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(54) EMERGENCY VEHICLE PASSAGE

(57) The present disclosure relates to a method performed by an EV passage planning system (1) for supporting free passage past road users for an approaching emergency vehicle, EV. The EV passage planning system determines (1001) that an EV (3) along its planned route is approaching a set of vehicles (2) respectively equipped with an Automated Driving System, ADS (21), wherein the set of vehicles has a field of view combined covering a continuous dynamic zone along the route; obtains (1002) sensor data of surroundings comprising the dynamic zone captured with support from one or more surrounding detecting sensors (22); determines (1003) based on surrounding and/or situational conditions in the dynamic zone derived from evaluating the sensor data, a preferred passage for the EV through the dynamic zone deemed having potential to be cleared from all traffic; and instructs (1004) the set of ADS-equipped vehicles to act according to a schema influencing road users (6) in the dynamic zone to maneuver such that the preferred passage is cleared in time for arrival of the EV.

The disclosure also relates to an EV passage planning system in accordance with the foregoing, an arrangement - for instance at least a first ADS-equipped vehicle and/or a centralized entity (4) such as at least a first cloud and/or cloud server - comprising such an EV passage planning system, and a respective corresponding computer program product and non-volatile computer readable storage medium.

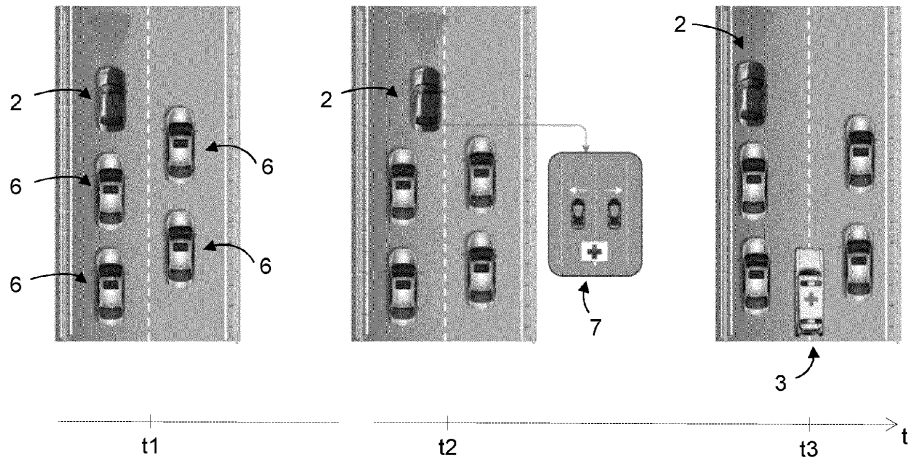

Fig. 3 1 EV passage planning system

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to supporting free passage past road users for an approaching emergency vehicle.

BACKGROUND

[0002] When an emergency vehicle in emergency mode - such as an ambulance, police vehicle or fire truck on call e.g. with sirens and/or warning lights activated - approaches road users such as e.g. vehicles driven along a stretch of road, said road users are obligated to, upon observing the emergency vehicle's sirens and/or warning lights, give way to said emergency vehicle. Such way-giving may for instance be accomplished by the road users changing lane to an adjacent lane and/or move towards lane markers of the current lane, to thereby provide enough space for the emergency vehicle to pass through. Occasionally, however, a road user - such as a driver of a vehicle - may fail to give way to an approaching emergency vehicle in time, for instance due to said driver not acknowledging the sirens and/or warning lights, and/or being unable to leave passage quickly enough. Should that be the case, the emergency vehicle may e.g. honk the horn to rouse such a driver to take appropriate action. Either way, the emergency vehicle is in such a scenario prevented from passing through traffic smoothly, which subsequently may cause the emergency vehicle to waste time by - e.g. repeatedly - being forced to slow down, accelerate and/or maneuver past other road users.

[0003] Within the automotive field, there has for quite some years been activity in the development of autonomous vehicles. An increasing number of modern vehicles have advanced driver-assistance systems, ADAS, to increase vehicle safety and more generally road safety. ADAS - which for instance may be represented by adaptive cruise control (ACC), lane centering, automatic lane changes, semi-automated parking, etc. - are electronic systems that may aid a vehicle driver while driving. Moreover, in a not-too-distant future, Autonomous Driving, AD, will to a greater extent find its way into modern vehicles. AD along with ADAS will herein be referred to under the common term Automated Driving System, ADS, corresponding to all different levels of automation, for instance as defined by the SAE J3016 levels (1 - 5) of driving automation. An ADS may be construed as a complex combination of various components that can be defined as systems where perception, decision making, and operation of the vehicle - at least in part - are performed by electronics and machinery instead of a human driver. This may include awareness of surroundings as well as handling of the vehicle. While the automated system has control over the vehicle, it allows the human operator to leave all or at least some responsibilities to the system. For instance, an ADS at level 4 or above - such as defined by SAE J3016 - offers high driving automation such as e.g. unsupervised automated driving, which thus may lead to enhanced comfort and convenience by allowing vehicle occupants such as the driver to engage in non-driving related tasks. To perceive its surroundings, an ADS commonly combines a variety of sensors, such as e.g. radar, lidar, sonar, camera, navigation and/or positioning system e.g. GNSS such as GPS, odometer and/or inertial measurement units, upon which advanced control systems may interpret sensory information to identify appropriate navigation paths, as well as obstacles and/or relevant signage.

[0004] Moreover, through commonly known probe sourcing, vehicles may further be made aware of environments beyond ranges of onboard sensors. This may subsequently enable ADS-equipped vehicles to perform even better planning in view of upcoming events, such as e.g. in view of a temporary road work and/or accident, and/or an approaching emergency vehicle, EV, in emergency mode. For an emergency vehicle in emergency mode, its destination - such as an address of a patient waiting for ambulance pickup and/or a location of an accident to which e.g. the police and/or a fire truck are heading - is commonly known, and the route of the emergency vehicle planned beforehand. An ADS-equipped vehicle - or rather any vehicle supporting connectivity - may thus be able to perform an early reaction upon receiving a notification stating there is an emergency vehicle approaching, such as adjusting its route and/or maneuvering out of the way not to obstruct the upcoming emergency vehicle's passage. A vehicle receiving such a notification, may potentially further inform also other connectivity-supporting road users of the approaching emergency vehicle, e.g. via V2V communication, such that also these other road users may give way. Presumably, however, not all vehicles along a route of an emergency vehicle necessarily support connectivity, and/or have the ability to know beforehand of a nearing emergency vehicle.

SUMMARY OF THE INVENTION

[0005] It is therefore an object of embodiments herein to provide an approach for in an improved and/or alternative manner support free passage past road users for an approaching emergency vehicle. The object above may be achieved by the subject-matter disclosed herein. Embodiments are set forth in the appended claims, in the following description and in the drawings.

[0006] The disclosed subject-matter relates to a method performed by an EV passage planning system for supporting free passage past road users for an approaching emergency vehicle, EV. The EV passage planning system determines that an EV along its planned route is approaching a set of vehicles respectively equipped with an Automated Driving System, ADS, wherein the set of vehicles has a field of view combined covering a continuous dynamic zone along the route. The EV passage

planning system further obtains sensor data of surroundings comprising the dynamic zone, captured with support from one or more surrounding detecting sensors. Moreover, the EV passage planning system determines based on surrounding and/or situational conditions in the dynamic zone derived from evaluating the sensor data, a preferred passage for the EV through the dynamic zone, deemed having potential to be cleared from all traffic. Furthermore, the EV passage planning system instructs the set of ADS-equipped vehicles to act according to a schema influencing road users in the dynamic zone to maneuver such that the preferred passage is cleared in time for arrival of the EV.

[0007] The disclosed subject-matter further relates to an EV passage planning system for- and/or adapted and/or configured for - supporting free passage past road users for an approaching EV. The EV passage planning system comprises an EV approach determining unit for determining that an EV along its planned route is approaching a set of vehicles respectively equipped with an ADS, wherein the set of vehicles has a field of view combined covering a continuous dynamic zone along the route. Furthermore, the EV passage planning system comprises a sensor data obtaining unit for obtaining sensor data of surroundings comprising the dynamic zone, captured with support from one or more surrounding detecting sensors. Moreover, the EV passage planning system comprises an AD passage determining unit for determining based on surrounding and/or situational conditions in the dynamic zone derived from evaluating the sensor data, a preferred passage for the EV through the dynamic zone, deemed having potential to be cleared from all traffic. The EV passage planning system further comprises a schema instructing unit for instructing the set of ADS-equipped vehicles to act according to a schema influencing road users in the dynamic zone to maneuver such that the preferred passage is cleared in time for arrival of the EV.

[0008] Furthermore, the disclosed subject-matter relates to an arrangement - for instance at least a first ADS-equipped vehicle and/or a centralized entity such as at least a first cloud and/or cloud server - comprising an EV passage planning system as described herein.

[0009] Moreover, the disclosed subject-matter relates to a computer program product comprising a computer program containing computer program code means arranged to cause a computer or a processor to execute the steps of the EV passage planning system described herein, stored on a computer-readable medium or a carrier wave. The disclosed subject-matter further relates to a non-volatile computer readable storage medium having stored thereon said computer program product.

[0010] Thereby, there is introduced an approach supporting and/or enabling sufficient space to be created for an emergency vehicle - e.g. in emergency mode - to pass through traffic efficiently. That is, since there is determined that an EV along its planned route is approaching a set of vehicles respectively equipped with an ADS, which set of vehicles has a field of view combined covering a continuous dynamic zone along the route, there is established that an emergency vehicle - such as e.g. an ambulance, police car and/or fire truck - up ahead along its predetermined route, is expected to reach, encounter and/or pass one or more ADS-equipped vehicles which vehicles between them have a sensor field of view covering a continuous - and/or concatenated - non-fixed portion of the EV's route. Accordingly, there is identified one or more ADS-equipped vehicles, which in addition to being expected to further ahead be encountered by the EV, additionally - with support from respective onboard surrounding detecting sensors such as image capturing devices e.g. radar(s), lidar(s), sonar(s) and/or camera(s) etc. - contribute to cover an uninterrupted dynamic zone along the EV's route. Furthermore, that is, since there is obtained sensor data of surroundings comprising the dynamic zone captured with support from one or more surrounding detecting sensors, there is captured utilizing surrounding detecting sensors e.g. of the set of ADS-equipped vehicles - and potentially further of static arrangements such as camera(s) provided on road-side infrastructure - sensory information of at least a portion of the continuous dynamic zone stretching along a section of the EV's route, which sensory information then subsequently - for instance should the set of ADS-equipped vehicles comprise more than a single vehicle - may be obtained e.g. by a centralized entity such as a cloud and/or by an ADS-equipped vehicle out of the set of ADS-equipped vehicles having the role of a master in a master/slave set-up, for subsequent evaluation. Moreover, that is, since there is determined based on surrounding and/or situational conditions in the dynamic zone derived from evaluating the sensor data, a preferred passage for the EV through the dynamic zone deemed having potential to be cleared from all traffic, there is - following assessment of the obtained sensor data - from considering surrounding and/or situational conditions such as traffic situation, number and/or constellation of road users and/or of vehicles in the set of ADS-equipped vehicles, road configuration(s) etc. in the dynamic zone, established an EV passage deemed suitable and/or favourable taking into consideration ability of said passage potentially being cleared from all road users in time of arrival of the EV. Accordingly, an EV corridor enabling the approaching EV to pass through, is derived, which not merely takes into consideration the set of ADS-equipped vehicles in a safe and/or sufficient manner clearing the way in time for the EV to arrive, but additionally takes into consideration potential of the EV passage being cleared also from other road user(s) in the dynamic zone, such as in a safe and/or sufficient manner, with support from and/or following guidance from the set of ADS-equipped vehicles. Furthermore, that is, since the set of ADS-equipped vehicles are instructed to act according to a schema - where optionally the ADS-equipped vehicles collaborate in a manner - influencing road users in the dynamic zone to maneuver such that

