

# The Augmented Painting: Playful Interaction with Multi-Spectral Images

Wim van Eck\*

AR Lab

Royal Academy of Art, The Hague

Yolande Kolstee\*\*

AR Lab

Royal Academy of Art, The Hague

## ABSTRACT

Museum conservators and researchers often take multi-spectral captures of the paintings they study, commonly using x-ray, infrared and ultraviolet equipment. Usually these captures are not accessible for the museum visitor, even though they offer valuable information about the painting. Since 2009 the AR Lab has been developing applications which allow museum visitors to explore these special captures in a user-friendly and playful way. This article describes and comments on the different phases this installation went through, and gives a preview of our latest augmented reality project.

**Keywords:** Augmented reality, painting, conservator, Van Gogh, restoration, visualization, user interface, installation.

**Index Terms:** H.5.1 [Information Interfaces and Presentation]: Artificial Multimedia Information Systems—Artificial, augmented, and virtual realities;

## 1 INTRODUCTION

Museum conservators and researchers often take multi-spectral captures of the paintings they study, commonly using x-ray, infrared and ultraviolet equipment. These captures allow them to among others check the condition of the painting, see what type of paint and canvas was used, and sometimes they even discover earlier sketches, drawing aids or completely new paintings underneath the top layer of the paint. Usually these captures are not accessible for the museum visitor, even though they offer valuable information about the painting. Since 2009 the AR Lab, which is based at the Royal Academy of Art (The Hague, The Netherlands), has been developing applications which allow museum visitors to explore these special captures in a user-friendly and playful way.

The article "The augmented Van Gogh's: Augmented reality experiences for museum visitors" [1] by the authors of this article already mentions the first phase of our installation. This article describes and comments on the different phases this installation went through, and gives a preview of our latest augmented reality project.

## 2 PHASE 1: THE DIGITAL SPRAY-CAN

Our first installation was specially made for the Van Gogh Friday Evening event which took place at the 28th of May 2010, organized by and located at the Van Gogh Museum (Amsterdam, The Netherlands). This installation is based on the painting 'The Bedroom' which Van Gogh painted in October 1888, when he was

living in the Yellow House in Arles. Since the painting was in the process of being restored at that moment by the Van Gogh Museum there were many recently made high-resolution captures available, namely infrared, ultraviolet, x-ray, the back of the painting, and photographs with the painting illuminated from the left, right, bottom, and top. Our installation could offer the museum visitor an insight of what was actually happening to the absent masterpiece.



Figure 1: A museum visitor trying the installation

Together with students of the Royal Academy of Art The Hague we created a digitally modified spray-can with which the visitor can 'spray' on the painting which is displayed on a large screen (figure 1). By doing this the visitor temporarily reveals the various captures of 'The Bedroom' (figure 2). Digital buttons located on the right side of the painting enable the user to choose between the various image captures. Using the opensource 'Wiimote Whiteboard' [2] software and a Nintendo Wiimote which is pointing towards the screen we are able to track the position of the infrared light emitting spray-can. Figure 3 shows not only the monitor with the digital painting, but also the tripod on which the Wiimote is anchored.

### 2.1 Using the Spray-can Installation in Practice

We presented this installation on three occasions: at the before mentioned Friday Evening event, during the 'Uitmarkt 2010' (the largest cultural festival in the Netherlands and the national opening of the cultural season) and at the Stedelijk Museum Amsterdam during their 'Play It!' evening which revolved around the latest forms of interactive media art. At all three events the audience responded very enthusiastic, many visitors wanted to see the installation and try it themselves. The visitors were especially fascinated by the x-ray capture and the back of the painting. The x-ray clearly shows all the small nails used to attach the canvas to the frame, and the back of the painting reveals writings from among others Theo van Gogh, Vincent's brother. While one visitor was using the spray-can many others were watching, which

\* w.vaneck@kabk.nl

\*\* y.kolstee@kabk.nl

almost turned it into a performance. We noticed more shy visitors were intimidated by this and would rather just watch.



Figure 2: Revealing the x-ray capture

The huge interest for our installation meant we had to deal with many people assembling in front of the screen and blocking each other sights, and important for us, blocking the Wiimote which is needed to track the position of the spray-can. Also bumping against the tripod holding the Wiimote would result in decalibration of the system. Thus, a crowd of people can easily disrupt the stability of the system. Also the spray-can itself was fragile and had to be handled with care. The performance of the spray-can was best if one would hold it in front of the screen at a distance of roughly one centimeter, in a slight angle so the infrared beams would reflect better towards the Wiimote. This was too much information to communicate to the visitors.

