Mobile takes social computing beyond Web 2.0

Social computing applications like Wikipedia, Facebook and Twitter have met with tremendous success in recent years and are revolutionizing how people work and play together. Facebook has reached over 400 million users and now accounts for nearly 25% of web traffic. According to Pew Research, nearly 1 in every 5 web users uses Twitter or some other service to check status messages of their friends and 94% of enterprises plan to maintain or increase their investment in enterprise social media tools. For the telecom industry, it is important to note that social computing encompasses but goes much beyond Web 2.0.

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With emerging technologies like smartphones and Internet of Things, social computing will become a cohesive experience embedded into both our online (virtual world) and offline (physical world) experiences. Users will access content from any device or platform, co-create and mashup their photos, videos and text with traditional content while interacting with each other. Such a trend will cut across all of our activities – from playing games on a website to shopping in the mall by the street.

What is mobile social computing?

Social computing in general refers to any technologies that involve either explicit or implicit computer mediated communication and interactions among people. In a shallow sense, social computing may refer to technologies that support social activities such as blogs, emails, instant messaging, wiki, etc. In the deeper sense, it could mean any technologies that allow computations carried out by groups of people, which is also known as the "prosumer" model where users not only consume an application but also produce value to the application via contributing content, tags, ratings, links or even software components. Despite some superficial limitations such as small screens, modest computational power, and unstable connections, we can foresee fast growth for social computing innovations in the telecommunication domain.

First, any social computing applications backed by the telecom operators can instantly tap into the huge existing social network of phone users rather than having to go through a cold start period as most web based applications. Compared with online social networks, the phone based social network could actually reach a broader population, including not only urban and youth population but also rural and elder populations, thanks to the much wide adoption of mobile phones in developing countries like China and India.

Second, the rich sensing capabilities and portable nature of the smartphone platform allow mobile social computing applications to interact with not only the digital information space but also the physical real world. A person's mobile phone encounters almost all the physical parameters that the person experiences – it feels the same force, travels at the same velocity, exposed to the same temperature, sounds and pollution levels. By recording the states of all these sensors attached to a mobile phone, such as GPS, accelerometer and other information, we can effectively record its owner's online experiences across a rich set of dimensions or features about the user's physical context such as his location, or his activity such as whether he is working or entertaining, or his social context such as whether he is with colleagues or families. The hope is that powerful, personal mobile devices and related technologies will enable whole new classes of adaptive, context-aware applications, which can

automatically serve the right information and functionalities to users at the right time and right place in support of the user's desired goals and tasks.

Four paradigms of mobile social computing

There are four most widely adopted mobile social computing application paradigms. And their relationships with common design patterns and core principles for social computing, we will touch upon one by one in later paragraphs.

Mobile collaborative filtering

The success of web-based collaborative filtering lies in the ease of collecting user feedbacks such as ratings and clicks from an enormous user population, whose aggregated opinion provides a powerful mechanism for tackling information overload. Mobile devices are essentially wearable sensors, and they allow software applications to monitor a much richer set of user behaviors in not only the online world but also the physical world at very large scales. Petabytes of data about human movements, transactions and communication patterns are continuously being generated by mobile phones. By applying large-scale data mining onto such data, one can gain insights into the dynamics of both individual and group behavior by capturing communication, proximity, location and activity information and build models for monitoring and predictions.

Collaborative filtering technology has been greatly successful at helping people explore the digital information space, such as choosing books in Amazon.com or selecting restaurants at Dianping.com (a Chinese website providing services of comment & recommendation on restaurants and other recreational spots). An attractive application in the mobile domain would be to facilitate people's exploration of the physical world and virtual world together. For example, the core technology of a recent start up company, Sense Networks, is essentially based on collecting and mining the massive number of people's geolocation data from cellphones, GPS devices, Wi-Fi and even taxis. Using machine learning techniques, it then indexes all of this location data and ranks places in the real world much like a search engine ranks websites. It looks at how much data is moving between locations. One of the mobile applications built by Citysense on Sense Networks' technologies allows people to visualize a heat map of where everybody in the city is at any given moment. It is supposed to help people figure out where the hottest clubs and nigh spots are. It also learns about where you like to go, shows you other people like you and makes personalized recommendations.

In the area of public health services, similar types of cellphone movement data are investigated by researchers at the Santa Fe Institute to improve existing computational

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models on how infectious diseases like SARS or H1N1 spread. By collecting data such as where and with whom people spend their time, the spread of a disease could be measured at an unprecedented level of detail, thus enabling more accurate understanding of the mechanism of infection.

It is worth noting that geolocation traces are only one particular form of user behavior that may be detected from a mobile device. By taking advantage of other sensors such as microphone or accelerometers built into modern devices like iPhone, a much richer set of behaviors can be observed and used in novel ways, such as building a user context. For example, clues to depression, a common illness in today's world, could be found from how people talk, as depressed people may speak more slowly than usual. By detecting such changes, the mobile device could warn people and give advice on precautions and treatment. Similarly, the speed of user's movement told by accelerometers may indicate whether she is walking, running or driving and can be used for health care purposes such as tracking the amount of calories consumed.

