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Case No: HP-2020-000050

IN THE HIGH COURT OF JUSTICE
BUSINESS AND PROPERTY COURTS OF ENGLAND AND WALES
INTELLECTUAL PROPERTY LIST (ChD)
PATENTS COURT

The Rolls Building
7 Rolls Buildings
Fetter Lane
London EC4A 1NL

Before:
Mr. Justice Meade
Monday 30 January 2023
Between:

AIM SPORT VISION AG **(incorporated under the laws of Switzerland)**	**Claimant**
- and -	
(1) SUPPONOR LIMITED **(2) SUPPONOR OY** **(incorporated under the laws of Finland)**	**Defendants**

- -

Hearing dates: 1-2 and 17 November 2022

APPROVED JUDGMENT

PIERS ACLAND KC and Edward Cronan (instructed by **Powell Gilbert LLP**) for the **Claimant**

BRIAN NICHOLSON KC and **David Ivison** (instructed by **Ignition Law**) for the **Defendants**

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Mr Justice Meade:

INTRODUCTION

1. The Claimant ("AIM") alleges that the Defendants (together, "Supponor", there being no need to distinguish between them) have infringed European Patent (UK) 3 295 663 B1 ("the Patent").

2. The Patent concerns billboards of the sort seen at sporting venues, and which allow the superimposition on TV broadcasts by electronic means of different advertising material from that seen in the ground and/or different advertising material in transmissions of coverage of the event in different territories. It contains method and product claims, but as will appear below only a single method claim (claim 12) is now in issue.

3. The alleged infringement is part of the Supponor "SVB System". There are several versions of the system, but for the purposes of this judgment there is no need to go into the details of how they differ and I will just refer to "the SVB System".

4. There is a conditional application to amend the Patent which is resisted by Supponor. It is conditional because it is put forward on the basis that it gives the claim scope which AIM says is anyway the right one on a proper interpretation of the granted claims.

5. There are parallel proceedings in Germany in which AIM has been successful so far, both on validity and infringement. AIM relied on this somewhat tangentially in its written submissions but I was not actually taken to either of the German Courts' decisions. Supponor's main response was that (as sometimes happens in the bifurcated German system) AIM had argued for different claim scopes in the two proceedings. AIM made no answer to this. It does not mean that the German results are adverse to AIM but it limits any help I could get in terms of reaching a correct decision where I have to apply a single consistent claim scope to infringement and to validity. In that context, I do not intend to give any weight to the German decisions and will say no more about them, other than that in taking such an approach I intend no disrespect to the German courts and am not criticising their analyses.

CONDUCT OF THE TRIAL

6. The trial was conducted live in Court and there were no COVID issues.

7. The trial took three days; two days almost exclusively taken up with the oral evidence and a third day of oral closing submissions. At the PTR, having read into the case somewhat, I had expressed my concern that that was likely to be too short. I was assured by both leading Counsel that the action was a simple one where there was no dispute about the disclosure of the prior art and that the case really turned on short points of claim interpretation. That was not so. There were a large number of issues and in

total I received approaching 200 pages of dense written submissions which, I have to say, lacked much in the way of introduction or overview to help me to orient myself. Specifically because I had been told at the PTR that the case was a simple one, virtually no time was allowed for oral openings and this exacerbated the problems. I extended the length of the day for closing submissions but it was still a very challenging fit.

8. This was all unfortunate. It is a fact of life that trial estimates sometimes go wrong but where the trial judge is able to hear the PTR and specifically interrogates the time allowed and the timetable, the parties need to play their part and give the most accurate guidance that they can.

9. The problem was made worse by the parties keeping issues in play after their usefulness had expired or when they were just not really being run. In particular, Supponor's skeletons maintained a large number of issues of claim interpretation, but it was only after I pressed their Counsel in closing that it was clarified that only two actually mattered.

10. During the brief oral openings I was given, by AIM, a long list of the issues that it perceived were live in the light of the written openings; this was not an agreed document. After written closings I was given a significantly shorter, but still substantial agreed list of the issue for decision, from which I have worked. It would have been welcome, and a good discipline, to have had this at the PTR, or at the start of trial.

THE ISSUES

11. At a relatively high level, the issues are:

    i) Two points on claim interpretation.

    ii) Whether the SVB System infringes. This depends entirely on claim interpretation.

    iii) Obviousness over Patent Application WO 2013/186278 A1 "**Nevatie**".

    iv) A squeeze argument over Nevatie, in addition to the allegation that the Patent is obvious over it in any event. This arises from the fact that Nevatie was filed by Supponor, and a major theme of Supponor's case was that the SVB System was an obvious development of Nevatie.

    v) An insufficiency allegation run mainly as a squeeze.

    vi) Whether the proposed amendments to the patent are allowable, the sub-issues being:

        a) Whether they render the Patent valid in the event that it is invalid without them;

b) Clarity;

c) Added matter.

vii) An allegation by Supponor that the combined effect of two separate admissions by AIM is that AIM admitted that the remaining claim in issue, claim 12, is invalid. I will call this the "*Promptu*" point.

OVERVIEW

12. Given the issues and their interrelation, I think it will assist to give an overview. This is necessarily simplified.

13. LED display boards are used at sporting events to show advertisements. In the stadium the spectators might see an advertisement for, e.g. a beer from a local brewery. The advertisement might well be a moving picture. Advertising in the stadium brings in revenue itself, but there is also money to be made from selling advertising in a broadcast of the event.

14. It was known to be possible to show a different advertisement in the broadcast of an event, and which appeared as if it was on the board in the stadium, by processing the video feed appropriately in real time with computers. So a beer advertisement in the stadium might be replaced with a car advertisement on the same board in a broadcast.

15. An issue with this arose where there was something blocking the camera's view of the LED display board. It might be a player, the ball, or a bird, for example. That is referred to in the Patent as an occluding object.

16. To give a full, accurate depiction of what is happening in the stadium the occluding object should be included, but its position may well change rapidly and it is a challenge to process the images from the TV cameras in real time while working out what is occluding object and what is advertisement from the LED board.

17. Nevatie, the prior art, addresses this issue (although its main focus is something else). It does so by having boards which emit infra-red ("IR") light and a camera which detects IR. The system to which the camera is linked "knows" where the board is and thus which pixels in the camera image relate to it. Occluding objects block the IR light, allowing pixels relating to the board's area but which are occluded to be identified. Then only the non-occluded pixels are overlaid with advertising by computer processing.

18. AIM says that the approach of the Patent is different. It says that instead of detecting the IR light from the board, the system in the patent detects light from the occluding object, and determines that it is indeed an occluding object by studying its "image property". In particular, AIM says, the Patent relates to using a frequency-based filter to cut out light from the display

board (which is arranged to be of known frequency), but to allow through the more varied radiation reflected by the occluding object.

19. So AIM says that Nevatie relates to dark occluding objects against a light board, the latter being detected, and the Patent relates to light occluding objects detected against a board which (because of the filtering) is dark in the relevant frequency range. I will refer for convenience to "light-on-dark" and "dark-on-light" in this judgment to reflect this, but I bear in mind that it is not the way the Patent's claims express matters and that Supponor disputes the claim interpretation relevant to it.

20. Supponor's SVB System is more complicated. It uses two IR cameras (in fact two optical paths in what the lay person would call a single camera, but this does not matter).

21. The system works pixel by pixel for those pixels which are expected to be within the bounds of the display board.

22. One camera is used for a Nevatie-style dark-on-light approach. Low brightness (relative to a threshold) indicates a pixel where there is an occluding object. This is not said to infringe.

23. The other camera is sensitive to a different IR frequency from the first camera.

24. In some circumstances, when there is more ambient IR radiation, such as on a sunny day, the system looks at the ratio of the brightnesses of the pixel in the image from the first camera and in the image from the second camera. If there were a high ratio that would be consistent with no occluding object, and a lower ratio would be consistent with an occluding object. The Nevatie-style method is still used for the first camera, and the system concludes that there is an occluding object for a pixel where there is either low brightness in respect of the first camera, or a low ratio using both cameras' results. AIM says there is infringement in these circumstances.

25. Supponor's position is that the Patent's claim 12 is not so broad as to cover what for the moment I will loosely call "mere brightness" of individual pixels. It says that the claim requires processing of what the occluding object (again loosely) "actually looks like". This was referred to in a number of ways at trial (I will in general refer to "higher order" techniques or processing), and appropriate methods for it are described in the Patent. They generally involve consideration of multiple pixels together and which compare the image from a camera with the expected characteristics of things that might be observed. If that construction is right then, it is common ground, there is no infringement.

26. Supponor's alternative position is that if the Patent's claims are so broad as to cover mere brightness of individual pixels then they must include both light-on-dark and dark-on-light. On that basis they are obvious over Nevatie, Supponor says. For practical purposes this argument is one of pure

construction, because if it is the right construction then the only other difference over Nevatie (displaying moving images on the board) is accepted to be obvious.

27. It is worth mentioning that Nevatie is not mentioned in the Patent and is not admissible as an aid to its construction.

28. AIM says that the Patent's claims do cover mere brightness, but only light-on-dark. But it says that if it is wrong about that, it can amend to achieve that result. That is where the conditional amendments come in. AIM accepts that the Patent also covers higher order processing, but that is not its route to infringement.

29. On AIM's construction, Supponor says it has two obviousness arguments.

    i) The first is that it would be obvious to enhance Nevatie by adding a second "dark" IR channel, on a different frequency to the first, to do a better job. AIM accepts that that would hit the claim on its construction, but says that it was not obvious to do. This was called the Nevatie Plus argument.

    ii) The second is that it would be obvious to do higher order processing on radiation from the occluding object. This was called the Nevatie-OD argument. For reasons I need not go into at the moment, this argument only matters (as I understand its position) if Supponor does not infringe. So it does not affect the overall result as between the parties.

30. I have already said that at trial AIM defended only a single method claim of the Patent, claim 12, and not the product claims (claim 1 and claim 13 being the main relevant ones).

31. AIM's acceptance that claim 1 would not be defended came close to trial. At an earlier stage in the litigation, it had agreed that claims 1 and 13 would stand or fall together. Supponor says that the combined effect of these two admissions was that claim 12 was also invalid (and therefore the whole Patent) because its features, even though it is a method claim, match those of claim 13. This is what I have called the *Promptu* point. AIM says that it never admitted that claim 12 or the whole Patent was invalid, but if necessary would apply to withdraw the admissions. Supponor resists that. This point needs deciding even if I reject all the other attacks.

THE WITNESSES

32. Each side called one expert. AIM's expert was Dr Graham Thomas and Supponor's was Prof Anthony Steed of UCL.

33. Supponor said that both experts were good witnesses. AIM on the other hand said that while Prof Steed had the necessary technical understanding to assist the Court, he was too academic in his background and approach.

34. I do not accept AIM's criticism of Prof Steed. I agree that in fact his background is more in academia than Dr Thomas', but in itself that is not material, and in any case he did have some industry experience from secondments and the like. AIM was also unable to point to matters where some lack of experience on Prof Steed's part was significant. It pointed out in closing written submissions that he had not used a TV camera; it accepted that this was of no particular importance but said that there were "unknown unknowns" in the sense that one could not know which of Prof Steed's opinions were affected by lack of relevant practical knowledge. I reject that. It is much too vague and anyway AIM had a full chance to test for the existence of such matters in cross-examination.

35. AIM also said that Prof Steed's approach was overly abstract and "open-ended". I do not accept this as a point directed at Prof Steed as a witness, but for reasons given below I think it is a valid criticism of the way that Supponor advanced its case.

36. I conclude that both witnesses were well-qualified and doing their best fairly to assist the Court. I found them to be good at explaining the technical issues and am grateful to them both.

THE SKILLED PERSON

37. The parties' written opening submissions suggested that there was a dispute about the identity of the skilled person, but this faded away and the list of disputed issues did not include any point about it. Such point as there was seemed to boil down to whether the skilled person's interest was only in live sports broadcasts where there was a need for overlaying advertisements, or also extended to studio applications. Prof Steed's written evidence did include some matters concerned with studio-only applications but these were not part of the real arguments at trial or developed with Dr Thomas in cross-examination. Supponor's written closing made clear that the cross-examination of Dr Thomas had been on the basis of his (Dr Thomas') conception of the skilled person and that the studio point made no difference to the CGK, which in any event is not in dispute (see below).

38. So I can proceed on the basis that the skilled person is someone with an interest in cameras and associated displays and computer systems for overlaying advertisements at live events, in particular sporting events, and with relevant academic training, probably a computer science degree, and practical experience implementing computer graphics rendering and image processing. So far as it matters, the evidence was that this was a real field of work.

THE COMMON GENERAL KNOWLEDGE

39. A joint document (the "ASCGK"), for which I am very grateful, showed the agreed CGK.

40. Although the parties said there was no CGK in dispute, the ASCGK contained two competing versions of the position on one topic, namely background removal, on the basis that although the experts agreed it was CGK, they did not agree about the extent to which the techniques available were regarded as a good basis for further action. So in a sense there was a dispute at that stage, but it faded away and by written closings no practical importance was attached to it.

41. In places the ASCGK went into more detail than is necessary as things have turned out, and in addition some aspects of the technology not relevant to the real disputes can be adequately understood without further underlying detail. So I have filleted out quite a lot of the document. What follows reproduces, with some editing, those parts which were important to the arguments, necessary for understanding, or the subject of significant discussion in the evidence at trial. The ASCGK used both past and present tenses (it frequently but not always used the present tense to describe a situation which existed at the priority date and has continued until the present). I have adjusted this in some but by no means all instances. I did not find it problematic and make no criticism; I mention it only in making it clear that what is referred to was CGK at the priority date whichever tense is used.

42. An important aspect of the argument on the Nevatie Plus obviousness attack was chroma-keying. This forms part of the agreed CGK, as set out below. I mention this because although there was no dispute about whether the technique was CGK, there was an important dispute about whether and how the skilled person would factor it into their thinking about Nevatie. By including the technique in the agreed CGK I am not prejudging that dispute.

