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DESIGN OF INTELLIGENT INTERFACE

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***Abstract*—*This work is devoted to the principles of building intelligent interfaces, which are a set of technologies and tools that allow for automated control of a vehicle, monitoring the state of the driver and passengers, as well as optimizing the route and travel planning. The need to develop interfaces that can exchange information with other vehicles and smart infrastructure has been identified. The paper classifies different types of interfaces and analyzes their composition. The structure of the intelligent interface is defined, which includes: sensors, processor, software, user interface, actuators. The analysis of existing intellectual interfaces is made. The list of stages of creating intelligent interfaces is given. It is shown that in the future, intelligent interfaces will be more personalized, interactive and adaptive, as well as provide safety and reduce driver distraction.*

Index Terms—Intelligent interface; vehicles; sensor; processor; software; passenger safety; route optimization.

I. INTRODUCTION

Technologies in the field of vehicles are developing rapidly, and intelligent interface technologies, artificial intelligence, and others are taking an increasing place in their management. The intelligent vehicle interface is a set of technologies and tools that allow for automated vehicle control, driver and passenger condition monitoring, passenger comfort and safety, as well as route optimization and travel planning [1] – [4].

An interface is a way of interaction between a user and a device, program or system. It can be an external or internal means of transmitting information and commands between the user and the system. That is, the interface is a set of tools and rules that ensure the interaction of computers, peripheral devices, input / output devices and / or computer programs. There are different types of interfaces, graphic, text, mixed hardware or software, but we will consider the intelligent interface as a combination of all types of interface and an artificial network that processes the received information and turns it into movements of the steering wheel and pressing the gas and brake pedals. So, what will our "Intelligent Interface" consist of ? First of all, it will include a hardware interface that will connect all the control elements of our car, sensors, cameras, etc. to artificial intelligence to process data for control. Next, the artificial intelligence itself, of course, will consist of a software interface, software, and a graphical interface that will show the user information from the dashboard, gps signal, and others. That is why our "Intelligent Interface" should be mixed and include all existing elements of interfaces, as well as a core for data processing and management.

The main purpose of the intelligent interface is to make interaction with the vehicle simpler, more convenient and safer for the user (Fig. 1). In particular, the intelligent interface can help the driver control various systems of the vehicle, such as the navigation system, climate control, audio system, security and others, which will allow.

However, the intelligent interface is not limited to the control of various vehicle systems. It can also provide users with access to information about road conditions, public transport schedules, weather conditions and more. In addition, the intelligent interface can be integrated with other devices and services, which allows users to receive a more complete and radically more extensive amount of information.

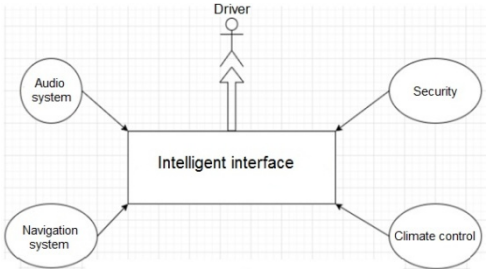

Fig. 1. Components and functionality of the video surveillance system

The intelligent interface is becoming more and more popular in modern transport systems and is of great importance for improving road safety, reducing the number of accidents, improving the environmental efficiency of transport, increasing the level of passenger comfort and reducing the burden on drivers.

In this article, we will consider the technologies used in the intelligent interface of the vehicle, the functions it performs, as well as the advantages and challenges of using such an interface.

II. Intelligent Interface and its Features

The structure of the intelligent interface of the vehicle includes various components that interact with each other [6], [7]. The main components of the system may include:

1) Sensors: Sensors are used to collect data about the environment and the state of the vehicle. Sensors can include cameras, radars, lidars, pressure sensors, fuel level sensors, and others.

2) Processor: The processor is responsible for processing data from sensors and interacting with other system components. It can be implemented as a microcontroller, FPGA or CPU.

3) Software (software): the intelligent interface is responsible for processing and analyzing data from sensors, interacting with the driver and passengers, making decisions about driving the vehicle.

4) User interface: The user interface allows the driver and passengers to interact with the system. It can be implemented in the form of a display, voice commands, gestures, touch sensors and other elements.

5) Actuators: Actuators are responsible for physically controlling the vehicle based on decisions made by the software. Actuators can include motors, brakes, steering, and others.

The successful functioning of a vehicle's intelligent interface depends on various factors, including:

1) Reliability requirements: the intelligent interface must be reliable enough to guarantee automatic control of the vehicle in all conditions.

2) Speed: the system must provide a quick response to the decisions made by the software.

3) Safety: the system must ensure safety for passengers and other road users. For example, it should be able to automatically avoid collisions and act according to traffic rules.

