

# Research on Navigation System of Patrol Robot Based on Multi-sensor Fusion

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**Abstract:** In this paper, the limitations of single navigation system are analyzed in view of the problems of position loss and navigation failure of inspection robot in actual industrial scenarios. For different application environments, a multi-sensor fusion navigation system is proposed to improve the accuracy of navigation and positioning by omni-directional monitoring.

## 1. Introduction

Robot is a high-tech product of civilization and Science in the 21st century, which brings great convenience to people's life and industrial production[1]. At the 2018 World Robot Congress, more than 200 Chinese and foreign robotic enterprises appeared collectively. In the exhibitions of industrial robots, service robots and special robots, service robots have become a hot spot. Compared with the previous situation of industrial robots singing the leading role, this service-oriented robot has made enough eyeballs [2]. Patrol robot belongs to professional service robot. The definition of professional service robots is mainly used to complete commercial, public, medical and other tasks, with special operators of robots. Rehabilitation robots, surgical robots, logistics handling robots, power inspection robots in public utilities are all special service robots[3]. Patrol robot has been applied in agricultural production, substation maintenance, bridge and tunnel maintenance, cable anomaly detection and so on. Outdoor inspection robots will replace the traditional manual inspection and become the main development trend in the future, and the advantages of outdoor inspection robots are more obvious. Using outdoor robot patrol can standardize and digitalize all patrol processes, patrol in accordance with the established route without dead angle, real-time image and related data return, and through the return of relevant data, can also establish a large data system of garden patrol work, laying a solid foundation for the whole wisdom garden. Compared with the traditional manual inspection method, the convenience, reliability and economy of intelligent inspection robot are particularly prominent[4-5].

## 2. Classification of Patrol Robots

According to the application scope of patrol robot, it can be roughly divided into: substation patrol robot, pipeline patrol robot, explosion-proof patrol robot, agricultural intelligent patrol robot and intelligent garden patrol robot.



Figure 1 Substation Patrol Robot



Figure 2 Pipe Gallery Patrol Robot



Figure 3 Explosion-proof inspection robot Figure 4 Agricultural Patrol Robot

### 3. Composition, Structure and Function of Patrol Robot

The application system of patrol robot includes robot end, security management platform, control terminal and communication network system. The robot end includes robot body and robot charging pile.

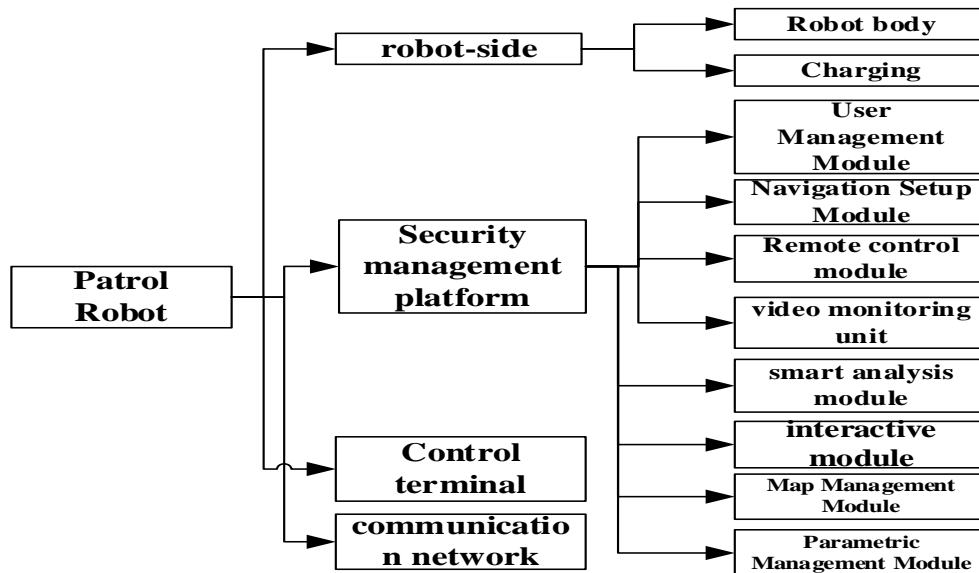


Figure 5 Composition and Structure of Patrol Robot

Among them, the function realization ontology of the robot terminal can realize autonomous walking, autonomous charging, one-button call for help, voice intercommunication, media delivery, video information collection, face information collection, environmental information collection, etc. The communication terminal completes the connection between the robot and the server and the establishment of data channels to support the 4G network and WIFI network; the robot control terminal is the robot control command and management. The instruction input terminal is also the display window for the robot to collect information. Users can realize all the control of the robot through the interactive interface of the control terminal, including navigation path setting, navigation task setting, electronic fence setting, remote control, video intercom, broadcasting, riot control, and can also manage the robot and users who access the control platform, including the basic parameters setting of each subsystem of the robot, the configuration of the access information of the robot, users. Information settings, user rights control, etc. Users can view all kinds of field information collected by the robot in the control interface, including video information, environment information, face information, robot status information and so on. Maintenance managers can set patrol tasks, adjust parameters of robots, and control robots remotely through PC or police service in central control room. They can also view real-time and historical monitoring

video, environmental information and alarm records. Intelligent security management platform is the information processing platform of robot system, which has the functions of robot management, task scheduling, data storage, data analysis, user rights management and so on. Robot background management and control server includes user management module, navigation settings module, remote control module, video monitoring module, intelligent analysis module, interactive management module, map management module, etc. Parametric management module, robot management module, responsible for robot management, task scheduling, intelligent monitoring, multimedia management, face recognition, pedestrian detection, large data storage and analysis.