Virtual graphics for TV broadcasting

43. Virtual graphics were regularly used in TV programs and live broadcasting at the Priority Date. Virtual graphics are computer-generated graphics which are inserted into an image to appear to be part of the real scene. Applications ranged from simple overlays of the scores and time in a broadcast of a football match, or a newsfeed ribbon at the bottom of a television screen, to more complicated "virtual graphics" applications where the graphics appeared anchored to objects in the scene. Sports specific applications of virtual graphics were developed, for example to insert a first down line on an American football pitch or instant replays with sports analysis graphics overlaid. (Thomas 1 §37)

44. The skilled person would have a working knowledge of a typical live broadcasting system set-up used to insert virtual graphics in the television feed. A simplified flow diagram of a typical studio-based system is as follows:

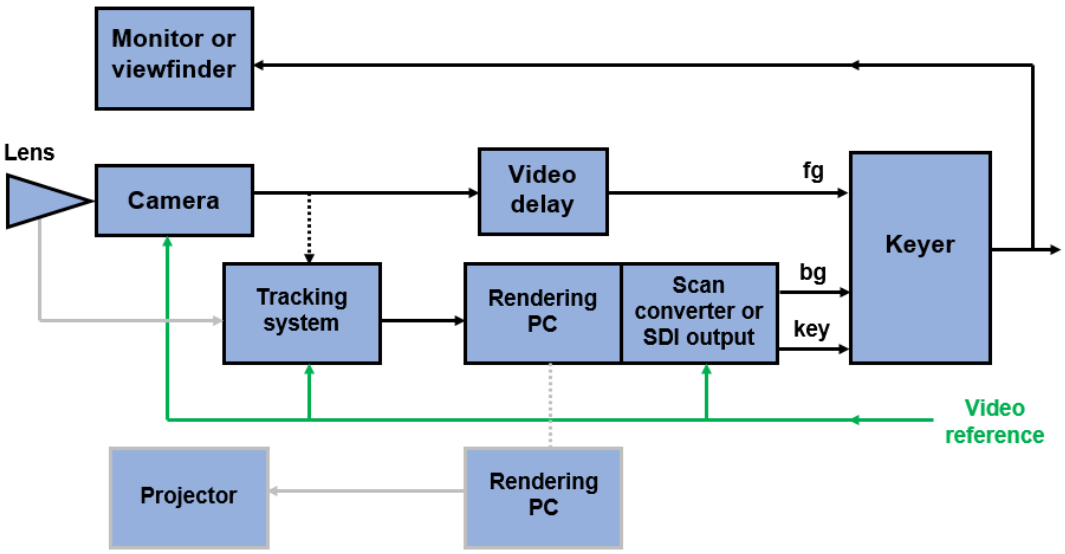


Figure 1: The main elements of a virtual graphics system

45. The figure above illustrates a studio-based TV production system consisting of a single camera (in reality there might be multiple cameras). The camera is equipped with a zoom lens and a sensor to measure the zoom and focus length of the camera. In this example, the camera is fixed to a tracking system, which during runtime measures the position and orientation of the camera. The sensor transmits camera-positioning information to the "rendering PC", which is essentially a PC with a graphics card running graphics rendering software. Rendering is the process by which graphics are produced ready to be later inserted into the image of the real scene to produce a composite image. The rendering PC renders the virtual graphics for the scene using the camera parameters measured by the sensor on the camera.

46. The rendered image is usually then converted to broadcast video format and output, and comprises two signals:

    i) a signal with the graphics that will be inserted into the broadcast feed; and

    ii) a "key" signal that indicates the areas in the image which are to be overlaid with the graphics in the broadcast feed. (Thomas 1 §41)

47. The purpose of the "video delay" is to ensure that the video signal from the camera accounts for the image processing undertaken.

48. The "keyer" is a piece of software or hardware that determines where the virtual graphics should appear in the image and combines the video signal and graphics into a single stream using the key signal. (Thomas 1 §44)

49. The use of virtual graphics in TV broadcasting was initially limited by the requirement for high-powered graphics rendering hardware, but by the Priority Date, much of the image-processing could be done on a conventional PC or laptop. (Thomas 1 §45)

Other relevant hardware

Filters

50. A filter for a camera is a material, e.g. coloured glass, that lets through only a subset of the wavelengths to which the camera sensor is sensitive. Such filters may be termed:

    i) *High-pass filter*: a filter which lets through wavelengths over a given wavelength.

    ii) *Low-pass filter*: a filter which lets through wavelengths under a under a given wavelength.

    iii) *Bandpass filter*: a filter which only lets through a range (or band) of wavelengths. The range of wavelengths that is let through is referred to as the pass-band.

51. Such filters were commercially available with a range of properties. Filters were available which would block or transmit wavelengths of infrared and ultraviolet light as well as visible light. (Steed 1 §§66-67)

Electronic Displays

52. Liquid Crystal Display ("LCD") panel displays display digital images by using the interaction of polarised light with liquid crystals to modulate the amount of light which can pass through individual pixels of the display.

53. Light Emitting Diode ("LED") panel displays have been used for many years as large-format signage (for example, in train stations, stadiums, and sports events). Typical LEDs contain semiconductor material which emits light in a relatively narrow band of wavelengths (such as red, green or blue) when an electrical current flows. LED panel displays can display moving and still digital images. LED displays typically contain red, green, and blue ("RGB") LEDs, which are adjusted in intensity to display images (Steed 1 §§160-161).

54. LEDs which emitted infrared light were available. (Steed 1 §246(b)(iii))

The camera and lens calibration

55. Before a broadcast TV camera is ready for broadcast, it must be calibrated to determine the geometric positioning of the camera used to produce the video feed. Camera calibration is an essential step in many computer vision applications as the camera positioning data is essential to understanding the

relationship between the real-world and how virtual graphics are to be inserted into the image. (Thomas 1 §47)

56. Calibration of a zoom lens typically involves calibrating it at a range of different zoom and focus settings to obtain the necessary camera parameters. The broadcast cameras will have a sensor which measure the zoom and focus length of the camera. Calibration may be carried out by using images of the real-world scene with reference points at a known distance to calibrate the cameras or using a calibration data chart. (Thomas 1 §53)

57. Further camera calibration is undertaken to calculate parameters including the position and orientation of the camera in the scene. At the Priority Date, virtual graphics systems for sports broadcasting utilised features or objects in the scene in known or fixed positions to calibrate fixed or moving cameras. For example, the pitch lines in the football stadium are at fixed positions in the natural scene and could be used to calibrate the camera. Further calibration steps may be required during runtime. (Thomas 1 §54)

Tracking the position and orientation of the camera

58. As explained above, in order to understand the position of an object in an image and where the virtual graphics should be inserted, it is necessary to track the position and orientation of the camera in runtime. Camera tracking also ensures that the virtual graphics are synchronised with the camera motion and the correct orientation of the virtual object in each image frame of the video feed is maintained. Additionally, camera positioning sensors are integral in calculating the zoom length of the camera to ensure that the virtual graphics are to scale with the image in the frame. Tracking is the process by which the camera position parameters are estimated at runtime. This is achieved by measuring the camera position at the same time as each video frame is captured. (Thomas 1 §55)

59. Tracking could be done using mechanical or optical means.

Image Processing

60. The term ‘image’ is frequently used to refer to the data or information encoding or representing an image, rather than the viewable image itself. (Thomas 1 §42)

61. Digital images can be processed in a variety of ways. The first type is simple manipulation of the colours by scaling the values. These types of function are built-in to most image processing software. (Steed 1 §73)

62. A greyscale image can be converted to black and white by thresholding. All pixels with a level less than a threshold are set to black, and all pixels at or above the threshold are set to white. (Steed 1 §74)

Spatial frequency techniques

63. A wide variety of image processing operations use spatial filtering. Spatial frequency difference techniques are a type of image analysis. Spatial frequency is not related to the frequency of light, rather it is a measure of the fineness of detail, texture or pattern, in an image. The units of spatial frequency are cycles per pixel, measured in the image plane. An image with low spatial frequency would have gradual changing or widely spaced changes between light and dark regions, for example, gradually changing colours or wide stripes. On the other hand, narrow, high contrast stripes would have a high spatial frequency. (Thomas 1 §163-164)

64. Spatial frequency analysis techniques may utilise descriptors. A descriptor is a shorthand way of recording the properties of something. In this case, each pixel has a descriptor that is a multi-dimensional vector containing information that describes its local neighbourhood. For example, the descriptor may include information about whether the pixel is at or near an edge or a corner; whether it has a first order gradient; its shape, colour or texture; or motion information. An important characteristic of spatial frequency descriptors is that they take into account the neighbourhood of the pixel, rather than just the pixel itself. The descriptors should also be invariant to matters that are important for the application, such as rotation, orientation, change of scale and small changes in brightness. (Thomas 1 §166)

65. Spatial filtering techniques need to be used with care if the accuracy of the resulting image is important. Whilst these techniques are useful for generally cleaning up an image it cannot be guaranteed that important details will not be moved or lost. In many cases, it is not possible for the algorithms to distinguish between artefacts and features that are genuinely a part of the scene. (Thomas 2 §13)

Cut and paste and binary masks

66. Multiple digital images can be composed simply by copying pixels from one image into another (Steed 1 §69). To copy more complex shapes, a process known as *binary masking* is used. A mask is created which has only black and white pixels. Essentially, when copying any pixel from the overlaying image to the composite image the mask is queried and if it is black, the pixel is not copied, if it is white the pixel is copied.

67. In more complex copying an *alpha mask* is used. Sometimes, especially when operating on images from real cameras, objects overlap on pixels. Thus the colour of a pixel can contain a contribution from the colour of a foreground object and a contribution from the colour of a background object. If a binary mask was used, the sharp boundary would be noticeable. Thus in a process known as *alpha-matting* a foreground object can be identified by creating an alpha mask that indicates the proportion in the range [0,1] how much the pixel corresponds to background or foreground.

That is 0 would be background, 1 foreground and 0.5, half foreground and half background (Steed 1 §71)

68. In practice creating the alpha mask can be a complex exercise. Tools to create alpha masks are common in offline image-editing and video-editing tools. It is also possible to approximate an alpha mask. One way would be to first identify all pixels that are definitely background and all pixels that are definitely foreground. This leaves some unknown pixels, which can simply be estimated by the ratio of the distance, in pixel space, from foreground to background. (Steed 1 §72).

Background Removal

69. Background removal is a common problem in image processing. There is a wide variety of techniques depending on the situation. A relatively easy case is if there is a static background and a reference image can be taken of the background without the foreground object.

70. In practice, the background image might be changing slowly. Thus a common technique would be to keep a sequence of images of the background, and then estimate the background as an average or median of the video value of pixels at each position. Then the foreground might be defined by distance of the colour of the current colour of the image from the estimated background.

71. Distance between two colours in a colour space can be defined in a number of different ways, but a simple one is the Euclidean distance, which is the square root of the sum of the differences squared. That is if two colours are $R_1G_1B_1$ and $R_2G_2B_2$ then, the distance is $\sqrt[2]{(R_1-R_2)^2+(G_1-G_2)^2+(B_1-B_2)^2}$ In practice, distance might be estimated in a different colour space.

72. More sophisticated models of colour estimation might use gaussian models to estimate the colour. Thus there is an expected distribution of colours modelled by a mean and standard deviation. A gaussian mixture model might be used if there is a background that changes between different colours: different gaussian distributions cover different parts of the colour space.

73. If the camera is moving, then there are a variety of background estimation processes, some of which are based on tracking the camera and thus estimating how previous images can be distorted to fit the expected view, see below.

Object Identification

74. Object identification is a common operation in computer vision. It is an unsolved problem for general objects under general viewing conditions. That is, given a particular object, it may not be possible to identify it given any camera move or object illumination. This problem can be made

practically impossible if there is not sufficient data about the object in the image (e.g. attempting to identify a face if there are only 4 pixels of that face in the image). However, even if the object is represented by a significant number of pixels in the image, there can be a lot of ambiguity because objects can look very different from different angles (e.g. consider the different images of a mug as the camera moves around the object), and many objects are very similar in overall appearance (e.g. faces). (Steed 1 §115)

75. In some computer vision systems, the object to be detected is a light source or other source that will appear bright in the image and so can be detected by thresholding at an appropriate level. Alternatively if the object has certain colour properties the computer vision system can be programmed with, or can be taught, the colours that it should seek. (Steed 1 §116)

76. Optical tracking technology can be used to track objects in a scene over which virtual graphics can be inserted. This technology usually involves an object with a set of markers, which enables the camera to identify the location and the orientation of the object in a scene. The camera is designed to identify those markers. (Thomas 1 §59)

77. More complex identification might rely on other features such as the presence of lines or corners in the image. A large class of schemes for matching an object to a template are model-based, where a model exists of the object.

