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System and method for remote vehicle control and pedestrian user coaching

Abstract

A vehicle control system includes at least one detection device configured to capture detection data. The system further includes a controller that identifies a travel path of the vehicle extending from a current position to a target position of the vehicle. In response to the travel path, the controller calculates a travel zone occupied by the vehicle traversing the travel path and determines at least one viewing zone proximate to the travel zone. The controller further determines a location of a user based on the detection data and controls a navigation routine of the vehicle along the travel path in response to a location of the user relative to the at least one viewing zone.

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Background/Summary

FIELD OF THE INVENTION

(1) The present disclosure generally relates to a system for assisting in a vehicle-trailer hitching operation. In particular, the present disclosure relates to a system for monitoring or controlling an alignment between a vehicle and a coupler of a trailer with a remote device.

BACKGROUND OF THE INVENTION

(2) Hitching a trailer to a vehicle can be a difficult and time-consuming experience. In particular, aligning a vehicle hitch ball with the desired trailer hitch can, depending on the initial location of the trailer relative to the vehicle, require repeated forward and reverse driving coordinated with multiple steering maneuvers to appropriately position the vehicle. Further, through a significant portion of the driving needed for appropriate hitch ball alignment, the trailer hitch cannot be seen, and the hitch ball can, under ordinary circumstances, never actually be seen by the driver. This lack of sight lines requires an inference of the positioning of the hitch ball and hitch based on experience with a particular vehicle and trailer, and can still require multiple instances of stopping and stepping out of the vehicle to confirm alignment or to note an appropriate correction for a

subsequent set of maneuvers. Even further, the closeness of the hitch ball to the rear bumper of the vehicle means that any overshoot can cause undesired contact between the vehicle and the trailer. Accordingly, further advancements may be desired.

SUMMARY OF THE INVENTION

(3) According to one aspect of the present invention, a vehicle control system is disclosed. The system comprises at least one detection device configured to capture detection data. The system further includes a controller that identifies a travel path of a vehicle extending from a current position to a target position of the vehicle. In response to the travel path, the controller calculates a travel zone occupied by the vehicle traversing the travel path and determines at least one viewing zone proximate to the travel zone. The controller further determines a location of a user based on the detection data and controls a navigation routine of the vehicle along the travel path in response to a location of the user relative to the at least one viewing zone.

(4) Aspects of the invention may include any one or a combination of the following features: a perimeter of the travel zone is calculated based on an exterior boundary and an orientation of the vehicle traversing the travel path; a vehicle maneuvering system that controls a velocity and a steering angle of the vehicle along the travel path in response to instructions received from the controller; the controller further detects a location of the remote device via the communication module; in response to the location outside the viewing zone, the controller further generates an instruction to relocate the remote device in the viewing zone, wherein the instruction provides at least one of a direction and a distance to relocate the remote device in the viewing zone; in response to the location outside the viewing zone, the controller further controls the vehicle to suspend the navigation routine of the vehicle along the travel path; the controller further instructs the remote device to demonstrate a simulated scene demonstrating the travel zone of the vehicle and the viewing zone, wherein the location of the remote device is further demonstrated in the simulated scene; an imager configured to capture image data in a field of view proximate to the vehicle; the controller further identifies a coupler position of a trailer in the image data and calculates the travel path to the target position aligning a coupler of the vehicle with a hitch of the trailer; the at least one viewing zone comprises a first viewing zone and a second viewing zone, the first viewing zone located adjacent to a first side portion of the vehicle along the travel path and the second viewing zone located adjacent to a second side portion of the vehicle along the travel path; the controller further detects an object the first viewing zone and, in response to the detection of the object, controls the remote device to output an instruction to position the user in the second viewing zone; and/or the instruction further instructs that remote device to remove the first viewing zone in response to the object detected in the first viewing zone.

(5) According to another aspect of the present invention, a method for enforcing a viewing zone for monitoring a semi-automated vehicle operation is disclosed. The method includes identifying a travel path of a vehicle. The travel path includes a travel zone of the vehicle extending from a current position to a target position. In response to the travel path, the method further comprises calculating the travel zone occupied by the vehicle traversing the travel path and determining a perimeter of at least one viewing zone based on the travel zone. In response to a location of a user relative to the perimeter of the at least one viewing zone, the method further includes controlling a navigation routine of the vehicle along the travel path.

(6) Aspects of the invention may include any one or a combination of the following features: the location of the user is detected based on a position of a remote device identified via a communication module; in response to detection of the remote device in the location outside the viewing zone, generating an instruction to relocate the remote device in the viewing zone, wherein the instruction provides at least one of a direction and a distance to relocate the remote device in the viewing zone; and/or in response to detection of the remote device in the location outside the viewing zone, controlling the vehicle to suspend a maneuvering routine along the travel path.

(7) According to yet another aspect of the present invention, a system for assisting in aligning a

vehicle for hitching with a trailer is disclosed. The system comprises a vehicle maneuvering system that controls a velocity and a steering angle of the vehicle along a travel path. The system further comprises an imaging system that captures and processes image data in a field of view. A controller identifies a coupler position of a trailer in the image data and calculates the travel path extending from a current position to a target position of the vehicle. The target position aligns a coupler of the vehicle with a hitch of a trailer. Based on the travel path, the controller calculates a travel zone occupied by the vehicle traversing the travel path and determines at least one viewing zone proximate to the travel zone. In response to the position of the remote device relative to the at least one viewing zone, the controller controls a navigation routine of the vehicle along the travel path.
(8) The invention may also include configurations wherein the controller further detects a location of the remote device via the communication module and, in response to the location outside the viewing zone, controls the vehicle to suspend the navigation routine of the vehicle along the travel path.
(9) These and other aspects, objects, and features of the present invention will be understood and appreciated by those skilled in the art upon studying the following specification, claims, and appended drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) In the drawings:
(2) FIG. **1** is a perspective view of a vehicle in an unhitched position relative to a trailer;
(3) FIG. **2** is a diagram of a system according to an aspect of the disclosure for assisting in aligning the vehicle with a trailer in a position for hitching the trailer to the vehicle;
(4) FIG. **3** is a plan view of a vehicle during a step of the alignment sequence with the trailer;
(5) FIG. **4** is a plan view of a vehicle controlling the alignment sequence with the trailer;
(6) FIG. **5** is a plan view of a vehicle and a trailer demonstrating a hitch viewing zone;
(7) FIG. **6** is a plan view of a vehicle and a trailer demonstrating a coupler viewing zone;
(8) FIG. **7** is a graphical depiction of a simulated scene of a vehicle and a trailer demonstrating a viewing zone;
(9) FIG. **8** is a graphical depiction of a simulated scene of a vehicle and a trailer demonstrating a viewing zone;
(10) FIG. **9** is a simulated scene of a vehicle navigating to a target position aligned with a trailer demonstrating a plurality of viewing zones;
(11) FIG. **10** demonstrates image data captured by a camera of the vehicle including a rendered depiction of a vehicle path and a viewing zone;
(12) FIG. **11** is a plan view of a vehicle navigating to a target position in alignment with a trailer demonstrating an object or obstruction located in one of the viewing zones; and
(13) FIG. **12** is a flow chart demonstrating a method for instructing a user/observer to maintain a position within a viewing zone during an automated hitching motion in accordance with the disclosure.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS
(14) For purposes of description herein, the terms “upper,” “lower,” “right,” “left,” “rear,” “front,” “vertical,” “horizontal,” “interior,” “exterior,” and derivatives thereof shall relate to the device as oriented in FIG. **1**. However, it is to be understood that the device may assume various alternative orientations, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments

disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise. Additionally, unless otherwise specified, it is to be understood that discussion of a particular feature or component extending in or along a given direction, or the like, does not mean that the feature or component follows a straight line or axis in such a direction or that it only extends in such direction or on such a plane without other directional components or deviations, unless otherwise specified.

(15) Referring generally to FIGS. **1-4**, reference numeral **10** designates a hitch assistance system (also referred to as a "hitch assist" system) for a vehicle **12**. In various embodiments, hitch assist system **10** includes a controller **14** configured to acquire position data of a coupler **16** of a trailer **18**. The controller **14** may be configured to derive a vehicle path **20** to align a hitch **22** (e.g., a hitch ball) of the vehicle **12** with the coupler **16**. Deriving the vehicle path **20** may include a variety of steps including detecting and compensating for a change in a coupler position **24** in order to control the vehicle **12** to locate a hitch position **26** aligned with the coupler **16**. The vehicle path **20** may comprise a plurality of segments **28**, which may correspond to changes in the operating direction or steering direction of the vehicle **12**. In various embodiments, deriving the vehicle path **20** may include navigating around intervening objects or structures, operating over uneven terrain, following a desired path indicated by an operator or user U, etc. Accordingly, the disclosure may provide for the hitch assist system **10** to provide improved navigation of the vehicle **12** and/or interaction with the coupler **16**, such that trailer **18** may be effectively connected to the vehicle **12** without complication.

(16) In some embodiments, the system **10** may be in communication with a remote device **30**. The remote device **30** may serve as a peripheral device or remote user interface that communicates operating instructions and a status of the system **10** between the user U and the controller **14** of the system **10** via a communication interface. In operation, the system **10** may communicate the vehicle path **20** or information related to the vehicle path **20** to the remote device **30**. Based on the vehicle path **20**, the remote device **30** may be configured to calculate at least one viewing zone **30***a*, **30***b* outside of a travel zone **30***c* of the vehicle **12** along the travel path **20**. The travel zone **30***c* may be calculated based on the orientation and proportions of the vehicle **12** (e.g., the perimeter of the vehicle **12**) in a simulated traversal of the vehicle path **20**. Additionally, the controller **14** of the system **10** may track a location of the remote device **30** in order to infer the location of the user U proximate to the vehicle **12**. Based on the location of the remote device **30**, the controller **14** and/or the remote device **30** may identify and communicate whether the remote device and, by association, the user U are in the at least one viewing zone **30***a*, **30***b*. In response to an identification that the remote device **30** is outside the at least one viewing zone **30***a*, **30***b;* the controller **14** of the system **10** may suspend the motion of the vehicle along the vehicle path **20**. The operation of the remote device **30** in coordination with the controller **14** is further discussed in reference to FIGS. **5-12**.

(17) With respect to the general operation of the hitch assist system **10**, as illustrated in the system diagram of FIGS. **2-4**, the system **10** includes various sensors and devices that obtain or otherwise provide vehicle status-related information. This information includes positioning information from a positioning system **32**, which may include a dead reckoning device **34** or, in addition to or as an alternative, a global positioning system (GPS), to determine a coordinate location of the vehicle **12** based on the one or more locations of the devices within the positioning system **32**. In particular, the dead reckoning device **34** can establish and track the coordinate location of the vehicle **12** within a localized coordinate system **36** based at least on vehicle speed and steering angle δ as shown in FIG. **3**. Other vehicle information received by hitch assist system **10** may include a speed of the vehicle **12** from a speed sensor **38** and a yaw rate of the vehicle **12** from an inertial measurement unit (IMU) **40**. In various embodiments, the IMU **40** may comprise or be in communication with a variety of sensors including, but not limited to, a gyroscope, an inclinometer, and/or an accelerometer. Additionally, the mass of the vehicle **12** may be measured by one or more weight sensors or pressure sensors in communication with the controller **14**. Further, it

is contemplated that in additional embodiments a proximity sensor **42**, or an array thereof, and other vehicle sensors and devices may provide sensor signals or other information, such as sequential images of the trailer **18**, including the detected coupler **16**, that the controller **14** of the hitch assist system **10** may process with various routines to determine the height H and position (e.g., based on the distance D.sub.c and angle α.sub.c) of coupler **16**. As discussed herein, the proximity sensor **42** may correspond to a radar sensor, laser sensor, ultrasonic sensor, inductive, or various sensory devices that may be implemented or incorporated with the vehicle **12**. In an exemplary embodiment, the at least one detection sensor may correspond to an image-based detection system (e.g., a camera system), which may comprise a plurality of imaging devices
(18) As further shown in FIG. **2**, one embodiment of the hitch assist system **10** is in communication with the steering system **50** of vehicle **12**. The steering system **50** may be a power-assist steering system **50** including a steering motor **52** to operate the steered wheels **54** (FIG. **1**) of the vehicle **12** for moving the vehicle **12** in such a manner that the vehicle yaw changes with the vehicle velocity and the steering angle δ. In the illustrated embodiment, the power-assist steering system **50** is an electric power-assisted steering ("EPAS") system including electric steering motor **52** for turning the steered wheels **54** to a steering angle δ based on a steering command, whereby the steering angle δ may be sensed by a steering angle sensor **56** of the power-assist steering system **50**. The steering command may be provided by the hitch assist system **10** for autonomously steering during a trailer hitch alignment maneuver and may alternatively be provided manually via a rotational position (e.g., steering wheel angle) of a steering wheel of vehicle **12**.
(19) In the illustrated embodiment, the steering wheel of the vehicle **12** is mechanically coupled with the steered wheels **54** of the vehicle **12**, such that the steering wheel moves in concert with steered wheels **54**, preventing manual intervention with the steering wheel during autonomous steering. More specifically, a torque sensor **58** is provided on the power-assist steering system **50** that senses torque on the steering wheel that is not expected from autonomous control of the steering wheel and, therefore, indicative of manual intervention. In this configuration, the hitch assist system **10** may alert the driver to discontinue manual intervention with the steering wheel and/or discontinue autonomous steering. In alternative embodiments, some vehicles have a power-assist steering system **50** that allows a steering wheel to be partially decoupled from the movement of the steered wheels **54** of such a vehicle.
(20) With continued reference to FIG. **2**, the power-assist steering system **50** provides the controller **14** of the hitch assist system **10** with information relating to a rotational position of steered wheels **54** of the vehicle **12**, including a steering angle δ. The controller **14** in the illustrated embodiment processes the current steering angle, in addition to various vehicle **12** conditions to guide the vehicle **12** along the desired path **20** (FIG. **3**). It is conceivable that the hitch assist system **10**, in additional embodiments, may be an integrated component of the power-assist steering system **50**. For example, the power-assist steering system **50** may include a hitch assist algorithm for generating vehicle steering information and commands as a function of all or a portion of information received from an imaging system **60**, the power-assist steering system **50**, a vehicle brake control or brake system **62**, a powertrain control system **64**, and other vehicle sensors and devices, as well as a human-machine interface ("HMI") **66**, as discussed further below.
(21) As also illustrated in FIG. **2**, the vehicle brake control system **62** may communicate with the controller **14** to provide the hitch assist system **10** with braking information, such as vehicle wheel speed, and to receive braking commands from the controller **14**. The brake control system **62** may be configured to control service brakes **62***a* and a parking brake **62***b*. The parking brake **62***b* may correspond to an electronic parking brake system that may be in communication with the controller **14**. Accordingly, in operation, the controller **14** may be configured to control the brakes **62***a* and **62***b* as well as detect vehicle speed information, which may be determined from individual wheel speed sensors monitored by the brake control system **62**. Vehicle speed may also be determined from the powertrain control system **64**, the speed sensor **38**, and/or the positioning system **32**,

