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(54) **Title:** METHOD AND APPARATUS FOR CAMERA CONTROL AND PICTURE COMPOSITION

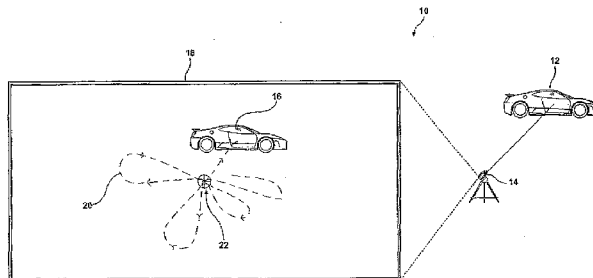


Figure 1

(57) **Abstract:** The present invention relates to an apparatus for capturing video footage of a moving object, including a plurality of movable cameras controlled by a control means, the control means being in communication with a tag device attached to said object such that at least one of said plurality of cameras tracks the movement of said object, wherein, the position of an image of said object, within a respective camera's picture frame, is biasly influenced by at least one biasing means. The biasing means, maybe a point within the camera's picture frame, or a magnetic line traversing at least portion of the camera's picture frame, or a target frame within the camera's picture frame, or a combination thereof. The present invention takes into consideration complex framing and cinematographic composition that provides footage of a race participant, such as a motor racing vehicle in which jerky footage is undesirable.

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Method and apparatus for camera control and picture composition

FIELD OF THE INVENTION

The present invention relates generally to the field of broadcasting and in one aspect relates to a system for broadcasting a sporting event wherein the position of an object's image, within a camera's field frame, is biasly influenced by at least one
5 biasing means.

BACKGROUND OF THE INVENTION

The popularity of sporting events, increased broadcast capabilities and viewers' preferences have resulted in an increase in television coverage of such
10 contests. There are now dedicated channels on free-to-air, satellite and cable television that provide 24-hour sports coverage.

The capacity of technologically advanced cameras to capture footage of sporting participants and events means that the viewer often has the best "seat in the house" without even having to leave their own home. Technological advances mean
15 that cameras can be mounted within motor cars during race events and within cricket stumps.

Despite these advances many cameras used to capture sporting events are mounted on pan tilt heads and are controlled by an inaccurate human operator. During high speed sports such as motor racing rapid direction changes and complex
20 framing are required. Currently available manually-controlled cameras are deficient in that they rely upon the skill level and reflexes of an operator.

Various camera-tracking systems have been suggested in paper publications that are able to track a target, wherein the target has a radio frequency or GPS tag attached thereto. These systems are however relatively simple and do not take into
25 consideration complex framing and cinematographic composition. Furthermore the footage obtained from such camera systems is often jerky or erratic, which detracts from the viewing experience.

It should be appreciated that any discussion of the prior art throughout the specification is included solely for the purpose of providing a context for the present invention and should in no way be considered as an admission that such prior art was widely known or formed part of the common general knowledge in the field as it existed before the priority date of the application.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention, but not necessarily the broadest or only aspect there is proposed an apparatus for capturing video footage of a moving object, including at least one camera configured to follow the movement of said object, wherein the position of an image of said object, within a camera's picture frame, is influenced or biased by at least one biasing means.

The term picture frame, or frame, is used throughout the specification and refers to the edges of the camera lens' field of view, or edges of the image as seen in a television, camera viewfinder or projected image onto a screen. A camera operator or motorised controller can be said to keep a car in frame by panning with it as it speeds past. In addition, the term point refers to a geometric element having a position located by coordinates, but no magnitude.

In a further aspect of the invention there is proposed an apparatus for capturing video footage of a moving object, including a plurality of movable cameras controlled by a control means, the control means being in communication with a tag device attached to said object such that at least one of said plurality of cameras tracks the movement of said object, wherein the position of an image of said object, within a respective camera's picture frame, is biased or influenced by at least one biasing means.

In one form the biasing means is a point within the camera's picture frame, or a magnetic line traversing at least a portion of the camera's picture frame. The position of the image of said object within the picture frame may be biased towards said point or magnetic line.

In another form the biasing means is a target frame within the camera's picture frame. The position of the image of said object within the camera's picture frame may be biased away from the target frame, such that the image of the object is retained within the target frame, and biased towards the centre of said target frame.

5 The target frame may be located at any position within the frame to primarily allow for compositional requirements, but also to compensate for advertisement or statistics tables that may be incorporated into the broadcast images. The target frame may form any 2D shape which includes all rectangular, circular and oval shapes.

10 The biasing means may be a combination of a point, magnetic line and target frame that influences the position of the image of said object within the camera's picture frame. There may be a hierarchical system used to determine which constant influences the position of the image. It should be appreciated that different biasing means could be sequentially used.

15 Alternatively a user could change the position of the biasing means depending upon the footage that is required.

The tag device may be an active or passive tag that is attached to the object and is recognisable by the control means.

20 In one form the tag may be an active RFID tag, which may contain a battery and can transmit a radio-frequency signal autonomously. The active RFID tag will generally contain an integrated circuit for storing and processing information, modulating and/or demodulating a radio-frequency (RF) signal. The active tag typically also contains a transmitter attached to an antenna for transmitting a RF signal and may contain a receiver.

25 In another form the tag is a passive tag, which require an external source to initiate signal transmission. The passive tag may include special coatings applied to the object, readable information contained on a device such as a silicon chip, memory chip or any other device that can be read without physical contact between the detection means and the passive tag.

In one form the passive tag may include a reflection prism, bar code, microwave detectable means, microchip or be marked with RF readable alphanumerics.

5 The apparatus may be configured to track a plurality of objects each preferably having a respective tag device attached thereto.

In another aspect of the invention there is proposed a method of tracking at least one object with a video capturing device to obtain video footage of the moving object, including the steps of:
controlling at least one camera using a control means to track the movement of object;
10 moving the camera such that the position of an image of said object within the camera's picture frame, is biased or influenced by at least one biasing means.

At least one biasing means may be a point within the camera's picture frame, or a magnetic line traversing at least portion of the camera's picture frame, or a target frame within the camera's picture frame, or a combination thereof.

15 In one form the method includes the further step of ordering a plurality of tagged objects so that the control means can be used to select and deselect preferred objects for which video footage will be obtained using the video capturing device.

A broadcast manager may be in control of said camera and the ordering of tagged objects by way of a control means, wherein said manager determines the type
20 of video footage obtained.

In yet another aspect of the invention there is proposed an apparatus for capturing video footage of a vehicle crash event, including a camera configured to selectively follow the movement of a vehicle to which a tag device is attached, wherein the position of an image of said tagged vehicle within a picture frame is
25 biased or influenced by at least one biasing means, and a control means configured to analyse the movement of a tagged vehicle to anticipate if said vehicle is going to be involved in a future crash event, the control means including a virtual map of the race course and a data source having information relating to expected vehicle race lines,

vehicle turning radius at specified speeds and conditions, and recommended maximum cornering speeds, wherein if said vehicle deviates from the expected race line or has a race alignment and speed that indicates a collision, or has a cornering speed that exceeds the recommended maximum cornering speed, or onboard accelerometers indicate a bump or crash, then said camera is controlled to follow and frame the movement of said vehicle in a specified manner.

In one form the control device can calculate the expected trajectory of said vehicle to determine the expected position of said crash event at the point where the expected trajectory of the vehicle intersects a roadside barrier, information of which is contained within said virtual map. This crash point may be used by the apparatus's cameras and system in their automated framing methods.

In still another aspect of the invention there is proposed an algorithm for controlling the operation of the preceding apparatus and for the apparatus's applications. In one form the algorithm is contained within a software program. The software program may be implemented as one or more modules for undertaking the steps of the present invention. The modules can be packaged functional hardware units for use with other components or modules. Multiple processing units may be used to control the operation of the apparatus.

Some of the components of the apparatus may be connected by way of a communication means such as, but not limited to, a RF Link, a modem communication path, a computer network such as a local area network (LAN), Internet, or fixed cables.

In one form the broadcast control means includes a computer having memory in the form of random access memory (RAM) and read-only memory (ROM), a central processing unit or units, input/output (IO) interfaces and at least one data storage device. The computer includes application software for controlling the servo encoded pan tilt heads, servo encoded zoom and focus lenses, and for undertaking the task of processing input data.

