Report from HotMobile 2009

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The 10th Workshop on Mobile Computing Systems & Applications (HotMobile 09) took place February 23 and 24 in Santa Cruz, California. The workshop, sponsored by ACM SIGMOBILE, attracted researchers from Asia, Europe, and North America. It brought together 77 attendees and a number of guests. The workshop began with an excellent keynote speech by Bob Ianucci, Senior Vice President of Nokia, followed by seven sessions, including a breakout session. There were two poster sessions: one general poster and demo session, and one for dissertation research presented in the Doctoral Consortium. This consortium was a forum for doctoral students to get comments on their research. The workshop format and size encouraged high-quality discussions and interaction among researchers from academia and industry.

Ubiquitous Structured Data: The Cloud as a Semantic Platform

In the keynote speech, Bob Iannucci, who also serves as Nokia's special technology advisor, highlighted a major shortcoming of current mobile devices: the lack of common data structures or common user-interaction modes. He argued that the development of previous computing platforms, from mainframes to desktops, was characterized by a progression from a world of isolated "complete system" vendors to one of compatible platforms in which most of the value was in software and then, ultimately, services.

In this model, mobile computing is still in the initial stage, without platform standardization and the resulting market for value-adding systems and services. He said that the need for standardization has less to do with the hardware and instruction set (as with System/360 or x86) and more to do with the fundamental data structures and user-interaction primitives. Iannucci suggested the "global social graph" as the common data structure that extends between users and data stores and across applications, devices, and data types. The argument goes that if we can find a way to organize and share all the data currently held in cell phones through some standard infrastructure, we'll be able to create a universal mobile computing platform and a huge mobile social graph.

Location and Privacy

The first session looked at location and privacy. Ryan Scudellari (Duke University) presented "We Saw Each Other on the Subway: Secure, Anonymous Proximity-Based Missed Connections," which showed how location services could find people who don't otherwise know one another but happened to cross paths at some point. During the collocation period, the mobile devices exchange keys that can be used later to filter results when querying a central server.

Romit Choudhury (Duke University) explained "Real Time Location Privacy via Mobility Prediction: Creating Confusion at Crossroads." He stated that better location information plus mobility leads to new services. However, users might face privacy risks if they release their position information to untrusted location services. The proposed service, CacheCloak, uses mobility prediction to prefetch information along multiple possible paths for each user and create confusion about the users' actual paths. This permits not only anonymity but also better service quality, because data is already available when the user arrives at any given location.

Alec Wolman (Microsoft Research) shared "Enabling New Mobile Applications with Location Proofs," which looks at how users can prove their location even when they have some incentives to lie. With his mechanism, the mobile device user receives a location proof from a nearby WiFi antenna. The relatively low distance needed to receive such signals confirms that the user must have been at that specific position at given time. The access point, in this case, should be trustable and the issued keys encrypted and certified.

Mobile Applications for People

The second session was very interactive. Linda Deng (Duke University) discussed "LiveCompare: Grocery Bargain

Hunting through Participatory Sensing," a mobile sensing system supporting price comparisons in grocery stores by aggregating information from phone cameras. The data can be further processed centrally to satisfy user queries such as, what's the minimum price of a specific item? After-talk discussions mainly involved dynamic price changes, large-database requirements, limitations in using cell phones in stores and some countries, and currency changes.

Jonathan Lester (University of Washington) described "Balance: Towards a Usable Pervasive Wellness Application with Accurate Activity Inference." He introduced a mobile-phone-based sensor platform that measures the caloric expenditure of subjects wearing the system. After explaining the research's motivation, he described the Balance system's general architecture, including its wireless sensing platform, mobile phone, and software framework. His approach infers the user's physical activity (such as walking, running, sitting, or standing) from a few motion sensors.

Tim Sohn (Nokia Research) presented "Sharing Airtime with Shair Avoids Wasting Time and Money," in lieu of Pan Hui (TU-Berlin). The Shair system lets mobile phone users with contracts sell or share their unused quota minutes and text messages by acting as relays for others' traffic. Following this presentation was heated discussion on implementation issues and Shair's benefits. Some people said telecom operators have no reason to support it, because the main "problem" Shair solves is a pricing structure that they established in the first place.

The Future of Mobile Social Computing

In the breakout session, conference attendees split into six groups to discuss the future of mobile social computing. Many interesting conclusions arose from these groups. Jeffrey Hightower (Intel Research) reported that his group had discussed automated sharing through automatic production and information release. They concluded that automated sharing can prove dangerous because you can easily lose the control of what's shared and who's receiving the information.

For the second group, Ramon Caceres (AT&T Labs) argued the importance of privacy. He stated the need exists for flexible finer-grained privacy preservation. The group stated that it's impossible to imagine all the mobile social applications that will arise but that compelling applications must be fast and addictive.

Landon Cox (Duke University) presented on behalf of the third group. Some of the compelling classes of mobile social applications from his group included aggregation of social information and citizen journalism. Cox's group observed that additional research is needed on consent in mobile social applications. For example, how do you get consent to publish something? Finally, they noted that mobile social applications need to strike a balance between overwhelming people with information and increasing the network's usefulness. Neither too much nor too little information is beneficial.

