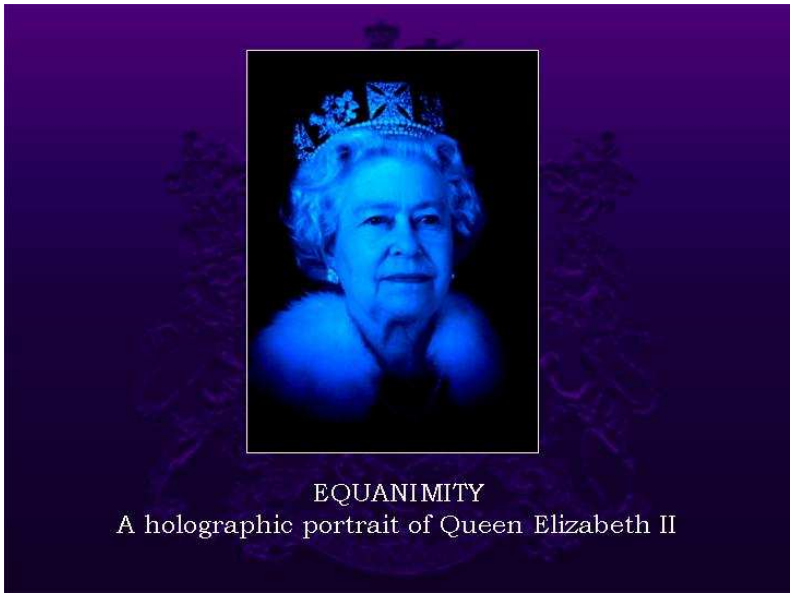
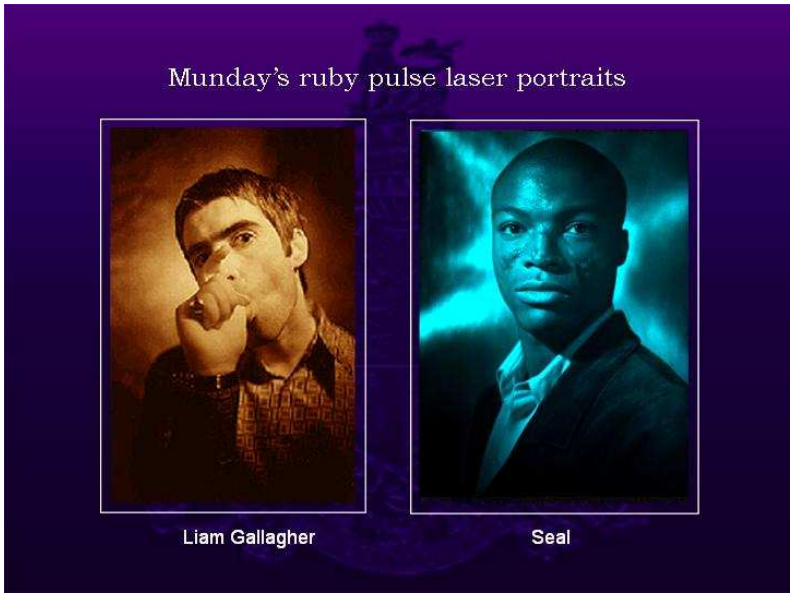
Equanimity
A holographic portrait of Queen Elizabeth II



Background to the project

In 2003, UK artist and designer Chris Levine was commissioned by the Jersey Heritage Trust to record the first ever holographic portrait of Her Majesty Queen Elizabeth II. The purpose of the commission was to commemorate the Island of Jersey's 800 year allegiance to the English Crown. Later that year, in August 2003, Chris Levine in turn commissioned Rob Munday of Spatial Imaging to produce the portrait.

The wheels were set in motion in 1998 when Gordon Young, an artist working with the Jersey Heritage Trust, visited an exhibition in London called HyperVisual. The exhibition, which had been put on by Chris Levine and toured around the world by the British Arts Council, displayed a number of holographic works. These holograms had either been commissioned from Rob Munday as commercial works or were Munday's personal artistic works. In particular, the exhibition featured holographic portraits of Oasis band members Noel and Liam Gallagher *1 and pop star Seal, which Munday had produced in 1994 and 1997 respectively. After a recommendation by Gordon Young, the Jersey Heritage Trust approached Chris Levine in February 2001.



