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Research on Intelligent Flight Software Robot Based on Internet of Things

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Abstract

2010 China Internet of Things Application Promotion Union pointed out that the robot is one of the 100 leading edge technology. 2015, the forefront of the field of robot top10 technology, including Internet of things embedded technology, simulation technology, large data technology, cloud computing robot, robot autonomy technology and so on. The robot uses the sensor technology in the key technology of the Internet of Things. In order to make life better and more convenient, the research of Internet of Things technology and application, focusing on research based on the Internet of intelligent flight spherical monitoring software robot technology. In this paper, you can use mat lab simulation robot and programming algorithm, the use of advanced programming language to develop intelligent flight robots. The research results of intelligent flight monitoring software robot technology can be applied in academia and industry and medical transportation. This paper studies the intelligent flight monitoring software robot under the Internet of Things.

Keywords Internet of Things; Monitoring software robot technology; Large data technology

Introduction

Internet of things, also known as sensor network, the definition of things is: system, laser scanner and other information sensing equipment, according to the agreement, any items connected with the Internet To carry out information exchange and communication, in order to achieve intelligent identification, positioning, tracking, monitoring and management of a network. Intelligent flight spherical theory: spherical aircraft is mainly to help fly. Unmanned aircraft compared with the traditional manned aircraft, with a portable and transport light, good motor performance [1], low working environment requirements [2], low-altitude flight capability [3,4] and other characteristics, quickly get The importance and favor of the nations of the world [5-10]. As a mobile robot with spherical rolling movement, the spherical robot has the advantages of flexible movement [11], strong adaptability to environment [12], high movement efficiency [13] and so on. It has been paid more and more attention by researchers [14-22]. Robot theory: With the development of science and technology, people's research on robots is more and more in-depth, more and more mature, and gradually invented can help people take care of life, do simple housework robots, can automatically control, repeatable Programming, multi-functional operation of the robot, according to the order and conditions in advance, in turn, control the robot's mechanical action program-controlled robot, through the guidance or other ways to first teach the robot action, enter the work program, automatically repeat the work lady A robot, a numerically controlled robot that can teach a robot by numerology, language, and the like, a sensor-controlled robot that controls the movement of the robot by the information acquired by the sensor, a robot capable of adapting to the change of the environment, controlling the adaptive control robot of its own action, Experience "work experience, have a certain learning function, and the" learning "experience for the work of the learning control of the robot, as well as artificial intelligence to determine the action of intelligent robots and so on. The application of these robots, to industrial production, people's lives and so has brought a lot of convenience, reducing the labor intensity. With the progress of science and technology, market demand and application of diversification, coupled with the past decade, artificial intelligence and sensor technology progress, people in the robot research has made great progress, dangerous operations robot, help Old robotic robots, lunar rover, underwater robots, humanoid robots, cooking robots, medical robots, and so have proved this point. Although the robot cannot break the machine now, but once it broke the "humanoid myth", the development of the robot will be infinite broad. Looking to the future, robots will not only labor, surgical assistants, conductors, cleaners and pets, as long as our imagination is endless, intelligent robots will bring infinite surprise for our lives. New technologies are often expensive at the time of the rise, for example, many years ago, GPS is only used in the military field, and now in mobile phones, cars and other household items in the use of very common, robot is also the same, with the development of science and technology, robot technology will change Get easier to get. With the related chip, sensor and motor market prices down, the cost of the robot will gradually decline; the robot's imagination will eventually go down the screen, into the homes of ordinary people, so that life is better.

Application value

The application of things: through the construction of exchange platform and application resources sharing service platform. Digitalization is the inevitable trend of urban development. Although the "digital city" construction has made some achievements, but there are some problems. Need to break the time, space and department of the many restrictions for the development of the city under the new situation to provide a good social environment, innovative city management, and thus promote the "digital city" construction. For example, "digital city" refers to the use of remote sensing technology (RS), geographic information systems (GIS), global positioning system

(GNNS), computer technology, multimedia and virtual simulation and other modern science and technology, the city's infrastructure and production, Life-related aspects of multi-subject, multi-level, all-round information processing and use, with the urban geography, resources, ecology, environment, population, economy, society and other aspects of digital, network management and services, Function of the information system. First, the social security card. Social security card multi-purpose pilot project mainly includes social security card, traffic card, also includes "card" regulations, standards, system construction, "card" background support system construction project, "card" front-end application system construction project, "card" service Support the environment construction project, and then integrate human resources, social security, civil affairs, health, family planning and petition and other areas of management resources, with information technology to enhance social security, so that people enjoy the information technology to bring convenient and efficient public services, and Expand the card holders to seek medical coverage, and gradually cover the retired, municipal public health care and rural cooperative medical care and other fields; the construction of intelligent audit system to ensure the safety of social security funds; promote social security card more than one card, social security card in the pension insurance, unemployment insurance, Employment and other areas of application development. To promote the traffic card in the traffic, garden, student management, small consumption and scenic spots and other areas of the use of more than one card, the use of real-name traffic card issued a disability card, free of charge in the disabled, free access to the park and enjoy rehabilitation services for the disabled In the promotion and application; second, intelligent transportation. The intelligent transportation system construction project includes the construction of small passenger car index control management information system, proceeds to study the traffic congestion charge management system scheme, also includes GIS geographic information system, integrated television monitoring system, health supervision and public health support capacity, and primary health care services. And to enhance the level of administrative supervision and management of medical and health services and improve the ability of telemedicine services to promote equalization of public health services to meet the needs of the people at various levels of diversified medical and health; Fifth, health insurance "card"; sixth, electronic video surveillance project Including the public area video surveillance probe installation project, infrared alarm system deployment, video surveillance system "four extensions", monitoring image information resources integration and sharing project; seventh, triple play, speed up the triple play pilot city construction, encourage radio and television, telecommunications Business two-way to enter, to support the integration of business development, improve the efficiency of information resources and network resources, etc., these large systems and projects need to be based on the method of Internet of things to develop. Development of Internet of things can shorten the development time, save labor costs, and can be developed, the edge of the wisdom of the city's knowledge, is conducive to the wisdom of the city as soon as possible, is conducive to the improvement of the people's life happiness index is conducive to the improvement of government efficiency. To overcome the traditional Internet can only access the lack of electronic equipment.

