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(71) Applicant: **MOBII SYSTEMS (PTY) LTD** [ZA/ZA]; Unit 6 Bella Rosa Mini-Factories, 30 Bella Rosa Rd, Rosenpark, 7535 Bellville (ZA).

(72) Inventor: **THACKER, MIchael Don**; 29 Wilger St, Amanda Glen, 7550 Durbanville (ZA).

(74) Agent: **SIBANDA & ZANTWIJK**; PO Box 1615, Houghton 2041, Johannesburg, Gauteng (ZA).

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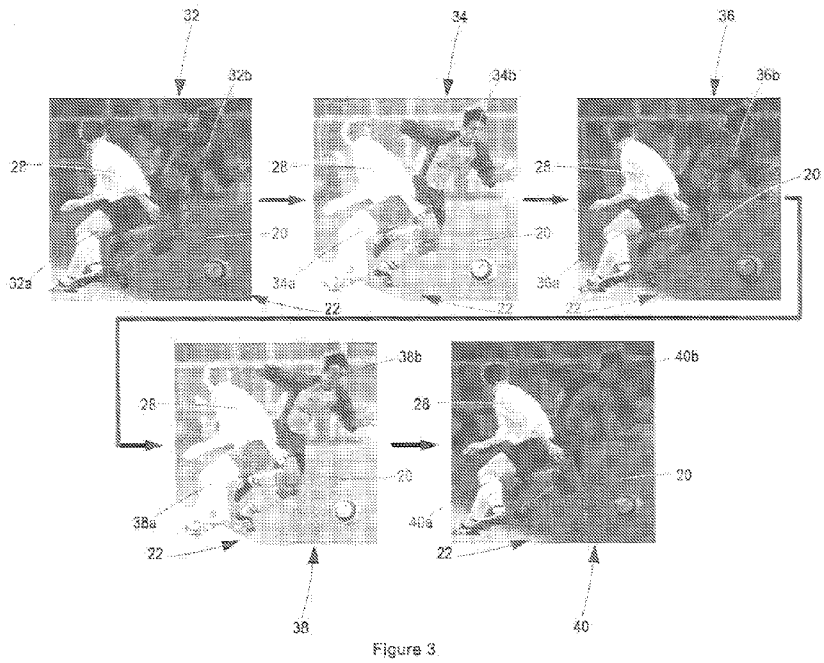

Figure 3

(57) Abstract: A method of generating and processing images with variable light conditions includes the steps of: (i) capturing a first image using a sensor or camera having a first quality parameter setting (e.g. ISO sensitivity setting, the shutter speed setting, the aperture setting and/or the sensitivity setting); (ii) capturing a second image using, a sensor or camera having a second quality parameter setting, which second quality parameter setting is different to the first quality parameter setting; (iii) creating a composite image using a portion of the first image and a portion of the second image, without overlap of the image portions; and (iv) performing an image processing technique on the composite image.

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METHOD OF GENERATING AND PROCESSING IMAGES

BACKGROUND

The present invention relates to a method of generating and processing images. More specifically, the present invention relates to a method of: (i) generating a composite image from sections of two images with different properties; and (ii) processing such composite image.

Using two cameras or sensors to generate images is known. For instance, WO03/043316 "Dual camera surveillance and control system" to Gin describes a camera including: (i) a high sensitivity mono camera with enhanced infrared response for zero ambient light surveillance; (ii) a colour camera for high ambient light conditions; and (iii) a switch for switching between the two cameras in response to changes in the ambient light condition. WO2007/069892 "Camera system" to Internova Holding BVBA describes a similar system, but using two cameras with different light sensitivity settings.

It is also known to use a first image to process a second image. For instance, US2013/0135445 "Primary and auxiliary image capture devices for image processing and related methods" to 3DMedia Corporation describes a system comprising a primary image capture device that captures a first image having a first quality characteristic (e.g. resolution, colour, luminance and shaking) and a secondary image capture device that captures a second image having a second quality characteristic of lower quality than the first quality characteristic, and using one of the captured images to adjust at least one parameter of the other captured image so as to align the quality characteristics of both images - the aim being to equalize and combine the images to form a 3D image.