The processor and the memory cooperate with each other and with other components of a computer to perform all of the functionality described herein. In another form the processor executes appropriate software to perform all of the functionality described herein. In an alternate form, some or all of the functionality described herein can be accomplished with dedicated electronics hardwired to perform the described functions.

Application software may be stored in a computer readable medium on a storage device such as a floppy disk, a hard drive, a magneto-optical disk drive, CD-ROM, magnetic tape, integrated circuit, a radio or infra-red transmission channel between the computer and another device, a computer readable card such as a PCMCIA card, a flash drive or any other of the number of non-volatile storage devices. The foregoing is merely exemplary of relevant computer readable mediums. Other computer readable mediums may be practiced without departing from the scope of the invention.

In another form the apparatus includes embedded software or firmware with corresponding hardware that is designed to perform one or more dedicated functions of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate implementations of the invention and, together with the description and claims, serve to explain the advantages and principles of the invention. In the drawings,

Figure 1 is a schematic view of an embodiment of the biasing means of the present invention used to position the image of the object within the picture frame;

Figure 2 is a perspective view of the biasing means of figure 1 with respect to the three-dimensional space defined by the camera's lens;

- Figure 3a-d are schematic views illustrating different biasing means of the present invention;
- Figure 4 is a schematic view of an embodiment of the apparatus of the present invention;
- 5 Figure 5 is a schematic view of a picture frame illustrating the position of a number of tracked targets and a mean target icon used in the present invention; and
- Figure 6 is a schematic view illustrating the crash aware function of the present invention.

10 DETAILED DESCRIPTION OF THE ILLUSTRATED AND EXEMPLIFIED EMBODIMENTS

There are numerous specific details set forth in the following description. However, from the disclosure, it will be apparent to those skilled in the art that modifications and/or substitutions may be made without departing from the scope and
15 spirit of the invention. In some circumstances specific details may have been omitted so as not to obscure the invention. Similar reference characters indicate corresponding parts throughout the drawings.

Referring to the drawings for a more detailed description, an apparatus 10 for capturing video footage of a moving object 12 is illustrated, demonstrating by way of
20 examples, arrangements in which the principles of the present invention may be employed. As illustrated in figure 1 the apparatus 10 includes at least one camera 14 configured to follow the movement of object 12, wherein the position of an image 16 of the object 12, within a camera's picture frame 18, is biased or influenced, by at least one biasing means 22.

25 To fully comprehend the present invention it is important to firstly examine the way in which video footage is obtained by the camera 14. As illustrated in figure 2 the picture frame is a two-dimensional image of a three-dimensional space 24. This three-dimensional space 24, within which objects are in focus, is defined by the field

of view 26 and depth of field 28 of the camera 14. The depth of field 28 has a minimum plane 30 and maximum plane 32 which are defined by the objective distances along the optical axis where an object appears to be "in-focus", outside of this range an object will appear out of focus. Midway between the minimum 30 and maximum 32 extremes is plane 34, where the object will be at optimal focus. It should be appreciated that the minimum plane 30, maximum plane 32 and plane 34 are all curved. This is called the field curvation and is an attribute of the camera's lens.

It is envisaged that the biasing means 22 of the present invention will be placed on plane 34. The biasing means 22 can be a point, magnetic line or target frame that is configured to attract or repel the image within the camera's picture frame 18. As indicated by the object's path of travel 20 on the camera's picture plane, where the biasing means 22 is a point configured to attract the image 16, the object 12 may be able to move, within the three-dimensional space 24, along axes x, y, z, or simply two axes.

As illustrated in figure 3a, a radio frequency tag 36 is attached to the object 12. In this way the object's position within the camera's picture frame 18 is known and the camera can move accordingly to capture footage of the object 12. The use of a biasing means reduces jerky movement of the camera that may lead to viewer discomfort. As further illustrated in figure 3a the biasing means 22 may be a point 38 that can be positioned at any location on the picture frame 18. Alternatively, as illustrated in figure 3b the biasing means 22 is a magnetic line 40, having a start point 42 and end point 44. The apparatus 10 can be configured so that the camera follows the object for a selected period of time such that the image 16 drifts along the magnetic line 40 from the start point 42 to the end point 44 being biasly weighted towards magnetic line 40 but being capable of drifting away therefrom.

In a further embodiment, as illustrated in figure 3c, the biasing means 22 is a target frame 46 within which the image 16 of the object 12 is biasly retained within the frame. The target frame 46 ensures that the image does not move outside a predefined area 46 of the screen but is nevertheless allowed a degree of movement.

Therefore as the image 16 approaches the target frame 46 the camera is moved so that the image's position is changed to ensure it does not exit the target frame 46. This embodiment may be used so that results or statistics can be selectively placed in a blank area 48 on the broadcast image without interfering with the image 16 of the race participant.

In yet a further embodiment, as illustrated in figure 3d, the biasing means 22 comprises a marker point 38, magnetic line 40 and target frame 46 that controls the path of travel 20 of the image 16 and the movement of the camera 14 depending upon the position of the image 16 on the camera's picture frame 18. It should be appreciated that other shapes and configurations of the biasing means 22 could be used.

The skilled addressee would appreciate that the further the object's image 16 moves away from, or toward, the biasing means 22 the stronger the influence will be. As the reader will appreciate this will be dependent upon whether the biasing means 22 is set to attract or repel the image 16. By increasing the magnetic weighting of the biasing means 22 the path of travel 20 of the object's image 16 within the picture frame 18 away from or towards the biasing means 22 can be changed. Hence the operator is able to restrain the movement of the target or targets within the picture frame or alternatively allow a relatively large amount of movement of the image 16 within the picture frame 18. Movement of the image 16 within the picture frame 18 is based upon the image's 16 speed and direction of travel, and the magnetic weighting of the biasing means 22. The strength properties of the magnetic weight of the biasing means 22 includes but are not limited to, directly and inversely proportional behaviour, linear relationship behaviour, and logarithmic proportional behaviour. The size of the magnetic area surrounding the biasing means 22 within the picture frame 18 can be adjusted by the operator.

The apparatus is useful for sporting events such as motor racing and ball sports where the targets are moving at high speeds and are difficult to frame without rapid movement of camera, which unfortunately often produces footage that is jerky and

less than desirable. The present invention provides a system for obtaining close-up footage without erratic movement of the picture.

When an operator is selecting an object 12 and a biasing means 22 referred to here as the marker point 38 is active, then the target is restrained around the marker point 38. The image 16 continues to stay on or close to the marker point 38 proportional to the calibrated magnetic strength of the marker point 38. The reader will now appreciate that a marker point 38 with high magnetic strength holds the image 16 firmly on to it, while a marker point with a low magnetic strength permits the image 16 to drift away and back to the marker point depending on the speed and direction of the target.

The principle function of the magnetic line 40 as illustrated in figure 3b is to bring the image 16 close to the magnetic line 40 via the shortest route, and keep it on the magnetic line, proportional to the specified magnetic strength. The magnetic line 40 may be a straight line as illustrated in figure 3b or it may be curved or shaped into any profile. The magnetic line 40 traverses the picture frame 18 at any angle or curve and at any location within the picture frame 18. An optional feature is that the operator can specify how the target travels along the magnetic line 40 by nominating speed of travel with an entry 42 and an exit point 44. The magnetic weighting, which allows for drifting of the object's image 16 produces a smooth visual cinematographic sequence between points 42 and 44.

The magnetic line 40 requires four specified calibrations, firstly a percentage calibration which governs the strength of the magnetic attraction, secondly the size of the magnetic area or field surrounding the line 40, thirdly a percentage calibration governing the speed that the object 12 can travel along the magnetic line 40, and fourthly the acceleration or deceleration at which the target visually bounces off the target frame 46 or picture frame 18.

The second and third calibrations involving speed and acceleration, and other live commands and presets can be linked to the master default setting, which can be used by all cameras 14 in the system.

The target frame 46 as illustrated in figure 3c enables a singular image 16 or multiple images to be confined within the frame 46. As such the target frame also controls the camera lens' zoom calibration to ensure that multiple selected images 16 remain within the target frame 46 at all times regardless of their grouped or dispersed location. As with all of the biasing means 22 the target frame 46 can be activated or deactivated at any stage during camera operation. When active the selected target or targets are restrained within the target frame 46. The edge of the target frame 46 has a magnetic weighting such that the object's image 16 is repelled.