the preferred passage is cleared in time for arrival of the EV, the set of ADS-equipped vehicles is - e.g. by the optional centralized entity and/or the optional master ADS-equipped vehicle - commanded to take action(s) according to a behavior and/or action pattern and/or plan affecting road users in the dynamic zone to clear the preferred passage prior to the EV arriving. Accordingly, the set of ADS-equipped vehicles are instructed to - for instance in collaboration should there be at least two ADS-equipped vehicles in the set - maneuver, for instance move laterally and/or decrease speed e.g. to create gap(s) for surrounding road user(s), and potentially further instructed to prompt instructions(s) - such as visually and/or wirelessly prompting surrounding traffic to change lane and/or move laterally - in a manner influencing road user(s) in the dynamic zone to clear the preferred passage in time for arrival of the EV. In other words, the schema of the set of ADS-equipped vehicles is set out to orchestrate other road users in the dynamic zone to collectively create space - namely to clear the preferred passage - prior to the EV is expected to arrive, for instance by the set of ADS-equipped vehicles - for instance coordinated should there be at least two ADS-equipped vehicles in the set - influencing road users behind to maneuver laterally e.g. toward lane barriers and/or lane markers should the preferred passage be represented by a corridor in between traffic and/or change lane should the preferred passage be represented by a cleared lane. Thus, with the introduced concept, according to which actions of the set of ADS-equipped vehicles - such as trajectories and/or prompting of instructions to other road user(s) in the dynamic zone - are proactively planned and carried out with the aim to clear a preferred EV passage from all traffic, the road user(s) in the dynamic zone may be influenced by the actions of the set of ADS-equipped vehicles such that said road user(s) ahead of the EV arriving, maneuver out of the way, i.e. clear the preferred passage. Should there be at least two ADS-equipped vehicles in the set, then rather than - as known in the art - respective ADS-equipped vehicle taking its own decision in clearing the way for an approaching EV, such clearing may with the introduced concept be achieved in a harmonized and/or coordinated manner. That is, in such a case, the two or more ADS-equipped vehicle may act in cooperation to create space for the approaching EV, thus collaborating strategically to effectively affect other road user(s) to follow the behavioral patterns formed by said ADS-equipped vehicles. Consequently, with the concept introduced herein, sufficient space may be created for an EV in emergency mode to pass through, in a proactive and/or efficient manner.

[0011] For that reason, an approach is provided for in an improved and/or alternative manner support free passage past road users for an approaching emergency vehicle. The technical features and corresponding advantages of the above-mentioned method will be discussed in further detail in the following.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The various aspects of the non-limiting embodiments, including particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Fig. 1 is a schematic block diagram illustrating an exemplifying EV passage planning system according to embodiments of the disclosure;

Fig. 2 is a flowchart depicting an exemplifying method performed by a buffer resources prioritizing system according to embodiments of the disclosure;

Fig. 3 depicts a schematic view of an exemplifying first traffic scenario handled by an exemplifying EV passage planning system according to embodiments of the disclosure;

Fig. 4 depicts a schematic view of an exemplifying second traffic scenario handled by an exemplifying EV passage planning system according to embodiments of the disclosure;

Fig. 5 depicts a schematic view of an exemplifying third traffic scenario handled by an exemplifying EV passage planning system according to embodiments of the disclosure;

Fig. 6a-d depict schematic views of exemplifying fourth, fifth, sixth and seventh traffic scenarios handled by an exemplifying EV passage planning system according to embodiments of the disclosure;

Figs. 7a and **b** depict schematic views of a respective exemplifying continuous dynamic zone according to embodiments of the disclosure; and

Fig. 8 depicts a schematic view of several separate exemplifying continuous dynamic zones along and/or in vicinity of a planned route of an EV according to embodiments of the disclosure.

DETAILED DESCRIPTION

[0013] Non-limiting embodiments of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the disclosure are shown. This disclosure may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like reference characters refer to like elements throughout. Dashed lines of some boxes in the figures indicate that these units or actions are optional and not mandatory.

[0014] In the following, according to embodiments herein which relate to supporting free passage past road

users for an approaching emergency vehicle, there will be disclosed an approach supporting and/or enabling sufficient space to be created for an emergency vehicle - e.g. in emergency mode - to pass through traffic efficiently.

[0015] Referring now to the figures, there is depicted in **Fig. 1** a schematic block diagram illustrating an exemplifying **EV passage planning system 1** according to embodiments of the disclosure. The EV passage planning system 1 is adapted and/or configured for supporting free passage past road users for an approaching emergency vehicle, EV. Accordingly, as illustrated in an exemplifying manner in exemplifying Fig. 1, the EV passage planning system 1 is - e.g. by means of an **EV approach determining unit 101** - adapted and/or configured for determining that an **EV 3** along its planned route is approaching a set of **vehicles 2** respectively equipped with an Automated Driving System, **ADS 21**, wherein the set of vehicles 2 has a field of view combined covering a continuous dynamic zone along the route. Thereby, there is established that an emergency vehicle - such as e.g. an ambulance, police car and/or fire truck - up ahead along its predetermined route, is expected to reach, encounter and/or pass one or more ADS-equipped vehicles 2 which vehicles 2 between them have a sensor field of view covering a continuous - and/or concatenated - non-fixed portion of the EV's 3 route. Accordingly, there is identified one or more ADS-equipped vehicles 2, which in addition to being expected to further ahead be encountered by the EV 3, additionally - with support from respective onboard **surrounding detecting sensors 22** such as image capturing devices e.g. camera(s), radar(s), lidar(s), ultrasonics etc. - contribute to cover an uninterrupted dynamic zone along the EV's 3 route.

[0016] The EV passage planning system 1 may be comprised - at least partly - in a **centralized entity 4** such as e.g. at least a first cloud and/or cloud server configured to communicate with the set of ADS-equipped vehicles 2 in a so called cloud solution, and/or - at least partly - be comprised in at least a first ADS-equipped vehicle 2 out of the set of ADS-equipped vehicles 2 in a master/slave set-up of sorts. Alternatively, the EV passage planning system 1 may - e.g. in case the set of ADS-equipped vehicles 2 comprises a lone ADS-equipped vehicle 2 - be fully comprised in said lone ADS-equipped vehicle 2 (the lone ADS-equipped vehicle throughout the disclosure being considered to be included under the term "master ADS-equipped vehicle"). The centralized entity 4 and/or master ADS-equipped vehicle 2 may continuously and/or intermittently - for instance through real-time tracking - receive and/or gather updates of states of the set of ADS-equipped vehicles 2, such as of positions, orientations and/or velocities thereof.

[0017] Determining that an EV 3 along its planned route is approaching a set of ADS-equipped vehicles 2 - between them having a field of view covering a continuous dynamic zone along said route - may be accomplished in any arbitrary - e.g. known - manner, feasible for the set-up and/or situation at hand. Accordingly, establishing an approach of an EV 3 may for instance be accomplished by - in addition and/or alternatively to e.g. detecting the EV 3 with support from sensors - obtaining and/or receiving a notification, an alert data and/or information indicating the EV's 3 position and/or at least a portion of its planned route - such as from the EV 3 itself and/or via e.g. inter-vehicle communication, V2V/V2I/V2X communication, swarm service(s), cloud service(s) and/or cloud computing etc. According to an example, upon determining that an EV 3 is approaching, dimensions of the EV 3 - such as e.g. a width and/or an estimated width - may additionally be obtained. Through assessment of and/or in comparison to one or more ADS-equipped vehicles' 2 - out of the set - position(s), poses and/or planned path(s), expected encounter(s) may then be derived. Such expected encounter(s) between the EV 3 and the set of ADS-equipped vehicles 2 may lie any feasible time and/or distance ahead, such as ranging from barely seconds up to minutes or even tens of minutes ahead and/or lie less then hundred meters up to thousands or tens of thousands of meters ahead. The approach of the EV 3 may then potentially be communicated to the set of ADS-equipped vehicles 2, such as from the optional centralized entity 4 and/or master ADS-equipped vehicle 2.

[0018] The EV 3 itself may be represented by any feasible emergency vehicle, such as an ambulance, police vehicle, fire truck etc., for instance in an emergency mode. The set of ADS-equipped vehicle(s) 2, on the other hand, may be represented by any arbitrary - e.g. known - manned or unmanned one or more vehicles, for instance combustion engine-propelled and/or electrically-powered, such as at least a first car, truck, lorry, van, bus and/or tractor. Furthermore, the ADS 21 on-board respective ADS-equipped vehicle 2 of the set may be represented by any arbitrary ADAS or AD system e.g. known in the art and/or yet to be developed. Respective ADS-equipped vehicle 2 and/or ADS 21 may comprise, be provided with and/or have onboard a perception system (not shown) adapted to estimate vehicle surroundings, and subsequently adapted to estimate world views of the surroundings e.g. with support from a - e.g. commonly known - digital map (not shown) such as a high definition, HD, map, and/or an equivalent and/or successor thereof. Such a perception system may refer to any commonly known system, module and/or functionality, e.g. comprised in one or more electronic control modules, ECUs, and/or nodes of the ADS-equipped vehicle 2 and/or the ADS 21, adapted and/or configured to interpret sensory information - relevant for driving of the ADS-equipped vehicle 2 - to identify e.g. objects, obstacles, vehicle lanes, relevant signage, appropriate navigation paths etc. The perception system - which may be adapted to support e.g. sensor fusion, tracking, localization etc. - may thus be adapted to rely on sensory information. Such exemplifying sensory information may, for instance, be derived from one or more - e.g. commonly known - sen-

sors comprised in and/or provided onboard the ADS-equipped vehicle 2 adapted to sense and/or perceive said vehicle's 2 whereabouts and/or surroundings, for instance represented by one or a combination of one or more of surrounding detecting sensors 22 and/or a positioning system, odometer, inertial measurement units etc. In other words, such a perception system is in the present context thus to be understood as a system responsible for acquiring raw sensor data from onboard sensors, such as from surrounding detecting sensors 22 etc., and converting this raw data into scene understanding.

