THE AUGMENTED REALITY AND ITS ROLE IN THE FUTURE OF E-COMMERCE AND E-MARKETING

Jorian Hendriks (389334)
Richard Blok (351107)
Tim Kahlhofen (383644)

Table of Contents

Introduction

The digital world is one of the fastest developing industries in the world. Technological advances are unstoppable and technologies which were considered futuristic a few years ago quickly become part of one's everyday life. Today, in a world where interconnectedness and digitalization are higher than ever before, the ever question emerges where this fascinating journey will take society over the next decades. Many experts consider augmented reality as one of the pillars for the future of e-marketing and e-commerce. Augmented reality (AR) is the direct or indirect view of the physical world that has been enhanced with digital information aiming to enhance the user's world by adding additional information to one's direct and indirect surroundings. This paper will primarily summarize the different forms and devices using AR. Afterwards different types of AR interaction including real life examples will be evaluated. These findings serve as a foundation for determining the key criterions for making AR devices attractive for public demand.

Forms of Display

The different types of displays using augmented reality can be categorized in the three main groups, which include head mounted-, handheld- and spatial displays (Carmigniani and Furht, 2011). All three of these displays have their advantages and areas of application.

Head mounted displays allow individuals to wear a device that computes augmented reality on the physical world directly on their heads. This allows hands-free usage of augmented reality. These head mounted devices use either video see -through or optical see-through technologies. Video see-through uses two cameras to provide a vision of the 'real' world. Augmented images are projected on the recorded world by using these two camera's. Optical see-through head mounted devices use a transparent lens and project an overlay with information.

Figure 1. The Oculus Rift and the HTC Vice are two examples of head mounted displays

Handheld devices (mobile phones, tablets) allow individuals to use a technique called video see-through to project information on the physical world by looking through the camera used by the phone. All modern smartphones, android or iOS, are able to use these technologies.

Figure 2. The new Pizza Hut App blends the iPhones camera image with its virtual navigation information

Spatial displays use still standing devices on which the augmented reality is projected. Key technologies involved in this process are image recognition, beaming and holograms. Examples of such still standing devices are mirrors and windshields.

Figure 3. BMWs new heads-up displays project virtual information of the cars windshield

Types of Interaction

The first form of interacting with the augmented reality is the usage of a tangible interface to project AR on the real world. This form of interaction uses physical items to add virtual information to your surroundings. Supplementary wristbands and gloves can be used to give users additional information of

real world objects by touching or scanning their surrounding. Interfaces can easily be controlled with slight wrist or finger movements by using this technology.

Secondly, there's a collaborative interface, which uses a multitude of displays to create a collaborate-like workspace. Simple usages of this are Skype and Facetime, which allow for videoconferences between people on different devices and screens. Future applications for this form of interaction will try to create an even bigger shared workspace (Regenbrecht, 2002).

There's also the usage of hybrid systems, which use a multitude of different devices using augmented reality to deliver as much useful information as possible to simplify the users work. An example of a hybrid system is using a phones GPS in combination with a head mounted device to find your location more accurately than solely using GPS.

The fourth and currently most popular form of interaction is the multimodal AR interface (Carmigniani and Furht, 2011). This form of interaction allows the device to read popular forms of language and behaviour like gestures, touch and speech. Modern examples of the usage of this interface would be Apple's SIRI and Microsoft's Kinect, which uses hand gestures and voice commands to navigate through its interface. This hand gestures are recognized by build in cameras, and the voice commands are programmed to recognize common language behaviour.

Mobile vs Stationary Devices

There are fixed devices, standing in one location, and mobile devices which can be carried to different places. Some are only suited for indoor purposes, some for outdoor purposes, and some for both. Mobile devices are currently getting more and more popular, while fixed systems have been rather unsuccessful in the past. An example of a stationary device could be found in H&M stores, which allowed customers to try on products virtually. However, due to inaccurate technology, which resulted in poor product display, the campaign was unsuccessful. Mobile systems benefit from enormous versatility and fulfil numerous purposes, while stationary systems generally serve only one purpose, which requires flawless functionality. As the technological development is lagging behind, the expectations towards such a specialized stationary device often exceed its actual capabilities. This doesn't mean stationary devices have no future. It implies that implementation should be delayed until technologies, like movement tracking and image recognition, have reached commercial viability. Mobile devices, where customer expectations are generally lower and mobility is higher, will therefore have a higher chance of being used commercially in the near future.

