NEWS REGARDING THE MANAGEMENT OF THE SUSTAINABLE DEVELOPMENT OF CAR TRANSPORTATION FROM THE PERSPECTIVE OF AUTONOMOUS VEHICLES

ȚÎȚU Aurel Mihail1,2,3, NEAMȚU Gheorghe4, STAN Sebastian Emanuel5
1Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, România, mihail.titu@ulbsibiu.ro;
2Academy of Romanian Scientists, 54 Splaiul Independenței, 5 District, Bucharest, Romania;
3Romanian Association for Alternative Technologies Sibiu, 10 Victoriei Street, Sibiu, Romania
4University Politehnica of Bucharest, Faculty of Industrial Engineering and Robotics, Splaiul Independenței nr. 313, 6th District, Bucharest, Romania, e-mail: geluneamtu@yahoo.com
5Land Forces Academy Nicolae Balcescu, Sibiu, Romania, sebastian.stan@armyacademy.ro

ABSTRACT: The scientific paper presents a practical research carried out by the authors in order to implement certain concepts of technical nature, so that those interested in this field can become aware of a certain way of exposing the problems regarding the role of technology and autonomous vehicles in the sustainable development of car transportation. According to previous research, it has been found that human error has a share of about 95% in the occurrence of road accidents in Europe, causing thousands of human lives to be taken away annually. Experts in the field say that autonomous vehicles can significantly reduce this percentage and at the same time contribute to increasing road safety. Digital technology also has its advantages and disadvantages. It helps reduce congestion and pollution in road traffic, increases access to mobility for people with disabilities, creates new jobs, brings economic growth, increases safety in road traffic but can also become dangerous when disturbances and malfunctions make their mark on artificial intelligence. We present further a technical and managerial study with engineering nuances, through which readers can look at and understand the concept of sustainable development in a global context, presenting the place, role and current stage of development of the autonomous vehicle in the road transport system. At the end, some conclusions and further research directions in the approached field are presented.

KEYWORDS: autonomous vehicle, artificial intelligence, radar sensor, redundancy power steering, road safety, sustainable development.

1. INTRODUCTION

Today, the car transport industry is undergoing unprecedented technological changes in history, with the connected and automated mobility becoming an indispensable goal of today's human being.

Mobility is at a crossroads. In the last century, the road transport sector has made great progress. But mobility is now crossing a new frontier - the digital one - where automation and increased connectivity allow vehicles to communicate with each other, with the road infrastructure and with other road users. These developments, which go hand in hand with progress in artificial intelligence [10].

The fundamental element that ensures the sustainability of this change and that represents the solution to solve all the problems in the field, is technology.

Transportation has a long and successful history in Europe. Europe plays a very important role in bringing new technologies and innovation to the world. European aircraft, trains and vehicles are synonymous with global quality [9].

Current trends in the durable and sustainable development of this sector are the development and implementation in the road transport system of autonomous vehicles, which represent the alternative to vehicles served by human beings, of intelligent transport systems that can manage connections between vehicles and other elements of the road transport system, can rigorously streamline the capabilities of vehicles by increasing the degree of ergonomics, safety and comfort of passengers, and last but not least, the digitization of the entire system, which leads to increased quality of life, services, human development in general.

2. AUTONOMOUS VEHICLES

An autonomous vehicle is a technical system on one or more wheels, hereinafter referred to as autonomous vehicle (AV), connected and autonomous vehicle (CAV), driverless car, robo car or robotic car [3] [7] [8], which has the ability to detect road traffic and road traffic elements using sensors such as radar, lidar, sonar, GPS, odometry and inertial units of measurement [3], high-performance video cameras through which they collect data from the outside, they analyse and process them, and in a very short time, based on artificial intelligence, they make decisions to move safely, regularly and ethically, without human input [12] that is, without the user intervening on the systems command or management.

Advanced control systems interpret sensory information to identify appropriate navigation routes, as well as relevant obstacles and signalization [2] [5].

Research in the approached field has been and continues to be done, but regarding the current state of autonomous vehicles, we will present further the devices specific to level 3 or 4 of automation of the autonomous car. These devices are the basic element by which they orient and perceive the elements of the road transport system scene.

The current level of development of autonomous cars is very promising. A number of goals have been achieved in recent years to produce full autonomy, but challenges remain. The
current level of development allows machines to perform the automation task up to levels 3 or 4 [14].

Long-distance transportation is considered to be at the forefront of technology adoption and implementation [16].