[0019] ADS-equipped vehicles 2 of the set between them covering a continuous zone, may be identified - and/or have been identified - in any feasible manner, such as based on and/or by assessment of respective ADS-equipped vehicle's 2 field of view. The continuous dynamic zone - thus without or essentially without gaps of attainable sensor information - may accordingly be of any feasible shape and/or dimensions, such as ranging less than hundred meters up to thousands of meters of more, e.g. depending on sensor coverage, number of ADS-equipped vehicles 2 within a same area and/or region, disposition of such ADS-equipped vehicles 2, etc. Respective field of view and/or extent of contribution to the continuous zone may thus vary from one ADS-equipped vehicle 2 to another. According to an example, the continuous zone may potentially additionally be supplemented by **surrounding detecting sensors 5** of static arrangements, such as surrounding detecting sensors 5 provided on road-side infrastructure, and further for instance be represented by surveillance sensors and/or camera(s). In exemplifying **Figs. 3-6** - which depict various traffic scenarios handled by exemplifying EV passage planning system(s) 1 - the stretches of roads in the illustrated snapshots of the exemplifying various traffic scenarios, may be understood to respectively be comprised in and/or covered by a dynamic zone of the corresponding set of ADS-equipped vehicles 2. In Figs. 3-5, the set of ADS-equipped vehicles 2 comprises an exemplifying lone ADS-equipped vehicle 2, whereas in Figs. 6a-d the set of ADS-equipped vehicles 2 comprises exemplifying two ADS-equipped vehicles 2. Moreover, in exemplifying **Fig. 7a**, there is depicted an exemplifying continuous dynamic zone covered by three exemplifying ADS-equipped vehicles 2, whereas there in exemplifying **Fig. 7b** is depicted an exemplifying continuous dynamic zone covered by two exemplifying ADS-equipped vehicles 2 and an optional surrounding detecting sensor 5 of a static arrangement. Furthermore, in exemplifying **Fig. 8**, there is depicted four separate exemplifying continuous dynamic zones along and/or in vicinity of a planned route of an EV 3, namely two dynamic zones positioned along the EV's 3 planned route, one dynamic zone currently not positioned but further on predicted to be positioned along the EV's 3 planned route, and one dynamic zone **not** positioned along the EV's planned route. The phrase "having a field of view combined covering" may refer to "having a sensor field of view combined covering", "having a respective field of view combined covering" and/or "having combined, together and/or between them a field of view covering", whereas "a continuous dynamic zone" may refer to "a continuous, concatenated and/or uninterrupted dynamic zone", "a continuous non-fixed and/or location-independent zone" and/or "a continuous dynamic segment and/or region". The phrase "zone along said route", on the other hand, may refer to "zone along at least a section of said route". Moreover, "determining that an EV along its planned route is approaching" may refer to "predicting and/or estimating that an EV along its planed route is approaching" and/or "determining that an EV along its predetermined route is approaching", whereas "a set of vehicles" may refer to "a set of vehicles comprising at least a first vehicle". The phrase "EV passage planning system", on the other hand, may refer to "EV passing planning system", "EV path planning system" and/or "behavior planning system", whereas "a method performed by an EV passage planning system" may refer to "an at least partly computer-implemented method performed by an EV passage system". Moreover, "for supporting free passage" may refer to "for supporting, planning and/or enabling free passage" and/or "for providing instructions - e.g. data instructions - enabling free passage", whereas "free passage" may refer to "cleared passage", "free passageway", "passage clearance" and/or "path clearance". The phrase "for an approaching EV", on the other hand, may according to an example refer to "for an EV approaching from behind".

[0020] As illustrated in an exemplifying manner in exemplifying Fig. 1, the EV passage planning system 1 is further - e.g. by means of a **sensor data obtaining unit 102** - adapted and/or configured for obtaining sensor data of surroundings comprising the dynamic zone captured with support from one or more surrounding detecting sensors 22, 5. Thereby, there is captured utilizing surrounding detecting sensors 22 e.g. of the set of ADS-equipped vehicles 2 - and potentially further utilizing optional surrounding detecting sensors 5 of static arrangements such as camera(s) provided on road-side infrastructure - sensory information of at least a portion of the continuous dynamic zone stretching along a section of the EV's 3 route, which sensory information then subsequently - for instance should the set of ADS-equipped vehicles 2 comprise more than a lone vehicle - may be obtained e.g. by the centralized entity 4 and/or master ADS-equipped vehicle 2, for subsequent evaluation.

[0021] The sensor data - which may be of any format and/or magnitude - may be and/or have been captured and/or gathered in any feasible - e.g. known - manner with support from surrounding detecting sensors 22, 5, potentially with additional support from - and/or processing, assessment and/or perception by - perception system(s) as commonly known. Respective contribution of sensor data from respective ADS-equipped vehicle 2 of the set, may vary, such as with the situation at hand e.g. constellation of ADS-equipped vehicles 2 in the set, their

respective pose, respective sensor field of view, etc. Moreover, respective captured sensor data may be obtained in any feasible - e.g. known - manner, such as being conveyed, communicated and/or transmitted, for instance to the optional centralized entity 4 and/or the optional master ADS-equipped vehicle 2. Further, the phrase "obtaining sensor data" may refer to "retrieving and/or deriving sensor data", "obtaining respective sensor data" and/or "obtaining, from one or more of the set of ADS-equipped vehicles, sensor data", and according to an example further to "obtaining, from one or more of the set of ADS-equipped vehicles and potentially further from one or more static arrangements, sensor data". Moreover, "sensor data of surroundings comprising said dynamic zone" may refer to "sensor data of surroundings comprising at least a portion of said dynamic zone", and according to an example further to "sensor data of vehicle surroundings comprising said dynamic zone". The phrase "captured with support from one or more surrounding detecting sensors", on the other hand, may throughout refer to "gathered with support from one or more surrounding detecting sensors", and according to an example further to "captured with support from one or more onboard surrounding detecting sensors".

[0022] As illustrated in an exemplifying manner in exemplifying Fig. 1, the EV passage planning system 1 is further - e.g. by means of an **EV passage determining unit 103** - adapted and/or configured for determining based on surrounding and/or situational conditions in the dynamic zone derived from evaluating the sensor data, a preferred passage for the EV through the dynamic zone, deemed having potential to be cleared from all traffic. Thereby - as further exemplified in Figs. 3-6 - following assessment of the obtained sensor data, there is from considering surrounding and/or situational conditions - such as traffic situation, number and/or constellation of **road users 6** and/or of ADS-equipped vehicles 2 in the set of ADS-equipped vehicles 2, road configuration(s) etc. - in the dynamic zone, established an EV passage deemed suitable and/or favourable - such as the best - taking into consideration ability of said passage potentially being cleared from all road users 6 in time of arrival of the EV 3. Accordingly, an EV passage enabling the approaching EV 3 to pass through, is derived, which not merely takes into consideration the set of ADS-equipped vehicles 2 in a safe and/or sufficient manner clearing the way in time for the EV 3 to arrive, but additionally takes into consideration potential of the EV passage being cleared also from other road user(s) 6 in the dynamic zone, such as in a safe and/or sufficient manner, with support from and/or following guidance from the set of ADS-equipped vehicles 2.

[0023] The preferred passage deemed having potential to be cleared from all traffic, may be determined in any feasible manner taking into consideration surrounding and/or situational conditions in the dynamic zone. The surrounding and/or situational conditions may be represented by any feasible one or more circumstances in the dynamic zone - such as being environmental- and/or traffic-related - and further for instance, as touched upon above, relate to one or more of traffic situation(s), number and/or constellation of road users and/or of ADS-equipped vehicles 2 in the set of ADS-equipped vehicles 2, road configuration(s) such as curve(s), road junction(s) and/or branches, number of lanes, road/lane width(s), etc., in the dynamic zone. In consideration thereof, the preferred passage may accordingly be of any feasible dimensions, such as for instance being of a width wider than a width of the EV 3, stretch for any feasible distance, run along any feasible portion of a road e.g. in any arbitrary lane and/or form a corridor overlapping and/or affecting multiple lanes such as in between traffic, etc., and further be determined taking e.g. safety considerations into account. The road users 6 - which may include the set of ADS-equipped vehicle(s) 2 - may be represented by any one or more feasible traffic participants, such as vehicles, e.g. passenger cars, buses, trucks etc., which may - or may not - support connectivity and/or may - or may not - be equipped with ADS(s). In an exemplifying manner, Figs. 3-5 respectively depicts four road users 6 in addition to a lone ADS-equipped vehicle 2, whereas Fig. 6a depicts four road users 6, Fig. 6b three road users 6, Fig. 6c seven road users 6 and Fig. 6d three road users 6 in addition to two ADS-equipped vehicles 2. The phrase "determining [...] a preferred passage" may refer to "deriving [...] a preferred passage", "determining [...] a suitable and/or favourable passage" and/or "determining [...] a preferred path and/or corridor", whereas "based on surrounding and/or situational conditions in said dynamic zone" may refer to "taking into consideration and/or using as input surrounding and/or situational conditions in said dynamic zone" and/or "based on surrounding and/or situational conditions applicable in, relevant for and/or pertinent said dynamic zone". The phrase "through said dynamic zone", on the other hand, may refer to "through said dynamic zone" and/or "through at least a portion of said dynamic zone", whereas "preferred passage [...] deemed having potential to be cleared from all traffic" may refer to "preferred passage [...] considered, predicted and/or estimated having potential to be cleared from all traffic", "preferred passage [...] deemed having an ability to potentially be cleared from all traffic" and/or "preferred passage [...] deemed having potential to be cleared from all road users". Moreover, "preferred passage [...] deemed having potential to be cleared from all traffic" may according to an example refer to "preferred passage [...] deemed having potential to be cleared from all traffic through support and/or guidance" and/or "preferred passage [...] deemed having potential to be cleared from all traffic with support from and/or following guidance from the set of ADS-equipped vehicles",

[0024] As illustrated in an exemplifying manner in exemplifying Fig. 1 and further exemplified in Figs. 3-6, the EV passage planning system 1 is further - e.g. by means of a **schema instructing unit 104** - adapted and/or configured for instructing the set of ADS-equipped vehicles

2 to act according to a schema - where optionally the ADS-equipped vehicles 2 collaborate in a manner - influencing road users 6 in the dynamic zone to maneuver such that the preferred passage is cleared in time for arrival of the EV 3. Thereby, the set of ADS-equipped vehicles 2 is - e.g. by the optional centralized entity 4 and/or the optional master ADS-equipped vehicle 2 - commanded to take action(s) according to a behavior and/or action pattern and/or plan affecting road users 6 in the dynamic zone to clear the preferred passage prior to the EV 3 arriving. Accordingly, the set of ADS-equipped vehicles 2 are instructed to -for instance in collaboration should there be at least two ADS-equipped vehicles 2 in the set - maneuver, for instance move laterally and/or decrease speed e.g. to create gap(s) for surrounding road user(s) 6, and potentially further instructed to prompt instructions(s) - such as visually and/or wirelessly prompting surrounding traffic to change lane and/or move laterally - in a manner influencing road user(s) 6 in the dynamic zone to clear the preferred passage in time for arrival of the EV 3. In other words, the schema of the set of ADS-equipped vehicles 2 is set out to orchestrate other road users 6 in the dynamic zone to collectively create space - namely to clear the preferred passage - prior to the EV 3 is expected to arrive, for instance by the set of ADS-equipped vehicles 2 - for instance coordinated should there be at least two ADS-equipped vehicles 2 in the set - influencing road users 6 behind to maneuver laterally e.g. toward lane barriers and/or lane markers should the preferred passage be represented by a corridor in between traffic and/or change lane should the preferred passage be represented by a cleared lane. Thus, with the introduced concept, according to which actions of the set of ADS-equipped vehicles 2 - such as trajectories and/or prompting of instructions to other road user(s) 6 in the dynamic zone - are proactively planned and carried out with the aim to clear a preferred EV passage from all traffic, the road user(s) 6 in the dynamic zone may be influenced by the actions of the set of ADS-equipped vehicles 2 such that said road user(s) 6 ahead of the EV 3 arriving, maneuver out of the way, i.e. clear the preferred passage. Should there be at least two ADS-equipped vehicles 2 in the set, then rather than - as known in the art - respective ADS-equipped vehicle 2 taking its own decision in clearing the way for an approaching EV 3, such clearing may with the introduced concept be achieved in a harmonized and/or coordinated manner. That is, in such a case, the two or more ADS-equipped vehicle 2 may act in cooperation to create space for the approaching EV 3, thus collaborating strategically to effectively affect other road user(s) 6 to follow the behavioral patterns formed by said ADS-equipped vehicles 2. Consequently, with the concept introduced herein, sufficient space may thereby be created for an EV 3 in emergency mode to pass through, in a proactive and/or efficient manner.