Software robot application

Robot has been widely used in military, industrial, scientific detection and many other fields. Conventional robots are typically constructed by rigid pairs of rigid modules, each of which provides one (or more) translational degrees of freedom or degree of freedom of rotation. The motion combination of all the motion pairs forms the working space of the robot end effector, which has the advantage of motion [23], but the rigidity of the structure makes its environment adaptable and the movement in the narrow space is restricted and cannot pass The scale is smaller than the robot scale or the shape of the complex channel. These shortcomings constrain the application of rigid robots in certain fields, such as military investigation, and hopefully reconnaissance robots can drill through the cracks in the wall, the small size of the door, the complex shape of the channel; mine, earthquake rescue in the robot Can be carried out in-depth investigation of the ruins; scientific detection often require the robot to enter the narrow space and so on. Software robots imitate the mollusks in nature, made of soft materials that can withstand large strain, with unlimited degrees of freedom and continuous deformation can be a wide range of arbitrary changes in their own shape and size. The software robot has an infinite number of degrees of freedom, so it has an infinite configuration so that its end effector reaches any point in the workspace [23]. Because of the low impedance of the pressure, the soft robot has better adaptability to the environment, through the passive deformation to achieve compatibility with the obstacles; through the active deformation of the robot in a different form and to achieve movement; active deformation and passive deformation, Robots can squeeze than their own normal size of the gap, into the traditional robot cannot enter the space. The software robot has an infinite number of degrees of freedom, so it has no software robot can be used as a new medical detection robot, such as endoscopy, it will be with the mouth, the excretion of the entrance to the size of the change, reduce invasive pain, and if the use of biological Decomposition of the material, when the software robot can be completed after the task can be absorbed and absorbed [24].

Based on the Internet of things intelligent flying spherical monitoring software robot technology research widely used, such as intelligent transportation, high speed, intelligent forest, intelligent agriculture, intelligent medical, intelligent city, intelligent buildings, aerospace, modern defense, etc., mainly used in intelligent Traffic monitoring and monitoring of intelligent trees in the field of comparison of the growth of flowers and trees, intelligent agriculture analysis and comparison of crop growth, thereby saving money and resources. In the aspect of urban traffic monitoring, the flight and rolling double motion patterns of the flying spherical robot can effectively combine the close proximity of the ground and the long distance monitoring of the air to provide effective traffic information for the traffic management department and improve the operation efficiency of the whole transportation system. Can measure whether the car speeding, traffic congestion and so on. The combination of unmanned aerial vehicle and spherical robot in the whole, making the robot both the characteristics of the movement, the robot will be in the industrial, agricultural, civil, national defense and other fields with a wide range of applications. The main application value is to improve the industrial level, produce social and economic benefits, for the country and society to make a great contribution.

Robot technology is the future of high technology, the development of new industries, one of the basis for the national economy and national defense construction has important significance. With the development of computer technology and network technology, robot is developing from traditional industrial manufacturing field to medical service, education and entertainment, biological engineering, exploration survey and fire rescue. Robot can be divided into industrial robot, mobile robot, and medical with rehabilitation robots, bionic robots, and so on. Mobile robots include wheeled crawler robots, leg-mounted mobile robots, humanoid robots, alien exploration robots, underwater robots, flying robots, etc. [25]. Robot in accordance with the development of content and application classification of industrial robots, manipulated robots (service-oriented robots and operating robot), intelligent robots and so on. According to the performance of the robot can be divided into large, large, medium, small, ultra-small robot. This paper focuses on small and ultra-compact robots. Robot is currently using technology to have virtual reality, 3D technology, mainly divided into two types of technology, the first is the electronic technology, mainly to the sensor-based, engage in sensor networking many of the robot, followed by computer artificial intelligence technology [26]. At home and abroad on the robot industry to lead the future development of the industry to give great expectations.