Nevertheless, also mobile AR technology also constantly need to develop to cope with the technological advancement. The technological benchmark and customer expectations continuously rise. Every industry has its own challenges for AR devices and therefore diversification and versatility will be critical in the coming years.

Areas of Application

Advertising & E-Commerce

Most company's use AR with the goal to promote their new products on the internet. Customer can upload personal content using image uploading or live-video streaming to allow users to virtually 'try on' a product. This can not only boost sales, but can also significantly lower the number of returns resulting in higher profitability and a better customer experience (higher customer loyalty).
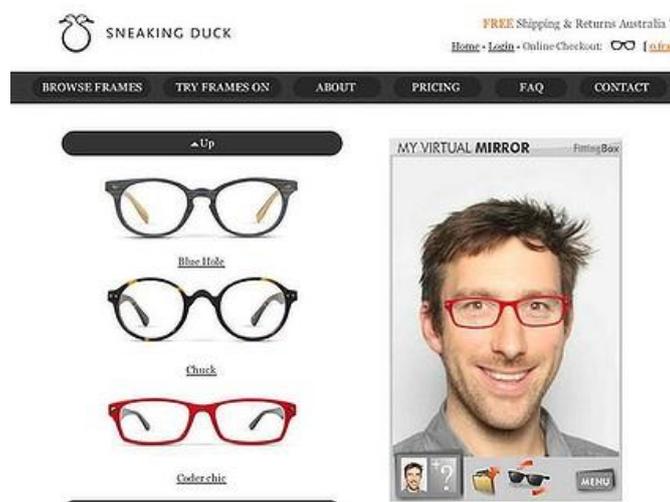

Figure 4. The Australian retailer "Sneaking Duck Eyewear" allows customers to virtually try on glasses before placing an order

Figure 5. The iOS App "Artelia 3D" allows consumers to visualize e-commerce products in their future surrounding

Also the offline retail industry benefits from AR, which is replacing the need to physically try on items from stores. This speeds up the shopping process and saves costly employee time. As customers can try on more items in the same time period, purchasing volume can increase. However stationary AR devices at offline retailers require further technological improvements be fully used in advertisement and mass-markets like fashion. Perfect product display is a key requirement. Colour display is also critical and colour differences between AR and the actual product are not acceptable.

However, not only customers benefit from augmented reality. Also producers benefits from this new technology. Prototype construction is a time-consuming and capital intensive process. Often a new prototype has to be built to visualize a new change. CAD Design has already boosted efficiency. AR can now build on and extend this optimization process. "The Institute of Industrial Technologies and Automation of the National Council of research of Italy works on AR and VR systems as a tool for supporting virtual prototyping" (Carmigniani and Furht, 2011). Physical prototype construction can now be reduced to a minimum.

Entertainment & Education

AR also plays a key role in entertainment and education. More and more companies are using AR with sightseeing and even guidance at cultural sights (e.g. museums). The Petronas twin towers, a major tourist attraction in Kuala Lumpur, also make use of this. The tourists take an elevator to the top of the building where they can enjoy the view. To make the attraction more entertaining, informative and interactive, AR elements were added. In figure 6 tourists can their ticket and their smartphone to see the layers of the Petronas Twin Towers in 3D. Tourists can therefore experience the architecture of this attraction through a completely new perspective.

Figure 6. Using augmented reality tourists can view inner layers of the Petronas Twin Towers in 3D

Also in school and university, mobile devices can make us of AR and transform a monotone class or lecture into a trilling atmosphere. There is a thin line between distraction and education, but if used correctly, AR can significantly enhance the educational system.

Figure 7. Dinosaurs and star wars characters can be virtually displayed in class to make education more interesting and interactive

Another interesting real-life AR example, is the virtual cave guide. It reconstructs old ruins and cave paintings on the persons smartphone. Within seconds the tourist receives precise information about the object he or she is currently viewing. Not only is the need for a human tour guide eliminated, but tourists can now also choose which objects there want to receive information about. This has been difficult in the past when following a guided tour with a large group of people. While a private tour guide quickly becomes a costly experience, an virtual AR tour guide comes at a much lower price and a 24/7 availability.