The Jersey Museum was attracted to the idea of using this contemporary medium and subsequently decided to commission a holographic portrait for this historic occasion.

Given the circumstances of the commissioning of the portrait, the project was accepted by Rob Munday on the basis that it would be conducted as a joint and equal creative collaboration between Chris Levine and himself and the project was duly conducted as such. As with all projects of this magnitude however there were several other people who played vital roles in the creation and production of the final work. Of particular importance and very much an equal member of the team was Jeffrey Robb who liaised between Chris Levine and Rob Munday, coordinated the project and offered creative advice and assistance throughout. The fourth key member of the team was American holographer Dr. John Perry of Holographics North, USA.

The initial stages

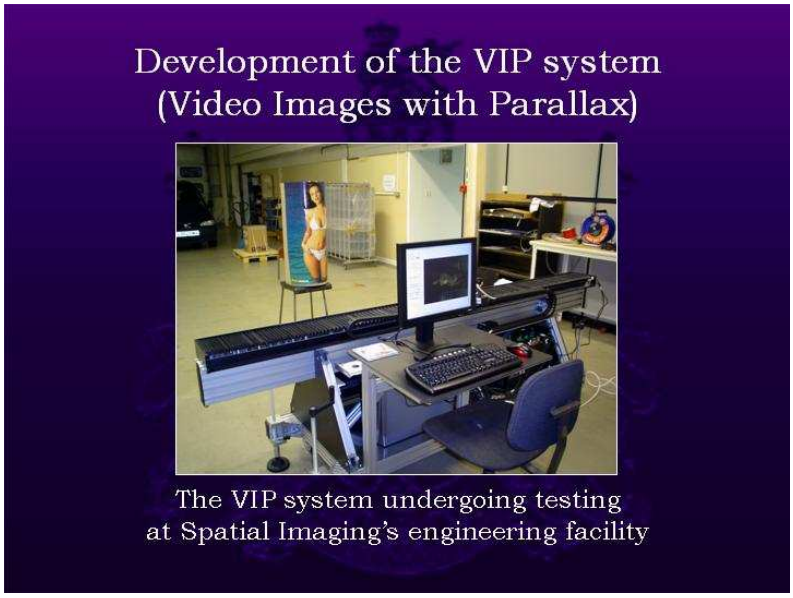
Initial discussions between Chris Levine, Rob Munday and Jeffrey Robb in July/August 2003 revolved around the recording of a pulsed laser holographic portrait using Munday's in-house ruby pulse laser. This however proved impractical due to the short time scale given and the fact that it was unlikely that the Queen would travel to Munday's holographic portrait studio on the outskirts of London, even though it lies midway between the Queen's two primary residences of Buckingham Palace and Windsor Castle. Instead Munday and Robb recommended the production of a holographic stereogram which could be produced from a sequence of photographic parallax images shot at Buckingham Palace. Various options with respect to the production of the final holographic stereogram were considered however the team finally decided to subcontract the production of a 'rainbow' holographic stereogram to Dr. John Perry at Holographics North. This decision was influenced by a highly successful collaboration between Dr. John Perry and Jeffrey Robb/Spatial Imaging in 2003 which involved the production of a large format holographic installation in Tokyo, Japan. It was also influenced by the fact that Dr. Perry could make very large stereograms.

A holographic stereogram portrait is made from a sequence of images taken of the sitter from different positions or angles using a specially designed moving camera. The technique is related to conventional 3D photography except that many more photographs are taken to give the illusion of parallax. A side benefit of holographic stereography is the fact that the resultant 'parallax' image sequences can be archived and used to produce many other types of holograms and three-dimensional images. For example Munday and Robb have subsequently created miniature digital holographic stereograms, high quality lenticular photographs and a full colour, three dimensional animated portrait of the Queen using the latest auto-stereoscopic 'glasses free' LCD monitor technology. It is very likely that the digital image sequences will be used for many other creative applications in the future.

In order to create the required parallax image sequences Munday took the decision to invest in and build a unique digital camera recording system especially for the project. Munday and Robb also proposed utilising the latest computerised three-dimensional head scanning technology from Wicks and Wilson, a UK company, to create a computer model of the Queen's head from which parallax image sequences could be generated at a later stage. Chris Levine also suggested that the model could be used to laser etch a life sized 3D portrait into a crystal glass block.