[0025] The schema according to which the set of ADS-equipped vehicles 2 are instructed to act, may comprise any feasible actions influencing road users 6 in the dynamic zone to maneuver such that the determined preferred passage is cleared in time for arrival of the EV 3. Said actions may - should there be at least two ADS-equipped vehicles 2 in the set - be on an individual basis of respective ADS-equipped vehicle 2 but coordinated and/or harmonized between the ADS-equipped vehicles 2. Respective ADS-equipped vehicle-related action(s) of the schema - which actions thus may differ from one ADS-equipped vehicle 2 to another- may accordingly relate to, as touched upon above, maneuvering of the ADS-equipped vehicle 2 - such as modifying and/or adapting vehicle movement such as lateral movement and/or speed e.g. to create gap(s) for other road user(s) 6 - and potentially further relate to the ADS-equipped vehicle 2 prompting instructions such as clearance instructions, the timing of which may differ from timing of maneuvering. The optional prompting of instructions may relate to one or more ADS-equipped vehicles 2 of the set prompting instructions in any feasible manner, such as visually - e.g. with support from one or more displays - in any feasible one or more directions e.g. in a backward direction, and/or wirelessly e.g. transmitting instruction data via inter-vehicle communication such as V2V to one or more road users 6 in the dynamic zone. Said instructions potentially prompted by one or more of the ADS-equipped vehicles 2 of the set - which thus may differ from one ADS-equipped vehicle 2 to another - may comprise any feasible information and/or data providing maneuvering instructions, such as prompting surrounding road user(s) 6 to adapt and/or modify movement e.g. lateral movement and/or speed. According to an example, actions of the schema may additionally comprise one or more of activating lights, high beam and/or honking. Moreover, a timing of instructing the set of ADS-equipped vehicles 2 to act according to the schema - and/or of respective ADS-equipped vehicle 2 to act upon said schema - may be set in consideration of the situation at hand, such as based on the surrounding and/or situational conditions and/or taking into consideration timing of the approaching EV 3. Accordingly, should there be at least two ADS-equipped vehicles 2 in the set, such timing may differ from one ADS-equipped vehicle 2 to another. The phrase "instructing said set of ADS-equipped vehicles" may throughout the disclosure refer to "commanding said set of ADS-equipped vehicles" and/or "providing data to the set of ADS-equipped vehicles instructing said set of ADS-equipped vehicles", whereas "to act according to a schema" may refer to "to take action and/or behave according to a schema", "to maneuver and/or prompt instructions according to a schema", "to act based on and/or following a schema" and/or "to act in a manner". Furthermore, "schema where said ADS-equipped vehicles collaborate" may refer to "schema comprising collaboration between said ADS-equipped vehicles" and/or "schema where said ADS-equipped vehicles collaborate, harmonize, synchronize, are coordinated and/or are organized". Moreover, "influencing road users in said dynamic

zone" may refer to "affecting and/or orchestrating road users in said dynamic zone" and/or "influencing one or more road users in said dynamic zone", and according to an example further to "influencing road users in said dynamic zone driving behind a foremost ADS-equipped vehicle of said set of ADS-equipped vehicles". The phrase "maneuver such that said preferred passage is cleared", on the other hand, may refer to "maneuver such that said preferred passage is cleared from traffic" and/or "maneuver such that said preferred passage is enabled", whereas "in time for arrival of the EV" may refer to "in time for expected, predicted and/or estimated arrival of the EV", "in time for the EV entering said dynamic zone" and/or "prior to arrival of the EV".

[0026] Exemplifying traffic scenarios handled in an exemplifying manner by an EV passage planning system 1 according to embodiments of the disclosure, will in the following be discussed in conjunction with Figs. 3-6.

[0027] In Fig. 3, an exemplifying traffic scenario is depicted in which **t1** reflects a first time instant prior to the EV passage planning system 1 performing its steps, **t2** reflects a second time instant following the EV passage planning system 1 having initiated its steps, and **t3** reflects a third time instant resulting from the EV passage planning system 1 having performed its steps. In Fig. 3, the set of ADS-equipped vehicles 2 - here comprising a lone ADS-equipped vehicle 2 traveling in the left lane - and four other road users 6 are traveling along a road with two lanes of the same direction, which road is - taking into consideration the surrounding and/or situational conditions - deemed wide enough for an EV 3 to drive through traffic - i.e. in a corridor - if traffic 6, 2 is steered close to the side lane markers. At t2, the set of ADS-equipped vehicles 2 - here the lone ADS-equipped vehicle 2 - has, following instructions, moved laterally toward lane markers separating the two lanes, with the intention to capture the attention of other road users 6, such as road users 6 behind the lone ADS-equipped vehicle 2. Additionally, for instance with a separate and/or differing timing, the set of ADS-equipped vehicles 2 has, following instructions, prompted **clearance instructions 7**, here represented by a back window projected image indicating instructions to road users 6 behind to maneuver toward side lane markers. Potentially, the set of ADS-equipped vehicles 2 may, following instructions, additionally have activated hazard lights, high beam and/or honking. At t3, the set of ADS-equipped vehicles 2 has, following instructions, as a last step - for instance after a predeterminable period of time and/or subsequent a clearance status indicating that one or more of the road users 6 has cleared and/or initiated clearing of the preferred passage here a corridor between traffic-moved laterally towards the side lane markers of respective right and left lanes, following which the preferred passage accordingly is cleared for the approaching EV 3.

[0028] In Fig. 4, an exemplifying traffic scenario is depicted in which **t1'** reflects a first time instant prior to the EV passage planning system 1 performing its steps, **t2', t3'** and **t4'** reflect second, third and fourth time instants following the EV passage planning system 1 having initiated its steps, and **t5'** reflects a fifth time instant resulting from the EV passage planning system 1 having performed its steps. In Fig. 4, the set of ADS-equipped vehicles 2 - here comprising a lone ADS-equipped vehicle 2 traveling in the left lane - and four other road users 6 are traveling along a road with two lanes of the same direction, where - taking into consideration the surrounding and/or situational conditions - lane changing into the right lane is considered the best and/or favourable choice to enable a preferred EV passage in the left lane, for instance due to the road not being wide enough and/or there being one or more relatively large vehicles e.g. trucks along the road obstructing space. Here, at t2', the set of ADS-equipped vehicles 2 - in the example the lone ADS-equipped vehicle 2 - has, following instructions, moved laterally toward lane markers separating the two lanes, with the intention to capture the attention of other road users 6, such as road users 6 behind the lone ADS-equipped vehicle 2. Additionally, for instance with a separate and/or differing timing, the set of ADS-equipped vehicles 2 has, following instructions, prompted a first set of clearance instructions 7', here represented by a back window projected image indicating - and/or informing road users 6 behind of - an approaching EV 3. At t3', the set of ADS-equipped vehicles 2 has, as part of its instructions, moved laterally toward the right lane. Additionally, for instance with a separate and/or differing timing, the set of ADS-equipped vehicles 2 has, following its instructions, prompted a second set of clearance instructions, here represented by a back window projected image indicating instructions to road users 6 behind to maneuver to the right lane. At t4', the set of ADS-equipped vehicles 2 has, following instructions, as a last step, moved laterally into the right lane, and decreased its speed with the intention to create a sufficient gap - e.g. time gap - in front, to provide the opportunity for road user(s) 6 in the left lane to maneuver and/or merge into said gap. At t5', the preferred passage - here the left lane - is accordingly cleared for the approaching EV 3.

[0029] In Fig. 5, an exemplifying traffic scenario is depicted in which the set of ADS-equipped vehicles 2 - here comprising a lone ADS-equipped vehicle 2 traveling in the right lane - and four other road users 6 are traveling along a road with two lanes of the same direction, where - taking into consideration the surrounding and/or situational conditions - lane changing into the right lane is considered the best and/or favourable choice to enable a preferred EV passage in the left lane. Here, the set of ADS-equipped vehicles 2 - in the example the lone ADS-equipped vehicle 2 - has, following instructions, moved laterally toward lane markers separating the left and right lanes with the intention to capture the attention of other road users 6, such as road users 6 behind the lone ADS-equipped vehicle 2. Additionally, for instance with a separate and/or differing timing, the set of ADS-equipped vehicles 2 has, following instructions, prompted a clear-

ance instructions 7", here represented by a back window projected image indicating instructions to road users 6 behind to maneuver into the right lane. As a last step (not shown), the set of ADS-equipped vehicles 2 may, following instructions, for instance after a predeterminable period of time and/or subsequent a clearance status indicating that one or more of the road users 6 has cleared and/or initiated clearing of the preferred passage here the left lane - move laterally back into the right lane, and decrease its speed with the intention to create a sufficient gap - e.g. time gap - in front, to provide the opportunity for road user(s) 6 in the left lane to maneuver and/or merge into said gap. The preferred passage - here the left lane - may then accordingly be cleared for the approaching EV 3.

[0030] In Fig. 6a, an exemplifying traffic scenario is depicted in which the set of ADS-equipped vehicles 2 - here comprising a first ADS-equipped vehicle 2 traveling in the left lane and a longitudinally close second ADS-equipped vehicle 2 traveling in the right lane - and four other road users 6 are traveling along a road with two lanes of the same direction, where - taking into consideration the surrounding and/or situational conditions - lane changing into the right lane is considered the best and/or favourable choice to enable a preferred EV passage in the left lane. According to this scenario, following instructions, the first ADS-equipped vehicle 2 in the left lane may remain at its current speed and move laterally toward the lane markers separating the two lanes. Additionally, for instance with a separate and/or differing timing, the first ADS-equipped vehicle 2 in the left lane and/or the second ADS-equipped vehicle 2 in the right lane may, following instructions, prompt clearance instructions, for instance represented by a back window projected image indicating - and/or informing road users 6 behind of - an approaching EV 3. Meanwhile, the second ADS-equipped vehicle 2 in the right lane may reduce its speed with the intention to create a sufficient gap - e.g. time gap - in front, to provide the opportunity for road user(s) 6 in the left lane to maneuver and/or merge into said gap. As a last step, the first ADS-equipped vehicle 2 in the left lane may move laterally into the right lane, following which the preferred passage - here the left lane - accordingly may be cleared for the approaching EV 3.

[0031] In Fig. 6b, an exemplifying traffic scenario is depicted in which the set of ADS-equipped vehicles 2 - here comprising a first ADS-equipped vehicle 2 traveling in the right lane and a longitudinally close second ADS-equipped vehicle 2 also traveling in the right lane - and three other road users 6 are traveling along a road with two lanes of the same direction, where - taking into consideration the surrounding and/or situational conditions - lane changing into the right lane is considered the best and/or favourable choice to enable a preferred EV passage in the left lane. According to this scenario, following instructions, the foremost first ADS-equipped vehicle 2 may move laterally toward the lane markers separating the two lanes. Additionally, for instance with a separate and/or differing timing, the foremost first ADS-equipped vehicle 2 and/or the rearmost second ADS-equipped vehicle may, following instructions, prompt clearance instructions, for instance represented by a back window projected image indicating - and/or informing road users 6 behind of - an approaching EV 3. Meanwhile, the rearmost second ADS-equipped vehicle 2 may, following instructions, reduce its speed with the intention to create a sufficient gap - e.g. time gap - in front, to provide the opportunity for road user(s) 6 in the left lane to maneuver and/or merge into said gap. As a last step, the foremost first ADS-equipped vehicle 2 may move laterally back into e.g. the center of the right lane, following which the preferred passage - here the left lane - accordingly may be cleared for the approaching EV 3.