among other conceivable means. In some embodiments, individual wheel speeds can also be used to determine a vehicle yaw rate, which can be provided to the hitch assist system **10** in the alternative or in addition to the vehicle IMU **40**.
(22) The hitch assist system **10** can further provide vehicle braking information to the brake control system **62** for allowing the hitch assist system **10** to control braking of the vehicle **12** during backing of the trailer **18**. For example, the hitch assist system **10**, in some embodiments, may regulate speed of the vehicle **12** during alignment of the vehicle **12** with the coupler **16** of trailer **18**, which can reduce the potential for a contact with trailer **18** and can bring vehicle **12** to a complete stop at a determined endpoint **70** of the path **20**. It is disclosed herein that the hitch assist system **10** can additionally or alternatively issue an alert signal corresponding to a notification of an actual, impending, and/or anticipated contact with a portion of trailer **18**. As mentioned above, regulation of the speed of the vehicle **12** may be advantageous to prevent contact with trailer **18**.
(23) In some embodiments, the powertrain control system **64**, as shown in the embodiment illustrated in FIG. **2**, may also interact with the hitch assist system **10** for regulating speed and acceleration of the vehicle **12** during partial or autonomous alignment with trailer **18**. During autonomous operation, the powertrain control system **64** may further be utilized and configured to control a throttle as well as a drive gear selection of a transmission of the vehicle **12**. Accordingly, in some embodiments, the controller **14** may be configured to control a gear of the transmission system and/or prompt the user U to shift to a desired gear to complete semi-automated operations of the vehicle **12**.
(24) As previously discussed, the hitch assist system **10** may communicate with a human-machine interface ("HMI") **66** of the vehicle **12**. The HMI **66** may include a vehicle display **72**, such as a center-stack mounted navigation or entertainment display (FIG. **1**). HMI **66** further includes an input device, which can be implemented by configuring display **72** as a portion of a touchscreen **74** with circuitry **76** to receive an input corresponding with a location over display **72**. Other forms of input, including one or more joysticks, digital input pads, or the like, can be used in place of or in addition to touchscreen **74**. Further, the hitch assist system **10** may communicate via wireless communication with another embodiment of the HMI **66**, such as with one or more handheld or remote devices **80** (FIG. **1**), including one or more smartphones. The remote device **80** may also include the display **72** for displaying one or more images and other information to a user U. For instance, the remote device **80** may display one or more images of the trailer **18** on the display **72** and may be further configured to receive remote user inputs via touchscreen circuitry **76**. In addition, the remote device **80** may provide feedback information, such as visual, audible, and tactile alerts.
(25) In some embodiments, the hitch assist system **10** may further be in communication with one or more indicator devices **78**. The indicator devices **78** may correspond to conventional vehicle indicators, such as a vehicle horn **78***a*, lights **78***b*, a speaker system **78***c*, vehicle accessories **78***d*, etc. In some embodiments, the indicator devices **78** may further include one or more accessories **78***d*, which may correspond to communication devices, remote controls, and a variety of devices that may provide for status and operational feedback between the user U and the vehicle **12**. For example, in some embodiments, the HMI **66**, the display **72**, and the touchscreen **74** may be controlled by the controller **14** to provide status updates identifying the operation or receiving instructions or feedback to control the hitch assist system **10**. Additionally, in some embodiments, the remote device **80** may be in communication with the controller **14** and configured to display or otherwise indicate one or more alerts or messages related to the operation of the hitch assist system **10**.
(26) Still referring to the embodiment shown in FIG. **2**, the controller **14** is configured with a microprocessor **82** to process logic and routines stored in memory **84** that receive information from the above-described sensors and vehicle systems, including the imaging system **60**, the power-assist steering system **50**, the vehicle brake control system **62**, the powertrain control system **64**,

and other vehicle sensors and devices. The controller may communicate with the various devices described herein via a communication network of the vehicle **12**, which can include a controller area network (CAN), a local interconnect network (LIN), or other protocols used in the automotive industry. The controller **14** may generate vehicle steering information and commands as a function of all or a portion of the information received. Thereafter, the vehicle steering information and commands may be provided to the power-assist steering system **50** for affecting the steering of the vehicle **12** to achieve a commanded path **20** (FIG. **3**) of travel for alignment with the coupler **16** of trailer **18**. The controller **14** may include the microprocessor **82** and/or other analog and/or digital circuitry for processing one or more routines. Also, the controller **14** may include the memory **84** for storing one or more routines, including an image processing routine **86** and/or hitch detection routine, a path derivation routine **88**, and an operating routine **90**.

