



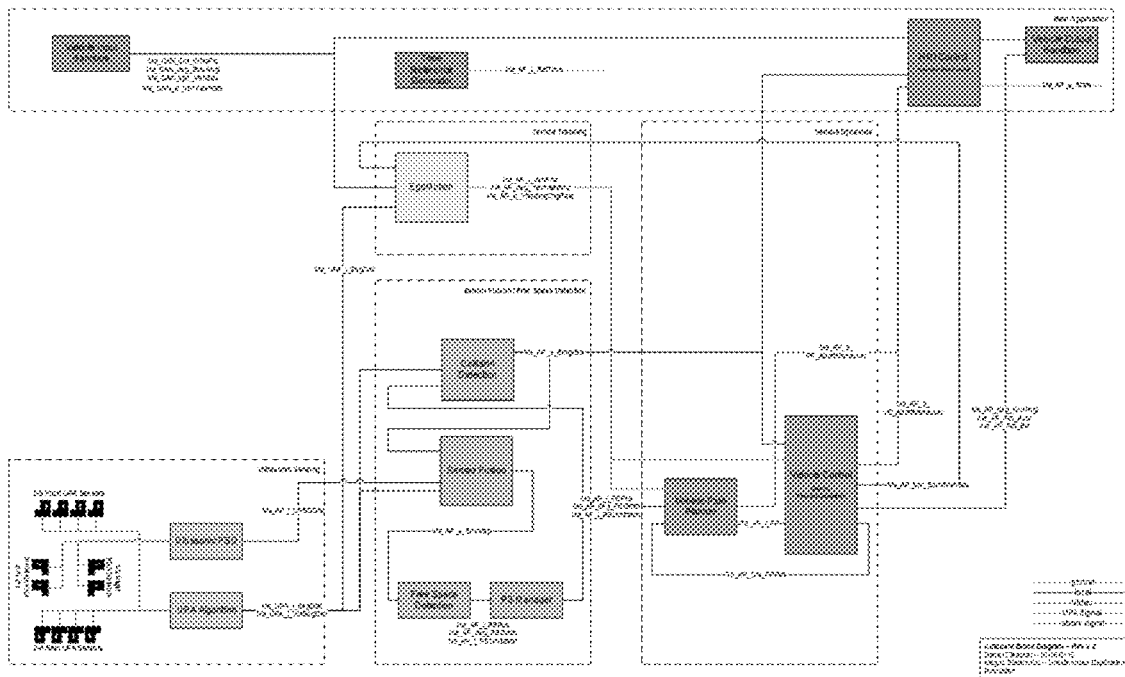
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Diessner(10) **Pub. No.: US 2017/0253237 A1**(43) **Pub. Date: Sep. 7, 2017**(54) **VEHICLE VISION SYSTEM WITH
AUTOMATIC PARKING FUNCTION**(71) Applicant: **MAGNA ELECTRONICS INC.**,
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1/0246 (2013.01); **B60W 2550/10** (2013.01);
B60W 2600/00 (2013.01)

(57)

ABSTRACT

A vehicle parking system of a vehicle includes a plurality of exterior viewing cameras and a control having an image processor operable to process image data captured by the cameras. The vehicle parking system learns a path of travel from a drop off location to a parking location during a learning maneuver that includes a driver driving the vehicle from the drop off location to the parking location. The control, upon the driver exiting the vehicle when the vehicle is positioned at the drop off location and at least in part responsive to the learned path of travel, controls the vehicle to autonomously drive the vehicle from the drop off location to the parking location. The control, responsive at least in part to image processing by the image processor of image data captured by at least one of the cameras, parks the vehicle at the parking location.



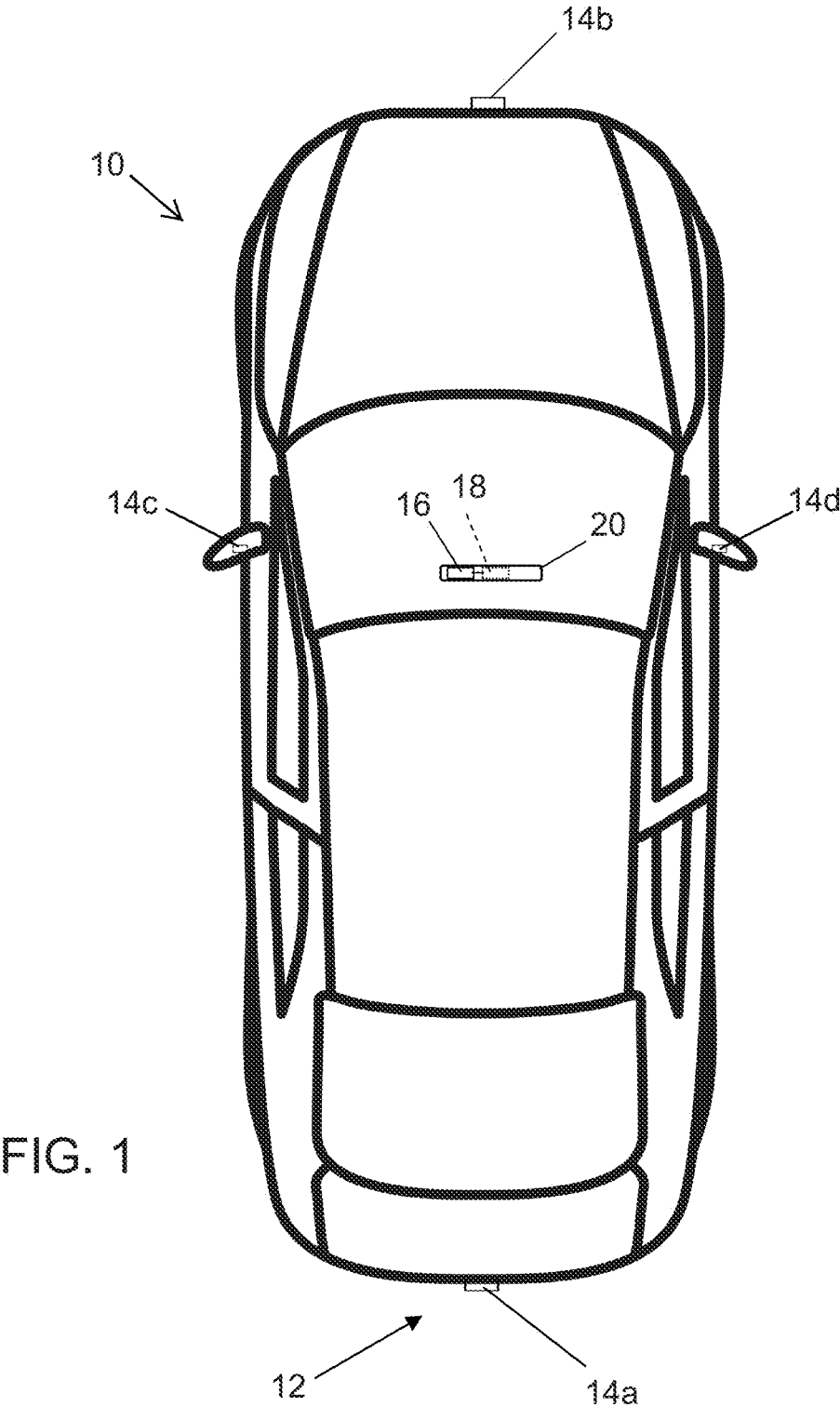
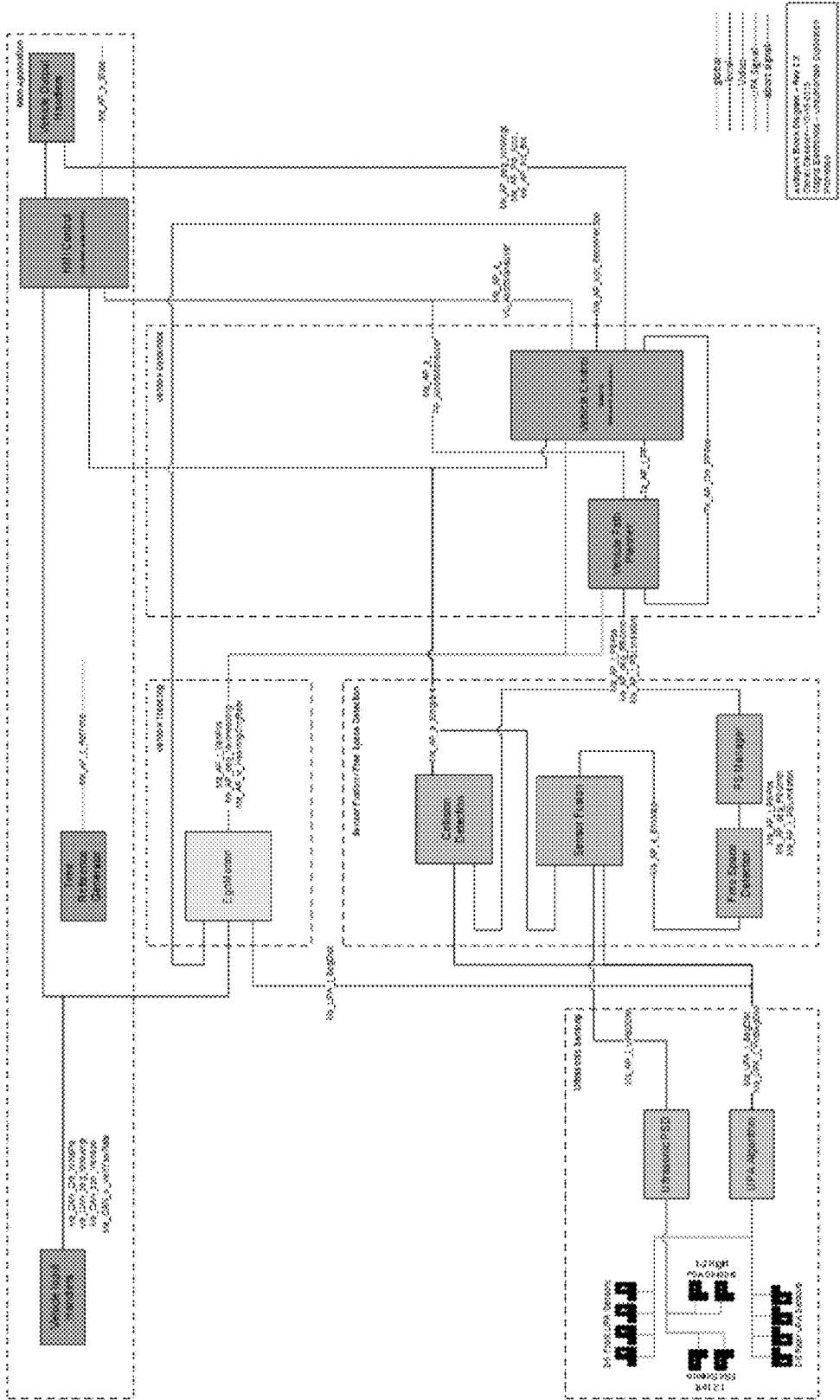
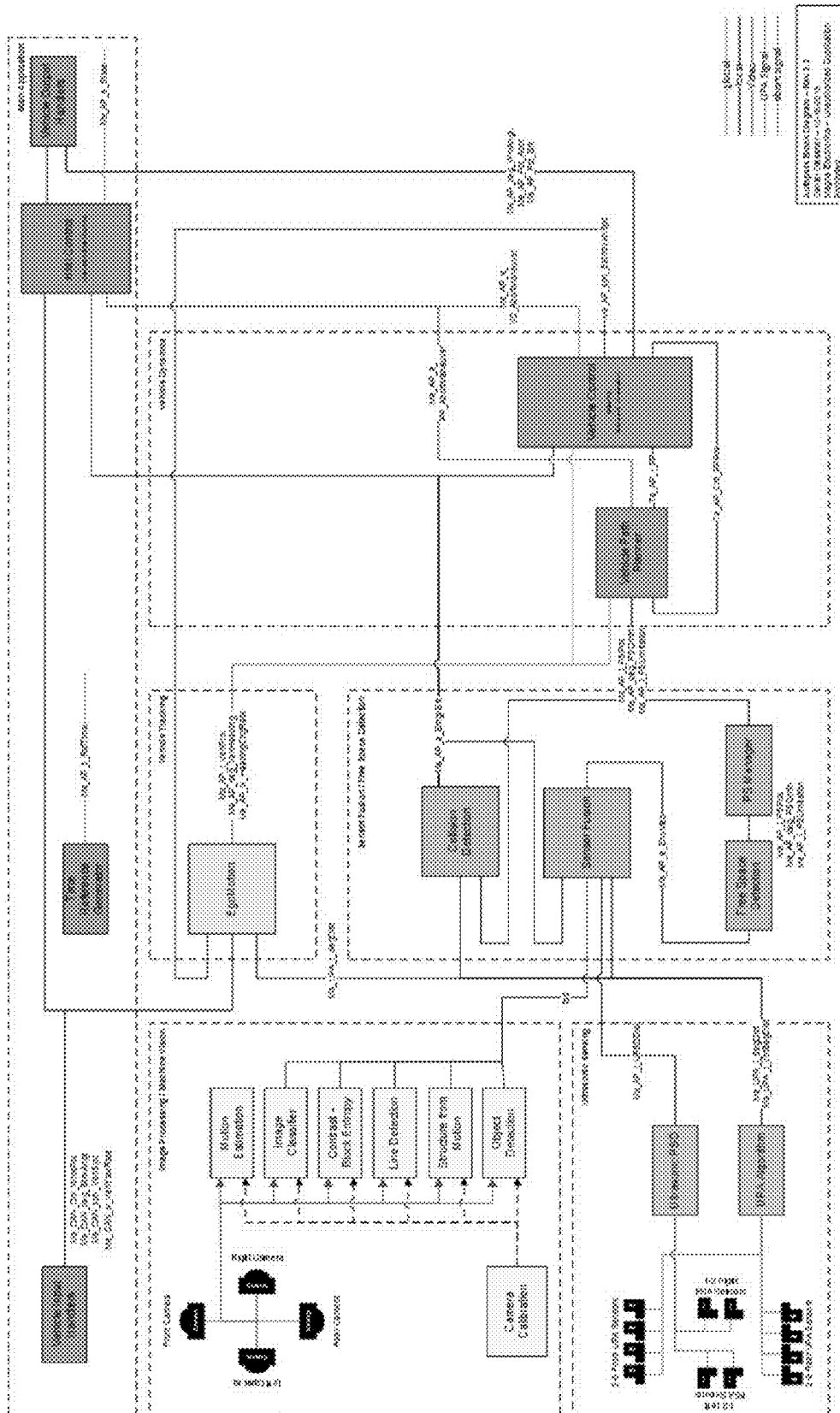


