Research on Data Fusion Technology of Mobile Intelligent Robot Based on Internet of Things

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Abstract: With the development of the Internet of Things, the increasing variety of sensors and the rapid development of sensor technology, multi-sensor data fusion technology has received more and more attention. And because of its strong survivability in solving problems such as detection, tracking and identification, it can enhance the detection performance, credibility and reliability of the system, improve the accuracy of measurement data, and expand the time and space coverage of the system. Multi-sensor The application of data fusion in various fields such as military, agriculture, and industry is becoming more and more frequent. Among them, the application of data fusion technology in the field of robotics research is also in a stage of rapid development, especially in mobile robots, the application of data fusion technology is more extensive. This paper analyses the multi-sensor data fusion technology used in existing mobile robots, and conducts reasonable design and research on the development of data fusion technology in the field of intelligent mobile robot research.

1. Overview of intelligent mobile robots
Intelligent mobile robot is a kind of robot system that can realize the autonomous movement facing the target in the environment with obstacles through sensors, perceiving the environment and its own state, so as to complete certain functions. The research of mobile robot technology integrates technologies such as path planning, navigation and positioning, path tracking and motion control. It involves a variety of external sensors including distance detection, video capture, temperature and humidity, sound and light, etc. [1] as input information for mobile robots. The motion control of the mobile robot is mainly to complete the motion platform of the mobile robot and provide a control method of the mobile robot. A good-performance mobile robot motion control system is the basis of mobile robot operation and can serve as a general development platform for mobile robot research.

2. Features of mobile robots
2.1. Robot structure
The selection and design of the mechanical structure of the robot are carried out according to actual needs. In terms of robotics, researchers have carried out rich and creative work in combination with the application of robots in various fields and various occasions. Currently, there are many researches on foot walking robots, crawler and special robots. However, most of them are still in the experimental stage, and wheeled robots are rapidly developing into practical use due to their simple control, stable motion and high energy efficiency. From the lunar rover in the Apollo moon landing plan to the recently launched master thesis wheel in
the United States Research on the control problems of robots. The six-wheeled sampling vehicles in NASA’s planetary roaming program, from battlefield patrol robots and reconnaissance vehicles being developed by Western countries to the newly developed pipeline cleaning and inspection robots, strongly show that mobile robots are being used by them. Value and broad application prospects have become one of the development directions of intelligent robots.

2.2. Architecture
The robot's intelligent system has the following characteristics: information-intensive, multi-level information and knowledge representation, rich and diverse interaction with the environment, and distributed storage of information and knowledge. Therefore, it is a high-intelligence, multi-system and complex system engineering. It is not a simple connection of unit technology. The overall function of the system is the integration of various sub-systems in multi-level coordination and division of labor. Therefore, the overall integration technology of the robot is a The core issue, the main content of which is the study of robot architecture. The research on architecture mainly focuses on conscious behavior and reflective behavior. How to unify the two is a current research hotspot. The inclusive system structure adopts the so-called "perception-action" structure [2], also known as the behavior-based structure. Some experiments show that the containment architecture has many advantages in dealing with uncertainties in dynamic environments and imitating the low-level reflection behavior of animals. Recently, a new system structure based on behavior control ideas has been proposed. At present, this behavior control-based system structure is still in the stage of theoretical discussion, and a lot of work needs to be deepened.

2.3. Mobile robot path planning technology
The path planning of a mobile robot is to give a robot and its working environment information, according to a certain optimization index, seek bounded input to make the system transfer from the starting point to the target point within a specified time. The research of robot path planning began in the 1970s, and the research on this issue is still very active, and many scholars have done a lot of work. Its main research content can be divided into static structured environment, dynamic known environment and dynamic uncertain environment according to different robot working environments. According to the different ways of robots obtaining environmental information, it can be divided into model-based path planning and sensor-based path planning. Motion planning is an important problem of mobile robots. For free-moving robots, that is, the robot's motion is not restricted, the motion planning problem can be solved by calculating a path in the free configuration space. Such a path is related to the working space. A feasible free path corresponds to it. However, the movement of the mobile robot is subject to non-integrity constraints, and not all paths are necessarily feasible. In a complex and dynamic environment, the problem of obstacle avoidance in motion must also be considered. Therefore, the motion planning of a mobile robot is a more complex issue. There are still many issues to be studied.

2.4. Navigation and positioning
In the application of mobile robots, accurate position knowledge is a basic problem [3]. Related position measurement can be divided into two categories: relative and absolute position measurement. The methods used can be divided into 7 types: odometer, inertial navigation, magnetic compass, active lighthouse, global positioning system, road sign navigation and map model matching.

3. Data Fusion Technology of Internet of Things and Mobile Robots
At present, the application of the Internet of Things is more focused on the research of the underlying technologies, such as Internet of Things coding technology, identification and anti-collision technologies. How to make efficient use of massive item information, integrate
various services, and provide more humane services to enterprises or individuals is the key to the successful application of the Internet of Things.

