

Clouds on our Horizon? Mobile AR Risks and Obstacles

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Christine Perey, Consultant and Industry Analyst

PEREY Research & Consulting

cperey@perey.com

+41 79 436 68 69

Abstract— The future for Augmented Reality is very bright. Given the achievements in 2009 and the activity level in 2010, the prospects for mobile AR are particularly encouraging. While we continue to develop better experiences and explore new areas for expansion, it is our responsibility to acknowledge “zones” where trouble is likely to be brewing, like clouds.

This paper examines five categories of risks to the growth of Mobile AR. Some of the risks can be addressed through a variety of market education efforts, without need for central coordination. Other risks will be best addressed with industry-wide agreement. Finally, some risks can be addressed with money, and time.

As a community, we must develop strategies to address the challenges ahead and take action—individually and as a group—which maximize our impact on the world.

I. INTRODUCTION

In 2009, Mobile Augmented Reality (Mobile AR) moved from prototypes to production. From a few to many. Set in the wilderness of a few examples of AR on PCs with webcams, some experience with markers on mobile, and over 10 years of scientific literature, there were few trails or sign posts. Like pioneers with their wagons heading West across North America, a handful of small companies designed, developed and delivered to the users of Android devices and iPhone 3GS phones the first wave of commercial and free applications.

We need not review the great achievements and phenomenal level of attention which these early leaders deservedly received, nor must we shed tears for those who were lost and painful lessons learned in the process. Virtually every list of technologies to watch in 2010 included Augmented Reality, and many specified Mobile AR in particular. We have small, medium and large companies dedicating considerable combined resources to proving that the forecasters were correct.

The purpose of this position paper is to put forth in one place an organized list of the factors which are already presenting challenges to the further growth of Mobile AR, to examine the characteristics of these risks, and, to encourage the multi-disciplinary, group exploration of different approaches to addressing them.

Five categories of concern may be immediately identified:

- Technological
- User Experience
- Market and business
- Sociocultural
- Legal and ethical

Within each of these categories, we classify each risk in terms of their relationship to the present as being:

- Near term-important today, it is a risk at present and may continue to evolve as a risk and remain a risk in coming years
- Medium term-approaching, will be important in 6-12 months
- Long term-uncertain, must be monitored and could become important beyond 12 months

We also suggest for each risk one or more of five possible approaches to mitigation:

- A. All industry participants perform continual, distributed and customized market education to different audiences
- B. One company or unaffiliated organization (e.g., OpenSource project) provides solution which is acceptable to all ecosystem participants (industry, defacto solution)
- C. One or a few market segments self-organize to develop, propose and agree upon solutions
- D. Industry-wide, centrally-coordinated initiative (working group) takes on effort necessary to reduce this problem
- E. University and corporate research centers undertake study to examine options and publish their results.

II. TECHNOLOGICAL RISKS AND OBSTACLES

Technical risks include all the challenges which can be addressed with an engineered (hardware and/or software) solution. Of course, there are some risks which overlap; there are market limitations which are obstacles, but a technical solution may be developed to address them.

Technological risks comprise the largest category at the time of writing of this paper and could further be separated into those which can be addressed with different hardware, mobile device OS issues, platform or content management issues, and those issues at the application or presentation layer.

In Figure 1, technological risks are listed although their order should not be taken as indication of the author's ranking of relative importance. Relative importance of a risk depends on the segment of the ecosystem to which a company belongs.

Figure 1. Technological Risks and Obstacles to Growth

Risk	Timeframe of this threat	Approaches to mitigation
Device and Mobile OS fragmentation (except on iPhone)	Near-term	Probably D
Map (and 3D map) fragmentation	Near-term	Probably C (Google, Apple Maps, Ovi Maps, etc)
Network coverage/bandwidth insufficient	Near-term	Probably C (mobile network operators are addressing this gradually)
Low (short) battery life	Near-term	Probably D, hardware
Lack of interoperability (silos)	Near-term	Probably D, development of AR standards or open API
Low AR registration accuracy due to limitations of GPS	Near-term	Probably A
Application does not work (or works poorly) indoors	Near-term	Probably A
Many different image recognizers	Medium-term	Probably E
Image recognizers with high false positives or false negatives	Medium-term	Probably E
Inflexible (or other problems with) Content Management Systems	Medium-term	Dissect to address root causes
Content must be resident on handset	Near-term	Need network-based data management/ CMS
Security	Medium-term	
Lack of support on preferred (popular) devices (e.g. RIM)	Medium-term	Probably B (support added by device manufacturer)

III. USER EXPERIENCE

For Mobile Augmented Reality to be successful the experience of the end user must be easy, stable and surprisingly rewarding at each encounter, especially during the period when the user is learning the new behaviors.

