

IMA

mobile
augmented reality

One step beyond

Augmented Reality (AR) cannot really be called a 'new technology', but for first time it is available and ready to change the way people will interact with the world.

This White Paper discusses the latest developments in Mobile Augmented Reality and summarizes the challenges and opportunities for the coming years.

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About the Atos Scientific Community

The Atos Scientific Community is a network of some 90 top scientists, representing a mix of all skills and backgrounds, and coming from all geographies where Atos operates. Publicly launched by Thierry Breton, Chairman and CEO of Atos, the establishment of this community highlights the importance of innovation in the dynamic IT services market and the need for a proactive approach to identify and anticipate game changing technologies.

Definition and scope

An individual is leaving the hotel. They're a bit tired but would like to eat something. They'd like to know the area to find out where the nearest cash point (ATM) they can get money from is and if possible, a decent place for dinner. They lift their phone to focus on the street, look through the screen and see that information about the buildings, shops and restaurants that are in front of them magically appears on the screen.

The closest cash machine is about 300m on the right and the sushi restaurant located at 3km at the end of the avenue has many recommendations, including one from their best friend, who is also a good reference for choosing a good restaurant. However, they do not want to walk and wonder if there is a subway or a bus to take them there. Again, they look through their phone and see that the underground is 400m in front of them, but the bus stop only 75m away, and just in four minutes a bus will arrive going in that direction.

Decision made

The individual gets to the restaurant. It's really authentic, so much so that the menu is in Japanese, and languages are not exactly their forte. They focus their phone on the menu and the text is instantly translated to their language. Any further questions are resolved when the final dish is depicted in 3D on the screen.

This could be a scene from the second part of the movie *Minority Report*, but the truth is that since augmented reality (AR) technology has been incorporated to the new smartphone generation, users have had real experiences like this that have been very successful in the mass market.

A user simply has to download an application on to a phone and look through the camera lens. These applications take advantage of new navigation features from new terminals and allow access to the Internet to mesh information from the two worlds and present it in a simple and intuitive way. They greatly enhance the ability to understand and process data about all that a user can see and experience around them. It could be said that AR technology enables high definition for the camera phone. Suddenly, everything on the screen is much more defined and clearer than before.

Technology overview

The idea of incorporating virtual information into objects is not new. It has been used for more than 20 years in specialized sectors, such as defense, medicine and aeronautics. Augmented reality is in fact a term that was coined in 1992 by Thomas Caudell, a Boeing employee at the time. However, it is only from mid-2008 with the appearance of smartphones, like HTC Dream or Nokia N97, that it reached the mainstream, taking advantage of all the functionalities that these devices provide.

Four key factors highlight the main reasons for this rapid adoption by mobile users:

- ▶ Democratization of smartphones: The high penetration of these mini computers coupled with the unlimited data flat rates associated with them have led to a market explosion for applications and Internet access from mobile phones, leading to the proliferation of on-the-go services.
- ▶ Maturity of the market: Users no longer demand mere mobile applications, they want to live experiences that are easy to use and that add value.
- ▶ A boom in location-based services: The success of location solutions in recent years acts as an enabler for the takeoff of AR solutions.
- ▶ Consolidation of Apps Stores: In a very short period of time, Apps Stores have managed to position themselves as the user's favorite distribution channel of mobile applications and have created a reliable ecosystem for the development of new services.

Today, the use of AR technology has spread mainly through the two mobile platforms already mentioned, Android and iPhone, and although with current penetration levels they are not dominant in the worldwide market (yet), at the level of mobile service usage and revenue generated by their contents, they are.

As with all new technologies when they first appear, the market is currently very fragmented. Smaller vendors, in some cases recent startups, provide AR applications. AR tools and facilities are not standardized so availability varies among mobile platforms. This means that the organizations that want to exploit this technology will need to choose between one or more platforms to deploy their new AR services.

At the moment, there are different kinds of AR services on the market that allow interaction with the outside world. These fall into two broad categories depending on the technology required to identify objects: Location and Recognition.

