

Virtual Omnimover

Background of the Invention

Field of the Invention

[0001] The subject matter described herein relates generally to devices and methods for monitoring motion of a vehicle and, more particularly, to monitoring vehicle motion
5 on a path.

Related Art

[0002] Currently, the monitoring of vehicle motion along a path, such as a railway or a track, is carried out using a central controller or computer. The computer monitors
10 each vehicle's position on the track and when vehicle spacing is within a predetermined minimum distance, all vehicles on the track are stopped. Such a system, in addition to the computer, includes multiple sensors mounted at various locations along the track and complex wiring for connecting each sensor and the computer. Because of the necessary computer, complex wiring, and multiple
15 sensors, the system is difficult to integrate and to costly to maintain. Other disadvantages include the requirement to test and prove system functionality after track installation, the technical challenge of aligning a sensor and target for the vehicle to track interface, the inability to sense a spacing problem until it has become sufficiently severe to violate the minimum spacing, and the inability to change

spacing criteria without adding additional sensors which makes the system less flexible.

[0003] Accordingly, it is now desired to reduce cost and eliminate the above-described disadvantages of a centrally controlled system.

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Brief Description of the Invention

[0004] In accordance with an embodiment of the present invention, a ride control system for controlling a plurality of vehicles on a path, comprises a path processor, a bi-directional voting circuit in circuit with the path processor, communication between
10 processors, and a busbar for conducting electrical signals along the path. Each vehicle of the plurality of vehicles may comprise a vehicle processor supported by the at least one vehicle and a voting shunt relay in circuit with the path processor and other vehicle processors. Each vehicle processor may be configured to close a respective shunt relay upon a predetermined condition of the vehicle whereby the bi-
15 directional voting circuit is activated to notify all other vehicles. Vehicle processors may communicate with other vehicle processors or a master processor via communication to initialize or maintain positions along the path.

[0005] In another aspect of the present invention a vehicle control system for a vehicle movable along a path comprises a vehicle energizing and stopping system, at
20 least a portion of which is mounted to each vehicle, and a vehicle sensor system.

The vehicle sensor system is mounted to each vehicle and in circuit with the vehicle energizing and stopping system. The vehicle sensor system is configured to determine an actual location of a particular vehicle while the vehicle is moving along

the path and compare the actual location to a range of predicted locations. The vehicle sensor system may be further configured to signal the vehicle energizing and stopping system to stop all vehicles on the path where the actual location of the particular vehicle is outside the range of predicted locations.

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Brief Description of the Drawings

[0006] The following detailed description is made with reference to the accompanying drawings, in which:

10 **[0007]** Figure 1 is a diagram showing one vehicle disposed on a portion of a path and wherein the vehicle includes a vehicle control system in accordance with one embodiment of the present invention;

[0008] Figure 2 is a diagram showing a top view of a portion of the path of Figure 1

[0009] Figure 3 is a block diagram showing details of the vehicle control system of
15 Figure 1;

[0010] Figure 4 is a diagram showing further details of the vehicle control system of Figure 3;

[0011] Figure 5 is a flow chart showing a method of energizing, stopping and monitoring location of a plurality of vehicles along a path in accordance with another
20 embodiment of the present invention;

[0012] Figure 6 is a schematic diagram of a ride control system in accordance with one embodiment of the present invention; and

[0013] Figure 7 is a schematic diagram showing further details of the ride control system of Figure 6.

Detailed Description of the Preferred Embodiment

5 **[0014]** One embodiment of the present invention concerns a system and a method for energizing, stopping, and monitoring a location of vehicles on a path. One particular embodiment of the system includes a vehicle energizing and stopping system, at least a portion of which is mounted to each vehicle, and a vehicle sensor device that is mounted to each vehicle and in circuit with the vehicle energizing and stopping
10 system.

[0015] Referring to Figures 1 and 2, one vehicle 10, out of a plurality of vehicles of a ride system, is shown with a body 12, wheels 14 and appropriate indicia 16 along with a guest 18 seated therein. The vehicle 10 is disposed on a path such as a track 20 which includes rails 22 that are supported by cross beams 24. A bus bar or
15 energizing rail 26 provides electrical energy from an electrical generator (described below) to the vehicle 10 through means of an electrode 28. A disc brake 30 is shown mounted to a wheel 14.