2.1 Device and basic elements specific to level 2 and 3 automation of the autonomous vehicle

The correct but also the regulatory action and attitude in the road traffic of autonomous vehicles, is based entirely on artificial intelligence. The technology and integrated systems of these vehicles are inspired by human biological mechanisms. Their behaviour in traffic, by complying exactly with road legislation, is defined by software and hardware systems. Perception devices mounted on them take traffic data, and based on algorithms, they distinguish between elements of the road system such as neural networks in the human brain.

For the perception of pedestrians, vehicles, objects or other traffic elements, autonomous vehicles use video cameras, ultrasonic radar sensors and redundant power steering.

A. Video cameras, which have the widest range of use, detect elements of the road system, transmit images and data to the electronic brain that estimates the distances between objects the same as human binocular vision.

One of the ways cars estimate distance has a striking resemblance to the way humans perceive distances through binocular vision. Also, the algorithms that allow them to distinguish between objects were initially inspired by the neural networks present in our brain [14].

They can be positioned anywhere on the vehicle body to transmit wide, 360-degree full-angle images segmenting the perception area.

Video cameras can be monocular, with a single image perception sensor and a single lens, and stereo video cameras are binocular, have two image perception sensors and two lenses. It is preferable to use stereo video cameras because, although they are more complex and expensive, they are more accurate in instantly detecting objects in the visual spectrum.

This is done by measuring the differences in the positioning of objects from the perspective of one objective in relation to the other, being similar to the way the perception of distance in humans works. Apart from estimating the distance, the next important function of video sensors is probably the ability to track objects in the viewed environment. This allows vehicles to be aware of moving bodies, such as pedestrians and other cars, as well as to take into account the direction in which they are moving. Through this, the car is able to locate itself in space and track its movement through the environment. The task of self-locating is also helped by other algorithms that detect landmarks such as lanes, traffic signs, fences, etc. [14].

Therefore, stereo video cameras distinguish images from the road system, transmit them to a computer that analyses them based on deep learning algorithms. Based on these algorithms, the computer interprets and determines the type of traffic indicator encountered on the side of the road, the colour of the electric traffic light at the corner of the intersection, the transverse and longitudinal markings on the road surface, segments images, acting accordingly on autonomous car control systems.

Perhaps the most innovative use of deep learning algorithms is in image segmentation. This process classifies the objects present in an image into appropriate classes, such as road surface, pedestrians, cars, and so on. This is done in real time, each pixel in an image belonging to one of the established categories [14].

Figure 1 shows how the computer of an autonomous vehicle perceives road traffic, segmenting the image.

B. Ultrasonic radar sensors support video cameras by providing additional information. If video cameras lose their functional qualities in bad weather, when it rains, snows, or is foggy, these types of sensors transmit clear, prompt and accurate information to the computer, in any condition.

In this case, the radar sensors transmit electromagnetic waves to the objects around them, and they, on the principle of reflectivity, return to the device that emitted them. The data thus obtained is then transmitted to the vehicle's computer, which combines it with that obtained from the video cameras. Thus, a precise mapping of the nearby area is performed and clarifications are made on the control systems of the autonomous vehicle.

The radar system not only estimates the structure of the environment but also its attributes. These include the relative positions of objects in the environment, whether they are static or moving, and, where appropriate, their direction of movement. Based on this information, it is able to decide what traffic situations may become dangerous and what maneuvers must be applied to avoid potential collisions [14].

Figure 2 shows how an ultrasonic radar works.

Ultrasonic radar sensors prove their efficiency and effectiveness both for long distances, but especially for short ones, between the components of road traffic.
Ultrasound provides data over an area of several meters, providing a very detailed map of the proximity of the vehicle [14].

An eloquent example is the systems with sensors for automatic parking, mounted at this time of classic road vehicles. Initially, these sensors were designed as a warning to drivers when approaching obstacles when parking the car, but also as a warning of other objects while driving classic cars, emitting only acoustic signals. Over time, the role of these sensors has been expanded and developed so well that, on autonomous vehicles, they transmit accurate and precise data to the computer, achieving the safe parking of autonomous vehicles.

Ultrasonic sensors provide the information that allows vehicles to find parking spaces and occupy them independently using the built-in processing unit. Modern cars, equipped with ultrasonic sensors of last generation are able to park parallel, perpendicularly or diagonally [14].

Another useful example of these sensors, at this time, on classic cars, is the driver's visual warning system in blind spots (areas outside the driver's field of vision).

In situations where the radar becomes inefficient, such as at very high speeds, ultrasound protects the blind spot of the vehicle, warning the driver not to change lanes. This functionality can prevent dangerous situations on highways, creating a safer environment for everyone [14].

Figure 3 shows the mode of action of this type of sensors when parking an autonomous vehicle.