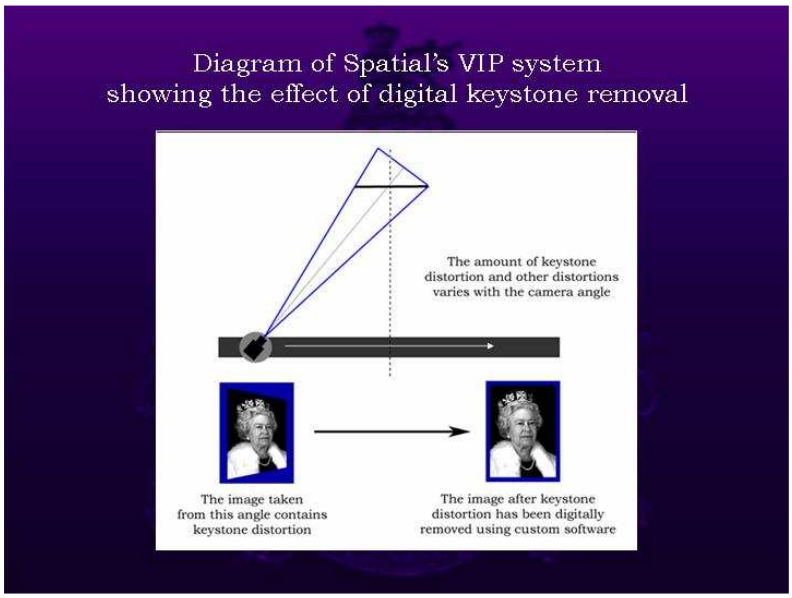
Several meetings followed between Chris Levine, Rob Munday and Jeffrey Robb in August, September and October 2003 to decide upon both the aesthetic and the technical requirements of the work. One such suggestion was to illuminate the stereogram with a vertical array of LED's. This type of illumination creates a sharp, single colour image whilst extending the otherwise restricted vertical viewing aperture of a rainbow hologram.

Development of the VIP system (Video Images with Parallax)



Only six weeks prior to the first sitting Munday embarked upon designing and building the digital camera system which would be used to shoot the images. Munday also embarked on writing custom software to control all aspects the imaging process. The system, which has since been christened as the V.I.P (Video Images with Parallax) incorporated a Pantera SA 2M30 full colour digital camera.

This camera was the highest specification full colour digital camera available and was made by Canadian company Dalsa Corporation. The Pantera camera was capable of outputting 10-bit greyscale images at a resolution of 1200 * 1600 pixels with RGB Bayer filtering at a blistering 30 frames per second. A high speed PCI frame grabber card was used to save these images in real time directly to RAM in a high specification computer workstation.



With respect to camera translation, Munday initially made the decision to employ a traditional shift lens/shift camera technique in order to avoid keystone distortion. It became apparent however that there were also some disadvantages to this method of shooting parallax image sequences and so the system was redesigned and reprogrammed to rotate the camera instead. Rotating the camera introduced undesirable image distortions, which the shift lens or shift camera system would have avoided, however by employing custom post processing software it was possible to reverse the distortions after the digital images had been recorded. After a lot of consideration Munday concluded that this method provided the ultimate compromise between photographic image quality, angle of view and final holographic stereogram quality. The three main advantages of rotating the camera to point towards the subject were that:

1. A superior quality, faster lens could be used rather than a much lower quality wide angle shift lens.
2. There was no reduction in the brightness of the images as the camera moved to the ends of the rail. This would normally be caused by light passing through the side of the wide angle shift lens.
3. The angle through which images could be recorded and hence the final hologram viewing angle was not limited by the travel limit of the shift lens. In other words a much larger viewing angle could be obtained.

Munday used a state-of-the-art linear motor rotational stage which rotated the camera smoothly, at high speed and with extreme accuracy. The rotational stage/camera assembly was itself mounted on a 2.5 meter linear motor rail. This also enabled the camera to be translated in a smooth and accurate manner at high speed. The two stages were electronically 'locked' together in a non-linear manner such that the camera continuously pointed at a particular position in space as it moved along the rail. The linear motor rail was believed to be the longest commercially available in the world and was manufactured, together with the rotary stage, by Anorad Europe in Holland. The entire motion control assembly was then mounted onto a rigid but portable sub-frame that enabled Munday and Robb to transport the system to Buckingham Palace.