FIG. 1





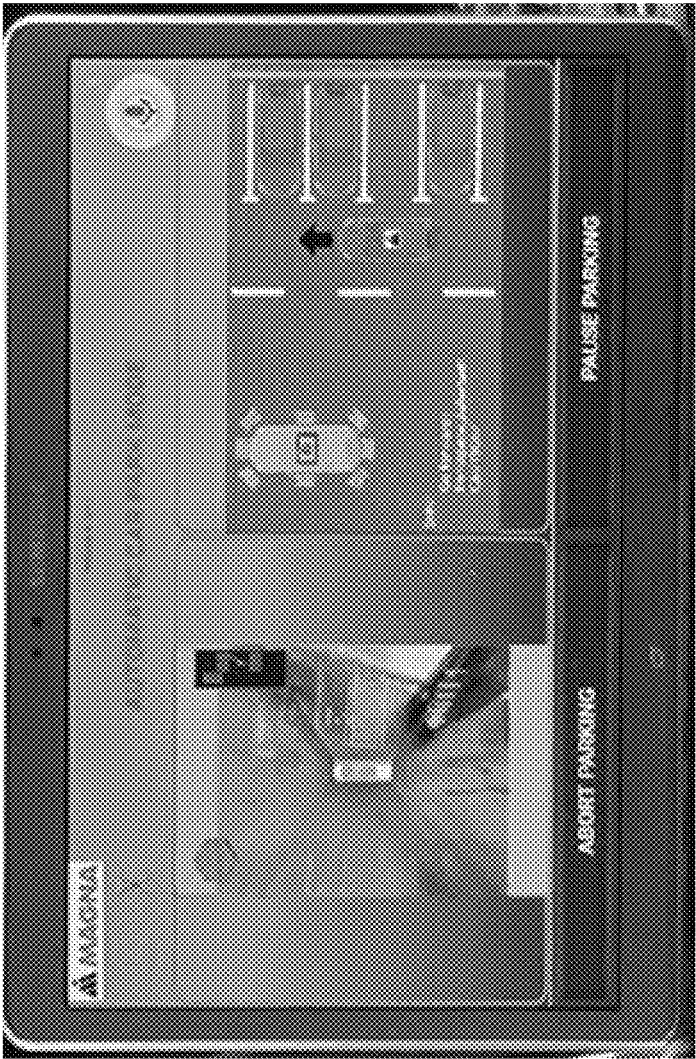
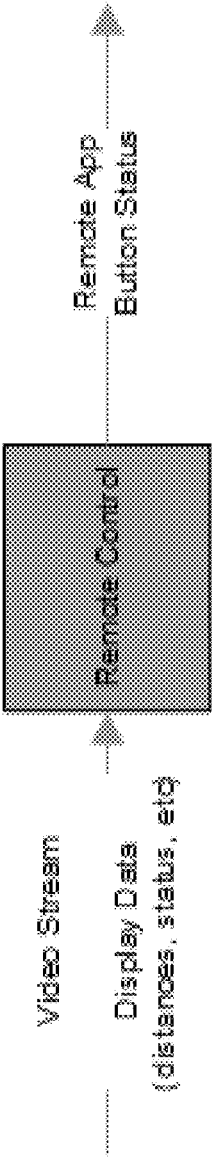


