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High risk environment information acquisition and prediction robot

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Abstract: **This paper designs a robot for information acquisition and prediction in high risk environment. The robot can be widely used in disaster areas, chemical leakage after the earthquake and other high-risk environment information collection. The robot is equipped with common hazardous gas detection devices and temperature and humidity sensor equipment, as well as a soil collection mechanism and video collection system. The robot can transmit data and video in high-risk environment to off-site staff, and realize the control of the robot by remote control, so as to improve the real-time performance and safety of on-site work.**

Keywords: Robot; High-risk environment; Information collection; Data transfer

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1. Introduction

The high-risk environment information acquisition and prediction robot designed in this paper includes the high-risk environment detection module, the battery module, the communication module, the information processing and storage module and the mobile module in the system design. The high-risk environment information acquisition and predict the robot through the battery module to provide the energy to make the robot stable work. When the robot starts, the driven mobile module, make the robot by means of wireless remote control and steering, the robot moves on in the process of high-risk environment detects the real-time detection module on the surrounding environment. High-risk environment detection module to detect all the data in the image data and the surrounding environment, these data through information processing and storage module for processing and storage by the communication module after the real-time transmission of data to a user terminal. The overall scheme design block diagram of the robot is shown in Figure 1.

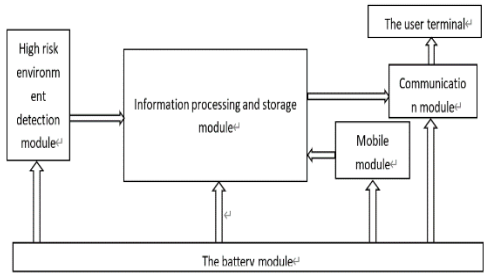

Figure 1. Block diagram of the overall scheme design of the robot Hardware system design.

2. High risk environment detection module

This high-risk environment detection module is mainly used to detect various parameters in high-risk environment, including toxic gas detector, temperature and humidity detector, soil detector, radiation detector and video monitoring instrument. The soil detector is made of Hitachi x-met spectrometer, which is light and durable. The toxic gas detector adopts ms600-6 composite gas detector, the temperature and humidity detector adopts M9405 temperature and humidity detector, and the radiation detector adopts yq07-adm300. These components can be used to comprehensively detect data in high-risk environments. The panoramic camera of tp-link brand IPC525CP can be used for the video monitoring device.

The real-time data of the high-risk environment detection module are summarized through the system and the danger degree of the high-risk environment is judged. The system will draw the real-time data transmitted from the field robot into a table and analyze the changing trend of the data to judge the specific situation of the environment. This high-risk environment detection module is capable of rapid detection of environmental temperature, humidity, soil moisture, salinity and pH, as well as rapid analysis of soil components in samples, and detection of toxic gas and high-energy, low-energy X and UV rays. The shell of each detector in the high-risk environment detection module is made of solid cast aluminum and aero-grade titanium alloy. In addition, it is equipped with a universal fully enclosed humidity and temperature sensor, which can be inserted into the hard soil without damage and has a long service life. The schematic diagram of the high-risk environment detection module is shown in Figure 2.

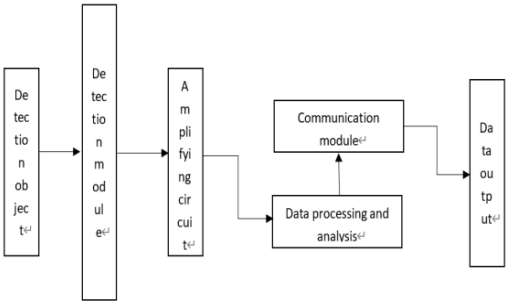

Figure 2. Schematic diagram of high-risk environment detection module.

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3. Information processing and storage module

The CPU can use STM32F103ZET6 processor, and the storage and processing modules include data storage, program storage, signal conditioning equipment and A/D converter. Among them, lcw-s01 memory is used for data storage and program storage. Transmitter is used for signal conditioning equipment to convert the physical quantity. Excitation signals are measured by the detector into electrical signals, such as voltage and current, and then convert or digitize these electrical signals into binary data for data storage.