Software robot research results

Software robot is a continuation of bionic robot research, because of its excellent flexibility and adaptability to the environment, in the military, detection, medical and other fields have a wide range of applications, so the software robot research has caused the United States and Europe Of the high degree of attention. In 2007, the US Department of Defense Advanced Research Projects Agency proposed a study of chemical robots Chembots, a flexible, removable carrier that can pass through smaller than its normal size; reconfigurable its own shape and size, carrying a payload Complete a certain task. Chembots Integrated Applications Materials Chemistry and Robotics, is a medium size software robot [27]. Europe has set up octopus project teams from seven research institutions in five countries with a project cost of about 10 million euros, launched in February 2009 and planned to be completed within four years. The project is devoted to the study of octopus sensing and driving principles, the establishment of the whole body of the bionic octopus robot prototype, explore the development of software robot new methods, new technologies, new science [28]. At present [29-31], the typical software robot has the US Department of Defense Advanced Research Projects Agency funded Tufts University developed the caterpillars (tobacco moth larvae) software robot and iRobot company developed Blob bot [32-34]; Bionic inchworm [35] based on chemical gel developed by Hashimoto Shuji Laboratory of Applied Physics, Waseda University, japan; Based on shape memory alloy Ritsumeikan University developed (Shape memory alloy, SMA) peristaltic jumping robot [36-38]. Italy LASCHI et al [39-41] is developing bionic octopus; iRobot's SCHOENFELD and the Massachusetts Institute of Technology CORRELL [42] developed the chemical robot "aerodynamic chain". Although the domestic rare robot robot research reports, but some bionic robots have some of the characteristics of the software robot. Such as Zhejiang University Liu Weiting et al. [43] developed based on SMA-driven, silica gel skin bionic earthworm; Harbin Institute of Technology Fu Yili et al. [44] designed based on SMA autonomous catheter-oriented robot. Software robot in the field of robots is not a very mainstream concept, but now more and more research institutions in the study of this new robot, the image of the film is the most typical representative of the software robot. Software robot and the traditional robot is different: popular point of view, the software robot is a flexible robot, its model mostly from the natural body of software, such as machine snakes, marine aquatic animals, such as robots. **Material:** The software of the software is mainly flexible material, rather than the traditional rigid connector and shell, the easiest way is to use 3D printing to produce. **Driving method:** Theoretically can move 100 times larger than their own weight of the object, so the movement principle is also very special, the entire robot does not need to use the traditional motor and other power devices driven, the current research institutions have two main directions: One way is to imitate people or animals to do the muscles of the action, the second is the use of environmental changes to get power, such as temperature, air and light and so on. Compared to rigid robots, the software robot has many advantages, it can better adapt to a variety of environments, by the outside world after the impact will not produce great harm in the space is small, non-structural environment can complete complex tasks, such as medical , Military and detection areas. In addition, the material can be produced using 3D printing, etc., the cost is much lower than the rigid robot. There are industry insiders believe that the software robot than the rigid robot has a stronger computing power, its importance as much as liquid metal robots. Morphological control: Because the structure and material of the software robot are non-linear, and have multiple degrees of freedom, which led to the robot's task than the rigid robot more complex, the algorithm requirements are very high. At present, the morphological calculation is a research direction, it can achieve a variety of physical models. It can be understood that the morphological calculation is the robot's body can achieve the calculation task, no external algorithm. (MITCSAIL) director Daniela Rus in the software robot research, and the Massachusetts Institute of Technology and Harvard University is the field of software robot, the most powerful two colleges and universities in the field of computer science and artificial intelligence (MITCSAIL). It is foreseeable that, with the robot technology is gradually overcome the difficulties, these small and beautiful software robot will be applied to more and more areas.

Research Status of Dual - motion Modes Robot in Air Flight and Ground Motion. The US Intelligent Systems Laboratory has developed a new platform for flying robots that can be used to move its ground on the ground

The wings can be moved in a rugged road surface without the addition of an additional drive mechanism that allows the robot to minimize its overall quality. Therefore, this design reduces the total weight of the platform, thus minimizing the impact on the robot's flight performance. Its wings are spinning at 25% speed to achieve the speed of the robot 0.2 m/s on the ground. The robot can walk in different gait, crossing the ground barrier to achieve its movement in rough terrain. The mechanism components of the robot can achieve different modes of motion and can self-adjust their shape to accommodate different modes of motion, and the efficiency in each motion pattern can be improved by an adaptive form suitable for the pattern. The motion of the flying robot is improved by the adaptive deployment of the wing to increase the motion efficiency of the robot. The two kinds of motion modes of the robot are realized by a set of structural parts, and their motion reliability cannot be guaranteed. When the structural parts are damaged, the two kinds of motion modes will be affected, which is not conducive to the reliable movement of the robot. Lockheed Martin is designing and developing a fleet of vehicles called "Transformer TX" [45,46]. The robot can travel quickly on the ground and fly freely in the air, which combines helicopters and cars effectively, making it more efficient and more versatile than helicopters and cars. The fightable vehicle combines ground and air sports tools to make its application more extensive. The design is now in the concept stage, there is no physical appearance. But the robot in the low-altitude investigation, narrow geographical environment and other aspects of movement is not dominant.

University of Illinois Institute of Robotics designs a hybrid motion robot based on four-rotor "HyTAQ" [47,48]. The robot through the four-rotor device to achieve not only in the air flight, and can move on the ground. It is through the four-rotor device placed inside the spherical shell, both can protect its propeller, by the spherical shell can be rolling through the ground forward, four rotor device and spherical shell through the bearing connection, when the four rotor forward to produce forward When the thrust, the spherical shell provides ground support to roll forward around the axis. With its small size, flexible handling, the robot can be free to move indoors and outdoors.

The ground and air motion of the robot are achieved by the power of the four-rotor, and when the four-rotor device is damaged, the two modes of motion cannot be achieved, so the robot's single power unit determines its motion reliability is limited The

Research Status of Unmanned Aerial Vehicle Motion and Control Technology. The flight control system is an indispensable part of the unmanned aerial vehicle and is a key element of the UAV system. For unmanned aircraft control system is mainly to increase the system SAS, which is mainly related to the attitude control. In addition to the stabilization system, the flight control system also includes speed/ position control, heading control, 3D track tracking and so on. Unmanned aircraft is a very complex nonlinear dynamic system, experts and scholars at home and abroad on the UAV flight control technology for a lot of research, a variety of flight control structures and algorithms emerge in an endless stream [49].