Nicholas Palmer (Vrije Universiteit) spoke for the fourth group. This group stated that attractive mobile social applications could dynamically identify nearby people meeting some search criteria—for example, an improved version of Craigslist or a service to get acquainted with similar people. They said that further research is needed on location-finding indoors, improving energy efficiency, privacy and trust in mobile social applications, and graceful degradation of service in slow or disconnected networks.

The fifth group wondered whether social computing should really be regarded as an application in its own right. They wondered if it isn't more of a component supporting another application. For example, in many applications the social network can be seen as a "filter" for something else, particularly a location-based activity. This group wanted more research into community-based networking. For example, how can social networks be made implicit or automatic?

Stefan Saroiu (Microsoft Research) summarized the sixth group's discussions. They argued that "social networks" aren't an application but a concept. This group found a need for research on better filtering and searching with mobile social applications, as well as improved privacy.

Cross-Layer Mobility

The first session on 24 February examined cross-layer mobility. Jason Flinn (University of Michigan) presented "The Case for Intentional Networking." Intentional networking is a set of interfaces and mechanisms that let applications, users, and operating systems proactively manage connectivity. Flinn said that a virtual link layer could be used to hide multiple interfaces.

Ashish Sharma (University of California, Santa Barbara) shared "A Case for Application Aware Channel Access

in Wireless Networks." He stated that an application-aware approach to medium access could improve application performance and save mobile device battery power. As a proof of concept, he and his colleagues created Rendezvous, an application-aware Media Access Control (MAC) protocol that operates on current IEEE 802.11 hardware. By using short-term dynamic channel reservations based on the application traffic profile, Rendezvous achieves higher quality of service with lower power consumption for mobile devices running Voice over Internet Protocol (VoIP) and real-time video applications.

Sayandeep Sen (University of Wisconsin, Madison) discussed "Exploiting Approximate Communication for Mobile Media Applications." He explained that in some cases applications could choose to treat received bit sequences as good approximations of the transmitted bit sequence. For a broad range of today's applications, an approximated value could be enough, thus avoiding the need for data retransmissions. Following Sen's presentation, Mahadev Satyanaran (Carnegie Mellon University) observed that the last two presentations had used a cross-layering approach, which was messy. He suggested that next year's conference should include a panel on how best to approach cross-layering.

Context-Aware Computing

Kent Lyons (Intel) shared "Context Aware Composition," in which he stated that context perception, through sensors, could facilitate network discovery. Devices can use sensors to automatically define their relative position among other devices. With this knowledge, you can predict and reserve network resources in advance. This makes the transmission of data streams fairly regular and decreases contention and hidden terminal problems.

Nigel Davies (Lancaster University) presented "Planning Ahead: Techniques for Simplifying Mobile Service Use." Davies and his colleagues developed a *context clipboard* that lets users prepare the services and data that they'd like to use when mobile. Feedback showed most users favored using this clipboard to simplify future mobile interactions.

Toshiya Nakakura (Kyoto University) discussed "Neary: Conversation Field Detection Based on Similarity of Auditory Situation." Neary is a system to detect participants in a conversation. The algorithm Nakakura and his colleagues developed can distinguish conversations between different subjects even if the subjects are far apart or in the same environment where other conversations are taking place.

Building and Testing Applications

Michele Sama and Julian Harty (Google) presented "Using Code Instrumentation to Enhance Testing on J2ME: a Lesson Learned with JInjector." They explored the difficulties in testing J2ME applications due to the variety of mobile devices with different Java implementations. JInjector uses code injection to work around the interface incompatibilities.

Peter Gilbert (Duke) shared "Experimenting in Mobile Social Contexts Using JellyNets." JellyNets is an experimental platform that allows simple deployment of experimental applications while guaranteeing user and mobile device confidentiality and security.

Nicholas Palmer (Vrije Universiteit), winner of the HotMobile 2009 Best Presentation Award, discussed "Ibis for Mobility: Solving Challenges of Mobile Computing Using Grid Techniques." Ibis is a software platform that handles grid networks and can help solve many challenges that current mobile networks face. An Android port of Ibis solved issues such as mobile devices' limited computer power.

Doctoral Consortium

Yong Liu (Indiana University) talked about his research on ubiquitous computing technology adoption and how a Web-based mobile platform can help in the adoption process. He presented the results of a large-scale survey of 35 top-tier research projects in this field and their current adoption statuses. He also introduced several major sources of resistance in the adoption process and proposed a Web-based open ubiquitous environment to tackle the adoption problem. Daniel Fokum (University of Kansas) presented ongoing research on optimal communication systems and network design for cargo monitoring. Eric Anderson shared a joint optimization-based system for spatial-reuse TDMA with reconfigurable antennas.

Hassan Ghasemzadeh (University of Texas at Dallas) discussed his ongoing research on system design

challenges of healthcare monitoring through wearable mobile devices. His thesis research focuses on movement-monitoring platforms that operate with inertial sensors. This research has potential applications in fall detection, rehabilitation, geriatric care, sports medicine, gait analysis, and sports training. In particular, he's working on developing power-aware signal-processing techniques in body sensor networks. Daniel Câmara (Eurecom) explained how to exploit supply and demand to manage and easily control the network topology for public-safety networks.

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