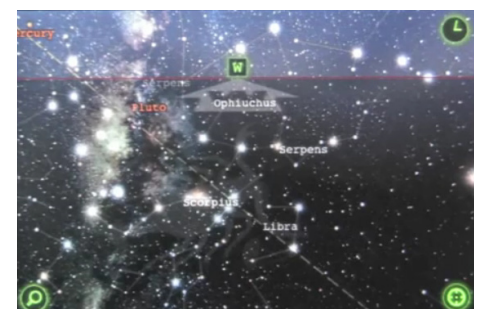
Location

If an individual knows their exact position and what their mobile camera is focused on, they can represent information about any object in their field of vision in 3D. This exploits the capabilities of the numerous navigation sensors incorporated in the latest smartphone generation to help contextualize surrounding information:

- ▶ A GPS to accurately locate the user's position using satellite triangulation.
- ▶ A digital compass, also called a solid-state compass, to measure the relative position to the Earth's magnetic North Pole.
- ▶ An accelerometer to detect changes in orientation and speed, and the variation of inertial motion, including falling and vibration shocks.
- ▶ A gyroscope to support the accuracy of the accelerometer and correct variations in the conservation of angular momentum.

All these features, which were unthinkable in a mobile phone just a few years ago, are now the basis for the development of all kinds of AR services that impose virtual information on real space. One example is the award-winning application Star Walk (Figure 1), where the terminal becomes a window for the recognition of stars from any position. By pointing the phone at the sky and watching the screen, the user can obtain information about any known object in the universe and become a smart astronomer, at least for a while!

Figure 1: Example of iPhone Star Walk Application



Recognition

The second method is more complex. It is based on the way that the phone is able to recognize the shapes and sounds that surround it by identifying digital patterns. Unlike the previous approach, this method can also work in indoor spaces because it does not depend on the user's GPS positioning. How does it work?

▶ **Using Markers:** Small images that allow the mobile device to recognize or translate content must be given. For example, when 2D barcodes (Figure 2), now ubiquitous in the market, are read by a terminal they are capable of generating an action: play a multimedia video, send an SMS, connect to a mobile web device, etc. LLA Markers from Junaio Company, can generate 3D content in real time from latitude, longitude and height as transmitted to the terminal that is then superimposed on the screen.

▶ **Marker-less indirect recognition.** With Shazam (Figure 3), the mobile device hears a song on the radio and is able to identify the album information to tell the user who the author is and simultaneously allow them to directly purchase the content. The sound is captured about for 20 seconds and is then sent in digital format to an Internet server, where it is compared with a database of songs to find similarities and return a result (title, album, singer, lyrics, etc.). A similar system, processing the data in the cloud and delivering a result, is used by the Google AR product known as Google goggles. Among its features is the ability to provide information about any monument, translate texts, read labels on wine bottles, download information from a picture in a museum, etc.

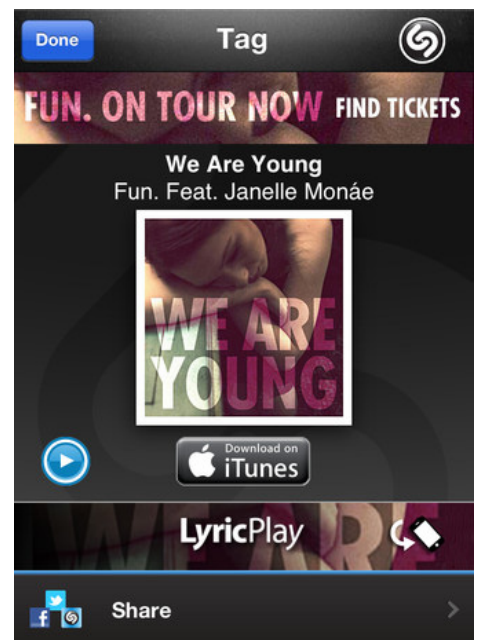
▶ **Marker-less direct recognition:** This mode is by far the easiest to use as it is based on live image recognition in real time. Any image or object is susceptible to being digitized to provide a digital identity that permits it to be recognized. Once this has been done, a user simply approaches it with their mobile camera and an AR application can identify patterns that shape it and display information or media, or project an image of a 3D object to enrich it. At the latest Mobile World Congress in Barcelona in February 2010, David Doherty from 3G Doctor, showed a proof of concept which involves simply focusing a camera on a medicine bottle to obtain information about its use and potential contraindications. In August 2010, about 550,000 Germans had the latest edition of the Sueddeutsche Zeitung magazine sent to their home. This is the first magazine that can interact with AR content simply focusing a mobile camera on printed images.