[0016] Referring now to Figure 6, a schematic diagram showing a ride control system in accordance with one embodiment of the present invention is shown generally at
20 50. As shown, the ride control system 50 comprises a path or track processor 52 which is in circuit with the energizing rail 26 comprising a number of circuit connections (not numbered) and a plurality of vehicle control systems 100 each being located with a vehicle 10 (Figure 1). It will be appreciated that in an optional

embodiment (not shown), the track processor 52 may communicate via wireless communications with each vehicle control system 100, rather than via the energizing rail 26. The track processor 52 may comprise a programmable logic controller and monitors track functions such as mode of the track machine, stopping and starting functions, and control of all track-switching elements via fail-safe signals. The track processor 52 and each vehicle control system 100 may communicate to ensure the mode of the track machine is safely controlled for the all vehicles mounted to the track. If there is disagreement of the mode of the track or if the vehicle senses itself out of range for position, velocity, or acceleration parameters or other fault conditions, the vehicle will communicate to the track processor and/or other vehicle processors to cause a stop or other reaction for each vehicle 10.

[0017] The track processor may also be configured to determine and broadcast an ideal location of each vehicle to each vehicle on the path according to some predetermined plan such as every vehicle is spaced equally along the path. Each vehicle may then synchronize or vary its position along the path by increasing velocity or braking to correct its spacing from other vehicles.

[0018] As shown in greater detail in Figure 7, the track processor 52 may be connected in circuit with a bi-directional voting circuit 56 (Figure 4) comprising a number of semiconductor gates arranged in a known manner, the function of which is described in more detail below and dual outputs 58 for bus bar control signals used to define the mode of the track machine, monitored by a plurality of vehicles. Each vehicle control system 100 may comprise an output switch controller 64 for energizing a shunt relay 66 and an input 68 for analog and/or digital signals sent from

the track processor 52. A load resistor (not shown) may also be employed to provide a known load for one vehicle to the track processor 52 so that the number of vehicles can be defined by the value of the analog input (not shown).

[0019] As illustrated in Figure 3, one embodiment of a vehicle control system for energizing, stopping and monitoring a location of a vehicle on a path in accordance with the present invention is illustrated generally at 100. In this embodiment, the control system 100 comprises a processor 110, a memory 112, a timer 114, a distance/speed sensor 116 and a vehicle energizing and stopping system 118. The processor 110, memory 112, timer 114, distance/speed sensor 116 and a portion of the vehicle energizing and stopping system 118 may be located in a compartment 119 located in the vehicle 10.

[0020] The processor 110 may be any suitable processor such as a programmable logic controller. The memory 112 may be any suitable type including but not limited to RAM, ROM, EPROM, and flash.

[0021] The memory 112 may store a program for the processor 110 and store a look up table for a predicted range of locations given a duration that a vehicle 10 is traveling along the track 20.

[0022] The timer 114 provides a timing function that may be used by the processor 110 to time an actual duration that the vehicle 10 is traveling along the track 20.

[0023] The distance/speed sensor 116 may comprise a magnet 120 and a magnetic field or optical sensor 122 which together function in a known manner to provide electrical pulses to the processor 110 which correspond to a distance traveled by the wheel 14. Optionally, other sensors such as a multi-turn encoder may be employed.

To determine the distance the pulses may be counted or directly measured by the processor 110 to determine a distance and, therefrom, a location of the vehicle 10 along the track 20. It will be appreciated that the distance/speed sensor 116 may also comprise known pulse shaping circuitry.

5 **[0024]** The processor 110 is configured, via any suitable means such as software or firmware, to receive an initial signal from a start indicator 124 that the vehicle 10 has started traveling along the track 20 and thereafter, to continuously, or at regular intervals, calculate an actual location for the vehicle along the track as described above. The processor 110 is further configured to look up a predicted range of
10 locations for the vehicle 10 along the track 20 based, e.g., on the duration from the timer 114 and compare that with the actual location. Where the actual location falls outside of that range of predicted locations, the processor 110 sends a signal along line 126 to the energizing and stopping system 118 which, as described in more detail below, is configured to stop the vehicle 10 from any further progress along the
15 track 20 along with the progress of any other vehicles traveling along the track.