78. Whilst object tracking is fairly straightforward in principle, in practice it can be harder, especially if highly reliable results are needed in real-time in a fairly unconstrained situation. For example, the key features on the object being tracked may become occluded, disappear from view, or not appear with sufficient contrast from the background. Sometimes the background might contain a pattern that can be confused with the object being tracked. (Thomas 2 §27)

Image Feature Identification

79. A large class of algorithms focuses on tracking specific *image features*. Image features are characteristic statistics of spatial regions of the image. Features might include regions that have certain frequencies of change in colour, e.g. it contains a pattern that repeats. The latter is sometimes called a *texture feature.* (Steed 1 §133)

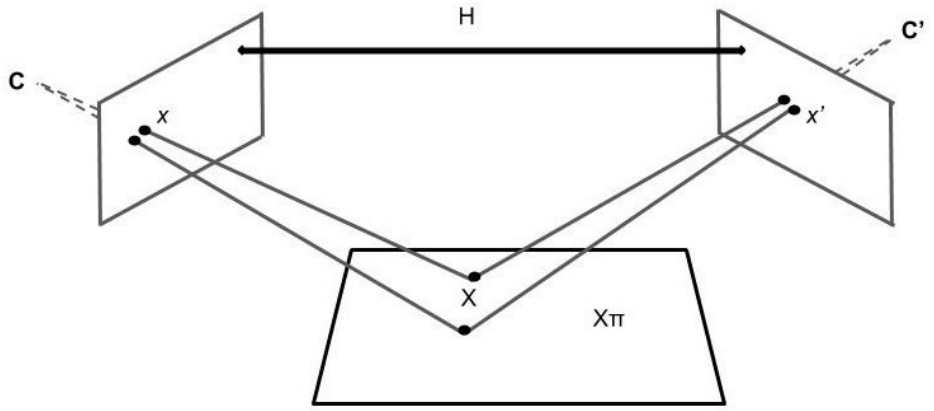
80. Features can be attributed to whole regions (sometimes called *blobs*), areas around lines or curves in the image, or an area around a specific pixel in the image. The last of these is very commonly used in tracking applications: if a pixel has identifiable or perhaps even unique characteristics in one image, then it might be identifiable in another image. (Steed 1 §134)

Foreground Object Detection

81. Some feature detectors can detect features of objects, but not whole objects. Ideally one would be able to identify whole objects, potentially for the purposes of identifying them as foreground objects. The process would thus output the complete set of pixels that comprised the object, perhaps as a binary mask. One can see that corner detectors or edge detectors would only identify certain parts of an object. (Steed 1 §143)

Stereo cameras

82. There is a strong relationship between two cameras that image a plane in the real world. This is illustrated in the following figure. Given a point X on a plane in the world, the points x and x' in cameras C and C' are related by a simple 3x3 matrix, a *homography (*Steed 1 §109).



83. The homography can be estimated by identifying the correspondence between any four points in the image in camera C in the image of camera C'. The four corners of a rectangle as seen in both images is a common way to do this. (Steed 1 §110

84. If there are two images of the same plane from two different cameras, or two different positions of one camera, then there is a homography that maps both images to ortho-rectified images. Pixels in the plane should be substantially the same. An object that is in front of this plane will be in a different position in these two images, due to motion parallax, or might not even appear in one images, depending on the relative positions (ignoring the case where it is front of the plane, but in neither camera's view). Thus, this object would occlude the plane, and this occlusion region would be different in the two images. In many cases, this allows the foreground object to detected because the colours of the two images are different at equivalent pixel locations. This can form the basis of a stereo background removal technique. (Steed 1 §114)

Camera motion and optical flow

85. One technique that is common in computer vision is to track the camera's own motion from an image sequence. Another is to determine the "optical flow" in the image. The two problems are related: if a camera is moving, then from frame to frame in the image sequence, objects will appear to move. From the patterns of movement (or flow) the movement of the observer (i.e. camera) can be estimated. (Steed 1 §129)

Keying

86. A keyer is a component of the graphics overlay system which separates the foreground of an image from the background based on a key signal. At the Priority Date, keying technology software products, such as Ultimatte and Keylight, were available. (Thomas 1 §60)

87. Broadcasting applications typically used a chroma-keyer (also referred to as a colour-based segmentation algorithm in computer vision applications). (Thomas 1 §61)

88. In computer vision applications, images are usually considered by reference to red, green and blue values ("RGB"). However, broadcast video usually converts an RGB image of the video feed into luminance (brightness) and chrominance (colour) signals. Chroma-keying is the process of classifying each pixel as either background or foreground using the chrominance of a specific colour. Traditionally, chroma-key used either green or blue as the key signal to identify the background of an image. However, other colours could be used, as well as signals in the non-visible light range (e.g., infrared, which might be useful in low lighting conditions or to avoid problems such as background colour spill). The skilled person would be aware of the main concepts of infrared chroma-keying, which had been developed by the Priority Date. For example, the skilled person would be aware of Paul Debevec's work on the Light Stage, which was a studio-based system that used infrared chroma-keying to composite an actor into a virtual background without affecting the illumination of the actor. (Thomas 1 §62)

89. Chroma-keying is typically used where the whole of the background is intended to be a virtual overlay, although it can be used for narrower applications. A well-known example of chroma-keying is that of a green screen behind a weather presenter. The green colour of the screen acts as the keying colour/chrominance. In the image of the studio, each pixel in the image is categorised as either the background (e.g. green screen) or as foreground (the weather presenter). The chroma-keyer will not generate a key signal for areas that it identifies as foreground and therefore should sit in front of the virtual object that will be inserted in the background. The weather map is subsequently keyed into the areas of the green screen which are not obstructed by the presenter. (Thomas 1 §63, see also Steed 1 §§87-89). Chroma key is useful not only for removing background, but for inserting graphics anywhere into an image. (Steed 1 §93)

90. Each pixel may have a value for red, green and blue or may be represented in terms of hue, saturation and brightness. For example, the below image of a person against a green screen and the slice-graph representing the pixels along the red axis in the left-hand image.

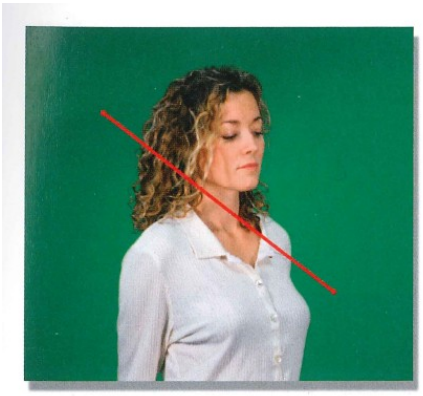


Figure 2-41 Real world picture

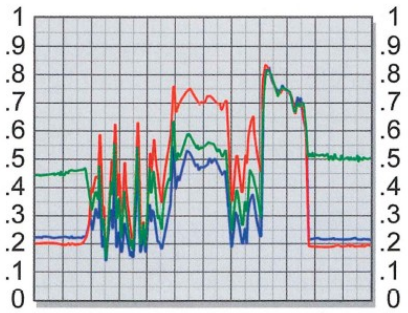


Figure 2-42 Graph of real world picture

Figure 4: Taken from "*Digital Compositing for Film and Video*," Wright (Focus Press, 2002)

91. Each pixel has certain levels of each of red, green and blue and these levels can affect whether the pixel is classified as foreground or background. An example of a well-known key generation formula for making this determination is:

key = G - MAX(R, B)

This formula outputs: (i) a high value for the key signal in areas of saturated green; (ii) zero in areas of pure white; and (iii) less than zero in areas that predominantly contain red and/or blue. The output value would usually be scaled and clipped to give a key (or mask, or alpha) value ranging from 0 for foreground to 1 for background. It is possible to set certain thresholds to allow for reasonably accurate identification of the background and to allow for natural variations in the colour of the real surface of the background (Thomas 1 §64).

92. In some sports applications at the Priority Date, grass pitches were used as the "green screen" for the chroma key colour. The keyer would work out whether each pixel in the captured image of the pitch was either background

(the grass pitch) or foreground (an occluding player or ball). Chroma-keying would often be done manually by a keying technician who would adjust the colours and thresholds throughout the broadcast when the lighting conditions (such as cloudy to sunny) or other conditions changed. Figure 5 illustrates the use of a traditional green chroma-key used in virtual graphics in a rugby match using the Piero sports graphics system (discussed below). (Thomas 1 §65)

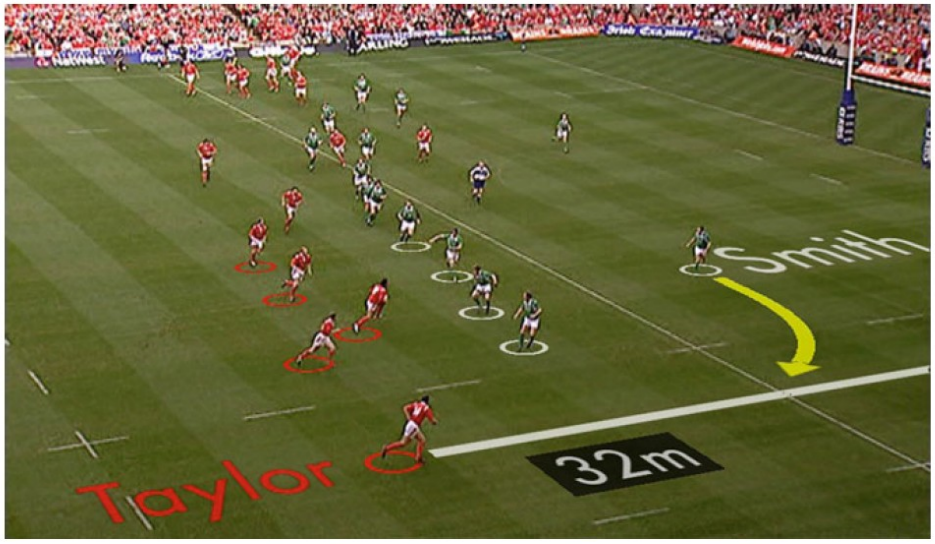


Fig. 1.4 Example of virtual graphics overlaid on a rugby pitch (picture courtesy of Red Bee Media)

Figure 5 – Example of virtual graphics overlaid on a rugby pitch

93. The skilled person would be aware of several considerations when using chroma keying in live broadcasting in a studio:

    i) Lighting and maintaining a clean background in the studio – if the presenter casts a shadow, it is difficult to identify a key on the shadow. Shadows and lighting require careful planning regarding the position of lights and camera.

    ii) It may be difficult to accurately distinguish the background from transparent or reflective surfaces (such as the presenter's hair, glasses or shadow) or blurred parts of the image (for example due to camera motion or de-focused edges).

    iii) The chroma-key will not work if the foreground is the same colour as the background.

    iv) Difficulty achieving a high-quality output image may require additional image-processing to clean up the edges of the foreground, such as removing background colour 'spill' through hair. (Thomas 1 §66)

94. Many of these issues could be addressed by careful planning of the lights and camera in a studio and the broadcaster would have control over the

clothing/appearance of the programme presenter. Furthermore, it is possible to set certain thresholds for level of saturation and brightness to identify the softer edges between the foreground and background pixels more accurately. (Thomas 1 §67)

95. Live sports broadcasting presents a number of further considerations which could impact the effectiveness of the chroma-key:

    i) Much of the external environment is out of the control of the system developer, which includes interference from the light of the scene (including by weather), the background, appearance of players, behaviour of the crowd (e.g. flares, pitch invasions and banners).

    ii) Control of the colours in a scene is outside the system developer's control. For example, it may be that the football shirts of a team are a similar colour to the pitch.

    iii) In a fast-paced sports broadcast, blurring of the camera image would have been a more frequent issue which was difficult to fully address with existing chroma-key technology. Rapid movement and blurring could result in small fast-moving objects not being reliably keyed.

    iv) The demand for a high-quality and accurately keyed image which is higher for live sports applications compared to the use of virtual graphics in a studio where audience expectations of production values are often lower, and the use of virtual graphics (such as a weather map) are expected. (Thomas 1 §68)

96. In studio-based applications an arbitrary colour could be chosen (not necessarily blue or green) and the key can be adapted so that it accommodates the natural variations in the colour of the background surface by allowing the user to set certain thresholds for aspects such as saturation and brightness. However, in live sports broadcasting the choice of key colour is limited to the colours in the real-world background (and control over that real world background is limited). For example, a football pitch cannot easily be made to appear a uniform, green colour regardless of changing weather conditions, shadows and mud etc. (Thomas 1 §69)

Virtual studio

97. While chroma-key establishes one way of compositing images from multiple sources together, the combination of camera tracking and real-time computer graphics enables computer graphics elements to be composited in a way that it seems that the computer graphics is an element of the real world. (Steed 1 §124)

98. In TV, real-time compositing is sometimes known as a *virtual studio*. The integration of real-time graphics is more challenging. The camera must be tracked, then a virtual model aligned with the real model using virtual cameras, while the areas to be used from real and virtual footage are identified by a mask. (Steed 1 §126)

Rendering

99. Rendering is the process by which a computer system processes information to produce an image. In television production, video rendering requires powerful graphics rendering hardware to be done in real-time, especially when the requirement is to render virtual graphics at the same video frame rate as the television broadcast. Rendering is conducted using a bespoke software application that runs in real-time. At the Priority Date, there were a range of software packages that were available for commercial use which had the capability of rendering graphics for virtual studio productions. Technological advancements in graphics processing units (GPUs) enabled more advanced rendering. (Thomas 1 §70)

Virtual Production around the Priority Date

100. Virtual graphics were used in a variety of television applications around the Priority Date. The skilled person would either be familiar with these specific examples of virtual graphics in sports or would have been familiar with the techniques used in these examples. (Thomas 1 §72)

The Piero sports graphics system

101. Piero is a system for producing 3D graphics to help analyse and explain sports events, for use by TV presenters and sports pundits. It has been used by the BBC since 2004 on Match of the Day, where it was initially used to highlight and track football players and draw off-side lines on the pitch. When launched in 2004, the system initially relied on PTZ data from sensors on special camera mounts. In 2005, the system was upgraded to use image processing techniques to track the camera movement by identifying lines on the pitch. (Thomas 1 §73)

102. In 2009, a new image-based camera tracker was implemented that could use arbitrary image features (not just lines) to compute the camera position and orientation, allowing the system to be used on a wider range of sports such as athletics. Further developments before the Priority Date included an intelligent keying system, to improve the ability of the system to distinguish the colour of athletes and background. This was particularly useful for distinguishing between sand and skin when placing graphics on a long-jump pit or in beach volleyball. (Thomas 1 §74)

103. Piero was still in popular use by the Priority Date (and as of 2011 was in use in over 40 countries around the world). (Thomas 1 §75)

'1st and Ten' and 'First Down Line'

104. The skilled person would have been aware of the development of the '1st and Ten' system which used virtual graphics to enhance the audience's understanding/enjoyment of American football games. The system was primarily used to insert graphics which represented the yard line needed for a touchdown onto the pitch using a traditional chroma-keying method. A 3D

model of the pitch would be used to calibrate the cameras before the match. (Thomas 1 §76)

Figure 6: The yellow line graphic is inserted to illustrate the yard line

105. The typical set up involved cameras with sensors which monitored the camera's position during the game (i.e. PTZ data). The camera tracking data is used to generate information regarding position of the camera, which in turn would be used to work out where the yard line should be inserted in the incoming video. A chroma-key was used to distinguish the (green) pitch from the players to ensure that the yellow line would align with the background. The yellow line would be inserted into the image and the feed is then sent to the production truck in real-time. (Thomas 1 §77)

106. Known issues with this early system included the inability of the chroma-key to distinguish between foreground and background in certain instances. For example, if the colour of the players' clothing was similar to the green of the grass, then the chroma-key could not distinguish between the foreground player and the grass and the yellow line would overlay the players. Other issues were if the pitch became very muddy and the "green screen" of the pitch was lost. For example, the muddy areas would be identified by the keyer as foreground. (Thomas 1 §78)

THE PATENT

107. The priority date is 13 May 2015; entitlement to priority is not challenged.

108. There was little dispute about the main features of the system that the Patent teaches; rather, the disputes centred around detailed points said to go to claim interpretation.