Collaborative mobile data sharing and annotation

Mobile phones are quickly becoming the most popular platform for users to create and upload data in many existing social computing applications. For example, photo-sharing site Flickr has enjoyed more than 50% increase in traffic on its mobile site and over 100 million photos are geo-tagged. By leveraging the vast amount of such geo-tagged multimedia data, researchers at Google had developed technologies to automatically recognize landmarks that are popular tourist destinations and build their visual models from the photos. The mobile social networking site FourSquare allows users to share location and status with their friends and earn credits via sharing valuable information about places. Rather than just being social networking tool, many shops and restaurants recognize FourSquare's value as a marketing platform and provide benefits such as free drinks or discounts to highly active users as a way to encourage visits to their venues.

The micro blogging service Twitter also heavily relies on the SMS services on mobile phones for users to conveniently send and receive status updates whenever and wherever they want, which is the key feature that distinguishes it from traditional blogging services and instant messengers. Social and psychological studies showed that the Twitter phenomena created a new type of lightweight but meaningful socialization by enabling the so called "ambient awareness" among people. An important implication of the success of Twitter like applications is that they provide strong evidence that people have a strong tendency toward sharing more and more personal data covering various aspects of daily life. We are expecting to see more diverse and interesting forms of user generated data and novel collaborative sharing services in the future.

Collaborative mobile content creation

Wiki-based systems are designed to facilitate quick and easy content generation, edit and distribution with large number of users. Wikis offer tremendous potential to capture knowledge from the minds of large groups of people and efficiently connect those with information to those seeking it, which is best evidenced by the tremendous success of Wikipedia. With the advanced data capture and sensing capabilities, mobile platforms would enable users to collaboratively produce more complex forms of data beyond textual knowledge as in Wikipedia.

For example, traditionally geospatial data are often very expensive to collect and maintain as maps can get out of date quickly in our fast changing cities. TomTom's MapShare extends the wiki principle to allow users to actively provide error correction and data feedback while using their navigation devices. In addition to data collection, the in-car navigation system Dash also

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uses the drivers as traffic sensors, who send GPS data to a centralized server for real-time traffic monitoring and prediction. In a spirit similar to Wikipedia, the OpenStreetMap project is even more ambitious and attempts to build a free and open database of the world's geospatial information. Contributors from anywhere can use GPS units and open source software to collect, annotate and contribute road data.

Collaborative human computation

Perhaps the most interesting paradigm of social computing is that of collaborative human computation, which tries to involve humans not only as users but also part of computing power. In other words, human brains are treated as processors in a distributed social computing system, and each can perform a small part of very difficult computation. Such a "collaborative human computation" paradigm has also been called "virtual artificial intelligence", as it provides potential solutions to hard artificial intelligence tasks including image and language understanding. Such potential has also led to a new production process known as crowdsourcing, which is pioneered by Amazon's Mechanical Turk online market place. It takes tasks traditionally performed by employees or contractors and outsources it to the general public.

Businesses needing tasks done (called Human Intelligence Tasks or "HITS") can use the Mechanical Turk APIs to access hundreds of thousands of registered workers, who would carry out the tasks on demand and return results that can be directly integrated into the business processes and systems. Mobile human computation represents a promising direction and is still in a very early stage, but it can already provide important services ranging from information giving to computational advertisement. The mobile crowd sourcing project Txteagle is similar to Amazon's Mechanical Turk but distributes tasks to cell phones using text messages or audio recording to enable people complete the tasks. Examples of currently supported tasks include translation, transcription, market research and survey.

The potential applications for mobile crowd sourcing could be very diverse. By allowing people to carry out computation anywhere and anytime, it could greatly enlarge the scope of human computation tasks. Moreover, with a mobile platform, not only could we tap into the human brain power for processing digital information, but also utilize a mobile work force that could more intelligently process their surrounding real world environment than traditional technologies such as surveillance cameras. For example, news agencies can utilize such a platform to have citizens who are often the closest witnesses of news events submit first hand images and stories. It can also help localize search services by utilizing people in a certain area to help locate places or objects unknown to the search system, or provide answers to questions that require analysis of a particular physical environment, such as "are there a lot of people flying kites at Tiananmen Square right now?"

Patterns and principles of mobile social computing

Telecommunications companies, like most other software companies, must consider a set of core patterns that are typically adopted by social computing applications. Chief among all patterns, we will see a paradigm shift in which the user is at the center of all the business operations and computation.

Patterns

Harnessing collective intelligence: We can create architecture of participation that uses the network effects and algorithms to produce software that automatically gets better when more people use it.

Data are the next "Intel Inside": We can use unique,

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hard-to-create data sources (e.g. eBay's auction data, YouTube's video library, and Craigslist's classified ads) to become the "Intel Inside" for this era in which data have become as important as functions. However, success does not always require owning the data itself but from the ability to derive knowledge from ranking, accessing, or formatting that data.