Further, the processor 110 may be configured to receive an ideal location from the track processor 52 and compare its location to the ideal location and either brake or not brake, as described below, to thereby increase vehicle velocity to compensate.

[0025] One embodiment of an energizing and stopping system 118 suitable for use in
20 the practice of the present invention is shown in Figure 4. As shown, the energizing and stopping system 118 comprises a processor 128 interconnected with a memory 130, a power source 132, the output switch controller 64 (see also Figure 7), a brake controller 136 and a vehicle track monitor 138.

[0026] The processor 128 may be similar to the processor 110 described above in connection with Figure 3, or, in one optional embodiment, instead of two separate processors 110 and 128, it will be appreciated that both may be combined together as one processor that performs functions described herein for both processors.

5 **[0027]** Likewise, the memory 130 may be similar to the memory 112 described above and may function to store a program for configuring the processor 128.

[0028] The power source 132 may be any suitable power source such as a battery, generator or transformer. Optionally, the power source 132 may omitted and/or transform power received via the electrode 28. The power source 132 may provide
10 sufficient electrical energy for energizing both the output switch controller 64 and the brake controller 136 which may be mounted to the brake 30 (Figure 1).

[0029] Referring now also to Figures 1 and 2, the vehicle track monitor 138 may be any suitable device for monitoring energy output along the energizing rail 26 and, upon absence of the energy notifies processor 128. In an optional embodiment, the
15 vehicle track monitor may also comprise an electrical motor (not shown) for driving the vehicle 10. The vehicle track monitor 138 is connected via the electrode 28 to the energizing rail 26 and through wheels 14 to a rail 22. An electrical generator 30 may be connected in circuit between the electronically controlled circuit breaker 56, connected to the energizing rail 26, and a rail 22. The shunt relay 66 (see also
20 Figure 7) that is normally closed may be in circuit between the electrode 28 and the wheel 14 and may be operated remotely by the switch controller 64.

[0030] In operation, the processor 128 may be configured, via, e.g., software or firmware, to respond to a command signal from the processor 110 to stop movement

of the vehicle 10 by notifying the brake controller 136 to apply the brake 30. At the same time, the processor 128 may be further configured to notify the output switch controller 64 to close shunt relay 66 to short the generator 30 and alert the bi-directional voting circuit 56 so that other vehicles traveling on the track 20 will be notified that stopping is required via each vehicles' vehicle track monitor system 138.

The processor 128 may also be configured to review the current speed and apply the brake 30 where necessary as described above to correct when an error in position on the track 20 is identified as described above. When the error in position is above a predetermined threshold position such as greater than five feet or, for example, within five feet of another vehicle, then the processor 128 may then alert the bi-directional voting circuit 56 so that other vehicles traveling on the track 20 will be notified that stopping is required.

[0031] A method of monitoring and controlling location of a plurality of vehicles movable along a path in accordance with another embodiment of the present

invention is illustrated generally at 200 in Figure 5. As shown at 210, the method comprises locating at least a portion of a vehicle control system on each vehicle, and as shown at 212, mounting a vehicle sensor device to each vehicle. The method also includes storing a range of predicted locations along the path for a given durations that each vehicle is on the path as shown at 214 and, as shown at 216, using each vehicle sensor to determine an actual location of each vehicle while the vehicle is moving along the path. Further, as shown at 218, the method comprises comparing the actual location of each vehicle to the range of predicted locations for a

number of given durations and, as shown at 220, stopping all vehicles where any actual location is outside the range of predicted locations.

[0032] Technical effects of the herein described systems and methods include determining a location of a vehicle on a track. Other technical effects include
5 determining whether the location is within a range of predicted locations.

[0033] While the present invention has been described in connection with what are presently considered to be the most practical and preferred embodiments, it is to be understood that the present invention is not limited to these herein disclosed

embodiments. Rather, the present invention is intended to cover all of the various

10 modifications and equivalent arrangements included within the spirit and scope of the appended claims.