US8,378,851 "Fusion of images in enhanced obstacle detection" to Stein *et al* describes a collision detection system utilizing an infrared camera and a visual light camera. The system overlaps/aligns and fuses the FIR and VIS images to determine the distance between objects captured in the images and the cameras.

Use of multi-camera systems to track objects during sports games is also known. For instance, US2013/0148861 "Systems and methods for video processing" to W-Ideas

Network Inc. describes a system that automatically switches between cameras to ensure that appropriate cameras are used to track selected objects on a sports field.

Furthermore, US2005/0036036 "Camera control apparatus and method" to Stevenson *et al* describes a system that records images from different cameras, as an object tracked by the system moves between the fields of view of the cameras.

None of the known systems are specifically suited to tracking objects within an area with variable light intensity. And, it is an object of the present invention to provide a system that is tailored to such an application.

SUMMARY OF THE INVENTION

According to a first embodiment of the present invention, a method of generating and processing images includes the steps of:

capturing a first image using a sensor or camera having a first quality parameter setting;

capturing a second image using a sensor or camera having a second quality parameter setting, which second quality parameter setting is different to the first quality parameter setting;

creating a composite image using a portion of the first image and a portion of the second image, without overlap of the image portions; and

performing an image processing technique on the composite image.

Typically, the first image is captured by a first sensor or camera and the second image is captured by a second sensor or camera. Alternatively, the first and second images are captured by the same sensor or camera, which quality parameter setting alternates between the first and second quality parameter settings for consecutive images captured.

Generally, the quality parameter setting is the exposure setting, the ISO sensitivity setting, the shutter speed setting, the aperture setting and/or the sensitivity setting.

Preferably, the first quality parameter setting is suited to high ambient light conditions and the second quality parameter setting is suited to low ambient light conditions.

Typically, the portion of the first image used to create the composite image is the portion showing an area with high ambient light conditions, and the portion of the second image used to create the composite image is the portion showing an area with low ambient light conditions.

Generally, the composite image is processed to identify or track an object in the composite image.

Preferably, the method of generating and processing images is used to track objects taking part in a sports event.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a sports event occurring on a field that is half in the shade, with cameras operating the method of generating and processing images according to a preferred embodiment of the invention;

Figure 2 is a first image captured by a first camera and a second image captured by a second camera according to the method in Figure 1;

Figure 3 is a series of consecutive frames captured by a single camera according to the method of generating and processing images according to a second embodiment of the invention; and

Figure 4 is a composite image generated according to the method of generating and processing images according to either the first or second embodiments of the invention.

DESCRIPTION OF THE INVENTION

With reference to Figures 1, 2 and 4, a method of generating and processing images 24 and 26 utilises a first camera or sensor 12 and a second camera or sensor 14 linked together so as to share the same field of view (i.e. to capture contemporaneous images of the same area).

The linked cameras 12 and 14 are located proximate each other. The first camera 12 has a first quality parameter setting (e.g. an exposure, ISO sensitivity, shutter speed, aperture and/or sensitivity setting), and the second camera 14 has a second quality parameter setting (e.g. an exposure, ISO sensitivity, shutter speed, aperture and/or sensitivity setting). The first quality parameter setting being different to the second quality parameter setting.

For example, the ISO setting on the first camera 12 may be low (i.e. suited for high ambient light conditions), while the ISO setting on the second camera 14 may be high (i.e. suited for low ambient light conditions).

Figure 1 shows a sports event taking place in a stadium 16. The sun 18 casts a shadow 20 over the field 22. As such, a portion of the field 22 is exposed to intense sunlight, whereas the rest of the field 22 is subjected to comparatively low ambient light. During the sports event, player 28 runs over the field 22, in and out of the shaded portion 20.

The quality of portions 24a of a first image 24 in the sunny part of the field 22 that is captured by the first camera 12 is good, since the ISO setting of the first camera 12 is specifically suited to these conditions. However, the quality of portions 24b of the first image 24 in the shade 20 captured by the first camera 12 is poor, since the ISO setting of the first camera 12 is too low for the low level of ambient light in this region. Similarly, the quality of portions 26b of a second image 26 in the shade 20 that are captured by the second camera 14 is good, since the ISO setting of the second camera 14 is specifically suited to these conditions, whereas the quality of the portions 26a of the second image 26 in the sunny part of the field 22 captured by the second camera 14 is poor, since the ISO setting of the second camera 14 is too high for the high level of ambient light in this region.