FIG. 4

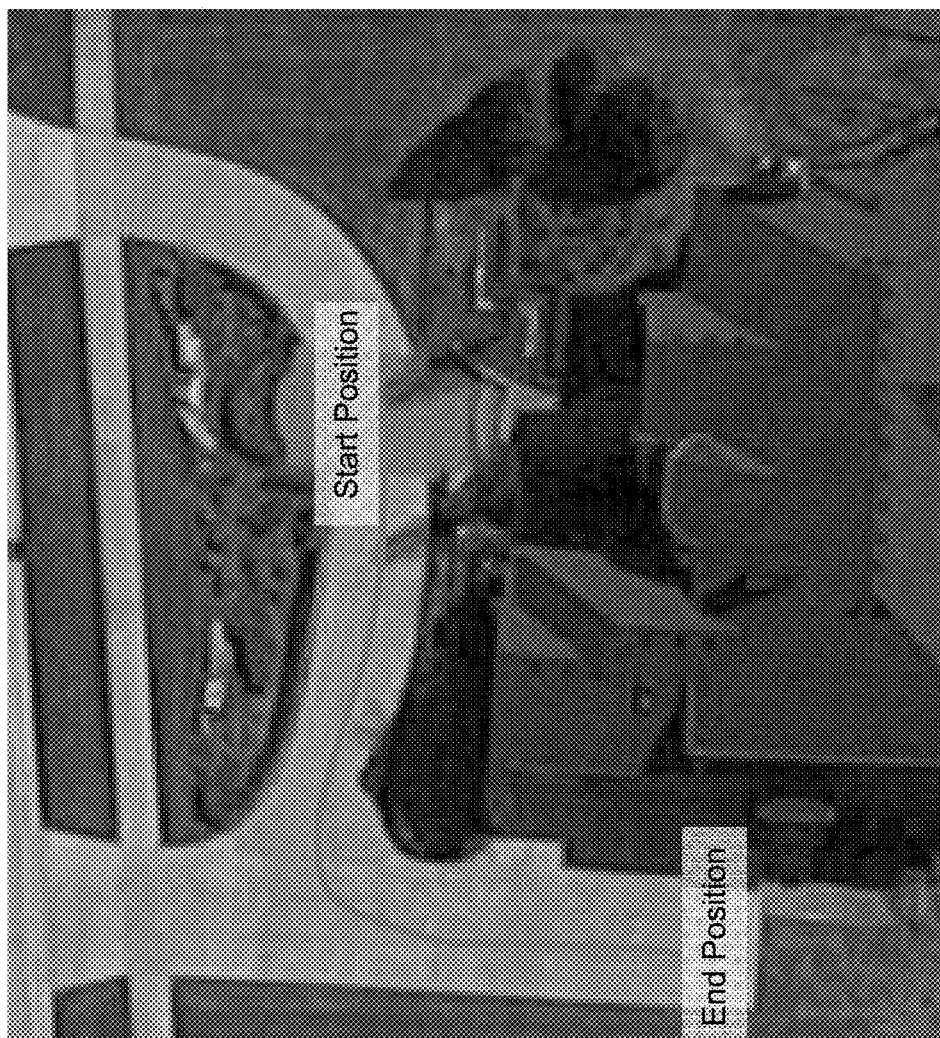


FIG. 5

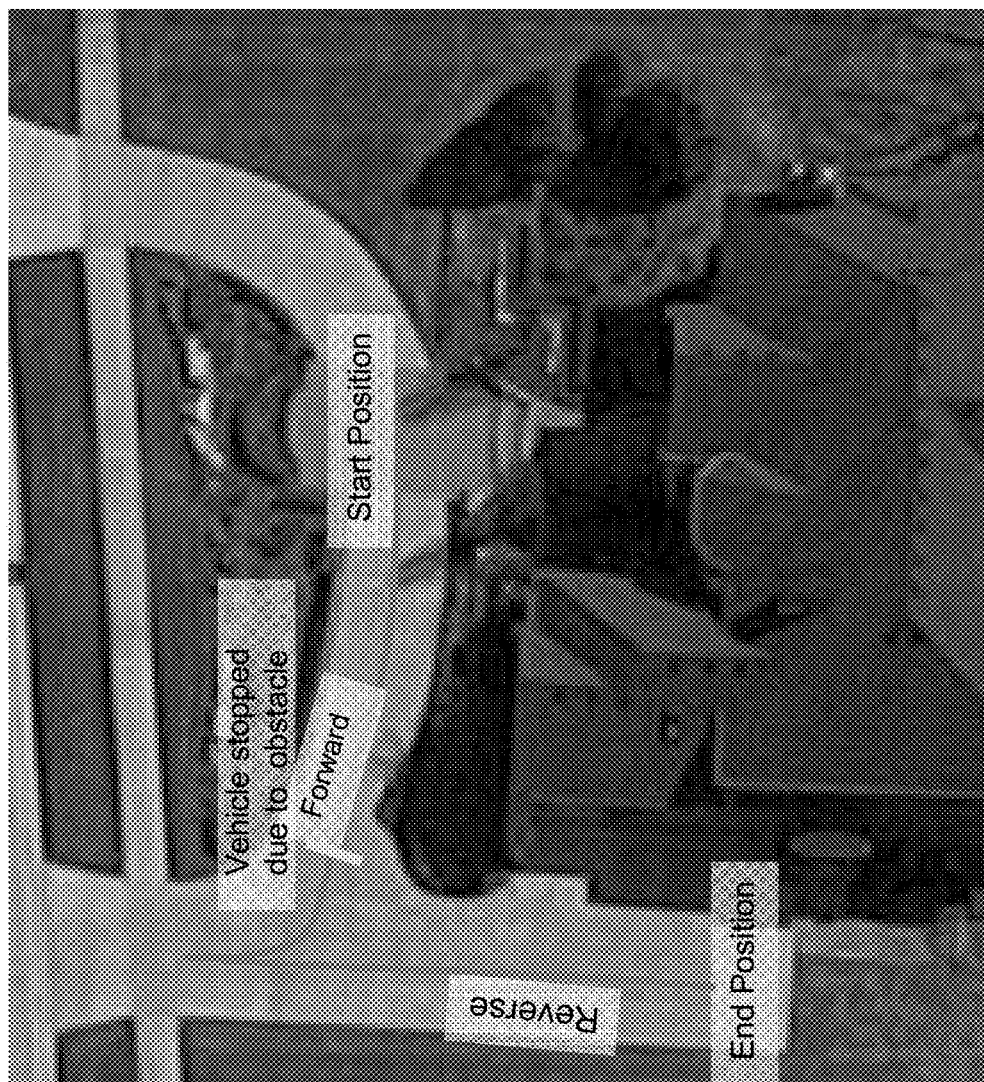


FIG. 6

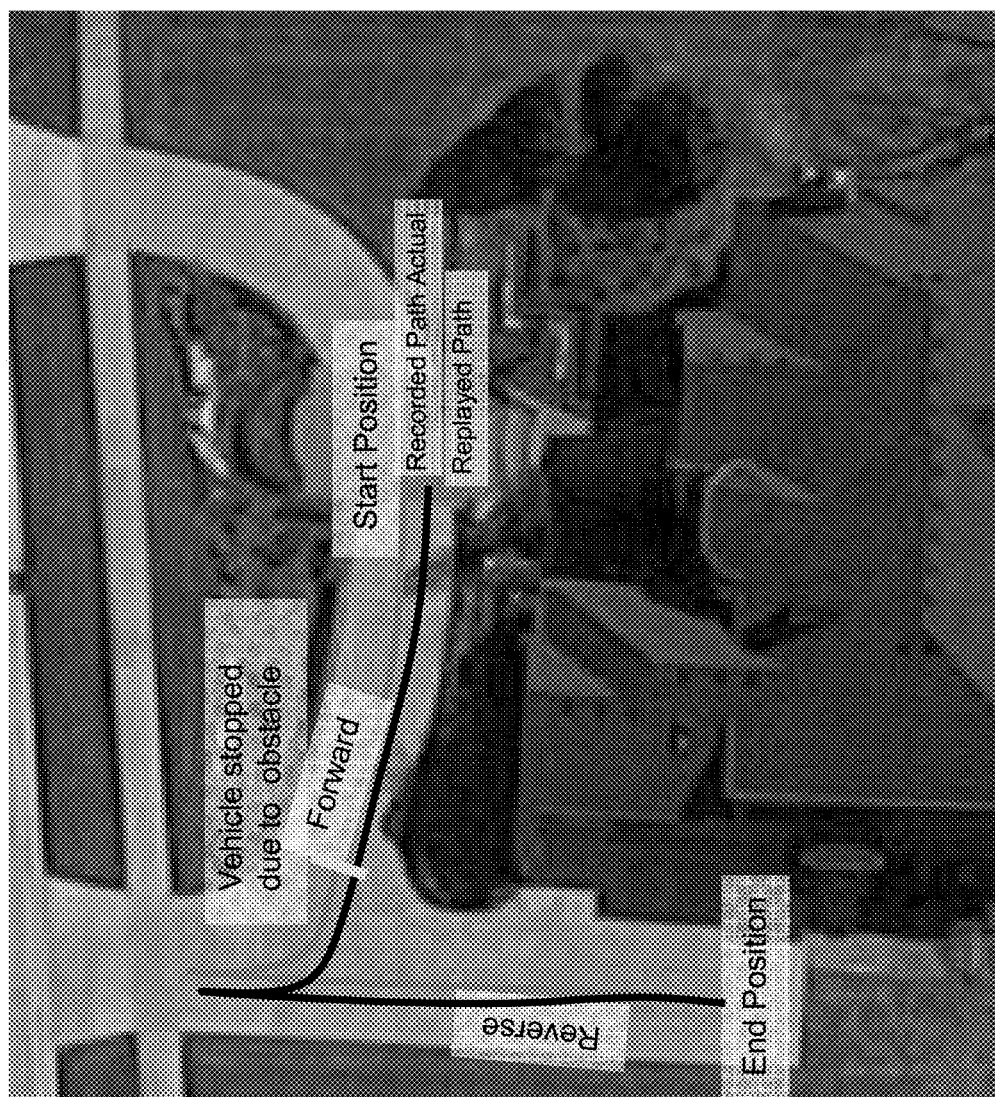


FIG. 7

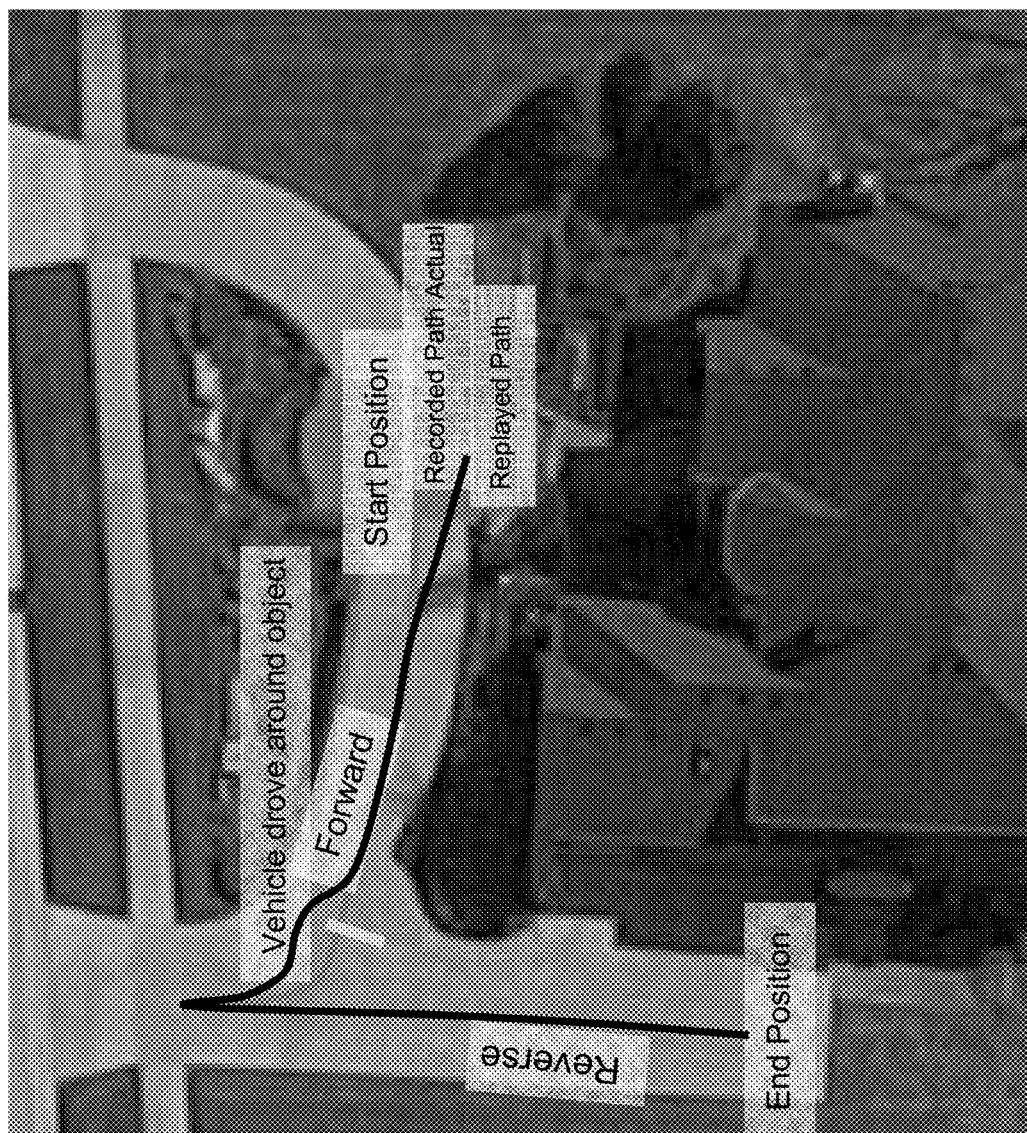


FIG. 8

Parking Structure equipped with Bluetooth / Wifi beacons for vehicle localization using fingerprinting technique