This means that the object's image 16 remains within the predetermined area of the picture frame 18 however is still able to move or drift because of its own speed and changes in directions. This means that the cinematographic sequence will be smooth even in the event that the target is moving randomly and rapidly. The target frame is able to be adjustable in size, shape and location, thus creating a variable negative space between the target frame and picture frame. Shapes of target frames 46 include squares, rectangles, ovals and circles.

It should be noted that the target frame 46 can be used with dynamic tagged objects such as a soccer ball and static tagged objects such as a soccer goal, so that the two objects will always be within the target frame 46. It should also be noted that it can be used with two dynamic tagged objects such as a cricket player and the cricket ball.

The target frame's 46 four calibrations are; strength, size, speed and acceleration. The following is an elaboration of these:

- Strength calibration - 100% (the highest) pushes the object's image 16 furthest away from the edge of the frame 46. 0% Strength calibration allows the target to float (according to its own direction) within the frame and touch the edge of the frame 46.
- Size calibration expands and contracts the size of the frame. Size calibration 100% - target frame 46 equals size of the picture frame 18. Size calibration 600% equals target frame six times larger than picture frame 18. Size calibration 50% equals target frame 46 half picture frame 18.

- The speed of the image 16 within the target frame must be specified. For instance, specifying the master default will use the calibrations of the master default pan speed.
- Acceleration within the target frame must be specified. For instance, specifying the master default will adopt those pan tilt acceleration calibrations.

Maximum and minimum zoom speeds can be individually specified or can be defaulted from the master default zoom speeds. Specified maximum and minimum zoom speeds stop excessive blurring and provide a desired working range.

The target frame 46 works in conjunction with the zoom function, thus as the selected targets visually spread out and touch the target frame, the automatic zoom zooms out enabling all selected targets 12 to remain within the target frame 46. As the selected targets converge, the zoom increases. If the target frame 46 is off then the picture frame 18 becomes the defining edge for the automatic zoom function.

The target's path or drift 20 through the target frame 46 has four options which must be specified.

1. Engage other ordering devices e.g. the magnetic line or marker point with the target frame.
2. The target may drift within the frame according to its own direction.
3. The angle of collision on the target frame equals a reflected angle of deflection.
4. The target is bounced off the target frame towards the centre after it contacts the frame.

In a further embodiment the tracking system can determine the trajectory of a ball being tagged and can identify a landing zone and the tagged players closest to that landing zone. As such a target frame 46 can be used to frame both tagged player and ball as both objects collide. Alternatively the operator may simply frame the player closest to the landing zone in a previously specified manner.

In a further embodiment, as illustrated in figure 4, the apparatus 10 comprises a radio frequency tracking system 50 that uses triangulation to locate selected objects 12 having respective RF tags 36 attached thereto. The selected objects 12 are within a preselected area such as a race course 52. It should however be appreciated that other tracking systems can be used, such as radar type tracking, optical recognition or DGPS devices. The tags 36 may be either active or passive as is well known in the art.

The apparatus 10 further includes a central processing unit 54 (CPU) and receivers 56. It is envisaged that the system 10 will include a plurality of receivers coupled to respective antennae which are located around the race course 52 or sporting field. Each receiver 56 is linked via fibre optic cabling or telemetry back to the tracking CPU 54.

This tracking CPU 54 relays to the camera CPU 68 the exact location of each tagged object 12. Cameras 14 can be zoomed in and focused on the desired tagged targets 12. The camera CPU 68 relays the pan, tilt, zoom and focus requirements to the cameras 14 by way of fibre optic cabling or alternative by way of a transmitter (not shown). The images 58 captured by the plurality of cameras 14 are conveyed back to the CPU 68 and the operator or director 60 is able to select the cinematic picture 62 suitable for broadcasting 64.

It is envisaged that each camera 14 will incorporate a servo encoded pan tilt head with tripod support as is well known in the art. However, the reader should appreciate that other camera operating system can be used including boom-mounted and dolly mounted cameras, and cameras suspended from cables in a flying fox configuration. Broadcast cameras and lenses are mounted on the servo encoded pan tilt heads, which align their pan tilt axes with dynamic accuracies of 0.03 degrees or better at the targets 12.

The camera controls 66 facilitate use of the various aspects of the invention and typically have ergonomic controls, joy sticks, live and preset function keys, calibration dials and a variety of computer-based commands enabling detailed and

progressive composition of the cinematic pictures. The camera controls 66 work in conjunction with the computer 68 and camera screen interface 62. Where several cameras or computers are being used, they will all be linked to the central processing unit 54.

5 The software commands can be utilised by individual cameras 14 and also by a Director who can manage all selected cameras 14 in a coordinated network.

The apparatuses' software commands can be broken into four basic distinct groups and are as follows:

- 10 1. Target lock-on - these commands enable the operator to capture desired tagged target or targets and track them using a camera or cameras. These commands include: engaging automatic mode; manual entry of target number; addition and subtraction; travelling keys; and priority targets.
- 15 2. Biasing Means 22 - the marker point 38, magnetic line 40 and target frame 46 can be set individually for each camera 14, or all cameras can utilise the master default biasing means 22. Biasing means 22 enable aesthetic framing, proportion, target placement within picture frame, speed and acceleration.
- 20 3. Live commands - these commands enable selected target or targets to be viewed and visually sequenced in a prescribed manner. These commands include: dynamic zoom shift; dynamic pan shift; collision framing; destination framing; and repeat.
- 25 4. Director's override - these commands enable the director to override individual operator controls and presets, and facilitate the coordination of all servo encoded pan tilt heads and associated cameras in a variety of ways. These commands include: unification; director's presets; accident aware; priority targets; and graphics allowance.

The tag 36 attached to each object 12 may emit a different individual frequency. This means that each of the targets 12 can be identified with an assigned number that appears within a target's icon on the operator's screen 62. The target icon that appears on the operator's screen 62 can be selected by typing the associated

number using the function keys or by moving crosshairs over the object's image 16 using a mouse or joystick. Target lock-on enables the operator to select one or more targets and frame them within the predetermined frame or portion of the picture frame. It is envisaged that there will be several different ways of locking onto or
5 selecting a target. Some of the methods are as follows:

1. When changing from manual mode to automatic mode the system recognises any targets within the target frame (if active) and locks on automatically.
2. Manual entry, which requires the operator to key in the target's I.D. number via the controls. Similarly targets can be removed by entering for example "-X
10 enter" using the function keys.
3. Priority targets are selected by the director on the master control which is then relayed to the individual operators. The operator may switch automatic priority targets to active, which will automatically lock-on to the priority target when within camera viewing area. When priority targets are within the specified
15 camera viewing area, the target icon both on the screen and in the target order will flash red until it has been selected. The priority target icon when selected remains red.
4. Addition and subtraction keys on the controls are used to add or remove targets from the selected targets. There are two sets of addition and subtraction keys.
20 The first set of keys controls the adding or removing from the front selected targets, e.g. from the leaders. The second set of keys controls the adding and removing from the rear of the selected targets, i.e. from the followers. This is particularly useful under race conditions.
5. Travelling keys can also be used in changing selected targets. If two targets
25 have been selected i.e. 2nd & 3rd place and the positive travelling key is pressed then the selected targets become 1st & 2nd place. Similarly, pressing the negative travelling key when 2nd & 3rd place are selected will result in 3rd & 4th place being tracked.
6. If the automatic function is selected and no targets are being tracked, the
30 function keys can be used to select the target closest to the centre of the picture

frame, or the target nearest a preselected point or magnetic line within the picture frame.

As illustrated in figure 5 the apparatus 10 can be used to track a number of objects. In the present example race vehicles 70, 72, 74, to which respective tags 36 are attached, are tracked by apparatus 10. The position of the respective images 76, 78, 80 within the camera's picture frame 18 are determined by the mean target location (MTL) 82 that is influenced by the biasing means 22, in this example being a point 38. When two or more objects have been selected and the target frame and the automatic zoom are active, then the zoom will automatically maximize the zoom calibration while still retaining all the selected targets within the camera's picture frame 18 or a specified target frame 46.

When two or more objects 12 are selected then the MTL icon 82 will appear on the screen 62. The MTL 82 becomes the defined target's location within the picture frame 18 when determining picture composition with the biasing means 22.