Wang [50] aims at A multi-objective H2 / H robust control algorithm based on linear matrix inequality is proposed to solve the hybrid control problem of UAV's multi-input and multi-output MIMO control system. This method avoids the problem of solving the Riccati equation, but there is a problem of parameter optimization. At the same time, an internal loop adopts H robust control and outer loop adopts PID control hybrid PID / H double loop flight control system to ensure the robust stability and dynamic performance of the system, but this method cannot tolerate its own perturbation, there is a problem of controller vulnerability. Wang Hongqiang [51] modeled the flight dynamics of a rotor / ductless fanless helicopter, and studied the mechanism of the hovering of the unmanned helicopter hover, and proposed to control the movement of the unmanned aerial vehicle Way to the hood hover pendulum movement control method, combined with linear quadratic optimal control design swing control. Aiming at the system uncertainty, a multi-target control requirement of multi-loop flight control combined with robust tracking decoupling and H/PI is proposed to study the robust non-fragile control problem of uncertain system under the constraint of H index and regional pole, but in the solution method has a certain degree of conservation. Hou Xuyang [52] designed a two-rotor dish-type aircraft, through the use of two orthogonal joints to achieve the rotor system and disc links to play a similar pendulum effect to adjust the aircraft movement posture. Through the double closed-loop nonlinear PID method, the attitude control of the aircraft is carried out, and the fault-tolerant adaptive algorithm is designed to perturb the system parameters to ensure the stability and control precision. Based on the Lyapunov method and the model predictive control, the sliding mode model predictive control algorithm is designed to optimize the stability and motion performance. However, based on the system identification, if the learning method is added, the model deviation can be better eliminated.

University of Bologna, Italy [53-55] aims at Based on the high gain output feedback, the vertical takeoff and landing aircraft can solve the problem of robust feedback stabilization of the control of the linear velocity and angular velocity of the aircraft. The proposed fee-star control method is effective in the use of the ductile aircraft with uncertain physical parameters. The Royal Melbourne Institute of Technology [56] studied the intelligent control of ducted aircraft. In order to reduce the white noise interference by using the control method of the sliding mode controller and the fuzzy reasoning mechanism, the paper analyzes the attitude analysis system by using the Lyapunov stability theory, and analyzes the attitude control of the unmanned aerial vehicle by using the control method of the unmanned aerial vehicle. The degradation of the white noise interference, and confirmed the effectiveness of the control method [57]. The Mississippi University of Science and Technology [58] uses the neural network based output feedback control for the underactuated system of the four-cantilever aircraft, using Lyapunov to track the attitude of the aircraft and effectively control the aircraft under nonlinear and bounded disturbances The University of Texas at Dallas [59]. Design and implementation of a robust optimal controller for a four-rotor vehicle with a mesh spherical shell, based on optimal control of parameter uncertainty and measurement error Device can effectively reduce the attitude error. The French Ballistic and Pneumatic Research Laboratory [60] is designed based on the output feedback controller of sensors such as vision and gyroscope, which can improve the stability of the closed-loop control system of the aircraft. The Automation System Laboratory of the Federal Institute of Technology, Zurich, Switzerland [61,62]. Design and implementation of a nonlinear controller for six rotorcraft, which is designed to improve aircraft problems based on problems such as model uncertainty and external disturbances Control precision and its robustness. Mexican Computer and Automation Laboratory [63] proposed and compared three control technologies for four rotorcraft: nested saturation, thrust and sliding modes. The control of the four rotorcraft is optimized by comparison, and the strategy is used to control the aircraft effectively based on the visual feedback. Japan's Chiba University [64] designed a double closed-loop (inner and outer ring) control scheme for a nonlinear model of a four-rotor aircraft, which is easy to achieve and ensures system stability. Massachusetts Institute of Technology [65] uses adaptive control of the parameters of the four rotorcraft to improve the robustness of the aircraft. Romanian University of Craiova [66]. Attitude control of small-sized aircraft using adaptive inversion control to achieve no one's vertical and horizontal movement. Iranian University of Science and Technology [67] for the four rotorcraft unmanned aircraft nonlinear subsystems between the strong fit, the uncertainty of model parameters, input and output uncertainty and other issues, through the internal attitude control loop and external The translational motion control loop is designed with an adaptive control algorithm to improve the stability of the motion of the aircraft. The University of Western Ontario, Canada [68,69] designed a two-axis vertical take-off and landing unmanned aerial vehicle through the attitude loop and speed loop double closed-loop controller to achieve effective control of the attitude and speed. British Cranfield University [70] proposed a fault-tolerant control scheme for eight rotorcraft. The eight power outputs provide redundancy for the aircraft to ensure that the aircraft is still able to fly safely when the motor fails. By assigning an instruction to the actuator to ensure that the aircraft is in the event of a motor failure, the motor is reallocated to maintain aircraft flight stability.

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Methods

The relationship between the Internet of Things and the robot is shown in Figure 1.

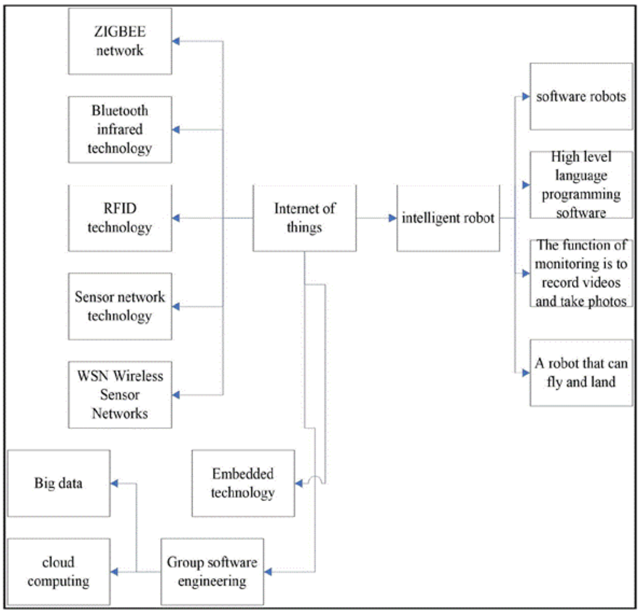

Figure 1: The relationship between the Internet of things and the robot.