Figure 8. Images of cave paintings can now be enhanced with virtual information

Medical Applications

Also the medical industry is currently experiencing a breakthrough with AR technology, where the applications deal with robot assisted and image guided surgery. These medical applications help to visualize in-body processes. AR is providing advantages in surgery such as improved precision, dexterity and visualization as showed in figure 9. Surgical teams can now drill smaller holes and follow the entire operation on LED screens. Endoscopic cameras have started this development on which AR is now building. The goal is to minimize patient discomfort and the risk of infections and scars. AR displays can also incorporate information of the patient's medical history allowing the doctor to make more educated decisions in less time. Success rates will also rise in the long-run.

Figure 9. A surgeon making use of AR to have a clear visual of the inside of a human body

AR helps neurosurgeons to visualize the brain in 3D scans which is bringing a huge innovation to brain surgery. Neurosurgeons can prepare for surgery by looking into the brains of a patient before they begin the operation. Surgeons see the brain, blood vessels, the skeleton and even the targeted tumour on a tablet. The surgeons can move the tablet around the patient head, giving them the opportunity to choose the best surgical path (Gorman, 2015).

However there is also a downside to this medical advancement. AR limits the doctor's natural intuitive because they now also need to deal with what is on the screen. Many doctors are currently training to operate using eye-sight. There has to be a significant amount of retraining before AR will be present in every operation room. In the future, AR is also supposed to be utilized to treat psychological disorders. However, brain-activity tracking technologies are not fully developed yet and privacy concerns are currently still high. Additional data and information also comes along with higher responsibility for confidentiality.

Apps & Games

Also existing mobile applications (apps) are incorporating AR. Examples include App which are used for navigation and/ or information. The application "Geo Travel" shows information about the surrounding on a mobile phone. It uses GPS to track the position of a user and compass, accelerometer and accesses the Wikipedia data set to give out information such as longitude, latitude, distance, history and points of interest (Reality and Vincenzi, 2015). Also finding ones parked car is not a problem with GeoTravel. The user simply saves the position where they have parked their car, and can get back by the use of AR technology.
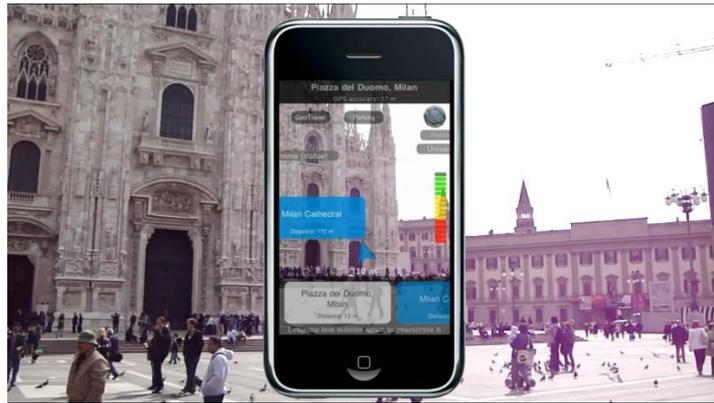

Figure 10. The App "Geo Travel" acts as a visual tour guide

When GPS however is not accurate, some problems may occur when using AR. For example places or items that need a tag next to it. If the GPS is slightly off, the tag will appear somewhere else on the screen and it can become confusing and unorganized. Incorrect navigation can also redirected to a different place. However, also the GPS technology is being improved and new technologies are already being developed.

Game developers are also starting to embrace AR because many believe it is the most important innovation in gaming for the future. AR allows consumers to play a digital game in the real world, adding a new exciting element to gaming. When you walk outside and just see a normal field of grass, thanks to AR the user can see all sorts of characters on the grass field. As shown in figure 11 a normal day at the office can become an exciting game on your break using magic leap. Magic leap uses 3D spatial mapping with obstruction technology and apparent reflections of virtual objects interacting with real objects (Magicleap.com, 2015).

Figure 11. The enterprise "Magic Leap" is already programming games which take place in the physical environment of the player

Key Criteria for Future Success

To make augmented reality attractive for the general public, there has to be flawless interaction between the user and the device. Augmented reality can be used for several purposes, and therefore there are several ways of interaction with augmented reality, some more successful than others. The significance on each criterion can vary depending on what the application will be used for.