Acceleration and deceleration zoom calibrations can be preset to ensure that the camera does not move too quickly which may lead to viewer discomfort. Automatic zoom is enabled when the system is in the automatic mode and a target or targets have been selected. The automatic zoom, when used in tracking a single target, enables the selected target to stay as a fixed proportion or fixed visual size of the target frame. Thus the target appears not to change in size as its focus changes and the automatic zoom adjusts. The operator can still change the automatic zoom setting via the camera control 66, after which the latest setting and thus visual size becomes the default setting.

Automatic focus is enabled when the system is in automatic mode and a target or targets have been selected. Because the target is being tracked the subject distance between camera and target is a known value and the system is calibrated to ensure that the target is in focus at all times. It is therefore important for the operator to specify one of the following parameters for this command:

1. Use the mean target location (MTL) as the focal length, or

2. Use the leading target for the focal length calculation, or
3. Use target closest to screen centre point (CP) for the focal length calculation, or
4. Use best fit, which uses both MTL and CP for calculation.

If the biasing means 22 are not active and an object 12 is selected, then the
5 object's image 16 will remain in the same location within the picture frame 18 as it
was when it was initially selected. The operator can shift this selected target or mean
target location within the picture frame 18 via the live interaction mode through the
joystick or any other mechanism. If the centre point of the picture is on the live
interaction mode the operator can shift the target away from the centre point of the
10 picture, but once joystick pressure is released then the target will move back to the
centre point. Live interaction mode can be used within all commands with the
exception of director's override commands.

Pan & zoom acceleration are individually adjustable percentage calibrations,
which govern the rate that an object image 16 travels across the picture frame 18 and
15 the zoom speed. High percentages correspond to sharp and aggressive changes. Low
percentages give gentle and slow changes. The master default pan and zoom
acceleration and speed are specified in the system preset and govern all pan and zoom
acceleration and speed settings within the commands, on the proviso that the
commands are set to master. Each command can have its own specified pan and zoom
20 acceleration & speed calibrations.

The speed bar governs the speed (forward and reverse) at which the dynamic
zoom, dynamic pan and live commands are performed. For example, if a dynamic pan
command is engaged with a specified pan speed of 50% (moderate) and the speed bar
is pushed fully forward, then the choreographed dynamic pan command will increase
25 its pan speed to 100%. In effect the speed bar combines all specified pan and zoom
acceleration & speed calibrations and collectively and proportionally changes them
depending on the movement of the speed bar. The master pan and zoom acceleration
& speed are utilised in a variety of live commands and presets. These include
automatic zoom, dynamic pan, changing selected targets, and camera story lines.

Master pan and zoom acceleration & speed have percentage calibrated, which are governed by individual calibrated dials on the control interface.

Dynamic zoom is a live command that zooms in or out on specified selected targets. For each dynamic zoom the operator must specify the:

- 5 - Pan start point and finish point locations.
- Start and finish zoom calibration.
- Zoom speed and acceleration.

Specifying the vehicle type, scenario number, creating a scenario and the zoom and pan calibrations for speed, acceleration, start and finish points is all performed through the CPU 68. The software has many standard dynamic zooms in the library and facilitates additional dynamic zooms to be created, catalogued and loaded for future use. Numerous dynamic zoom and dynamic pans can be linked together into a single live command. All live commands (eg. a dynamic zoom) have a genesis scene, which is created from the command start point, zoom calibrations and ordering biasing means 22. If the live command button on the camera control 66 is pressed and held down then the dynamic zoom scene will remain at the genesis scene calibrations. This action is called a genesis hold. When the button is released then the remainder of the command will be instigated. Each choreographed scenario is performed at specified speed and acceleration rates. These combined rates may be changed using the speed bar. The speed bar enables the choreographed scene to be sped up or even reversed.

A dynamic pan function pans across a selected target or targets from a specified pan start point to a specified pan finish point along a specified travel path with intermediate points, within specified pan speed, pan acceleration and zoom calibrations. The command itself is intrinsically the same as the dynamic zoom shift, except one is calibrated for zooming and the other panning. This is useful for the operator in organising the commands. The pan shift command requires a specified path of travel upon which the target tag or the MTL of numerous targets travels. The software facilitates dynamic pans to be created, catalogued and loaded for future use. Each dynamic pan scenario can be loaded onto a live button. As the reader would

now appreciate a dynamic pan command enables panning from the front of the selected vehicle (i.e. F1) to its rear at a specified pan and zoom calibration.

In a further embodiment of the invention, as illustrated in figure 6, the apparatus 10 incorporates a vehicle crash event function 84. In such an embodiment
5 84 the camera 14 is configured to selectively follow the movement of a vehicle 12 to which a tag device 36 is attached and a control means 86 configured to analyse the movement of a tagged vehicle 12 to anticipate if said vehicle 12 is going to be involved in a future crash event 88, the control means 86 including a virtual map of the race course 90 and a data source having information relating to expected vehicle
10 race lines 92, cornering ability and recommended maximum cornering speed, wherein if said vehicle 12 deviates 94 from the expected race line 92, has no chance of making a corner, or has a cornering speed that exceeds the recommended maximum cornering speed said camera is controlled to follow and frame the movement of the vehicle 12 in a previously specified manner.

15 In use the tagged race car 12 moves along the race track 90 at known speed and direction. The central processing unit 86 is able to calculate the racing line 92 under the present race conditions such as weather. If the tagged vehicle 12 deviates 94 from this racing line 92 or if the vehicle 12 is approaching a corner at too great a speed the CPU 86 is able to calculate that the vehicle is about to lose control. Since
20 the speed and direction of the vehicle is known the CPU 86 is able to calculate an approximate crash path 96. The system can include information about the layout of the circuit such that the CPU 86 is able to control cameras 14 to capture footage of the impact 88. Live interaction through the joystick is permitted. The camera will stay selected to the accident aware target until lock off by the operator. No automatic
25 commands such as priority targets will override the accident aware command with the exception of another accident aware command. The operator may lock off the accident aware target with another command or delete at any time. Once a target has departed from the track for more than a specified period of time, it is classified as dead. A dead target is tracked but will not activate the accident aware command by
30 being off the race track. A dead target may become alive if it passes onto the track.

The operating system specifies the maximum cornering speeds of vehicles and camber of track surfaces, the acceleration and deceleration rates and specification of time period between deviation from track and when target is classified as dead. This time period may be set as a default of five seconds. Individual cameras can have their
5 preset zoom, centre point and target frame calibrations set as required for each camera location.

The operator can nominate priority targets such as race leaders. When the priority targets enter a camera's viewing area the camera automatically locks on to the priority target and overrides currently selected targets. Priority targets may be set by
10 individual camera operators or by the director.

The various aspects of the invention relate to picture composition and control of a camera or cameras used to obtain footage of an event such as a sporting contest. There are several features covered by the invention including, but not limited to, a tracking system, picture composition, camera controls, and software commands. The
15 reader should appreciate that each of these features can be used in combination or alternatively can be used in isolation from each other.

As the reader will now appreciate when biasing means 22, such as a point 38, are used to restrain the object's image 16 around the preselected position within the picture frame 18 the jerky movement of the camera 14 is reduced which results in
20 footage that is smooth. The point 38 can be positioned anywhere within the picture frame 18 which means that the object's image 16 can be restrained to a position distinct from the actual centre point of the picture frame 18. This is useful for compositional control and allowing for screen graphics. The marker point 38 has a magnetic weighting, which attracts the object 12. Accordingly, the camera 14 is
25 adjusted to thereby restrain the movement of the object's image 16 within the picture frame 18 such that the object's image 16 moves or drifts around the point 38 as illustrated by dotted line 20.

The skilled addressee will now appreciate the many advantages of the present invention. The invention overcomes the issues relating to the reliance on human

accuracy and agility to focus on and frame a subject. The system can be used to frame a target moving at high speed such as a race car or football without producing erratic footage.

Various features of the invention have been particularly shown and described
5 in connection with the exemplified embodiments of the invention, however, it must be understood that these particular arrangements merely illustrate and that the invention is not limited thereto. Accordingly the invention can include various modifications, which fall within the spirit and scope of the invention. It should be further understood that for the purpose of the specification the word "comprise" or "comprising" means
10 "including but not limited to".