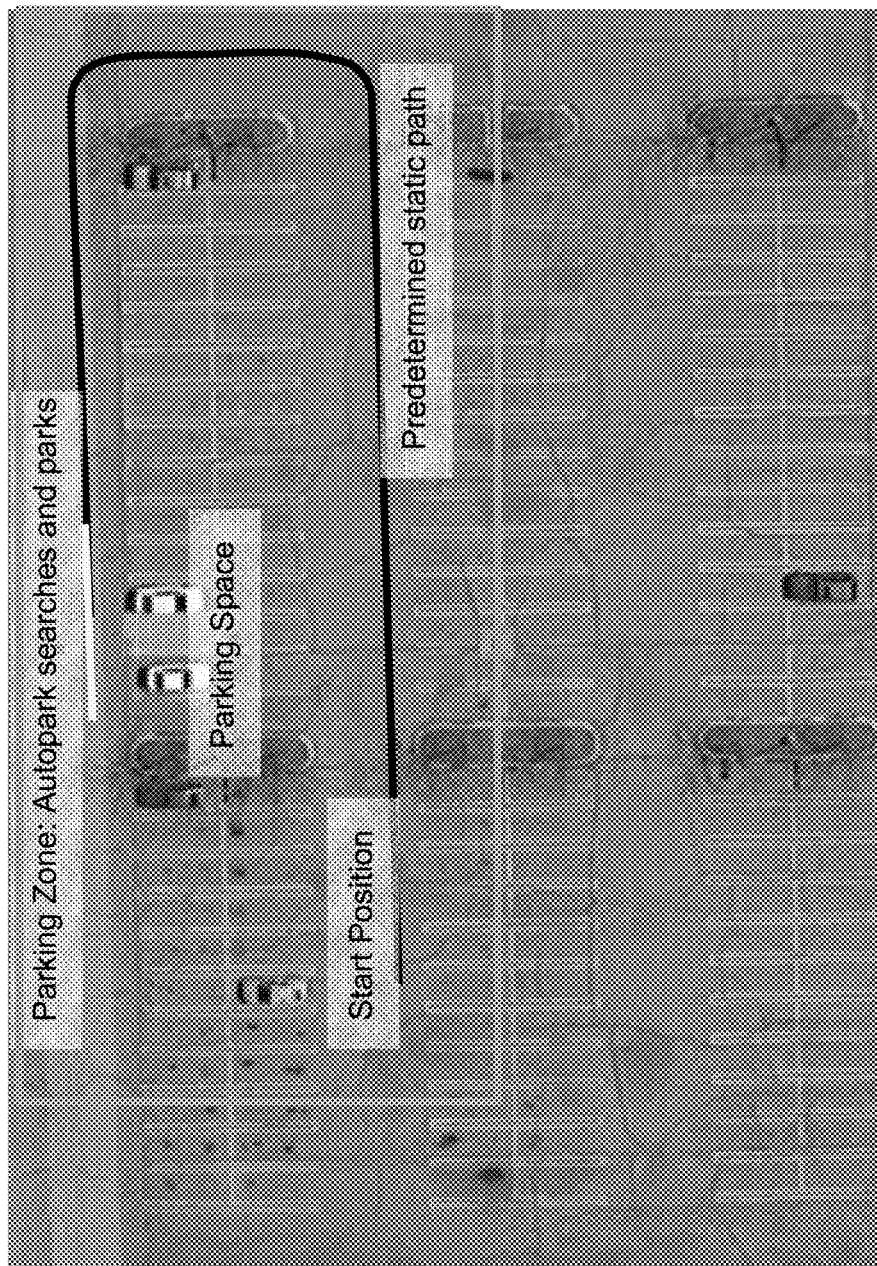


FIG. 9

Parking Structure equipped with Bluetooth / Wifi beacons for vehicle localization using fingerprinting technique

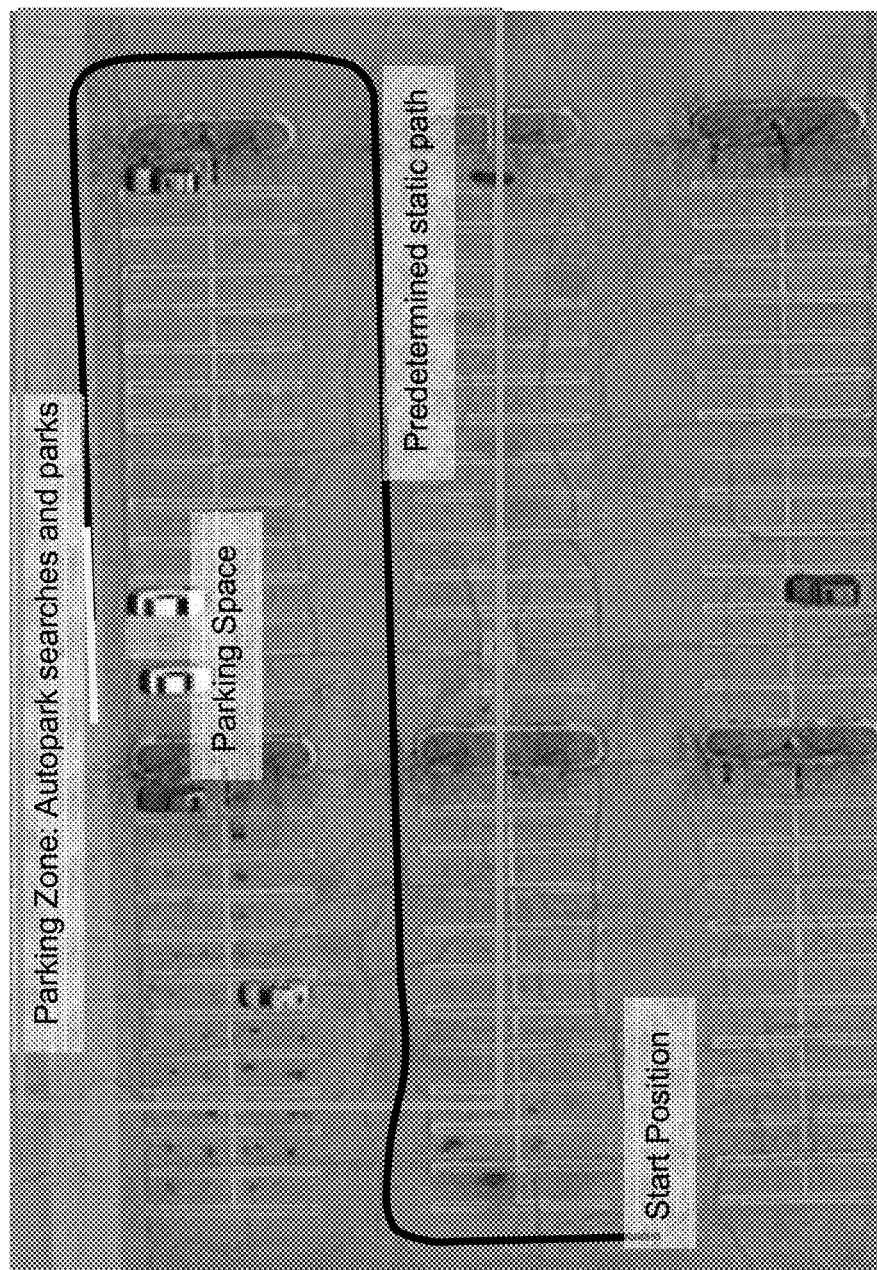


FIG. 10

Parking Structure equipped with Bluetooth / Wifi beacons for vehicle localization using fingerprinting technique

