Overview of intelligent vehicle core technology and development

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Abstract. This paper introduces the key technology progress of intelligent vehicle, and analyzes the sensing technology, recognition and decision technology of intelligent vehicle. Then the tracking technology of intelligent vehicle, vehicle attitude and path planning are reviewed. Finally, the research status of intelligent vehicle is summarized, and the research direction of intelligent vehicle in the aspect of integrated control is pointed out, which lays a theoretical foundation for the further solution of intelligent vehicle control.

Keywords: intelligent vehicle, integrated System, intelligent vehicle control

1. Introduction
Intelligent vehicle is a collection of environment perception, planning and decision-making, multi-scale auxiliary driving, and other functions in an integrated System, it focus on the computer and modern sensing, information fusion, communication, artificial intelligence and automatic control technology, is a typical combination of new and high technology [1-3]. It has the automatic identification of road barriers, automatic alarm, automatic braking, keep a safe distance, speed and automatic cruise control, and other functions as the Intelligent transportation System (ITS: Intelligent Trnasportation System) is an important component. The introduction of intelligent vehicle system, can improve the rate of traffic safety and road [4-6]. At present, in cars, trucks, public transportation, and industrial and military fields, intelligent vehicle system has been applied, and the application field of diversity and is growing. Can be predicted that as the information collection, information processing technology, system engineering and related technology research and development, intelligent vehicle system will be the important domain of intelligent transportation systems research and development [7-9].

2. Intelligent vehicle key technology and research
Smart car is a collected numerous integrated system of high and new science and technology, especially the environment as the key link of smart car control access to information and intelligent decision-making, but also depends on the strong support of new and high technology, such as sensor technology, image recognition technology, electronics and computer technology, control technology. Intelligent driving decision control as shown in figure 1.
2.1. Sensing technology
Accepted human when driving a car that almost all the information from the visual, traffic signs, traffic signs, road signs, traffic pattern can be regarded as a language environment on the driver's visual communication. At the same time, human, when driving a car, through the surrounding road scene observation to determine what operation. Therefore, choose machine vision as the road scene perception of sensors is a natural choice. Machine vision applications in intelligent vehicle is shown in figure 2.

![Figure 1. Intelligent driving decision control](image1)

![Figure 2. Application of machine vision sensors in intelligent vehicles](image2)

Vision system in the intelligent vehicle is mainly used to identify vehicles around traffic environment, such as to determine the vehicle position and orientation in the lane, lane of the geometric structure, test vehicles around obstacles such as recognition of vehicles and pedestrians, traffic signs and traffic signals, etc. When machine vision is used in the intelligent vehicle must have real-time performance, robustness and practicability of the three aspects of technical characteristics. When the real sex refers to the data processing of visual processing system must be simultaneous with the high speed of the vehicle; Robustness refers to the intelligent vehicle to different road conditions, such as highway, urban standard highway, ordinary highway, etc., different road environment such as road and the driveway line width, color, texture and dynamic random obstacles and traffic, etc., as well as changing climate conditions such as sunlight and shadow, dusk and night scenery, cloudy and rain and snow, have good adaptability; Practical means that intelligent vehicles can be accepted by ordinary car users in terms of size and cost.
Intelligent vehicle system is the premise of reliable operation in a variety of sensor accurately capture environment and status information of its own, and processed, subsequent warnings or automatic control vehicles. Study how to make effective treatment, the sensor information from the analysis, and accurate determination of the environment and the state of the vehicle itself is very important. But so far, no any kind of sensor can guarantee to provide reliable information completely in any case, the multi-sensor fusion technology, the synthesis of multiple sensors to collect information and form a comprehensive description of environmental characteristic method, At present, in the field of intelligent vehicles, in addition to visual sensors, the commonly used sensors are lidar, millimeter-wave radar, sonar, infrared detection, magnetic guidance, GPS and so on.

2.2. Decision-making technology
In auxiliary driving or automated driving technology, need to make decisions based on perception system to obtain information to determine, and warned the driver or to control vehicle. For example, in the lane departure warning systems and collision warning systems, the need to predict the state of the vehicle and other vehicles in the future a certain period of time. Advanced decision-making techniques including fuzzy reasoning, reinforcement learning, such as neural networks and bayesian network technology.

2.3. Control technology
For automatic driving vehicle or auxiliary driving vehicle, the use of environmental awareness information for planning decision-making after the need to control the vehicle, such as automatic tracking of path, the high performance controller has become a crucial part of the intelligent vehicle, become the key of the intelligent vehicle. Intelligent control represents the latest development of automatic control stage, is the application of computer simulation of human intelligence, human mental and manual labor is an important field of automation. Intelligent control is an emerging discipline, it includes five aspects: hierarchical control system, expert control system, fuzzy control system, neural control system and learning control system.

