Mobile Mashups: Thoughts, Directions, and Challenges

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Abstract

The twin mainstream computing shifts of mobility and programable Web are fundamentally impacting how humans interact, socialize, and access information. Never before has computing been so disruptive and important in our daily activities. With such profound change looming, what are the challenges we still face and the challenges that we will increasingly have to deal with to make these coming changes as smooth and useful as possible?

1. Introduction

Mobile computing has gone mainstream. There are more mobile computers in the form of cellular phones, smart phones, GPS devices, and laptops then there are any other forms of computing devices. These devices are increasingly connected to the internet and are self-aware of their current location. With the concurrent shift to a programmable Web [1] the opportunities of linking these mobile devices with Web content is leading the way to a shift in how humans communicate, interact, and socialize.

Indeed various important societal changes are occurring today. People all over the world are increasingly using the Web to access information about current events (online news and Craigslist), to express their opinions (blogs), access and exchange video and photos (YouTube and Flickr), and to create communities and social networks (MySpace, Hi5, and Facebook). While many of these activities require a connected computer they are increasingly enabled with mobile communication devices that are always connected. Furthermore, these ubiquitous mobile devices' [3] affordability make them the primary and sometimes the only computing experiences of many all around the world.

The arrival of the Apple iPhone in June 2007 showed that mobile devices computing experiences can be as satisfying as a laptop computer. The revolutionary Web browser on the iPhone has opened the flood gate on how Web content can be accessed and delivered on such devices. With the constraints of mobile browsing virtually extinguish and a mountain of personal and social information instantaneously available to mobile users, the opportunities are to integrate such information in meaningful ways and at the moment of need.

Web APIs mashups [2] have shown the power of integrating Web data and processes to create novel and situational Web applications to serve needs of niches. The next challenges in this approach to creating Web application and integrating data and content is to increasingly make use of the mobile computing resources and additional information that such devices offers. For instance, mobile devices typically include location information and that information is refreshed as mobile users move about and perform their activities.

The opportunities to take advantage of mobile information to dynamically integrate relevant Web content is real and now. For instance, my phone can make use of my social graph information on Facebook to alert me that one of my friends is nearby the coffee shop I am currently located to write this paper. More interestingly, using my friends' birthday information (also on Facebook) and their gifts wish lists on Amazon, my phone could alert me that one of the items on my friend's list is going on sale today at a shop down the block from the coffee shop. Such dynamic and novel interactions are possible today and will be commonplace soon all over the world.

While clearly interesting and powerful, these new social, dynamic, and location-aware mashups have serious technological and societal consequences. In particular, the privacy implications are severe since the information is mobile, changing, and accurate. Not only is your current location being transmitted constantly but the inferences that can be made with this information may be irreversible. How does one opt out of such a rich and dynamic environment? What happens to the trail of information that is being collected as these mobile, mainly ephemeral mashups, disappear? In this paper I attempt outline some of these challenges both from a technological view point but also outline some of the potential societal, legal, and political consequences.

1.1. Organization

The remainder of this paper is organizes as follows. The next section gives some examples to how mobile mashups will increasingly solve real problems faced by

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individuals and enterprise workers. Next I outline the important components of a possible architecture to realize such mobile mashups. Section 5 outlines the engineering, research, and social challenges that current mashup communities will face as we go mobile. Finally, Section 6 concludes with a call to action for openness as we move forward.

3. Motivation

The motivations for mobile mashups [4] follow from the general use cases for mashups. Primarily mashups enable quick and situational integration of Web data and process. Mobile devices provide contextual information (e.g., location) that in turn provides a richer ground for mashups. I explore use cases for mobile mashups by looking at two primary user classes: (1) the casual end-user, and (2) the more formal enterprise user.

3.1. End-User Examples

In the modern world, young adults are increasingly attached to their mobile phone as their primary means of communications with their parents and their friends. The possibilities for mobile mashups using these phones for that class of users increases significantly as we consider the various social networks that teenagers are part of. For a specific scenario, imagine a group of teens going to the movies. The mobile phones of the teens are able to broadcast location data that would allow parents to keep a watch on the routes taken as well as allowing the teens to be alerted of friends from their Facebook profile who are near in the mall.

The mall's stores and movie theater could partner with Facebook to broadcast coupons from Blockbuster for movies by the same actors as the movies currently playing. These types of cross-selling are happening right now. The key advantage of a mobile platform is to allow the alerts and cross-selling timing to happen at the moments and locations that are more likely to translate into actual purchases.

