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(54) Vehicle monitoring system.

(57) A vehicle monitoring system, e.g. for identifying automatically vehicles exceeding a maximum speed limit, comprises a video camera (14) for capturing a video frame at any instant; vehicle detecting means, for example a radar (13), responsive to the presence of a moving vehicle (10) to trigger the camera (14) to capture a video frame at an instant when the image of an identification mark (e.g. a bar code 11b on the number plate) would appear at a predetermined position within that video frame; a temporary frame store (16) for the captured video frame; and on-line data processing means (17) programmed to identify the image of the identification mark in the frame store and to produce in real time an output signal (18) representing uniquely the detected vehicle.

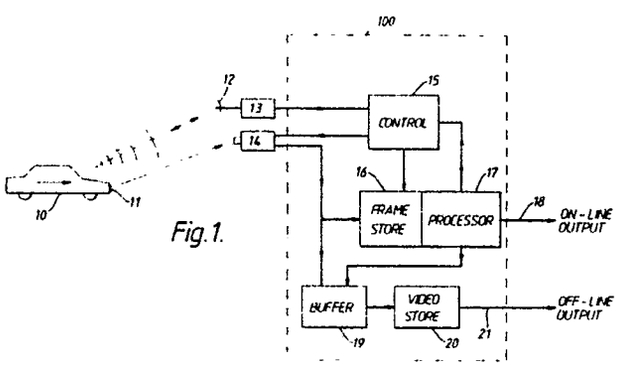

Fig.1.

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VEHICLE MONITORING SYSTEM

This invention relates to a vehicle monitoring system for identifying uniquely a moving vehicle using its number plate or some alternative identification mark, and is particularly useful in the policing of speed limits.

It is recognised that conventional methods of enforcing speed limits do not sufficiently deter motorists from speeding, and the purpose of the invention is to automate the enforcement procedure. Attempts at automation have already been made, one system for example using a radar to detect a speeding vehicle and to trigger a video camera to record a video image of part of the vehicle. All such existing systems, however, fall short of full automation because they still require the labour-intensive human identification of vehicles by scanning the stored video images. Such existing methods also suffer from a significant time delay between the alleged offence and the identification of the offending vehicle.

Accordingly, the present invention provides a vehicle monitoring system comprising: a video camera capable of capturing a video frame at any instant; vehicle detecting means responsive to the presence of a moving vehicle to trigger the video camera to capture a video frame at an instant when the image of an identification mark on the vehicle would appear at a predetermined position within the field of view of the camera; a temporary frame store for the captured video frame; and on-line data processing means programmed to identify the image of the identification mark in the frame store and to produce in real time an output signal representing uniquely the detected vehicle.

By capturing a video frame at precisely the correct instant, a short integration time in the camera may be used to avoid blurring of the image, and existing computer programs may be used in the recognition of the identification mark. Such programs recognise alpha numeric characters on a number plate, and have been used to recognise stationary vehicles; it is, however, a preferred feature of the invention that the identification mark should be a machine-readable code such as a bar code, to facilitate the recognition process. It is preferred that the camera is operated asynchronously as described in our co-pending U.K. Patent application, publication serial number 2196811A. This enables exposure to be controlled and ensures that there is no complete loss of image should capture be attempted during the field blanking interval. Also an image within the frame will appear at a constant position. The camera may be operated in a fully asynchronous mode without disruption of the video timing sequence.

The invention, in another aspect, provides a method of identifying uniquely a moving vehicle which carries a unique identification mark at a known position on the vehicle, using a video camera capable of capturing a video frame at any instant, comprising: detecting when the vehicle reaches a position such that the image of the identification mark would appear at a predetermined position within the field of view of the camera; and processing the video frame to identify the image of the identification mark and to produce, in real time, an output signal representing uniquely the detected vehicle.

In the vehicle monitoring system of the invention, the vehicle detecting means preferably comprises means for detecting when the vehicle reaches a predetermined position relative to the video camera. It also preferably comprises means for determining whether the speed of the vehicle exceeds a predetermined maximum speed and for preventing the said triggering unless the vehicle exceeds that maximum speed.