Path planning problems, in order to avoid the construction and verification of obstacles: The robot and the obstacles are equipped with sensors, can communicate with each other. The construction of the environment road map, the mobile robot in the process of running its own sensor system in real time to detect the path information to update the environment in real time road map, on the one hand, the sensor system can accurately access the obstacle information directly affect the environment road The accuracy of the update, on the other hand, is also critical to finding an efficient way to reconstruct the environment. The method of neural network can be used to solve the problem of increasing the controller's data processor and reduce the responsiveness of the robot. If the mobile robot detects an obstacle to regenerate the road map.

The first step in the establishment of environmental information, positioning the robot, the robot needs to be known by the known location and the distance forward, trolley wheel speed, angular velocity and moving distance and other parameters. Due to the inaccurate model, the finite accuracy of the encoder and some unforeseen factors, such as wheel slip, the current record error will always accumulate, and even affect the next positioning. In the two-dimensional space localization problem of the robot, the state of the robot is its position and direction. The three-dimensional path planning deals more than one position variable and two pose and state variables than the two-dimensional path planning. Therefore, the two-dimensional path planning problem can be as a special case of three-dimensional path planning, which will be one of the position variables and two attitude variables can be taken as a constant. The algorithm can be applied to three-dimensional, can also be applied to two-dimensional, without any correction, which is with the conventional path planning algorithm is completely different.

The second step is to locate the obstacle through the laser detector and the ultrasonic sensor to get the distance between the obstacle and the robot and the distance between the obstacle and the obstacle and robot distance. After the work environment is established, The robot obtains the path through the path planning algorithm based on the neural network, and realizes the path planning task.

Path planning algorithm based on neural network: A Neural Network for Computing Collision Energy Function. Create an environmental roadmap, puff the obstacle, and then turn the robot into a particle, and then extract the discrete center of the obstacle as the generator of the modeling. The neural network is used to describe the environmental constraints, and the collision energy function is calculated. The collision energy function and the distance function of the path point set are taken as the objective function. By determining the value of the objective function, the motion equation of the path set is determined. The iterations of the set of points tend to the optimal planning path. B energy function. The distance energy function is defined as the sum of squares of the length of all segments. C path planning simulation and experiment. The car by detecting and judging the obstacle size, distance and other information to adjust the speed reading and braking distance, when the car suddenly encountered obstacles, re-planning the path; if the path is too narrow, the car stopped and the signal passed to the main control module In this case, the car waits until the obstacle disappears before planning the path according to the current position and planning algorithm. If the path is wide enough, the car will plan the path according to the current position and planning algorithm and adjust the parameters such as speed reading and braking distance. Car in a different environment in a timely manner to search out the shortest path and like the end of the movement. To build and solve the image of the local feature similarity of the dense matching (target recognition) to build and verify: According to the previously mentioned passive and active visual matching algorithm, the matching performance of the two is discussed and analyzed mainly from the experimental data.

Experimental part based on adaptive weight filtering matching algorithm (passive)

Step 1: To discuss the experimental part of the adaptive weight filter matching algorithm, focusing on the accuracy and efficiency of the best local matching algorithm, and analyzing the influence of the algorithm parameters on the performance of the algorithm.

Step 2: We discuss the matching experiment based on DICM, mainly elaborate the contents of IGSV and IGV for image texture quality analysis, and verify the validity and efficiency of adaptive window matching algorithm through a large number of practical experiments.

Step 3: To carry out the algorithm accuracy experiment. The experimental part based on the adaptive weight filtering matching algorithm is used to compare the accuracy and efficiency of the best local matching algorithm. The test set selects four sets of stereoscopic images in Middlebury Stereo Dataset: "Tsukuba", "Venus", "Cones" and "Teddy".

Step 4: To set the parameters of the adaptive weight filter matching algorithm. The parallax values of the four groups of matching images were calculated in turn using HC and GIF.

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Step 5: The algorithm of efficiency experiment. Adaptive weight filter matching algorithm and GIF method to run the efficiency of the situation. Program test environment for the Intel Core 2 Duo, 2.99GHZ processor, Matlab R2007a running platform.

Step 6: The impact of parameter setting on the performance of the algorithm. A match the cost of the weight coefficient. B classification clustering binary tree height.

The seventh step, the spatial standard deviation of the CJs and the magnitude of the standard deviation of Or.

Experimental part of the dense matching algorithm based on adaptive window (active)

Step 1: Image texture quality analysis.

Step 2: Adaptive window matching experiment. The third step, the algorithm efficiency experiment.

Visual navigation technology issues, target detection and obstacle detection of the construction and verification

For the first second little problem. Aiming at the requirement of autonomous navigation of unknown space intelligent robot, a design scheme of miniature visual assistant navigation system is proposed. First select the model of the sensor to determine the composition of the hardware and connection, given the system of working principle and process, the final system software development. Set up intelligent robot vision navigation platform.

The body is a multi-joint 6-degree-of-freedom manipulator that precisely controls the movement of the end mechanism to any specified position in the space and installs a visual navigation system on the end flange to assist the robot in autonomous navigation. The design of the visual navigation needs to be specific to the unknown, narrow space, and to consider the weight of the arm to carry restrictions. The main hardware part of the main display, robot control system, visual navigation head, control box and industrial computer components. Visual navigation system principles and workflow as shown in Figure 2.