Mobile phones are increasingly part of daily activities of individuals in the third world. Many of these countries lack the structural infrastructure to support regular communication equipment. With the relatively minimal infrastructure needed to install cellular towers, mobile devices are a boom in these countries, and increasingly part of all adults lives. The opportunity for mobile commerce tied with location information as well as improving health and social care have potential for deep impact and consequences. Specifically, in these countries the lack of doctors means that one doctor can be the only one available for miles and miles. The doctors move about the countryside to provide care to the most needy based on regular rounds of care. Doctors could use mobile devices to record health information and keep tab on patients thereby allowing them to address a vast number of patients than would normally possible.

3.2. Enterprise Examples

The success of the Blackberry mobile phones has shown that enterprise workers starve for instant access to information such as email and corporate data. The next steps in deeper integration of corporate information and mobile workforce will be in mobile mashups that enhance employee activities and workflows. Consider two such mobile corporate employees: (1) an insurance agent and (2) a real-estate broker.

Part of an insurance agent's job is to to visit the cars, apartments, and real-estate that she is insuring. At time these visits are done during catastrophic event, e.g., an earthquake or hurricane. Using her phone the agent is able to snap pictures and record the description of what she sees on the scene. A mobile mashup of corporate data for damage estimation can take description of the house and give an estimate of the amount of the check that she needs to give the insured. Further, the agent can quickly dispatch location information to corporate where necessary arrangements can be made to send in repair crew. Note that this typical workflow would have normally involved multiple phone calls and offsite operations that can now be done in a semi-automated fashion.

Another group of corporate workers that tend to be frequently mobile are real-estate brokers. Since these agents get paid by sellers they are incited to see as many clients as possible showing various properties. Using a mobile phone is an essential communication tool for their day to day workflows. Augmenting these devices with the ability to automatically integrate real estate content would allow them to have a stream of live new availabilities instantaneously. Currently this information needs to be printed and a priory decided before each trip. With the ability to see new matches during trips the agent can refine his matches as the client provide feedback on previously visited properties. This info can quickly be entered on the phone and the corporate program, knowing the agent's location, would provide new suggestions that better match the clients' taste, needs, and preferences.

4. Architecture

In order to enable the various scenarios allowing users of mobile devices to automatically integrate with public Web and private corporate intranet content and processes, there is a need for these devices to have a comprehensive software architecture supporting the various features and use cases highlighted in Section 3.

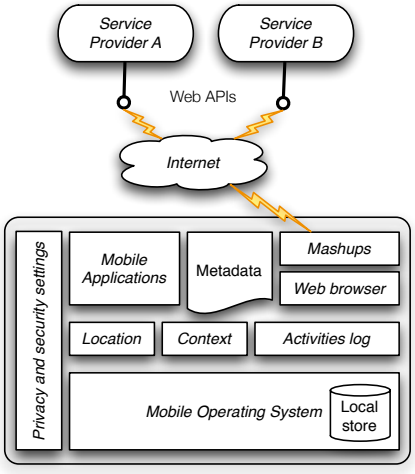

Figure 1 Generic high-level architecture.

Figure 1 illustrates the main component of this software architecture. Some of the main components are shown.

4.1. Open Mobile Platform

Implementing such an architecture which would allow dynamic augmentation and integration with corporate and Web content is most feasible with an open mobile platform. This is especially the case since there exists a multitude of devices that can make use of the same features and capabilities. Application and mashup creators will be incentivized to create their applications as the number of users reach critical mass. The Google Android[1] mobile platform is a step in that direction.

Two other important open external services are vital to enable these rich mobile mashups. First, location information while being open format need to be usable openly as well, e.g., to generate standard location queries for services and nearby landmarks, businesses, and events. The second service needing to open data access are the social networking service providers who currently allow users to create their own social graphs. Social utility services such as Facebook, MySpace, and LinkedIn have mostly proprietary social graphs structures and metadata. While it is important for these services to protect user's privacy and security, agreeing on common formats, structures, and semantics for social graphs would allow better interoperation and use cases for their customers. The Google FriendConnect initiative and the DataPortability.org alliance are steps in that direction.

