Poster: Crowdsourcing to Smartphones: Social Network based Human Collaboration

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ABSTRACT
Crowdsourcing is an increasingly popular solution for human intelligence tasks (HITs). Existing systems consist centralized control platforms. We are exploring a more comprehensive system in which a smartphone network is adopted as an effective supplement for location and time sensitive tasks. Additionally, social networks are used for more efficient potential worker selection. The system architecture is designed featuring the dual communication paradigm, Internet-based centralized communication mode and the wifi-based ad hoc communication mode.

Categories and Subject Descriptors
C.2.1 [**Network Architecture and Design**]: wireless communication.

General Terms
Algorithms, Design, Economics, Experimentation

Keywords
Ad hoc connection; Crowdsourcing; human computation; smartphone; social networking

1. INTRODUCTION
The 21th century is witnessing the fast growth of the computational machine. Supercomputers and even personal computers have replaced and can outperform manpower significantly. Yet there are certain works, such as language, visual processing, and analysis and reasoning that still demand human involvement, which is referred to as human intelligence tasks (HITs). Crowdsourcing, as the result of rich human computer collaboration, has been adopted for HITs when computers and networks provide a platform to distribute, coordinate, and collect the work of millions of human workers [1]. Amazon Mechanical Turk [2] is such a platform, among many others.

The proliferation of smartphones in people's daily lives allows for ubiquitous Internet access, and thereby facilitates the booming use of digital social networks such as Twitter, Facebook, and WeChat. Exploring the smartphone and digital social networks for crowdsourcing tasks is expected to be promising due to the following features and/or advantages.

- Ubiquitous internet access for time sensitive tasks,
- Ad hoc connections among smartphones for location sensitive tasks,
- Variety of social networks for accurate potential human worker search, and
- Embedded sensors on smartphones for environment-aware tasks.

The existing Internet-based crowdsourcing system offers centralized control. The system accepts an uploaded task and divides it into micro-tasks and coordinates workers when they work on the tasks iteratively or parallelly. Such a system performs inefficiently with time sensitive and location sensitive tasks. For example, in the scenario of finding missing children, the most effective action is to inform people close to where the child was lost and immediately after the child was discovered lost to help locate the child. In this case, a supplement real time ad hoc connection among nearby smartphone users for task distribution is expected to acquire higher efficiency. Figure 1 illustrates the communication streams. Task workers may report to the centralized control and a trajectory map may be generated for locating the child or predicting his/her location.

In this work, we explore the mobile smartphone network as the platform for HITs and propose the architecture for the social network-based crowdsourcing system. We study the research challenges of the communication method of the proposed system, which incorporates the real time ad hoc connections among mobile smartphones, and design a dual communication paradigm for it.

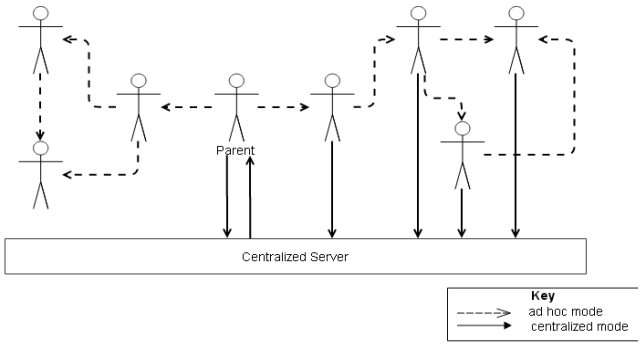

Figure 1. Communication stream in the finding missing child scenario

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2. RELATED WORK

The general research issues for crowdsourcing systems include job preparation, worker motivation, quality control, result aggregation, etc., as classified in [1]. Among the few works considering crowdsourcing to smartphone networks, [3] most proposed an incentive mechanism to motivate the participation of smartphone users for crowdsourcing tasks. [4] designed a workload dissemination scheme to minimize makespan in mobile wireless network. Both can be incorporated into our proposed smartphone crowdsourcing system.

