# *Design of Intelligent Control System for Mine Fire Extinguishing Robot Based on Interactive Data*

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***Abstract:*** In recent years, with the rapid development of science and technology, the research of intelligent robots has great room for development in practical applications. Robotics combines artificial intelligence, automation, sensors and information technology. The emergence of intelligent robots has freed humans from heavy physical labor and has replaced humans to monitor and control areas that people cannot reach. How to deploy a wireless monitoring communication system for rescue robots that can monitor and stably transmit environmental information in a complex mine disaster environment is already a very important research content. In view of the fact that many domestic newly built mines have already built industrial Ethernet, wireless technologies such as WIFI have been selected in the mine to achieve a relatively convenient premise for wireless services. It is extremely important to have timely and accurate rescues for disaster relief personnel, reduce casualties and save state property.

## 1. Introduction

The robot carries the mobile node to the mine environment, and the integrated sensor on the node collects the environmental information, and then transmits the wireless node to the gateway node connected to the upper computer through the mobile node. After being processed by the host computer software, it is used for environmental monitoring and analysis and judgment. The mine mobile robot platform adopts a four-wheel structure. The chassis frame is made of aluminum. The overall structure is simple and compact, and the structural parameters of the mechanical platform can be changed by adjusting the length of the profile to obtain different sports performance. The main control board of the mine mobile robot experimental platform integrates ultrasonic obstacle avoidance circuit, drive motor circuit, remote control circuit and serial port circuit.

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In general, the development level of coal mine rescue robots reflects the level of research in the field of mine robots at home and abroad to a certain extent, but the current research is compared with the actual application requirements, the gap is still very large, there are still Many key technical issues to be addressed. For example, the design of mobile mechanisms, robot control and communication systems, autonomous navigation positioning, energy supply, etc. Among them, the communication system as a bridge connecting the site and the disaster relief center is the first problem to be solved, which greatly affects the integration and intelligence of the data transmission information transmitted by the disaster relief robot.

In summary, with the continuous improvement of the coal mine rescue robot system and the continuous development of the mine wireless communication system, the practical application of the coal mine rescue robot in the underground has been greatly improved. However, research on the coverage of underground wireless networks, robotic remote communications, rapid construction and recovery of accidental downhole communication systems needs to be deeper. A stable and reliable communication system is an important basis for the underground rescue robot to work safely downhole, and it is also an important prerequisite for ensuring the smooth implementation of rescue work. Real-time collection and analysis of disaster environment information under the mine provides important decision-making basis for the formulation of rescue plans and timely rescue.

## 2. The Proposed Methodology

### 2.1 Interactive Data Collection.

Traditional data preprocessing techniques are not well suited for big data environments. In a massive data scenario, a data preprocessing process involves extracting information from a data table with 10 million rows of records, often taking hours. Time, and thus the efficiency of the entire system will become extremely low. In the face of the challenges brought by big data, Hadoop technology has become the standard for big data processing. Many large enterprises use Hadoop and its related products Hive, Pig, etc. to solve data pre-processing. Handling problems. Although Hadoop can process data efficiently, the disadvantages are obvious. Hadoop is based on the MapReduce batch method and the processing is slow.

The data preprocessing process based on Hadoop relies on the operation of the job, lack of interactivity. These operations are performed in batch mode. There is no feedback in the whole process. Any deviation may lead to redoing of the whole step. To solve this problem, This paper explores the implementation of interactive data preprocessing based on Spark technology. The system of this paper makes full use of the advantages of Spark, establishes an interactive execution engine based on Spark, and provides common data preprocessing components. The system also provides a spreadsheet form. The interactive front end, the user's each operation result can be displayed very intuitively, and can be revoked at any time, thereby increasing the efficiency of data preprocessing.

### 2.2 Features of Interactive Data Exploration.

Traditional Web data exploration queries or search engines represented by Google and Baidu have characteristics such as keywords and versatility, but their limitations and shortcomings are particularly evident in the era of information explosion. For example, based on the content filtering method, the user's future interest can be estimated based on the user's prior interest, but the user cannot find new resources of interest, and only resources similar to the user's already interested interest can be found. Another advantage, based on the collaborative filtering method, is that it can discover new information of interest for the user, but it is difficult to solve the problem of sparsity and scalability.

The query dynamics and interactive feedback of interactive data exploration are complementary. The interactive feedback is reflected in the system that dynamically adjusts the query according to the user's behavior, accurately predicts the data, and provides a set of matching user interests, providing users with more accurate and personalized query results. For example, in the AIDE system, when the relevant object phase is found, the data is classified by the user's relevance feedback, and the sampling area is determined to improve the accuracy of the labeled sample, so that the scope of the query result optimization in the next space exploration is more accurate.

In interactive data exploration, the introduction of learning initiative can improve the efficiency and accuracy of data exploration. The method of machine learning is applied to all stages of data exploration.

### 2.3 Visual Enhanced General Data Mining Method.

Before using the data mining method, the user can use the visualization method to pre-explore the data. This method helps the user to obtain the approximate distribution characteristics of the input data, and can guide the subsequent data cleaning, parameter setting and other work. Visualization It can also be used to improve the interpretability of the results, so that expert users in the field of non-data mining can also draw certain conclusions from the algorithm results. The Explainer system proposes an interpretation method of classification results, which will be the normal of the linear classification plane. The direction is interpreted as a new meaningful dimension, and the data points are sorted according to the normal dimension.

In addition to simple input or output data visualization, iterative visualization methods help users modify input parameters or data based on existing exploration results, generate new models and output results, and use iterative strategies to guide users to optimize algorithm results. .