109. The Patent's system can be understood from Figures 1 and 3:

Fig. 1

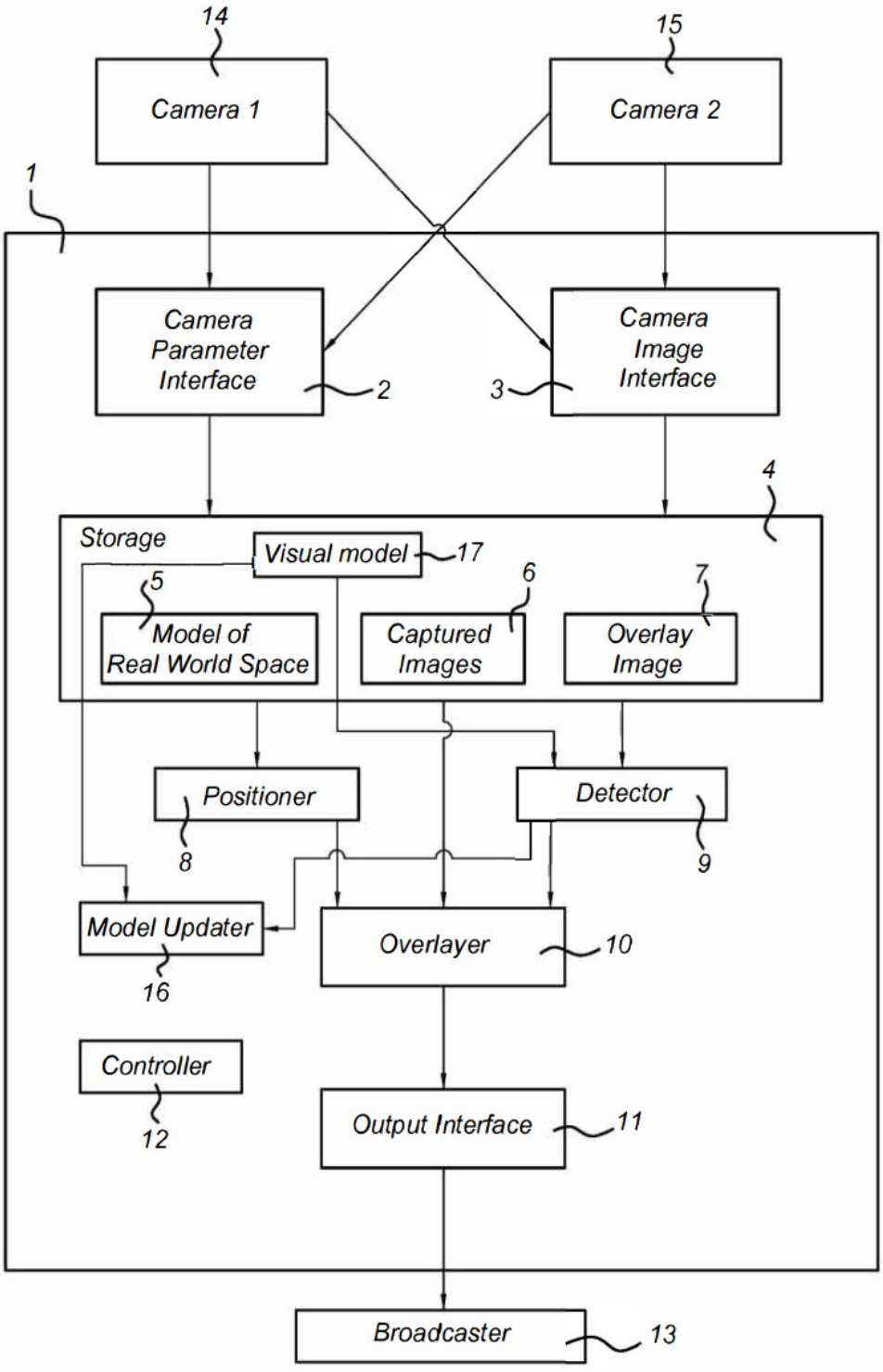
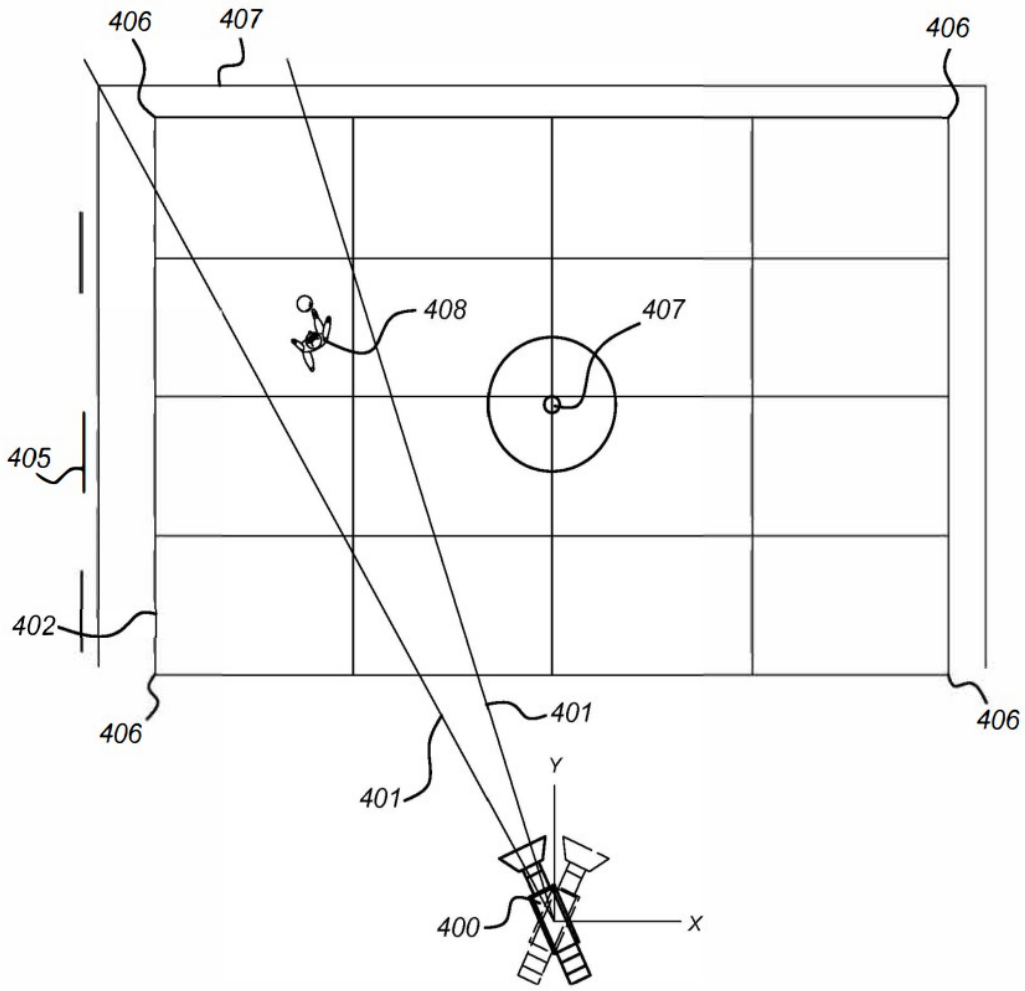

14
15
Camera 1
Camera 2
1
Camera Parameter Interface
2
3
Camera Image Interface
4
Storage
Visual model
17
5
6
7
Model of Real World Space
Captured Images
Overlay Image
Positioner
8
Detector
9
Model Updater
16
Overlayer
10
Controller
12
Output Interface
11
Broadcaster
13

Fig. 3



110. Figure 1 is a block diagram of the system and Figure 3 is a schematic picture of a camera of the system in a stadium with the position of various features such as the corners of the pitch and advertising display boards marked.

111. As is explained at [0009] and [0012], the system uses a model of the real world which includes things such as the corners and boards.

112. At least one camera is required, Figure 1 shows two. It is explained later (at [0022]) that detection of radiation other than visible light, such as near-IR, IR or UV, is contemplated.

113. [0013] explains as follows:

> [0013] In operation, the camera 400 captures a series of images and transmits them to the camera image interface 3, which receives them and stores them (at least temporarily) in the storage 4. The camera 400, and/or additional devices cooperating with the camera 400, generate camera parameters, such as X, Y, and Z coordinates of the camera and orientation parameters and zoom parameters, and transmit them to the camera parameter interface 2 which forwards the received camera parameters to the positioner 8, possibly via the storage 4. The positioner 8 positions the overlay surface in the captured image. That is, when an overlay surface 407 is in the field of view 401 of the camera 400, the overlay surface is captured in the captured image and the positioner determines where in the captured image the overlay surface is, based on the coordinates of the overlay surface in the real world model 5 and the camera parameters.

114. Camera parameters such as this were CGK.

115. [0013] goes on to explain that the detector 9 detects whether there is an occluding object in the way of the "overlay surface", which in the embodiments is a display board. The detail of this description is relevant to the claim interpretation issues and I return to it there. If there is an occluding object then the overlayer 10 works out which parts of the board are not occluded and replaces them with the "overlay image", such as an alternative advertisement.

116. [0015] makes clear that the system, while explained by reference to a single image, can also be used for a sequence of images, such as video.

117. Following on from this general explanation, the Patent gives further teaching about detecting occluding objects. Again, I will return to this in more detail when I come to claim interpretation, but for present purposes I point out that there are some general matters covered in the passage down to [0021], and then three more detailed sections:

    i) "Detection of the occluding object: Stereo image" at [0033], which picks up from a general pointer at [0021];

    ii) "Detection of occluding objects using active boards" at [0034]-[0035];

    iii) "Detection of Occluding objects using spatial frequency differences" at [0036] to [0043] which covers three different types of algorithm.

Claims in issue

118. The only claim remaining in issue is claim 12. Three versions are in play:

Claim 12 – As Granted

12	A method of digitally overlaying an image with another image,

12.1	comprising creating (200) a model of a real world space,
12.1.1	wherein the model includes an overlay surface to be overlaid with an overlay image,
12.1.1.1	wherein the overlay surface in the model represents a display device in the real world,
12.1.1.2	wherein the display device is configured to display a moving image on the display device in the real world by emitting radiation in one or more pre-determined frequency ranges;
12.2	identifying (201) camera parameters, which calibrate at least one camera with respect to coordinates of the model;
12.3	capturing (202) at least one image with respective said at least one camera substantially at the same time, said at least one captured image comprising a detection image,
12.3.1	wherein the camera used to capture the detection image is configured to detect radiation having a frequency outside all of the one or more predetermined frequency ranges and distinguish the detected radiation outside all of the one or more pre-determined frequency ranges from radiation inside the one or more pre-determined frequency ranges;
12.4	positioning (203) the overlay surface within said at least one captured image based on the model and the camera parameters;
12.5	detecting (204) an occluding object at least partially occluding the overlay surface in a selected captured image of said at least one captured image based on an image property of the occluding object and the detection image;
12.6	overlaying (205) a non-occluded portion of the overlay surface in the selected captured image with the overlay image, by overlaying the moving image displayed on the display device in the real world with the overlay image in the selected captured image.

Claim 12 – Revised Amendment 1 (conditional)

12	A method of digitally overlaying an image with another image,
12.1	comprising creating (200) a model of a real world space,
12.1.1	wherein the model includes an overlay surface to be overlaid with an overlay image,
12.1.1.1	wherein the overlay surface in the model represents a display device in the real world,
12.1.1.2	wherein the display device is *a LED board* configured to display a moving image on the display device in the real world by emitting radiation in one or more pre-determined frequency ranges;
12.2	identifying (201) camera parameters, which calibrate at least one camera with respect to coordinates of the model;
12.3	capturing (202) at least one image with respective said at least one camera substantially at the same time, said at least one captured image comprising a detection image,
12.3.1	wherein the camera used to capture the detection image is configured to detect radiation having a frequency outside all of the one or more predetermined frequency ranges and distinguish the detected radiation outside all of the one or more pre-determined frequency ranges from radiation inside the one or more pre-determined frequency ranges;
12.4	positioning (203) the overlay surface within said at least one captured image based on the model

	and the camera parameters;
12.5	detecting (204) an occluding object at least partially occluding the overlay surface in a selected captured image of said at least one captured image based on an image property of the occluding object and the detection image;
12.6	overlaying (205) a non-occluded portion of the overlay surface in the selected captured image with the overlay image, by overlaying the moving image displayed on the display device in the real world with the overlay image in the selected captured image;
12.7	*wherein* *the LED screen has a uniform, monotone distribution as if it was not active on the captured detection image*.

