the pixels P of the individual image column components LN_1... LN_m of the display image I. It is recognized that the collection of pixels P in each of the column components LN_1... LN_m make up the composite display picture elements (e.g. single image components) of the display image I. Accordingly, it is recognised that each individual display unit 12 can be referred to uniquely by the system 10 as LN (e.g. L1, L2, L3, etc.), such that N refers to the number of display units in the series 9. For example,$L1_{1-m}$ refers to the collection of image column components for specific image display unit L1,$L2_{1-m}$ refers to the collection of image column components for specific image display unit L2, etc. The reference "m" refers to the total number of image columns that are aggregated (e.g. built) by the human visual system to build a single display image IN, as compared to a series of display images IN (e.g. I1, I2, I3... as static plane images) displayed in sequence that perceived by the human visual system as an animated film or movie. It is recognised that one explanation for the above-noted functioning of the human visual system is "the short range apparent motion effect" and "the beta effect".

[0033] The one or more row elements 16 in each row R can be used to control the intensity of each pixel P as variable, such that for color images I a color of each pixel P can be represented by a plurality (e.g. two, three or four) component intensities such as red, green or red, green, and blue or cyan, magenta, yellow, and black. It is recognized that the colour of each pixel P can be provided by a single row element 16 capable of emitting different colours (e.g. multicolor LEDS) and/or by a collection of different coloured elements 16 (e.g. a grouping of colour dedicated LEDs - one red, one green and one blue – energized in different combinations to produce the desired colour of the pixel P). It is also recognized that the brightness intensity of each pixel P can be varied by an element 16 capable of emitting different brightness intensities (e.g. according to different energizing voltages as per parameters 22) and/or by a collection of different elements 16 (e.g. a grouping of LEDs energized in different number combinations - one as compared to two or more simultaneously - to produce the desired brightness intensity of the pixel P). In any event, it is recognised that each row R can contain one or more row elements 16 used to form each pixel P of the display image I.

measurements for each train. The predefined structure 70 (e.g. gap) is a known dimension D obtained by utilizing measurements representative of the vehicle 24 (e.g. the prescribed rolling stock of the train). In this embodiment, the speed sensor 26 sends a detector beam (e.g. light such as but not limited to infra red as current standards may not allow a laser beam in the tunnel)) across the pathway 14 (e.g. track)from a light source 72 to a light reflector 74 (or light detector), in order to detect the time of passage of the structure 70 by the speed sensor 26.

[0037] Using the example of the gap between train cars, the light source 72 and light reflector/detector 74 would be positioned on opposite sides of the pathway 14, such that the edges of the gap would be detected by presence of the light beam at (or reflected from) the reflector 74. Using the detected time between gap edges and the known dimension D of the gap, the speed of the vehicle 24 can be calculated using appropriate speed equations such as but not limited to speed equals distance divided by time. Therefore, when no vehicle 24 is present, as during the gap between the cars of the train, the light beam can be reflected back to the sensor causing a positive response, such that the duration of this positive response is then converted into a rate of speed based on the known distance between the cars of train. It is recognised that other light source 72 and reflector/detector 74 arrangements can be used to inform the speed sensor 26 of the duration for passage of the known dimension D of the predefined structure 70 of the vehicle 24, as desired. It is envisioned that the multiple speed V measurements of the vehicle 24 could be accomplished for the train example by measuring the speed V of the train when the subsequent gap (or other predefined structure 70) passes the speed sensor 26 (or array of speed sensors 26 in the case where the system 10 has more than one speed sensor 26). It is recognised that multiple speed V measurements can be determined by detecting the speed for the passage of each predefined structure 70 (e.g. each time the gap is identified) or for a specified subset of the plurality of these predefined structures 70 (e.g. every second gap, the first and middle gap of the train, etc.), as utilized by the display controller 18 and/or system controller 30 to coordinate the display of the image IN for any one display unit 12 or respective display units 12 of the series 9.

The effect is achieved because with light flashes of relatively short duration of the elements 16, as controlled by the parameters 22, combined with the motion of the vehicle 24, result in the human visual system processing the display of image I and successive images I as short-range apparent motion. In this manner, the moving viewer perceives each apparent light column $L1_1..L1_m$ combined as a frame of image I with dimensions of L x M. The successive images I consisting of light columns L1..LN result in the short range apparent motion of the images I1 to IN. Thus, where a series (i.e. successive multiple activations of each of the elements 16 in series to produce the adjacently perceived image column components $L1_1...L1_m$ of the display image I1), all the flashes appear to the eye to have occurred at the same time such that while the viewer has moved relative to the array, the eye perceives a composite light pattern as display image I1, comprising the series of individual image column components $L1_1...L1_m$ emitted by the respective column L of the display unit 12. The effect of using the column L of row elements 16 to produce the display image IN of width M can be attributed to the short range apparent motion effect, such that the image IN of the display unit 12 (of the series 9) is perceived as the collection/composite of the individual image column components $L1_1...L1_m$that remain visible at the same time as perceived by the passenger of the vehicle 24 when looking at the display unit 12 as the vehicle 24 moves past the display unit 12 at measured real time variable speed V.