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An apparatus for capturing video footage of a moving object, including at least one camera configured to follow the movement of said object, wherein the position of an image of said object, within a camera's picture frame, is biasly
5 influenced by at least one biasing means.
2. An apparatus for capturing video footage of a moving object, including a plurality of movable cameras controlled by a control means, the control means being in communication with a tag device attached to said object such that at least one of said plurality of cameras tracks the movement of said object,
10 wherein the position of an image of said object, within a respective camera's picture frame, is biasly influenced by at least one biasing means.
3. The apparatus according to claims 1 or 2 wherein the biasing means is a point within the camera's picture frame, or a magnetic line traversing at least a portion of the camera's picture frame, such that the position of the image of
15 said object within the picture frame is biased towards said point or magnetic line.
4. The apparatus according to claims 1 or 2 wherein the biasing means is a target frame within the camera's picture frame, wherein the position of the image of said object within the camera's picture frame is biased away from the target
20 frame, such that the image of the object is retained within the target frame, and biased towards the centre of said target frame.
5. The apparatus according to claim 2 wherein the tag device is an active or passive tag that is attached to said object and recognisable by said control means.
- 25 6. A method of tracking at least one object with a video capturing device to obtain video footage of the moving object, including the steps of:
controlling at least one camera using a control means to track the movement of object;

moving the camera such that the position of an image of said object within the camera's picture frame, is biasly influenced by at least one biasing means.

7. The method according to claim 6, wherein the, at least one biasing means, is a point within the camera's picture frame, or a magnetic line traversing at least
5 portion of the camera's picture frame, or a target frame within the camera's picture frame, or a combination thereof.
8. The method according to claims 6 or 7 including the further step of ordering a plurality of tagged objects so that the control means can be used to select and
10 deselect preferred objects for which video footage will be obtained using the video capturing device.
9. The method according to any one of claims 6 to 8 wherein a broadcast manager is in control of said camera and the ordering of tagged objects by way of control means, wherein said manager determines the type of video footage obtained.
- 15 10. The method according to any one of claims 6 to 9 including the further step of selectively controlling the position, size, movement, time period or combination thereof, of the object's image within said picture frame.
11. The method according to claim 10 wherein the position, size, movement, time period or combination thereof, of said object's image within said picture frame
20 is controlled using a plurality of computer coded instructions that may be linked or altered.
12. The method according to claim 11 including the further step of identifying geographical areas or trigger events, that when reached activate at least one of said plurality of computer coded instructions.
- 25 13. The method according to any one of claims 6 to 12 including the further step of controlling a plurality of cameras with substantially the same biasing means settings, target selection and interaction methods.

14. The method according to any one of claims 11 to 13 including the further step
of creating a hierarchy catalogue that details which computer coded
instructions have precedence in the event that multiple computer coded
instructions are selected, and wherein the hierarchy catalogue determines which
5 zoom, pan speed or other parameter has precedence in the event of a conflict.
15. An apparatus for capturing video footage of a vehicle crash event, including a
camera configured to selectively follow the movement of a vehicle to which a
tag device is attached, wherein the position of an image of said tagged vehicle
within a picture frame is biasly influenced by at least one biasing means, and a
10 control means configured to analyse the movement of a tagged vehicle to
anticipate if said vehicle is going to be involved in a future crash event, the
control means including a virtual map of the race course and a data source
having information relating to expected vehicle race lines, cornering ability and
recommended maximum cornering speeds, wherein if said vehicle deviates
15 from the expected race line or has a cornering speed that exceeds the
recommended maximum cornering speed, then said camera is controlled to
follow and frame the movement of said vehicle.