[0032] In Fig. 6c, an exemplifying traffic scenario is depicted in which the set of ADS-equipped vehicles 2 - here comprising a first ADS-equipped vehicle 2 traveling in the right lane and a longitudinally separated second ADS-equipped vehicle 2 also traveling in the right lane - and seven other road users 6 are traveling along a road with two lanes of the same direction, where - taking into consideration the surrounding and/or situational conditions - lane changing into the right lane is considered the best and/or favourable choice to enable a preferred EV passage in the left lane. According to this scenario, following instructions, both the foremost first ADS-equipped vehicle 2 and the rearmost second ADS-equipped vehicle 2 may move laterally toward the lane markers separating the two lanes, and further reduce vehicle speed with the intention to create sufficient gaps - e.g. time gaps - in front, to provide the opportunity for road user 6 in the left lane to maneuver and/or merge into said gaps. Additionally, for instance with a separate and/or differing timing, the foremost first ADS-equipped vehicle 2 and/or the rearmost second ADS-equipped vehicle 2 may, following instructions, prompt clearance instructions, for instance represented by a back window projected image indicating - and/or informing road users 6 behind of - an approaching EV 3. The preferred passage - here the left lane - may then accordingly be cleared for the approaching EV 3.

[0033] In Fig. 6d, an exemplifying traffic scenario is depicted in which the set of ADS-equipped vehicles 2 - here comprising a first ADS-equipped vehicle 2 traveling in the right lane and a longitudinally separated second ADS-equipped vehicle 2 traveling in the left lane - and three other road users 6 are traveling along a road with two lanes of the same direction, where - e.g. taking into consideration the surrounding and/or situational conditions - lane changing into the right lane is considered the best and/or favourable choice to enable a preferred EV passage in the left lane. According to this scenario, following instructions, the foremost first ADS-equipped vehicle 2 in the right lane may move laterally toward the lane markers separating the two lanes, and further reduce its speed with the intention to create a sufficient gap - e.g. time gap - in front, to provide the opportunity for road user(s) 6 in

the left lane to maneuver and/or merge into said gap. Meanwhile, the rearmost second ADS-equipped vehicle 2 in the left lane may remain at its speed and move laterally toward the lane markers separating the two lanes. Additionally, for instance with a separate and/or differing timing, the rearmost second ADS-equipped vehicle 2 in the left lane and/or the foremost first ADS-equipped vehicle 2 in the right lane may, following instructions, prompt clearance instructions, for instance represented by a back window projected image indicating - and/or informing road users 6 behind of - an approaching EV 3. After a while, the set of ADS-equipped vehicles 2 may reach the configuration of exemplifying Fig. 6a, whereupon the scenario described in conjunction therewith may play out.

[0034] As another example, with reference to Fig. 8, instructions to ADS-equipped vehicle(s) (not shown) covering the exemplifying continuous dynamic zone to the right in Fig. 8 - which zone currently is not positioned but further on is predicted to be positioned along the EV's 3 planned route - may for instance comprise said ADS-equipped vehicle(s) being instructed to act such that potential road users (not shown) in said dynamic zone are influenced to stop before merging into the road of the EV's 3 planned route.

[0035] It may be noted that although the exemplifying traffic scenarios of Figs. 3-8 described above relate to right-hand side traffic, the concept introduced herein is by no means restricted thereto but may naturally also support and/or be adapted to left-hand side traffic.

Optionally, and as illustrated in an exemplifying manner in exemplifying Fig. 1, the EV passage planning system 1 may further - e.g. by means of an optional **subsequent sensor data obtaining unit 105** - be adapted and/or configured for obtaining subsequent sensor data of surroundings comprising the dynamic zone with support from one or more surrounding detecting sensors 22, 5. Moreover, the EV passage planning system 1 may then further - e.g. by means of an optional **status determining unit 106** - be adapted and/or configured for determining from assessing the subsequent sensor data, status of clearance of the preferred passage. Thereby, there may be established from evaluating the - e.g continuously and/or intermittently - derived updated sensor data, whether- and/or to what extent - the preferred passage is and/or has been cleared from traffic, for instance whether - and/or to what extent - the preferred passage is drivable and/or non-drivable by the approaching EV 3. Similar to the discussion around sensor data above, the subsequent sensor data - which may be of any format and/or magnitude - may be and/or have been captured and/or gathered in any feasible - e.g. known - manner with support from surrounding detecting sensors 22, 5, potentially with additional support from - and/or processing, assessment and/or perception by - perception system(s) as commonly known.. Furthermore, similarly, contribution of subsequent sensor data from respective ADS-equipped vehicle 2 of the set, may vary, such as with the situation at hand e.g. constellation of ADS-equipped vehicles 2 in the set, their respective pose, respective sensor field of view, etc. Moreover, similarly, respective captured subsequent sensor data may be obtained in any feasible - e.g. known - manner, such as being conveyed, communicated and/or transmitted, for instance to the optional centralized entity 4 and/or the optional master ADS-equipped vehicle 2. The phrase "obtaining subsequent sensor data" may refer to "retrieving and/or deriving subsequent sensor data", "obtaining respective subsequent sensor data", "obtaining subsequent said instructing, subsequent sensor data" and/or "obtaining from one or more of the set of ADS-equipped vehicles, subsequent sensor data", and according to an example further to "obtaining, from one or more of the set of ADS-equipped vehicles and potentially further from one or more static arrangements, subsequent sensor data". The phrase "subsequent sensor data", on the other hand, may refer to "updated sensor data". Moreover, "subsequent sensor data of surroundings comprising said dynamic zone" may refer to "subsequent sensor data of surroundings comprising at least a portion of said dynamic zone", and according to an example further to "subsequent sensor data of vehicle surroundings comprising said dynamic zone". According to an example, "with support from one or more surrounding detecting sensors" may refer to "with support from at least a first of said one or more surrounding detecting sensors".

[0036] Furthermore, and as illustrated in an exemplifying manner in exemplifying Fig. 1, the EV passage planning system 1 may further - e.g. by means of an optional **subsequent schema instructing unit 107** - be adapted and/or configured for instructing, when the clearance status reveals that the preferred passage after a predeterminable period of time is not cleared to a predeterminable extent, the set of ADS-equipped vehicles 2 to act according to a subsequent schema. Thereby, should clearance of the preferred passage after some time not reach a desired level and/or degree, then adapted and/or modified actions for the set of ADS-equipped vehicles 2 may follow, such as e.g. alternative, more intense and/or escalated maneuvering and/or prompting of instructions. The subsequent schema according to which the set of ADS-equipped vehicles 2 may be instructed to act, may comprise any feasible subsequent actions in an escalated manner influencing road users 6 in the dynamic zone to maneuver such that the determined preferred passage is cleared in time for arrival of the EV 3. Respective ADS-equipped vehicle-related subsequent action(s) of the subsequent schema - which subsequent actions thus may differ from one ADS-equipped vehicle 2 to another should there be at least two ADS-equipped vehicles 2 in the set - may accordingly relate to adapted and/or modified maneuvering of one or more of the ADS-equipped vehicle 2 and potentially further to one or more of the ADS-equipped vehicles 2 prompting adapted and/or modified instructions. The phrase "to act according to a subsequent schema" may refer to "to take action and/or behave according to a subsequent schema", "to maneu-

ver and/or prompt instructions according to a subsequent schema", "to act based on and/or following a subsequent schema" and/or "to act in a manner", whereas "subsequent schema" may refer to "alternative, modified, adapted, escalated and/or intensified schema". Moreover, "when the clearance status reveal" may refer to "when said status reveals", "when the clearing status reveals", "when the clearance status indicates" and/or "should and/or if the clearance status reveal", whereas "after a predeterminable period of time" may refer to "after a predeterminable period of time and/or at a predeterminable point in time". The phrase "is not cleared to a predeterminable extent", on the other hand, may refer to "is not opened up and/or cleared from traffic to a predeterminable extent" and/or "does not fulfill clearing criteria stipulating under what conditions a preferred passage is deemed cleared".

[0037] Furthermore, and as illustrated in an exemplifying manner in exemplifying Fig. 1, the EV passage planning system 1 may further - e.g. by means of an optional **status data communicating unit 108** - be adapted and/or configured for communicating data indicating the clearance status. Thereby, relevant and/or interested parties - such as e.g. the approaching EV 3 - may be informed, for instance via inter-vehicle communication, V2V/V2I/V2X communication, swarm service(s) and/or cloud service(s) etc., of whether- and/or to what extent - the preferred passage is and/or has been cleared from traffic, for instance whether - and/or to what extent - the preferred passage is drivable and/or non-drivable by the approaching EV 3, and/or merely whether or not there is free passage past the dynamic zone. The phrase "communicating data" may refer to "providing, sharing and/or transmitting data" and/or "communicating wirelessly data", whereas "data indicating the clearance status" may refer to "data indicative of and/or revealing the clearance status" and/or "data indicating said status".

[0038] Furthermore, and as illustrated in an exemplifying manner in exemplifying Fig. 1, the EV passage planning system 1 may further - e.g. by means of an optional **post passage communicating unit 109** - be adapted and/or configured for communicating, when there is determined from assessment of the subsequent sensor data that the EV 3 has passed the dynamic zone, data indicative thereof. Thereby, following evaluation of updated sensor data - e.g. by the optional centralized entity 4 and/or master ADS-equipped vehicle 2 - should there be established that the EV 3 has left the dynamic zone, then there may be provided - for instance via inter-vehicle communication, V2V/V2I/V2X communication, swarm service(s) and/or cloud service(s) etc. - to relevant and/or interested parties - such as e.g. vehicles further ahead along the EV's 3 planned route and/or e.g. a central server and/or service associate with such vehicles - information indicative of that the EV 3 has passed the dynamic zone, for instance that clearance of the preferred passage has ceased to be required. The phrase "communicating when there is determined" may refer to "providing, sharing and/or transmitting when there is determined", communicating wirelessly when there is determined" and/or communicating provided and/or if there is determined", whereas "data indicative thereof" may refer to "data indicating that clearance of said preferred passage has ceased to be required".