(27) It should be appreciated that the controller **14** may be a stand-alone dedicated controller or may be a shared controller integrated with other control functions, such as integrated with a vehicle sensor system, the power-assist steering system **50**, and other conceivable onboard or off-board vehicle control systems. It should further be appreciated that the image processing routine **86** may be carried out by a dedicated processor, for example, within a stand-alone imaging system for vehicle **12** that can output the results of its image processing to other components and systems of vehicle **12**, including microprocessor **82**. Further, any system, computer, processor, or the like, that completes image processing functionality, such as that described herein, may be referred to herein as an “image processor” regardless of any other functionality it may also implement (including simultaneously with executing image processing routine **86**).

(28) System **10** may also incorporate the imaging system **60** that includes one or more exterior cameras. Examples of exterior cameras are illustrated in FIG. **4** and include rear camera **60***a*, center high-mount stop light (CHMSL) camera **60***b*, and side-view cameras **60***c* and **60***d*, although other arrangements including additional or alternative cameras are possible. In one example, imaging system **60** can include rear camera **60***a* alone or can be configured such that system **10** utilizes only rear camera **60***a* in a vehicle with multiple exterior cameras. In another example, the various cameras **60***a*-**60***d* included in imaging system **60** can be positioned to generally overlap in their respective fields of view, which in the depicted arrangement include fields of view **92***a*, **92***b*, **92***c*, and **92***d* to correspond with rear camera **60***a*, center high-mount stop light (CHMSL) camera **60***b*, and side-view cameras **60***c* and **60***d*, respectively. In this manner, image data from two or more of the cameras can be combined in image processing routine **86**, or in another dedicated image processor within imaging system **60**, into a single image.

(29) As an example of combining image data from multiple cameras, the image data can be used to derive stereoscopic image data that can be used to reconstruct a three-dimensional scene of the area or areas within overlapped areas of the various fields of view **92***a*, **92***b*, **92***c*, and **92***d*, including any objects (obstacles or coupler **16**, for example) therein. In an embodiment, the use of two images including the same object can be used to determine a location of the object relative to the two image sources, given a known spatial relationship between the image sources. In this respect, the image processing routine **86** can use known programming and/or functionality to identify an object within image data from the various cameras **60***a*, **60***b*, **60***c*, and **60***d* within imaging system **60**. In either example, the image processing routine **86** can include information related to the positioning of any cameras **60***a*, **60***b*, **60***c*, and **60***d* present on vehicle **12** or utilized by system **10**, including relative to a center **96** (FIG. **1**) of vehicle **12**, for example, such that the positions of cameras **60***a*, **60***b*, **60***c*, and **60***d* relative to center **96** and/or to each other can be used for object positioning calculations and to result in object position data relative to the center **96** of vehicle **12**, for example, or other features of vehicle **12**, such as hitch **22** (FIG. **1**), with known positions relative to center **96** of the vehicle **12**.

(30) The image processing routine **86** can be specifically programmed or otherwise configured to locate coupler **16** within image data. In one example, the image processing routine **86** can identify

the coupler **16** within the image data based on stored or otherwise known visual characteristics of coupler **16** or hitches in general. In another embodiment, a marker in the form of a sticker, or the like, may be affixed with trailer **18** in a specified position relative to coupler **16** in a manner similar to that which is described in commonly-assigned U.S. Pat. No. 9,102,271, the entire disclosure of which is incorporated by reference herein. In such an embodiment, the image processing routine **86** may be programmed with identifying characteristics of the marker for location in image data, as well as the positioning of coupler **16** relative to such a marker, so that the position **24** of the coupler **16** can be determined based on the marker location.

(31) Additionally or alternatively, controller **14** may seek confirmation of the determined coupler **16** via a prompt on touchscreen **74**. If the coupler **16** determination is not confirmed, further image processing may be provided, or user-adjustment of the position **24** of coupler **16** may be facilitated, either using touchscreen **74** or another input to allow the user U to move the depicted position **24** of coupler **16** on touchscreen **74**, which controller **14** uses to adjust the determination of position **24** of coupler **16** with respect to vehicle **12** based on the above-described use of image data. Alternatively, the user U can visually determine the position **24** of coupler **16** within an image presented on HMI **66** and can provide a touch input in a manner similar to that which is described in commonly-assigned U.S. Pat. No. **10**,**266**,**023**, the entire disclosure of which is incorporated by reference herein. The image processing routine **86** can then correlate the location of the touch input with the coordinate system **36** applied to image data shown on the display **72**, which may be depicted as shown in FIG. **3**.

(32) As shown in FIG. **3**, the image processing routine **86** and operating routine **90** may be used in conjunction with each other to determine the path **20** along which hitch assist system **10** can guide vehicle **12** to align hitch **22** and coupler **16** of trailer **18**. In the example shown, an initial position of vehicle **12** relative to trailer **18** may be such that coupler **16** is only in the field of view **92***c* of side camera **60***c*, with vehicle **12** being positioned laterally from trailer **18** but with coupler **16** being almost longitudinally aligned with hitch **22**. In this manner, upon initiation of hitch assist system **10**, such as by user input on touchscreen **74**, for example, image processing routine **86** can identify coupler **16** within the image data of camera **60***c* and estimate the position **24** of coupler **16** relative to hitch **22**. The position **24** of the coupler **16** may be identified by the system **10** using the image data by receiving focal length information within image data to determine a distance D.sub.c to coupler **16** and an angle α.sub.c of offset between coupler **16** and the longitudinal axis of vehicle **12**. This information may also be used in light of the position **24** of coupler **16** within the field of view of the image data to determine or estimate the height H.sub.c of coupler **16**. Once the positioning D.sub.c, α.sub.c of coupler **16** has been determined and, optionally, confirmed by the user U, the controller **14** can take control of at least the vehicle steering system **50** to control the movement of vehicle **12** along the desired path **20** to align the hitch position **26** of the vehicle hitch **22** with coupler **16**.

(33) Continuing with reference to FIGS. **3** and **4** with additional reference to FIG. **2**, controller **14**, having estimated the positioning D.sub.c, α.sub.c of coupler **16** as discussed above, can, in one example, execute path derivation routine **88** to determine vehicle path **20** to align the vehicle hitch **22** with coupler **16**. In particular, controller **14** can have stored in memory **84** various characteristics of vehicle **12**, including the wheelbase W, the distance from the rear axle to the hitch **22**, which is referred to herein as the drawbar length L, as well as the maximum angle to which the steered wheels **54** can be turned δ.sub.max. As shown, the wheelbase W and the current steering angle δ can be used to determine a corresponding turning radius ρ for vehicle **12** according to the equation:

(34) $= \frac{1}{W \tan}$ (1)

in which the wheelbase W is fixed and the steering angle δ can be controlled by controller **14** by communication with the steering system **50**, as discussed above. In this manner, when the maximum steering angle δ.sub.max is known, the smallest possible value for the turning radius ρ.sub.min is determined as:

(35) $$_{min} = \frac{1}{W \tan \quad _{max}} \quad (2)$$

(36) Path derivation routine **88** can be programmed to derive vehicle path **20** to align a known location of the vehicle hitch **22** with the estimated position **24** of coupler **16** that takes into account the determined minimum turning radius ρ.sub.min, to allow path **20** to use the minimum amount of space and maneuvers. In this manner, path derivation routine **88** can use the position of vehicle **12**, which can be based on the center **96** of vehicle **12**, a location along the rear axle, the location of the dead reckoning device **34**, or another known location on the coordinate system **36**, to determine both a lateral distance to the coupler **16** and a forward or rearward distance to coupler **16** and derive a path **20** that achieves the needed lateral and forward-backward movement of vehicle **12** within the limitations of steering system **50**. The derivation of path **20** further takes into account the positioning of hitch **22**, based on length L, relative to the tracked location of vehicle **12** (which may correspond with the center **96** of mass of vehicle **12**, the location of a GPS receiver, or another specified, known area) to determine the needed positioning of vehicle **12** to align hitch **22** with coupler **16**.