These are just some examples of how this new technology is being integrated into daily life, but they offer an idea of how the market is evolving. It is true that the market is still in an early phase, but the possibilities that begin to appear are endless and point to the birth of new services designed to improve one's perception of reality.

Figure 2: Example of 2D code



Figure 3: Example of Shazam Application



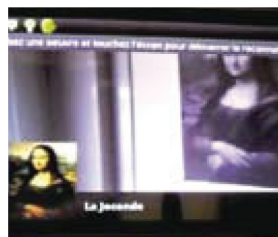
Use cases

Current efforts to develop Mobile Augmented Reality services are focusing on marketing services and entertainment, but as greater use develops among users, advertisers understand better how to use the medium and technology becomes more mature, it will gain a foothold in other major service sectors and will likely be found incorporated into the business processes of many companies.

Today, there is a great diversity in regard to the actual application of technology in the real world. There are no written rules of how to use it and already there are several scenarios where AR has been found to provide clear value to the user:

- ▶ Showing the price of an item of clothing and the level of stock in the store.
- ▶ Checking the technical specifications for a vehicle and its price from different dealers.
- ▶ Enhancing the tourist experience with contextual information about buildings and monuments (Figure 4).
- ▶ Knowing the store and stock position of items stocked.
- ▶ Marking shops that offer more loyalty points and their best deals.
- ▶ Submitting social information (a Virtual ID): email address, LinkedIn, Facebook, etc.
- ▶ AR can also enhance information via the simulation of 3D elements projected over surroundings.
- ▶ Animating the illustrations in textbooks, magazines and classifieds with interactive content.
- ▶ Displaying virtual ads on the facades of buildings and deals on store sideboards.
- ▶ Trying virtual shoes or sunglasses on one's real body
- ▶ Learning with videos that incorporate the cooking instructions for a food package or how to assemble furniture.
- ▶ Participating in social games by locating people.

Figure 4: Atos Worldline Louvre Museum Concept Mobile App

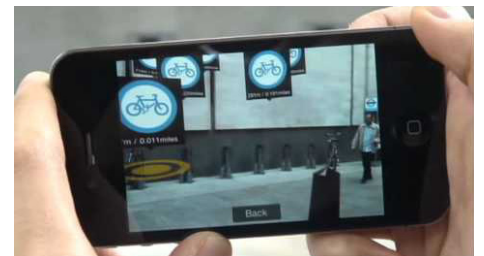


And finally, AR helps people make decisions in a simpler way from a few years ago, by:

- ▶ Showing the pharmacy that is closest and indicating how to get there.
- ▶ Drawing the virtual route of the road whilst a user drives on the real road.
- ▶ Guiding the user in the supermarket to a specific product.
- ▶ Indicating where and in what direction the nearest public service office is and checking opening times.
- ▶ Indicating where the nearest city bike can be found (Figure 5).
- ▶ Showing the way to the assigned gate when transferring at an unfamiliar airport.

In summary, in a very short time we will see how we can make some of our daily activities more comfortable thanks to some of the possible applications of this technology.

Figure 5: Example of parking bike searching in AR



Market forecast

Currently, the success of Mobile Augmented Reality relies on two main elements; the availability of smartphones that incorporate all required capabilities and user communities providing applications and content that others may find useful.

The increase of application stores amongst both OS vendors (iTunes App Store from Apple, BlackBerry App World, Nokia Ovi Store, Google Android market, etc.) and network operators, allied to a steady rollout of Augmented Reality-enabling technology on smartphones, will lead to a greater number of Augmented Reality Apps being made readily available to end users, and to subsequent rapid increases both in the levels of adoption and service usage.