The total investment made by Rob Munday and Jeffrey Robb's company Spatial Imaging in developing the VIP system was approximately £50,000 ($95,000).

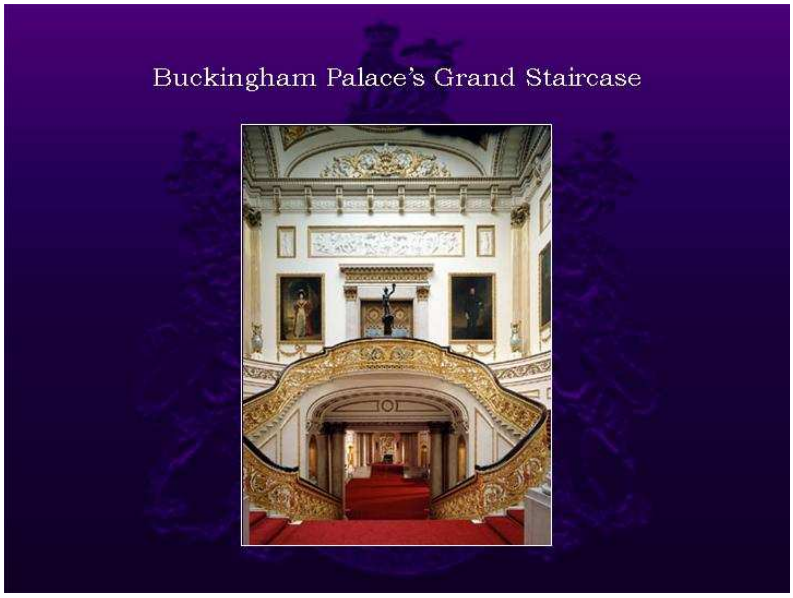
Set up prior to the first sitting

Prior to the first sitting in November 2003 a meeting was held between Chris Levine and Miss Angela Kelly, the Queen's personal assistant, to choose the clothing to be worn by the Queen. Chris Levine chose a royal blue velvet dress, a single string of white pearls and the George IV State Diadem.

This particular Crown is depicted on British postage stamps and coins and was made in 1820 for George IV's Coronation. It incorporates 1,333 large diamonds and 169 pearls and was also worn by both Queen Victoria and Queen Elizabeth at their respective coronations.

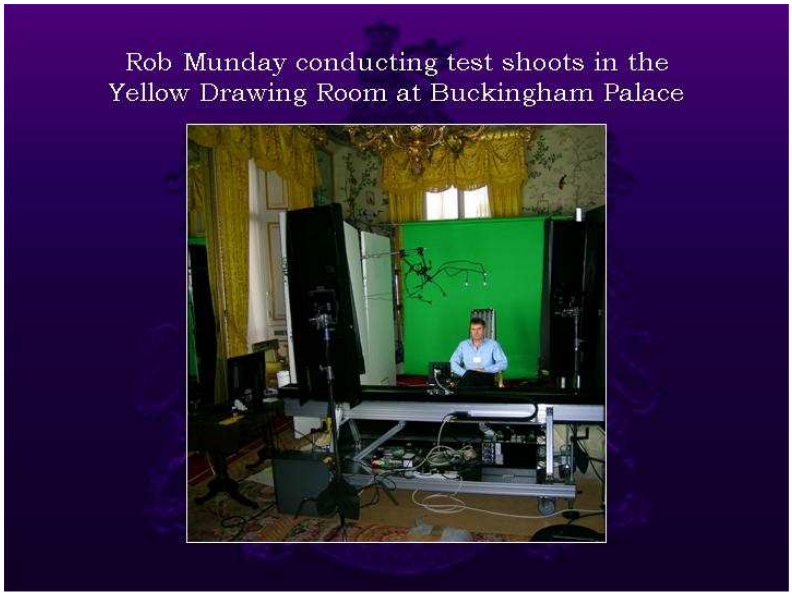
The sitting was to be held in the Yellow Drawing Room at Buckingham Palace and Munday and Robb were allowed three days prior to the shoot to set up and test the equipment and conduct dry runs. The Yellow Drawing Room is the Queen's preferred environment for portrait sittings. It is a corner room with windows on two sides and has more natural light than most of the rooms in the Palace. As such it's the room most often used by artists for more traditional painted and photographic portraits.

