Technical Documentation in 3D

Using Augmented Reality

Group 2 ▸ TCN 701 ▸ 12/10/2010

Athel Chikove ▸ *Bryn Snow* ▸ *Pamela Meddings* ▸ *Peter Moutsias* ▸ *Aaron Courtice*

Technical Documentation in 3D

Using Augmented Reality

Figure 1: Virtual First-down Line

Introducing AR

Is your technical documentation suffering from lack of adequate visual representation? Wouldn't it be convenient if you could display your documentation in real time, off of the written page and into the physical work space, all in a fully interactive 3D projection?

If you answered *yes* to these questions then we have good news for you. The technology to achieve these goals exists and it is already in widespread use. It is what is known as Augmented Reality (AR).

You may have already come into contact with AR without even realizing it. Technologies such as the virtual first-down line in televised football and the motion-sensitive Nintendo Wii function via AR. These are but two examples of highly successful AR-based products. The field is expanding rapidly within all sectors.

Figure 2: Nintendo Wii

How AR Works

1) Information is gathered from your surroundings.
2) The input information is linked to a database.
3) Output information is virtually displayed back onto your surroundings in real time.

Using AR to Improve Your Documentation: Scenario One

Say you work at creating technical documentation for a famous Swedish furniture manufacturer. Your flagship store is full of customers. The customers stand in long lines to purchase your merchandise. All is good. But you have a problem…

While most customers are smiling now, they will be shaking their fists at your documentation once they try to assemble your product. They will take that two dimensional diagram which falls out of the package, and try to mentally connect what is drawn on the black and white printed page with the pile of clamps, screws and plywood sitting in front of them.

Now, wouldn't it be great if your two dimensional diagram suddenly became animated and grew into a three dimensional image, much like a hologram? Your customers could see exactly what the furniture piece would look like. Just think of how many raging "I always put this thing together wrong" sessions you could help avert by using an AR enhanced instruction manual.

Increased customer satisfaction equals increased sales. Invest a little in AR now and watch your profits grow exponentially.

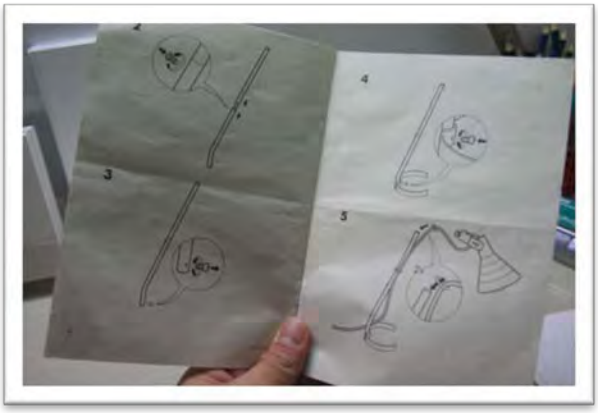

Figure 3: Furniture Assembly Manual

Figure 4: AR Enhanced Assembly Manual

Using AR to Improve Your Documentation: Scenario Two

A young couple is travelling through Rome and they've heard of a great trattoria to get a meal. They've looked it up in your two dimensional travel book, and now they are left wandering the streets, wondering where the restaurant is and what it looks like. Ideally, they need to connect the image in your guidebook with the streetscape in front of them.

Enter AR. Their cell phone camera scans the façades of the buildings they pass and identifies the names and addresses of each establishment as they walk by. Utilizing its built-in GPS in conjunction with your AR-enabled map, the phone can even provide the couple with three dimensional, street level directions to their target location.

The original, two-dimensional guidebook would likely get left behind in a hotel room after a day or two. The AR enabled guidebook, on the other hand, could be considered an invaluable resource for navigating the city.

Figure 5: 2D Map

Figure 6: AR Assisted Phone Map

Have We Captured Your Interest?

We hope that the previous examples have given you cause to consider incorporating AR technology into your technical documentation. Read on for more ideas regarding the application of AR within specific industries.

AR Applications in the Automotive Industry

AR is already being used to help mechanics diagnose car problems and carry out maintenance. Mechanics at BMW wear a head mounted display (HMD), much like sunglasses that project a 3-dimensional information overlay over any part of a car. The HMD overlay labels and highlights the car parts in the user's plain of vision. The system provides the user with step-by-step voice instructions for completing a task, along with virtual imaging to highlight the necessary work areas. AR for mechanical repair will eventually render paper manuals obsolete, saving time and improving work accuracy. (BMW, 2010)

When this form of AR technology becomes readily accessible to consumers, even untrained amateurs will be able to carry out tasks like car maintenance. Applications are already being developed in which users upload relevant workflow files onto their HMD (Metaio GmbH, 2007). Imagine the convenience of downloading an AR workflow online to help with just about any task.

Technical writers would surely be needed to develop thousands XML-based documents concerning workflow.

