Organization of automobile traffic using Internet of Everything technology

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Abstract. The automobile traffic in the modern conditions is a high human risk source. The road infrastructure and car informative and measuring system Internet of Everything technology application increases significantly the road condition participants safety. The road infrastructure main components (traffic lights, road signs and other) are equipped with reception transmitters supporting the Internet of Everything so that why the car constantly receives the road situation actual information while on the move. The Internet of Everything technology creates the smart city intellectual space, which unites all road traffic participants into a single information field. The Internet of Everything and information transmission wireless channels speed characteristics may support the road traffic intensive pace. There is a functional scheme of a driverless car control system including the informative and measuring system necessary components which data is processed with the car board computers. In some road situation examples the urban conditions driverless road traffic organization principle is described engaging the Internet of Everything information transmission channel. There is a general driverless car traffic algorithm evaluating in real time the smart city conditions road situation.

1. Introduction

The navigation and automobile transport control intellectual system research of today is an actively developing humanity activity. Today this field is being researched by the following companies such as General Motors, Volkswagen, Audi, BMW, Volvo, Google and some others [1, 2].

To improve the road traffic they established some huge science programs to develop the navigation automobile systems and controlling programs «2getthere» (Netherlands), the «ARGO» program (Italy), the «DARPA Grand Challenge» program (USA), the «driverless car Google» project (USA) and other. The most results realized in first experimental prototypes were received in Google and Tesla companies projects. The car automatic driverless control system are being developed by those companies [3, 4]. A car moves in general access roads observing the established road traffic rules. Such tests were conducted with a Toyota Prius car and that car passed over 1600 kilometers in driverless mode.

RoboCV company (Russia) today develops a universal navigational computer «Autopilot for transports». Some car navigation system components are being researched by MGTU University of Bauman specialists (The Moscow State Technical University of Bauman). The driverless car traffic clear advantages are [5, 6]:
• road traffic improvement by reducing the number of accidents and car crashes excluding the human;
• goods transportation in dangerous situations which do not correspond the human life and environment peculiar things;
• a driverless car application as a special purpose asset;
• an increase in the road traffic pass through ability with a centralized system of car interaction with surrounding road lines, road signs, traffic lights, other transport units and other.

A driverless car control system is based on a number of detectors and a processing device, which control the car itself conditions and the environment conditions around the car. In the road traffic conditions the system must detect objects around the car while on the move without an error. That could be a road sign, the traffic lights condition, road marking lines, pedestrians and other traffic units [7]. Errors, which the system made while on the move could be fatal or may bring some hard consequences like human casualties. So that why the safety provision for all road traffic units is one of the most important task in developing a driverless car system [8].

In some projects how to control or prevent driverless car accidents including the environment objects they apply a laser scanning distance meter. This device is placed on the car roof with a circle looking around sector [9]. The video cameras installed inside a car help the control system to check out traffic lights signals and road signs. Apart of this there is a plenty of detectors and systems, which are responsible for the car movement parameters. A dependence of a large number of expensive systems to provide the car interaction with the environment around it is a negative factor for the designers. For example to cover a path from point А to point В a car must cover the same path several time being conducted with a driver (education stage) because during this period the car navigation system evaluate the «reference» road environment. Without the previous education stage a car cannot guarantee the necessary safety level in the city tide and road traffic rules necessary observance [10].

Because of that there is another actual approach how to create the car navigation system when a car is slightly technically modified and the system initial education stage is excluded with real road marking lines. Such approach relates to the application of being developed today technology of Internet of Everything which is integrated in the smart cities urban infrastructure [11, 12].

2. **The car intellectual control system based on the Internet of Everything**

The car control system functional scheme for the smart city environment driverless movement is given in figure 1.

![Figure 1. The driverless car control system functional scheme.](image-url)
The car control system has a multi-channel information system principle to collect and process the information. The car is equipped with a multi-sensor system of ultra-sonic detectors to collect the navigation information for autonomous driving. Detectors are located in the car perimeter to reduce the summary square of so called the blind view zone around the transport. Each detector is an independent radio signal emitter and receiver.