There are many factors which contribute to a high quality user experience. Likewise, there are many potential contributors to a poor or unstable user experience. Many of the contributors are technical at their origin, however, with this new mode of interaction with digital content, there are also new challenges. The acceptance of a new User Experience is also influenced by sociocultural factors, such as the age of the user, experience with other mobile interactivity paradigms, and cultural acceptance of walking while holding up one's phone at eye level.

In Figure 2, we list a few of the experiences which could discourage the users of early applications and cause them to abandon mobile AR.

Figure 2. User Experience Risks and Obstacles to Growth

Risk	Timeframe of this threat	Approaches to mitigation
Multiple (too many) items in view	Near-term	New methods of filtering content
Slow (long) response time	Near-term	Reduce size of objects, formats for content transmission

Mobile AR Summit participants have submitted numerous papers which deal in depth with the user experience challenges. Some also offer proposals for how these may be addressed through adoption of guidelines, exploring creative solutions for presentation of information on digital devices and creating new accessories which would make it easier for the user to interact with the digital content in the environment.

IV. MARKET AND BUSINESS RISKS

If, in another universe, there were easy solutions to the technological challenges highlighted in Figure 1, and the user experience obstacles highlighted above and in other papers, many of the business and market development risks would be relatively easy to address or would not exist. In the current universe, however, the interplay between the categories of risks needs to be recognized and managed.

In Figure 3, the market and business risks are listed and, once again, their order is not intended to indicate their relative severity or impact on overall market growth.

Figure 3. Market and Business Risks to Growth

Risk	Timeframe of threat	Approaches to mitigation
Too few users to justify investment	Near-term	Increase end user awareness (A). Reduce the barrier to entry.
Too many low utility (just novelty) options	Medium-term	
Too little high quality, licensable content (Social media related)	Medium-term	

Risk	Timeframe of threat	Approaches to mitigation
Business model relies on in-app commerce	Medium-term	Probably C
Business model relies on contract with mobile subscriber	Near-term	Probably C (with cooperation of mobile operators)
Business model does not align with value of the partner in the ecosystem	Near-term	Probably D
Go-to-Market fragmentation (too many storefronts for apps)	Near-term	Probably A
Content provider must negotiate many times	Near-term	Probably D
Content provider does not have rights for use in AR	Medium-term	Probably C
Content model relies on partnership with social networks	Medium-term	Probably C

V. SOCIOCULTURAL RISKS AND OBSTACLES

If the technical and business risks were reduced or eliminated, there would remain a number of barriers to widespread adoption of Mobile AR. These barriers can be summarized as problems between the technology as it is proposed and delivered, and the social norms and conventions in a region or country at the time when the services are introduced. In Figure 4, the sociocultural issues are listed. These risks could lead to there being negative connotation association with AR technology use in public places, although there could still be a use case for private AR uses. As above, the order of listing does not indicate the relative urgency or magnitude of the challenge.

Figure 4. Sociocultural Risks

Risk	Timeframe of threat	Approach to mitigation
Fear: Threat to anonymity and consumer privacy in public spaces	Near-term	Probably A
Use case considered awkward or geeky	Near-term	Probably C, D and E (eyewear)
Novelty wears off and applications provide insufficient value	Medium-term	Probably C, D

VI. LEGAL AND ETHICAL RISKS AND OBSTACLES

In mobile AR platforms which use GPS, as in other location-based services, the user's every movement is being tracked and logged. The provider of the platform, just as the provider of the network service, knows all the movements of the user, and in the case of AR, the interests of the user. The historical information may be very useful for the application to automatically adapt the user experience and, in the future, for proposing new options or removing POIs which are never of interest to a user.

What if a Mobile AR system is not only used for detecting a user's environment and context, but also for capturing all the information around a user and storing it in the user's account?

Currently, the number of people using mobile AR, and social AR in particular, is much too small to be of high concern to law makers and government agencies in populated countries, however, when the popularity of mobile AR increases, there will certainly be those who raise concerns. Urban area policies could be developed. There may need to be legal guidelines implemented to control the type of transparency and reduce potential abuses which the geo-location-aware mobile AR technology could foster.

Already, in Switzerland the privacy protection acts are being enforced. When a minister was captured by the Google StreetView camera strolling down the road with a woman who was not his wife ("co-locational monitoring"), Google was reminded of the requirement to "erase" faces. And Google StreetView now must also remove the names of all street signs in the database of Swiss images.

VII. CONCLUSION

While the future is rosy for mobile AR, and it is certain to expand in the next 12 months, it is not too early to examine some of these barriers more closely. In the papers [1], [2] and [3] the author calls on the participants of the Mobile AR Summit to begin working as a group and individually on these and other possible obstacles to continued growth.

In addition, as the custodians of a nascent industry, we must be aware of our responsibility to monitor the horizon, to detect and to discuss with the other stakeholders all early signs of new barriers which may develop.

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