An important criterion for ensuring that AR will be success is social acceptability. Using the Apple Watch as an example, people found and partially still find it bizarre to use a watch for the same tasks a smartphone is normally used for. In some cultures it considered rude to have phone calls in public. Society had privacy issues when the Google glasses were announced, and getting a call while you're talking to someone can be disruptive and distractive. Therefore, the AR technologies should slowly make their way into the day-to-day life of people. Adjusting norms and viewpoints and be a time-intensive process and here a subtle market implementations will give people more time to adapt. Perfect functioniality is also key for convincing new individuals. A product that doesn't work flawless would make it feel awkward and reluctant to use in public. Users should be proud to present their new AR device in public. To snowball-marketing affect caused by pure word-of-mouth recommendation is often underestimated. Design is also key for easing public acceptance. There have been a lot of head mounted devices in the past to test augmented reality, but they had no fashionable design whatsoever. In a time where many devices are reaching technological maturity, design is often the key differentiating factor. Again an elegant design is essential for ensuring the public will consider these devices as normal.
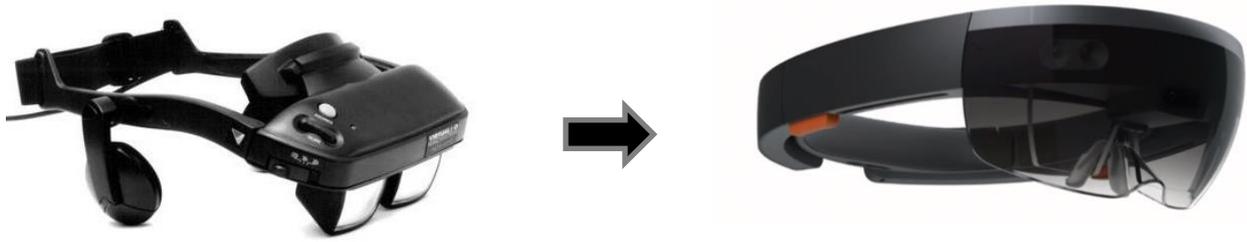
Figure 12. Head mounted displays are given a fashionable futuristic look to increase public acceptance.

Another important criterion for augmented reality is to either share information when desired, or kept personal if the user wishes to. A lot of the recently researched AR systems focus on variable privacy levels. For example glasses or contact lenses allow very personal use, but there is no possibility to share any information with other people, because it's a head mounted device. On the other hand, there are AR systems that project information for everybody to see, which neglects any room for private purposes. A successful AR system should be able to switch between these options.

Affordability (similar to the first computers and first mobile phones) – only an affordable price will make the product suitable for large-scale public demand. An example is the developer kit for the Microsoft HoloLens available in 2016 with a price of $3000. While this product is still in development, the possibilities for economies of scale are still limited at this stage. For this reason the price is currently still unattractive for the general public (Kuchera B, 2015). Cost-efficiency and scalability are essential in the next years.

The last criterion for a successful AR system is technological advancement. A major reason why current AR devices are often rather unsuccessful is a lack of flawless working tracking technologies for the movement of the human body. Even now this technology is under heavy development, but with the use of complementary objects (like a green sock to better track the users feet for fitting virtual shoes) there is great improvement in tracking technologies. Fixed systems allow these technologies to work even better, because they allow for more controllability in the environment. Mobile devices can use visual tracking just like the fixed devices (which is even harder to use outdoors), but to complement that they can use GPS tracking, as well as gyrometers and other tracking technologies available on every modern phone to improve tracking a certain object or location. Combining all these forms of tracking technologies and creating a hybrid form of tracking allows these technologies to be more successful in the future. To make AR successful, there has to be continuous improvements of tracking technologies.

Future Outlook

The future of augmented reality has a lot of possibilities. But what we can observe is a general trend towards mobile augmented reality systems. These systems could either be mounted to the head, like glasses or contact lenses, or they could be applications on phones. There are a lot of shared visions for virtual fitting rooms, replacing the need to fit clothes in stores. This technology is already being used for fitting accessories like glasses, but has yet to be successfully developed for full body clothing. Glasses and contact lenses will be able to provide an informational personal experience for users. Microsoft is researching the use of holograms, while Nintendo is close to releasing their first big game using augmented reality.

More medical possibilities with augmented reality will be developed, and AR might even help people that cope with bad sight or hearing by giving visual or sound clues (Carmigniani and Furht, 2011).