![Figure 3. Operation mode of radar sensors mounted on an autonomous vehicle when it is parked [14].](image)

C. Power steering with redundancy system

The steering system is the basic element of the movement of any vehicle in space. It is specific to each means of transport and is adapted to the environment on which, or in which, the vehicle in question moves (land, air, water, underwater, etc.). The maneuverability of the steering system of a land vehicle is directly influenced by the number and type of mechanical elements that make up the steering mechanism, but also by the frictional forces of the main elements that interact during operation. To facilitate the driver's effort when operating the steering wheel of a land vehicle, the technology comes in support with hydraulic or electric power-assisted systems, parallel or in series. Of course that they intervene when the steering wheel is operated, increasing the comfort and ergonomics of the driving position, but what happens when the car becomes autonomous in terms of driving and the driver is missing from the steering wheel?

Technology also has the answer to this question. In order to increase the safety of autonomous vehicles, given the paramount importance of the steering mechanism in traffic, we go on the option adopted by specialists in the field of aeronautics: systems with redundancy, ie those identical parallel systems, which have the same role and perform the same functions. In the field of autonomous vehicles are called fail - operational systems (systems that intervene in case of failure of the basic system).

Electric power steering or more clearly electric-assisted power steering, because on road vehicles there must be a mechanical connection as a fail-safe safety in case of failure, is a system consisting of a steering rack, an electric motor and a steering bar. The power steering functionality is composed of two complementary attributions. The first is to help the driver move the car's wheels when he turns the steering wheel, and the second is to maneuver the car when the autonomy functions are activated.

Although a mechanical failure safety system is used by modern vehicles in the age of digitalisation and motor vehicles, a complete electronic cable transmission unit is expected to come into use. Such a system is more energy efficient and significantly faster than a mechanical system [14].

Figure 4 shows the scheme and principle of operation of a redundancy power steering system for an autonomous vehicle.

This new fail-operational system uses two copies of each hardware and software component to add a layer of redundancy to each function. This means two sets of electric motors, two microcontrollers, two sensors, two separate communication channels with the vehicle and an additional battery. In fact, the removal of the mechanical component is not feasible under current regulations, which means that a third layer of redundancy will still be present for additional security [14].

![Figure 4. Scheme and operating principle of a redundancy power steering system for an autonomous vehicle [14].](image)
Figure 5 shows how the transfer of responsibility between the two parties (human side and artificial intelligence) is done.

2.2 Automation levels of autonomous vehicles

According to the SAE (Society of Automotive Engineers), there are five levels of automation in the field of autonomous vehicles. Following the evolution of the high technology of autonomous vehicles, the European Commission has established a timetable for the implementation of automation levels for such vehicles by 2030.

According to the European norms in the field, the vehicles driven by the driver, are the vehicles located at level 1 and 2 of automation. They are already manufactured and run on European roads. At this time, the level 3 and 4 vehicles, which are autonomous vehicles, are still in the testing phase and we expect to see them circulating on European roads between 2020-2030. Vehicles with complete automation will run on European roads after 2030.

There are expectations regarding vehicles manufactured in Europe at this time, regarding the connection systems and it is expected that from 2022, they must meet the following requirements:

✓ will depend on digitization and will assist the user in a way in which, partially or totally, the management driving functions are switched to an IT system;
✓ equipping vehicles with internet connection devices, which communicate in an efficient and effective way with the traffic control centre and with the other traffic vehicles;
✓ technologies regarding automation and connection must be accessorized to autonomous vehicles as soon as possible, so that they are fully connected in the near future;
✓ fully automated / autonomous vehicles, will be level 3, 4 or 5;

To demonstrate partial topical capability, here are the six levels of road vehicle automation:

- Level 0, without automation where, the entire responsibility for moving the car on public roads, belongs to the driver;
- Level 1, also called the level of assisted driving, where only one system, of those listed above, comes to the aid of the driver (e.g. cruising speed control function);
- Level 2, also called the level of partial automation, where other systems from those listed above, intervene and ensure the safe movement of the car on public roads (e.g. steering control system). In this case, the driver of the vehicle constantly monitors and intervenes on the smooth running of the vehicle;
- Level 3, also called the level of conditional automation, where the vehicle travels most of the time alone, driven by its automated systems that perceive the transport system, collect the data, analyse it and put it into practice. The driver is obliged, in this case, to be at the driving position, to take control of the vehicle, if necessary;
- Level 4, also called the high level of automation, where the car is driven almost entirely by the systems and installations mounted on it. The driver now intervenes occasionally;
- Level 5, also called the autonomy level, in which the car is completely autonomous, is driven exclusively by the systems and installations mounted on it. In this case the driver is no longer needed, his presence is no longer mandatory.