Claim 12 – Revised Amendment 2 (conditional)

12	A method of digitally overlaying an image with another image,
12.1	comprising creating (200) a model of a real world space,
12.1.1	wherein the model includes an overlay surface to be overlaid with an overlay image,
12.1.1.1	wherein the overlay surface in the model represents a display device in the real world,
12.1.1.2	wherein the display device is *a LED board* configured to display a moving image on the display device in the real world by emitting radiation in one or more pre-determined frequency ranges;
12.2	identifying (201) camera parameters, which calibrate at least one camera with respect to coordinates of the model;
12.3	capturing (202) at least one image with respective said at least one camera substantially at the same time, said at least one captured image comprising a detection image,
12.3.1	wherein the camera used to capture the detection image is configured to detect radiation having a frequency outside all of the one or more predetermined frequency ranges and distinguish the detected radiation outside all of the one or more pre-determined frequency ranges from radiation inside the one or more pre-determined frequency ranges;
12.4	positioning (203) the overlay surface within said at least one captured image based on the model and the camera parameters;
12.5	detecting (204) an occluding object at least partially occluding the overlay surface in a selected captured image of said at least one captured image based on an image property of the occluding object and the detection image;
12.6	overlaying (205) a non-occluded portion of the overlay surface in the selected captured image with the overlay image, by overlaying the moving image displayed on the display device in the real world with the overlay image in the selected captured image;
12.7	*wherein* *the LED screen has a uniform, monotone distribution as if it was not active on the captured detection image; and*
12.8	*the occluding object is still visible in the captured detection image*.

119. Claims 1 and 13 will also be relevant to the *Promptu* point, but I will explain that, and their role, when I come to it in due course. Claim 2 is not in issue as such, but is relied on by AIM in relation to claim interpretation.

CLAIM SCOPE

120. The legal principles that apply to "normal" claim interpretation are set out in *Saab Seaeye v Atlas Elektronik* [2017] EWCA Civ 2175 at [17]-[18], applying *Virgin v Premium* [2009] EWCA Civ 1062. No issue of equivalence arises in the present case.

Issue 1 – claim feature 12.5

121. Supponor says that this claim feature requires higher order processing. On that basis, the claim feature is not present in the SVB System. I do not think a categorical definition of "higher order" processing was put forward by Supponor or agreed by AIM, and indeed a range of expressions were used in the evidence and argument, but for the purposes of this judgment I can refer to what Prof Steed said and was relied on by Supponor: that an image property of the occluding object requires a descriptor that is a "*property of the detection image whose presence can be associated specifically with the presence of an expected type of occluding object, and which can be identified by the detector and used to ascertain the size, shape and location of the area of pixels which correspond to the occluding object with the detection image."*

122. This requires some pre-existing overall appreciation of the occluding object's likely appearance and does not extend to simply looking at one pixel at a time in isolation to see how bright or dark it is.

123. AIM on the other hand says that while the claim covers higher order processing, it is not so limited and also extends to an assessment of the brightness of individual pixels. The SVB System does have that.

124. However, AIM's broad construction is in danger of going too far for it, because if the claim extends to identifying a dark occluding object (i.e. one not emitting or reflecting light in the relevant wavelengths) against a light background then Nevatie has that, and the Patent is obvious, subject to AIM's amendments.

125. The words of central importance are "based on an image property of the occluding object", but the feature has to be interpreted as a whole and indeed along with the other features of the claim. For reasons I will go on to explain, I think it is relevant to consider features 12.3, 12.3.1 and 12.5 as a whole, especially on the issue of whether the claim extends to dark-on-light.

126. The words are not terms of art or even very technical. They are ordinary words to be interpreted in context.

127. The main relevant context in the Patent is:

    i) The section in [0013] at column 4 lines 10-19. This says that a vision model "may include a descriptor of the occluding objects". Shape, colour and texture characteristics are mentioned. The passage also refers to "image characteristics", which was not suggested by either side to be different from "image properties".

    ii) [0016] which says that "[t]he image property of the occluding object relates to a descriptor of a neighbourhood of a pixel".

    iii) [0019] which concerns detecting the occluding object by comparing a detection image with a previous detection image.

    iv) [0021] which refers to stereo images being used, and contains the words "image property", it being, in that instance, a disparity between the two stereo images.

    v) The three sections from [0033] onwards:

        a) The "Detection of the occluding object: Stereo image" section at [0033].

        b) The "Detection of occluding objects using active boards" at [0034]-[0035]. This does not refer to "image properties" but does refer to "image" a number of times.

        c) The "Detection of Occluding objects using spatial frequency differences" section at [0036] to [0043]. This also refers to "image properties" at [0037].

128. Although not included in claim 12, the word "descriptor" is mentioned in a number of places in the above passages. This does have a technical connotation going beyond its ordinary English meaning, as was set out in the ASCGK at [37], which I have quoted above in the section dealing with spatial frequency analysis.

129. This was relied on by Supponor for the sentence that "An important characteristic of spatial frequency descriptors is that they take into account the neighbourhood of the pixel, rather than just the pixel itself."

130. Supponor's argument for a narrow meaning had the following main elements:

    i) [0016] teaches that the image property of the occluding object is a descriptor of a neighbourhood of a pixel.

    ii) The CGK as to the use of "descriptor".

    iii) The three sections referred to above from [0033] onwards are very different, and it is only the third, relating to spatial frequency

differences, that uses image properties and falls within claim 12.

131. Supponor's position on the third point seemed a little bit changeable, because [0021] in the Patent uses the term "image property" in relation to the use of stereo images. However, it satisfied me in its closing submissions that stereo detection of the kind described does conventionally use a descriptor according to [37] of the CGK and does not work on a simple pixel by pixel basis. So, I think it was argued, the stereo approach could be said to use an "image property" while still being meaningfully distinct from the second approach based on an active board.

132. There was also a subsidiary dispute about whether Algorithm 3 at [0042] could work with "mere brightness" as opposed to using genuinely higher order processing. Based on Prof Steed's evidence I find that using mere brightness would not be a meaningful way to proceed in the context of Mixture of Gaussians. Algorithms 1 and 2 both, it was not disputed, require reference to surrounding pixels and a model of expected characteristics.

133. Supponor also relied on [0019] which refers to identifying occluding objects by comparing images over time, and said that [0034] at column 10 lines 11-15 was referring to the same thing. As I understood it, the point was said to be that since recognising objects by changes between frames was conventional, as [0019] says, the reader would not think that what was being described at [0034] would be claimed. I do not accept this point in relation to what [0034] says. It is referring to *differences* between static background and moving foreground which will be reflected in their characteristics within individual images (for example in the event that the techniques of [0034] were not used on video, as Prof Steed accepted was possible). "Change" is loose wording, but the meaning is clear. The reader would not in any event think that the totality of what was described in [0034] was conventional. In any event, this was a minor part of Supponor's argument.

134. In my view, Supponor's argument that "image property" is limited to higher order processing is wrong. "Image property" is a broad term and the skilled person's first impression of the Patent would be that it was very general.

135. The skilled person would know from the CGK what a "descriptor" was, and that in general it could include a spatial frequency descriptor of the kind described in the ASCGK. The skilled person would see how this *could* be used in the Patent, from teaching including [0013], [0016] and the sections on stereo images and spatial frequency analysis.

136. However, that is not at all the same thing as the skilled person thinking that spatial frequency analysis/descriptors or higher order processing *must* be used. [0013] is extremely permissive, with the use of "For example" and "may". [0016] looks more like a direction, but it is well capable of being understood as simply informative, saying that in the context under discussion the image property in fact concerns the neighbourhood of the pixel.

137. Importantly, claim 2 of the Patent is specifically limited to an image property that "relates to a descriptor of a neighbourhood of a pixel, wherein the descriptor comprises a spatial frequency …"; claim 1 just refers to detection based on an image property, as with claim 12. I appreciate of course that claim 1 is not defended over Nevatie, but the reader of the Patent would not know that and the fact that the narrow requirement contended for by Supponor is optional in the parallel situation of that claim family is still material to claim interpretation of claim 12.

138. I also reject the idea that the skilled person would think that the stereo image approach (possibly) and the spatial frequency approach were within claim 12 but the active boards approach was not. There would seem no reason for this. Certainly no technical reason was advanced. It would seem odd to the skilled person that that division was being made (if they thought about it, which I do not think they would), and still odder that, if such a division was to be made, it should be by using the words "image property".

139. I have recognised above that the active boards section does not refer to "image property" whereas the phrase is used for the stereo image approach and the spatial frequency approach. I do not think there is anything to this. It is a very semantic point. "Image property" just means a property of an image, and [0034] refers to "image" multiple times while discussing the characteristics of what is "captured" by the set up in terms of frequency etc.

140. Finally, Counsel for Supponor argued that if feature 12.5 meant what AIM said then it was redundant and added nothing to feature 12.3.1, which he described as requiring a "frequency-selective camera". I do not accept this submission. Feature 12.3.1 does indeed specify the camera and I think "frequency-selective" is a fair paraphrase. Feature 12.5 however specifies the processing and so relates to something different. It is true that in a mere brightness active board set-up the processing will be very simple given what the camera does, but that does not make feature 12.5 redundant.

141. So I reach the conclusion that "image property" is broad, as AIM contends. I move on to consider the dark-on-light aspect. Not without some hesitation, I have concluded that AIM is correct on this too. My main reasons are as follows:

    i) It is not relevant that rejecting AIM's argument would run into Nevatie. The skilled person would not have that in mind.

    ii) It is a point against AIM that its drive on the first aspect of feature 12.5 was that a broad meaning was intended.

    iii) However, both sides agreed that the teaching of the Patent was about processing radiation from the occluding object. That is a consistent thrust of its teaching, common to the fairly general discussion at [0013] to [0021] and the three more specific sections from [0033]ff.

iv) Conversely, there is no teaching about using the absence of radiation from the occluding object.

v) Although I have said that "image property" has a broad meaning, the context also includes "detecting" an occluding object. I do not think it would be a natural use of language to say that something is being "detected" when it cannot be seen at all.

vi) This is fortified by the way that feature 12.3.1 is written concerning the camera. It is to detect radiation outside the one or more predetermined frequency ranges, i.e. not radiation in the range emitted by the display device.

vii) In a dark-on-light situation one would naturally say that the presence of the occluding object was *inferred* but one would not say that it was *detected*. This is perhaps just another way of looking at the points above.

142. On this basis, AIM does not need to amend the Patent to avoid dark-on-light being within the claims.

Issue 2 – claim feature 12.3

143. Supponor contends that feature 12.3 is to be interpreted to require one and only one detection image. This is the last vestige of a much wider argument that it was running at the start of the trial that claim 12 is an exact recipe that allows no additions in any respect, which could have supported a non-infringement argument based on the SVB System having the two cameras and its processing approach.

144. That wider argument was always going to be very difficult given the "comprising" language in the opening words of the claim (which conventionally means including but not limited to) so it is no surprise that it is not pursued in its whole breadth.

145. Supponor bases its argument on feature 12.3 firstly on the fact that claim 12 repeatedly uses the words "at least one" in relation to the captured image – see integers 12.3, 12.4 and 12.5 – but does not use the same words in relation to the detection image.

146. Supponor also relies on the fact that integer 12.3 requires capturing the "at least one image", with the "at least one camera", "substantially at the same time".

147. This is inelegant language but in context it is clearly trying to cater for the *possibility* of more than one captured image, with them all having to be captured at the same time.

148. Indeed, it is not just the "at the same time" language that is inelegant; the whole of the definition of the captured images and their relation to detection images is ugly and rather messy. But it is not especially hard to understand

in context, and Supponor did not suggest that it was unclear what the captured image or the detected image was: the captured image is the picture taken by the camera (or one by each camera) which will be fit for use (usually by broadcast) after it has had the occlusion of the overlay surface dealt with, if necessary. The detection image is a product of the processing to achieve the desired result of detecting the occluding object (if there is one).

149. I do not think Supponor had any purposive basis for its approach.

150. Supponor accepted, as it had to, that there can be multiple cameras and each of them can capture an image, in particular at the same time. Integer 12.3 says in terms that (each) "at least one" captured image comprises a detection image. There is no linguistic hook on which to hang an argument that the claim only allows one detection image in the overall method. It would in fact seem very odd if the claim could be avoided because of the use of more complex processing that in some way processed the captured image in stages and created multiple detection images.

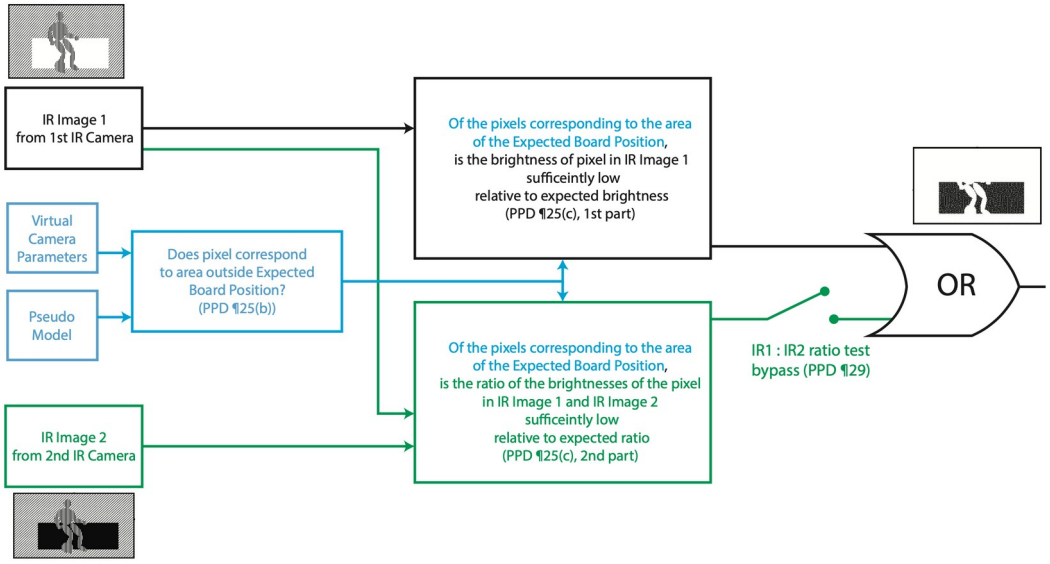
151. To try to make sense of this, Counsel for Supponor argued that in a "normal minimal implementation" of the invention of claim 12 there would be two captured images, one of which is used for overlaying and the other of which "forms" the detection image. This involves illegitimately reading the claim down by reference to an idealised single normal implementation.