Their first task in assembling the equipment at the Palace was to manoeuvre the VIP system into the room. They did not anticipate any problems in achieving this however as soon as they arrived they realised that the rail was far too big to be taken up to the first floor either using the lift or the nearby spiral staircase. Fortunately the Queen's senior porter came to the rescue and suggested that it could be carried from the main entrance, through the Grand Hall and up the curving marble stairs of the Grand Staircase.



Six of the Palace porters then proceeded to man-handle the system up one of the most famous staircases in the world, past priceless antiques and grand master paintings. It was with relief that the VIP system arrived at the top unscathed.

A UK photographer by the name of Nina Duncan assisted with the lighting and photographically recorded the shoot for the archives. At no time in the past had such an assemblage of high tech equipment been allowed inside the Palace.

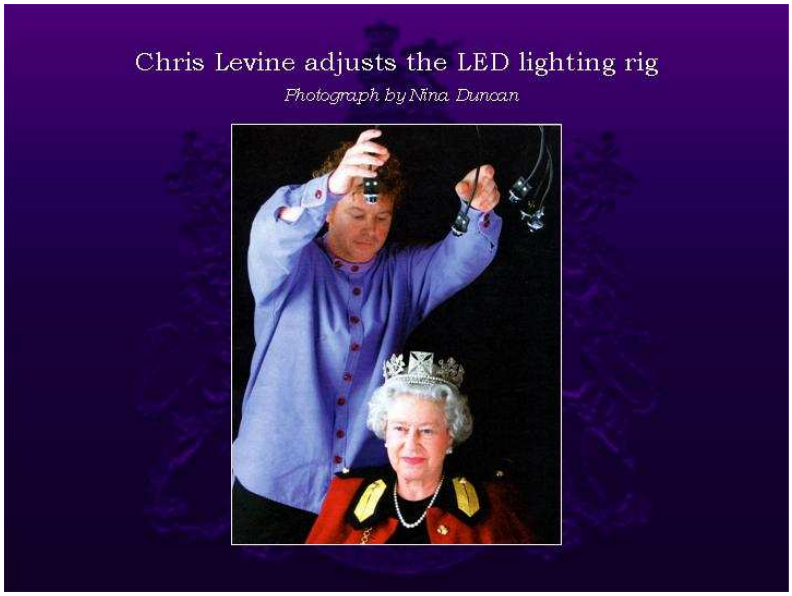


The First Sitting.

At the first sitting the team, comprising Munday, Robb and Levine, were given only one hour of

the Queen's time in which to shoot the required image sequences. At precisely 3.00 p.m. on the 14th November 2003 the Queen entered the room with her PA and dresser Miss Angela Kelly and they introduced themselves to her. The Queen then enquired as to which cape we would like her to wear whilst her PA prepared the Crown. This was apparently the first time that the Crown had been removed from the safely of the Royal vault for many years. The Queen swiftly placed the Crown on her head arranging it herself in the mirror much as you or I would arrange a hat at which point she muttered 'it ruins ones hair'!

The team then directed her to sit in the specially prepared chair and whilst she settled herself Chris Levine lit the Crown using a specially made LED lighting unit. This was designed to highlight the diamonds in the most effect manner.