State-of-the-art technology is currently approaching level 4, while certain level 3 functions, such as traffic jam pilot or pilot highway, are in development for production vehicles” [15].

Figure 6 shows the levels of automation of autonomous vehicles and the transfer of responsibility.

2.3 Functions specific to automation levels

The specific functions of each level of automation for autonomous vehicles are the following:

A. For the level of automation on the assisted driving of the vehicle:

- Pilot function in automatic parking;
- Remote parking assistance function;
- The evasive support function of the steering;
- Function for automatic emergency braking;

B. For the level of partial automation of the vehicle:

- Roadside assistance function;
- Integrated cruise assistance function (cruise speed control, lane crossing warning);

C. For the complete and high-level automation of the vehicle:

- The pilot function in the urban environment;
- Pilot function on the road / highway (keeping the traffic lane, recognition of traffic indicators / signs, automatic high beam);
- Autopilot function in traffic jams;

Figure 7 shows the functions corresponding to each level of automation.
2.4 Legislative uncertainties of artificial intelligence in the field autonomous vehicles

The introduction of autonomous vehicles on the road transport market is a big challenge, but also a big concern, because there are some big disadvantages. It should be understood that, if they do not have their own road or street networks, such vehicles participate in traffic alongside other types of non-automated vehicles, pedestrians, cyclists, motorcyclists, etc. To this end, solutions must be found to harmonize safety and road rules.

With regard to management, command, driving and control systems, especially in high safety systems, power steering and braking systems, it is very important not to cause disturbances or malfunctions, as major disasters can occur.

It is mandatory that no intruder is allowed to enter the steering system, endangering traffic participants. Safety is essential in the process of developing steering systems for the era of autonomous cars [14].

Also, the action and ethical attitude of autonomous vehicles is debatable. From the point of view of a possible imminent accident in which the other traffic participants are involved (motorists, motorcyclists, cyclists, pedestrians, etc.), there is the question of the choice that the electronic brain of autonomous vehicles will make.

For example, in the event of an unavoidable accident, the questions are asked: What will be the decision of the computer of an autonomous vehicle make? Who will the autonomous vehicle protect? The pedestrians in traffic, or the passengers in the vehicle?

It should also be noted that autonomous vehicles take over the driving tasks from the driver. Here we have to intervene on the amendment of the legislation because, in case of an incident or accident in traffic, you do not know who will be responsible, the owner of the vehicle or the manufacturer.

To this end, solutions must be found to harmonize safety and road rules.

Some technological progress, primarily connectivity and automation, will create new road safety opportunities in the future by reducing the role of human error. However, the best cars are not yet as good as their human counterparts and, at least in the transition phase, new risks arise, for example related to the presence of vehicles with a wide range of automated capabilities / connected in mixed traffic with traditional vehicles and vulnerable road users, such as motorcyclists, cyclists and pedestrians [11].

At the same time, EU data protection rules are applied in all areas, including the area addressed, but it has not been specified what will happen to these vehicles in the event of a cyber attack.

In these cases, who will guarantee that autonomous vehicles are safe and not dangerous. Respect for freedom of choice and human dignity must be the first priority for this type of vehicle. To this end, the governments of countries with highly developed economies in the EU are developing instructions on artificial intelligence. In order to see such vehicles circulating on European roads, it is necessary to introduce specific standards for the development of these technologies, the implementation of an infrastructure adapted to this type of vehicle, but also massive investments in research and innovation.

All these aspects are still being worked on, both in terms of legislation and in terms of artificial intelligence.

In the near future, autonomous vehicles will be used in all transport systems, including short sea shipping, inland waterway vessels, freight vessels and light rail systems. Efforts for international standardization will continue to be coordinated by specialists to guarantee cross-border security. This guarantee will be ensured by installing on board vehicles the so-called "black boxes”, i.e data loggers, similar to those used in aviation. On-board recorders will prove useful in road events and allow liability issues to be addressed.

It is also necessary to urgently develop appropriate rules that will govern the ethics and data protection of the automated transport sector. The need for these rules lies in the need to increase the confidence of the citizens of the Community countries vis-à-vis these types of vehicles, but also to provide adequate support to people with disabilities or reduced mobility to use them with confidence.

In this field, suppliers of cars and buses for passenger transport and suppliers of trucks for the transport of goods, have been at the forefront of technological progress by investing huge financial funds in research, developing technologies that surpass any human imagination.

Vehicles themselves are also changing as a result of digital technologies. They are becoming smarter as new and connected on-board cooperation services become available, as well as increased levels of automation. There are currently significant investments in the development of driverless vehicles. Automatic vehicles will have to rely on secure data exchanges between vehicles and between vehicles and road infrastructure, which in turn will require sufficient and robust network capacity for millions of vehicles to interact at the same time. [9].