[0051] In view of advances in scientific knowledge concerning functioning of the human visual system with respect to displayed images I of short duration, (i.e. less than 0.06 seconds, less 0.055 seconds, less that 0.05 seconds, less that 0,045 seconds, less that 0.043 seconds, less than 0.042 seconds) the concept of after-image has been rebuked in the scientific community over the past 30 years. It is now recognised that the former understanding of persistence of vision concept is now known to be false. There is actually no lingering of image components produced by multiple sequential activations of the display apparatus, rather the composite image I1..IN is constructed by the human brain as it interprets (e.g. builds or otherwise aggregates) the vertical image columns$LN_1..LN_m$ into a picture plane IN, and the sequence of picture planes I1..IN into a moving image is also known as the short range apparent motion effect. In other words, the short range apparent motion effect allows the viewer to perceive smooth motion as

using the same speed for each of the activations of the successive activations or different speeds for each of the activations of the successive activations, as further discussed below.

[0053] Referring to Figure 9, shown is a further embodiment of the system 10 having the vehicle 24 traveling along pathway 14 with one or more inhibited display zones IZ, such as those portions of the vehicle 24 (e.g. train) in which train personnel 76 (e.g. driver) are located. The system 10 is configured to identify the inhibit zones IZ such that the display unit(s) 12 is/are not activated (i.e. their respective row elements 16 are energized to produce image IN) when the inhibit zone(s) IZ is/are within line of sight LS of the display unit(s) 12. A location sensor 27 is used by the system 10 to inform the controller 18 (and/or controller 30) to cause selected elements 16 in the rows R of the column L (see Figure 1) of the display unit 12 to be turned OFF and/or to remain OFF while the inhibited zone IZ remains within the line of sight LS of any images IN that could be produced by operation of the display unit(s) 12.The function of delayed timing (e.g. inhibited operation) of the display unit 12 operation provides for keeping any activated display to remain not visible to train operators 76 (i.e. those individuals located in the inhibited zone IZ), and is implemented as a safety enhancement. The timing of inhibited operation of the display unit(s) 12 within line of sight LS of the inhibited zone IZ can be facilitated by delaying (or otherwise restricting) the firing of the display units 12 for a period of time sufficient to allow the drivers compartment of the train car (e.g. first) to pass the display units 12 but prior to the first passenger window passing the display units 12, as one example of the inhibited zone IZ. This can be done by using the speed V of the vehicle 24 by the controller 18 (and/or controller 30) as identified by the speed sensor 26, detecting a reference location R of the vehicle 24 by the location sensor 27 (e.g. the front of the train), and setting a clock to delay/restrict the firing of the display units 12 by a time period sufficient for the vehicle 24 to travel a prescribed zone distance (representing a effective line of sight length of the inhibited zone IZ with respect to the location of the display unit(s) 12) past each of the display units12 within line of sight of the inhibited zone IZ. The prescribed zone distance can be based on known measurements and locations of any identified inhibited zone(s) IZ from the prescribed rolling stock of the trains using the pathway 14.

signals on the network 111 carrying data packets 120 go in both directions simultaneously). The remote network controllers 118,130 communicate using the master/slave relationship, in which the master controller 130 initiates the data frame transmission of the data packet 120. When the master controller 130 generates a clock signal SCLK and selects via a slave select signal SS1, SS2, SS3, etc to a slave device, data can be transferred in either or both directions simultaneously. In the case of data in the data packets 120,121 representing parameters 122, the previously submitted parameters 122 that were used to activate the respective elements 116 are returned as a "used" data packet 121 from the display controller 118 to the system controller 130, while the next data packet 120 containing parameters 122 for use in activating the next number (one or more) elements 116 is transmitted to the display controller 118 from the system controller 130. In fact, as far as SPI is concerned, data packets 120,121 are transferred in both directions on the network 111 and it is up to the master and slave devices to know whether a received byte is meaningful or not. So respective a device must discard the received byte in a "transmit only" frame or generate a dummy byte for a "receive only" frame.