The future of AR will also find ways to aid us in our everyday behaviour. Head mounted devices will be able to monitor driver awareness, and tell us when it's a good time to stop. Future technology will even make it possible to drive autonomously by the help of recording countless amounts of real time images using augmented reality (Murphy-Chutorian and Trivedi, 2010).

Lastly, future augmented reality will hold possibilities for new applications that haven't been seen before. AR will be able to support warfare by making it possible to send maps and other information to soldiers' direct field of vision. Also waypoints and friendly forces could be shown by the use of AR (Prigg, 2014). The same technology will be used for spacecraft in the future. Instructions will be send to the astronaut's field of vision for maintaining and repairing space shuttles. Astronauts can also send back live feedback to a more knowledgeable person and video instructions could be send to help out the astronaut. This would save a lot of time and money on training ground training for missions in space (Tilley, 2015).

Conclusion

All in all the development of AR in the last years is very favourable. Every major technology has required extensive testing and continues development before being successful. The course is set for AR and a vast number of industry experts are confident that various forms of AR will become an inherent part of society in the upcoming years. It is now the job of industry leading companies like Google, Apple and Facebook (Jewish Business News, 2015) to further drive this technological shift. Smaller and medium sized businesses can secure themselves a competitive advantage by adapting to this new technological early on. Consumers should also be open-minded to this new technology to facilitate a market introduction. AR provides a vast number of benefits to everyone and we can be optimistic about the future. E-Marketing will change and Augmented Reality will be one of the key drivers.

Works Cited

Carmigniani, J. and Furht, B. (2011). *Augmented Reality: An Overview*. 1st ed. [ebook] Florida: Springer Science+Business Media. Available at: http://pire.fiu.edu/publications/Augmented.pdf [Accessed 27 Oct. 2015].

Ghoshal, A. (2015). *An augmented reality PokÃ©mon game is coming in 2016*. [online] The Next Web. Available at: http://thenextweb.com/apps/2015/09/10/nintendo-is-making-a-pokemon-augmented-reality-game-with-wearable-device/ [Accessed 27 Oct. 2015].

Gorman, C. (2015). *Kinect + Brain Scan = Augmented Reality for Neurosurgeons*. [online] Spectrum.ieee.org. Available at: http://spectrum.ieee.org/automaton/robotics/medical-robots/microsoft-kinect-fusion-augmented-reality-neurosurgeons [Accessed 28 Oct. 2015].

Jewish Business News, (2015). *Zuckerberg confirms Facebook is working on Augmented Reality*. [online] Available at: http://jewishbusinessnews.com/2015/10/08/zuckerberg-confirms-facebook-is-working-on-augmented-reality/ [Accessed 27 Oct. 2015].

Magicleap.com, (2015). *Magic Leap*. [online] Available at: http://www.magicleap.com/#/home [Accessed 28 Oct. 2015].

Murphy-Chutorian, E. and Trivedi, M. (2010). Head Pose Estimation and Augmented Reality Tracking: An Integrated System and Evaluation for Monitoring Driver Awareness. *IEEE Trans. Intell. Transport. Syst.*, 11(2), pp.300-311.

Prigg, M. (2014). *US military reveals augmented reality system for soldiers*. [online] Mail Online. Available at: http://www.dailymail.co.uk/sciencetech/article-2640869/Google-glass-war-US-military-reveals-augmented-reality-soldiers.html [Accessed 27 Oct. 2015].

Reality, A. and Meixner, M. (2015). *Artelia 3D - Augmented Reality on the App Store*. [online] App Store. Available at: https://itunes.apple.com/us/app/artelia-3d-augmented-reality/id543137431?mt=8 [Accessed 22 Oct. 2015].

Reality, G. and Vincenzi, D. (2015). *GeoTravel™ - Worldwide Travel Guide with Augmented Reality on the App Store*. [online] App Store. Available at: https://itunes.apple.com/us/app/geotravel-worldwide-travel/id365582380?mt=8 [Accessed 28 Oct. 2015]. Reality, G. and Vincenzi, D. (2015). *GeoTravel™ - Worldwide Travel Guide with Augmented Reality on the App Store*. [online] App Store. Available at: https://itunes.apple.com/us/app/geotravel-worldwide-travel/id365582380?mt=8 [Accessed 28 Oct. 2015].