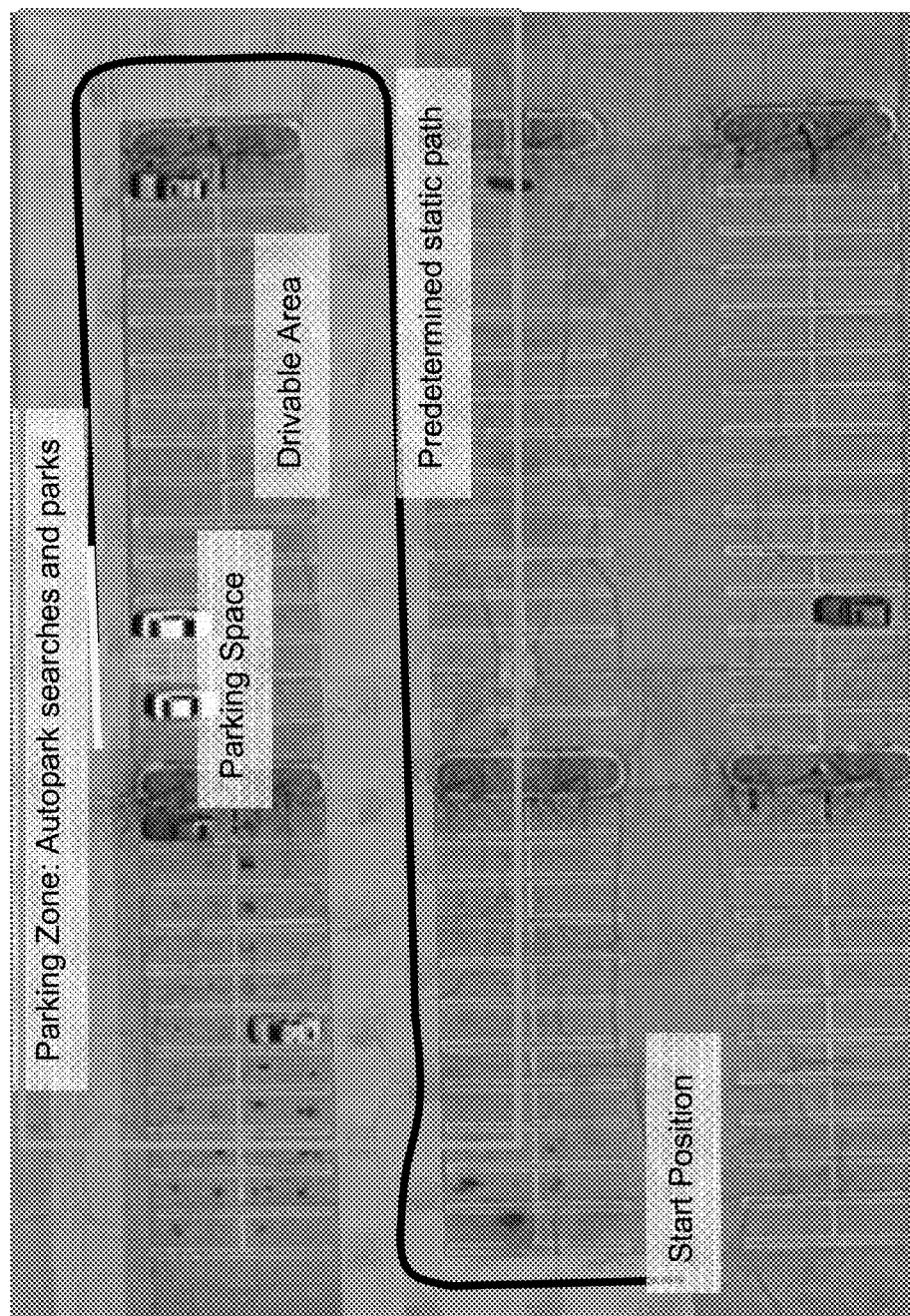


FIG. 11

Parking Structure equipped with Bluetooth / Wifi beacons for vehicle localization using fingerprinting technique

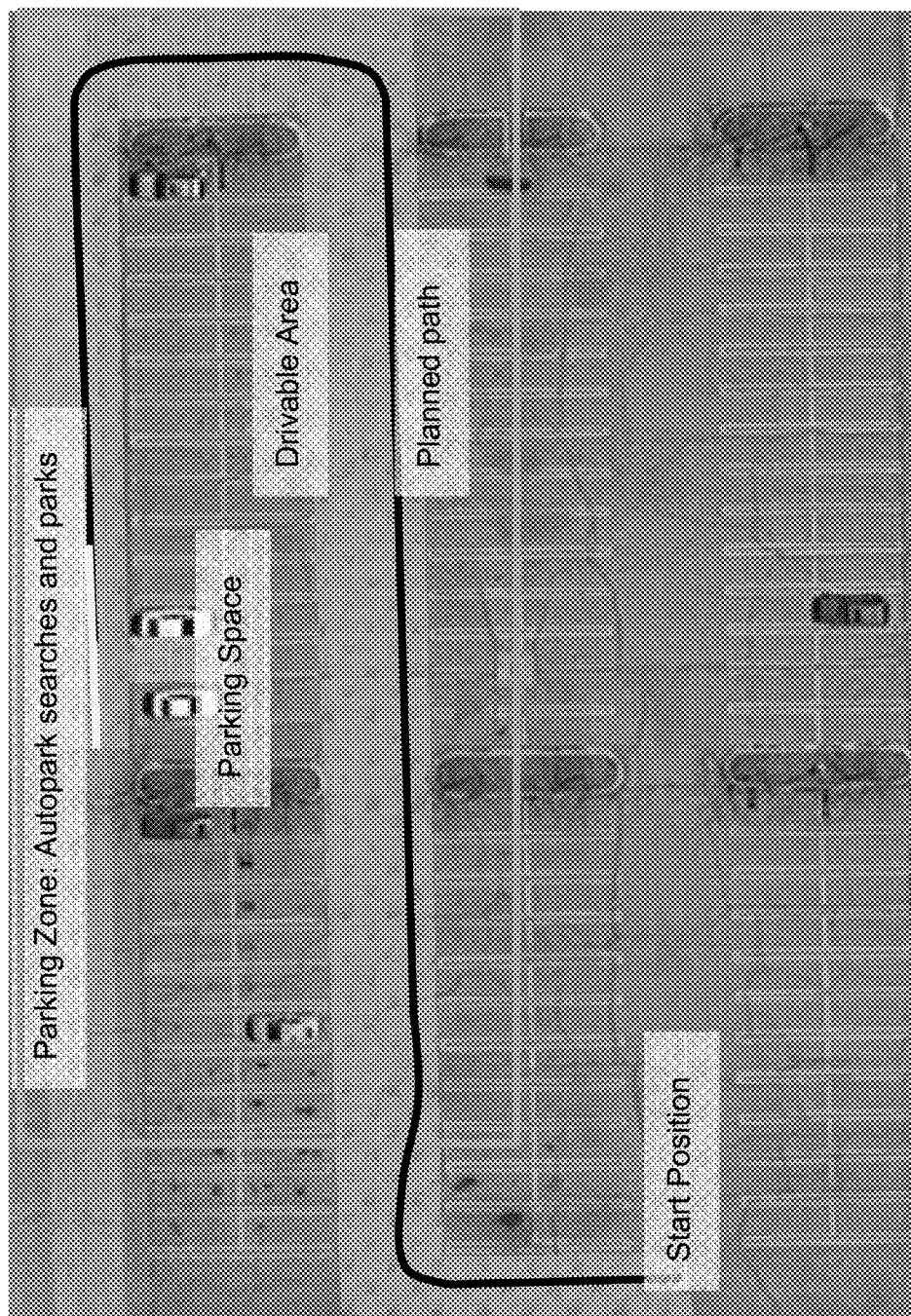


FIG. 12

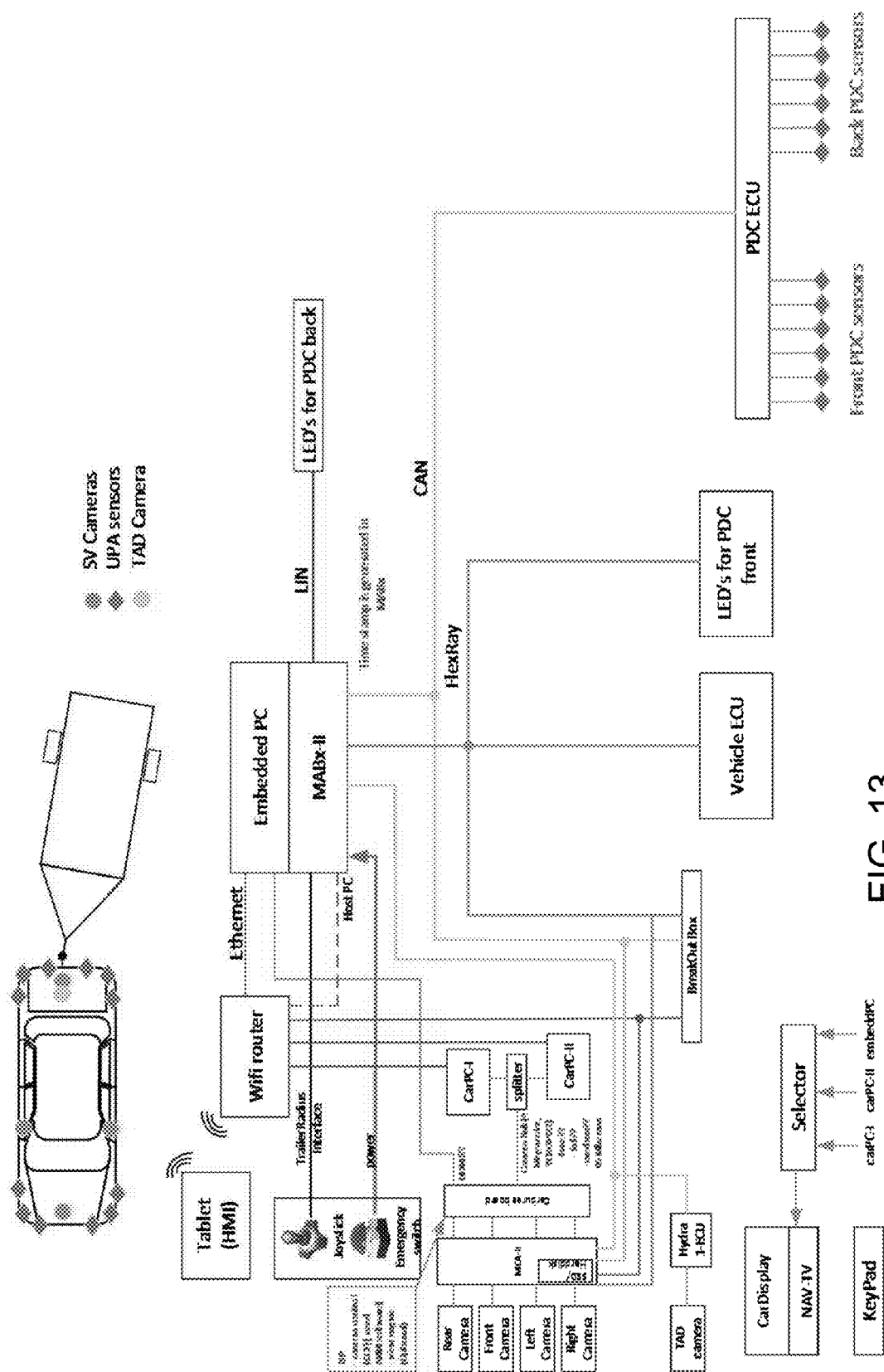


FIG. 13

VEHICLE VISION SYSTEM WITH AUTOMATIC PARKING FUNCTION

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims the filing benefits of U.S. provisional application Ser. No. 62/302,346, filed Mar. 2, 2016, which is hereby incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a vehicle vision system for a vehicle and, more particularly, to a vehicle vision system that utilizes one or more cameras at a vehicle.