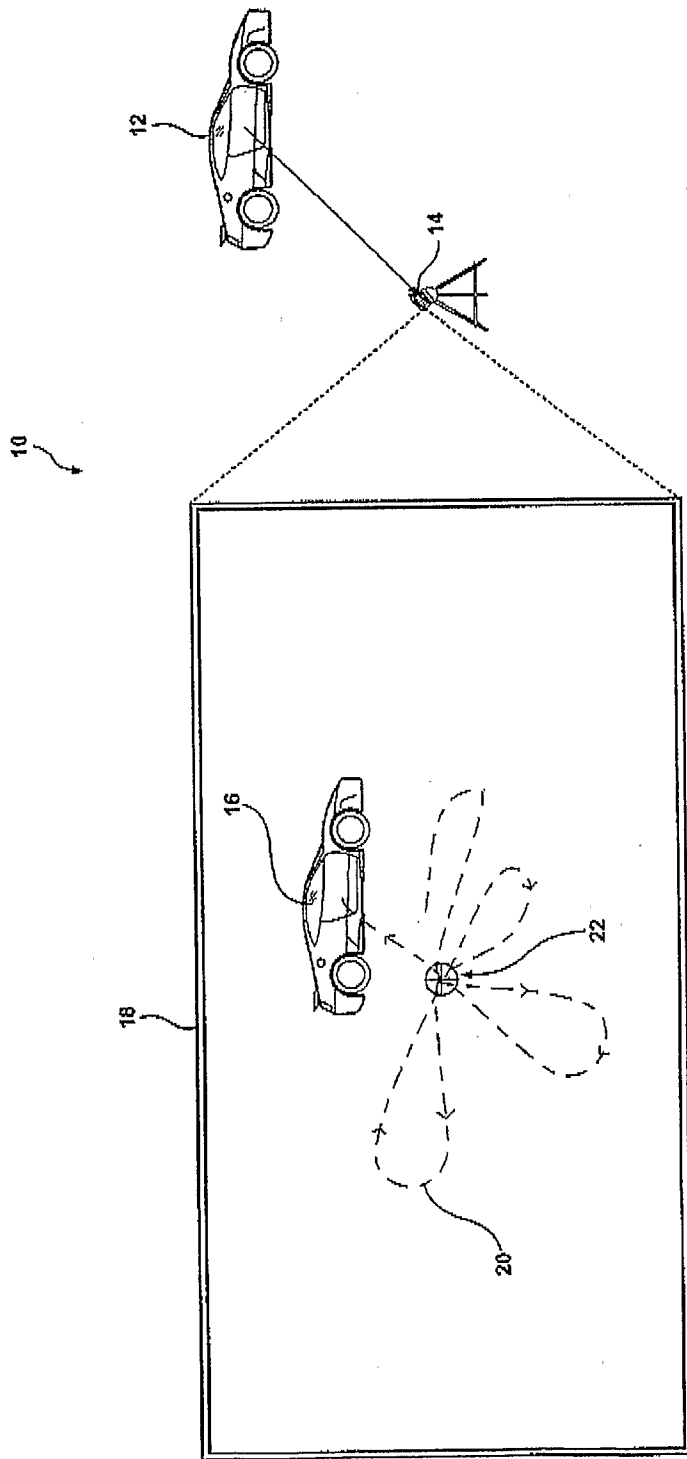


Figure 1

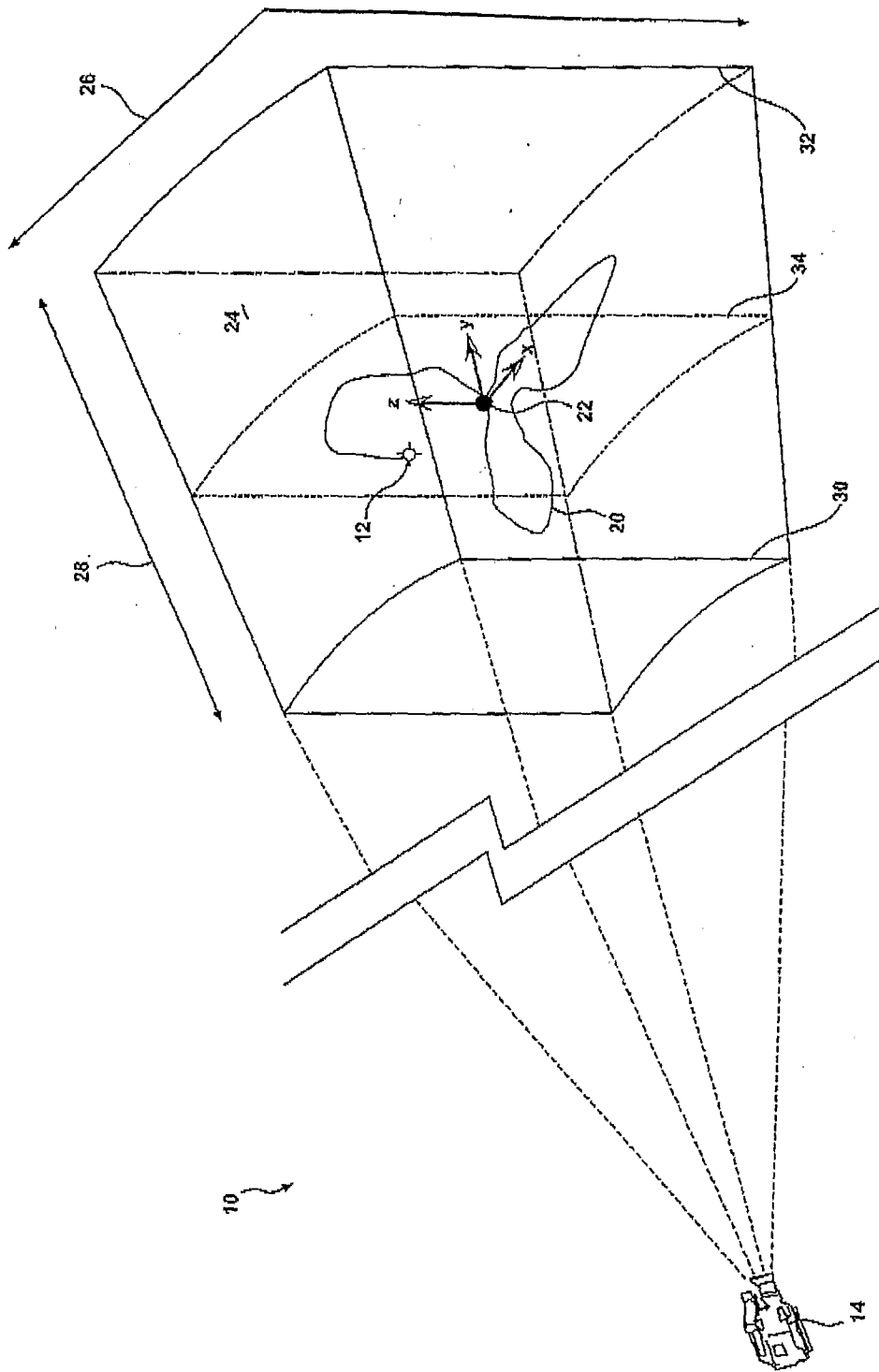


Figure 2

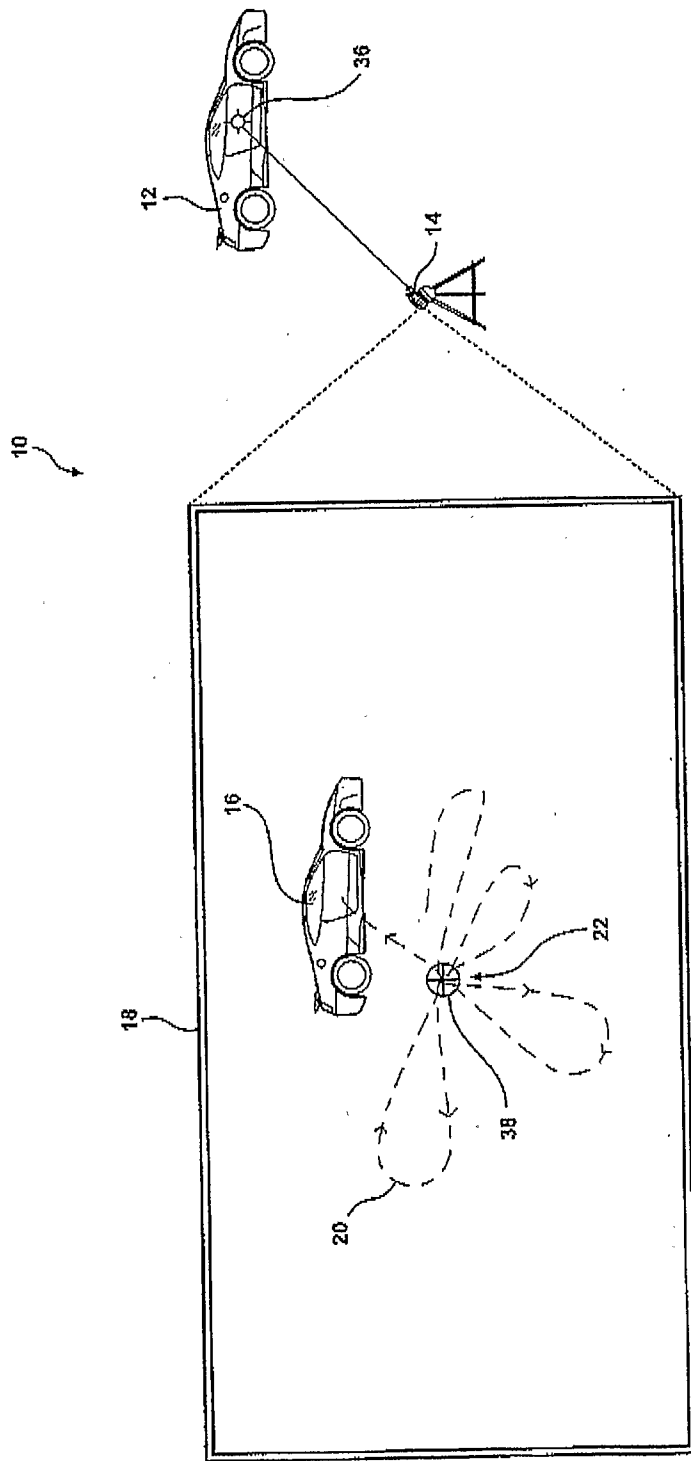


Figure 3a

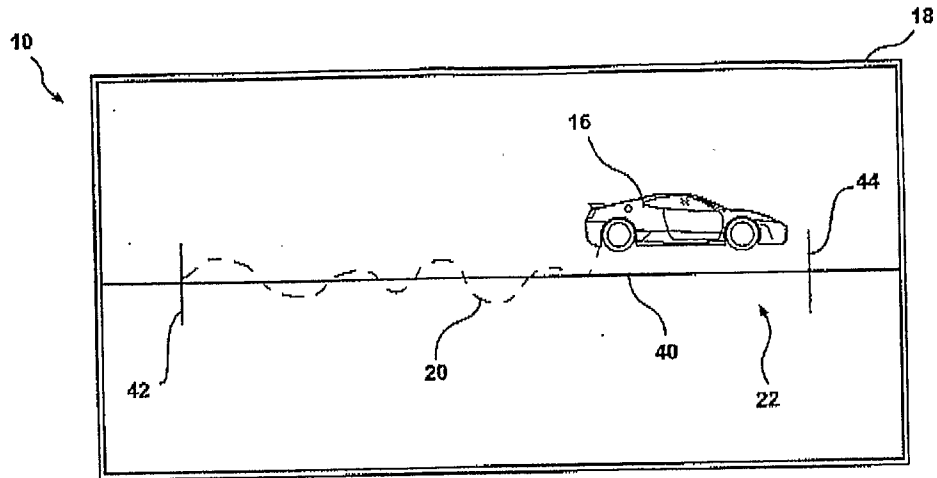


Figure 3b

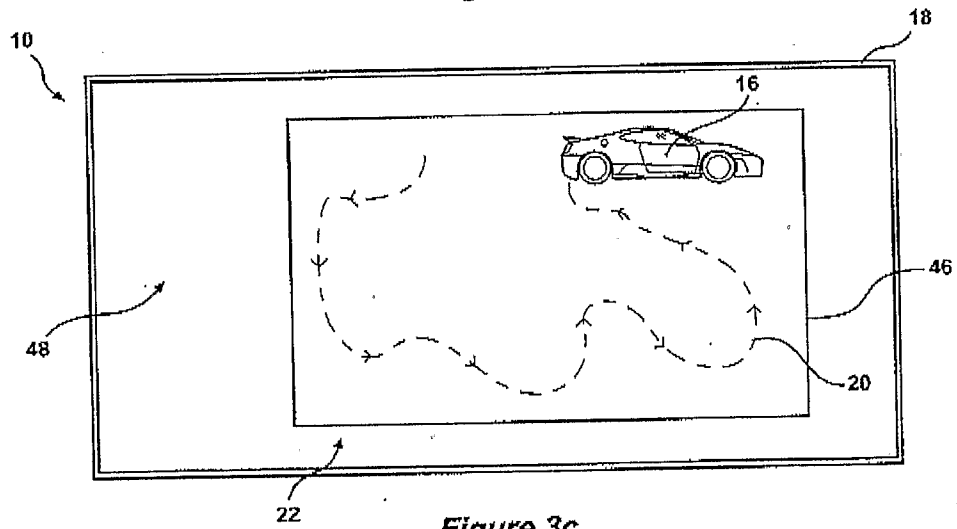


Figure 3c

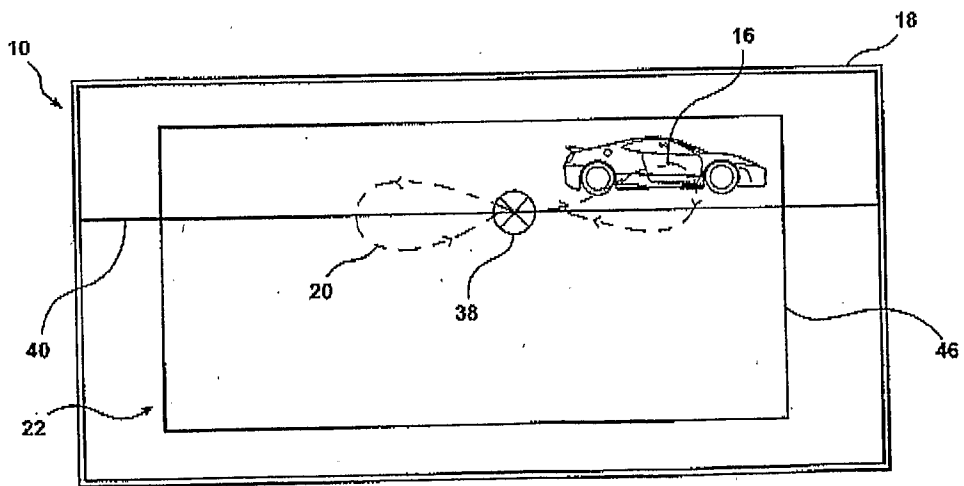


Figure 3d

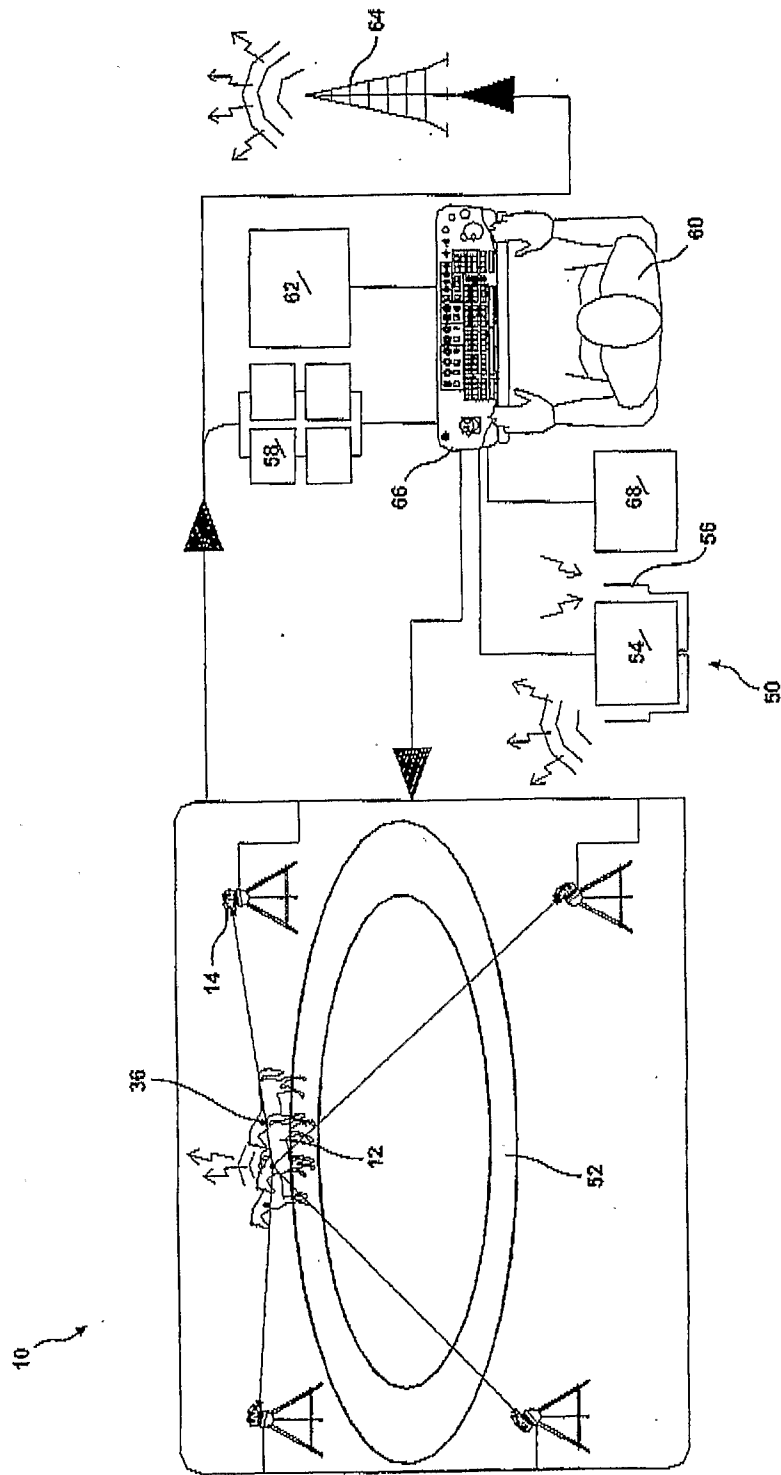


Figure 4

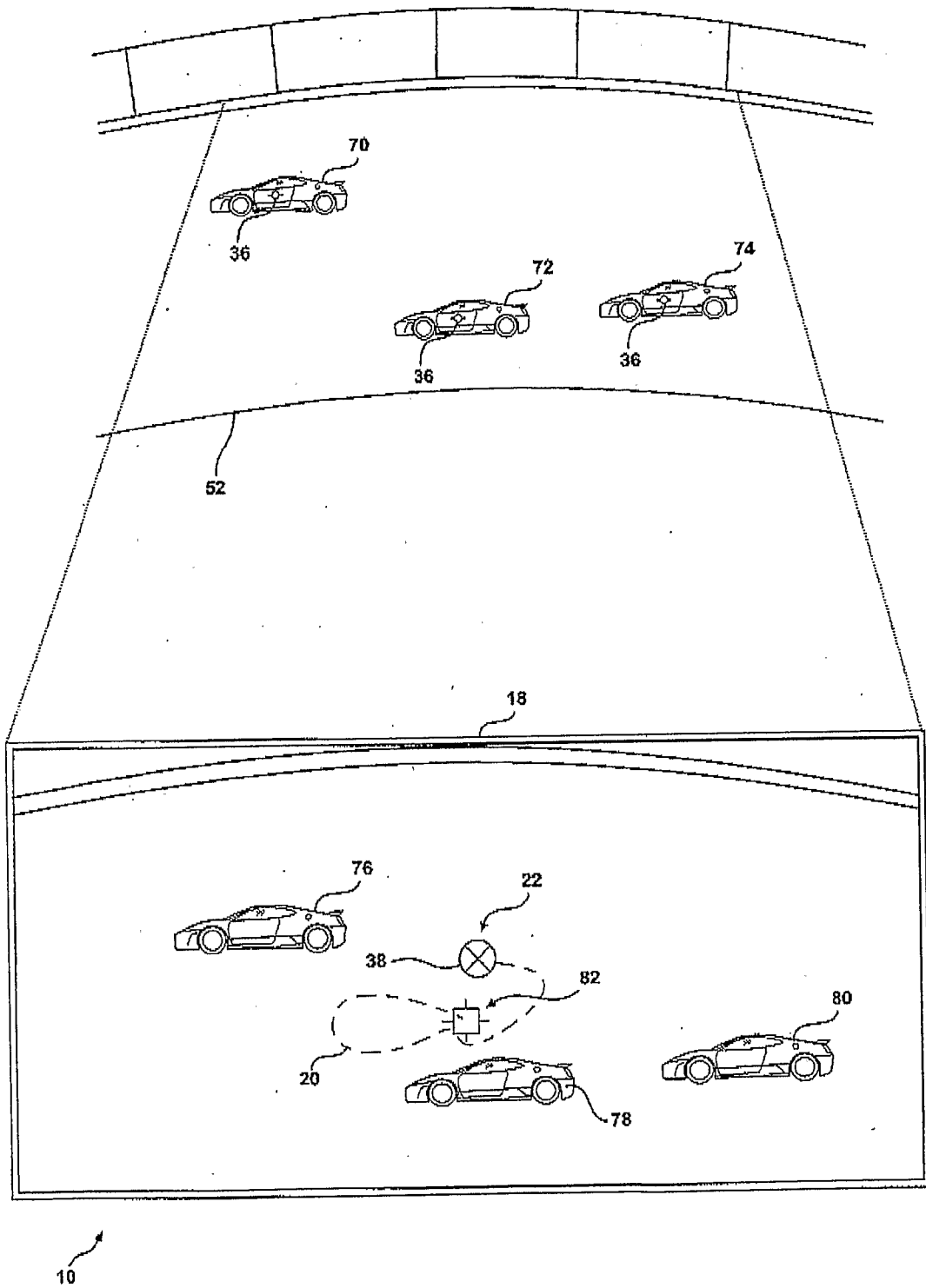


Figure 5

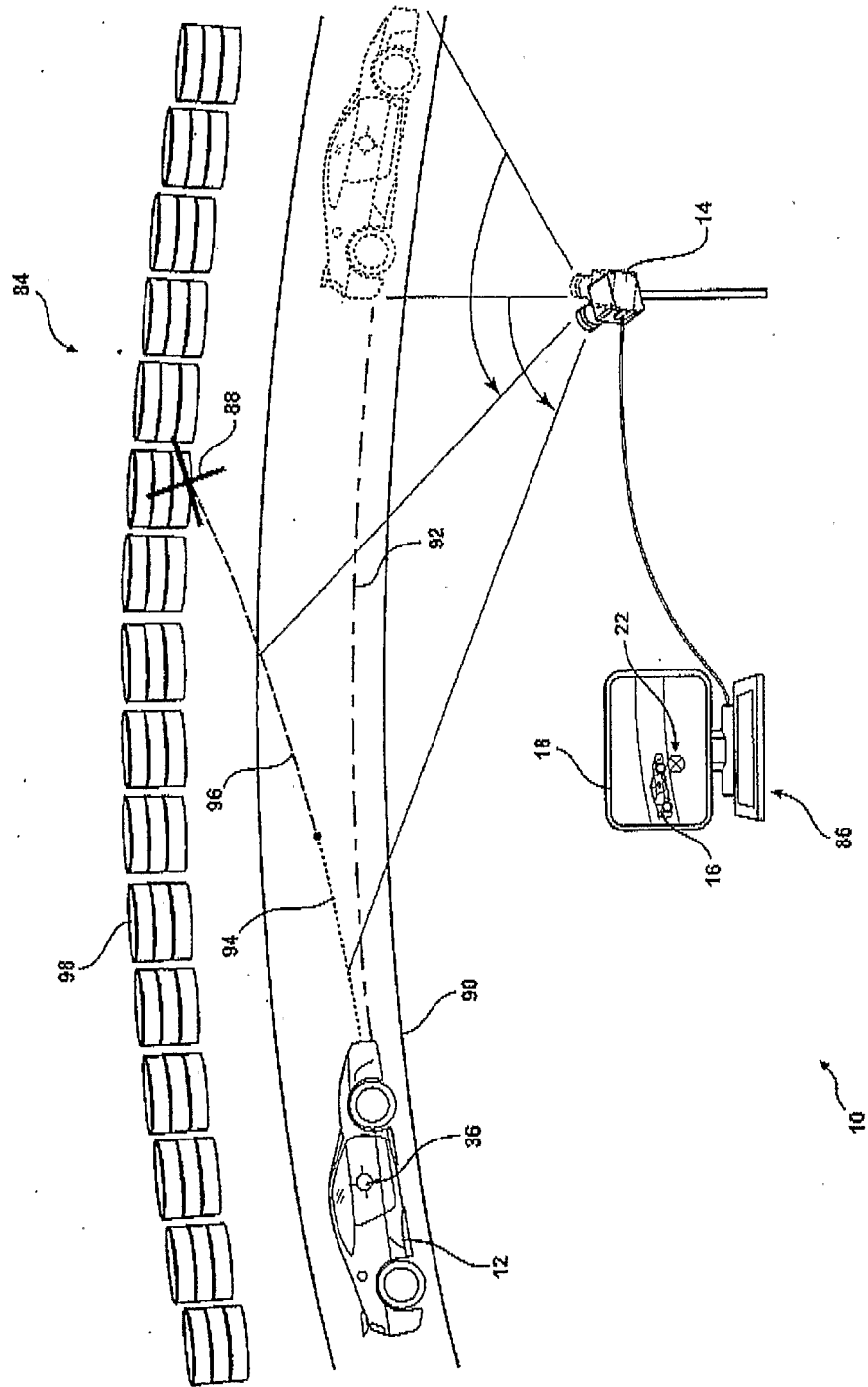


Figure 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2009/000569

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

H04N 5/222 (2006.01) *H04N 5/28* (2006.01)
H04N 5/262 (2006.01) *H04N 7/18* (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC & WPI: Cameras, frame, tag, track, position, bias, center and similar terms.

Espace: video, vehicle, crash, object, track.

Google Patents: vehicle, pre-crash, camera.

USPTO: video footage, moving object, track.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6661450 B2 (YATA) 9 December 2003 Abstract; Col. 1, line 55-Col. 9, line 33	1,3,4,6-12,14
Y	Col. 1, line 55-Col. 9, line 33	2, 5
X	EP 1765014 A2 (FUJINON CORPORATION) 21 March 2007 Page 3 Paras [0008-0013]; Page 10 Paras [0052 & 0054]	1, 6, 9, 13
Y	Page 3 Paras [0008-0013]; Page 10 Paras [0052 & 0054]	2, 5
Y	GB 2355876 A (ROKE MANOR RESEARCH LIMITED) 2 May 2001 Abstract	2, 5

Further documents are listed in the continuation of Box C See patent family annex

<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p>	
<p>"E" earlier application or patent but published on or after the international filing date</p>	<p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p>	
<p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p>	<p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p>	