Accordingly, when a player 28 runs around the field 22, in and out of the shade 20, the suitability of the first and second cameras 12 and 14 to capture good quality images 24

and 26 of the player 28 alternate – the first camera 12 providing good quality first images 24 of the player 28 in the sun and the second camera 14 providing good quality second images 26 of the player 28 in the shade 22.

Figure 2 shows a first image 24 captured by the first camera 12 and a second image 26 captured by the second camera 14.

A computer (not shown) analyses the first and second images 24 and 26 and identifies the good (24a and 26b) and poor (24b and 26a) quality portions of each image 24 and 26. This could be done by analysing differentiations in the colour of pixels. For example, where the differentiation in colour between foreground objects and the background is low, that portion of the image could be recorded as over or under-exposed (see portion 24b and 26a, which are under and overexposed, respectively). Alternatively, the computer could analyse the general colour of a portion of the image 24 and 26. Where this is too light or dark, that portion 24b and 26a could be recorded as over or underexposed.

The good portions (24a and 26b) of each of the first and second images 24 and 26 are extracted. Where common portions of the first and second image 24 and 26 are extracted, the computer retains the portion that is of a higher quality than the other. These extracted portions (24a and 26b) of the first and second images 24 and 26 are then combined to form a composite image 30 shown in Figure 4. It will be appreciated that none of the portions 24a and 26b of the first and second images 24 and 26 forming part of the composite image 30 overlap. Instead, distinct portions 24a and 26b are "stitched" together.

The method of combining images according to the present invention should be contrasted against High-Dynamic-Range Imaging (HDRI) techniques. HDRI comprises taking a series of consecutive source images of the same subject matter at different luminosity settings and calculating a weighted sum of the pixel luminance of the source images to generate a "composite" image. Since each source image is spaced in time, this technique is not particularly suited to generating "composite" images of moving objects, as the moving object in each source image will have shifted, creating "ghosts" and/or blurred outlines. It is also worth pointing out that averaging the pixel luminosity of a series of source images effectively constitutes "overlapping" source images.

Furthermore, the computer processing required to generate an HDRI image is typically greater than that required to generate a composite image 30 according to the present invention.

Returning to the method according to the present invention, since the composite image 30 includes only the good quality portions 24a and 26b of the first and second images 24 and 26 the colour of the objects (e.g. the player 28) in the foreground of the composite image 30 is distinct from the colour of the background (which distinct outline should be contrasted with the blurred outline of moving objects generated by HDRI). This differentiation in pixel colour renders the composite image 30 suitable for image processing techniques, such as object identification and/or tracking. Furthermore, since the composite image 30 generated by the present invention does not overlap portions of first and second images 24 and 26, "ghosting" of a moving image does not occur.

It will be appreciated that, using the method described above, movement of the player 28 can be tracked when the player 28 is running in both the sunny and the shady parts of the field 22.

According to a second embodiment of the invention, the method of generating and processing images utilises a single camera 12. The ISO sensitivity of the camera 12 is variable so as to switch between low and high ISO settings for consecutive images captured by the camera 12 (otherwise known as "frames"). As shown in Figure 3, the camera takes a series of images 32 to 40 of a player 28 on a field 22 that is partially in the shade 20. The first image 32 is taken at a low ISO setting and therefore captures the sunny part of the field 22 in good quality (see portion 32a), while underexposing the shaded 20 portion 32b. The consecutive, second image 34 is taken at a high ISO setting and therefore captures the shaded part 20 of the field 22 in good quality (see portion 34b), while overexposing the sunny portion 34a. Consecutive images 36 to 40 similarly alternate between low and high ISO settings.

Unlike the preferred embodiment, where the first and second images 24 and 26 are taken contemporaneously, the images 32 to 40 are spaced in time. However, using a high speed camera 12 will limit differences between consecutive images 32 to 40.

A computer (not shown) then uses pairs of consecutive images (i.e. images 32 and 34, 34 and 36, 36 and 38, and 38 and 40) to create four composite images 30 in the same manner as previously described, which composite images 30 may be subject to image

processing techniques to identify or track a mobile object (e.g. the player 28) captured by the images 32 to 40.