3. SMARTPHONE CROWDSOURCING

3.1 SYSTEM ARCHITECTURE DESIGN

The proposed crowdsourcing system adopts the mobile network as a communication platform to deliver real time accomplishment for time sensitive and location sensitive tasks. The following is the components in the *dual communication centric* design, also shown in Figure 2.

- **Dual Communication Paradigm.** This component controls all communication in the system and switches between an Internet-based cloud, which provides a centralized communication mode, and the wifi-based ad hoc, which provides a distributed communication mode.
- **Task Submission and Management.** This component accepts a user's requested task and divides it into micro-tasks. Tasks are also analyzed and labeled with different attributes. This component may need to handle task dependency.
- **Worker Selection and Task Dissemination.** Based on the attributes of the task, this component looks into the social networks to select potential workers and push the task to the users' interface. Also a corresponding communication mode is selected for task dissemination.
- **Progress Monitor and Handling.** This component monitors the workers' progress by working with the worker selection and the task dissemination component to reassign tasks if workers quit or if an iterative collaboration is needed.
- **Results Aggregation.** This component collects results of the micro-tasks and merges them if necessary. This component may also be required to handle result evaluation and payment management.

Note that most existing crowdsourcing system schemes can be adopted and integrated into the above corresponding components. Therefore, in this work, we will focus on the design of the novel communication paradigm.

3.2 DUAL COMMUNICATION PARADIGM

The dual communication paradigm is implemented mainly at the user end of the system. When the task is generated and submitted through Internet to the centralized control system, the ad hoc communication mode may also be activated to broadcast the task to local smartphone users, if the task is location sensitive and emergent. Additionally, receivers of the task may also help to rebroadcast the task by using an ad hoc connection to propagate the request.

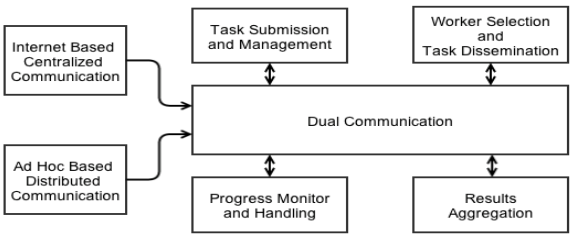

Figure 2. System architecture

Algorithm 1 is a sample user-end protocol (receiver of a task) for the proposed dual communication-based crowdsourcing system. Let $\mathbf{T_i}$ be the i^{th} task submitted to the system. There are several labels associated with $\mathbf{T_i}$. D_i indicates expiration time of the task. L_i indicates location scope for location sensitive tasks. E_i indicates emergency tasks, which will be automatically pushed to users. P_i indicates the pay information of the task. M_i is the communication mode, using 0 for ad hoc and 1 for centralized mode. These labels will determine whether the task is valid for the user to work on, or push to the user in the case of emergency and broadcast to other smartphones via wifi connection if necessary.

Algorithm 1. User End Protocol.

```
UserInterface (T_i)
1.  if (D_i) not expire
2.      if (L_i) in scope
3.          if (E_i)
4.              push (T_i) to user
5.          else
6.              if (P_i) qualified
7.                  put (T_i) to task queue
8.      if (M_i == 0)
9.          broadcast (T_i)
10. end.
```

4. CONCLUSION AND FUTURE WORK

In this abstract, we propose the preliminary work of a project concerning a smartphone network-based crowdsourcing system. We design a dual communication centric design for the crowdsourcing system, in which the ad hoc connection among mobile users is explored for real time, location sensitive HITs. Additionally, social networks are employed to push tasks to potential workers for higher performance. The dual communication protocol is designed. In the future, we will develop a prototype system to implement our proposed protocols and algorithms and to work towards the delivery of a flexible, efficient, real time, and low cost smartphone-based crowdsourcing system.

5. REFERENCES

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