BACKGROUND OF THE INVENTION

[0003] Use of imaging sensors in vehicle imaging systems is common and known.

[0004] Examples of such known systems are described in U.S. Pat. Nos. 5,949,331; 5,670,935 and/or 5,550,677, which are hereby incorporated herein by reference in their entireties.

SUMMARY OF THE INVENTION

[0005] The present invention provides a driver assistance system or vision system or imaging system for a vehicle that utilizes one or more exterior sensors, such as cameras and/or ultrasonic sensors and/or radar sensors or the like to capture data representative of the vehicle surroundings, and provides an autonomous parking feature that controls the vehicle to park the vehicle at a targeted parking location. The system may provide a home parking function, where the system can record or learn a path for the vehicle to travel from a drop off location (such as by a front door of a house) to a parking location (such as in a garage of the house). The system can then follow the recorded path to park the vehicle after the driver has exited the vehicle at the drop off location. Optionally, the system may provide a valet parking feature, where the system may autonomously control the vehicle to drive the vehicle through a parking structure to a parking space or zone.

[0006] These and other objects, advantages, purposes and features of the present invention will become apparent upon review of the following specification in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a plan view of a vehicle with a vehicle parking system that incorporates cameras and/or other exterior sensors in accordance with the present invention;

[0008] FIG. 2 is a schematic showing system architecture of the parking system of the present invention;

[0009] FIG. 3 is another schematic showing system architecture of the parking system of the present invention, shown using cameras and image processing;

[0010] FIG. 4 is a block diagram of a remote control system for controlling the parking system of the present invention, showing a display screen that shows the vehicle as it is being automatically or remotely driven in accordance with the present invention;

[0011] FIGS. 5-8 are plan views of a parking scenario for a home parking system of the present invention;

[0012] FIGS. 9-12 are plan views of a parking scenario for a valet parking system of the present invention;

[0013] FIG. 13 is a schematic showing system architecture of the parking system of the present invention; and

[0014] FIG. 14 is another schematic showing system architecture of the parking system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] A vehicle vision system and/or parking system and/or driver assist system and/or object detection system and/or alert system operates to capture images exterior of the vehicle and may process the captured image data to display images and to detect objects at or near the vehicle and in the predicted path of the vehicle, such as to assist a driver of the vehicle in maneuvering the vehicle in a rearward direction. The vision system includes an image processor or image processing system that is operable to receive image data from one or more cameras and provide an output to a display device for displaying images representative of the captured image data. Optionally, the vision system may provide display, such as a rearview display or a top down or bird's eye or surround view display or the like.

[0016] Referring now to the drawings and the illustrative embodiments depicted therein, a vehicle 10 includes a vehicle parking system 12 that includes at least one exterior facing sensor or imaging sensor or camera, such as a rearward facing imaging sensor or camera 14a (and the system may optionally include multiple exterior facing imaging sensors or cameras, such as a forward facing camera 14b at the front (or at the windshield) of the vehicle, and a sideward/rearward facing camera 14c, 14d at respective sides of the vehicle), which captures images exterior of the vehicle, with the camera having a lens for focusing images at or onto an imaging array or imaging plane or imager of the camera (FIG. 1). Optionally, a forward viewing camera may be disposed at the windshield of the vehicle and view through the windshield and forward of the vehicle, such as for a machine vision system (such as for traffic sign recognition, headlamp control, pedestrian detection, collision avoidance, lane marker detection and/or the like). The parking system 12 includes a control or electronic control unit (ECU) or processor 18 that is operable to process image data captured by the camera or cameras and may detect objects or the like and/or provide displayed images at a display device 16 for viewing by the driver of the vehicle (although shown in FIG. 1 as being part of or incorporated in or at an interior rearview mirror assembly 20 of the vehicle, the control and/or the display device may be disposed elsewhere at or in the vehicle). The data transfer or signal communication from the camera to the ECU may comprise any suitable data or communication link, such as a vehicle network bus or the like of the equipped vehicle.

[0017] The present invention provides an automatic parking system that will "valet park" a vehicle by driving or controlling the vehicle from a location where the driver and passenger may be dropped off to a parking space a relatively short distance away.

[0018] The system includes a plurality of sensors, such as multiple (e.g., about 12) ultrasonic sensors or the like, and an embedded ECU for ultrasonic park assist (UPA) functions and for ultrasonic park space detection (UPSD) functions

(see FIG. 2). The system may include CarPC using AppControl for evaluation of UPA and UPSD data for collision detection, free space detection and free space detection manager functions, and may include CarPC using AppControl for CAN based EgoMotion functions. The system may include Microautobox for path planner and vehicle control functions, and may include Microautobox for all application functions such as reference time generator and human-machine interface (HMI) control, and may include Microautobox for communication with the vehicle using Flexray or the like. The embedded ECU, CarPC and Microautobox may communicate using a local CAN bus of the vehicle.

[0019] Optionally, the vehicle parking system may include or utilize cameras and machine vision algorithm blocks for surround view systems (SVS) or rear vision camera (RVC) systems and ultrasonic autopark, and may include motion estimation, image classifier, contrast+block entropy, line detection, structure from motion and/or object detection (see FIG. 3).

[0020] Optionally, the parking system of the present invention may use a remote control application running on mobile device (see FIG. 4). The remote control app should allow the user to execute an automated vehicle maneuver by holding down a button while the driver is outside the vehicle, and to maneuver the vehicle manually forward/backward, left/right (like a remote control car). The system may display the system status/obstacle information, distances to objects on the app display and/or images captured by one or more cameras of the vehicle or of the structure where the vehicle is being parked (such as via a vehicle-to-infrastructure communication or the like). The remote control app may be generic in order to support re-use in various projects such as an auto-park system and/or a home zone parking system and/or a trailer backup assist system or the like.

[0021] Optionally, the parking system of the present invention may be operable as a home zone parking system that allows a user or driver to get out of the vehicle (such as at a driveway near the front door of the house), whereby the system will autonomously drive the vehicle from the drop off location to the parking location, such as into the garage or the like (see FIGS. 5-8). The system allows for learning or recording of a parking maneuver while the driver is controlling the vehicle (such as responsive to the driver actuating a user input to commence the learning function when the vehicle is at a start or drop off location), for example driving and parking of a vehicle from the entrance door of a house to a designated parking location, and then replaying or re-enacting the parking maneuver without a driver in the vehicle, where the parking system controls the vehicle during the maneuver. For example, the driver, when the vehicle is positioned at a drop off location (such as at or near the door of a house), may actuate the learning feature of the system (via actuation of a first user input when the vehicle is at a start or drop off location), and then the driver may drive the vehicle from the drop off location to the parking location (such as at or in a garage). After the path of travel (between the drop off location and the parking location) has been learned by the system, the next time the driver positions the vehicle at the drop off location, the driver may exit the vehicle and actuate the parking feature (such as via actuation of a second user input of the vehicle when the driver is exiting the vehicle at a start or drop off location or via actuation of a remote device or key fob or the like when

the vehicle is at a start or drop off location), whereby the control drives the vehicle (following the previously learned path) from the drop off location to the parking location.

[0022] The system utilizes object detection using cameras, UPA (and radar) sensors during the replay or autonomous parking/driving maneuver in order to avoid collisions and control the vehicle along the learned path (see FIGS. 6-8). The system allows for dynamic adjustment of the recorded path in order adjust for variation of the vehicle start position and to reach the exact end position (FIGS. 7 and 8). The system allows for dynamic adjustment of the recorded path in order for the vehicle to maneuver around temporary objects on the path (see FIG. 8).

[0023] The system thus may provide a static record and replay without object detection and dynamic path adjustment, such as for a controlled environment, with only static objects present (no other moving vehicles), no pedestrians present (FIG. 5). As shown in FIG. 5, there are no objects present on the path (path is clear), so the system can record path data while the driver is maneuvering the vehicle to the parking position, with the vehicle control limited to maneuvering in one direction (such as only forward maneuvers), with a targeted maximum path length of less than 50 m, preferably less than about 30 m, and a maximum speed of less than about 10 km/h during the recording phase. During static replay of the path data and maneuvering of vehicle on and along the pre-recorded path without using camera/UPA/radar data, the maximum speed may be further reduced, such as less than about 5 km/h during the replay.

[0024] The system may provide enhanced control of the vehicle by providing for static record and replay with object detection and without dynamic path adjustment (FIG. 6). As shown in FIG. 6, the vehicle is in a controlled environment, with only static objects present (no other moving vehicles), no pedestrians present. The system may record path data while the driver is maneuvering to the parking position, and may limit the maneuvering to forward and reverse maneuvers (such as 3 sweeps), with a maximum path length of less than 50 m, preferably less than about 30 m, and with a maximum speed of less than about 10 km/h during recording. During controlled parking, the system may perform object detection during the maneuver using cameras/UPA/Radar or the like, and will stop the vehicle if an object is detected in the path of travel of the vehicle. Upon detection of such an object, the system may stop or pause the vehicle maneuver until the object is removed, and then may resume the parking maneuver.

[0025] Optionally, the system may provide for static record and replay with object detection and with dynamic path adjustment at the end of the path (FIG. 7). As shown in FIG. 7, the vehicle is in a controlled environment, with only static objects present (no other moving vehicles), no pedestrians present. The system may record path data while the driver is maneuvering to the parking position, and may limit the maneuvering to forward and reverse maneuvers (such as 3 sweeps), with a maximum path length of less than 50 m, preferably less than about 30 m, and with a maximum speed of less than about 10 km/h during recording. The system records landmarks while the driver is maneuvering the vehicle (for example, the system may determine distances to edges of the driveway at certain points, or distances to the garage walls at the final parking position), such as at or near the end of the path (for example, the last five meters or thereabouts of the path). The system may perform object

detection during the maneuver using cameras/UPA/Radar and may stop the vehicle if an object is detected on the path of travel of the vehicle, whereby the system may stop or pause the vehicle maneuver until the determined object is removed, and then may resume the maneuver. As shown in FIG. 7, the system may dynamically adjust the maneuver at the end of the path in order to park the vehicle consistently in the same parking position.