4) Accessibility: The user interface should be easy to use and accessible to different categories of users.

5) Efficiency: An intelligent interface must be efficient in the use of resources such as energy and computing power.

Taking into account these factors, it is possible to create an intelligent vehicle interface that will ensure safe and comfortable movement of passengers in any traffic conditions.

III. Analysis of Existing Intelligent Interfaces

Research in the field of intelligent vehicle interface has been carried out for many years, and the results of this research have already led to a number of innovative solutions [2], [3], [9], [10].

One example is Tesla's Autopilot system, which uses artificial intelligence to control the car. This system allows the driver to give control of the car to the system and allows for automatic control on high-speed roads.

Another example is the Airbus Autopilot system, which is used to automatically control aircraft. The system uses artificial intelligence to determine the optimal route and automatic navigation.

Research is also being conducted in the field of vehicle user interface. For example, a study on the effectiveness of a voice interface for car users was conducted and found that a voice interface is more effective and less distracting compared to other types of interfaces.

A study was also conducted on the effectiveness of the driver fatigue control system. This system uses artificial intelligence to determine the state of the driver and detect signs of fatigue, which can help avoid accidents on the road.

Overall, the research results show that the intelligent vehicle interface can provide a safe and comfortable ride for passengers, as well as improve the efficiency and speed of vehicles.

A comprehensive review of intelligent car interface development from conceptual design to real-world application is provided in [5], which highlights the need for interfaces that can provide drivers with relevant information in a timely and efficient manner, as well as being intuitive and easy to use. The article [5] builds on a number of previous studies to provide a framework for designing effective interfaces, including the use of icons, color coding and voice commands.

The principle of operation of the video surveillance system is first of all very similar to the principle of operation of our system, the only difference is that in our "Intelligent Interface" data analysis and decision-making will be done by an artificial intelligence that was previously

programmed and passed all tests and control norms. In the picture, the elements of the principle of operation of the video surveillance system are considered in detail, it can be seen that all of these elements will be useful in using the autopilot of the vehicle.

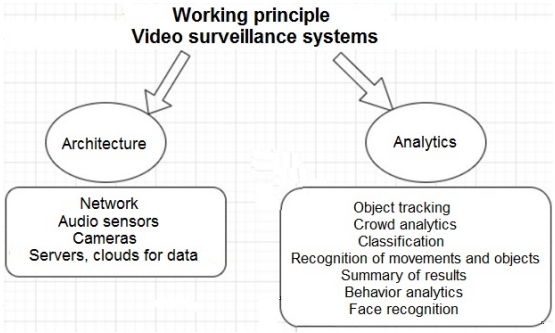

Fig. 2. Components and functionality of the video surveillance system

In article [8] explores the human-machine interaction of an intelligent vehicle, highlighting the need for interfaces that can adapt to the user's needs and preferences. The authors note that interfaces should be designed to provide drivers with personalized information that matches their current driving situation. They also emphasize the importance of designing interfaces that can convey information without distraction, such as through tactile feedback or audio cues.

IV. Creation of Intelligent Interfaces

An intelligent vehicle interface is a complex project that involves many different stages. The very first step is the development of the concept, which includes the analysis of user needs and their requirements for the interface, the definition of functional requirements and the creation of interface prototypes.

After developing the concept, it is necessary to create an interface design that should be intuitive and convenient for users. To achieve this goal, you can use various technologies and methods of interface design, such as pictures, animations, videos, and others.

The next step is to develop the software that will use the interface. At this stage, it is necessary to determine which vehicle functions will be accessible through the interface, which data will be collected and how they will be processed, and which other systems will be integrated with the interface.

Artificial intelligence and machine learning can be used to create an intelligent vehicle interface. With their help, you can recognize voice commands, perform data analysis and predict user behavior.

The final stage is interface testing.Internal tests allow you to check whether the software is working correctly, while external tests allow you to evaluate the efficiency and user-friendliness of the interface. After testing, additional adjustments may be made to the design and functionality of the interface.

Creating an intelligent vehicle interface is an important step in improving the user experience and ensuring road safety. The smart interface can help users perform a variety of tasks with ease, such as navigation, music control, and climate control settings. In addition, the intelligent interface can collect data about the state of the vehicle and the behavior of drivers, which will help in improving maintenance and developing new technologies for safe driving.

One of the key functions of the intelligent interface is the automated control of the vehicle, which allows to reduce the burden on the driver and increase the level of safety on the road. In addition, the intelligent interface provides monitoring of the condition of the driver and passengers, which allows timely detection of possible dangers and prevention of emergency situations. In addition, the intelligent interface allows to optimize the route and travel planning, which ensures the efficient use of passengers' time and the reduction of fuel costs, while performing vehicle control without the assistance of the driver, using all vehicle control tools, as shown in Fig. 3.