Kuchera, B. (2015). *Hololens development kit will be $3,000, latest stage demo still misleading.* Available at: http://www.polygon.com/2015/10/6/9461791/microsoft-hololens-price-dev-kit [Accessed 27 oct, 2015].

Kuchera, B. (2015). *New HoloLens video isn't shy about the technology's limitations.* Available at: http://www.polygon.com/2015/7/8/8915617/hololens-field-of-view-real-honest [Accessed 27 oct, 2015].

Regenbrecht, H. (2002). *Interaction in a Collaborative Augmented Reality Environment*. 1st ed. [ebook] Ulm: DaimlerChrysler AG. Available at: http://www.sigchi.org/chi2003/docs/interaction_collaborated.pdf [Accessed 27 Oct. 2015].

Sneaking Duck, (2015). [online] Available at: http://images.smh.com.au/2011/10/10/2681364/sneakingduckmain-420x0.jpg [Accessed 27 Oct. 2015].

Tilley, A. (2015). *Forbes Welcome*. [online] Forbes.com. Available at: http://www.forbes.com/sites/aarontilley/2015/03/11/nasa-odg-augmented-reality-in-space/ [Accessed 27 Oct. 2015].

Figures Cited

Figure 1

GIGA, (2015). *HTC Vive vs. Oculus Rift: Welche VR-Brille ist besser?*. [online] Available at: http://www.giga.de/zubehoer/htc-vive/specials/htc-vive-vs.-oculus-rift-welche-vr-brille-besser/ [Accessed 27 Oct. 2015].

Figure 2

Augmented Planet, (2015). *Pizza Hut Goes AR*. [online] Available at: http://www.augmentedplanet.com/2010/05/pizza-hut-goes-ar/ [Accessed 27 Oct. 2015].

Figure 3

BimmerFile, (2011). *BMW to Introduce Augmented Reality Heads-Up Displays - BimmerFile*. [online] Available at: http://www.bimmerfile.com/2011/10/12/bmw-to-introduce-augmented-reality-heads-up-displays/ [Accessed 27 Oct. 2015].

Figure 4

Sneaking Duck, (2015). [online] Available at: http://images.smh.com.au/2011/10/10/2681364/sneakingduckmain-420x0.jpg [Accessed 27 Oct. 2015].

Figure 5

Reality, A. and Meixner, M. (2015). *Artelia 3D - Augmented Reality on the App Store*. [online] App Store. Available at: https://itunes.apple.com/us/app/artelia-3d-augmented-reality/id543137431?mt=8 [Accessed 22 Oct. 2015].

Figure 6

Flickr - Photo Sharing!, (2015). *Petronas Twin Towers*. [online] Available at: https://www.flickr.com/photos/davies/6989590101 [Accessed 27 Oct. 2015].

Figure 7

TG Daily, (2013). *32 Augmented Reality Apps for the Classroom | TG Daily*. [online] Available at: http://www.tgdaily.com/augmented-reality/79430-32-augmented-reality-apps-for-the-classroom [Accessed 27 Oct. 2015].

Figure 8

Edutopia, (2015). *Augmented Reality Brings New Dimensions to Learning*. [online] Available at: http://www.edutopia.org/blog/augmented-reality-new-dimensions-learning-drew-minock [Accessed 27 Oct. 2015].

Figure 9

Helmholtz.de, (2015). [online] Available at: http://www.helmholtz.de/fileadmin/user_upload/allgemein/SurgeryPad_DKFZ_Schnelleinstieg_Wirtsch_250x166.jpg [Accessed 27 Oct. 2015].

Figure 10

Hub.codebaby.com, (2015). [online] Available at: http://hub.codebaby.com/h/i/17353040-insights-on-how-augmented-reality-apps-can-revolutionize-the-way-we-live [Accessed 27 Oct. 2015].

Figure 11

WANT, (2015). *Magic Leap toont dat de toekomst van augmented reality er rooskleurig uitziet - WANT*. [online] Available at: http://www.want.nl/magic-leap-toont-dat-de-toekomst-van-augmented-reality-er-rooskleurig-uitziet/ [Accessed 27 Oct. 2015].

Figure 12

3D Heaven, (2015). *Virtual I/O i-Glasses Personal 3D Viewer*. [online] Available at: http://ep.yimg.com/ca/I/yhst-49619517642657_2267_136267779 [Accessed 27 Oct. 2015].