(37) Referring again to FIGS. **1** and **2**, in some instances, the HMI **66** further includes an input device, which can be implemented by configuring the display **72** as a portion of the touchscreen **74** with input circuitry **76** to receive an input corresponding with a location over the display **72**. Other forms of input, including one or more joysticks, digital input pads, or the like, can be used in place of or in addition to touchscreen **74**.

(38) Further, the hitch assist system **10** may be communicatively coupled via a communication circuitry **102** with one or more handheld or remote devices **30** (FIG. **1**), Which may additionally and/or alternatively be configured as the user-input device. The communication circuitry **102** may include a radio frequency transmitter and receiver for transmitting and receiving signals. The signals may be configured to transmit data and may correspond to various communication. protocols. The communication. circuitry **102** may be used to send and receive data and/or audiovisual content. The communication circuitry **102** may utilize one or more of various wired or wireless communication mechanisms, including, any desired combination of wired (e.g., cable and fiber) and/or wireless (e.g., cellular, wireless, satellite, microwave, and radio frequency) communication mechanisms and any desired network topology (or topologies when multiple communication mechanisms are utilized). Exemplary wireless communication networks include a wireless transceiver configured to communicate via one or more wireless protocols (e.g., a Bluetooth®, Bluetooth® Low Energy [BLE], Ultra-Wideband [UWB]; and Z-Wave®; Zigbee®, Wi-Fi [802.11a, b, g, n, etc.], IrDA, RFID, etc.), local area networks (LAN), wide area networks (WAN), including the Internet, GSM, CDMA, WCDMA, GPRS, MBMS, WiMax, DVB-H, ISDB-T, etc., as well as advanced communication protocols that may be developed at a later time.

(39) In various implementations, the system **10** may identify the location of the remote device **30** proximate the vehicle based on one or more location detection techniques, which may be attributed to the communication circuitry **102**. For example, the communication circuitry **102** may detect the location of the remote device **30** based on time of flight detection as well as an angle of arrival or angle of departure directional signal determination based on RSS (Received Signal Strength), AOA (Angle of Arrival), TOA (Time of Arrival), and TDOA (Time Difference of Arrival), which may be supported by one or more wireless protocols (e.g., Bluetooth® Low Energy (BLE), Ultra-Wideband, etc.). Based on these methods, the location of the remote device **30** and the inferred location of the user U may be identified within a range of less than **20** centimeters. Additionally, the location of the remote device **30** may be detected in the image data by detecting an associated location of the user U identified in the image data captured by the imaging system **60**. As further discussed in reference to FIGS. **7** and **8**, the image data may be displayed on the display **72** of the

HMI **66** and/or on the remote device **30**.

(40) The remote device **30** may also include a touchscreen **104** having a display **106** for displaying graphic data **110** or simulated scenes **122** (FIGS. **7** and **8**) and other information to a user U and touch input circuitry **1108**. For instance, the remote device **30** may display the graphic data **110** of the trailer **18** on the display **106** and may be further able to receive remote user inputs via the touch input circuitry **108**. In addition, the remote device **30** may provide feedback information, such as visual, audible, and tactile alerts. It will be appreciated that the remote device **30** may be any one of a variety of computing devices and may include a processor and memory. For example, the remote device **30** may be a cell phone, mobile communication device, key fob, wearable device (e.g., fitness band, watch, glasses, jewelry, wallet), personal digital assistant, headphones and/or other devices that include capabilities for wireless communications and/or any wired communications protocols.

(41) Referring now to FIGS. **1** and **5-12**, the coordinated operation of the system **10** in combination with the remote device **30** is discussed in further detail. In operation, the remote device **30** may serve as a peripheral device or remote user interface to support remote operation of the vehicle **12** with the user U located outside of a passenger compartment **120** of the vehicle **12**. In some instances, the controller **14** may communicate the vehicle path **20** or information related to the vehicle path **20** to the remote device **30** via the communication circuitry **102**. Based on the vehicle path **20**, the controller **14** and/or the remote device **30** may be configured to calculate a first viewing zone **30***a* and a second viewing zone **30***b* outside of the travel zone **30***c* of the vehicle **12**. As previously discussed, the travel zone **30***c* may be calculated based on the orientation and proportions of the vehicle **12** (e.g., the perimeter of the vehicle **12**) in a simulated traversal of the vehicle path **20**. More specifically, the controller **14** and/or the remote device **30** may simulate the steering angles and corresponding orientation required for the vehicle **12** to traverse the vehicle path **20**. In this way, the remote device **30** may be operable to display a simulated scene **122** of the travel zone **30***c* and the related viewing zones **30***a* and **30***b* of the vehicle **12** as depicted by the graphic data **110** demonstrated in FIGS. **7** and **8**.

(42) Referring now to FIGS. **5** and **6**, a plan view of the vehicle **12** and the trailer **18** are shown demonstrating a hitch viewing zone **130***a* of the hitch **22** and a coupler viewing zone **130***b* of the coupler **16** are shown. In some instances, the viewing zones **30***a* and **30***b* may be calculated and simulated based on the geometry of each of the vehicle **12** and the trailer **18** based on the estimated or assigned height of the user U. For example, the regions surrounding the vehicle **12** from which the user U may have a line of sight to the hitch **22** may vary based on the proportions of the vehicle (e.g., width, box-side height, truck/tailgate height, and proportions, etc.) and the height of the user U. The geometry of the vehicle **12** may be programmed in the memory **84** of the system **10** by the manufacturer. Accordingly, based on the predetermined or user-defined height of the user U, the controller **14** of the system **10** may define the hitch viewing zone **130***a* proximate to the vehicle **12** and outside of the travel zone **30***c*.