CLAIMS

1. A method of generating and processing images including the steps of:

capturing a first image using a sensor or camera having a first quality parameter setting;

capturing a second image using a sensor or camera having a second quality parameter setting, which second quality parameter setting is different to the first quality parameter setting;

creating a composite image using a portion of the first image and a portion of the second image, without overlap of the image portions; and

performing an image processing technique on the composite image.

2. A method according to claim 1, wherein the first image is captured by a first sensor or camera and the second image is captured by a second sensor or camera.

3. A method according to claim 1, wherein the first and second images are captured by the same sensor or camera, which quality parameter setting alternates between the first and second quality parameter settings for consecutive images captured.

4. A method according to claim 2 or claim 3, wherein the quality parameter setting is the exposure setting, the ISO sensitivity setting, the shutter speed setting, the aperture setting and/or the sensitivity setting.

5. A method according to claim 4, wherein the first quality parameter setting is suited to high ambient light conditions and the second quality parameter setting is suited to low ambient light conditions.

6. A method according to claim 5, wherein: (i) the portion of the first image used to create the composite image is the portion showing an area with high ambient light conditions; and (ii) the portion of the second image used to create the composite image is the portion showing an area with low ambient light conditions.

7. A method according to claim 6, wherein the composite image is processed to identify or track an object in the composite image.