In the past few decades, although database management system evolution has provided complex data management capabilities, management query tools are relatively primitive compared to big data. One of the reasons is that queries are usually output through the application. After the debugging is successful once, it can be reused many times. As the way in which interactions change, scientists need to collect, store, retrieve, explore, and analyze large amounts of data in areas such as biology, physics, astronomy, and earth sciences, and they need the ability to explore analytical data queries. In these new contexts, data management systems must provide powerful query management capabilities that improve the technology through query recommendations and optimization of query results, enabling implementation from query browsing to automated query recommendations.

### 2.4 Intelligent Fire Extinguishing Robot Software Design.

When the robot detects obstacles approaching the robot while advancing, the robot should change the trajectory to avoid collisions. The robot first detects if the front distance is less than 20 cm. If it is less than 20cm, it is judged whether the left side distance is smaller than the right side distance. If it is smaller, the position will be turned right, otherwise it will turn left. The robot makes corresponding actions according to the distance of the detected obstacles, effectively avoiding the obstacles from advancing.

The function of the fire source is to determine the position of the fire source by analyzing the measured value of the electronic compound eye sensor, and then drive the motor to bring the fire extinguishing robot close to the fire source. By connecting an electronic compound eye sensor, the robot can detect a source of fire or a high heat source with a viewing angle of 180 degrees. After the robot starts, it will read the measurement data of the electronic compound eye. If the maximum value of the electronic compound eye measurement data exceeds 250, it is considered to have reached the fire source, so the program control robot stops traveling. If the measured maximum value is less than 35, it is considered that there is no source of ignition and the robot will not advance. If the measured maximum value is greater than 35 and less than 250, the fire-fighting robot will further analyze the electronic compound eye measurement data, find the specific orientation of the fire source and drive the motor to bring the robot close to the fire source.

During the debugging process, we improved the sensor data transmission speed and improved the stability of the fire extinguishing robot. The height of the infrared compound eye sensor is improved, enabling the robot to accurately identify the direction of the fire source. After repeated debugging and improvement, the operational stability of the intelligent fire extinguisher and the accuracy of judging the fire source have been greatly improved, and the performance of the fire extinguishing machine has been significantly improved.

### 2.5 Wireless Channel Characteristics and Hardware Design of Mine Mobile Communication.

The channel refers to the medium that carries and transmits information, and the wireless channel corresponds to wireless communication, which is an image metaphor of the path between the transmitting end and the receiving end. Since the transmitting antenna induces current, electromagnetic oscillations are generated at the transmitting end, and electromagnetic waves are radiated, and finally received by the receiving end to generate an induced signal.

The characteristics of electromagnetic wave propagation are the first problems to be studied in any wireless communication system. Propagation characteristics are directly related to the ability of communication equipment, the determination of antenna height, the calculation of communication distance, and the technical measures that must be taken to achieve high-quality and reliable communication. Moreover, for a wireless channel of a mobile communication system, its channel environment is more complicated than a channel environment of fixed wireless communication. Since the mine roadway is a narrow enclosed space, the propagation of wireless signals in the roadway, in addition to direct radiation, there are many other propagation mechanisms, such as reflection, refraction, scattering, diffraction, and so on. This can cause multipath effects of the received signal.

The intelligent fire extinguishing robot can use the flame sensor to determine whether there is a fire source in front. The flame sensor is mainly composed of five infrared receiving tubes and several resistors and capacitors. The circuit schematic is shown in Figure 3. The flame sensor can detect the flame or the light source with the wavelength in the range of 760~1 100 nm. The horizontal detection range is about 60o. The flame sensor is directly connected to the I/O port of the single-chip microcomputer. When there is a fire source in front of the robot, the infrared receiving tube resistance value When it becomes smaller, the voltage returned by the I/O port becomes lower, and the measurement result is displayed on the digital tube, and the value is from 1 to 1024.

The ground monitoring layer is mainly composed of ground staff, data transmission interface and monitoring host. The monitoring host is equipped with monitoring software and equipped with multi-screen display system. In addition, the ground monitoring layer can be expanded and configured, for example, it can be equipped with closed-circuit television, network server, etc., so that the underground disaster environment can be more clearly and intuitively reflected. Each downhole monitoring device is assigned a fixed IP address. When the host computer needs the device to perform the corresponding action, it only needs to send the address and command to the communication network. Through the corresponding address identification, the monitoring node will respond to the host according to the received host command, decide to send information data or perform actions to achieve the purpose of monitoring. The ground personnel monitoring layer issues relevant operational commands according to the transmitted data information, and can monitor the disaster level and formulate corresponding measures to ensure timely rescue through the video and environmental parameter monitoring information uploaded by the underground rescue robot monitoring system.

Different from the information collection methods of other monitoring systems, the rescue robots carrying the collection equipment developed in this subject can walk along the roof of the paved mine roadway, which not only avoids complicated path planning and obstacle avoidance, but also realizes all-round and multiple angle information detection.

## 3. Conclusion

The main program of the control system of the fire extinguishing robot consists of the following main subroutines: the forward subroutine module, the steering subroutine module, the backward subroutine module, the sensor subroutine module, and the stop subroutine module. This paper designs an intelligent fire extinguishing robot based on the interactive data acquisition scheme. The robot integrates an infrared ranging sensor and an infrared flame identification sensor, which is a good way to complete the stable walking of the intelligent fire extinguishing robot. Only fire-fighting robots can accurately detect fire sources and effectively implement fire-fighting functions. After repeated debugging, a fast and accurate fire extinguishing was finally achieved.

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