(43) The system **10** may further be configured to calculate the coupler viewing zone **130***b* based on the geometry of the trailer **18**. Unlike the geometry of the vehicle **12**, the geometry of the trailer **18** may vary and may not be specifically defined by a manufacturer of the vehicle **12**. The geometry of the trailer **18** may be entered by the user U or loaded via a trailer database accessible by the controller **14** via the communication circuity **102**. The entry of the trailer geometry may be assisted based on a recognition of a type or category of the trailer **18** identified via an image processing algorithm of the controller **14**. Accordingly, a category or template for the trailer **18** may be assigned by the controller **14** based on the image data and processed via processing techniques similar to those discussed in reference to the image processing routine **86**. In this way, the controller may detect and/or receive inputs identifying the geometry of the trailer **18**, and, based on the trailer geometry and the height of the user U, the controller **14** may define the coupler viewing zone **130***b*.

(44) Once the hitch viewing zone **130***a* and the coupler viewing zone **130***b* are determined, the controller **14** may define the viewing zones **30***a* and **30***b* as the union between the hitch viewing zone **130***a* and the coupler viewing zone **130***b*. With the hitch viewing zones **30***a* and **30***b* defined for the combination of the vehicle **12** and the trailer **18**, the system **10** may control the vehicle HMI **66** and/or the remote device **30** to display the simulated scene **122** of the travel zone **30***c* and the related viewing zones **30***a* and **30***b* based on the specific geometry of the vehicle **12** and the trailer **18** as demonstrated and further discussed in reference to FIGS. **7** and **8**. In this way, the system **10** may communicate a position for the user U to stand with the remote device **30** to provide an optimum view of the alignment of the hitch **22** of the vehicle **12** with the coupler **16** of the trailer **18**.
(45) Additionally, the location of the remote device **30** may be detected in the image data by detecting an associated location of the user U identified in the image data captured by the imaging system **60**. As further discussed in reference to FIGS. **7** and **8**, the image data may be displayed on the display **72** of the HMI **66** and/or on the remote device **30**.
(46) Referring now to FIGS. **7** and **8**, the simulated scene **122** of the vehicle **12** and the trailer **18** is shown demonstrating the viewing zones **30***a* and **30***b* as well as the travel zone **30***c*. In operation, the simulated scene **122** may be updated based on the movement of the vehicle **12** along the vehicle path **20** as well as a location **124** of the remote device **30**. In this way, the system **10** may provide for the display of the simulated scene **122** on the HMI **66** and/or the remote device **30**. The simulated scene **122** may further include one or more instructions **140**, which may guide the user U to move in order to locate the remote device **30** in one of the viewing zones **30***a*, **30***b*. In this way, the system **10** may communicate graphical instructions to coach and instruct the user U to be positioned within and thereby locate the remote device **30** within the viewing zone **30***a*, **30***b*, while implementing the operating routine **90**.
(47) As depicted in FIG. **7**, the simulated scene **122** is shown including the instruction **140** directing the user U to exit the vehicle **12** and position the remote device **30** in one of the viewing zones **30***a*, **30***b*. In operation, the simulated scene **122** depicted on the HMI **66** and/or remote device **30** may demonstrate an estimated position of the vehicle **12** in relation to the trailer **18** and the corresponding travel zone **30***c* positioned therebetween along the vehicle path **20**. Additionally, a user symbol **142** may be depicted in the simulated scene **122** identifying a relative location of the remote device **30** and an inferred location of the user U. As depicted in FIG. **7**, the user U is located in the first viewing zone **30***a*. In this way, the system **10** may provide instructions and feedback to the user U, such that the user may easily be located in one of the viewing zones **30***a*, **30***b* and outside the travel zone **30***c* of the vehicle **12**.
(48) Referring now to FIG. **8**, the simulated scene **122** demonstrates additional instructions **140** communicated to the user U to assist in the completion of the operating routine **90**. As further discussed in reference to FIG. **12**, the disclosure may provide for the remote operation of the vehicle **12** via the remote device **30** and may track the location of the remote device **30** to enable the motion of the vehicle along the vehicle path **20**. During such operation, the controller **14** of the system **10** may halt or suppress the motion of the vehicle **12** in response to the remote device **30** and the inferred location of the user U being outside the viewing zones **30***a*, **30***b*. As depicted in FIG. **8**, the instruction **140** indicates that the vehicle motion is paused and requests the user to step into one of the viewing zones **30***a*, **30***b* to resume the operating routine **90**. As previously discussed, the simulated scene **122** may include the user symbol **142** identifying a location of the remote device **30** approximate the vehicle **12** and the trailer **18**. Additionally, the simulated scene **122** may include a graphical representation of a positioning instruction **144**, which may assist the user U in identifying where to move in order to enter one of the viewing zones **30***a*, **30***b*. Accordingly, the system of may provide for the simulated scene **122** to be displayed on the display **72** of the HMI **66** and/or the display **106** of the remote device **30** in accordance with the disclosure.
(49) As previously discussed, the system **10** may identify the location of the remote device **30** by

monitoring communication signals to and from the remote device **30** via the communication circuitry **102**. The location of the remote device **30** may, therefore, be detected by the system **10** based on RSS (Received Signal Strength), AOA (Angle of Arrival), TOA (Time of Arrival), and TDOA (Time Difference of Arrival), which may be supported by one or more wireless protocols (e.g., Bluetooth® Low Energy (BLE), Ultra-Wideband, etc.). Additionally, the location of the remote device **30** may be used to infer the location of the user U. Though specific locating techniques are described herein in reference to the detection of the location of the remote device **30**, the system **10** may utilize various techniques including ultrasonic proximity detection, mono or stereoscopic imaging, LIDAR (laser imaging, detection, and ranging), etc. Accordingly, the methods and system described herein may be implemented via a variety of sensory technologies without departing from the spirit of the disclosure.

(50) FIG. **9** demonstrates a plan view of the vehicle **12** navigating along the vehicle path **20** to a target location or position **150**. The target location **150** may correspond to a position where the hitch **22** of the vehicle **12** is aligned with the coupler **16** of the trailer **18**. As shown, the travel zone **30***c* of the vehicle **12** may extend along the vehicle path **20** and may be calculated based on the orientation and proportions of the vehicle (e.g., the perimeter of the vehicle) based on a simulated traversal of the vehicle path **20**. In this way, the system may calculate the travel zone **30***c* of the vehicle **12** and provide an indication to the user U identifying at least one viewing zone **30***a*, **30***b* from which to observe and/or control the operation of the vehicle **12** during the operating routine **90**.