2.4. Vehicle positioning and path planning
Vehicle positioning and navigation system applies vehicle automatic positioning technology, digital map and communication technology to provide vehicle with path guidance, wireless remote control and other functions. In vehicle positioning and navigation system, positioning is the premise and foundation to realize navigation function, and vehicle positioning technology can be roughly divided into three categories: Inertial navigation, radio positioning and satellite positioning. Vehicle positioning navigation system as shown in figure 3, path planning is the bridge of intelligent vehicle information perception and vehicle control, is the foundation of the intelligent vehicle autonomous driving, can be divided into global path planning and local path planning. The global path planning is in the case of a known map, using local information such as known obstacle position and road boundary, to determine the feasible and optimal path, It combine optimization and feedback mechanism is very good. The local path planning are generated in the global path planning under the guidance of the range of area, based on the sensors to the local environmental information to decision-making vehicles have to driving the trajectory of the road ahead. Compared with the mobile robot path planning, the motion of the vehicle environment has many characteristics, such as unstructured, dynamic and uncertainty, so the researchers in the use of mobile robot path planning results at the same time, also in an in-depth study of intelligent vehicle path planning problem.
2.5. Other technologies
The key technology of intelligent vehicle also includes random vehicle state estimation and the structure of the intelligent vehicle system research, etc. In order to effective control of vehicles, must be full and accurate to obtain the vehicle status parameters, such as vehicles yawing angular velocity estimation, the coefficient of friction between tire and road surface is estimated, and the vehicle side impact model of nonlinear dynamic parameter identification and so on. Because of the intelligent vehicle system is of high complexity, comprehensive, and generally need a group of researchers to research and development, at the same time in order to make the system can be made within the limited time and computing resources each function, Computation often requires a certain degree of parallelism, which raises the question of what architecture is needed to efficiently distribute computing resources over a set of processors. This is the problem that the Intelligent Vehicle Controller Architecture Architecture (IVCS) addresses.

3. New theories and technologies supporting the development of intelligent vehicles

3.1. Uncertainty theory of artificial intelligence
Artificial intelligence in certainty about simulating human intelligent logical thinking, has made great achievements, but the uncertainty in human intelligence simulation has not too big progress, but in a simulated human's thinking in images in the discussion stage. Therefore, uncertainty in artificial intelligence is the hot research topic in artificial intelligence, is also a significant forefront subject in artificial intelligence. Uncertainty in artificial intelligence is to make the machine can have the uncertainty of the brain as the representation of information and knowledge, processing ability and thinking ability, is a new developed after entering the 21st century the multidisciplinary penetrating into a new discipline, it has become the contemporary science and technology Research hotspot areas. Humans are the objective world is full of uncertainty, mankind itself also has the uncertainty in the process of cognition. Because human perception is actually a subjective response of the objective world, the uncertainty of the objective world, determines the uncertainty of human subjective cognitive process. For example, visual perception would appear even illusion, uncertainty about memory also will increasingly blurred as time goes on, and thinking in images such as lenovo, creativity and insight is no certainty.Uncertainty theory of artificial intelligence for intelligent vehicle technology research is one of the most important content is to analyze different drivers on the same uncertainty produced by the external environment stimulation and the uncertainty of the processing ways. For example, an image uncertainty knowledge is to point to in the face of the same pool of water on the road, some drivers will think that is a little roadblocks, while some drivers will find it doesn't matter. Uncertainty is handled is also facing the beach water, some drivers will choose to go round, and others will choose to slow down
directly through. Uncertainty can be further subdivided into several small artificial intelligence theory it includes rough set and fuzzy set, cloud model and particle computing theory.

4. Conclusions

As represented by computer technology and information technology of the development of high and new technology, constantly changing people's behavior and thinking mode, the artificial neural network, fuzzy control, neural fuzzy technology and virtual reality technology, new ideas, new technologies such as fold, as we stand at a new height the intelligent vehicle. This is a to be able to auto industry, traffic system and combining the information industry of the new field. Intelligent vehicle research and development for new and high technology industries around the world and a broad space for development. Europe, Japan, the United States and other developed countries while ahead, But as long as we grasp this opportunity, plan, step by step to formulate the corresponding development strategy, provide a variety of preferential policies to actively guide and guide its healthy development, so as to improve and develop our country's traffic, improve traffic safety at the same time, narrow the gap between the field and developed countries.

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