4.2. The Role of Semantics

Another component of this software architecture are the metadata for applications and context. This could be in the form of a standard taxonomy of tasks, activities, contact, and context that can be communicated to external trusted applications to enable discovery and integration. This metadata can be tailored for different classes of users, e.g., corporate, and allow applications to have a standard means for communicating their capabilities and services. While such an approach is widely challenged in the open Web [1] mobile devices could easily make use of such approach for enhanced contextual and location information. This is especially possible since with the location of the devices, mapping services can provide categorized lists of nearby landmarks, businesses, and realtime events, e.g., concerts or accidents.

Some of that context information could be inferred from general templates as well as personal information management applications, e.g., calendar and tasks lists. The context can be used to augment location data so that the device would "know" that the user is at lunch in a downtown area and thus be open to know about future activities happening in that location during the weekend.

4.3. Programmable Web

The final salient aspect of this architecture is the continuing movement toward a programmable Web [1]. The availability of Web APIs in the form of data feeds (Atom and RSS) and more elaborated resource-based manipulation APIs such as REST and AtomPub allow external services to expose their content and processes in the form of reusable and scalable Web resources. This trend gave rise to the mashup ecosystem we are witnessing. While these programmable primitive are enabling mashups today, there remain various challenges to facilitate mobile integrations and usages.

5. Challenges

Many challenges remains to be solved to allow mobile mashups to also go mainstream as regular mashups and mobile devices. However, unlike regular mashups the challenges are primarily outside the realm of engineering and technology but rather social, legal, and political. This is due to the fact that mobile mashups have the ability to quickly and directly impact human activities and social fabric.

[1] http://code.google.con/android

5.1. Engineering and Research

The engineering and research challenges for mobile mashups lie in the realm of data engineering, metadata agreement, and user interfaces.

First, sound data engineering is important to minimize and disambiguate information coming and going to mobile devices. Unlike regular computers, mobile devices' connection to the internet is prone to high-failure rates and slower bandwidth. This means that minimizing communication to the devices are key to increase user experiences and prolong battery life.

Location information allows mobile devices owners to have access to contextually relevant data and services. However, these enhancement cannot happen without communicating metadata information about the activities the current user is engaged in and will be taking part of. For instance, knowing that the current user is during work hours adds a tremendous amount of context to the location information transmitted.

Finally, mobile devices (almost by definition) have constrained operable user interfaces. This means that application interfaces are constrained to portions of the screen. Taking advantage of the environment and device means that mobile mashups will need to strive to keep a user experience that facilitate quick reading, minimize direct user input, and make use of novel human interfaces such as voice, orientation, and novel gestures.

5.2. Social, Legal, and Political

The final set of challenges, which I believe are the most interesting and difficult, are the social, legal, and political challenges that will have to be addressed as interesting mobile mashups gain popularity.

Examples of social challenges are the huge privacy implications that come with transmitting user location. Imagine the consequences of an application that has knowledge about your whereabouts and could keep such information over time. The inference on habits and knowledge about the likelihood of individuals being in certain places or having met will cause various changes to how we perform our regular activities.

The legal implications of location information are severe. Could such information be used as alibi when one is accused of certain crime? The possibilities for misuse and abuse are beyond our current legislation. Further, now that individuals will have what is a connected device in their hands at all time, the possibility to broadcast realtime information, photos, blogs, text, and even video will cause further reexamination of current content ownership and protection laws. For instance, imagine a user broadcasting with their phone[2] the finals of the Wimbledon tennis championships. What are the consequences with the current broadcaster who has purchased the rights to the event?

Politically the consequences are also severe since none of the social and legal implications have clear cut answers. In many cases the decisions will be the result of who is in power today in the country in question. Further, since the internet is a global phenomenon and that mobile devices and mashups are open to a global audience, decisions in one juristrisction can be overcome by the users or service providers moving to a more friendly country. Cooperation between countries in order to deal with clear cut issues that should be prevented, e.g., pedophile, will require global political agreement and cooperation.

6. Conclusion

As mobile computing go mainstream and Web content and processes are widely available in forms that allow remixing, the opportunities for creating mashups that take advantage of a user's contexts are becoming increasingly possible and useful. Mobile platform such as Google's Android and Apple's iPhone are providing the tools, connectivity, and operating system services to make these applications feasible.

While these new application will provide clear benefits to users, there are also serious consequences with challenges that are yet to be fully understood or addressed. In particular, the privacy issues around broadcasting location information and mixing that with the social graph will potentially create unintended situations for users and potentially have societal impacts beyond the simple usage and value that these applications provide. Open platforms and collaborations maybe two sources to enable this mobile mashups future while curbing the potential pitfalls.

10. References

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