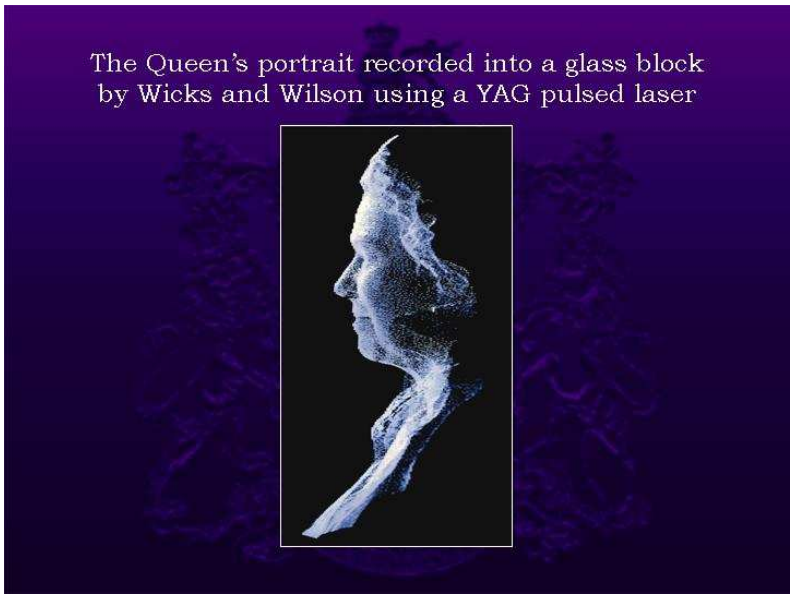
Photograph by Nina Duncan

After several dry runs the shoot began in earnest. Munday controlled the VIP system and camera from the computer consol, Robb checked exposure, focus and composition of the Queen in the frame and Levine directed the Queen to look into the distance and remain motionless for the duration of the pass. The Queen, well used to posing for photographs and paintings, adopted her naturally regal pose without intervention and remained still for the 8 seconds it took to record each 205 frame sequence.

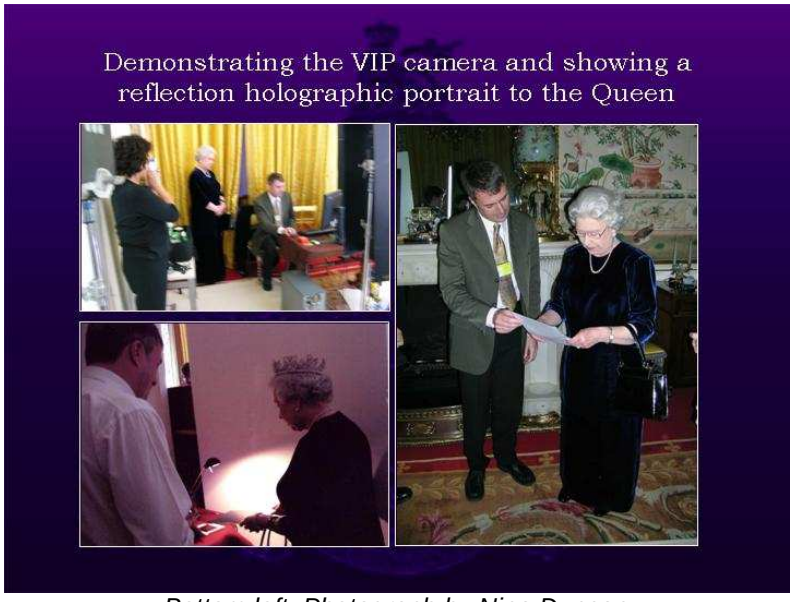
Photograph by Nina Duncan

Nerves and the concentration required meant that the first fifteen minutes of the shoot was a rather hushed affair. It was Robb that finally broke the ice by asking the Queen if she remembered unveiling a commemorative hologram at the University of Surrey which Munday had produced some eight years earlier. She replied that she did and also remembered that she had been presented with a copy of the hologram. Munday asked the Queen what had become of the hologram and was pleasantly surprised to be told that it was in the Palace Library. Jeffrey Robb also light-heartedly mentioned that the process was a bit like having your passport photo taken to which she jovially replied that she didn't need one! The conversation broke the ice and created a more relaxed atmosphere after which the Queen chatted freely.

During the sitting, the Queen's head was also scanned into a computer as a three dimensional model. A unique head scanning system, designed and built by British company Wicks and Wilson of Hampshire and operated by Stuart Winsborough, was used. The Queen's head was scanned automatically and only took a few minutes. The system was originally designed by Wicks and Wilson for the production of glass bock 'crystal' three dimensional portraits however the resultant 'point cloud' 3D data set can be converted to any 3D model format and hence used for all manner of other three-dimensional imaging techniques.



Although visibly tired, the Queen stayed fifteen minutes longer than was originally planned which, according to the Queen's PA, was a sign that she had found the shoot interesting. During the 75 minute sitting the team shot 18 parallax image sequences each of 205 images. Both black and white and colour sequences were recorded of the Queen wearing a selection of capes and at the end of the shoot Munday demonstrated the VIP system to the Queen showing her the images that had been recorded.



Bottom left: Photograph by Nina Duncan

After the shoot the images were thoroughly examined. Despite the hundreds of hours of testing of the camera system it was found that, whilst the image sequences were very good and entirely usable, the black and white image sequences in particular displayed a less than perfect noise level. This was unfortunately caused by an unexpected and rare camera fault. Due to the fault and the circumstances surrounding the Queens tiredness and also the relative inexperience of the team in shooting such prestigious portraits Rob Munday suggested strongly that they request a second sitting. Chris Levine wrote to the Queen directly and we were pleased to receive a reply stating that another shoot would be possible on March 24th 2004.