The following figure (Figure 6) shows how the total number of augmented reality applications published by Apple's AppStore per month is holding steady, starting in mid-July when the first smartphones with the necessary technology were available, with considerable growth in mid-2009 with the launch of Apple iPhone 3GS. On average, there have been 35 augmented reality applications published every month in the first half of 2010.

There is no doubt about the continued development of the market for Mobile Augmented Reality over the next years and several consultants, like ABI Research and Juniper Research, predict an exponential growth over the next five years.

According to the ABI Research study, 'Augmented Reality: Adding Information to Our View of the World', from October 2009, handheld platforms will transform the Augmented Reality ecosystem, with revenue associated with Augmented Reality growing from about \$6 million in 2008 to more than \$350 million in 2014. As advertisers learn to insert tags into navigation displays, mobile advertising revenue will grow slowly, representing a large portion of revenues in the sector in the 2013-2014 timeframe.

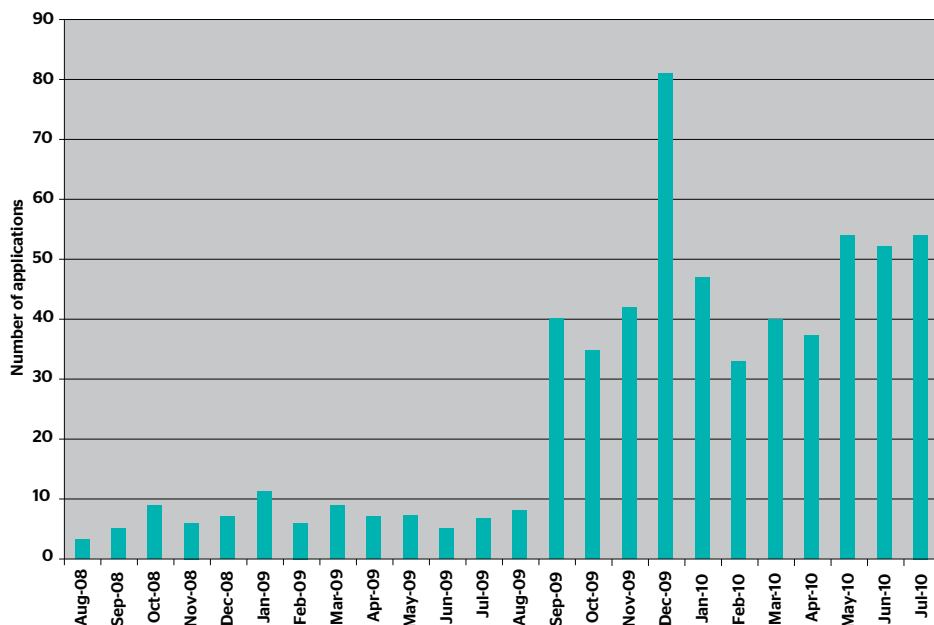
The report by Juniper Research, 'Mobile Augmented Reality - Forecasts, Applications & Opportunity Appraisal 2009-2014', from November 2009, states that the market for mobile-augmented reality services will reach \$732 million by 2014, up from less than \$1 million in 2009. These revenues will be largely derived from paid application downloads, subscription-based services and advertising. This prediction can be shown in the following figure in which the total Mobile Augmented Reality market is split by three revenue streams from 2010 to 2014. (Figure 7) Initial service adoption will be driven by applications based on location-based search, and revenues from mobile enterprise solutions will increase considerably from 2012 onwards, once enough Augmented Reality-enabled handsets are available. This prediction is based on the availability of at least 350 million of smartphones.

Figure 7: Market Growth (in \$m) in Mobile Augmented Reality 2009-2014



The report noted that incremental revenues from subscriptions, up-sold content and licenses would together compose the largest AR revenue stream by 2014, overhauling point-of-sale revenues.