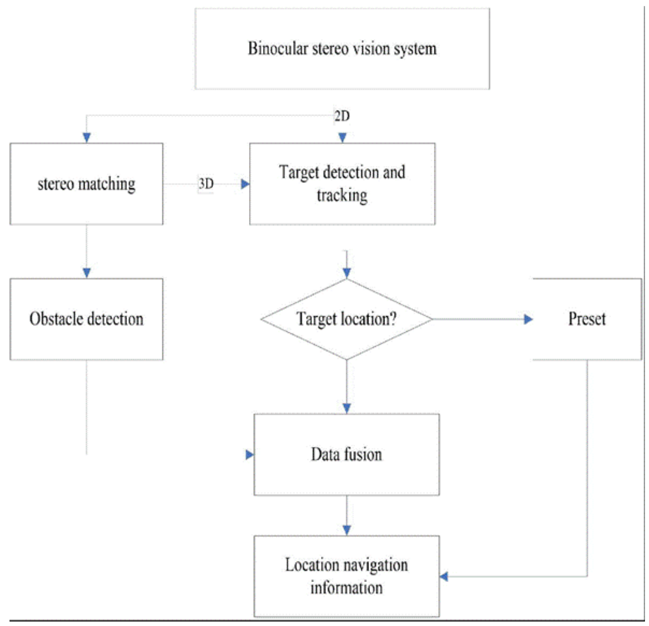

Figure 2: Intelligent robot vision navigation system and its workflow.

The various functional modules and functions are shown below:

A- Binocular stereoscopic vision system module. The module consists of binocular computers, collecting the scene of the image information.

B- Stereo matching module. First, the parallax and stereo vision of the structural information, can be targeted for the detection of objects and the environment of 3D information. Secondly, the obstacle can be detected on the basis of the disparity map.

C- Obstacle detection module. In order to avoid the robot in the process of collision or in trouble. On the basis of the parallax graph, plan a local, safe forward path.

D- Target detection and tracking module. In order to detect and identify whether the target of the robot pre-operation exists in space.

E- Target positioning and presetting modules. The main purpose is to prevent the robot from working properly.

F- Data fusion module. Consolidate the target and the position of the obstacle to determine the direction of the next movement of the robot.

G- Positioning and navigation module. The above steps to get forward direction information into a data protocol and through the RS485 transmission to the robot control system to complete the adjustment of the movement posture.

In the unknown environment, the intelligent robot visual navigation work steps: (1) Complete binocular stereo system stereo calibration, and then access to unknown environment in the image information (2), use the visual matching algorithm to reconstruct the environment of the 3D parallax graph (3), Use of disparity map for obstacle area detection (4), use 2D and 3D parallax to detect the target object. If no target is detected, it is set to the preset motion direction. Instead, locate the location of the target with the tracking algorithm and enter the information into the data fusion module (5), According to the target and obstacle location information, select the robot can pass the safe path, and keep close to the target. H system software master interface and main functions. (1) Binocular camera acquisition and image display. In the software interface at the same time show the two cameras to capture the video information, and can adjust the camera exposure and color parameters. (2) Stereoscopic vision system calibration. In the software design binocular stereo vision system calibration interface, calculate, show the calibration of the internal and external parameters and accuracy analysis results. (3) Target detection and tracking. In the software design target detection and tracking interface, the user can arbitrarily select the target area, after the calculation of the object in the image and space after the location information. (4) control system. Camera acquisition and transmission control, light intensity control. Can use Microsoft Visual Studio 2008 platform to develop system software, mainly rely on Open CV image processing library, CUDA 5.5 compiler and camera capture card development kit. The main interface is the main equipment, preview, calibration, target detection, light drop-down menu. Click the device button, you can open the camera parameter settings, the main parameters of the camera brightness, contrast, saturation and color information. Click the preview button, the system began to collect images, and in the left and right window real-time display image information. Click the target detection button, you can call up the target detection and tracking window, the upper left corner of the debugging window for the user to select the area, in the region where the user can click on the area selection, will pop up a new window, use the mouse to select the target rectangle area. The lower left corner is the parameter setting of the target detection and tracking, including the number of targets, the number of LBFs, the number of LBF comparison points, and the parameters of KNN imagery coefficient and KNN template size. After setting the parameters, the display will start tracking. The right side is the detected image coordinates and the three-dimensional coordinates in space. Click the calibration button to open the stereoscopic calibration interface. The input calibration plate information area and the calibration file input area are set for the parameter characteristics of the target information. After the input is complete, the calibration button is displayed to complete the stereoscopic calibration by the calibration process. The final internal and external parameters are shown in the corresponding areas below, and the results of the error analysis are given.

For the third little problem. The first step is to use 2D image target recognition technology to divide the scene area and divide the path that the robot can pass. Learn the color of the obstacle and the feasible channel from the image or the texture information, so that the path can be identified in the test scene. Limited to the texture information is more abundant, the environment is simple and the light changes little situation. The second step, 2D image recognition technology is susceptible to interference from the environment, their attitude changes and occlusion and other factors. The third step, the use of 2D images and 3D depth of the combination can also identify and detect the scene can be accessible area.

Target detection technology has always been one of the hot and difficult aspects of computer vision research. Target detection has a lot of classic theories and algorithms. Most of the essence of the algorithm cannot be separated from the target feature extraction and matching two key technologies. Feature matching can be understood as feature recognition, which can be done using a classifier. The method of combining local feature descriptors with generalized Hough transform is effective. The concrete reason is that the local feature descriptor is not easily affected by the target occlusion and deformation. The advantage of the generalized Hough transform is that it can still detect the target information and has strong anti-noise ability.