In a preferred form, the vehicle detecting means comprises means for determining the speed of the vehicle and for providing a signal to the data processing means representative of that speed so that the said output signal includes a representation of the vehicle speed.

One way of putting the invention into effect will now be described with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic representation of the vehicle monitoring system operating to detect a moving vehicle; and

Figure 2 is a representation of a vehicle number plate including a bar code beneath the conventional alpha-numeric characters.

The vehicle monitoring system shown in the drawings comprises a radar 13 having an antenna 12 directed towards traffic along a road, a video camera 14 similarly directed to view the traffic, and an electronic processing system 100 for controlling the radar and the video camera to produce an on-line output 18 and an off-line output 21 for use as hard-copy evidence. Each vehicle 10 travelling on the road has a number plate 11, shown in Figure 2 to include an upper portion 11a containing alpha-numeric symbols and a lower portion 11b containing a machine readable code such as a bar code.

The radar 13 is of the conventional type commonly used for detecting the speed of moving vehicles and for determining the range of a moving vehicle. It sends output signals to a control unit 15 representative of the speed and range of each

successive vehicle travelling along the road. The control unit 15 determines whether the speed of each vehicle exceeds a predetermined maximum speed limit, and determines also the instant that the vehicle reaches a predetermined range, i.e. a predetermined position on the road. It then sends a trigger signal to cause the video camera 14 to capture a video frame. The trigger signal is sent only when a vehicle is found to exceed the speed limit, and is sent only at the instant at which that vehicle reaches the predetermined position. It is at this predetermined position that the image captured by the video camera 14 contains an image of the number plate 11 at the correct position within the video frame. Clearly, some tolerance is allowable in the position of the image of the number plate within the video frame, to allow for variations on the position of the vehicle in a traffic lane and variations in the relative position of the number plate on the vehicle concerned.

The video camera is operated according to the asynchronous image capture technique disclosed in our copending U.K. patent application, publication serial number 2196811A. The camera comprises a CCD image sensor operated in an asynchronous mode to enable it to capture short-lived events: the image is acquired during an integration period which is triggered by a strobe pulse, and the resulting charge is held in a storage section of the CCD sensor until a regularly occurring field read-out period occurs, during which the charge is read out to constitute a video signal. Since the image may be captured asynchronously with the otherwise periodic operation of the image sensor, there is no danger of an image being lost because its capture is attempted during a field blanking period, and the vehicle number plate will appear at a constant position within the video frame thus greatly facilitating machine identification of the vehicle.

A processor 17, which interacts with a temporary video frame store 16 comprising semiconductor memory, receives a signal from the control unit 15 whenever the camera trigger pulse is generated. This causes the processor 17 to read the captured video frame from the camera 14 into the frame store 16, and also to read from the control unit 15 a signal representing the speed detected by the radar 13. The processor 17 is programmed to identify within the frame in the frame store 16 the image of the number plate 11, in particular the bar code 11b, and to process the data in this portion so as to recognise uniquely the vehicle from which it was obtained. The processor 17 then provides an on-line output signal 18 including, for each detected vehicle, a representation of the vehicle identity and of its speed. In a preferred form, this output signal is fed to an external processor which interrogates a central computer database containing vehicle registration information, in order to identify the registered keeper of the vehicle which has been driven at an excessive speed. This interrogation procedure could also be carried out completely automatically, so that the policing of traffic speeding offences may be carried out entirely automatically right up to the procedure for issuing the summons.

As an alternative, the output signal 18 may be stored temporarily in a buffer store (not shown) whose contents may be read out periodically.

In order to provide hard-copy evidence that an offence has been committed, and also to provide a means for monitoring the efficency of the system, a video store 20 is provided, preferably in the form of a video tape recorder. Each successive video frame from the camera is sent by way of a buffer 19, under the control of the processor 17, to be stored in the video store 20. The video store 20 may be read out, when required at intervals of perhaps 24 hours, in the form of an off-line output signal 21, or video tapes may be removed and replaced with blank tapes. Each video frame entering the buffer 19 is identified by a unique signal supplied from the processor 17, which signal includes a representation of the vehicle speed and of the date and time that the measurement took place, together with any further relevant information such as the location of the system. A similar unique signal could be sent also as part of the on-line output signal 18.