(1) Mobile robot bottom system design: The bottom system design of mobile robot includes mobile robot control circuit design, motor drive circuit design and ultrasonic distance measuring circuit design. The software algorithms involved in the underlying design include motor drive and speed closed loop, motor code disc robot positioning, ultrasonic ranging, etc.

(2) Realization of mobile robot control system: the main content of mobile robot control system is to generate robot motion control information and control robot motion. Trajectory tracking is one of the tasks that mobile robots need to complete, and its typical working process is robot motion. Trajectory tracking is one of the tasks that mobile robots need to complete. Its typical working process is that the robot completes the corresponding movement and completes the tracking of the planned path. The input information used in the process of motion control includes obstacle distance information provided by bottom ultrasonic ranging module, position and speed information of robot provided by motor code disk, and video information collected and processed by panoramic camera and monocular vision camera.

(3) The information detection of mobile robots is divided into internal perception and external perception [4], so the sensors used are also divided into internal sensors and external sensors. Internal sensors are used to monitor the internal state parameters of the robot system, such as position, speed, acceleration, power supply voltage, wheel position, etc.; internal sensors mainly include tachogenerators, acceleration sensors, gyroscopes, torque sensors and photoelectric encoders. External sensors are used to identify external environmental information, such as environmental temperature, humidity, detected gas components, pressure generated by contact objects, distance between obstacles and robots, etc.; there are many types of external sensors, such as vision sensors, ultrasonic sensors, and laser ranging Sensors, pressure sensors, infrared sensors, temperature sensors, etc. Different sensors are integrated on the mobile robot to form a multi-sensor data fusion perception system.

4. Discussion

For mobile robots with different structures, the sensor devices involved are different, and the corresponding data fusion technology used is also different [5]. At present, the multi-sensor data fusion methods used in the field of mobile robots mainly include: Kalman filtering, Bayesian estimation, weighted average algorithm, fuzzy logic algorithm, neural network algorithm, wavelet transform method, Dempster-Shafer (D-S) theory, etc. The application of these methods can carry out the fusion of different levels such as the data layer, the feature layer, and the decision-making layer. It can also realize the information fusion among the internal track estimation system information, the ranging sensor information, and the global positioning information, thereby ensuring that the mobile robot can be a comprehensive and accurate perception of one's own state and surrounding environment, so as to make correct judgments and decisions.

First of all, we must consider the way of movement, which can be wheeled, crawler, legged, and for underwater robots, it is a propeller. Secondly, the control of the drive must be considered to make the robot achieve the desired behavior. Third, navigation or path planning must be considered. For the latter, there are more aspects to consider, such as sensor fusion, feature extraction, collision avoidance and environment mapping. Therefore, the mobile robot is a comprehensive system integrating environment perception, dynamic decision-making and planning, behavior control and execution and other functions.

Neural network algorithm is a processing method that imitates the biological nervous system. It starts from the structure of the human brain to study human intelligent behavior and simulates the information processing function of the human brain [6]. It has good fault tolerance, hierarchy, plasticity, self-adaptation, associative memory and parallel processing capabilities. It is precisely because of the advantages of neural network algorithms that its applications in data fusion are becoming more and more extensive.

The intelligent mobile robot based on the information fusion of the Internet of Things can realize a series of functions such as target recognition, target object pose measurement, accurate self-positioning, navigation, and target tracking. In the process of realizing different
functions, the number and types of sensors used by mobile robots may be different, and the applicability and pros and cons of various data fusion algorithms at different stages are also different. Generally, when directly operating on the data source, you can use neural networks or weighted average algorithms, etc.; when using the statistical characteristics and probability models of the object to operate, you can use Bayesian estimation, multi-Bayesian estimation, Kalman filtering, statistics Decision theory, etc.; and in the decision-making layer of the system, it is better to adopt rule-based reasoning methods, such as fuzzy logic, evidence reasoning, production rules, etc.

5. Conclusion
In order to be practical, mobile robot must have competent motion system, reliable navigation system, accurate perception ability, and the ability to work with people safely and friendly. The intelligent indexes of mobile robot are autonomy, adaptability and interactivity. The robot not only has the ability to recognize and operate the surrounding environment, but also has the ability to recognize and work independently according to the surrounding environment; Interaction is the basis of intelligent generation. Interaction includes three types: robot and environment, robot and human and robot, which mainly involves information acquisition, processing and understanding.
At present, among various data fusion algorithms, neural network algorithms are more suitable for mobile robots to recognize targets. It can enable mobile robots to have accurate recognition and estimation of obstacles, so as to obtain correct running trajectories. The data fusion method based on neural network can better solve the problem of correct navigation and autonomous travel of mobile robots. In order to effectively improve the calculation speed and realization effect of neural network data fusion, the data fusion model of array neural network can be used, and the decomposition and fusion of information can be realized through the self-network.

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