Figure 6: Number of Augmented Reality applications published in AppStore by month



(Source: www.augmentedplanet.com)

Business opportunities

Most of the applications based on Mobile Augmented Reality available nowadays are designed to enhance communication with the real world, aligning perfectly with the new Context-Awareness Computer technology wave. Smart Cities could be an interesting example; live sensors automatically send environmental and facilities status information, citizens act like sensors and send real-time feeds about traffic, emergencies or social information directly from their mobiles, and public workers give real-time feedback from their tasks, all ultra connected, mixed and presented in an easy way to the on-the-go end user, allowing them to take better decisions and to be more efficient with time and life.

More 'efficient' is a trendy topic in companies that aspire to survive in this globalized world. The necessity of interaction with their surrounding has normally been notably different to that of consumer markets. Currently, mobile phones can interact with ERP or CRM systems to boost business procedures by moving the information to where the user is and making it always available. The next step will consist of expanding this interactivity adding recognition and location capabilities to take business workers to the next level. They will have a powerful tool that will allow them to see, feel and hear better than with human senses, turning the mobile phone into an extension of themselves. This means they may dynamically interact with assets, objects and people, sending and receiving automated contextual information from devices, delivering new tangible benefits to enterprises.

The opportunities introduced by this technology are enormous. Many applications and services are currently emerging in all sectors. The following explains some of these and their business models in different sectors as a reference for inspiration for a second generation of applications:

Public Sector

This is one of the sectors where many applications are currently being developed. The main reason is that there is a huge amount of information available and Mobile Augmented Reality offers the possibility to provide all this information easily to citizens to improve their quality of life.

Some examples were provided above regarding improving travel experiences in the city using public transport. However, many new applications can also be identified: locating the nearest citizen facilities, providing relevant tourist information about a sight, monument or museum (Figure 8), even allowing the user to see on their mobile screen what that site was at any given moment in the past, providing a map or the ability to see through the camera the nearest public offices with their opening times, offering additional information from a code inserted in a book as part of a game that facilitates learning and encourages study, etc.

Figure 8: Tourist AR Mobile app for Diputación Provincial de Málaga & Orange, developed by Tempos 21, the Atos Mobile Company



Urban management will be another interesting area for the incorporation of this kind of technology: inventory, control, tracking and reporting. Additional capabilities could be incorporated into the mobile devices of task field forces to increase the productivity of their procedures: Which rubbish containers are full and need emptying? How many lamps need changing in this street? Where exactly is that broken swing? The answer will come easily if the worker can see it on the screen of their mobile phone.

Telecom

Mobile operators are the primary responsible entity ensuring consistency and interoperability between sensors, devices and networks. They will have an important role in the value chain to provide better network performance and services and to try to capture data plans and content revenues to grow ARPU (Average Revenue Per User). Today, devices that are not connected aren't interesting. Recent movements in terms of flat-fee limitations indicate that mobile operators are aware of this.

Media & Entertainment

This sector provides many opportunities mostly related to the gaming industry and the new experience that users can have using this technology to play in a real-world environment, interacting with real and virtual objects. They may play games for fun or use their smartphone to bet in real time with odds adjusted in real time.

Location-based marketing (when you need it, where you need it), together with the inclusion of interactivity in printed ads in press, magazines, catalogues, posters, etc. and on TV will be another area of growth in this sector, bearing in mind that it is a key area of investment for advertisers.

Energy & Utilities

Workforce management applications for operations and maintenance will be fed with real-time data from sensors to complement the information needed by workforce teams in the field. The inclusion of this additional information and the virtualization of manuals for maintenance will be the first services incorporating augmented reality. In this case, devices will be smartphones and also new tablets with a wider screen.

Another application that will benefit from this new technology is the mobilization of data from the CRM system for the sales force. Client data may be superimposed on the screen of the sales person when meeting that client.

Finance

The first applications in the finance sector are around marketing campaigns with customers:

- ▶ Providing the locations of offices and cashiers closest to the customer along with additional information, such as the distance from the customer, whether it is open and a possible meeting time.
- ▶ Facilitating access to the redemption of the rewards obtained from credit card loyalty programs for clients subscribed to them. Some of these rewards may be used directly in shops with offers superimposed as advertisements on the screen of the client's mobile.
- ▶ Adding interactivity to printed content with personalized information.