152. In short, the claim uses deliberately open and non-limiting language in respects relevant to this point. It could be better written but there is nothing in its language to support Supponor's narrow reading and no purposive support either.

INFRINGEMENT

153. There is no material dispute about how Supponor's SVB System works (as I said in the Introduction above, there are multiple versions but the differences do not matter). It is rather fiddly to understand, however, and the verbal description in the PPD is not easy to follow. Supponor made an effort to depict it pictorially in its opening written submissions. This was the subject of complaint by AIM, which criticised the depiction as incomplete in its closing written submissions.

154. I agree that Supponor's representation did not cover all that was in the PPD; it was not intended to, because it was meant to make matters comprehensible for me. I did not think it was unfair and I found it helpful. So I will use it here. My use of it is to make this judgment accessible to the reader and does not displace the PPD, which remains the definitive account.



155. The diagram has three main parts, shown by the use of three colours.

156. The blue part, shown in the middle, depicts the system's ability to assess which pixels in an image being processed correspond to where the display board is expected to be. Only those pixels are tested to see whether there is an occluding object. So the output of the blue part feeds into both the other two parts.

157. The system has two IR channels.

158. The black part, uppermost, shows the processing of IR Channel 1. This happens all the time, and in IR Channel 1 the billboard is arranged to be "bright". The detection algorithm processes each pixel expected to correspond to the position of the board, and compares its brightness to a threshold. If it is "dim" by this measure that indicates an occluding object blocking the IR light from the board which would otherwise have made the pixel "bright".

159. Supponor says that the black part corresponds at the relevant level of generality to Nevatie Figure 3. I agree and I do not think AIM disputed this.

160. The green part, lowermost, does not work all the time. It is intended to be put into operation when the ambient light is relatively bright, as denoted by the open switch going into the "OR" gate on the right hand side of the figure. It uses IR Channel 2, in which the board appears "dark".

161. In the green processing, for each pixel expected to correspond to the position of the board, a ratio is assessed of the brightness in IR Channel 1 to the brightness in IR Channel 2. If the ratio is low (i.e. the brightnesses are close to each other) then that indicates an occluding object. This is not completely intuitive, but can be understood by looking at the small diagrams at the top left and bottom left of the diagram that show a stylised

silhouette of a football player. Pixels for non-occluded parts of the board have very different brightnesses so the ratio will be large, whereas pixels for the parts of the board occluded by the player have similar brightnesses and the ratio will be small.

162. This pixel-by-pixel processing allows the creation of a mask for overlaying, which is shown just above the OR gate on the left hand side. When only the IR Channel 1 (black) processing is used, each pixel's status depends on that alone. When the IR Channel 2 processing is also in use, a pixel within the expected bounds of the board is considered to correspond to an occluding object when either the IR Channel 1 threshold or the IR Channel 2 ratio so indicates; hence the OR gate.

163. AIM's infringement case is based on the IR Channel 2 (green) processing.

164. Supponor made the point that the IR Channel 1 processing is always in operation. This is true. AIM responded that there will be circumstances in which the IR Channel 2 processing "dominates" because the ambient light is very bright and so the reflections from an occluding object are not dim enough for it to be recognised as such; in such a situation the ratio test on IR Channel 2 will still give the "right" answer. I am not in a position to determine how likely or common that is, and I do not need to do so to determine the infringement questions, but the set-up of the system makes clear that the IR Channel 2 processing can be decisive in assigning a pixel as being part of an occluding object when the IR Channel 1 processing would say that it was not.

165. Supponor accepts that the IR Channel 2 processing is different from Nevatie, but says that it corresponds to what it would be obvious to do in keeping with the Nevatie Plus obviousness attack.

166. Supponor said there is no infringement because the SVB System does not use higher order processing, only pixel-by-pixel brightness analysis, and has multiple "detection" images as a result of the use of the IR 1 Channel and IR 2 Channel cameras.

167. My conclusions follow from my decisions on claim interpretation.

168. First, claim 12 does not require higher order processing and covers pixel-by-pixel brightness analysis. So feature 12.5 is met.

169. Second, claim 12 is not limited to a single detection image. So feature 12.3 is met.

170. Therefore both Supponor's points fail and claim 12 is infringed if valid.

VALIDITY OVER NEVATIE

171. Nevatie is alleged to render claim 12, as granted and as proposed to be amended, obvious.

Obviousness – the law

172. The basic approach to obviousness is as set out in the decision of the Supreme Court in *Actavis v. ICOS* [2019] UKSC at [52] – [73], with its endorsement at [62] of the statement of Kitchin J, as he then was, in *Generics v. Lundbeck* [2007] EWHC 1040 (Pat) at [72]. The number of routes forward is one relevant factor, but there may be more than one obvious option (*Brugger v Medicaid* [1996] RPC 635 as interpreted in the case law since).

Disclosure of Nevatie

173. Nevatie was filed on 12 June 2013 and published on 19 December 2013. The applicant was the Second Defendant; this is of course not directly relevant to its status as prior art, but it is part of Supponor's narrative that there is a squeeze.

174. Nevatie's main focus is, as the parties and experts agreed, about how to replace content in images, with specific focus on television broadcast images such as sporting events. This is not directly relevant to the Patent; instead Supponor's attack focuses on the disclosure in Nevatie of how to generate a mask so as to replace content. I agree with Supponor's characterisation that this is about the "underlying system" to which Nevatie's core invention is then applied.

175. At trial, a key focus was Figure 3 of Nevatie:

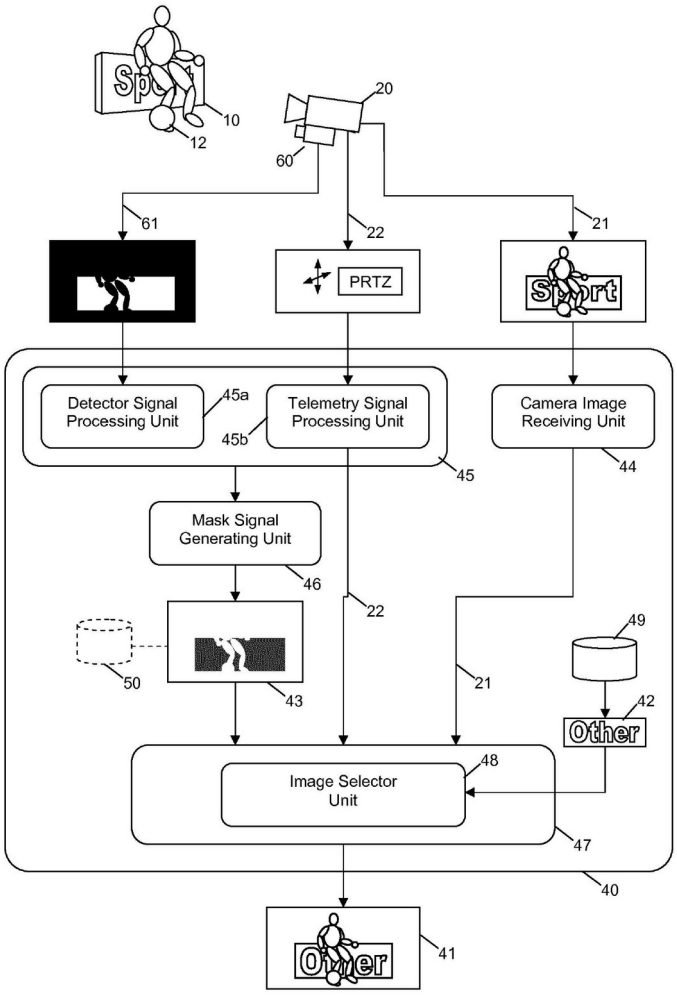


Fig. 3

176. Figure 3 is described at length from pages 9 to 12 of Nevatie.

177. The billboard 10 (referred to as the "subject" in Nevatie) can be either "passive", illuminated by ambient radiation, or active, including LED lights.

178. There is a camera 20, and an infra-red detector 60. In addition, 22 indicates the provision of telemetry signalling for the camera, such as pan and tilt.

179. Signals (61) from the detector 60 pass to the detector signal processing unit 45a. The signals represent the field of view as an array of digital pixel values each representing an intensity of the detected radiation. As one can see visually from Figure 3, the array is "dark-on-light" in the sense that LED light results in high intensity in those pixels corresponding to parts of the billboard that are not blocked by an occluding object.

180. In conjunction with the telemetry signals, this allows the generation of a mask, which is shown at 43, and replacement content (in Figure 3, the "Other" at 42) is overlaid at positions shown to be appropriate by the mask. The result can be seen at 41, where "Other" now appears behind the football player in place of "Sport".

181. Supponor emphasised that:

    i) There may be more than one detector.

    ii) Processing is pixel-by-pixel.

    iii) The system uses a 3D model, such that the telemetry signal processing allows the system to estimate where the billboard is.

182. I accept those points, which were not materially challenged.

183. AIM emphasised the second paragraph on page 2 of Nevatie:

> In one embodiment, the subject is a billboard. In one example, a subject billboard reflects or emits electromagnetic radiation in one or more predetermined wavelength bands. A camera observes the subject to provide camera video images. At least one detector unit also observes the scene to derive a detector signal relating to the radiation from the subject to thereby distinguish the subject from its surroundings. A content replacement apparatus selectively replaces one or more marked areas within the camera video images with alternate image content, such as displaying an alternate advertisement on the billboards, according to a mask signal that is accurately and efficiently identified by the detector signals.

184. Counsel for AIM cross-examined Prof Steed about this paragraph. The point made was that the paragraph discloses the possibility of the billboard emitting more than one wavelength of radiation, and by contrast does not say anything about using radiation other than from the billboard. Prof Steed accepted that that was the disclosure, and that it is early in the teaching of Nevatie. It was also apparent that he had not really previously picked up on the passage, and his written evidence that there was no suggestion in Nevatie to configure a billboard to emit two kinds of radiation was mistaken.

185. Attention was also focused in submissions on page 9 and the first two paragraphs of page 10. In my view both sides tended somewhat to over-interpret and overemphasise these passages, which are fairly general. But allowing for that, I agree with AIM that the emphasis is on using radiation from the billboard, and the skilled person's reaction to the suggestion to use more than one type or wavelength of radiation would be that what was being suggested still concerned radiation from the billboard.

The skilled person's reaction to Nevatie

186. I believe it was common ground, and anyway I find on the basis of the evidence, that the skilled person would think that:

    i) Nevatie's system could be a useful one, worth taking forward; and

ii) The system of Figure 3 might present practical problems of identifying the billboard and distinguishing it from its surroundings in conditions of bright ambient sunlight.

187. However, the expectation of potential practical problems would be a provisional and rather general one.

Supponor's arguments

188. I will deal with Nevatie Plus first. By the time of closing, the essential elements of Supponor's case on it were that (with quotes from paragraphs 29 and 31 of Supponor's closing written submissions):

i) The skilled person would realise that the Nevatie system was a form of IR chromakeying.

ii) The skilled person would identify the potential problem posed to the Nevatie system by bright ambient sunlight.

iii) The skilled person would appreciate that the problem was precisely the same as the CGK issue with visible light chromakeying, i.e. that "*where light with the same wavelength (or 'colour') as is being used to generate the background key signal is ambiently illuminating the entire scene, it will reflect from foreground objects, so that there is no longer a clean 'key' which distinguishes the background from the foreground*."

iv) Having appreciated that, the skilled person would know the solution from visible light chromakey, which was to add "*another IR channel in which the ... billboard ... should appear dark*." In this second IR channel, another IR wavelength would be used so as to detect IR reflected from occluding objects.

v) Supponor said that the IR chromakey rationale was set out in Prof Steed's first report (at paragraph 255(b)) and his second report (at paragraph 15(c)(ii)(3)).

189. I agree with the first of those points, and Dr Thomas had said as much. But he was clear that he was using "chromakey" in a broad sense when referring to Nevatie and did not accept that by analogy or extension the skilled person would make a connection to visible light chromakeying, either in terms of the problem or the solution. I return to other aspects of Dr Thomas' evidence below.

Analysis

190. Regardless of Dr Thomas' evidence I think there were two fundamental problems with Supponor's case.

191. The first was that chromakeying was central to it, and not just chromakeying but an analogy from the IR situation in Nevatie to the known

visible light chromakeying problem and solution. These things were central because they provided the logic and rationale to drive the skilled person forward to modify Nevatie to use two IR channels, one light and one dark.

192. But this whole line of thinking was, as AIM submitted, wholly absent from Prof Steed's first report. Paragraph 255(b), relied on by Supponor, just said that two cameras with different bandpass filters "could" (not a promising basis for obviousness) be used to observe two different frequency ranges of light which "could" be visible and/or non-visible. This was very general stuff. Its scope might be said to cover what Supponor argued to be obvious, but it certainly did not spell it out. Even to the extent that it did specify that which Supponor argued for, it contained no reasons, and it certainly did not contain the essential (for Supponor's case) logic about chromakeying. Indeed, as Counsel for AIM pointed out, at that stage Prof Steed had not articulated the issue with visible light chromakeying on which Supponor now relies (there is no dispute that it *is* CGK, rather the point is that Prof Steed had not mentioned it or attached importance to it).

193. Prof Steed's second report did make more of a link to chromakeying, but the logic linking back to visible light chromakeying was still absent.

194. Persuasive reasons for the skilled person to think or act in a particular way are always a key element of an expert's report supporting an obviousness attack. I accept Counsel for AIM's submission that the central reason put forward by Supponor at trial was not supported by Prof Steed's written evidence and shows every sign of having been put together in the immediate run up to trial. I also find that it is, objectively speaking, only the product of hindsight and would not have occurred to the skilled person without knowledge of the invention of the Patent.

195. The second fundamental problem with Supponor's case (although the first would have been enough for me to reject the attack over Nevatie), was that it failed to engage with AIM's point that Nevatie teaches at an early stage that if two detectors are used they should (or at the very least, may) both detect radiation from the billboard. This omission meant that Prof Steed's assessment of the possible ways forward was artificially narrow.

