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**Development of Self-driving Cars**

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Currently, there is an era of high technologies and automation of almost all types of activities. Computers are performing a huge part of our work, both in everyday life and in the professional sphere. The development of traffic control and traffic flows without involving operators in the driving process, implies a new level of design and application of new developments.

What functions does a self-driving car have? It can perform a lot of things that are not available to conventional cars. First of all, it moves completely independently from point A to point B, and chooses the best route, taking into account not only the map data, but also information from the Internet about traffic jams. Secondly, it independently regulates the speed, brakes when cornering and accelerates on straight sections of the path. It also finds a free parking space and parks on its own. Thirdly, a self-driving car identify other vehicles, clearly "sees" through fog, snow and rain, notices road signs and traffic lights. The principle of operation of a self-driving car is carried out by constant scanning of the territory using sensors: lidars (laser radars), cameras, radars and high-precision maps – necessary conditions for autonomous vehicle movement. The self-driving car system interacts with the Street View service, which gives a panoramic view of the city streets from a height of 2.5 m [1].

The idea for the development appeared back in the 30s of the XX century, when the engineers of the General Motors

company came up with two brilliant ideas for that time. The first idea was that the cars were controlled by radio signals. So they were to control the distance on the track and avoid emergencies.

The second idea was more interesting - in order to organize self-driving trip, it was necessary to build special tracks in the form of skateboard ramps. Cars went in the middle, and if they start to lean to the side of the road, the force of gravity will returned them to their place. Although the ideas were met with skepticism, they provided a powerful rise for the development of technology in the right direction.

General motors Firebird II - the first car in the world with a cruise control system. Already in the 50s, General Motors technologists tested the "smart" car Firebird II, which, in addition to the new braking system, had magnetic sensors and interacted with the "smart" road (with an electric cable under the asphalt). Version 3 of this car was equipped with the first autopilot system known today as cruise control. This system was responsible for maintaining a constant speed and facilitated the driver's tasks on the road. But the autopilot was still a long way off. The year 1961 went down in self-driving history when Stanford student James Adams created and tested the first self-driving carriage. It was controlled by a conventional signal through a cable.

This experiment wasn't left unnoticed, and in the 1970s, the scientist J. McCarthy equipped it with a technological vision system. Now the cart could move independently and focus on the white line. And in the 70s, he tried to create three-dimensional mapping of the area.

Following McCarthy's successes, the efforts of engineers were thrown into creating a 100% autonomous vehicle without remote control. Scientists from the United States and Japan achieved significant success, but the real breakthrough was made by German researchers led by Ernst Dyckmans.

In fact, their development was a model of a machine mechanism, capable of adequately assessing the entire environment. On the basis of Dickmans' developments from 1987 to 1995, the project "Prometheus" was in operation, aimed at improving self-driving vehicles. More than $ 1 billion was invested in this project, making it the most expensive robotic car project in history. In 1994, the car "VAmP" Mercedes equipped with Dickmans technologies for several hours independently at a speed of up to 130 km/h moved along the streets of Paris, turned, overtook other cars and changed lanes from one lane to another.

Google's achievement was the ability of the car to set your own route, navigate the territory and respond to other road users, including pedestrians. In 2012, the company reported that its self-driving cars covered 480,000 km without a single accident. However, the participation of such vehicles in the general flow of traffic creates obstacles for other drivers (extremely cautious Google cars often collect the "tails" of traffic jams). Also, Google cars cannot move in bad weather conditions, they are also unable to recognize temporary traffic signals, they cannot distinguish police from ordinary pedestrians, etc. But the developers promise that these disadvantages will be removed.

Over the past 10 years, self-driving cars have developed at a tremendous rate. One example is the TOYOTA CONCEPT-I.

A distinctive feature of the car is the presence of an artificial intelligence system. The on-board computer has a built-in Yui agent, the main task of which is to create the most natural relationship between the car and the person. Concept-i can conduct a dialogue with a person using voice, light, and holograms. Yui can also output some words on the side doors. The Toyota Concept-i is a self-driving car, but the developer has kept the steering wheel and pedals for control. Interesting

car details: teardrop shape for improved drag, lifting doors like sports cars, the presence of an electric motor, which is enough for 300 km.

Constantly self-learning artificial intelligence Yui can adjust to the driver, change the climate, switch settings and recognize the emotional state of a person. Yui doesn't just study you and make your trip comfortable for your family, it can even anticipate your expectations - and, for example, offer you the right music at the right time.

And, as it turned out, this is not the limit in the development of self-driving cars. In 2020, Honda announced an autopilot that works in traffic jams [2].

This relatively minor news was one of the few bright spots for automakers. The Honda Legend will have a built-in "autopilot for traffic jams", which will allow you to be distracted while driving in heavy traffic. When you get out of it, you'll have to drive yourself again. While many companies promised to release similar systems, and then took their promises back, Honda is going to release a robotic car and the company is ready to take full responsibility for it. Given the fact that once existing self-driving cars seemed to us a fiction, and now they are available in multi-million cities, we should not exclude that this technology will become a reality in the coming years. Self-driving cars to this day do not cease to surprise people with new developments, which only confirms their promising future and rapid development.

References:
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