Innovation in assembly: By providing a common open platform to facilitate user innovations, a new phenomenon known as "widget economy" is emerging. The most prominent example is probably Facebook, which provides a social network application platform (SNAP), which allows any third party applications based on it to instantly tap into an enormous social network that is already in place.

Rich user experience: We can go beyond traditional human computer interfaces to deliver rich user experiences by combining the real time responsiveness of desktop application, ease of use of web applications and rich sensory inputs of smartphones. Deep and adaptive personalization could be enabled to optimize the experience of each user and increase both customer loyalty and revenue opportunity.

Leveraging the long tail: We can capture niche markets profitably through the low-cost economics and broad reach enabled by the Internet. Aggregation and filtering technologies would be indispensable for matching the supply and demand down the long tail.

Principles

There are also a set of principles to follow in order to best implement the above patterns:

Connected: The network effects move us from the one-to-many publishing and communication models of the past into a true web of many-to-many connections.

Decentralized: The bottom-up design principle now competes with top-down in everything from global information flow to marketing to new product design.

User centric: The user is at the center of mobile social computing. Network effects give users unprecedented power for participation, collaboration and ultimately impact. Consumers have become publishers with greater control, experiences are tailored on the fly for each user, and mobile users actively shape the product evolutionary trend.

Open: Open data, open APIs and reusable components form the foundation of social computing. Open means more than technology – it means greater transparency in corporate communications, shared intellectual property and greater visibility into how products are developed.

Emergent: Rather than relying on fully predefined application structures, popular structures and behaviors are allowed to emerge over time. A flexible, adaptive strategy permits appropriate solutions to evolve in response to real world usage. Success comes from cooperation, not control.

Technical challenges in mobile social computing

The management of user generated telecom data in various forms is the essential technology for social computing applications. This involves several types of technical challenges:

Systems must support real time content generation and sharing in order to support user communication and collaboration in real time. This requires a highly dynamic data management infrastructure. For example, data indexes must be updated continuously to provide real time retrieval of information.

The openness of communication and freedom to share information would raise new security challenges. The way users use social computing applications are often very casual. The system should provide mechanisms to help user automatically control privacy and security

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settings to reduce the risks of sensitive information being misappropriated.

The systems should impose minimum computational burden on the client side to ensure high performances on mobile devices. Designing thin client based architectures with distributed computing and cloud computing models will be the future trend.

Effective data mining technologies are essential for collaborative filtering and other personalization applications. The analysis of two types of data would be of critical importance. The first is social network data which comprise all forms of user communications and relations. Discovering patterns in such data could enable a system to more effectively support user's social activities. The second type of data is user generated data including ratings, reviews, messages, etc. These data provide the core value of a social computing service. How to present, retrieve and summarize such data is directly related to user experiences. These data also provide the basis for modeling individual user's behaviors, which is the key to successful personalized mobile online services.

Vision of the future

Imagine 10 years from now, a post 90's youngster would probably have a day like this: On her way to her work, a car accident blocked the traffic. Using a social GPS system, she noted other drivers heading to the same direction were taking another route that had much less traffic. Thus she followed them as well and successfully avoided a traffic jam. As she passed a supermarket, a reminder on her mobile phone suggested that there was no milk left at home. Scanning the bar code of a new brand of milk, she instantly got its sales statistics and online reviews. Later, at a bookstore, a new book by her favorite author caught her attention. As she took a copy and flipped the pages, her mobile phone browser automatically loaded the book's page on Douban (a Chinese Web 2.0 website providing review and recommendation services for movies, books and music) and showed the rating and list of reviews by other users. Through these reviews she found a book dealer on Taobao – China's largest Internet retail platform that offered even lower price. She then decided to wait and buy the book from Taobao, to save some money.

At night, she went to meet with some friends for supper at a new restaurant, but she had difficulty finding the place. So, she opened up a social mapping site on her mobile phone to identify both herself and her friend's current location on the map. At dinner, she took pictures with her friends and it was automatically labeled with location, time and her friend's names. The dinner finished early so she decided to visit a local bar. It was crowded when she arrived, as it was weekend. She wanted to find some people to talk to by opening up the Hook-Me-Up application, which automatically searched for other nearby devices with this feature turned on. By checking the compatibility of different users' profiles on Douban, it returned a list of three young men. After several rounds of text messages, she was approached by one of them and they had a great conversation that night.

Social computing will enter our lives faster than we think. It will soon become a single, cohesive experience embedded in our daily activities and technologies. As mobile platforms take center stage, we could foresee its application scope to quickly expand beyond Web 2.0 to become an indispensable component of users' offline experiences. Emerging mobile social computing applications will introduce new dimensions to the meaning of “social networking” by taking us into a new era of connected experiences unbounded by distance, time, location or any physical constraints.

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