196. I return to the evidence of Dr Thomas. I have already said that he did not accept the analogy to visible light chromakey. He did accept, as I have said, that Nevatie would be interesting to the skilled person but would present possible problems. He proposed possible solutions, including increasing the brightness of the billboard LEDs and arranging for the billboard to emit both infrared and ultraviolet radiation.

197. Counsel for Supponor attacked these proposals on a number of fronts, saying that increasing the brightness would lead to complications with camera saturation, power consumption, heat generation and object reflection. While these would be issues, Dr Thomas did not to my mind accept that any were insuperable. The cross-examination overall gave me the impression that the situation presented by Nevatie was relatively

complex and to the extent that a concrete problem turned up in due course (which was uncertain) it did not offer a clear way forward to a definite solution. Rather, as often seemed to be the case in this field, trial and error would be necessary.

198. As to an IR/UV solution, Counsel for Supponor argued that Dr Thomas had been unduly limited in his thinking by a close textual reading of Nevatie. I do not think Dr Thomas was pedantic in his reading and I agree that the thrust of Nevatie is the detection of radiation from the billboard.

199. Supponor also argued that Dr Thomas never gave any technical reason why Prof Steed's suggestion of two IR cameras with a light and dark channel would not work, or would not occur to the skilled person. As to the first, it was not AIM's case or Dr Thomas' evidence that the proposal would not work; it would. As to the second, I have already accepted Dr Thomas' point of view that Nevatie's focus is on radiation from the billboard, and it was for Supponor to put forward reasons to think of the use of two IR cameras with a light and dark channel, which it failed to do.

200. For these reasons, the Nevatie Plus obviousness argument fails.

Long felt want

201. AIM argued long felt want as a secondary indication of non-obviousness. Its point was that Supponor had had a similar idea to Nevatie Figure 3 in 2007 (in a patent application introduced for the first time in the cross-examination materials for Prof Steed) but did not launch the SVB System, said to be an obvious development of Nevatie, until 2016.

202. I found the argument unpersuasive. It was not flagged in advance to give Supponor the ability to address it. There was also no evidence that the 2007 concept was at all well known. So the most one can reliably say is that Supponor did not take the concept forward; this is not the sort of case where the prior art was known to a whole industry and no one progressed it in the way said to be obvious. Moreover, there could be a host of practical reasons why Supponor did not progress matters, such as having other priorities, and the fact that the SVB System was not launched until 2016 does not necessarily mean that the ideas behind it took that long to conceive. It cannot be excluded that Supponor had the basic idea much earlier.

203. I also agree with Supponor that this argument was severely weakened by not being developed by reference to Nevatie itself. A long felt want argument over Nevatie could not work because its publication was too close to the priority date, and hence the reliance on the 2007 application. But AIM did not show that what was material in Nevatie was also in the 2007 application, and I do not think it was (for example, the telemetry inputs).

204. In these circumstances the long felt want argument fails and I give it no weight at all. That is unimportant, though, given that the obviousness case

over Nevatie fails on my assessment of the primary evidence.

Nevatie-OD

205. The argument here was that it would be obvious to enhance Nevatie by using some CGK object detection techniques in the nature of higher order processing. It was argued by Supponor that it would be obvious to do that regardless of the Nevatie Plus case, in other words whether or not it was obvious to add a second, dark IR channel. Despite that, I found it hard to see the circumstances in which Nevatie-OD would add much, if anything to the practical result of this action. I see it this way:

    i) I have held that granted claim 12 does not require higher order processing and does not cover dark-on-light.

    ii) I hold below that if granted claim 12 did cover dark-on-light, the amendments are allowable and exclude it.

    iii) I have held that the Nevatie Plus obviousness argument fails.

    iv) I do not understand Supponor to argue that the Nevatie-OD case helps it in relation to getting to Nevatie Plus. They are independent.

    v) If light-on-dark is a requirement of claim 12, either as granted or by way of amendment, then Supponor loses on validity, given my finding on obviousness of Nevatie Plus. Nevatie-OD does not help.

    vi) If light-on-dark is not a requirement of claim 12 as granted and the amendments were to fail or do not require it either, then AIM accepts the Patent is invalid, because it says that higher order processing is not a requirement of claim 12 and the other differences over Nevatie are not inventive.

    vii) On the other hand, Supponor says that higher order processing *is* a requirement of claim 12, and Nevatie does not have that, but nor does the SVB System.

206. The practical upshot is that if claim 12 is narrower than AIM contends, because it requires higher order processing, then the Nevatie-OD argument has the additional effect that the claim is not only not infringed, but also invalid, if, contrary to my decision above, the Nevatie Plus obviousness argument were to succeed. Otherwise it makes no difference.

207. I am conscious that I may have misunderstood the full interactions of all the contingencies. I would have been assisted by this being fully mapped out by Supponor, whose choice it was to add this issue into the case and keep it there. In closing submissions, both written and oral, Supponor said that the issue was secondary, an add-on, it "becom[ing] aggressive" (so as to revoke the patent even when it did not infringe).

208. In case I have misunderstood the position, and because in a scenario that could arise if my other findings are overturned on appeal it could make the difference between non-infringement and revocation, hence possibly affecting a public monopoly, I will decide the point.

209. Supponor's case on Nevatie-OD is that while the skilled person would think that Nevatie was attractive to take forward, he or she would at the same time be concerned about its performance and would consider a range of ways to improve it, including at least basic object detection algorithms, going beyond mere brightness but satisfying Supponor's interpretation of claim 12.

210. Supponor also said that the fact that there were other obvious routes (including going to light-on-dark, as I understood it) did not mean that object detection was any the less obvious.

211. A further part of Supponor's argument was that object detection algorithms were part of the CGK, and it strengthened this by pointing to the fact that the Patent expects the skilled person to be able to implement the three types referred to at [0033]ff with only minimal teaching. If the skilled person could not, the Patent would be insufficient.

212. AIM responded that in the context of live broadcasting it would be uncertain how much benefit could be gained from higher-order processing, that there was a difference between looking for an overall feature such as a football and processing individual pixels, and that Nevatie presented a simple ("rugged, reliable and easy to implement") approach which would be expected to work. AIM also submitted that Prof Steed was giving his evidence on this point from a perspective where he did not know how well the simple masking against a bright background in Nevatie would work, or how much help higher-order processing would be in that context. It said that higher-order processing would add complexity and require more computational time, which seemed to be accepted.

213. I accept the force of some of Supponor's points. In particular, the skilled person would realise the need to think about how Nevatie would perform in bright ambient light, and if they found they had a problem such that they thought of using, and then found they needed to implement, a higher-order processing technique they could do it with some trial and error (this was the evidence and I also accept that it is the effect of the insufficiency squeeze that I have touched on above). I also accept that the claim is a broad one to aim at: any higher-order processing that detects occluding objects is covered.

214. However, these points are vague ones. The general need to think about bright ambient conditions does not mean that the skilled person would positively expect there to be a problem, still less any specific one, or to have an expectation that higher-order processing would help. AIM's point that Nevatie is a simple solution that would be expected to work is a powerful

one and works against it being obvious to add a layer of complexity without a clear steer that it would be necessary, or help.

215. I also accept AIM's point that Prof Steed's evidence on this topic was not informed by specific expectations of how Nevatie would perform, and as with Nevatie Plus, his written evidence relied on in support of Nevatie-OD, especially in his first report, was no more than that certain techniques formed a list of thing that would or "might" be considered. This is much too vague to support obviousness.

216. Taking these matters in the round, I reject the Nevatie-OD attack.

Gillette defence

217. Supponor also framed its attack over Nevatie as a *Gillette* defence; that the Supponor SVB System is an obvious development of Nevatie: the Nevatie IR Channel 1 processing plus the (Supponor says) obvious IR Channel 2 light-on dark. I can understand why it did this, to try to form part of a narrative that it had taken forwards the prior art which was its own technology.

218. However, I do not see how the *Gillette* approach could add anything. If it were obvious to develop a light-on-dark approach from Nevatie then claim 12 would be obvious whatever Supponor had or had not done. If it were not, then the Supponor SVB System would not be an obvious development from Nevatie.

AMENDMENT OF THE PATENT

219. As I said in the introduction to this judgment, amendment of the Patent was sought by AIM as a precaution in case light-on-dark was not a requirement of claim 12.

The amendments sought

220. I have set out the two versions of proposed amended claim 12 above. The relevant difference is that the second version additionally includes feature 12.8, that "the occluding object is still visible in the captured detection image".

221. There were other proposed amended claims put forward at earlier stages but they are no longer relevant.

222. Supponor objects to the amendments on the grounds that:

    i) They make no difference and do not validate claim 12 if it is obvious over Nevatie.

    ii) Lack of clarity.

iii) Added matter.

UKIPO observations

223. The UKIPO wrote to the Court with its views on the amendments. The only objection that it supported was a point about lack of clarity based on the features "LED screen" and "LED board".

224. As ever, I am grateful to the UKIPO for the care and promptness of its input. I have given careful thought to its point about clarity but have reached a different conclusion. I have had more time and information, more detailed submissions, and some evidence that it did not.

Do the amendments make any difference?

225. Supponor submits that the amendments would not make any difference.

226. It will be recalled that AIM relies on the amendments in case light-on-dark is not already a requirement of claim 1. I have held that it is, but for present purposes must proceed on the basis that I am wrong about that.

227. Supponor submits that neither "uniform monotone" nor "object is still visible" in the proposed amendments can bring in the requirement of light-on-dark. I broadly agree with that and Counsel for AIM did not really dispute it.

228. However, Counsel for AIM argued that "as if it was not active on the captured detection image" did require light-on-dark even if granted claim 12 did not. I agree with this. Counsel for Supponor engaged with it only fleetingly and hardly at all in oral submissions; the argument in Supponor's written closing was that the words refer only to the *visible* light emitted by the LED board/screen and that this did not exclude the possibility of non-visible (IR) light. However, the words do not deal with visible and non-visible light separately. They say that in the captured detection image the LED screen looks like it is not active, i.e. is not doing anything. In a system such as Nevatie (dark-on-light) the captured detection image will show that the LED screen is highly active, emitting IR.

Clarity

229. The legal standard was not in dispute: the claim needs to be as clear as the subject matter reasonably admits of: *LG Philips v Tatung* [2006] EWCA Civ 1774 per Neuberger LJ (as he then was) at [20].

230. Supponor makes four objections of lack of clarity.

<u>"LED screen/LED board"</u>

231. As I have said, this ground (alone) was supported by the UKIPO. The point is that the proposed amended claim has the expression "LED board" in the introductory part but "LED screen" in the closing clause.

232. The UKIPO's objection is that the use of these two different expressions would leave the skilled person in doubt about whether they were the same device; the UKIPO said that the expressions would appear to relate to the same device.

233. While respecting the UKIPO's views, and while I accept that the lack of antecedent basis for "LED screen" in the claim is an imperfection, I think it is extremely minor. The skilled person would read the amended claim in the light of the section of the application about active boards and that is very clear that they are in substance the same thing, at least to the extent that the self-same LEDs emitting light, which are what really matter, are in the "board" and the "screen". Such a practical approach is supported by Dr Thomas' evidence (not challenged) that "board" was sometimes used to mean the whole physical device and "screen" the part that displays the images.

234. Supponor made a complex argument about this point based on an assertion that AIM intended positively to deploy a difference between the two expressions in some way to help it on claim interpretation (the same point was also run for added matter). This did not turn out to be the case. Supponor also said (on added matter) that AIM "[d]eliberately plucking two different terms from the Patent Application and carefully inserting them into the claim to teach something which is <u>not</u> taught in the Patent Application is undoubtedly adding matter."

235. I do not think these points (the intention behind the wording, a possible tactical motive) are legally relevant to clarity, or indeed added matter. A claim amendment is either clear and properly based in the application, or not. In any event, it seems highly probable that AIM chose "board" in the first part of the claim and "screen" later simply because that is how the relevant teaching in the section of the application about active boards is arranged.

<u>"Uniform, monotone"</u>

236. Neither of these words is hard to understand. Supponor's objection is not really about the words used. It accepted that the words are clear enough if applied to a system which works by comparing a sequence of images (as in the passage on pages 12-13 of the application, corresponding to [0034] in the Patent, although I have rejected Supponor's analysis of what this means in any event, when I dealt with claim interpretation), but it says they are unclear when used in the context of a system which does not require that. I can see no logic to that, and the remark which Supponor said was about a sequence of images is after and separate from the "uniform, monotone" explanation. Uniform, monotone is also the appearance that one gets if the filter set up described is used, as the application makes explicit.

"Still visible"

237. Supponor said that this expression was unclear when taken out of context. For reasons given in relation to added matter, I think the teaching in which the expression appears would be understood to be general. Supponor's criticism focused most specifically on "still", but that is easy to understand: the word is just there to draw a contrast between the board, which looks inactive, and the occluding object which is visible because of its different optical qualities, as explained.

"Captured detection image"

238. The objection here is that claim 12 refers to detection image and the amended term is "captured detection image". This is trivial. The claim already refers to the captured image comprising a detection image and to a camera "used to capture the detection image". So I do not think there is any substantive lack of clarity. Supponor's written submissions were couched in terms of "captured detection image" not having an antecedent, but even that formalistic point (not raised by the UKIPO) is bad because "capture the detection image" is no less a good antecedent because it is in the active rather than passive voice.

Added matter

239. The legal principles were not in dispute. I summarised them recently in Nokia v OPPO [2023] EWHC 23 (Pat) at [253]:

> 253. The law on added matter is well known and was not in dispute. A strict comparison must be made and if the amended patent discloses new matter relevant to the invention that was not clearly and unambiguously disclosed before, the amendment is not allowable; see *European Central Bank v Document Security Systems* [2007] EWHC 600 at [97]ff, cited with approval in *Vector v Glatt* [2007] EWCA Civ 805. A species of this general rule arises when there is intermediate generalisation by taking a feature from a specific embodiment and introducing it into a claim when there is no indication that it was generally applicable. See *Nokia v IPCom* [2012] EWCA Civ 567.