Most of these applications can be created by incorporating information in specific mobile applications or creating layers of information for third-party application providers (Layar, Junaio, etc.). Many banks are already testing these technologies in order to be early adopters once the technology and the market are ready.

Industry & Retail

A shop can reinforce the sale of its products by providing enriched information about them. Several examples can be easily thought of: placing a piece of furniture in its final location, providing a recipe to cook a meal and showing where the ingredients can be found in the shop

and the total cost of the recipe, showing how clothes fit and changing the color of the fabric with just one click to see which looks best, virtual offers in window displays, etc.

In addition, businesses could integrate this technology into sales supervision, stock control or asset inventory and location. At the moment, SAP Business Objects is working on a project to build an 'augmented corporate reality' prototype.

Health

Imagine a patient who has to take 20 different medications per week, now imagine how a camera phone (without the need for barcodes, text entry or NFC) can ensure they comply with their meds and never forget whether they've taken them or not (because it time stamps and can even video record every time it sees the meds). Move this scenario to a hospital where nurses have to know at every moment which and how many medications a patient needs and if they are up to date. Then think of a corridor full of rooms with a lot of patients. This technology could improve the accuracy of tracking tasks by offering information in real time about all patients in every room and their needs.

Augmented Reality Issues

It is clear that Mobile Augmented Reality will provide a huge number of opportunities in the coming years with many new services in all sectors, but it is also evident that providers should carefully consider the potential legal implications of enabling such services.

The main difference that augmented reality introduces with respect to existing applications is the provisioning of content from different independent sources, in many cases anonymous, which changes frequently. This situation is different from that of a single authority that controls the accuracy of all virtual information associated with a physical location. Imagine that someone wants to sell their house and someone else with whom they don't get on

associates virtual negative information with the information about the house that can be accessed by anyone. If someone geotags information about another individual, is that against their privacy or it is part of their right to freely express themselves? This is one of the main threats introduced by this technology that is not currently regulated. And while this may affect people's privacy, it may also affect businesses that depend on the information being provided. The possibilities introduced by the technology are huge, but negative use by criminals or terrorists can also introduce new sources of concern for governments if it is not regulated or controlled. Security is therefore another critical issue when using augmented reality.

Mobile Augmented Reality as any new technology is something that can affect anyone even if they do not use it. There are a number of analogous cases that have existed for a few years; social networks where people can upload photos and tag any information to them. Mobile Augmented Reality applications and services will have to learn from similar situations and the use of other technologies while there are no concrete laws regulating it.

Conclusion

Atos sees augmented reality becoming a part of everyone's reality in the next few years, transforming mobiles into advanced sensors and lives into connected networks. Augmented Reality Services will emerge from different sectors crossing over current niches to generate direct benefits to users, businesses and workers. Because users will need to download contents and information from the Internet, network performance and cost will be key. Indeed, the last market changes in flat-rate contracts may slow down AR adoption.

Despite the need for standardization, it is unlikely to occur in the short term as the fight between technologies has only just begun. And until a privacy regulation that makes the medium more secure and clear is created, for which it is advised to wait, different cases will emerge that will highlight the limits of the technology.

Atos also expects that the natural evolution of the technology will transform the mobile device into a router for other Augmented Reality peripherals, like glasses or car windshields, integrating different Context-Enriched Services that will be born in the next years.

About Atos

Atos is an international information technology services company with annual 2011 pro forma revenue of EUR 8.5 billion and 74,000 employees in 48 countries. Serving a global client base, it delivers hi-tech transactional services, consulting and technology services, systems integration and managed services. With its deep technology expertise and industry knowledge, it works with clients across the following market sectors: Manufacturing, Retail, Services; Public, Health & Transports; Financial Services; Telecoms, Media & Technology; Energy & Utilities.

Atos is focused on business technology that powers progress and helps organizations to create their firm of the future. It is the Worldwide Information Technology Partner for the Olympic and Paralympic Games and is quoted on the Paris Eurolist Market. Atos operates under the brands Atos, Atos Consulting & Technology Services, Atos Worldline and Atos Worldgrid.

For more information, visit: atos.net