[0026] Optionally, the system may provide for static record and replay with object detection and with dynamic path adjustment during the entire maneuver (FIG. 8). The system may record landmarks in an environment map while the driver is maneuvering the vehicle (such as, for example, determining and recording distances to edges of the driveway at certain points, or distances to the garage walls at final parking position). The system may perform object detection during the maneuver using cameras/UPA/Radar or the like and may stop the vehicle if an object is detected on the path of travel. If an obstacle is detected, the system may determine if the vehicle can maneuver around the object and may adjust the path if such maneuvering around is possible. The system may stop or pause the maneuver if maneuvering around is not possible, and then may resume the maneuver after the object is removed from the path. The system may compare the recorded environment map and the current environment map and may modify the path in order to move the vehicle on the exact same path, and to compensate for differences in the start position of the vehicle (when the system commences control of the vehicle). The end position shall be the same for every replay.

[0027] Optionally, the system of the present invention may provide a valet parking function, where the system may park a vehicle at a public parking space after the driver has dropped himself or herself off at a desired location. Optionally, the desired location may be remote from the parking structure and the system may control the vehicle to follow a learned or predetermined path from the drop off location to an entrance of the parking structure (such as in a similar manner as discussed above). The system allows for autonomous maneuvering of the vehicle from any point inside or in the vicinity of a parking structure (such as at an entrance to the parking structure) to a designated parking location inside the parking structure. The system may include detection of available parking spaces in the vicinity of the designated parking location inside the parking structure using an autopark system that detects available parking spaces (such as by utilizing aspects of the systems described in U.S. Pat. No. 8,874,317 and/or U.S. Publication Nos. US-2017-0015312; US-2015-0158499; US-2015-0251599; US-2015-0124096; US-2015-0344028; US-2014-0375476 and/or US-2013-0116859, which are all hereby incorporated herein by reference in their entireties). The system provides autonomous parking of the vehicle in the detected parking space.

[0028] The system provides predetermined static path maneuvers from a defined point inside a parking structure to a desired parking zone inside the parking structure on the same floor level followed by automated parking (see FIGS. 9-12). As shown in FIG. 9, the vehicle is in a controlled environment, with only static objects present (no other moving vehicles), no pedestrians present. The system may include detection of static objects (parked vehicles, structural elements, guard rails, posts, and/or the like) using cameras and ultrasonic sensors. The system may abort the maneuver if the system determines that the vehicle would

collide with any static object, and may provide emergency braking in case the vehicle would collide with any static object. The system may include a parking structure fingerprinting system to locate the vehicle during maneuver. An autopark system of the vehicle may be activated as the vehicle approaches the end of the predetermined static path (the parking zone) and searches for open parking spaces. The system stops the vehicle when the autopark system finds a parking space, and vehicle control is turned over to the autopark system, which parks the vehicle in the detected parking space.

[0029] Optionally, the system may perform a predetermined static path maneuver from a defined point outside the parking structure to a desired parking zone inside the parking structure on the same floor level, followed by automated parking (FIG. 10). The system may function in a similar manner as described above, and may use GPS data for maneuvering the vehicle from its location outside the parking structure and then may switch to BLUETOOTH/Wi-Fi fingerprinting for vehicle localization and maneuvering inside the parking structure. The path length outside the structure may be limited to a relatively short distance, such as less than about 100 meters, preferably less than about 50 meters or thereabouts.

[0030] Optionally, the system may perform a predetermined static path maneuver with path adjustments from a defined point outside the parking structure to a desired area inside the parking structure on the same floor level followed by automated parking (FIG. 11). The system may function in a similar manner as described above, and may detect the drivable area while the vehicle is moving using machine vision (and radar sensors). The valet parking system detects objects along the drivable area using ultrasonic sensors and detects lines using line detection algorithms. All of the detected and determined information is entered into an environment map, which is used to adjust or fine tune the predetermined vehicle path in order to maneuver the vehicle centered on the lane, with a constant distance from limits at the right vehicle side.

[0031] Optionally, the system may perform a planned path maneuver with path adjustments from a defined point outside the parking structure to a desired area inside the parking structure on the same floor level followed by automated parking (FIG. 12). The system defines a layout of the parking structure (parking structure map), and the "smart parking structure" defines the area with free parking spaces (parking zone). The valet parking system plans a path from the current vehicle position outside the parking structure to the parking zone using the parking structure map. This system adds the functionality of path planning to maneuver the vehicle to the parking zone, but the rest of the functionality is similar to that discussed above. Optionally, for example, the system may learn a path from a common drop off location to a location inside a parking structure (such as described above) and then, when the vehicle is autonomously positioned at the location inside the parking structure, the system switches from following the learned path to being responsive to the parking structure layout/zones.

[0032] For applications where the system parks the vehicle within a parking structure, the system may utilize an indoor positioning system for underground (or not outside) parking structures. The system may utilize absolute positioning via Bluetooth LE or WLAN or the like and relative positioning with vehicle sensors and optionally a navigation map. The

position fingerprinting system or function determines position of the vehicle by comparing the measured signal patterns with previously measured signal patterns in reference points. Optionally, and desirably, the parking garage may have WLAN access points and/or 60 Bluetooth access points and a plurality of fingerprints, whereby the system can determine the vehicle's position within the garage via processing of signals from the access points. The system may combine this information with data captured by vehicle sensors (and processed by a vehicle-based processor) to enhance the determination of the position of the vehicle. The system may use CAN data and Kalman Filtering and/or Particle Filtering to enhance the position or location determination to enhance the vehicle's controlled path of travel when the system is autonomously controlling and parking the vehicle. Optionally, the system may extract map information for further enhancement.

[0033] As shown in FIG. 13, the system may be adaptable to park a vehicle pulling a trailer, such as by utilizing various trailer angle detection systems and trailer assist systems of the types described in U.S. Pat. No. 9,085,261 and/or U.S. Publication Nos. US-2017-0050672; US-2015-0002670; US-2014-0160276; US-2012-0265416; US-2014-0085472 and/or US-2015-0217693, which are hereby incorporated herein by reference in their entireties.

[0034] Optionally, the system may comprise simplified system architecture as shown in FIG. 14. Additional signals/data flows may be required, and the system may utilize a sensor fusion map generation in CarPC or the like, and path planning in Microautobox (MAB) or the like.

[0035] The camera or sensor may comprise any suitable camera or sensor. Optionally, the camera may comprise a "smart camera" that includes the imaging sensor array and associated circuitry and image processing circuitry and electrical connectors and the like as part of a camera module, such as by utilizing aspects of the vision systems described in International Publication Nos. WO 2013/081984 and/or WO 2013/081985, which are hereby incorporated herein by reference in their entireties.

[0036] The system includes an image processor operable to process image data captured by the camera or cameras, such as for detecting objects or other vehicles or pedestrians or the like in the field of view of one or more of the cameras. For example, the image processor may comprise an image processing chip selected from the EyeQ family of image processing chips available from Mobileye Vision Technologies Ltd. of Jerusalem, Israel, and may include object detection software (such as the types described in U.S. Pat. Nos. 7,855,755; 7,720,580 and/or 7,038,577, which are hereby incorporated herein by reference in their entireties), and may analyze image data to detect vehicles and/or other objects. Responsive to such image processing, and when an object or other vehicle is detected, the system may generate an alert to the driver of the vehicle and/or may generate an overlay at the displayed image to highlight or enhance display of the detected object or vehicle, in order to enhance the driver's awareness of the detected object or vehicle or hazardous condition during a driving maneuver of the equipped vehicle.

[0037] The vehicle may include any type of sensor or sensors, such as imaging sensors or radar sensors or lidar sensors or ladar sensors or ultrasonic sensors or the like. The imaging sensor or camera may capture image data for image processing and may comprise any suitable camera or sensing

device, such as, for example, a two dimensional array of a plurality of photosensor elements arranged in at least 640 columns and 480 rows (at least a 640x480 imaging array, such as a megapixel imaging array or the like), with a respective lens focusing images onto respective portions of the array. The photosensor array may comprise a plurality of photosensor elements arranged in a photosensor array having rows and columns. Preferably, the imaging array has at least 300,000 photosensor elements or pixels, more preferably at least 500,000 photosensor elements or pixels and more preferably at least 1 million photosensor elements or pixels. The imaging array may capture color image data, such as via spectral filtering at the array, such as via an RGB (red, green and blue) filter or via a red/red complement filter or such as via an RCC (red, clear, clear) filter or the like. The logic and control circuit of the imaging sensor may function in any known manner, and the image processing and algorithmic processing may comprise any suitable means for processing the images and/or image data.

[0038] For example, the vision system and/or processing and/or camera and/or circuitry may utilize aspects described in U.S. Pat. Nos. 9,233,641; 9,146,898; 9,174,574; 9,090,234; 9,077,098; 8,818,042; 8,886,401; 9,077,962; 9,068,390; 9,140,789; 9,092,986; 9,205,776; 8,917,169; 8,694,224; 7,005,974; 5,760,962; 5,877,897; 5,796,094; 5,949,331; 6,222,447; 6,302,545; 6,396,397; 6,498,620; 6,523,964; 6,611,202; 6,201,642; 6,690,268; 6,717,610; 6,757,109; 6,802,617; 6,806,452; 6,822,563; 6,891,563; 6,946,978; 7,859,565; 5,550,677; 5,670,935; 6,636,258; 7,145,519; 7,161,616; 7,230,640; 7,248,283; 7,295,229; 7,301,466; 7,592,928; 7,881,496; 7,720,580; 7,038,577; 6,882,287; 5,929,786 and/or 5,786,772, and/or U.S. Publication Nos. US-2014-0340510; US-2014-0313339; US-2014-0347486; US-2014-0320658; US-2014-0336876; US-2014-0307095; US-2014-0327774; US-2014-0139676; US-2014-0320636; US-2014-0293057; US-2014-0309884; US-2014-0226012; US-2014-0293042; US-2014-0218535; US-2014-0218535; US-2014-0247354; US-2014-0247355; US-2014-0247352; US-2014-0232869; US-2014-0211009; US-2014-0160276; US-2014-0168437; US-2014-0168415; US-2014-0160291; US-2014-0152825; US-2014-0139676; US-2014-0138140; US-2014-0104426; US-2014-0098229; US-2014-0085472; US-2014-0067206; US-2014-0049646; US-2014-0052340; US-2014-0025240; US-2014-0028852; US-2014-005907; US-2013-0314503; US-2013-0298866; US-2013-0222593; US-2013-0300869; US-2013-0278769; US-2013-0258077; US-2013-0258077; US-2013-0242099; US-2013-0215271; US-2013-0141578 and/or US-2013-0002873, which are all hereby incorporated herein by reference in their entireties. The system may communicate with other communication systems via any suitable means, such as by utilizing aspects of the systems described in International Publication Nos. WO/2010/144900; WO 2013/043661 and/or WO 2013/081985, and/or U.S. Pat. No. 9,126,525, which are hereby incorporated herein by reference in their entireties.