Despite these technical problems The Van Gogh Museum saw the potential of the installation and asked us to develop a more robust and reliable version.



Figure 3: Setup of the installation at the Van Gogh Museum

### 3 PHASE 2: TOUCH-SCREEN USING AN IPAD

Instead of building more robust and reliable hardware ourselves for phase 2 of our installation we decided to choose a device which already proved itself in everyday practice, the iPad made by Apple. This device is rugged enough to withstand everyday usage by museum visitors, and since the device is in general well known many visitors already know how to interact with it. This means the interaction model changed considerably; instead of using the digital spray-can visitors now directly touch the screen with their finger to reveal the special captures (figure 4). This resulted in a less playful, but easier to operate installation. The application is programmed in HTML5 and runs in a browser.

Instead of using the painting 'The Bedroom' the Van Gogh Museum asked us to complement their exhibition 'Van Gogh's studio practice: Canvases re-used', which was on exhibit from 21-06-2011 till 12-06-2012. This presentation examines the different ways Vincent van Gogh re-used his canvases. 'Nude girl, seated', 'Self-portrait with pipe', 'View from Theo's apartment', 'Trees' and 'Basket of pansies' are the five painting which were highlighted during this exhibition. The Van Gogh Museum chose these five painting because they all feature unique research results. One wall featured the real paintings together with printed text and images about the research, a connected wall had our iPads attached to it.



Figure 4: A museum visitor trying the installation

We used five iPads for our setup, one for each painting. This meant each ipad has slightly different options depending on the available captures of the painting. Besides showing x-ray and infrared captures we also added hotspots on the screen (figure 5). When you touch these hotspots you zoom in on the painting, highlighting fine details which deserve special attention. Each layer has an 'information' button which offers the visitor extra information about the current capture, a '?' button on the top right of the screen gives general information on the usage of the installation.



Figure 5: The hotspots on the painting

#### 3.1 Using the iPads in Practice

Also this installation was well received by the museum visitors. To our surprise many visitors actually spend more time interacting with our installation than looking at the real paintings which were exhibited on the other wall, with waiting rows in front of our installation as a result. Compared with phase 1 of our installation

the interaction was more private and visitors spend more time discovering all options. The visitors were waiting for their turn instead of watching together. We conducted a small scale survey to learn how the visitors perceived the installation. In general the results were positive, even visitors not familiar with the operation of an iPad quickly learned how to use the installation, mostly by watching other visitors operate the device. The iPads proved to be rugged enough, the installation was running without problems for a full year. The iPads were placed in a special enclosure to make sure visitors wouldn't switch to another application

#### 4 PHASE 3: TRACKING THE REAL PAINTING

Although our iPad installation was a success we were still questioning how we could improve our product. While the iPad installation was very easy to use we did miss the more playful interaction we achieved with phase 1 of the installation. We also disliked the clear separation between our iPad installation and the real paintings. We questioned if it would be possible to use augmented reality software and track the painting itself as a natural feature, so we can overlay the special captures directly upon the real painting. After some research and testing we concluded the Vuforia tracking software [3] by Qualcomm offers the performance needed, again running on an iPad. For this prototype we chose to use 'The Bedroom' again since we had so many captures of this painting available.