(51) As previously discussed, the viewing zones **30***a*, **30***b* may be calculated as the union of the hitch viewing zone **130***a* and the coupler viewing zone **130***b*, which are positioned on opposing sides of the travel zone **30***c* outside the maneuvering path of the vehicle **12**. In various implementations, the proportions of the viewing zones **30***a*, **30***b* may be fixed or may be adjusted to optimize the view of the hitch **22** and the coupler **16** throughout the operating routine **90**. For example, arrows **152** represent the changing boundary of each of the viewing zones **30***a*, **30***b* based on the position of the vehicle **12** along the vehicle path **20**. In such instances, the user U may be instructed to relocate the remote device **30** within the viewing zones **30***a*, **30***b* in response to the changing proportions of the viewing zones **30***a*, **30***b*. The changing proportion of the viewing zones **30***a*, **30***b*, as represented by the arrows **152**, may be the result of a change in the hitch viewing zone **130***a* as a result of the movement of the vehicle **12** along the vehicle path **20**. In such implementations, the system **10** may be operable to display instructions in the simulated scene **122** identifying the changing boundaries of the viewing zones **30***a*, **30***b* and instructing the user U to maintain the remote device **30** within the changing proportions of the viewing zone **30***a*, **30***b*.

(52) In addition to or alternatively to the display of the simulated scene **122**, the system **10** may be configured to output various indications instructing the user U to maintain a position within one of the viewing zones **30***a*, **30***b*. For example, the controller **14** may control the indicator devices **78** of the vehicle **12** (e.g., the lights **78***b*, the speaker system **78***c*, the accessories **78***d*, etc.) to instruct the user U to move away from, further behind, or in a direction relative to a portion of the vehicle **12**. For example, the controller **14** may illuminate the taillights of the vehicle **12** with increasing intensity or frequency to identify that the vehicle **12** is approaching the user U. Similarly, the controller **14** may control the turn indicators of the vehicle to instruct the user U to move in a corresponding left or right direction relative to a rear portion of the vehicle **12**, such that the user U is positioned within one of the viewing zones **30***a*, **30***b*. Additionally, the controller **14** may output audible instructions to the user U via the speaker system **78***c* instructing a relative location for the user U to move in relation to the vehicle **12**. Accordingly, the system **10** may instruct or guide the user U to maintain a position in one of the viewing zones **30***a*, **30***b* in a variety of ways.

(53) Referring now to FIGS. **10** and **11**, exemplary operation of the system **10** is discussed in reference to the detection of an object or obstruction within one of the viewing zones **30***a*, **30***b*. FIG. **10** demonstrates a rearward directed scene **160** captured by the imaging system **60** of the

vehicle **12** demonstrating a graphical representation of the vehicle path **20** and the first viewing zone **30***a*. FIG. **11** depicts a plan view of the scene **160** depicted in FIG. **10**. In the example shown, an obstruction or object **162** is located within the second viewing zone **30***b*. As depicted, the obstruction **162** corresponds to an automotive vehicle. However, the obstruction **162** may be identified by the controller **14** as any object or encumbrance that may limit the movement of the user U within or proximate to the boundaries of one of the viewing zones **30***a*, **30***b*. In this way, system **10** may insure that each of the viewing zones **30***a*, **30***b* are not only suitable for viewing the hitch **22** and the coupler **16** during the operating routine **90** but also that the regions corresponding to the viewing zones **30***a*, **30***b* are accessible to the user U.

(54) As shown in FIG. **11**, the simulated scene **122** identifies that the second viewing zone **30***b* is obstructed. Accordingly, the simulated scene **122** demonstrates graphical instructions identifying a location for the user U within the first viewing zone **30***a*. Additionally, the arrow **152** represents the changing proportions of the first viewing zones **30***a* and a corresponding path along which the user U may be instructed to relocate as the vehicle **12** is controlled to traverse the vehicle path **20** to reach the target position **150**. Accordingly, the system **10** may identify the obstruction **162** for various objects located within one of the viewing zones **30***a*, **30***b* and provide corresponding instructions to the user U to position the remote device **30** within the viewing zone **30***a*, **30***b* that is unobstructed by the object or obstruction **162**.

(55) Referring again to FIG. **10**, the rearward directed scene **160** may be displayed on the display **72** on the HMI **66** and/or the display **106** of the remote device **30**. The rearward directed scene **160** may include graphical representations of the viewing zones **30***a*, **30***b*, shown relative to the coupler **16** and the trailer **18**, in the image data captured by the imaging system **60**. Additionally, a location of the coupler position **24** may be outlined or emphasized by a border **164** superimposed over the image data. The border **164** may serve to notify the user U of a general location of the identified coupler position **24** of the coupler **16** identified in the rearward directed scene **160**. Finally, a graphical representation of the vehicle path **20** may be superimposed over the image data of the rearward directed scene **160** identifying an approximation of the vehicle path extending from the hitch **22** to the coupler **16**. Accordingly, the system **10** may provide for visual instructions in the form of the simulated scene **122**, as well as enhanced video including graphic overlays superimposed over the rearward directed scene **160**. In this way, the system **10** may provide intuitive instruction to the user U to locate the remove device **30** within one of the viewing zones **30***a*, **30***b*.

(56) Referring now to FIG. **12**, a method **170** for coaching the user U to locate the remote device **30** within one of the viewing zones **30***a*, **30***b* is shown. The method **170** may begin in response to initiating the operating routine **90** with a remote observation option selected, allowing the user U to view the navigation of the vehicle **12** from outside the passenger compartment **120** (**172**). Upon initiation of the operating routine **90**, the method **170** may calculate the travel zone **30***c* of the vehicle **12** and the viewing zones **30***a*, **30***b* (**174**). With the viewing zones **30***a*, **30***b* calculated, the controller **14** may scan the image data for various sensor data to determine if an obstruction or object is located in one of the viewing zones **30***a*, **30***b* (**176**). If an obstruction is identified in step **176**, the controller **14** may identify the corresponding viewing zone **30***a* and/or **30***b* and restrict or withdraw an instruction to the user, such that the obstructed viewing zone is not available for observation (**178**). If no obstruction is identified in step **176** or following the restriction of one of the viewing zones in step **178**, the method **170** may continue to identify a location of the remote device (**180**).

(57) With the proportions of the viewing zones **30***a*, **30***b* and the location of the remote device **30**, the controller **14** may output one or more instructions coaching the user U to enter one or either of the viewing zones **30***a*, **30***b* (**182**). As discussed herein, the instructions may be provided to the user U via the display **72** of the HMI **66** and/or the display **106** of the remote device **30**. The instructions may also be output via various indicator devices **78** of the vehicle (e.g., the lights **78***b*, the speaker

system **78***c*, the accessories **78***d*, etc.) as well as similar indicator devices of the remote device **30** or various other vehicle accessories that may be in communication with the system **10**. Additionally, in step **184**, the controller **14** may update the instructions communicated to the user U based on detected changes in the location of the remote device **30**. Accordingly, the method **170** may provide for a flexible solution to instruct the user U to locate the remote device **30** within one of the viewing zones **30***a*, **30***b*.