Although the invention has been illustrated in the form of a vehicle speed monitoring system, there are other possible uses of the monitoring system which do not require the radar 13. For example, a system could be used to identify those vehicles in respect of which the road fund tax remains unpaid; to enable this to be carried out effectively, it would be convenient if the road fund licence were mounted in some proximity to the number plate, so that it could be detected by the same video camera. Additionally, a system could be arranged to scan for stolen vehicles by checking the identity of the vehicles against files of number plates of stolen vehicles. This system could also be employed to detect other motoring offences such as driving past red traffic lights and evading tolls.

In the system described, the integration period for the video camera is of the order of one millisecond, but this period could of course be varied to suit the purpose to which the system is put. The speed of operation of the system illustrated is sufficient to record up to 5 vehicles per second, which is well in excess of motorway traffic rates.

Although in the system described the instant that the vehicle has reached the predetermined

position relative to the video camera is determined by the radar 13, this instant could alternatively be determined by means of a separate sensor, for example by the use of an inductive wire positioned beneath the road surface, or by means for detecting when a vehicle obstructs an optical beam directed across its intended path.

Claims

1. A vehicle monitoring system comprising: a video camera (14) operable to capture a video frame at any instant; vehicle detecting means (13, 12, 15)responsive to the presence of a moving vehicle (10) to trigger the video camera (14) to capture a video frame at an instant when the image of an identification mark (11a, 11b) on the vehicle would appear at a predetermined position within the field of view of the camera (14); a temporary frame store (16) for the captured video frame; and on-line data processing means (17) programmed to identify the image of the identification mark (11a, 11b) in the frame store and to produce in real time an output signal (18) representing uniquely the detected vehicle (10).

2. A vehicle monitoring system according to claim 1 wherein the camera (14) is operated in an asynchronous mode.

3. A vehicle monitoring system according to claim 1 or 2, wherein the vehicle detecting means (13, 12, 15) comprises means for detecting when the vehicle reaches a predetermined position relative to the video camera (14).

4. A vehicle monitoring system according to claim 1, 2 or 3 wherein the vehicle detecting means (13, 12, 15) comprises means for determining whether the speed of the vehicle (10) exceeds a predetermined maximum speed and for preventing the said triggering unless the vehicle (10) exceeds that maximum speed.

5. A vehicle monitoring system according to any preceding claim, wherein the vehicle detecting means (13, 12, 15) comprises means for determining the speed of the vehicle (10) and for providing a signal to the data processing means (17) representative of that speed so that the said output signal (18) includes a representation of the vehicle speed.

6. A vehicle monitoring system according to any preceding claim, comprising video storage means (20) for storing each successive captured video frame to provide off-line a permanent record.

7. A vehicle monitoring system according to claim 6 as appendant to claim 5, wherein the video storage means (20) responds to the said speed signal to insert on the permanent record corresponding to each video frame a representation of that vehicle speed.

8. A vehicle monitoring system according to any preceding claim, wherein the integration time of the video camera (14) is of the order of 1 millisecond or less.

9. A video monitoring system according to any preceding claim, wherein the identification mark (11a, 11b) is the vehicle number plate (11), and the data processing (17) means is programmed to read the alpha-numeric symbols (11d) thereon to identify the vehicle (10).

10. A vehicle monitoring system according to any preceding claim, wherein the identification mark is a machine-readable code (11b) positioned at a predetermined location on the vehicle (10), and the data processing means (17) is programmed to read that code (11b) to identify the vehicle (10).

11. A vehicle monitoring system according to any preceding claim, further comprising data processing means responsive to the said output signal to interrogate a central database storing vehicle registration information and thereby to identify the registered keeper of the vehicle (10).

12. A method of identifying uniquely a moving vehicle (10) which carries a unique identification mark (11a, 11b) at a known position on the vehicle (10), using a video camera (14) capable of capturing a video frame at any instant, comprising: detecting the vehicle (10) which is a position such that the image of the identification mark (11a, 11b) would appear at a predetermined position within the field of view of the camera (14); and processing the video frame to identify the image of the identification mark (11a, 11b) and to produce in real time an output signal (18) representing uniquely the detected vehicle.