To provide the road infrastructure and car interaction, traffic lights, road signs and other, a car is equipped with an information reception device, which is being transmitted through the transmitters installed in stationary and non-stationary road traffic participants shown in figure 2. The machine system of technical vision is used additionally (video cameras) through which the objects are identified which do not have emitters to support Internet of Everything.

Figure 2. An example of road situation equipped with the Internet of Everything technology for an autonomous car to interact with the environmental city infrastructure (1 – the road signs have the system installed to transmit the identification information to the passing by cars; 2 – traffic lights equipped with a system to transmit the identification data to the passing by cars; 3 – cars equipped with autonomous control system and road infrastructure information reception system).

In figure 2 there is a road situation shown with road traffic typical participants. The cars are equipped with autonomous control intellectual system and information radio reception system. While on the move the ultra-sonic detectors placed in the car perimeter constantly emit and receive the radio signals, which let the car keep a distance to prevent a crash and control its speed while on the move. The Internet of Everything based navigation system receives from detectors placed on road signs, traffic lights and other the actual information of the road sign type, the traffic light color being emitted, the road marking lines type and other. The information is recognized according to the road traffic classes established rules. This information is processed by the car calculation system and according to the programmed algorithm the controlling signals to complete a movement maneuver are formed.
To increase the road movement safety they use the image recognition system based on optical signals processing system from video cameras established in a car. If they reserve the navigation system in a way like that they increase the received road situation detectors data accuracy and may increase the road movement participants safety.

3. The road situation classification

Information from detectors and video cameras system is processed by the car board calculation machine with an extended algorithm given in figure 3.

![Algorithm Diagram](image)

Figure 3. The road traffic city infrastructure information processing general algorithm.

To organize the car driverless movement based on the Internet of Everything technology there is the following road movement participants relationships system proposed using road infrastructure standard elements:

- the traffic lights inform the driverless car of the traffic light color being indicated through the radio connection the color is recognized through the Internet of Everything;
- the road marking lines and its type are scanned and recognized with a driverless car using optical signals from video cameras (there is a possible option of additionally installed the road marking lines beacons based on the Internet of Everything);
- the road signs transmit to the car through the Internet of Everything radio connection the sign type information (informative, warning sign and prohibition sign). Also they duplicate the road sign recognition process with the video camera optical signal analysis;
- the movement participants (cars) transmit and receive the information from other road traffic participants (cars) with the Internet of Everything radio connection;
- petrol stations (petrol refilling stations), shops, hotels, the objects placed near the road transmit their presence fact to a driverless car with the Internet of Everything radio connection;
- being on the move the car keeps the programmed route distance and speed and through the Internet of Things channels detects pedestrians presence using their mobile gadgets and by processing the optical information from the video cameras system (in some critical cases the car
stops abruptly).

While on the move a car continuously receives information through radio connection from other traffic participants and infrastructure objects; video cameras scan the road marking lines, the Internet of Everything provides the traffic lights conditions, road signs, moving objects. Ultra-sonic detectors constantly duplicate the distance measurement in the car perimeter.

Information received from cameras and transmitters installed in the road infrastructure contain its unique identifier, which is kept in the car board calculation machine data base. The received identifier is compared to the identifier stored in the data base if it is matched the car performs necessary maneuver according to the road situation classification and if it is not matched the identifier is rejected and the measure is done again.

This approach based on Internet of Everything lets increase the car surrounding situation information reception speed because in this case there is no need of constant scanning and the same type objects recognition. The road infrastructure objects inform the car for themselves which group road traffic participants they belong to, say a traffic light informs the type of color or a road sign informs of its type.

4. Conclusion

By creation and implementation the driverless car control system into day to day life they may effectively increase the road traffic safety or improve the road situation. The proposed technical solutions how to design intellectual driverless car control system could be used for a transport mean being manufactured (typical) without any significant car design modernization. A driverless car could be used for civilian needs and special needs or also as a mode of car conduction when it is piloted by a driver.

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