CLAIMS

1. A ride control system (50) for controlling a plurality of vehicles (10) on a path, comprising:

a track processor (52) configured to determine and communicate data indicative of a predicted location range (214) for each of the plurality of vehicles (10);

a plurality of vehicle control systems (100), wherein each of the plurality of vehicles (10) houses a one of the plurality of vehicle control systems (100) and wherein each of the plurality of vehicle control systems (100) comprises:

a sensor (116) configured to detect indicators of an actual location (216) of the one of the plurality of a vehicles (10) in which the sensor is housed and configured to communicate data indicative of the actual location (216);

a processor (110) configured to receive the data indicative of the actual location from the sensor (116), to receive the data indicative of the predicted location range from the track processor (52), and to compare the data indicative of the actual location (216) with the data indicative of the predicted location range (218); and

a velocity control system (118) configured to adjust vehicle velocity based on comparing the data indicative of the actual location and the data indicative of the predicted location range (218).

2. The ride control system of claim 1, wherein the data indicative of the predicted location range and the data indicative of the actual location each comprises a time value.

3. The ride control system of claim 1, wherein the processor (110) is wherein the processor (110) is configured to compare time values from the data indicative of the actual location and the data indicative of the predicted location range to facilitate adjustment of the velocity control system.

4. The ride control system of claim 1, comprising an electronically controlled circuit breaker (56) configured to disable movement of each of the plurality of vehicles when a malfunction is identified in any one of the plurality of vehicles.
5. The ride control system of claim 4, comprising identifying the malfunction by determining that the actual location of a particular vehicle (10) of the plurality of vehicles (10) is outside of the predicted location range for the particular vehicle.
6. The ride control system of claim 1, wherein the sensor (116) comprises an optical sensor or a magnetic sensor.
7. The ride control system of claim 1, wherein the processor (110) is configured to receive a time value and convert the time value to a location value based on a lookup table stored in a memory (112, 130).
8. The ride control system of claim 1, wherein each of the plurality of vehicle control systems (100) comprises a shunt relay (66) that is configured to be activated by a switch controller (64) that is controlled by the processor (110), wherein the shunt relay (66) prevents a power source (132) from providing electrical power to components of the ride control system (50) when closed.
9. The ride control system of claim 8, wherein the processor (110) is configured to activate the switch controller (64) such that it causes the shunt relay (66) to close when the actual location for a particular vehicle (10) of the plurality of vehicles (10) is outside of the predicted location range for the particular vehicle (10).
10. The ride control system of claim 1, wherein the velocity control system (118) comprises a braking system (136) configured control braking to adjust the vehicle velocity.
11. A ride control system (50) for controlling a plurality of vehicles (10), comprising:
 - a track (20) comprising a rail (22) and a bus bar (26);
 - a power source (30) in circuit with the rail (22);
 - a vehicle (10) disposed on the track (20);

a track processor (52), wherein the track processor (52) is configured to communicate data indicative of a predicted location range of the vehicle (10) to the vehicle (10);

components of the vehicle comprising a wheel (14), a vehicle track monitoring system (138), and an electrode (28), wherein the vehicle track monitoring system (138) is in circuit between the wheel (14) and the electrode (28), the wheel (14) is configured to electrically communicate with the rail (22) when the vehicle is on the track, and the electrode (28) is configured to electrically communicate with the bus bar (26) when the vehicle (10) is on the track (20);

a location sensor (116) disposed on the vehicle (10), wherein the sensor (116) is configured to detect indicators of an actual location of the vehicle (10);

a processor (110) disposed on the vehicle (10), wherein the processor (110) is configured to receive data indicative of the actual location from the sensor (116), to receive the data indicative of the predicted location range from the track processor (52), and to compare the data indicative of the actual location with the data indicative of the predicted location range; and

an energizing and stopping system (118) disposed on the vehicle (10), wherein the energizing and stopping system (118) is configured to make adjustments to at least one of power supply and braking of the vehicle (10) based on results from comparing the data indicative of the actual location with the data indicative of the predicted location range.

12. The ride control system of claim 11, wherein the track processor (52) is in circuit with the bus bar (26) and communicates with the processor (110) disposed on the vehicle (10) via the bus bar (26).

13. The ride control system of claim 11, wherein the energizing and stopping system (118) is configured to close a shunt relay (66) in circuit between the wheel (14) and the electrode (28) such that power is not supplied from the power source (30) to the vehicle track monitoring system (138).

- 14.** The ride control system of claim 11, wherein the vehicle track monitoring system (138) comprises a vehicle motor configured to pull the vehicle (10) along the track.
- 15.** The ride control system of claim 11, wherein the data indicative of the actual location and the data indicative of the predicted location range each comprises a time value.