(58) By continuing to monitor the location of remote device **30**, the method **170** may determine if the remote device **30** is located in the viewing zone in step **186**. If the remote device **30** is not located in one of the viewing zones **30***a*, **30***b*, a motion control operation of the vehicle may be suspended (**188**). As previously discussed in reference to step **178**, if one of the viewing zones **30***a*, **30***b* is restricted due to an object or obstruction **162**, the detection in step **186** may be limited to one of the viewing zones **30***a* or **30***b* that is identified as accessible or unobstructed. If the remote device **30** is identified within one of the viewing zones **30***a*, **30***b* in step **186**, the method **170** may continue to control the motion of the vehicle **12** along the vehicle path **20** (**190**).

(59) As previously discussed, the system **10** may provide for updated parameters for proportions of the viewing zones **30***a*, **30***b* based on the hitch viewing zone **130***a* of the hitch **22** resulting from changes in the position or motion of the vehicle **12** (**192**). Based on the changing proportions of the viewing zones **30***a*, **30***b*, the method **170** may continue to monitor the location of the remote device **30** and provide instructions to the user U to locate the remote device **30** in the viewing zone(s) as previously discussed in steps **180**, **182**, and **184**. Finally, based on the continuing motion of the vehicle **12** along the vehicle path **20**, the system **10** may identify if the vehicle is located aligned with the target position **150** in step **194**. If the vehicle **12** is not aligned with the target position **150** in step **194**, the method may return to step **186** to verify that the remote device **30** is located in one of the viewing zones **30***a*, **30***b*. If the vehicle **12** is located in the target position **150** in step **194**, the method **170** may end as a result of the automated or semi-automated movement of the vehicle **12** being stopped in response to the alignment of the target position **150** (**196**).

(60) It will be understood that any described processes or steps within described processes may be combined with other disclosed processes or steps to form structures within the scope of the present disclosure. The exemplary structures and processes disclosed herein are for illustrative purposes and are not to be construed as limiting.

Claims

1. A vehicle control system comprising: at least one detection device configured to capture detection data; and a controller that: identifies a travel path of a vehicle extending from a current position to a target position of the vehicle; in response to the travel path, calculates a travel zone occupied by the vehicle traversing the travel path; determines at least one viewing zone proximate to and outside of the travel zone, wherein the at least one viewing zone comprises a first viewing zone and a second viewing zone, the first viewing zone located on a first side portion of the vehicle along the travel path and the second viewing zone located on a second side portion of the vehicle along the travel path; identifies an obstructed region in a portion of the at least one viewing zone and limits the at least one viewing zone based on the obstructed region, wherein the obstructed region is detected in response to an object in the first viewing zone; determines a location of a user based on the detection data; in response to the detection of the object, controls a remote device to output an instruction to position the user in the second viewing zone; and controls a navigation routine of the vehicle along the travel path in response to the location of the user relative to the second viewing zone.
2. The control system according to claim 1, wherein a perimeter of the travel zone is calculated based on an exterior boundary and an orientation of the vehicle traversing the travel path.
3. The control system according to claim 1, wherein the controller further: in response to the

location of the remote device outside the second viewing zone, generates an instruction to relocate the remote device in the second viewing zone, wherein the instruction provides at least one of a direction and a distance to relocate the remote device in the viewing zone.
4. The control system according to claim 1, wherein the controller further: in response to the position of the remote device outside the second viewing zone, controls the vehicle to suspend the navigation routine of the vehicle along the travel path.
5. The control system according to claim 1, wherein the controller further: instructs the remote device to demonstrate a simulated scene demonstrating the travel zone of the vehicle and the second viewing zone, wherein the location of the remote device is further demonstrated in the simulated scene.
6. The control system according to claim 1, further comprising: an imager configured to capture image data in a field of view proximate to the vehicle, wherein the controller identifies a coupler position of a trailer in the image data, and wherein the controller calculates the travel path to the target position aligning a coupler of the vehicle with a hitch of the trailer.
7. The control system according to claim 1, wherein the instruction further instructs the remote device to remove the first viewing zone from a simulated scene demonstrating the travel zone of the vehicle and the at least one viewing zone in response to the object detected in the first viewing zone.
8. A method for enforcing a viewing zone for monitoring a semi- automated vehicle operation, the method comprising: identifying a travel path of a vehicle, wherein the travel path includes a travel zone of the vehicle extending from a current position to a target position; in response to the travel path, calculating the travel zone occupied by the vehicle traversing the travel path; determining a first viewing zone and a second viewing zone based on the travel zone, wherein the first viewing zone and the second viewing zone are outside of the travel zone; identifying an obstruction in the first viewing zone; in response to the obstruction, instructing a user to enter the second viewing zone; and controlling a navigation routine of the vehicle along the travel path in response to a location of the user in the second viewing zone.
9. The method according to claim 8, wherein the location of the user is detected based on a position of a remote device identified via a communication module.
10. The method according to claim 9, further comprising: in response to the location of the remote device outside the second viewing zone, generating an instruction to relocate the remote device in the viewing zone.
11. The method according to claim 10, wherein the instruction provides at least one of a direction and a distance to relocate the remote device in the viewing zone.
12. The method according to claim 9, further comprising: in response to the location of the remote device outside the second viewing zone, controlling the vehicle to suspend a maneuvering routine along the travel path.
13. A system for assisting in aligning a vehicle for hitching with a trailer comprising: a vehicle maneuvering system that controls a velocity and a steering angle of the vehicle along a travel path; a communication module configured to communicate with a remote device comprising a user interface, wherein the communication module identifies a position of the remote device and infers a location of a user; an imaging system that captures and processes image data in a field of view; and a controller that: identifies a coupler position of a trailer in the image data; calculates the travel path extending from a current position to a target position of the vehicle, wherein the target position aligns a coupler of the vehicle with a hitch of a trailer; based on the travel path, calculates a travel zone occupied by the vehicle traversing the travel path; determines at least one viewing zone outside of and adjacent to opposing sides of the travel zone, wherein the at least one viewing zone comprises a first viewing zone and a second viewing zone, the first viewing zone on a first side portion of the vehicle along the travel path and the second viewing zone located on a second side portion of the vehicle along the travel path; identifies an obstructed region in the first viewing zone,

wherein the obstructed region is identified in response to an object in the first viewing zone; in response to the detection of the object, outputs an instruction to position the user in the second viewing zone; and controls a navigation routine of the vehicle maneuvering system along the travel path in response to the position of the user relative to the second viewing zone.

14. The system according to claim 13, wherein the controller further: in response to the position of the user outside the second viewing zone, controls the vehicle maneuvering system to suspend the navigation routine of the vehicle along the travel path.