13. A method as claimed in claim 12 wherein the camera (14) is operated in an asynchronous mode.

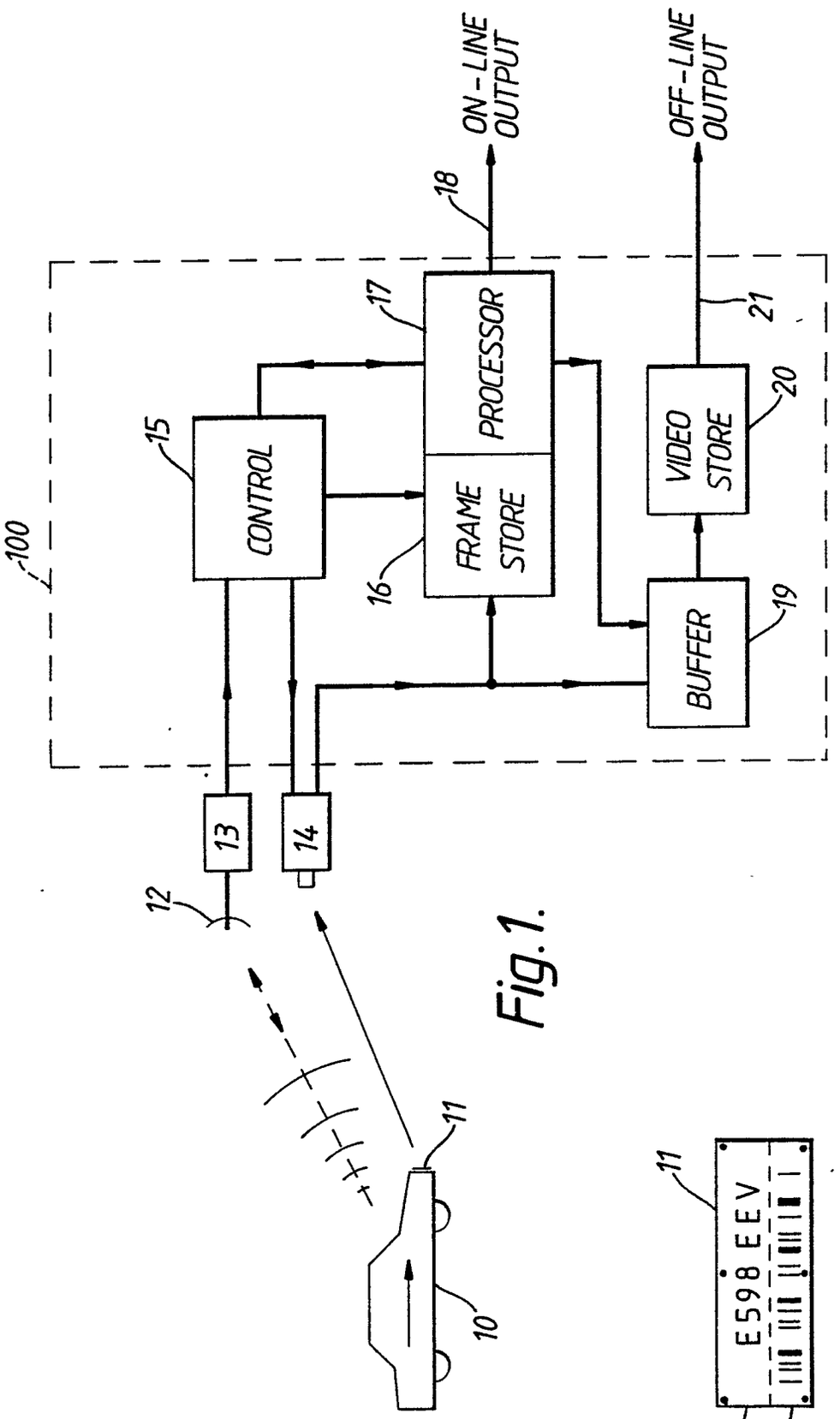

Fig. 1.

Fig. 2.