[0039] The system may also communicate with other systems, such as via a vehicle-to-vehicle communication system or a vehicle-to-infrastructure communication system or the like. Such car2car or vehicle to vehicle (V2V) and vehicle-to-infrastructure (car2X or V2X or V2I or 4G or 5G) technology provides for communication between vehicles and/or infrastructure based on information provided by one or more vehicles and/or information provided by a remote

server or the like. Such vehicle communication systems may utilize aspects of the systems described in U.S. Pat. Nos. 6,690,268; 6,693,517 and/or 7,580,795, and/or U.S. Publication Nos. US-2014-0375476; US-2014-0218529; US-2013-0222592; US-2012-0218412; US-2012-0062743; US-2015-0251599; US-2015-0158499; US-2015-0124096; US-2015-0352953; US-2016-0036917 and/or US-2016-0210853, which are hereby incorporated herein by reference in their entireties.

[0040] The system may utilize aspects of the parking assist systems described in U.S. Pat. No. 8,874,317 and/or U.S. Publication Nos. US-2017-0050672; US-2017-0017848; US-2017-0015312 and/or US-2015-0344028, and/or U.S. provisional applications, Ser. No. 62/335,248, filed May 12, 2016, and/or Ser. No. 62/330,558, filed May 2, 2016, which are hereby incorporated herein by reference in their entireties.

[0041] Optionally, the vision system may include a display for displaying images captured by one or more of the imaging sensors for viewing by the driver of the vehicle while the driver is normally operating the vehicle. Optionally, for example, the vision system may include a video display device, such as by utilizing aspects of the video display systems described in U.S. Pat. Nos. 5,530,240; 6,329,925; 7,855,755; 7,626,749; 7,581,859; 7,446,650; 7,338,177; 7,274,501; 7,255,451; 7,195,381; 7,184,190; 5,668,663; 5,724,187; 6,690,268; 7,370,983; 7,329,013; 7,308,341; 7,289,037; 7,249,860; 7,004,593; 4,546,551; 5,699,044; 4,953,305; 5,576,687; 5,632,092; 5,677,851; 5,708,410; 5,737,226; 5,802,727; 5,878,370; 6,087,953; 6,173,508; 6,222,460; 6,513,252 and/or 6,642,851, and/or U.S. Publication Nos. US-2012-0162427; US-2006-0050018 and/or US-2006-0061008, which are all hereby incorporated herein by reference in their entireties. Optionally, the vision system (utilizing the forward facing camera and a rearward facing camera and other cameras disposed at the vehicle with exterior fields of view) may be part of or may provide a display of a top-down view or bird's-eye view system of the vehicle or a surround view at the vehicle, such as by utilizing aspects of the vision systems described in International Publication Nos. WO 2010/099416; WO 2011/028686; WO 2012/075250; WO 2013/019795; WO 2012/075250; WO 2012/145822; WO 2013/081985; WO 2013/086249 and/or WO 2013/109869, and/or U.S. Publication No. US-2012-0162427, which are hereby incorporated herein by reference in their entireties.

[0042] Changes and modifications in the specifically described embodiments can be carried out without departing from the principles of the invention, which is intended to be limited only by the scope of the appended claims, as interpreted according to the principles of patent law including the doctrine of equivalents.

1. A vehicle parking system for a vehicle, said vehicle parking system comprising:

- a plurality of exterior viewing cameras disposed at a vehicle, each camera of said plurality of exterior viewing cameras having a respective field of view exterior of the vehicle;
 - a control comprising an image processor operable to process image data captured by said cameras;
- wherein said vehicle parking system learns a path of travel from a drop off location to a parking location

during a learning maneuver that comprises a driver driving the vehicle from the drop off location to the parking location; and

wherein said control, upon the driver exiting the vehicle when the vehicle is positioned at the drop off location and at least in part responsive to the learned path of travel, controls the vehicle to autonomously drive the vehicle from the drop off location to the parking location, and wherein said control, responsive at least in part to image processing by said image processor of image data captured by at least one of said cameras, parks the vehicle at the parking location.

2. The vehicle parking system of claim 1, wherein said vehicle parking system learns the path of travel from the drop off location to the parking location responsive to a user input that, when actuated by a user when the vehicle is at the drop off location, actuates a learning function of said vehicle parking system.

3. The vehicle parking system of claim 1, wherein said control, after said vehicle parking system learns the path of travel and responsive to actuation of a user input when the vehicle is at the drop off location, autonomously drives the vehicle from the drop off location to the parking location.

4. The vehicle parking system of claim 1, wherein, responsive at least in part to processing by said image processor of captured image data while said control autonomously drives the vehicle from the drop off location to the parking location, said vehicle parking system determines the presence of an object in the path of travel and, responsive to determination of the object, said control adjusts steering or braking of the vehicle as said control autonomously drives the vehicle along the learned path of travel.

5. The vehicle parking system of claim 1, wherein, responsive to a determination of a variation in the location of the vehicle along the learned path of travel, said control adjusts steering or braking of the vehicle as the vehicle is autonomously driven towards the parking location.

6. The vehicle parking system of claim 5, wherein said control determines the variation via image processing by said image processor of captured image data.

7. The vehicle parking system of claim 1, wherein the parking location is at an entrance of a parking structure and wherein, after the vehicle is autonomously driven to the parking location at the parking structure, said control parks the vehicle at a parking space of the parking structure responsive at least in part to signals from beacons at the parking structure.

8. The vehicle parking system of claim 7, wherein, responsive at least in part to signals from beacons, said vehicle parking system determines the current location of the vehicle at the parking structure.

9. The vehicle parking system of claim 8, wherein said control autonomously drives the vehicle from the parking location at the parking structure to a selected parking space of the parking structure responsive at least in part to the determined current location of the vehicle at the parking structure.

10. The vehicle parking system of claim 9, wherein said vehicle parking system is operable to determine, at least in part via image processing by said image processor of image data captured by at least some of said cameras, the presence of an object in the path of travel of the vehicle and, responsive to determination of the object, said control adjusts steering or braking of the vehicle as said control

autonomously drives the vehicle toward the selected parking space of the parking structure.

11. The vehicle parking system of claim 1, wherein said vehicle parking system is operable at least in part responsive to a remote control device, whereby a user controls steering and braking of the vehicle via the remote control device remote from the vehicle.

12. The vehicle parking system of claim 1, wherein said control controls the vehicle to autonomously drive the vehicle from the drop off location to the parking location responsive at least in part to image processing by said image processor of image data captured by at least some of said cameras.

13. The vehicle parking system of claim 1, wherein said control controls the vehicle to autonomously drive the vehicle from the drop off location to the parking location responsive at least in part to a plurality of non-imaging sensors of the vehicle.

14. A vehicle parking system for a vehicle, said vehicle parking system comprising:

- a plurality of exterior viewing cameras disposed at a vehicle, each camera of said plurality of exterior viewing cameras having a respective field of view exterior of the vehicle;

- a control comprising an image processor operable to process image data captured by said cameras;

wherein, responsive at least in part to actuation of a first user input, said vehicle parking system learns a path of travel from a drop off location to a parking location during a learning maneuver that comprises a driver, after actuating the first user input, driving the vehicle from the drop off location to the parking location; and wherein said control, responsive to the driver actuating a second user input when the vehicle is positioned at the drop off location, controls the vehicle to follow the learned path of travel to autonomously drive the vehicle from the drop off location to the parking location, and wherein said control, responsive at least in part to image processing by said image processor of image data captured by at least one of said cameras, parks the vehicle at the parking location.

15. The vehicle parking system of claim 14, wherein, responsive at least in part to processing by said image processor of captured image data while said control autonomously drives the vehicle from the drop off location to the parking location, said vehicle parking system determines the presence of an object in the path of travel and, responsive to determination of the object, said control adjusts steering or braking of the vehicle as said control autonomously drives the vehicle along the learned path of travel.

16. The vehicle parking system of claim 14, wherein the parking location is at an entrance of a parking structure and wherein, after the vehicle is autonomously driven to the parking location at the parking structure, said control parks the vehicle at a parking space of the parking structure responsive at least in part to signals from a parking system of the parking structure.

17. The vehicle parking system of claim 14, wherein said control controls the vehicle to autonomously drive the

vehicle from the drop off location to the parking location responsive at least in part to (i) image processing by said image processor of image data captured by at least some of said cameras and (ii) a plurality of non-imaging sensors of the vehicle.

18. A vehicle parking system for a vehicle, said vehicle parking system comprising:

- a plurality of exterior viewing cameras disposed at a vehicle, each camera of said plurality of exterior viewing cameras having a respective field of view exterior of the vehicle;

- a control comprising an image processor operable to process image data captured by said cameras;

wherein said vehicle parking system learns a path of travel from a drop off location to a parking structure during a learning maneuver that comprises a driver driving the vehicle from the drop off location to the parking structure; and

wherein said control, upon the driver exiting the vehicle when the vehicle is positioned at the drop off location and at least in part responsive to the learned path of travel, controls the vehicle to autonomously drive the vehicle from the drop off location to the parking structure;

wherein, after the vehicle is autonomously driven to the parking structure, said control parks the vehicle at a parking space of the parking structure responsive at least in part to signals from a parking system of the parking structure; and

wherein, responsive at least in part to signals from the parking system of the parking structure, said vehicle parking system determines the current location of the vehicle at the parking structure and said control autonomously drives the vehicle to the parking space of the parking structure responsive at least in part to the determined current location of the vehicle at the parking structure.

19. The vehicle parking system of claim 18, wherein said vehicle parking system is operable to determine, at least in part via image processing by said image processor of image data captured by at least some of said cameras, the presence of an object in the path of travel of the vehicle and, responsive to determination of the object, said control adjusts steering or braking of the vehicle as said control autonomously drives the vehicle toward the selected parking space of the parking structure.

20. The vehicle parking system of claim 18, wherein said control controls the vehicle to autonomously drive the vehicle from the drop off location to the parking structure responsive at least in part to (i) image processing by said image processor of image data captured by at least some of said cameras and (ii) a plurality of non-imaging sensors of the vehicle.

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