[0039] As further shown in Fig. 1, the EV passage planning system 1 comprises an EV approach determining unit 101, a sensor data obtaining unit 102, an EV passage determining unit 103, a schema instructing unit 104, an optional subsequent data obtaining unit 105, an optional status determining unit 106, an optional subsequent schema instructing unit 107, an optional status data communication unit 108 and an optional post passage communicating unit 109, all of which already have been described in greater detail above. Furthermore, the embodiments herein for supporting free passage past road users for an approaching EV, may be implemented through one or more processors, such as a processor 110, for instance represented by at least a first Central Processing Unit, CPU, at least a first Graphics Processing Unit, GPU, at least a first Tensor Processing Unit, TPU, and/or at least a first Field-Programmable Gate Array, FPGA, together with computer program code for performing the functions and actions of the embodiments herein. Said program code may also be provided as a computer program product, for instance in the form of a data carrier carrying computer program code for performing the embodiments herein when being loaded into the EV passage planning system 1. One such carrier may be in the form of a CD/DVD ROM disc and/or a hard drive, it is however feasible with other data carriers. The computer program code may furthermore be provided as pure program code on a server and downloaded to the EV passage planning system 1. The EV passage planning system 1 may further comprise a **memory 111** comprising one or more memory units. The memory 111 optionally includes high-speed random access memory, such as DRAM, SRAM, DDR RAM, or other random access solid-state memory devices, and further optionally includes non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid-state storage devices. Moreover, the memory 111 may be arranged to be used to store e.g. information, and further to store data, configurations, scheduling, and applications, to perform the methods herein when being executed in the EV passage planning system 1. For instance, the computer program code may be implemented in the firmware, stored in FLASH memory 111, of an embedded processor 110, and/or downloaded wirelessly e.g. from an off-board server. Furthermore, units 101-109, the optional processor 110 and/or the optional memory 111, may at least partly be comprised in one or more **nodes 112** e.g. ECUs of at least a first ADS-equipped vehicle 2 - such as an ADS-equipped vehicle 2 having the role of a master in a master/slave set-up - e.g. in and/or in association with the ADS 21, and/or in a centralized entity 4, such as

e.g. at least a first cloud and/or cloud server. It should thus be understood that parts of the described solution may be implemented in a system located external the set of ADS-equipped vehicles 2, or in a combination of internal and external the set of ADS-equipped vehicles 2, for instance in one or more servers in communication with the set of ADS-equipped vehicles 2, e.g. in a so called cloud solution. Those skilled in the art will also appreciate that said units 101-109 described above as well as any other unit, interface, system, controller, module, device, element, feature, or the like described herein may refer to, comprise, include, and/or be implemented in or by a combination of analog and digital circuits, and/or one or more processors configured with software and/or firmware, e.g. stored in a memory such as the memory 111, that when executed by the one or more processors such as the processor 110 perform as described herein. One or more of these processors, as well as the other digital hardware, may be included in a single Application-Specific Integrated Circuitry, ASIC, or several processors and various digital hardware may be distributed among several separate components, whether individually packaged or assembled into a System-on-a-Chip, SoC.

[0040] **Fig. 2** is a flowchart depicting an exemplifying method performed by an AD passage planning system 1 according to embodiments of the disclosure. Said method is for supporting free passage past road users for an approaching EV. The exemplifying method, which may be continuously repeated, comprises one or more of the following actions discussed with support from Figs. 1 and 3-8. Moreover, the actions may be taken in any suitable order and/or one or more actions may be performed simultaneously and/or in alternate order where applicable. For instance, Actions 1001 and 1002 may be performed in alternate order and/or simultaneously.

Action 1001

[0041] In Action 1001, the EV passage planning system 1 determines - e.g. with support from the EV approach determining unit 101 - that an EV 3 along its planned route is approaching a set of vehicles respectively equipped with an ADS 21, wherein the set of vehicles 2 has a field of view combined covering a continuous dynamic zone along the route.

Action 1002

[0042] In Action 1002, the EV passage planning system 1 obtains - e.g. with support from the sensor data obtaining unit 102 - sensor data of surroundings comprising the dynamic zone captured with support from one or more surrounding detecting sensors 22,

Action 1003

[0043] In Action 1003, the EV passage planning system 1 determines - e.g. with support from the EV passage determining unit 103 - based on surrounding and/or situational conditions in the dynamic zone derived from evaluating the sensor data, a preferred passage for the EV 3 through the dynamic zone, deemed having potential to be cleared from all traffic.

Action 1004

[0044] In Action 1004, the EV passage planning system 1 instructs - e.g. with support from the schema instructing unit 104 - the set of ADS-equipped vehicles 2 to act according to a schema influencing road users 6 in the dynamic zone to maneuver such that the preferred passage is cleared in time for arrival of the EV 3.

[0045] Optionally, the set of ADS-equipped vehicles 2 may comprise at least two ADS-equipped vehicles. Action 1004 of instructing the set of ADS-equipped vehicles 2 may then comprise - and/or the schema instructing unit 105 may then be adapted and/or configured for - instructing the ADS-equipped vehicles 2 to act according to a schema where the ADS-equipped vehicles collaborate in a manner influencing road users in the dynamic zone to maneuver such that the preferred passage is cleared in time for arrival of the EV 3.

Action 1005

[0046] In optional Action 1005, the EV passage planning system 1 may obtain - e.g. with support from the optional subsequent sensor data obtaining unit 106 - subsequent sensor data of surroundings comprising the dynamic zone with support from the one or more surrounding detecting sensors 22.

Action 1006

[0047] In optional Action 1006, which may follow upon optional Action 1005, the EV passage planning system 1 may determine - e.g. with support from the optional status determining unit 106 - from assessing the subsequent sensor data, status of clearance of the preferred passage.

Action 1007

[0048] In optional Action 1007, which may follow upon optional Action 1006, the EV passage planning system 1 may instruct - e.g. with support from the optional subsequent schema instructing unit 107 - when the clearance status reveals that the preferred passage after a predeterminable period of time is not cleared to a predeterminable extent, the set of ADS-equipped vehicles 2 to act according to a subsequent schema.

Action 1008

[0049] In optional Action 1008, which may follow upon optional Actions 1006 or 1007, the EV passage planning

system 1 may communicate - e.g. with support from the optional status data communicating unit 108 - data indicating the clearance status.

Action 1009

[0050] In optional Action 1009, which may follow upon either of optional Actions 1006-1008, the EV passage planning system 1 may communicate - e.g. with support from the optional post passage communicating unit 109 - when there is determined from assessment of the subsequent sensor data that the EV 3 has passed the dynamic zone, data indicative thereof.

[0051] The person skilled in the art realizes that the present disclosure by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the scope of the appended claims. It should furthermore be noted that the drawings not necessarily are to scale and the dimensions of certain features may have been exaggerated for the sake of clarity. Emphasis is instead placed upon illustrating the principle of the embodiments herein. Additionally, in the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

Claims

1. A method performed by an EV passage planning system (1) for supporting free passage past road users for an approaching emergency vehicle, EV, said method comprising:

   determining (1001) that an EV (3) along its planned route is approaching a set of vehicles (2) respectively equipped with an Automated Driving System, ADS (21), said set of vehicles (2) having a field of view combined covering a continuous dynamic zone along said route;
   obtaining (1002) sensor data of surroundings comprising said dynamic zone captured with support from one or more surrounding detecting sensors (22);
   determining (1003) based on surrounding and/or situational conditions in said dynamic zone derived from evaluating said sensor data, a preferred passage for said EV (3) through said dynamic zone deemed having potential to be cleared from all traffic; and
   instructing (1004) said set of ADS-equipped vehicles (2) to act according to a schema influencing road users (6) in said dynamic zone to maneuver such that said preferred passage is cleared in time for arrival of the EV (3).

2. The method according to claim 1, wherein said set of ADS-equipped vehicles (2) comprises at least two ADS-equipped vehicles (2), said ***instructing*** (1004) the set of ADS-equipped vehicles (2) comprising instructing said ADS-equipped vehicles (2) to act according to a schema where said ADS-equipped vehicles (2) collaborate in a manner influencing road users (6) in said dynamic zone to maneuver such that said preferred passage is cleared in time for arrival of the EV (3).

3. The method according to claim 1 or 2, further comprising:

   obtaining (1005) subsequent sensor data of surroundings comprising said dynamic zone with support from one or more surrounding detecting sensors (22); and
   determining (1006), from assessing said subsequent sensor data, status of clearance of said preferred passage.

4. The method according to claim 3, further comprising:
   Instructing (1007), when the clearance status reveals that said preferred passage after a predeterminable period of time is not cleared to a predeterminable extent, said set of ADS-equipped vehicles (2) to act according to a subsequent schema.

5. The method according to claim 3 or 4, further comprising:
   communicating (1008) data indicating the clearance status.

6. The method according to any one of claims 3-5, further comprising:
   communicating (1009) when there is determined from assessment of said subsequent sensor data that the EV (3) has passed the dynamic zone, data indicative thereof.

7. An **EV passage planning system** (1) for supporting free passage past road users for an approaching emergency vehicle, EV, said EV passage planning system (1) comprising:

   an **EV approach determining unit** (101) for ***determining*** (1001) that an EV (3) along its planned route is approaching a set of vehicles (2) respectively equipped with an Automated Driving System, ADS (21), said set of vehicles (2) having a field of view combined covering a continuous dynamic zone along said route;
   a **sensor data obtaining unit** (102) for ***obtaining*** (1002) sensor data of surroundings comprising said dynamic zone captured with support from one or more surrounding detecting sensors (22);
   an **AD passage determining unit** (103) for ***determining*** (1003) based on surrounding and/or

situational conditions in said dynamic zone derived from evaluating said sensor data, a preferred passage for said EV (3) through said dynamic zone deemed having potential to be cleared from all traffic; and
a schema instructing unit (104) for ***instructing*** (1004) said set of ADS-equipped vehicles (2) to act according to a schema influencing road users (6) in said dynamic zone to maneuver such that said preferred passage is cleared in time for arrival of the EV (3).

8. The EV passage planning system (1) according to claim 7, wherein said set of ADS-equipped vehicles (2) comprises at least two ADS-equipped vehicles (2), said schema instructing unit (104) being adapted for instructing said ADS-equipped vehicles (2) to act according to a schema where said ADS-equipped vehicles (2) collaborate in a manner influencing road users (6) in said dynamic zone to maneuver such that said preferred passage is cleared in time for arrival of the EV (3).

9. The EV passage planning system (1) according to claim 7 or 8, further comprising:

a **subsequent sensor data obtaining unit** (105) for ***obtaining*** (1005) subsequent sensor data of surroundings comprising said dynamic zone with support from one or more surrounding detecting sensors (22); and
a **status determining unit** (106) for ***determining*** (1006), from assessing said subsequent sensor data, status of clearance of said preferred passage.

10. The EV passage planning system (1) according to claim 9, further comprising:
a **subsequent schema instructing unit** (107) for ***Instructing*** (1007), when the clearance status reveals that said preferred passage after a predeterminable period of time is not cleared to a predeterminable extent, said set of ADS-equipped vehicles (2) to act according to a subsequent schema.

11. The EV passage planning system (1) according to claim 9 or 10, further comprising:
a **status data communicating unit** (108) for ***communicating*** (1008) data indicating the clearance status.

12. The EV passage planning system (1) according to any one of claims 9-11, further comprising:
a **post passage communicating unit** (109) for ***communicating*** (1009) when there is determined from assessment of said subsequent sensor data that the EV (3) has passed the dynamic zone, data indicative thereof.

13. An arrangement, for instance at least a first ADS-equipped **vehicle** (2) and/or a **centralized entity** (4) such as at least a first cloud and/or cloud server, comprising an EV passage planning system (1) according to any one of claims 7-12.

14. A computer program product comprising a computer program containing computer program code means arranged to cause a computer or a processor to execute the steps of a method according to any of claims 1-6, stored on a computer-readable medium or a carrier wave.