Target detection based on local area. The first step, the target detection technology for the full theoretical analysis and derivation. In the second step, IHRF (Invariant Hough Random Ferns) and target detection method based on RGB-D image are proposed. IHRF is 2D sensor; RGB-D is 3D sensor. IHRF combines the principle of generalized Hough transform with the RFC to establish the spatial mapping of the local information of the target on the image to the Hough parameter, and consider the rotation and scale characteristic of the feature matching. The third step is to validate the IHRF target detection algorithm. The fourth step, IHRF parameter settings for the target classification accuracy of the impact. The fifth step is based on the RGB-D image-based target detection algorithm to verify the experiment. In order to compare with other algorithms under the same conditions, the training set and the test set are the mainstream standard database in the target detection field. Are using VS2008 platform to develop related software programs, test environment for the Intel Core 2 Duo, 3.2GHZ computer research and solve the target tracking technology to build and verify: Research on Single Objective Tracking Based on Online Learning and Detection Mechanism. Moving target tracking is one of the key technologies in the field of computer vision research, and it is also an important symbol to realize intelligent robotization. This paper proposes a target tracking algorithm based on the online learning detection mechanism. The algorithm mainly deals with the first, multi-feature extraction and fusion method. Second, multi - target cascade classifier design. Finally, the traditional optical flow method and the target detection module, give full play to the advantages of both, so as to ensure that the tracking algorithm can continue to detect the target. The performance of the algorithm.

A Tracking Algorithm Based on Whole Area Information Detection and Segmentation. This algorithm mainly includes single target tracking experiment and multi-target tracking experiment. Multi - target tracking algorithm based on online learning detection mechanism. Can be divided into target detection and target tracking two modules. The steps are as follows: First, initialize the target model and classifier. Second, target detection and tracking. Third, the detection and tracking data fusion. Fourth, model updates and relocations. Fifth, record the target location. Multi - target tracking algorithm and single - target tracking algorithm. A Tracking Algorithm Based on Local Area Information Detection and Segmentation.

The first step is to verify the effectiveness of the target segmentation algorithm to ensure that subsequent tracking experiments are not affected by sample drift. The second step, the design of long-term online tracking experiment.

Results

Path planning problems, in order to avoid obstacles to the solution

The LS-SVM method in the neural network is mainly used to study the path planning and avoid obstacles.

The existing methods mainly have the shape space method, the graph search method, the topological method, the determination grid method, the grid method and so on. These methods are usually computationally intensive and difficult to extend from two-dimensional optimization problems to three-dimensional optimization problems. Neural network processing speed is high, and has a certain fault tolerance, is an efficient environment roadmap reconstruction method, dealing with three-dimensional path planning problem does not bring additional complexity.

Raster method: The small-scale mobile robot autonomous return route is obtained by processing the raster map. First, the expansion operator described in the mathematical morphology is used to inflate the obstacle described in the raster map, and the raster map is generated. The description of the obstructions is carried out by the expansion operation, resulting in a grid Voronoi diagram, which becomes a set of return path networks. Secondly, the vector path is obtained by vectorizing the two-path path of the path network to facilitate the execution of the mobile robot motion control system. Thirdly, in order to reduce the data path storage space and improve the efficiency of path planning, the vector path is topology. Finally, the Dijkstra algorithm is used to route the topology path, and a global return path with high executable performance is selected.

Research and solve the image of the local feature similarity of the dense matching (target recognition) solution

A can be used to obtain a dense parallax after a region match for all the pixels on two different viewing angles.

B According to the principle of image denoising, it is possible to reduce the noise of the parallax by filtering.

From the results of low-pass filtering, it can be seen that although the overall noise is reduced, the edge detail of the object cannot be well maintained. This phenomenon is called the edge widening effect.

D The edge filter with edge preserving characteristics is used in the adaptive filtering model of the stereo matching cost function.

E The bilateral filtering model is mainly the Gaussian kernel product of the spatial domain and the amplitude domain.

F Adaptive Filtering Weight Matching Algorithm Based on Minimum Spanning Tree.

G is a method to achieve the matching cost function filtering by using the hierarchical clustering algorithm. By using the similarity of the amplitude in the local area of the image, a series of sampling samples are obtained by the hierarchical clustering algorithm, Like the region has a larger weight, on the contrary, to give a smaller weight.

Visual navigation technology issues, target detection and obstacle detection solution

For the first second small problem, you can use the experimental method to solve, that is, to build a robot visual navigation experimental platform. For the third little problem: A light flow method. Moving a three-dimensional motion scene in space to an image is represented as a two-dimensional optical flow field. Ideally, the optical flow in the image can detect the area of the object that is relatively moving with the camera in the scene and can calculate the size and direction of the movement of the object without knowing any information in the scene. Optical flow navigation technology is the use of optical flow field size and direction to determine the distance between the object and the camera, in order to obtain their own posture navigation information. UAV vision system only use the monocular camera optical flow field information can restore the structure of the scene information, so as to assist the UAV to achieve obstacles and close to the target object and other tasks. By using the optical flow method combined with the result of three-dimensional measurement (provided by stereo vision or inertial sensor), the distance information of the object can be obtained accurately, and the reference information can be provided for the local path planning and navigation of the robot. B Navigation based on scene recognition and segmentation. And human beings to achieve independent navigation in different ways, only the use of images or other sensors to obtain information on the distance in the environment to determine the information available path.

For the perception of technology: A multi-sensor perception of external environment information, the need for a variety of data fusion through the way to achieve a unified description of the measured object. B Depending on the requirements of the robotic mission book, the combination of different sensors is selected. C to visual sensors, the integration of a variety of other sensors in one, the formation of smaller, lighter weight, more functional robot navigation system. Research on Target Detection Based on Generalized Hough Transform and Random Fern Classifier to solve and solve the target tracking technology solutions:

Research on Target Tracking Based on Online Learning Detection Mechanism. Target tracking based on overall area detection. Including single target tracking experiment and multi-target tracking experiment. Target Tracking Based on Local Area Detection and Segmentation.