[0084] The slave select signal SS is used by the master controller 130 to indicate to a selected slave controller 118 that the master controller 130 wishes to start an SPI data exchange between that remote slave device and itself. The select signal SS can be set as active low, so a low on this line can indicate the SPI is active, while a high can signal inactivity. Further, the select signal SS can be used to improve noise immunity of the system 10, so as to help reduce cross talk and undesirable cross activation of the display units 112 out of sequence. The select signal SS in the present system 10 can function as a reset for the

~~[0085]~~ SPI slave controller 118 so that it is ready to receive the next byte associated with the next display image IN.

~~[0086]~~[0085] Therefore in view of the above, it is recognised that the SPI communication protocol implemented by the controllers 130,118 is a Data Exchange protocol, whereby each device has two data lines, one for input and one for output, such

that as data 120 is being clocked out new data is also being clocked in 121 (in the case of the master controller 130). Further, as data 121 is being clocked out new data is also being clocked in 120 (in the case of the slave controller 130). Therefore, when one controller "transmits" data, the incoming data is read before attempting to transmit again. If the incoming data is not read, then the data will be lost and the SPI controller can become disabled as a result. Therefore, in the present system 10, the controllers 118,130 are configured to read the data after a transfer has taken place, even if the data has no use by the respective controller. It is recognised that these data exchanges between the controllers 130,118 are controlled by the clock line, SCLK, which is set by the master device based on the reported vehicle speed V. Accordingly, the master controller 130 is configured (for example as part of a parameter generation module 134 to either increase or decrease the clock signal frequency based on changes in reported speed V, as determined by the speed sensor in real time.

~~[0087]~~[0086] It is recognized that operation of the speed sensor 26 in real time can be defined as multiple vehicle speed V readings are performed or otherwise identified by the speed sensor 26 within the time period for display of the all of the pixels P for all of the display images I of the plurality of display units 112. For example, a plurality of speeds V are reported in the time period (or time periods) measured between the start of activation of the first element 16 of the display image I for the first display unit 112 (of the plurality of display units 112) in the first individual column image component LN_1 and the start of activation of the last element 16 of the display image I in the last individual column image component LN_m of the last display unit 112 (of the plurality of display units 112) , or any other time interval there between. It is recognized that the reporting of the speeds V can be on a periodic basis (regular or irregular), as desired, such that each display image IN for each of the plurality of display units 112 is initiated based on a respective clock signal SCLK determined using a plurality of different vehicle speeds V, as further described below.

~~[0088]~~[0087] In implementation of this duplex communication for an indeterminate number of parameters 122 to be transmitted in the data packets 120, 121, the number of bytes transmitted in the packet 120 can be specified as a constant or specified/predefined

number. For example, this number of bytes in the data packets 120,121 can be specified as the number of bytes needed to represent the parameters 122 for all of the elements 116 in a particular column image component LN_m, or a specified subset thereof. For example, in the case where a speed V change is detected before generation of all of the parameters 122 for the elements 116 of one of the column image component LN_m, null or dummy bytes can be inserted into the package 120 representing those parameters 122 not yet generated and thus would be dependent on the different speed V. Similarly, for those parameters 122 not used by the slave controller 118 in activation of the elements 116, null or dummy bytes can be inserted into the data package 121 representing those parameters 122 not used in the previous activation of the elements 116.

~~[0089]~~[0088] As such, use of different SPI clock signals SCLK for the different display units 112, such that each of the clock signals SCLK for two or more display units 112 is based on a different vehicle speed V, provides for synchronization of the plurality of display units 112, such that the data packets 120 can be transmitted and the clock control signals SCLK on the respective clock control lines can be used to synchronize the start/activation time of the display action of the elements 116 for each of the plurality of display units 112. In this manner, the respective start times for display of the display image IN on each of the plurality of display units 112 is synchronized in view of variable vehicle speed V. In the present system 10, the SPI communication interfaces of the communication modules 138,140 can specifies four signals: clock (SCLK); master data output, slave data input (MOSI); master data input, slave data output (MISO); and slave select (SS), such that SCLK is generated by the master and input to all slaves. MOSI carries data from master controller 130 to slave controller 118. MISO carries data from slave controller 118 back to master controller 130. A slave device is selected when the master controller 130 asserts its respective SS signal, such that the master controller 130 generates a separate slave select signal SS for each slave controller 118. It should be noted that that the master controller 130 initiates the frames of the data packets 120,121 for both the master controller's 130 command and the slave controller's 118 response. Therefore, synchronization can be realized between the different display units in an environment of changing vehicle speed V, as no data will be transferred over the network 111 between the controllers 118,130 unless the clock is manipulated. As such, all slave

controllers 118 are controlled by the clock which is manipulated by the master controller 130 based on reported readings of the vehicle speed V by the speed sensor 126. Further, it is recognised that the slave controllers 118 can not manipulate the clock and the SSP configuration registers can control how a device will respond to the clock input.