#### 4. Navigation System of Patrol Robot Based on Multi-sensor Fusion

At present, there are some difficulties in the application and popularization of intelligent garden outdoor inspection robot, such as weak environmental adaptability, inadequate sensitivity of outdoor concession avoidance, inaccurate outdoor positioning accuracy and so on. When the outdoor inspection robot deviates **from** the preset running route due to positioning errors, it will not be able to correctly calculate and correct the current position and running route. When this happens, the robot will easily impact the facilities in the station and cause it to stop running. For this reason, the key problem in the research of patrol robot is positioning and navigation. The multi-sensor fusion navigation system can avoid the loss of navigation position and improve the stability and reliability of real-time positioning information of inspection robot. The structure of multi-sensor navigation system is shown in Fig.

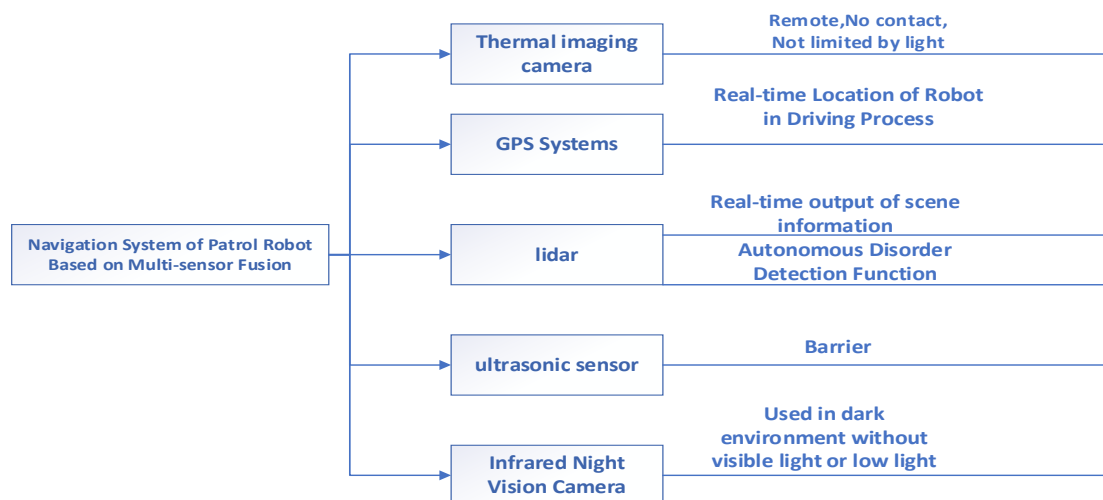


Figure 6 Navigation System of Patrol Robot Based on Multi-sensor Fusion

Thermal imaging technology uses infrared detector and optical imaging objective to receive the infrared radiation energy distribution pattern of the target to be measured and reflected on the photosensitive elements of the infrared detector, so as to obtain the infrared thermal image, which corresponds to the thermal distribution field on the surface of the object. Generally speaking, infrared thermal imager is to transform the invisible infrared energy emitted by objects into visible thermal images. Thermal imaging detection technology has the characteristics of long-distance, non-contact and non-sampling. At the same time, thermal imaging is not affected by illumination, and can make the image clear no matter day or night. GPS is a terminal for positioning or navigation by receiving satellite signals. Infrared night vision camera is mainly used in dark environment without visible light or low light. It uses infrared transmitter to actively project infrared light onto the object, and infrared light is reflected into the lens for imaging. Ultrasound sensor is a sensor that converts the ultrasonic signal into other energy signals (usually electrical signals). It has the characteristics of high frequency, short wavelength, small diffraction phenomenon, especially good directivity and directional transmission. Ultrasound has great penetration ability to liquid and solid, especially in solids with opaque sunlight. When ultrasound

touches impurities or interfaces, it will produce significant reflection and form reflection echoes. When it touches a moving object, it will produce Doppler effect. Ultrasound sensors are widely used in industry, national defense, biomedicine and so on.

## **5. Conclusions**

Firstly, this paper describes the application background of inspection robot, and then studies the general classification of inspection robot and the structure of its application system. Aiming at the problems existing in the application of inspection robot at present, a navigation system based on multi-sensor fusion is proposed. This system can be used for all-round detection, positioning and navigation in various application environments, and meet the basic needs of industry.

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