Participation Management for Mobile Crowdsensing

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1. INTRODUCTION

The ubiquity of sensor-rich smartphones and other portable digital devices has propelled the research on large-scale mobile crowdsensing applications, where a large number of mobile users can be exploited to collect sensing data. Examples include include traffic monitoring, environmental monitoring, and many others.

Fostering and maintaining user participation is crucial yet challenging for mobile crowdsensing applications with limited and opportunistic attention from mobile users. Existing crowdsourcing platforms such as Amazon Mechanical Turk [1] and mCrowd [2] require users to actively search for crowdsensing tasks. Such pull-based systems are inefficient in utilizing potential participants as it is time consuming and cumbersome for mobile users to find sensing tasks from numerous candidates, especially considering the small form factor of mobile phones. Instead of pull-based approaches, an alternative is to proactively push sensing tasks to users in the hope of notifying potential participants with tasks suggestions. However, existing push-based schemes are often in lack of a mechanism to ensure that a task is pushed to the right user at the right time. Without such mechanism, task pushing would easily degrade to spamming.

Our objective is to develop a participation management system that pushes tasks to the *right* set of users. In particular, we focus on the following challenges: 1) how likely a user would participate? 2) how much the data contributed by this user can help the application? and 3) what is the cost of having this user participate? In other words, our goal is to determine the set of participants such that *expected contributions meet the crowdsensing application requirements while the total cost is minimized*.

2. OUR CONTRIBUTIONS

We propose a user participation management platform for mobile crowdsensing applications, as illustrated in Figure 1. Our work includes several contributions to address the aforementioned challenges. First, we provide a framework for user behavior learning, which exploits historical participation information as well as user context to estimate user participation patterns. Second, based on the learned user behavior pattern, we model the sensing task assignment problem as a combinatorial problem, and provide an approximated optimal solution for the over-sensing problem with minimum participants and ensured coverage. Third, we incorporate incentive schemes to our model, and solve the incomplete coverage problem by incentivizing a targeted group of users. We show that better coverage can be achieved with reduced costs. Furthermore, our algorithm design takes the scale of crowdsensing applications into consideration, and we provide approximated yet efficient solutions for large-scale crowdsensing applications.

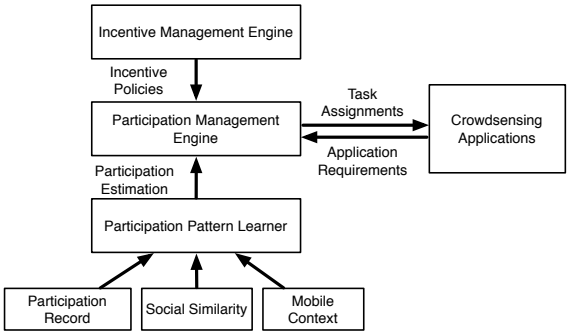

Figure 1: Participation Management Architecture

3. CONCLUSION AND FUTURE WORK

We propose a participation management framework that accommodates personal context, participation history, and social similarities into the consideration of sensing tasks assignments for large-scale crowdsensing applications. Our next step is to implement and evaluate our proposed system in real crowdsensing applications. In particular, we plan to improve our system including learning of user behavior pattern as a function of incentives, develop adaptive algorithm to capture the underlying evolution of user participation patterns, and discover new participant patterns from existing users.

4. REFERENCES

[1] Amazon mechanical turk. https://www.mturk.com/mturk/.
[2] T. Yan, M. Marzilli, R. Holmes, D. Ganesan, and M. D. Corner. mcrowd: a platform for mobile crowdsourcing. SenSys 2009.