During the intervening weeks Munday took the opportunity to upgrade the camera, redesign parts of the VIP system and improve the quality of the digital images still further. Jeffrey Robb and Chris Levine also visited Dr. Perry at his studios in Vermont to discuss the project and how the images might further be improved for the second shoot. The lighting was also extensively discussed and for the first time Chris Levine and Jeffrey Robb saw a large format holographic stereogram portrait first hand. On returning from the States it was decided that a very large format holographic stereogram portrait, approximately 1 x 1.5 meters in size, and similar to those produced by Dr. Perry for Harriet Casdin-Silver, would be commissioned from him. Chris Levine chose the name 'Equanimity' for the portrait which means ‘the quality of being calm and even-tempered’ and it was also decided that the hologram would be lit with blue light to enhance the sense of ‘equanimity’. Several emails followed between Dr. Perry and Munday on the implications of using this lighting technique and how it may affect the production of the stereogram.

In February 2004 Munday created the first hologram of the Queen using his in house Lightgate digital hologram printer. This took the form of a small format surface relief holographic stereogram recorded onto photoresist. It proved very useful in confirming that the images had been shot with the correct degree of parallax and it was also shown to the Queen before conducting the second sitting.

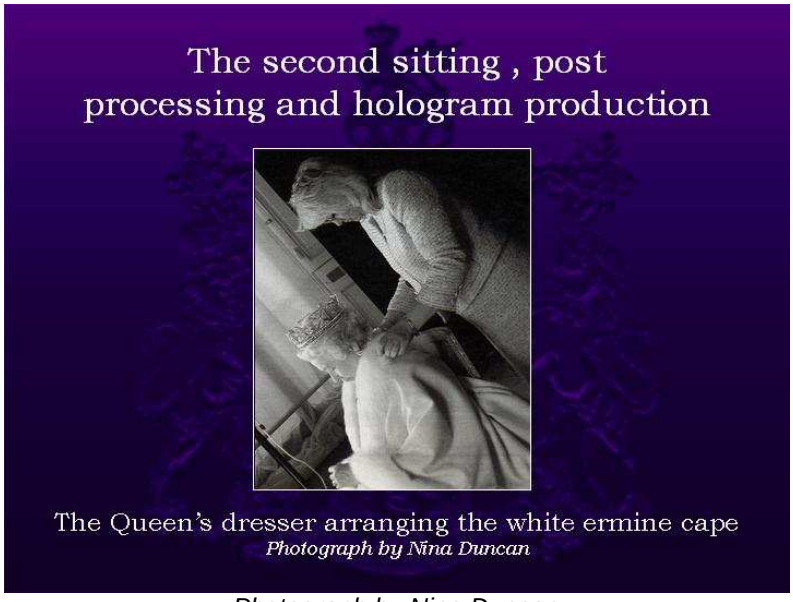
The Second Sitting

The second sitting was conducted on the 24th March 2004. The experience gained from the first shoot together with a thorough examination of the initial images meant that several improvements were made, both technical and aesthetic.

Only two days were available to set up the system for the second sitting. The lighting was modified to give a more flattering illumination and also to provide a higher intensity illumination for the digital camera.

On the day of the shoot the Duke of Edinburgh, apparently a fan of new technology, came to see the set up. He appeared very interested and commented that he looked forward to seeing the end result.

The Queen again arrived promptly at 3.00 p.m. and was clearly far more relaxed and less tired than at the first sitting. Chris Levine commenced the proceedings by showing the Queen some printouts of the images shot at the first sitting and the holographic stereogram portrait made by Munday.



Photograph by Nina Duncan

Unhappy with the choice of capes worn for at first sitting Munday strongly recommended that a lighter, more 'hologenic' cape was worn by the Queen. The Queen's dresser hastily disappeared and then reappeared a few moments later clutching a selection of white capes, one of which was a white ermine cape. On seeing it the team expressed in unison that it was the perfect cape for the shot and it has ultimately proven to be a major feature of the work.