<p>"O" document referring to an oral disclosure, use, exhibition or other means</p>	<p>"&" document member of the same patent family</p>	
<p>"P" document published prior to the international filing date but later than the priority date claimed</p>		

Date of the actual completion of the international search 13 July 2009	Date of mailing of the international search report 23 JUL 2009
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Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer JUZER KHANBHAI AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2176
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2009/000569

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
For details, see the Supplemental Box.

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2009/000569

Supplemental Box

(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No: III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1 to 14 are directed to an apparatus and method of capturing video footage of a moving object wherein the position of an image of said object is biasly influenced by at least one biasing means. It is considered that the position of an image of said object being biasly influenced by at least one biasing means comprises a first distinguishing feature.
- Claims 15 is directed to an apparatus for capturing video footage of a vehicle crash event wherein a picture frame is biasly influenced by at least one biasing means and a control means configured to analyse the movement of a tagged vehicle to anticipate if said vehicle is going to be involved in a future crash event, the control means including a virtual map of the race course and a data source having information relating to expected vehicle race lines, cornering ability and recommended maximum cornering speeds wherein if said vehicle deviates from the expected race line or has a cornering speed that exceeds the recommended maximum cornering speed, then said camera is controlled to follow and frame the movement of said vehicle. It is considered that a control means configured to analyse the movement of a tagged vehicle to anticipate if said vehicle is going to be involved in a future crash event, the control means including a virtual map of the race course and a data source having information relating to expected vehicle race lines, cornering ability and recommended maximum cornering speeds wherein if said vehicle deviates from the expected race line or has a cornering speed that exceeds the recommended maximum cornering speed, then said camera is controlled to follow and frame the movement of said vehicle comprises a second distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

The only feature common to all of the claims is position of an image of said object being biasly influenced by at least one biasing means. However this concept is not novel in the light of:

- 1) US 6661450 B2 Yata
- 2) EP 1765014 A2 Fujinon Corporation

This means that the common feature can not constitute a special technical feature within the meaning of PCT Rule 13.2, second sentence, since it makes no contribution over the prior art.

Because the common feature does not satisfy the requirement for being a special technical feature it follows that it cannot provide the necessary technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a posteriori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2009/000569

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	6661450	EP	1107584	JP	2001160916	JP	2001169169
		JP	2001169170	JP	2001268425	US	2001002843
EP	1765014	CN	1937766	JP	2007116666		
GB	2355876	NONE					

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX