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PRINCIPLES AND TYPES OF CARS FOR BUILDING A SEMI-UNMANNED TRANSPORTATION NETWORK

Annotation. It is impossible to create a transport network built exclusively on self-driving cars at the present stage of development of science and technology; therefore, this article developed principles for creating a transport network that combines unmanned movement and movement under the control of a driver, and also describes four main types of vehicles for such a semi-unmanned transport network: a semi-unmanned truck, a semi-unmanned bus, a semi-unmanned passenger car and an urban passenger unmanned vehicle.

Keywords: car, road transport, self-driving cars, road infrastructure, intelligent transportation system, drone

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Part 1. Initial reasoning

Contemporary state of affairs

In the late 2010s, the development of computer technology led to the fact that experiments began to be carried out in different countries to create fully autonomous vehicles. According to the plans of the developers, such cars will move without human intervention and be controlled by a computer that receives information, in particular, from radars, lasers and cameras. By the beginning of the 2020s, samples of this kind of machines were created, which began to be tested.

The existing wrong principle for building an unmanned transport network

Currently, the principle is implicitly adopted that it is possible to create an unmanned vehicle moving on public roads.

In my opinion, this principle is wrong. A clear illustration demonstrating the fallacy of this principle is an airplane:

1. Civil airliners are controlled by pilots who periodically turn the autopilot on or off.

2. Combat aircraft are controlled by military pilots.

3. Unmanned flying drones are controlled by ground operators.

As you can see, even in the air, where there is no such active rapidly changing movement as on highways, with the modern level of technicians development, it turns out to be impossible to create a completely unmanned airplane.

Semi-unmanned movement

Definition. Semi-unmanned movement is such movement of a vehicle, during which the car either moves under the control of the driver, then moves without the control of the driver.

For a more accurate understanding of the definition of semi-unmanned movement, you should clarify:

1. The movement of the car, remotely controlled by the operator, should be equated to the movement of the car under the direct control of the driver.

2. Movement of a car without driver control or unmanned movement is an solo movement of a car that is not directly controlled by the driver.

Part 2. Four principles for building a semi-unmanned transport network

Principle № 1. About the impossibility of organizing car traffic without drivers.

Car traffic without drivers on all roads, in any weather and with all possible traffic conditions is impossible to organize.

Principle № 2. On the limited ability to organize the movement of cars without drivers.

There are road sections on which, in conditions of acceptable traffic conditions, it is possible to organize the movement of cars without the participation of drivers.

Remark 1.

Cars moving without drivers control must have built-in limits on the maximum speed of unmanned movement.

Principle № 3. About driving a car on various sections of the road.

A car driven by a driver can move on sections of roads that are allowed for unmanned driving; but a car moving without a driver's control is not allowed to move on roads on which cars are allowed to move exclusively under the control of drivers.

Principle № 4. About difficult road situations.

In the event of a traffic situation that is not provided for by the program controlled by unmanned traffic, the car moving in unmanned mode must immediately stop moving. Further movement of such a car is possible only under the control of the driver. If, within a given period of time, the driver does not take control in the current traffic situation, then the car moving in unmanned mode must independently stop moving and stand on the side of the road or at the edge of the road.

Principle № 4 describes the behavior of an unmanned car in difficult conditions, when the life and health of people and other living beings, as well as the safety of material values, depend on the result of the choice. These kinds of questions are ethical.

Remark 2. Program controlling by a car for movement in unmanned mode has no right to decide ethical objectives. Only a person has the right to solve ethical problems, and only he can be responsible for the result of solving such problems. An unmanned car in this interpretation turns out to be an analogue of a conventional industrial robot, as a result of which the problem of creating artificial intelligence for controlling an unmanned car.

Five consequences follow from these four principles.

Consequence № 1.
On all roads, in any weather and with all possible road conditions, it is possible to organize semi-unmanned car movement.

Consequence № 2.
In the event of a change in the weather or traffic situation in an unfavorable side on the traffic area where the movement of motor vehicles without the control of drivers is allowed, it is necessary to temporarily prohibit the unmanned movement of cars, allowing only the movement of cars under the control of drivers.

Consequence № 3.
Traffic safety services must use permanent and temporary road signs that prohibit or permit unmanned vehicle movement on this section of the road.

Consequence № 4.
If the driver does not take control of a car driving in an unmanned mode at the moment of entering a road on which cars are allowed to move exclusively under the control of drivers, then such a car must independently stop driving and stand on the side of the road or at the edge of the road.

Remark 3. To quickly switch the car from the driving mode under driver control and unmanned mode, and vice versa, a person should be in the driver's seat all the time: in unmanned mode, such a person is a passenger, and in a driver-controlled mode, such a person becomes a driver.

Remark 4. Traffic safety services should organize the transition of the car from the unmanned driving mode to the driver-controlled mode and vice versa so that the person has enough time to switch his car from one driving mode to another.

Consequence № 5.
A car moving in unmanned mode must demonstrate this fact to the surrounding road users.

Part 3. Four types of cars for trip in a semi-unmanned transport network

In accordance with consequence 1, the existing transport network, designed for the movement of cars driven by drivers, can be converted into a **semi-unmanned transport network**. For such a network, four main types of civilian cars can be distinguished (military and special vehicles moving on public roads are not included in these four types, since these types of transport are specific).

Type № 1. The truck is semi-unmanned.

This is a truck that is driven by a driver, and this vehicle can move in an unmanned mode.

In the city, in difficult weather or road conditions, this truck must be driven by a driver; on intercity routes, in acceptable traffic conditions, this truck can drive in an unmanned mode.

Type № 2. The bus is semi-unmanned.

This is a large multi-seat passenger car that is driven by a driver, and this car can move in an unmanned mode.

In the city, in difficult weather or road conditions, this bus must be driven by a driver; on intercity routes in acceptable traffic conditions, this bus can go unmanned.

Type № 3. Semi-unmanned passenger car.

This is a passenger car that is controlled by a driver, while this car can move in an unmanned mode.

In the city, in difficult weather or road conditions, this car must be driven by a driver; on intercity routes in acceptable traffic conditions, this car can go unmanned.

The simplified name of such a car can be as follows: passenger semi-pilot.

Remark 5. (Clarification of Remark 1). As can be seen from their descriptions, cars of types 1, 2 and 3 can move in unmanned mode exclusively outside settlements, that is, along trails. Trucks and buses carry more people and material values than passenger cars, so semi-unmanned trucks and buses should have stricter limits on the maximum permitted speed of unmanned traffic on the track than for semi-unmanned passenger cars.

Type № 4. Unmanned city passenger car.

This is a small passenger car, usually a two-seater (less often - the size of a larger semi-unmanned passenger car).

This type of vehicle is intended exclusively for movement within the city, it should be prohibited from driving outside this clearly delineated settlement. This prohibition should be entered into the car's electronic card.

This type of car can only move in unmanned mode; in addition, in accordance with Remark 1, the maximum speed of these vehicles should be limited.

If the city has difficult weather conditions, then these cars are not allowed to move. It is possible to prohibit the movement of such vehicles by issuing a specific command via radio communication by the service responsible for traffic safety. Similarly, these vehicles should be allowed to move after bad weather conditions improve.

This type of car is the main one as a taxi.

The simplified names for such a car can be as follows: a passenger unmanned vehicle, a passenger drone, an urban drone, unmanned aerial vehicle, or simply a drone.

Remark 6. A passenger unmanned vehicle is not allowed to move on a road on which the movement of vehicles not driven by drivers is prohibited; therefore, if a passenger unmanned vehicle receives a signal (from radar, through radio communication or otherwise) prohibiting further movement without driver control, then this passenger unmanned vehicle must bypass the road section closed for it in another way, along the roads allowed to it.

Remark 7. To avoid traffic jams and, therefore, for the convenience of the movement of passenger unmanned cars, traffic police should:

A.   To block not a small section of the road, but a section of the road from the intersection to the intersection (this will make it more convenient for passenger drones to turn around).

B.   To transmit data via radio waves to all passenger unmanned cars that a certain section of the road is closed for their movement (so city drones can change their routes in advance).

Remark 8. In the future, the city will move both cars under the control of drivers and without the control of drivers, therefore, traffic police should clearly distinguish between a complete ban for movement of all vehicles and a ban for movement only for cars moving without driver control.

Remark 9. Corollary 5 requires that a car moving in unmanned mode demonstrate this fact to surrounding road users. For passenger drones, the best way is to use a contrasting color that is unchanged and known to everyone. For the other three types of cars, the question remains - when should the light signals be on: when the car is driving in unmanned mode or when it is directly controlled by the driver.

The general picture of semi-unmanned movement

Trucks and buses are driven by professional drivers who manually drive their cars only in difficult conditions, so cargos and people will be successfully delivered, as now, to the most remote and inaccessible corners of the planet. An assistant for professional drivers is the autopilot, which on the highway, in an acceptable road situation, will be able to drive a large car in an unmanned mode, as a result of which a person will get less tired from driving, which means a decrease in the number of road accidents, as well as a decrease in the number of professional drivers.

The semi-unmanned passenger car transports people and small loads anywhere and anytime, and the autopilot allows lay drivers to take a break from driving on the track in acceptable road conditions.

A passenger unmanned car safely transports cargos and people around the city (from home to work and back, from home to a store and back, etc.), takes up little space on city streets and frees up a huge amount of time that would otherwise be spent by

people on direct control of yourself vehicles for boring and monotonous trips along the same city routes.

Conclusions:

1.   It is impossible to create a transport network built exclusively on unmanned cars at this stage of development of science and technology.

2.   Four principles have been developed for building a semi-unmanned transport network: about the impossibility of organizing car traffic without drivers, about the limited ability to organize the movement of cars without drivers, about driving by car on various road sections and about difficult road situations.

3.   Four types of cars for trip in conditions in a semi-unmanned transport network are described: a semi-unmanned truck, a semi-unmanned bus, a semi-unmanned passenger car and a city passenger unmanned car.

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