8. A method according to claim 7, used to track objects taking part in a sports event.

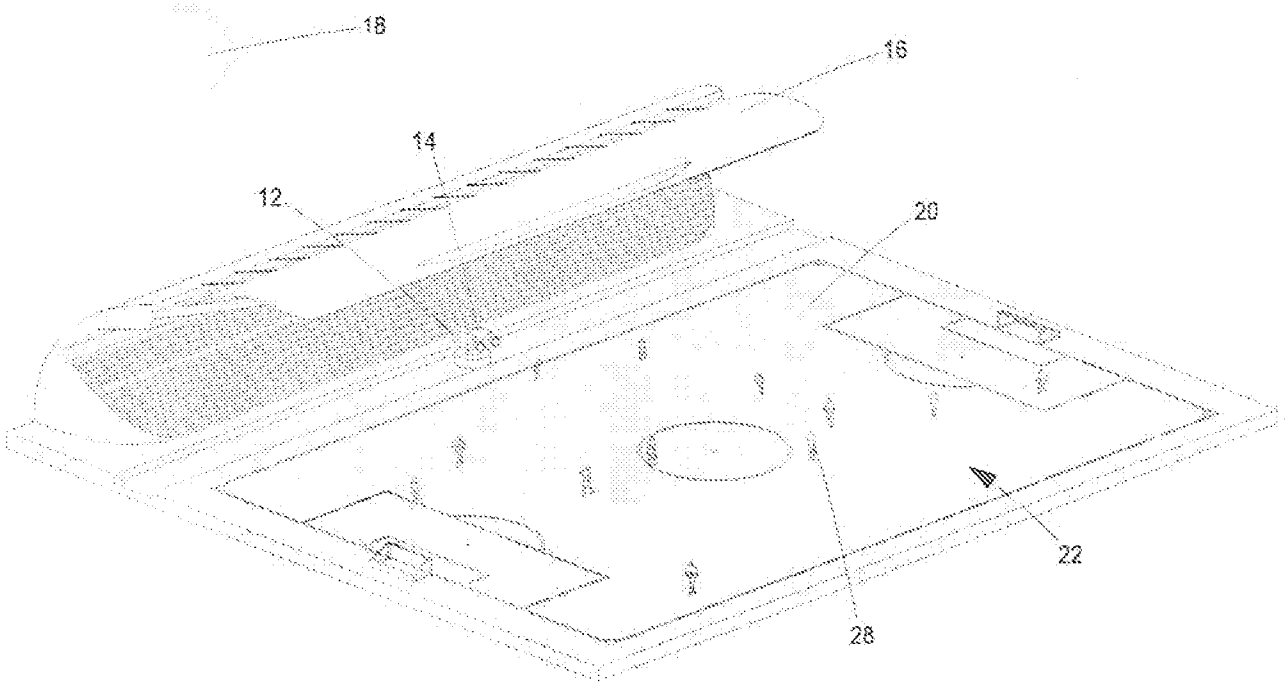

Figure 1