4. Robot structure design

The main body of the robot designed in this paper was placed symmetrically on both sides. The components of the high-risk environment detection module were reasonably arranged on the main body, which was conducive to the accuracy of detection results and the maintenance of the mechanical balance of the main body. The moving module was connected with the main body and could adjust the wheel distance between the corresponding two wheels. The driving wheel of the mobile module was driven by an embedded motor, and the telescopic device USES an electric push rod. The end of the telescopic part of the electric push rod was connected to the wheel shaft of the mobile module. The main body was equipped with solar panels, which were connected to the battery. The front of the fuselage was equipped with lighting equipment. The back end of the main body was equipped with GPS radar to locate the main body in real time. The structure design of the robot is shown in Figure 3.

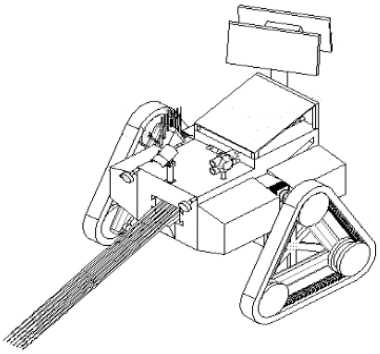

Figure 3. Structure design of robot.

5. System testing and analysis

The robot was composed of multiple sensors, which were used to obtain comprehensive and complete information about the current environment. Therefore, the main algorithm of the robot is embodied in the fusion algorithm. Therefore, the core of the robot algorithm is fusion algorithm. For the robot, the information collected by the robot was diversity and complexity. Therefore, the basic requirements for the robot algorithm were reliability and multi-line processing capability. In addition, the robot has certain requirements for the speed, accuracy, preprocessing ability and coordination ability of the algorithm. The fusion algorithm of the robot designed in this paper included weighted average method, kalman filtering method and multi-bayesian estimation method.

The weighted average method was used to weighted average the data information of the sensor. The result was used as the fusion value. Kalman filtering method was mainly used for data fusion of low-level real-time multi-sensor. This method used the statistical characteristics of the measurement model to infer and determine the optimal statistical fusion and data estimation. By referring to each sensor, the relative probability distribution of each reference object was combined into a composite cumulative distribution function to minimize the likelihood function of the distribution function, so as to provide the final fusion value of the multi-sensor information. The robot has three algorithms mentioned above at the same time. Each algorithm has its own advantages. It could provide optimal data for the system in different environments. The system flow chart is shown in Figure 4.

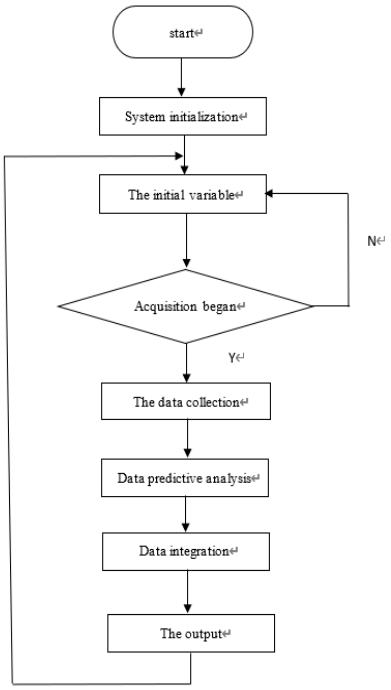

Figure 4. System flow chart.

6. Conclusion

The robot has the characteristics of flexibility and obstacle surmounting ability. The robot eliminates the internal complex mechanical transmission structure can reduce the overall weight and the power consumption of the whole machine, can improve the stability and reliability of the robot operation. Many modules of the robot work together to improve the practicability of the robot. The robot is equipped with a large number of detection equipment, unique signal processing and

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reasonable use of algorithm, which greatly improves the accuracy of environmental information prediction.

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