[0090][0089] A pair of parameters called clock polarity (CPOL) and clock phase (CPHA) determine the edges of the clock signal SCLK on which the data of the data packets 120,121 are driven and sampled. Each of the two parameters CPOL and CPHA has two possible states, which allows for four possible combinations, all of which are incompatible with one another. So a master/slave pair use the same parameter pair values to communicate. If multiple slaves are used that are fixed in different configurations, the master controller 130 to reconfigures itself each time it needs to communicate with a different slave controller 118. As such, it is advantageous in use of the SPI master/slave configuration for the remote controllers 130,118 SPI in which the devices transfer the data packets 120,121 as data streams over the network 111.

Example controller configuration

[009067] Referring to Figures 1 and 12, each of the above-described devices 12,18, 26, 27, 30,78 can be implemented on one or more respective computing device(s) 101. The devices 101 in general can include a network connection interface 200, such as a network interface card or a modem, coupled via connection 218 to a device infrastructure 204. The connection interface 200 is connectable during operation of the devices 101 to the network 11 (e.g. an wired and/or wireless intranet and/or an extranet such as the Internet), which enables the devices 101 to communicate with each other as appropriate. The network 11 supports the communication 14 of the data parameters 22 and data 80 between the controllers18,30, between the controllers 18 and the respective display units 12 and between the network controller 78 and one or more system controllers 30 that oversee one or more series 9 of display units 12. Also contemplated is the communication of vehicle location and speed data over the network 11.

[009168] Referring again to Figure 12, the devices 101 can also have a user interface 202, coupled to the device infrastructure 204 by connection 222, to interact with a user (e.g. technician). The user interface 202 can include one or more user input devices such as but not limited to a QWERTY keyboard, a keypad, a track wheel, a stylus, a mouse, a microphone and the user output device such as an LCD screen display and/or a speaker. If the screen is touch sensitive, then the display can also be used as the user input device as controlled by the device infrastructure 204.

[009269] Referring again to Figure 12, operation of the device 101 is facilitated by the device infrastructure 204. The device infrastructure 204 includes one or more computer processors 208 and can include an associated physical memory 213 (e.g. 32,36) (e.g. a random access memory) for storing of data parameters 22 (both speed dependent and speed independent factors), speed and location data, demographic data and for processing communications communicated between the devices 101. The computer processor 208 facilitates performance of the device 101 configured for the intended functionality (e.g. of the controllers 18,30, 78, display units 12 and sensors 26,27) through operation of the network interface 200, the user interface 202 and other application programs/hardware 206 of the device 101 by executing related instructions. These related instructions can be provided by an operating system, and/or software applications 206 located in the memory, and/or by operability that is configured into the electronic/digital circuitry of the processor(s) 208 designed to perform the specific task(s) of the controllers 18,30, 78, display units 12 and sensors 26,27. Further, it is recognized that the device infrastructure 204 can include a computer readable storage medium 212 coupled to the processor 208 for providing instructions to the processor 208 and/or to load/update client applications 206. The computer readable medium 212 can include hardware and/or software such as, by way of example only, magnetic disks, magnetic tape, optically readable medium such as CD/DVD ROMS, and memory cards. In each case, the computer readable medium 212 may take the form of a small disk, floppy diskette, cassette, hard disk drive, solid state memory card, or RAM provided in the memory. It should be noted that the above listed example computer readable mediums 212 can be used either alone or in combination.

[009370] Further, it is recognized that the computing devices 101 can include the executable applications 206 comprising code or machine readable instructions for implementing predetermined functions/operations including those of an operating system, for example, in response to user command or input. The processor 208 as used herein is a configured device and/or set of machine-readable instructions for performing operations as described by example above. As used herein, the processor 208 may comprise any one or combination of, hardware, firmware, and/or software. The processor 208 acts upon information by manipulating, analyzing, modifying, converting or transmitting information for use by an executable procedure or an information device, and/or by routing the information with respect to an output device. The processor 208 may use or comprise the capabilities of a controller or microprocessor, for example. Accordingly, any of the functionality (e.g. any of of the controllers 18,30, 78, display units 12 and sensors 26,27) provided by the systems and process of the FIGS may be implemented in hardware, software or a combination of both. Accordingly, the use of a processor 208 as a device and/or as a set of machine readable instructions is hereafter referred to generically as a processor/module for sake of simplicity.

[009471] It will be understood that the computing devices 101 may be, for example, programmable logic controllers or other network configured devices (e.g. having SPI configuration). Server computing devices 101 (e.g. for the network controller78) may additionally include a secondary storage element such as the memory (e.g. database). Each server, although depicted as a single computer system, may be implemented as a network of computer processors, as desired.