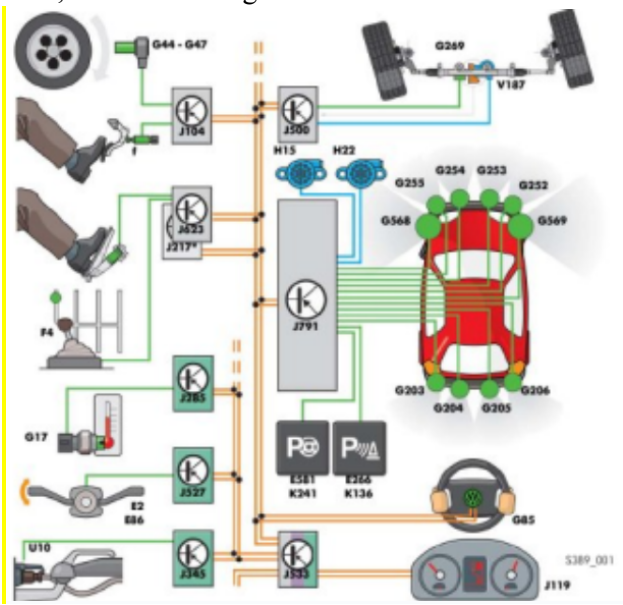

Fig. 3. Machine controls affected by the intelligent interface

V. Conclusions

Future research in the field of intelligent transportation interfaces is likely to focus on several

key areas. One area of interest is the development of interfaces that can adapt to the needs of individual drivers. This can include the use of machine learning algorithms that can analyze driver behavior and preferences in real-time and adjust the interface accordingly. For example, the interface can automatically adjust font size or brightness according to the driver's age or visual acuity.

The intelligent interface of the vehicle plays an important role in the development of the transport system, ensuring an increase in the level of comfort and safety of passengers, reducing the number of accidents and improving the environmental efficiency of transport. Technologies used in the vehicle's intelligent interface provide control automation, driver and passenger condition monitoring, route optimization, and trip planning.

Despite the advantages, the use of an intelligent vehicle interface also introduces challenges related to the protection of personal data and cyber security. However, the growing popularity of artificial intelligence and reinforcement learning technologies provides prospects for their future use. There is also a need to develop interfaces that can communicate with other vehicles and smart infrastructure. This could allow intelligent vehicles to share information about traffic conditions and road hazards, helping to improve safety and reduce congestion. The development of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication systems is likely to become an important area of research in the coming years.

Finally, there is a need to develop interfaces that can support autonomous vehicles. As self-driving cars become more common, there will be a need for interfaces that can provide occupants with information about the state of the vehicle and the environment, as well as interfaces that allow occupants to control the vehicle in certain situations. Developing intuitive and easy-to-use interfaces for autonomous vehicles will be a challenging task, but will be critical to ensuring the safety and comfort of passengers.

Overall, the development of intelligent transportation interfaces is an important area of research that can change the way we drive and travel. Future research in this area is likely to focus on developing interfaces that are more personalized, interactive, and adaptable, while also providing safety and reducing distraction for drivers.

Therefore, the intelligent interface of the vehicle is an important component of the modern transport system and has significant potential for further development and improvement.

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В. М. Синєглазов, Д. А. Диніков. Побудова інтелектуального інтерфейсу
Ця робота присвячена принципам побудови інтелектуальних інтерфейсів, що являють собою сукупність технологій та інструментів, які дозволяють забезпечити автоматизоване керування транспортним засобом моніторингом стану водія та пасажирів, а також оптимізацію маршруту та планування подорожі. Визначено потребу у розробці інтерфейсів, які можуть обмінюватися інформацією з іншими транспортними засобами та «розумною» інфраструктурою. У роботі проведено класифікацію різних видів інтерфейсів, а також проаналізовано їх склад. Визначено структуру інтелектуального інтерфейсу, що включає: сенсори, процесор, програмне забезпечення, інтерфейс користувача, актуатори. Здійснено аналіз існуючих інтелектуальних інтерфейсів. Наведено перелік етапів створення інтелектуальних інтерфейсів. Показано, що в бідному інтелектуальні інтерфейси будуть більш персоналізованими, інтерактивними та адаптивними, а також забезпечать безпеку та зменшення відволікання водіїв.
Ключові слова: інтелектуальний інтерфейс; транспортні засоби; сенсор; процесор; програмне забезпечення; безпека пасажирів; оптимізація маршруту.

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