Figure 7: BMW AR Program (1)

Figure 8: BMW AR Program (2)

AR Applications in Medicine

Projected on patients, AR can be used to visualize and label parts of under the skin such as the brain, joints and the spine. AR has also been developed for positioning implants, placing screws into bones. AR for medical procedures is still under development. HMD hardware needs to become more accurate before it can regularly be used on patients. (Bender, 2004)

AR has seen particular success when applied to simulators, as in the case of child delivery. It is considered to be better than virtual reality simulators. This is because AR allows the user to learn in the moment. (Sielhorst, 2004)

AR in medicine shows enormous potential on the patient and physician end. Existing technologies like online health databases and AR on mobile phones offer exciting prospects for AR in medicine. Online databases like Google health, for example, allow users to upload their entire medical history, including medications they take. AR may someday allow a doctor to apply an overlay on a patient, immediately tapping into online health information, instantly identifying the patient and their needs — all within the doctor's field of view. (Doherty, 2010)

Just imagine: a patient applying an overlay on a medication and immediately obtaining information about the drug as well as its relevance to the patient.

Figure 9: AR Anatomical Projection (1)

Figure 10: AR Anatomical Projection (2)

Military Applications of AR

The development of AR owes a lot to the military. Just think of the fighter pilot HUD. Currently in development is a system of lightweight sensors and displays that collect and provide data from and to each individual soldier in the field. UV and infrared sensors, stereoscopic cameras, a 360° camera, a computer, and OLED (organic light-emitting diode) translucent display goggles make up the system. Wearing a helmet, where the technology is housed, a soldier will be able to communicate with an enormous "home base" server. The information that is collected from the server is then rendered as a 3D image onto the wearer's goggles in real time. This means soldiers can be aware of such things as friendly fire, rendezvous points, impending air raid locations, potential danger spots and more. Various people and objects can be outlined with a specific colour. This "painting" technology acts as a warning.

In Figure 11, a spotter on a roof marks an area danger spot in a red colour for his squad mates. Troops fighting in unfamiliar urban areas will have at their disposal the ability to virtually communicate the location of hostile forces to fellow soldiers. Since local forces will have the home field advantage because they are fighting on their home turf, this invaluable technology should enable opposing troops to overcome that by giving them a better understanding of their surroundings.

Figure 11: AR Target Painting (1)

Figure 12: AR Target Painting (2)

Military leaders can monitor this technology from a central base location. A virtual map of the battlefield with live location data for their troops is viewable to them. Soldiers new to previous battlegrounds will have the benefit of knowing the location of those danger spots. Tanagram Partners, the developers of this technology, is in the process of developing it right now. Funded by a grant from DARPA (Defense Advanced Research Projects Agency), the company plans on having a working model that runs on the iPhone by the first quarter of 2011. In addition, Tanagram hopes to have the server and client in operation by the second quarter, and an open source head-mounted display (HMD) client, by the end of next year. (Cameron, 2010)

AR Applications in Tourism

How does being transported back in time to experience the sights and sounds of ancient time sound? AR blends live and digital images in real time, using a camera and a video screen. It gives you the sense that you that artificial objects are appearing in the physical world. Right now in Switzerland, France, China, Germany, and many other locations, you can view reconstructed images of past landmarks that overlap with current images of those same landmarks. Tourists have the sense of travelling back in time.

The Yuanmingyuan (loosely translated as the Garden of Perfect Brightness) in Beijing, China was lost as a result of armed combat and looting, as has happed to so many other historic sites around the world. This imperial garden, constructed in the 18th and 19th centuries, was destroyed in 1860 during the second Opium War. Today's citizens of China have had to rely on paintings and sketches to see how the beautiful gardens once appeared—but no longer. A team at the Beijing Institute of Technology have created a virtual reconstruction of the gardens. Tourists use a coin-operated viewing platform to view it in augmented reality.

In Berlin, you can use your iPhone or other smart phone to capture images of historic landmarks to see how they've changed over the years, through use of an augmented photo system. The smart phone user is connected through a central server, to a database of photographs covering decades of the city's growth. In essence, your phone overlays digital information on top of reality. A satellite map of the city which can be toured in a similar manner has also been constructed.

Figure 13: AR Assisted Museum Tour

Summarizing the Business-related Benefits of AR Usage

The incorporation of AR technology into documentation, products and services has been shown to increase customer satisfaction and generate increased revenue.

Here are a few key features that AR provides:

- Quick reference to information:
  - Mechanics - can reference simplified instructions of fixing a car including diagrams.
  - Surgery – A surgeon can get instructions while performing surgery on the details of the procedure.
  - Assembly - Instructions can be referenced for assembling complex machines.
  - Tourism – A tourist can locate a building using augmented reality by simply typing one word or phrase on the smart phone.

- Convenience:
  - Advertising – A customer can interact with a product through a web camera.
  - Tourism – A tourist does not have to look for the information centre, it is a matter of pointing at a historic feature with the smart phone, take a picture of it, and details will appear on the screen instantly.
  - Art – an artist can use Eyewriter technique to draw.
  - X-Ray view – A doctor can observe a fetus in the womb with real time images instead of the black and white x-ray images that are not very clear.

- Accuracy:
  - Surgery – can be performed with accuracy because devices can see hidden areas in the body.
  - An orthopaedic surgeon can be able to see the structure of a broken bone and be able to accurately map, construct, and replace the broken bone.

- Gaining an advantage point:
  Is applicable to the military, the fighter pilot can spot the enemy first and take immediate action.

- Customer satisfaction:
  When a customer interacts with a product first and then goes ahead and buy the product, chances are high that the customer will not return the product because they have made an informed decision and therefore satisfied with the product.