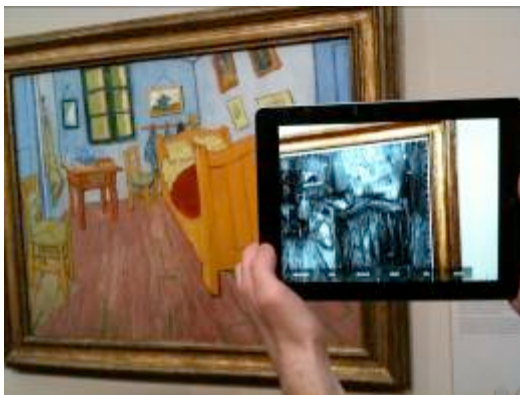


Figure 6: Testing the application at the Van Gogh museum

The resulting interaction is very straightforward, by pointing the iPad towards the painting the software recognizes it and overlays the first special capture upon the painting (figure 6). By moving the iPad closer to the painting you can zoom in on the high-resolution capture and see finer details. A menu on the bottom of the screen allows the visitor to select the different captures (figure 7). Besides x-ray, ultraviolet and the back of the painting we added some new options. Through processing the photographs with the painting illuminated from the left, right, bottom, and top we were able to construct a heightmap of the painting, an image without colour information showing only the height differences of the paint (figure 8). This clearly shows the thick splotches of paint which are very typical for Van Gogh's style of painting. Another new addition is a layer with hotspots which play a pre-recorded verbal narration when touched, which can be used to give extra information about specific parts of the painting. Finally there is a layer with hotspots which allows you to zoom in on a specific part of the painting, revealing for example small cracks of the paint.

At the moment the application only recognizes a single painting, but it would also be possible to include the whole museum collection. This way our application could even function

as a replacement for the traditional audio tour. Instead of walking a pre-determined route or entering pre-defined numbers for each painting one could simply point the iPad towards a painting to identify it and get extra information.



Figure 7: The menu of the installation located at the bottom

#### 4.1 Testing the prototype

Currently we are in the final stages of completing the prototype of our application, fixing the last bugs and adding the final content. We did some early tests at the Van Gogh Museum which showed the tracking of the paintings is very stable. The museum visitors which noticed us testing were very enthusiastic and impressed by the technology, they immediately wanted to try the application themselves. It took few time to explain how to operate the application, it mostly speaks for itself.

Though these first tests looked promising they also showed us some downsides of this approach. Especially at a busy museum such as the Van Gogh Museum there are many visitors standing in front of the paintings, by this blocking the painting for tracking purposes. You can also question if it is desirable to have the museum visitors look at the paintings through the screen of an iPad. Phase 2 of our installation already showed the real painting was getting less attention than our installation, and we don't want to draw the attention away from the beautiful paintings themselves. It is normally also not allowed by the museum wardens to point an iPad towards a painting since it is forbidden to take photographs in the museum. These are some serious downsides we have to take into account.



Figure 8: Heightmap of 'The Bedroom'

## 5 RELATED WORK

A cooperation of the Tangible Media Group of the MIT Media Laboratory and the UCSD, Center of Interdisciplinary Science for Art, Architecture and Archaeology resulted in a project similar to ours called 'Wetpaint' [4] [5]. A Painting is shown on a large touchscreen and the viewer touches the screen to scrape off part of one layer of the painting to reveal the next. A later version featured an aesthetically pleasing easel design.

The 'Holoman' installation [6] by the Ars Electronica Futurelab (figure 9) has some resemblance to phase three of our installation. The visitor holds a piece of frosted plexiglass on which an anatomical representation of the human body is projected. Since the piece of plexiglass is optically tracked the projected anatomical representation corresponds to the height the visitor is holding it in front of their body.



Figure 9: 'Holoman' installation by Ars Electronica Futurelab

## 6 FUTURE WORK

Section 4.1 of this article already showed we still have quite some work on our hands before we can successfully use phase 3 of our application in practice at for example the Van Gogh Museum. This museum might be too crowded, and you are not allowed to walk around holding an iPad. Also having visitors watch Van Gogh's masterpieces through the camera of an iPad might not be desirable.

There are museums however where our application might be more practical, such as a science museum. These museums are generally less crowded by tourists and it might be less of an issue to use iPads within the museum. Instead of paintings we could also enrich other kind of objects. We are in contact with the Science Centre Delft and are planning to conduct some tests.

Another possible solution is to use a replica of the painting instead of the real artwork. This replica could get a less crowded spot in the museum, and there could be an iPad provided for the visitors to use. This would solve most of our present problems. This approach might be tested at Museum Catharijneconvent Utrecht (The Netherlands). Their painting 'Isaac Blessing Jacob' by Govert Flinck, one of Rembrandt van Rijn's most famous students, is currently subject of a large scale research. Delft University of Technology, one of our partners, is planning to make a high-precision replica of the painting. This would be an ideal opportunity for us to test case our application in practise.

## 7 CONCLUSION

The three installations we made certainly show potential. Phase 1 showed us it is possible to present scientific data in a playful way. Phase 2 of our installation was more user-friendly, but still

managed to attract the attention of museum visitors for over a year. Although also phase 3 shows great potential, we still have to solve some practical problems. Using a replica of the painting instead of the real artwork is one of the next steps we are planning to take.

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