240. There are four points on added matter. None was supported by the UKIPO.

241. The first point is LED board/LED screen. I have explained the context in addressing clarity. On the basis of my decision on clarity I do not see that there is any room for a separate added matter objection, and essentially the structure of Supponor's submissions is that they go together. In any event, there is clear basis for both expressions in the application as filed and the skilled person would learn nothing new from the proposed amended claim in this respect.

242. The other three points are all allegations (at least it is now said) of intermediate generalisation. They relate to the features of "detecting

object", "LED screen has a uniform, monotone distribution" and "occluding object is still visible".

Detecting object

243. As pleaded, this seemed to be an allegation that there was an undisclosed combination of part of the "active boards" section with part of the "spatial frequency" section, and that is what AIM dealt with in its written opening. It only made sense if "image property" had the meaning for which Supponor contended and which I have rejected (since that would have built higher order processing such as spatial frequency analysis into claim 12 prior to amendment and so with amendment there would have been features of the two sections mixed together).

244. Supponor reinforced its argument on this point by saying that the active boards section requires comparison of a sequence of images whereas the spatial frequency analysis section does not. This does not matter given my finding that "image property" does not connote spatial frequency analysis but in any event, as I have said, I have dealt with the relevant disclosure when considering the Patent and rejected Supponor's contention.

LED screen has a uniform, monotone distribution, occluding object is still visible

245. The objection in each case is that the feature is only disclosed in the context of the visible light set up of the "active boards" section.

246. I agree that the only specific example given is the visible light set up, and that is a relevant consideration for added matter. But the teaching in the section of the application as filed about active boards from page 13 line 10 onwards is in general terms. The visible light set up is context that allows the general teaching to be fully understood but there is no implication that the visible light set up has to be used and in my view the general teaching would clearly be understood to be just that: general.

247. Supponor objected that there was no expert evidence saying that the teaching was general or would be understood as such. Expert evidence of that kind is not necessary to assess added matter. Often when it is put it in turns out to be inadmissible.

THE *PROMPTU* POINT

248. The procedural context is central to the arguments on this point so I will set it out in some detail.

249. A letter from Powell Gilbert LLP (AIM's solicitors) of 21 July 2022 said "Our client would be content for the Court's decision regarding the validity of claim 1 to apply to claim 13. Please let us know if you concur."

250. Supponor's solicitors, Ignition Law, wrote back on 22 July 2022 agreeing to the proposal.

251. Later, by letter of 18 October 2022 from Powell Gilbert, AIM said that *"Our client no longer contends in these UK proceedings that claim 1 of EP(UK) 3 295 663 B1 as granted is valid. Claim 12 is therefore the only granted claim which falls to be considered at trial."* It was at this point that AIM put forward the amended versions of claim 12 that I am considering.

252. Ignition Law's initial response on 19 October 2022 included seeking confirmation that AIM's concession on claim 1 meant that claim 13 would not be defended. That was rapidly followed by a Part 18 Request in a letter of 21 October 2022 asking which features of claim 12 AIM would be contending were not in claim 13 and "upon which the Claimant will rely at trial to assert that claim 12 as amended is independently valid of claim 13."

253. AIM replied to the Part 18 Request by a letter of 21 October 2022 (the second of that day) saying that Supponor was not entitled to the information sought because claim 13 was not in issue and the differences between it and claim 12 were not relevant to any issue.

254. Ignition Law responded with a long letter of 21 October 2022 saying that because AIM had to be taken to have accepted that claim 13 was obvious, if there were no inventive difference between claim 13 and claim 12 then claim 12 was invalid. It said that it was entitled to take claim 13 as a starting point in this way, and that that was why its Part 18 Request was for relevant information. In support of this approach it cited my decision in *Promptu v Sky* [2021] EWHC 2021 (Pat) ("Promptu") at [118]-[124]. I consider that decision below.

255. Powell Gilbert replied for AIM on 23 October 2022 disputing the relevance and application of *Promptu*, and saying that its facts were different. It included a Response to the Part 18 Request, saying that "The Claimant does not contend that there is any material technical difference between claim 12 and claim 13." Earlier in the letter it had said that the validity of claim 13 should go along with claim 12 and not claim 1 because it was common ground between the parties that there was no material technical difference between claim 12 and claim 13.

256. In another long letter of 24 October 2022, Ignition Law for Supponor said the consequence of AIM's position was the whole Patent had to be revoked. It also said that it would be unfair if AIM were able to hang on to claim 13 if it won on claim 12, because claim 13 was potentially broader. Supponor challenged AIM to go to Court if it wanted to withdraw its admission(s) that claim 13 was invalid if claim 1 was.

257. This led to an application being made in the week before trial pursuant to which Joanna Smith J made an Order (without a hearing) that essentially held the ring pending trial. I do not think it is necessary to go into the details of the Order. I note that AIM put in evidence from Mr Laakonen of Powell Gilbert which pointed out that claim 13 had not been alleged to be infringed, and said that AIM's proposal that it would stand or fall with claim 1 was a pragmatic one. He broadly accepted that on closer analysis

claim 13 was very similar to claim 12 but said that that had not been noticed before. He challenged Supponor's advisers to say that Supponor had thought that AIM's concession on claim 1 also affected claim 12, a challenge which was not taken up.

The *Promptu* decision

258. In *Promptu* the patentee, which was seeking to amend the patent in suit, decided shortly before trial that it would only defend proposed amended claim 13. That claim was dependent on claim 11 which was dependent on claim 1. They were all method claims.

259. What happened thereafter and on which Supponor relies can be seen from my judgment at [118]-[124]:

> *Promptu's concession*
>
> 118. As I have already said, shortly before trial Promptu conceded the validity over the prior art of all claims down to and including proposed amended claim 11, but it said that it would defend proposed amended claim 13. Thereafter, Sky narrowed its case down to just Houser, and did not pursue its other pleaded prior art. I was not addressed in detail about the dropping of the other prior art but it seems that there was pragmatic recognition by both sides that Houser was the most relevant art once proposed amended claim 13 was the only remaining target.
>
> 119. Following Promptu's narrowing to proposed amended claim 13, correspondence ensued in the course of which Promptu's solicitors said Promptu would "assert the inventiveness of amended claim 13 alone", and that "the only validity issues that remain concern amended claim 13".
>
> 120. Promptu's opening skeleton, paragraph 48, then said:
>
> > "Amended claim 13 is dependent on amended claim 11, itself dependent on amended claim 1. Those two prior claims add the features of (i) a content engine which feeds into the speech recognition system and (ii) a remote control with a microphone and a talk button which pre-processes the user's speech and communicates with the set top box using radio-frequencies. These features are not relied on as inventive in these proceedings."
>
> 121. During the cross-examination of Dr Robinson a dispute emerged about the effect of this concession, when Counsel for Promptu asked Dr Robinson questions about the steps necessary to get from Houser to proposed amended claim 11. Counsel for Sky objected that those were no longer in play as a result of Promptu's concession. I directed that the evidence should conclude and that the point could be argued afterwards.

122. When the discussion returned to this point, Counsel for Promptu took the position that although the concession precluded his arguing that getting to proposed amended claim 11 from Houser was inventive, it was nonetheless legitimate for Promptu to rely on the sequence of steps involved as part of a *Technograph* (*Technograph Printed Circuits v. Mills & Rockley* [1972] RPC 346 HL) argument, albeit that each was uninventive. I must say that I had not anticipated that that line would be taken, and nor, clearly, had Counsel for Sky, who had not cross-examined on those steps individually.

123. After some discussion, Counsel for Promptu took the fair and pragmatic stance that Promptu would not rely on the steps necessary to get from Houser to proposed amended claim 11, but would maintain that the steps necessary to get from there to proposed amended claim 13 had to be shown by Sky to be obvious in the specific context of Houser; that Sky could not treat proposed amended claim 11 itself, as an abstract collection of features, as being part of the prior art.

124. I think that was right in principle, and was fair. One reason it was fair was that any confusion about the scope of the concession was, in the circumstances, the responsibility of Promptu. In practical terms it meant that the logic for making, in the context of Houser, the further step to proposed amended claim 13 had to be consistent with Sky's concrete case relating to proposed amended claim 11 as it had been developed in the context of Houser through the evidence of Dr Robinson. Sky always knew that that was going to be the case and there can have been no surprise about it.

125. There was some further discussion about this point, right at the end of the oral argument, in Promptu's reply, in the context of *Pozzoli* question 3. I felt that Promptu was trying to retreat from its previous position as identified above, because it contended that the *Pozzoli* differences included all of the features arising on the claims prior to proposed amended claim 13.

126. However, although Promptu was in this way presenting a somewhat moving target in point of principle, at a concrete level I do not think it made any difference, because it was clear that the only specific point that Promptu sought to make was an alleged inconsistency between the threshold feature in Houser and the implementation of the push-to-talk button, also taught in Houser, that Sky relied on. I am able to deal with this, and do so below.

260. Summarising what happened:

i) In a cascade of dependent (method) claims of the usual kind, the patentee had conceded that it was obvious to get all the way to claim 11, but not from claim 11 to claim 13.

ii) The reason for the concession was a piece of prior art called Houser.

iii) In the circumstances of the case, I thought that the patentee was trying to act inconsistently with the concession by arguing that it was not, after all, obvious to get to claim 11.

iv) After discussion the patentee accepted that it could not say that it was not obvious to get to claim 11, but would attack the defendant's case for going from claim 11 to claim 13 if that was inconsistent with how the defendant had said it was obvious to get to claim 11 from Houser.

v) Although there was some further debate, I ruled that that was fair. In the end the patentee failed on the alleged inconsistency anyway (in a part of my judgment on the facts, not quoted above).

261. As will be apparent from the (rather long) quote above, I did not purport to decide any point of principle in *Promptu*. And furthermore, in the most part the issue was resolved because the patentee took a reasonable stance after discussion during its submissions. So I do not see that it can be cited by Supponor for any principle applicable to this case, and Supponor in its closing submissions said that it was not drawing any close analogy on the facts. I agree with that, for reasons I will come to in a moment. I am left rather uncertain on what basis of principle Supponor asks me to proceed.

Analysis

262. The gist of Supponor's argument is that AIM admitted that claim 13 was invalid if claim 1 was, that claim 13 is indistinguishable from claim 12 in any relevant way that could make it independently valid, and therefore that claim 12 must be invalid.

263. In my view, and in agreement with AIM, this argument is fallacious at at least three stages.

264. First, AIM did not admit that claim 13 was invalid if claim 1 was. It just made a pragmatic concession that there was no point defending claim 13 separately. In fact it is quite easy to see how in theory claim 13 could be valid if claim 1 was not, because of the different claim types.

265. Second, AIM never admitted that claim 12 was invalid if claim 13 was. It may be that the conclusion is difficult to resist in logic, but AIM did not formally admit it, even allowing for its somewhat odd suggestion in its letter of 23 October 2022 that claim 13 should stand or fall with claim 12 instead of claim 1.

266. Third, AIM never admitted that claim 12 was invalid. It has always defended it, and in its letter dropping claim 1 it made clear that claim 12 required resolution.

267. I do not think it legitimate to combine admissions and matters said logically to flow from admissions to reach a result which was expressly not accepted

by the party making admissions.

268. This case is quite different from *Promptu*, where the admission that had been made was clear and explicit and not in dispute, and the debate was over the consequences.

269. I do not believe that a reasonable person in the position of Supponor would have interpreted AIM's conduct as admitting by implication that claim 12 was invalid. I also do not believe that Supponor in fact thought that. The letter of 19 October 2022 says nothing of the kind but does ask for confirmation that claim 13 (and claim 10) fell away with claim 1. Had Supponor thought as much then I would have expected it to rise to the challenge in Mr Laakonen's witness statement and to say so. I think Supponor's conduct was and has been opportunistic and a distraction.

270. Stepping back, I consider that it would be extremely unjust to prevent AIM from relying on claim 12. Its concession that claim 13 would fall with claim 1 was, on the evidence (which is inherently plausible), a purely pragmatic one given that claim 13 was not alleged to be infringed. The later concession on claim 1 was no doubt necessitated by realising that its product form made it too vulnerable, and more vulnerable than claim 12. There was no reason for AIM to think about any knock on effect on claim 12 via claim 13 and I do not believe it did so.

271. I would also say that it would be unfortunate to discourage patentees in this sort of situation from making sensible admissions about claims other than the main ones for fear of an unforeseen consequence.

272. Since I do not think there is any relevant admission standing in the way of AIM's defending claim 12, the issue of withdrawing an admission does not arise (indeed, it is rather hard to identify what admission it would apply to withdraw) and I do not need to decide it. I have found all the facts and I have indicated where, from my perspective as trial judge, the justice of the situation lies. So if it does become necessary to consider matters from the point of view of withdrawing an admission, I think the Court of Appeal would have the necessary primary findings.

273. As I have touched on above, in the rather confused and fast-changing situation that arose AIM tried to tie claim 13 to claim 12 rather than claim 1 and hence (potentially) save it. That is not legitimate and is inconsistent with AIM's pragmatic decision to give up on claim 13 if it lost claim 1. So claim 13 must be deleted.

CONCLUSIONS

274. My conclusions are:

    i) Claim 12 of the Patent is valid as granted so no amendment to it is necessary.

ii) The proposed amendments to the Patent would be permissible were they necessary.

iii) Supponor's SVB System infringes.

iv) All other claims must be deleted because AIM did not defend them (claim 1), accepted that they were not independently valid of claim 1, or (claim 13) accepted that it should stand or fall with claim 1.

275. I will hear Counsel as to the form of Order if it cannot be agreed. I direct that time for seeking permission to appeal shall not run until after the hearing on the form of Order (or the making of such Order if it is agreed). I draw attention to paragraph 19.1 of the Patents Court Guide, which says that a hearing on the form of Order should take place within 28 days of hand down. In the present case, 28 days from hand down will be 27 February 2023.