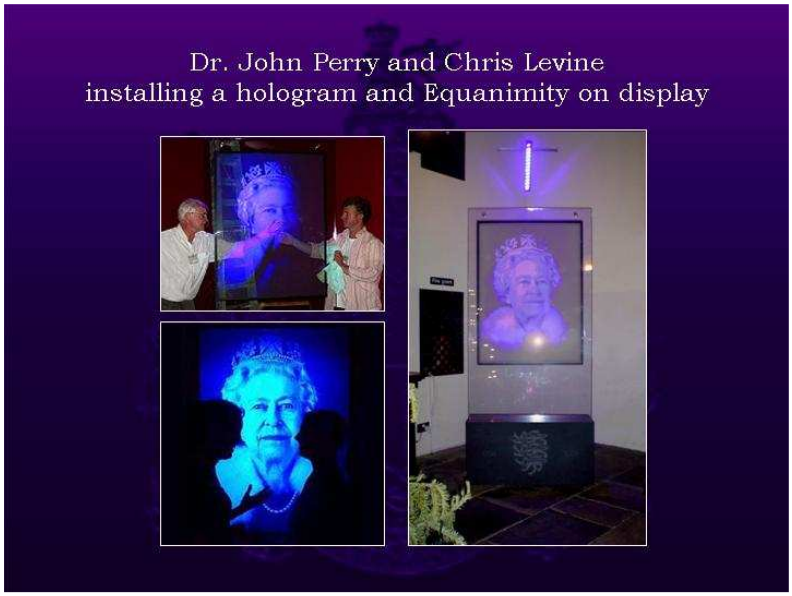
Again the Queen adopted her naturally regal pose whilst fixing her gaze on an LED light unit provided by Chris Levine which was positioned at the back of the room. This prevented her from looking at and following the camera with her eyes. The improvements made, together with a much more relaxed and even slightly jovial atmosphere, enabled the team to record a further 20 enhanced 205 frame sequences.

After a total of two and a half hours of the Queens time, during both sittings, in excess of 8,200 parallax images were recorded for posterity.

Post processing and hologram production

Three weeks after the second sitting an image sequence was chosen by the team from which to make a hologram. Munday then post processed the images using custom software that he had written to reverse the image distortions naturally inherent in the parallax image sequences. Following Dr. Perry's recommendations Munday also registered the images with respect to each other such that Dr. Perry could achieve the correct degree of projection in the final hologram. The images were then further enhanced using specialist computer graphics software by London based computer artist Richard Bainbridge. In particular undesirable reflections in the Queen's eyes were removed.

The processed parallax image sequence was then sent to Dr. Perry via an FTP web site. Dr Perry further adjusted the images to pre-compensate for the distortion inherent in shooting a blue hologram with a red Helium Neon laser. He then transferred the images to 35 mm film, shooting from a 1200 * 1600 pixel LCD monitor. The film was processed and placed into his proprietary stereogram printer to produce the master hologram. Finally four 'rainbow' film hologram copies were created, two artist's proofs and two final works, each 3 x 4 ft in size.



John Perry then flew to London to assist with the installation of one of the two holograms at the Queen's Gallery at Buckingham Palace. The final mounting and presentation of the hologram, which was designed by Chris Levine, was kept intentionally simple. The hologram was sandwiched between two thick sheets of glass which were held upright using a solid block of granite onto which the three leopards of Jersey were engraved.

A second hologram was unveiled by The Prince of Wales in June 2004 and is now on permanent display on the Island of Jersey. The portrait has subsequently toured the UK and has been without exception very well received.

During the last two years several other works have been produced. In particular Jeffrey Robb at Spatial Imaging has been responsible for creating a range of lenticular images from 8*10 inches to 6 * 4 ft in size. These have been used to commemorate the Queen's 80th birthday this year and have been on display at various venues as well as sold in several galleries. A lenticular image has also featured on limited edition commemorative gold and silver medals made by the Royal Mint. Rob Munday has also created smaller images for application to stamps and coins in the future.

Jonathan Carter, Director, of the Jersey Heritage Trust, and one of the driving forces behind the commission stated 'As Jersey has a long and fascinating relationship with The Crown, we wanted to commission a Royal Portrait that not only reflects this history but is also a contemporary iconic image of distinction. By presenting our heritage in this contemporary form, the portrait will symbolise and celebrate Jersey, its people and the future'.

*1 The portrait's of Oasis were produced in association with photographer Jill Furmanovsky.