At this time, the technology is not so developed as to give this type of car total autonomy to move safely on public roads. The driver's presence is still needed. We are only talking about a partial autonomy, rendered by certain systems and installations mounted on vehicles, which fulfill some functions that ensure the safety of vehicles in road traffic.

Specialists predict that by 2025 the autonomous vehicle market will grow a lot. To date, new jobs will be created in this area and profits of €620 billion euros will be made for the car industry and 180 billion euros for the EU electronics sector.
3. EVALUATION OF THE LEVEL OF AUTOMATION OF DRIVING ASSISTANCE SYSTEMS THAT CONTRIBUTE TO THE MANAGEMENT OF ROAD SAFETY, EXISTING ON THE TOYOTA RAV 4 LUXURY CAR, 2019 MODEL

The Toyota Safety Sense system was introduced on the entire range of vehicles by the Japanese manufacturer Toyota, in order to ensure users a comfortable, safe and efficient driving. It was designed with the user carefully driving the vehicle as a starting point.

The system is designed to contribute effectively and efficiently to mitigating the effects of road accidents to which occupants, cars and other road users are subjected in the event of collisions and to help the driver in normal road conditions.

However, in the case of this vehicle, given the accuracy of the various systems and their level of automation, the coincidence and record of the control function it can guarantee, the driver must not rely excessively entirely on systematic driving management, because some functions have a low level of development.

In this case, the driver bears full responsibility for paying due attention to road traffic, the area in the vicinity of his vehicle and for preventive driving.

On the Toyota RAV 4 car, 2019 Luxury model, the Toyota Safety Sense safety system is based on video cameras mounted in the front, at the rear and sides of the vehicle, but also on radar sensors mounted on the front and rear of the vehicle.

The radar sensor 1, mounted on the front is the type Denso, model DNMWR009 and has a maximum output power of 416.87 mW, operates at a frequency of 76.5 Ghz and is certified in accordance with the requirements of Directive 2014/53 / EU [13], [15].

The radar sensor 2, mounted on the rear, for blind spot monitoring is type “Denso, model DNSRR004, has a maximum output power of 20mW, operates at a frequency of 24.15 Ghz and is certified in accordance with the requirements of the 2014 Directive /53 / EU [13], [15].

Table 1 presents all the driving assistance systems that contribute to road safety management, existing on the Toyota RAV 4 car, 2019 Luxury model, the level of automation, the shortcomings and the stage of development at which they are.

<table>
<thead>
<tr>
<th>Name of the assistance system</th>
<th>The system/mechanism where it operates, acts, or intervenes on the vehicle</th>
<th>The receiver on which the operation is based</th>
<th>Function/Level of automation</th>
<th>Functions performed</th>
<th>Shortcomings/malfunctions</th>
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</thead>
<tbody>
<tr>
<td>1. Pre-collision safety system (PCS)</td>
<td>Acts on the brake system</td>
<td>Radar sensor 1</td>
<td>A/4</td>
<td>1. Optical and acoustic warning Veh. = 10-180 km/h; Cyclists and pedestrians = 10-80 km/h</td>
<td>When the vehicle or detectable object moves unevenly</td>
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<td></td>
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<td>Front video camera arranged in the radiator grille</td>
<td>2. Automatic brake assist Veh. = 30-180 km/h; Cyclists and pedestrians = 30-80 km /h</td>
<td>When the detectable object is near a wall, fence, pole or tree</td>
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<td>If the VSC system is disabled</td>
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<td>When the detectable object is under another structure</td>
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<td>When part of the detectable object is masked by an umbrella, a railing, a luggage</td>
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<td>When the detectable object is white, or shines brightly</td>
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<td>If the vehicle in front has:</td>
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<td>- very high ground clearance</td>
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<td>- reduced width</td>
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<td>- lowered rear shutter</td>
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<td>- oversized gauge at the rear</td>
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<td>When the detectable object cuts the path or appears suddenly in front of the vehicle;</td>
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<td>When visibility is obscure or at dusk, at dawn or in the tunnel</td>
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<td>If the front of the vehicle is sprayed with water, snow or mud</td>
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<td>If the height of the pedestrian is less than 1 m or greater than 2 m</td>
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<td>If it rains heavily or it snows heavily</td>
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<td>If the front of the car is raised or lowered</td>
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<td>If the pedestrian or cyclist wears very bulky clothing</td>
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</table>