Discussion and Conclusion

Mobile robot is an important branch of robotics, and with the rapid development of related technology, it is toward the intelligent and diversified direction, widely used, almost penetrate all areas. Here the use of visual navigation, the robot based on the structure of the road environment to achieve road tracking, the target point of the dock, as well as tour guide comment, and achieved good results. Navigation robots are used in large exhibition halls, museums or other convention centers to guide visitors to visit along a fixed route, to explain to visitors and to engage in simple conversations. Therefore, the navigation robot must have the functions of autonomous navigation, path planning, intelligent obstacle avoidance, target point docking and location, voice explanation and simple dialogue with the visitor, and has the ability to respond quickly and adapt to the outside environment. The basic principle that we will use robotic robots as mobile robots (Mobile Robot, MR) mobile robots is that the central processor, which is the heart of a mobile robot, uses multi-sensor information fusion technology to acquire robots themselves from multiple sensors The environment of the various information together, the integration of these information, so that the robot can understand their own state and their own environment, and real-time decision-making exercise control, in order to achieve the escape obstacles, to find the optimal path, To carry out autonomous movement and track tracking and other basic functions. Mobile robots can be divided into indoor and outdoor according to the working environment: according to the movement can be divided into wheel type, crawler, bipedal walking and no peristalsis, etc., of which the most commonly used wheeled mobile robot [71]. Environmental perception is the basic technology of mobile robots, mainly including two-dimensional and three-dimensional information processing, understanding. Data fusion and local path planning are the manifestations of high-level intelligent behavior in mobile robots. The former comprehensively understands the environment by synthesizing the information collected and processed by a variety of sensors, and the latter gives the action description of the robot according to the overall goal and the environment [72].

Robot programming commonly used four languages are VAL language, AL language, IML language, SIGLA language. Robot project is the most common inspection line, tentacles obstacle avoidance, ultrasonic / infrared barrier, Bluetooth remote control and so on.

Technical problems can be understood as technical shortcomings. Avoiding obstacles requires path planning. Autonomous planning and navigation based on some of the known environment path planning is usually used two kinds of strategies, the first is not updated road map directly through the sensor information around the obstacles, the second is the use of sensor information to update the road map and re-planning the path The first strategy is applied in an environment where the obstacle is not dense. The planning efficiency is relatively high. If the obstacles in the environment are relatively dense, the first strategy is longer than the second strategy and lacks the learning ability. The robot detects the environmental changes through a sensor system consisting of a laser detector and an ultrasonic sensor, and constantly corrects the workspace information and preprocesses the path, and searches for a collision-free path by searching the data structure. In this paper, an algorithm for online path planning based on sensor information is studied by using neural network dynamic path optimal algorithm for path planning problem of mobile robot with some known environmental information.

Question 1: Path planning problems, in order to avoid obstacles

The robot detects the environmental changes through a sensor system consisting of a laser detector and an ultrasonic sensor, and constantly corrects the workspace information and preprocesses the path, and searches for a collision-free path by searching the data structure. Obstacles mainly have buildings, trees, rocks and so on.

Problem 2: Study and solve the close matching (target recognition) of image local feature similarity.

Target recognition refers to a process in which a particular target (or a type of target) is distinguished from other objects (or other types of targets) [73]. It includes both very similar target recognition, as well as the identification of a type of target with other types of goals. The video image robot will cover these three aspects [74]. For example, the task of pattern recognition is to determine, classify, and reduce the dimension.

As the binocular stereo vision can immediately restore the three-dimensional scene information, stereo vision matching technology in the robot navigation has been widely used. An accurate, dense disparity map will provide a good foundation for subsequent obstacle detection and 3D object recognition. On the basis of stereo vision matching technology, we propose a dense matching algorithm for passive and active stereoscopic vision. The former is a matching algorithm based on adaptive weight filtering, which is an adaptive window matching algorithm.

A dense matching algorithm for passive stereoscopic vision. The main research and solve the practical problems in the calculation of high complexity, poor real-time, poor accuracy. Passive stereoscopic vision matching technology is suitable for scenes with rich texture. And in reality, there will be weak texture, or even no texture of the scene, so to rely on the natural characteristics of the method to match the great difficulties.

Intensive Matching Algorithm for Active Stereo Vision. Therefore, in order to increase the amount of texture information space, usually with the projector to the measured space projection of a special coding pattern. Due to the size and weight of the visual navigation system carried by the robot, the system cannot carry too large a projector, and choose two small-size semiconductor laser spot projectors. They can be projected to the measured space of the periodic arrangement of the spot, but the two different period, so superimposed together after a certain range of measurement to form a unique coding pattern, and then use digital image related technology can be completed Match the point of search, and finally calculate the scene of the three-dimensional coordinates. According to the characteristics of spot distribution, we study and solve how to evaluate the texture quality of the pattern in the matching window more quickly and effectively, and design the algorithm of adaptive window matching to solve the problem of dense matching in complex and non-texture scenes.

How to reduce the noise in the parallax graph, but also can better keep the details of the edge of the object, which is the stereo vision matching algorithm research and solve the problem. Focusing on intensive matching based on adaptive weight filtering.

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Question 4: Study and solve the target tracking technology

To obtain the environmental information through the visual sensor, through the effective processing and analysis of image information to solve the unknown complex environment, the robot target detection and tracking of key technical issues.

Target Tracking Meaning: Target tracking is based on the target color and texture to determine the location and area of the object, there are area-based tracking, model-based tracking, tracking based on target characteristics, and so on.

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