15. A non-volatile computer readable storage medium having stored thereon the computer program product of claim 14.

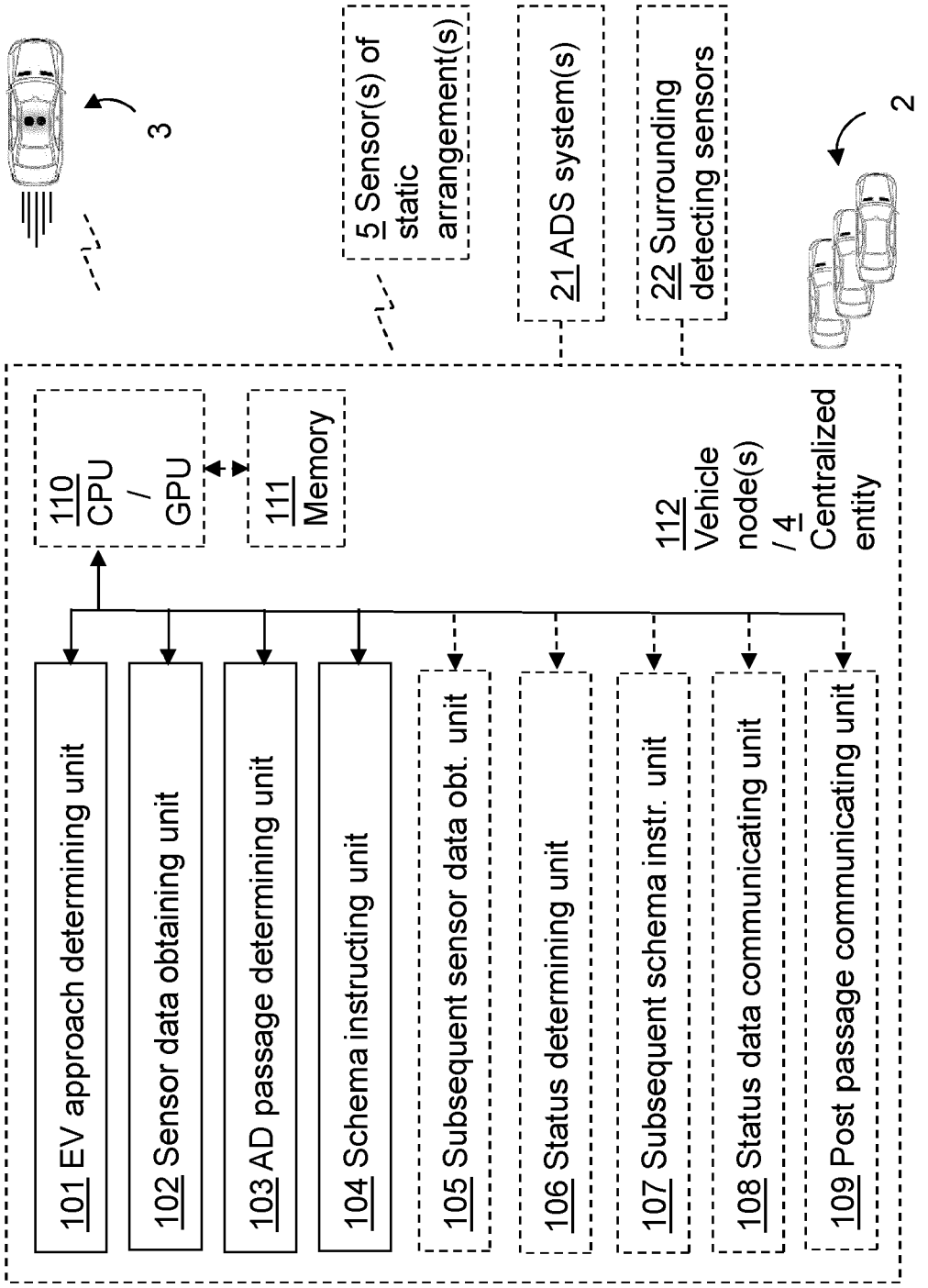

3
5 Sensor(s) of static arrangement(s)
21 ADS system(s)
22 Surrounding detecting sensors
2
110 CPU / GPU
111 Memory
112 Vehicle node(s) / 4 Centralized entity
101 EV approach determining unit
102 Sensor data obtaining unit
103 AD passage determining unit
104 Schema instructing unit
105 Subsequent sensor data obt. unit
106 Status determining unit
107 Subsequent schema instr. unit
108 Status data communicating unit
109 Post passage communicating unit
1 EV passage planning system

Fig. 1

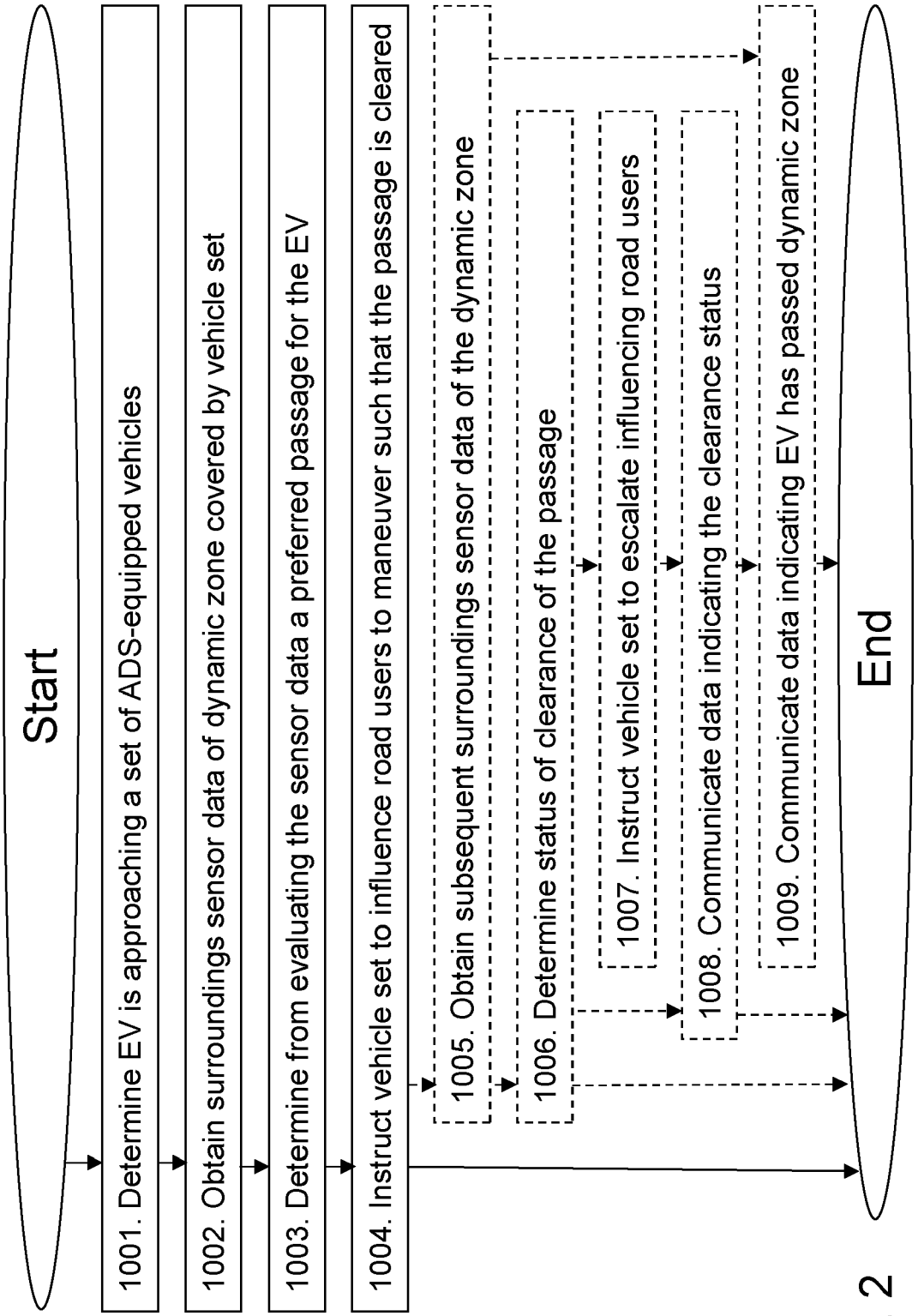

Start
1001. Determine EV is approaching a set of ADS-equipped vehicles
1002. Obtain surroundings sensor data of dynamic zone covered by vehicle set
1003. Determine from evaluating the sensor data a preferred passage for the EV
1004. Instruct vehicle set to influence road users to maneuver such that the passage is cleared
1005. Obtain subsequent surroundings sensor data of the dynamic zone
1006. Determine status of clearance of the passage
1007. Instruct vehicle set to escalate influencing road users
1008. Communicate data indicating the clearance status
1009. Communicate data indicating EV has passed dynamic zone
End

Fig. 2

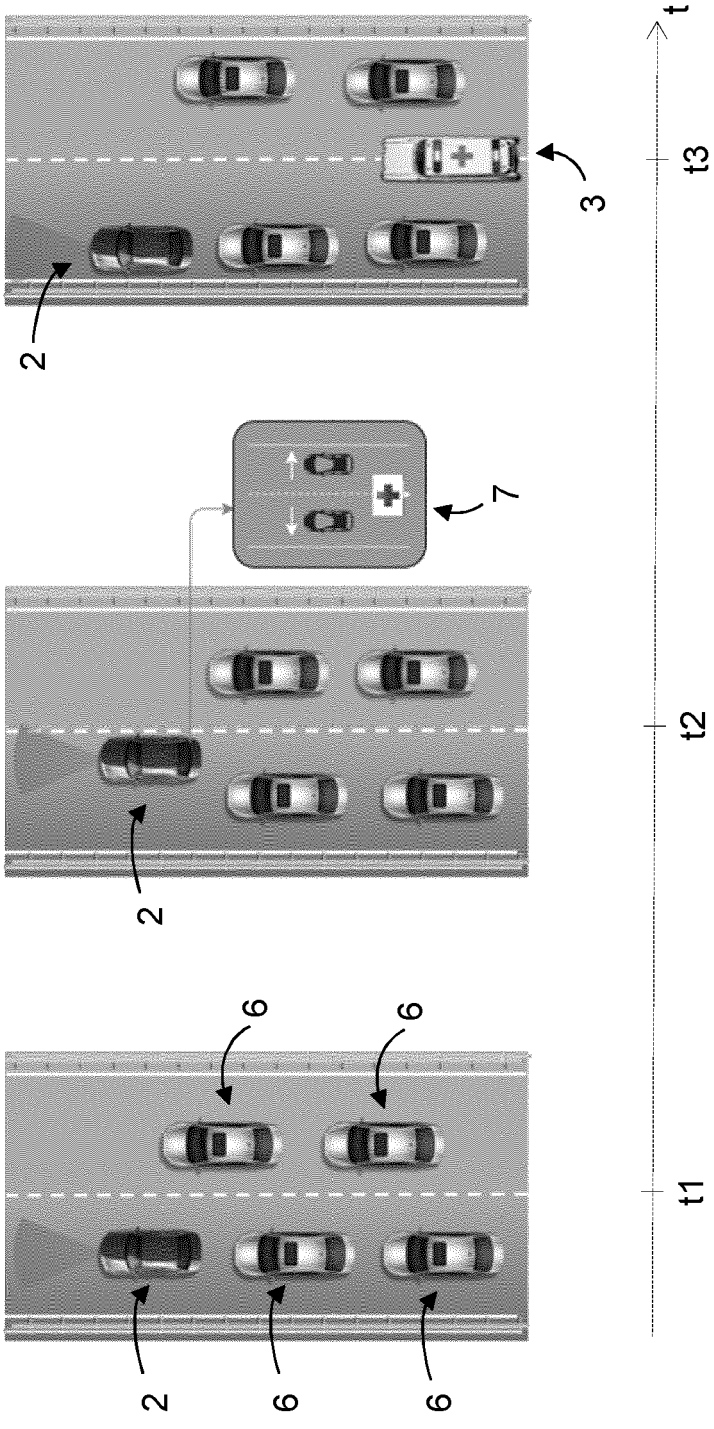


Fig. 3

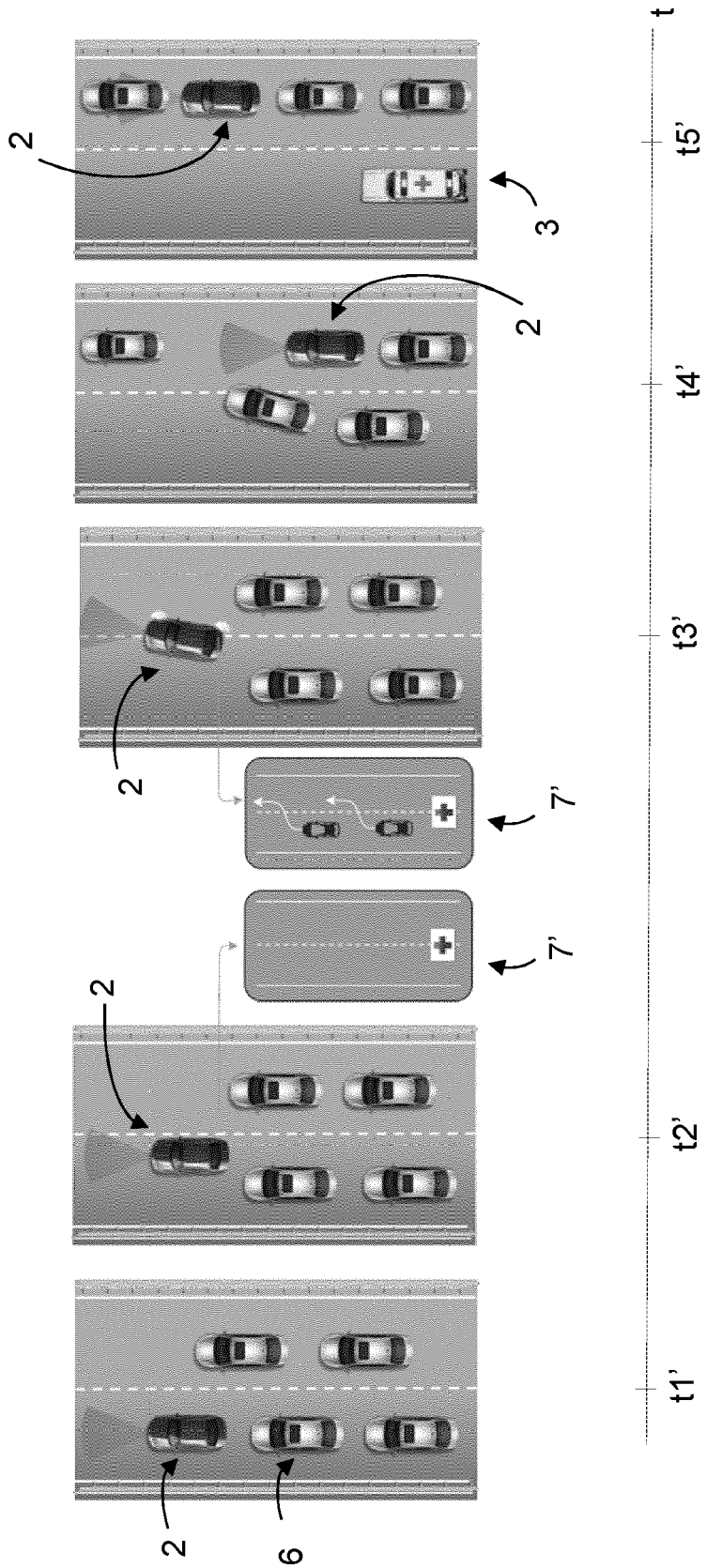
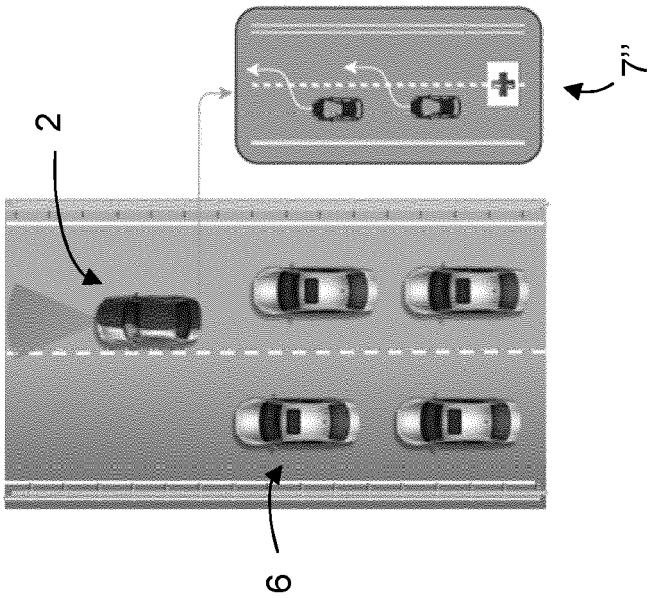


Fig. 4



1 EV passage planning system

Fig. 5

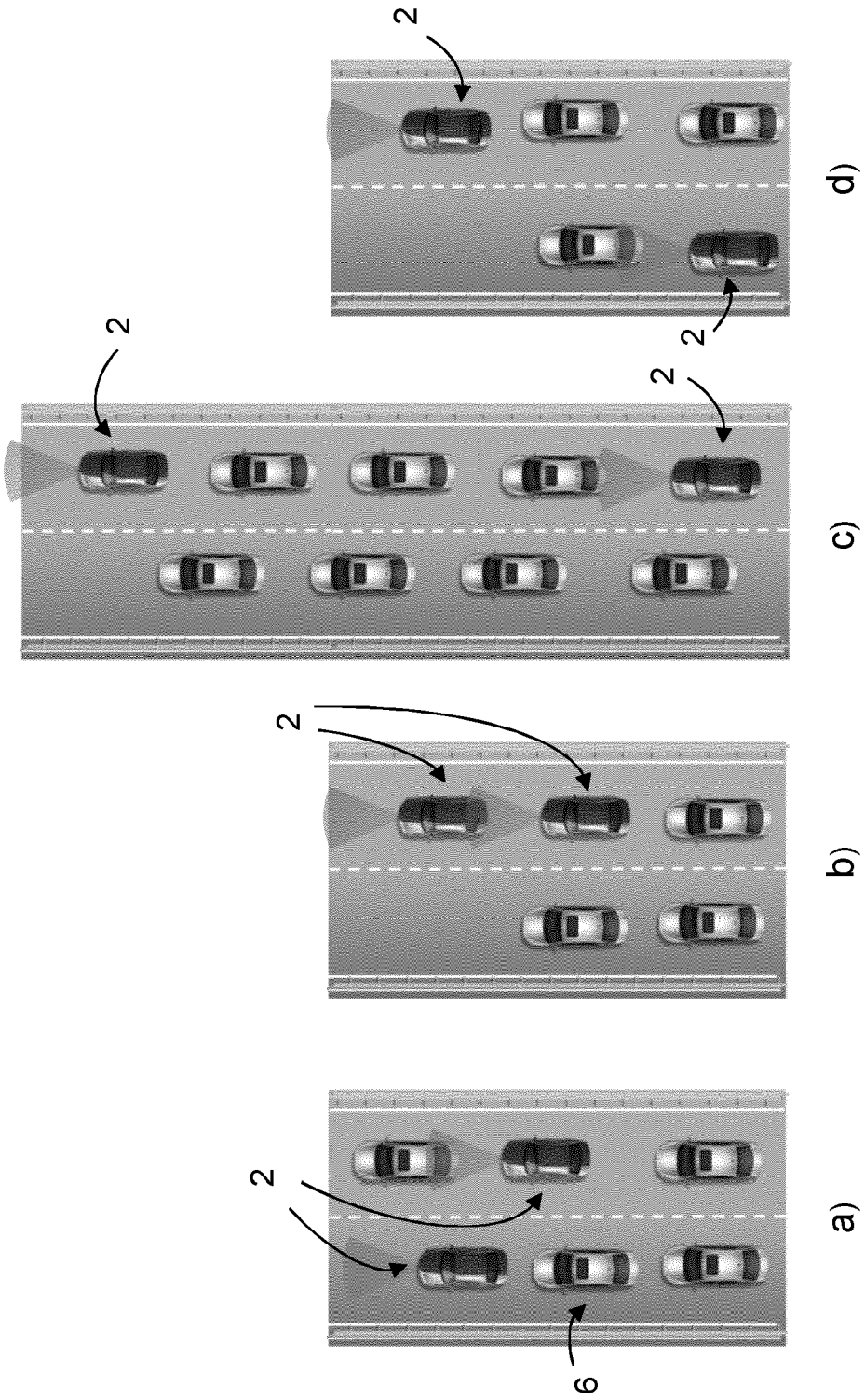


Fig. 6

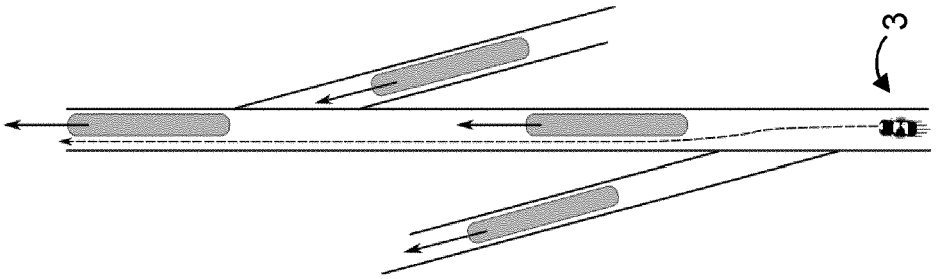


Fig. 8

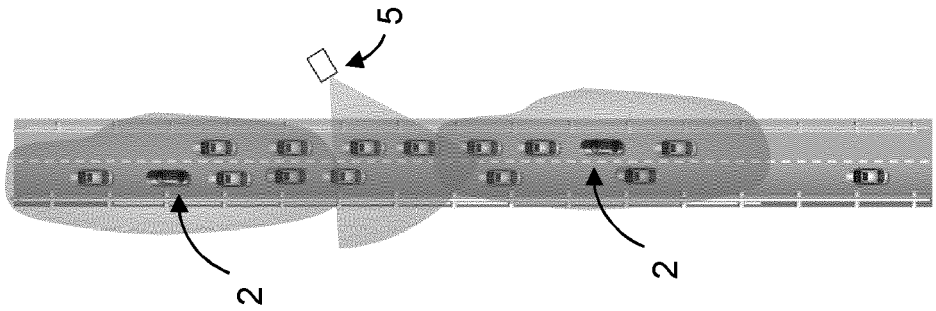


Fig. 7b

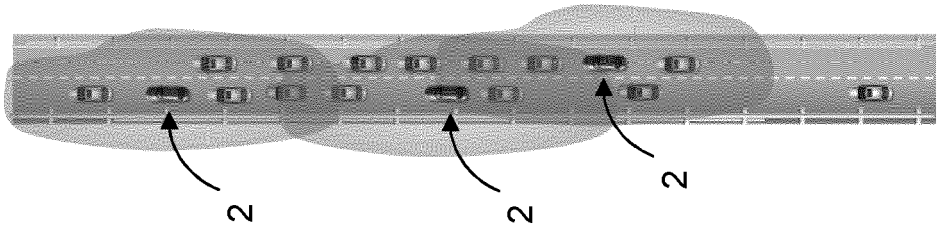


Fig. 7a

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 3558

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 November 2022	Lamelas Polo, Yvan

CATEGORY OF CITED DOCUMENTS

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03-11-2022

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