Table 1. Driving assistance systems that contribute to the management of existing road safety on the Toyota RAV 4 car, 2019 Luxury model, the level of automation, the shortcomings and the stage of development at which they are.
<table>
<thead>
<tr>
<th>2. Tread Tracking Assistance System (LTA)</th>
<th>It acts on the steering mechanism</th>
<th>B/2</th>
<th>1. <strong>Warns optically and acoustically when leaving the tread and the vehicle starting to side swing</strong></th>
</tr>
</thead>
</table>
|  | Front video camera arranged in the radiator grille  
Radar sensor 1 frontal. |  | If the road is under construction and the lines are yellow (they are marked for a temporary period), the road is covered with snow, dust, soil or mud, and the longitudinal markings are erased, undefined, illegible, or missing. |
|  | When the display for the cruise control module is displayed and the vehicle in front:  
- changes the tread  
- it swings  
- is driven close to the left / right lane demarcation line  
- exits the visual field of the front video camera |  | When on the edge of the tread there are other objects that delimit it (reflective poles, curbs, railings) |
|  | When the road is under construction and the lines are yellow (they are marked for a temporary period), the road is covered with snow, dust, soil or mud, and the longitudinal markings are erased, undefined, illegible, or missing |  | If there are shadows parallel to the longitudinal markings of the road or the road shines brightly |
|  | - another vehicle suddenly enters in front of the vehicle  
- the vehicle in front is moving at low speed;  
- the front vehicle has a small rear surface (e.g. unloaded trailers towed by a car)  
- two-wheeled vehicles traveling on the same tread  
- when water or snow sprayed by surrounding vehicles obstructs the sensor;  
- when the front of the vehicle is lifted by the load of the trunk  
- when the vehicle in front has a very high ground clearance | C/4 | If the longitudinal markings are cracked, embossed, have stones, the road is wet, or with puddles |
|  | If there are shadows parallel to the longitudinal markings of the road or the road shines brightly |  | If the road slopes sharply to the left / right or has serpentine curves |
| 3. Dynamic cruising speed radar control system over the entire speed range | Acts on:  
- engine at accelerations and decelerations  
- braking system at stops |  | If the road is paved or bumpy |
|  | Radar sensor 1 frontal  
Front video camera arranged in the radiator grille |  | The sensor does not correctly detect the speed of the front vehicles when:  
- another vehicle suddenly enters in front of the vehicle  
- the vehicle in front is moving at low speed;  
- the front vehicle has a small rear surface (e.g. unloaded trailers towed by a car)  
- two-wheeled vehicles traveling on the same tread  
- when water or snow sprayed by surrounding vehicles obstructs the sensor;  
- when the front of the vehicle is lifted by the load of the trunk  
- when the vehicle in front has a very high ground clearance |
|  |  |  | After the vehicle in the column brakes and stopping for more than 5 seconds it does not leave on its own, except when the accelerator pedal is depressed by the driver |
1. Recognizes traffic signs (speed limit and overtaking prohibited), displays them on board, signals visually and acoustically when the maximum speed limit is exceeded.


3. Automatically maintains speed at a constant limit depending on the speed of the vehicle in front.

4. Warns the driver visually and acoustically, when the distance between the vehicles is less than that established.

5. Warns the driver visually and acoustically to intervene when the deceleration provided by the system is insufficient.

6. Keeps the vehicle at a preset maximum speed limit by the driver.

In the following situations, the system does not warn correctly:
- when the speed of the vehicle in front is equal to or greater
- when the vehicle in front is moving at a very low speed
- immediately after the cruising speed has been set
- at the driver's intervention on the accelerator pedal

Does not correctly detect if the traffic sign is dirty, erased, is totally or partially masked by vegetation or another obstacle.

