Demo: CoMon - Resource-aware Cooperative Context Monitoring System for Smartphone-centric Sensor-rich PANs

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ABSTRACT

In this work, we demonstrate the operation of CoMon, a cooperative context monitoring platform, under various usage scenarios. Deployed over smartphones and sensor devices, CoMon monitors diverse contexts of mobile users and their surroundings, and provides applications with the contexts of interests. Especially, to support long-term monitoring of highly diverse user contexts, it enables a smartphone to collaborate with other smartphones as well as external sensor devices in a nearby space opportunistically. Through cooperation, it overcomes the limitation of a single smartphone-based context monitoring, i.e. inherent scarcity of sensing modalities (e.g. no environmental sensors) and positions (e.g. in a pocket) or potential shortage of computation resources and battery power.

Utilizing CoMon, context monitoring applications need to simply delegate their context monitoring requests to CoMon and become capable of fully exploiting resources within nearby spaces. Instead, CoMon plans the resource use for concurrent applications in cooperation with other devices. Specifically, CoMon maximizes sharing of sensing and computing resources among multiple devices of nearby users. Also, it avoids unnecessary usage of energy and computing resources by removing repetitive sensing and context processing across multiple devices.

Categories and Subject Descriptors
C.3[Computer Systems Organization]: Special-Purpose and Application-Based Systems
General Terms:
Design, Experimentation
Keywords:
Cooperative Context Monitoring

1. DEMONSTRATION SETUP

We implemented a prototype system of CoMon using Nexus One smartphones running Android and diverse sensor motes with TinyOS. Figure 1 shows an example deployment of CoMon with diverse hardware devices we have exploited. For the demonstration, we plan to use multiple Nexus One smartphones as well as sensor motes with diverse sensing modules (e.g. accelerometers, gyroscopes, ECG, dust sensor, microphones).

A smartphone constructs a *personal area network* (PAN) with diverse personal sensor motes through BlueTooth or ZigBee protocols. Such constructed PANs negotiate with each other through smartphones when they meet together, and plan for the best resource use. Context processing is performed as planned and monitored contexts are shared among multiple devices and users.

We plan to show the operation of CoMon through several example applications and cooperation patterns. Beyond application demo, we plan to visualize internal system operation, e.g., resource monitoring, device discovery, negotiation process, on a desktop PC by exporting important system status of smartphones and sensor devices to the PC.

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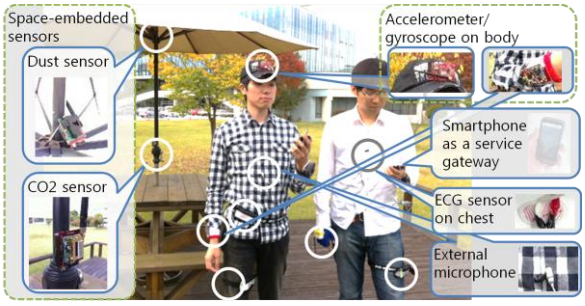

Figure 1 Example Deployment and Hardware Devices

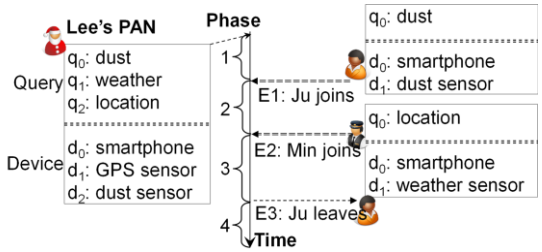

Figure 2 Example Demonstration Scenario

2. DEMONSTRATION SCENARIO

Figure 2 shows an example demonstration scenario with three PANs owned by Lee, Ju, and Min. It shows the registered queries (contexts of interests) and available devices for each PAN.

Phase 1: Lee runs "CareMe", an air pollution monitoring application. He also uses a "LifeLog" application for recording his daily life such as walking path and nearby environment. For location monitoring, CoMon can utilize either smartphone-embedded GPS or an external GPS device. Considering the resource status and priorities of Lee's devices, more suitable device is adaptively selected and utilized.

Phase 2: As Ju comes closer to Lee, Lee's CoMon automatically discovers Ju's PAN and identifies two potential cooperation cases: (1) collaboratively monitoring dust level with Ju in rotation, (2) obtaining location contexts from Ju in exchange of providing dust level. Both cases enable Lee and Ju to save the energy by reducing the sensing and monitoring duration. In demo, we will show the negotiation process, expected resource benefits, and cooperative context processing as negotiated.

Phase 3: Min joins Lee and Ju. As detecting Min's PAN automatically, Lee's CoMon generates two potential cooperation cases; (1) collaboratively monitoring location data in rotation and (2) providing location data in exchange of weather data. The former case allows Lee and Min to save energy for sensing. The exchange case enables Lee's application to obtain weather information newly, which had been unavailable from his own devices. Considering the application priorities and resource status, more beneficial cooperation case will be selected and executed.

Phase 4: This phase shows CoMon's adaptation for an unexpected leave of a cooperator. As Ju leaves, Lee's CoMon detects the event, and adapts its operation to utilize local resources again for seamless application support.