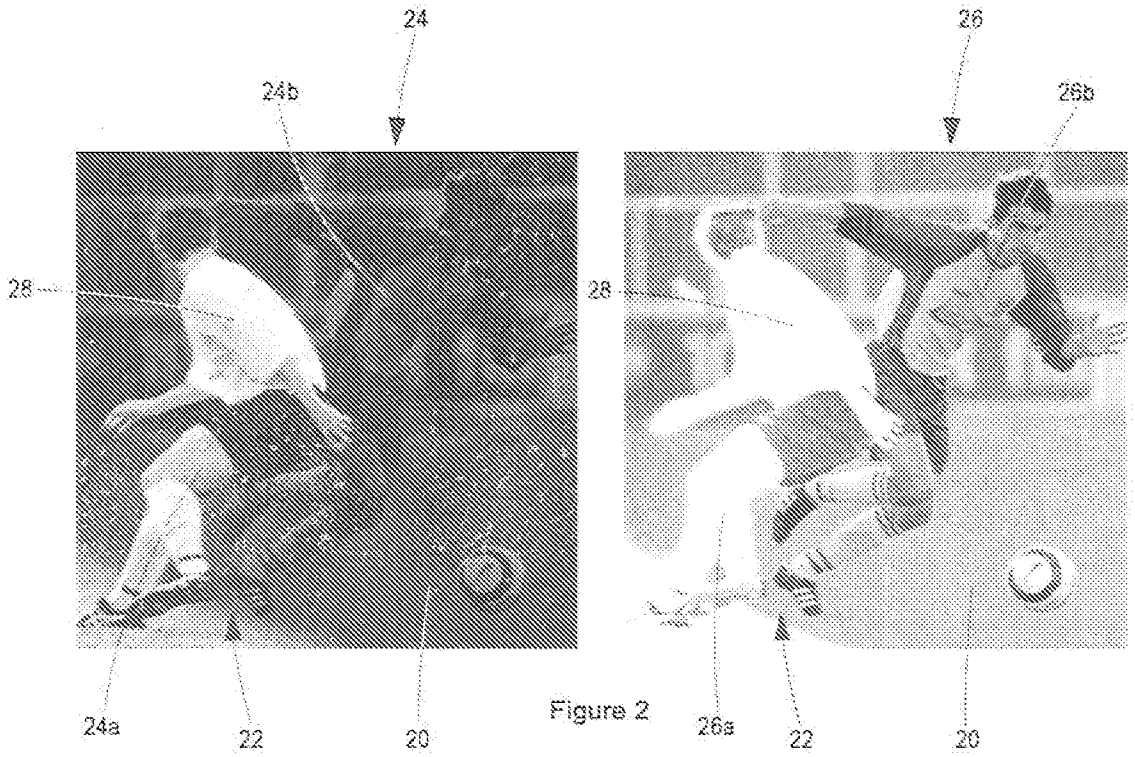

Figure 2

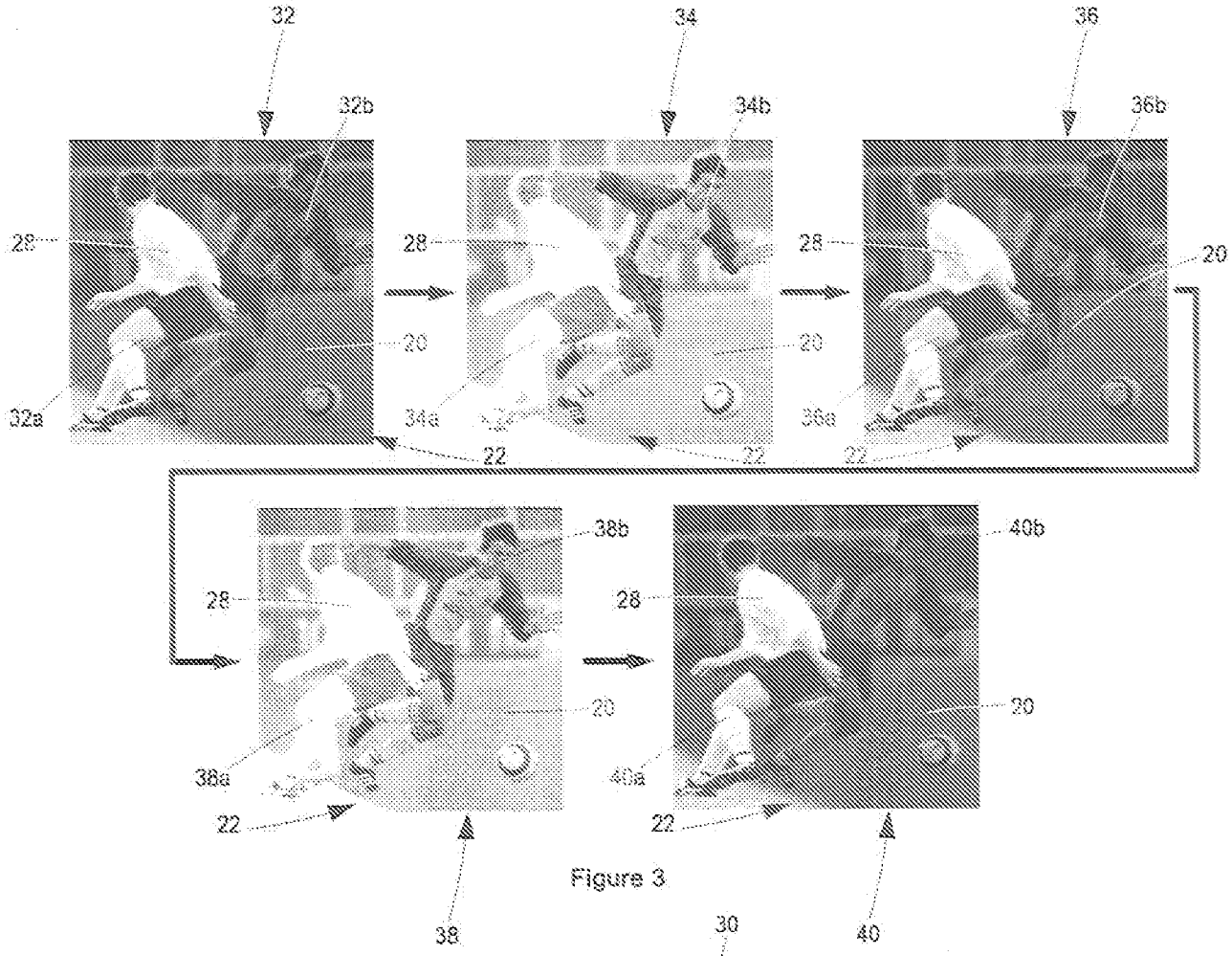

Figure 3

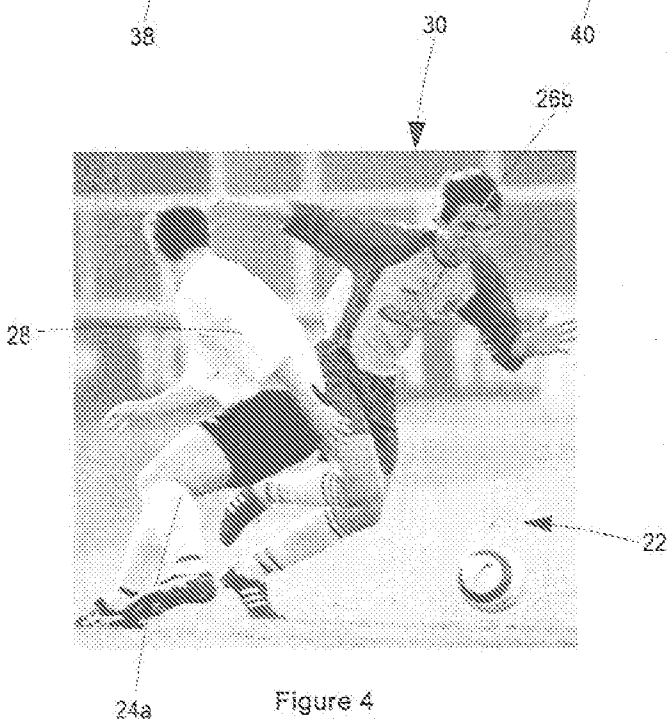

Figure 4