Situations in which the control mode of the distance between the vehicles does not work correctly:
- in turns when the vehicle in front disappears from the visual field of view of the video camera
- when the treads are narrow
- when acting on the steering wheel or the position of the vehicle on the tread is unstable (side skidding, vehicle oscillations, etc.)
- when the vehicle in front suddenly decelerates
- when the speed of the vehicle decreases to a set speed, after the driver has intervened by depressing the accelerator pedal.
| Recognizing traffic signs (RSA) | Radar sensor 1 frontal Front video camera arranged in the radiator grille | C/4 | speed limit set by them is exceeded  
2. Displays on board and visually informs the driver on the areas where the traffic sign acts (the area where it has legal effect) | No traffic signs are detected if the video camera is disturbed due to a mechanical action, is dirty or covered with mud, snow, etc.  
No traffic signs are detected correctly if it is raining heavily, it is snowing heavily, the vehicle is driving through fog or sandstorm  
No traffic signs are correctly detected if the light of vehicles traveling in the opposite direction "blinds" the front video camera  
They are not detected correctly if the traffic sign is visible for a short period of time  
They are not correctly detected if the traffic situation (turn approach, change of lane in overtaking, etc.), the situation being incorrectly assessed by the system  
No traffic signs are correctly detected if the traffic sign is visible for a short period of time.  
No traffic signs are correctly detected if the traffic situation (turn approach, change of lane in overtaking, etc.), the situation being incorrectly assessed by the system  
They are not detected correctly if the front vehicle has stickers on the back  
No traffic signs are detected correctly if a traffic sign incompatible with the system is recognized  
If other traffic signs are detected on the roads in the immediate vicinity of the vehicle  
No traffic signs are detected correctly if the front of the vehicle is too high or too low |
|---|---|---|---|---|
| Blind spot monitoring system (BSM and RCTA) | It has no action in the control or driving systems of the vehicle  
Optically warns in the left / right side mirrors | B/2 | 1. Assists the driver in making the decision when changing the tread - blind spot monitoring system (BSM)  
2. Assists the driver when reversing - the warning function on cross traffic and behind the vehicle (RCTA) | When the sunlight is strong, the optical indicator of the BSM system in the exterior rear-view mirrors (left-right) may not be noticed by the driver  
The RCTA audible warning may not be heard by the driver when the volume of the vehicle's audio system is high  
The system does not warn correctly when the sensors are blocked or masked by mud, snow, ice, or the towed trailer load exceeds the lateral gauge  
The system does not warn correctly when the hot or frosty weather may affect the proper operation of the sensors  
The system does not warn correctly when the sensors are deregulated due to mechanical actions  
The system does not warn correctly when several vehicles are approaching and the distance between them is small  
The system does not correctly warn when the speed of the approaching vehicle is equal to that of the vehicle on which the sensors operate  
The system does not warn correctly in the area of slopes or steep ramps, in tight curves or uneven surfaces  
The system does not warn correctly when there is a significant difference in height between the vehicle on which the sensors operate and the vehicle approaching from behind  
The system does not warn correctly when the vehicle is parked or moving backwards on an inclined plane |
### Driving assistance systems

To ensure optimal, efficient and effective driving performance, but also to ensure the safety and security of goods or users, the car manufacturer Toyota has installed active systems that act automatically in response to various situations encountered in road traffic. However, it should be noted that they intervene and support the driver as needed, depending on the situation, but they cannot completely eliminate an unpleasant road accident. Therefore, the vehicle must be driven with caution.

We forward present these systems generically.

| 6. Parking assistance system | Radar sensors with ultrasonic waves arranged in the front grille and the front and rear bumper | Video cameras arranged in the front and rear bumper Video cameras arranged in the side exterior mirrors | A/2 | 1. Warns the driver optically, acoustically and visually (on display), on the position of the car, the distance between the car and nearby objects during parking<br>2. Brakes the vehicle when the system estimates the risk of a collision with nearby objects during parking maneuvers - parking brake assist function for static or dynamic objects (PKSB) | The system does not warn correctly when the vehicle on which the sensors operate creates water vapor or snow behind it<br>The system does not work or does not work properly when the sensors or video cameras have low detection visibility, are covered with snow, ice, mud or other objects<br>The system does not work or does not work properly when the ambient temperature is too high in summer, or too low in winter<br>The system does not work or does not work properly when the vehicle is on a bumpy road, there is high vegetation or gravel<br>The system does not work or does not work properly when there is excessive noise nearby, heavy rain, heavy snow or if the car is tilted excessively<br>The system does not work or does not work properly when the car makes a steep turn or an excessive turn<br>The system does not detect: wires, cables, cotton, strings, ropes, sharp-angled objects, water, snow, other low or sound-absorbing objects |
| 7. Automatic high beam | Camera sensor mounted in the vehicle | C/4 | 1. Evaluates the brightness of the street lighting system and oncoming vehicles, etc.<br>2. Automatically activates or deactivates the high beam depending on needs | The high beam may not be turned off automatically:<br>- when vehicles suddenly appear in the opposite direction, after a curve or after a hill<br>- when the vehicle is overtaken by another vehicle<br>- when the vehicles coming from the front have the lights off, have only the headlights on, or have a low headlight brightness;<br>- when the vehicles in front disappears from sight<br>The system is malfunctioning or not working at all:<br>- when it rains heavily, it snows heavily, there is fog or dense smoke, or when meeting some very reflective objects<br>- when the vehicle is very inclined at the front, rear or side |

