The data are then stored in a server to share with other participants. This type of explorative participatory sensing involves shifts and refinement of information need, and therefore requires dynamic coordination of participants during “sensing time.”

We present *Kitokito*, a system that supports impromptu collaboration in participatory sensing using Android-based smart camera phones. Mobile information seekers can select appropriate participants based on their location, orientation, and status and ask them to capture geo-tagged images along with additional sensor data. The system then accumulates the captured data in a centralized server. Additionally, *Kitokito* has the auto-upload feature that allows people to share ‘fresh’ image data in a few seconds, thereby supporting the dynamic aspect of open-ended participatory sensing.

2. Design and Implementation

Kitokito is based on a client-server architecture, and the client software operates on Android-based smart camera phones. We have tested the software on HTC's NexusOne (Android OS 2.2) and HT-03A aka HTC Magic (Android OS 1.6). When a user takes a photograph using a client device, it automatically uploads the image data to a server, together with relevant device ID, location and orientation information (see Figure 1.) The server also provides a task matching service [3] to support impromptu collaboration. The task matching service receives a sensing request from a participant, and forwards the request to appropriate people based on their current location, orientation, etc.

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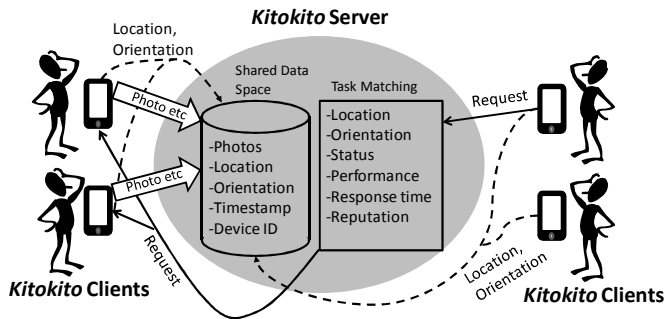


Figure 1. System overview.

2.1 Mobile Phone Client

Kitokito clients can communicate with a server using either WiFi or the 3G network. When a user takes a photograph using the interface shown in Figure 2, the client reduces the resolution of the captured image to about 250x200 pixels, and the upload process completes in less than a second on a WiFi connection. It takes about 3 seconds on a 3G connection. The clients use GPS and cell-tower positioning to determine their location information. The positioning error for the cell tower-based approach is usually hundreds of meters. In case of the GPS-based approach, the positioning error ranges from 15m to tens of meters in urban environments. The orientation sensor is highly accurate, which facilitated our system development without considering the impact of the orientation error. To test the overall usability of *Kitokito* clients, we recruited ten volunteers who used our system to collect (and upload) photo data at a summer festival.

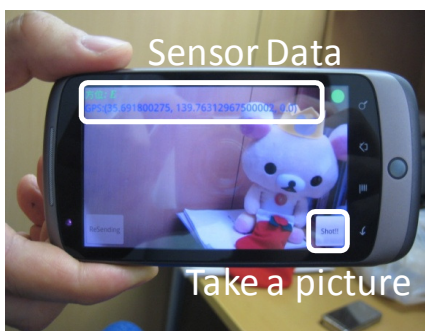


Figure 2. Using *Kitokito* client.

2.2 Collaboration Support

When a participant requests a sensing task using a client, the server receives a corresponding request message and determines candidates to carry out the task using the task matching protocol [3] (see Figure 1). The matching protocol calculates a score based on the request message and the candidates' location, performance record,

responsiveness, reputation, and status (e.g., “busy” and “available.”)

The server either selects the best candidate(s) automatically, or presents the list of candidates so that the requester can manually select preferable candidates. Note that nicknames are used to protect the privacy of participants. The server then sends a request to the selected candidates via email using either the serial or the parallel forwarding modes. In the serial forwarding, the candidates are contacted one after the other. That is, if a candidate either refuses to perform the task or fails to reply before the reply timer expires, the system contacts a next candidate. In parallel forwarding, the server sends the request to multiple candidates simultaneously.

3. Demonstration

We will demonstrate the usefulness of our approach based on the following three demo scenarios:

- (1) Find interesting demos at SenSys 2010 and fetch more information about them.
- (2) How are things in my hometown?
- (3) Creating “Street View” images of a small area. (Ask volunteers to upload ‘missing’ photos.)

We will use several Android-based smartphones as *Kitokito* clients. The clients will use WiFi to communicate with the server via a WiFi-enabled notebook computer that is connected to the internet. Therefore, our demo works best if internet connectivity is available. However, we can demo the first and possibly the third scenarios even if there is no internet connectivity. As for the second scenario, we intend to ask some volunteers in Japan to share ‘fresh’ photographs taken in Japan.

4. References

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