### Driving assistance systems

- **8. Electronically controlled braking system (ECB)** - generates braking force depending on the application of the brakes;
- **9. Stability control system (VSC)** - supports the driver to control skidding;
10. Trailer balance control system - supports the driver to control the balance of the trailer by selectively applying the braking force of each of the wheels and reducing engine torque;
11. Traction control system (TRC) - helps maintain traction and prevents the wheels from slipping when starting or running the vehicle on low-grip surfaces;
12. Active cornering assistance system (ACA) - prevents the vehicle from skidding to the outside of the turn by controlling the braking of the wheels from inside the turn when trying to accelerate while approaching a turn;
13. Ramp start assist system - prevents vehicles from moving backwards when leaving the ramp;
14. Power steering system (EPS) - uses an electric motor to reduce the effort of turning the steering wheel by the driver;
15. Emergency braking signal system - in the event of sudden braking, the hazard warning lights start flashing automatically to warn the driver of the rear vehicle;
16. Anti-lock brake system (ABS) - helps prevent the wheels from locking in sudden braking, or when grip on the tread is low;
17. Driving mode selection system:
   - eco-driving mode - the vehicle saves fuel by generating torque due to the finer operation of the accelerator pedal and limits the operation of the air conditioning system (heating / cooling by reducing the operation and speed of the fan);
   - sport mode - controls the sensitivity of the steering wheel and the hybrid system to ensure an acceleration response for sporty, in force driving;
   - trail mode - designed for rough terrain, the system controls the vehicle so that the torque is distributed to the wheel(s) that have the highest grip on the ground.

4. FINAL CONCLUSIONS

Technology has allowed autonomous vehicles to develop rapidly, so that their current state of development allows them to perform automation tasks up to levels 3 or 4.

From the evaluation of the level of automation of the driving assistance systems that contribute to the management of road safety, existing on the Toyota RAV 4 Luxury car, 2019 model, it results that there is a series of shortcomings that create incorrect functioning. They create and put strong imprints but also big question marks regarding the autonomy and automation of the vehicles of the future, which reduces the speed of durable and sustainable development of car transport. However, for this car, some systems such as: the pre-collision safety system (PCS), the cruising speed radar control system on the entire speed range, the dynamic cruising speed radar control system with signal recognition function traffic and longitudinal markings on the road (RSA) and automatic high beam, are systems that have been developed up to level 4 of automation at this time. These systems, due to their development, work very well on the car, which shows that the automation of the road transport system is on the right track and at a fairly high level, but there is still much to be done in this direction. Some systems cannot ensure full safety for passengers and other road traffic participants.

The development in the next period depends on the design and development of sensors and technologies that are much better than the existing ones, on smarter architectures in terms of deep learning, but also on the development of new systems and elements that contribute to increasing safety, security and their proper functioning in road traffic.

At this time in the existing road transport system, the common traffic of autonomous vehicles along with pedestrians, cyclists, motorcyclists and classic cars is uncertain.

We consider that urgent measures are needed to readapt the entire road transport system to the working conditions of autonomous vehicles, or to create dedicated travel routes, individual to this type of vehicle.

Regarding the action and ethical attitude of autonomous vehicles, at this time we can say that this is still debatable. We say this because, from the point of view of a possible accident caused by the decisions taken by the artificial intelligence of an autonomous vehicle in road traffic, in which third parties involved in traffic are involved (motorists, motorcyclists, cyclists, pedestrians, etc.), it is not known to whom this type of vehicle will ensure protection: the other vehicle, the pedestrian, the cyclist or motorcyclist in traffic, or the passengers it carries.

The road legislation in this case is ambiguous and unfinished. Here we have to intervene on the amendment of the legislation because, in case of an incident or accident in traffic, you do not know who will be responsible, the owner of the vehicle or the manufacturer. To this end, solutions must be found to harmonize safety and road rules.

The years to come will create new premises for the development of autonomous vehicles, and time will certainly solve all the impediments, non-conformities, incorrect functioning and shortcomings in the field of autonomous mobility.

The benefits obtained from the development of autonomous mobility are reduced fuel consumption, reduced pollution, coverage of driver shortages, increased quality of comfort, traffic safety and passenger satisfaction, reduced delays, decongestion of road traffic and reduced traffic accidents.

The current safety systems on Toyota RAV 4, Luxury cars model 2019, being of level 3-4 require the intervention of the driver in the handling of the vehicle.

The non-conformities presented in this paper demonstrate the insecurity of travel and also the low effectiveness and efficiency but also the current stage of development of autonomous driving systems, existing in the equipment of modern cars (eg. Treademill Assist System – LTA, Dynamic Cruise Speed Radar Control System for the entire speed range, Automatic Phase Length).

Autonomous driving of contemporary vehicles is becoming increasingly clear as a solution for the future. Several equipment manufacturers are working hard on such technologies, and autonomous vehicles will contribute to and be the foundation for the sustainable development of modern road transport.

REFERENCES