

STM32-based all-terrain remote rescue exploration trolley

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Abstract

The all-terrain remote control rescue and exploration vehicle based on STM32 has the functions of laser and ultrasonic ranging, attitude real-time perception, thermal imaging and long-distance low-power communication. Obstacle avoidance function and attitude awareness can help operator to posture and position of the equipment make accurate judgment in time to rescue to explore further to adjust the position and the location of the car, we can design the thermal imaging function can be helpful for operator fast accurate positioning the location of the trapped workers to shorten the rescue time, fully utilize the golden 72 hours of post-disaster relief, Greatly improve the survival rate of disaster victims.

Keywords

MCU-STM32 chip·LoRa wireless communication technology·Ultrasonic sensor ·Thermal imaging technology.

1. Function introduction of the system

The system consists of STM32 microcontroller, thermal imaging module, laser ranging module, gyroscope sensor, camera module, ultrasonic sensor and information receiving system. By thermal imaging sensors, camera module, laser range finder, gyroscope, ultrasonic range finder environment terrain information collection, the optical signal, gravity signals, acoustic signal into electrical signal is transmitted to the STM32 MCU signal processing, again by LoRa wireless communication module to the data terminal storage, analysis and display the data, The operator can plan the exploration route in real time through the computer to detect the area that needs search and rescue, and provide reliable terrain information support for the formulation of rescue plan.

When used in geological disaster rescue operations, our works can plan the forward search route of the car in real time through terminal equipment, and conduct multi-dimensional efficient search of the demarcated area through sensors such as camera equipment and infrared sensors, which can not only speed up the search and rescue progress, so that the wounded can get timely treatment. But also can enter the search and rescue personnel difficult to enter the terrain complex and narrow gap area, for the commander to provide real-time reliable terrain data for the commander to adjust the search and rescue plan according to the specific terrain in real time. In the exploration of dangerous terrain, the trolley can also replace the inspectors to explore the dangerous environment, effectively improve the safety factor of the explorers in the dangerous area. At the same time, all kinds of sensors attached to the trolley can also provide first-hand field data for the rear operators, providing significant help for human scientific research and exploration activities.

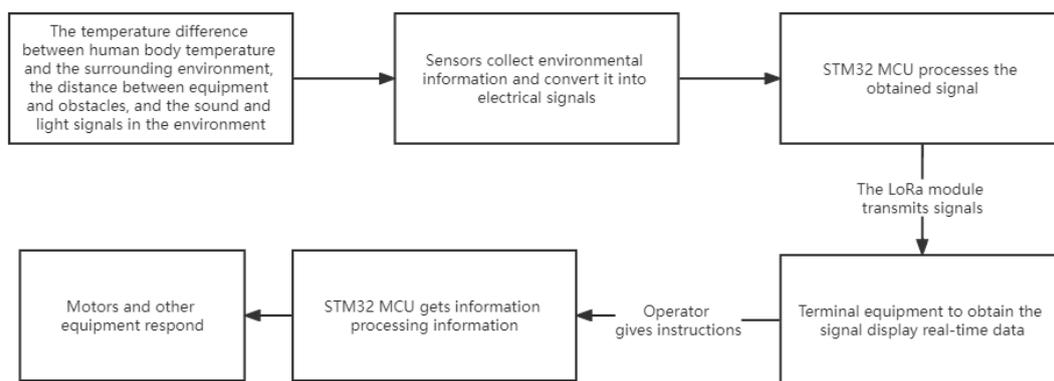


Fig.1. Work flow chart of all-terrain remote control rescue and exploration vehicle based on STM32

The research body is divided into three parts: hardware drive system, detection system, signal transmission system.

Auxiliary functions: terminal control system.

1. Hardware drive system

STM32 processor is mainly used to drive all kinds of sensors and mechanical structures, receive and process all kinds of information and instructions from sensors and cloud, and control the car to carry out activities according to the instructions. During the running of the car, it will constantly repeat this process, so as to realize the organic combination of various components.

2. Detection system

Detection system mainly adopts the ultrasonic module, laser radar, screw, thermal imaging instrument sensor module and video module, in the process of the travel of the car, can through the camera module, ultrasonic module real-time data collection and the surrounding environment, the car with a gyroscope sensor to own space posture real-time monitoring, The detected data will be compared, processed and calculated in THE STM32 microcontroller, and then the processed signal will be transmitted to the operating terminal through LoRa module and displayed in the form of real-time images to assist the operator in operation.

3. Signal transmission system

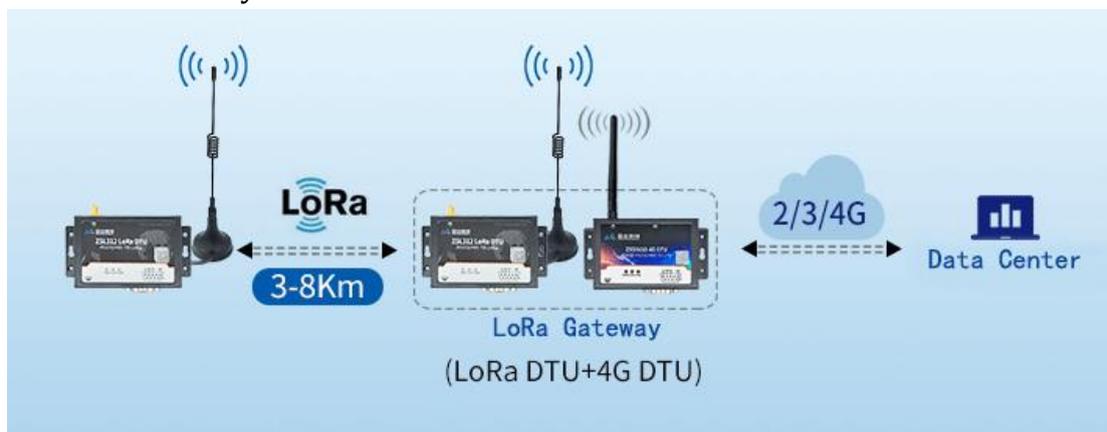


Fig.2. LoRa communication process diagram

LoRa wireless communication technology is used in the communication between the car and the terminal. LoRa is a long-distance wireless transmission technology based on spread spectrum technology. The reason why we choose LoRa wireless communication technology is firstly because of its long communication distance and strong anti-interference ability, which is suitable for the working environment with low signal intensity and large working range. Secondly, because of its low power consumption, the receiving current is only 12mA, the

transmitting current is only 32mA, and the sleeping current is less than 1 μ A. It can greatly improve the endurance of the equipment without increasing the mass and volume of the car. The signal transmission system designed by us increases the endurance of the equipment on the premise of ensuring the communication distance and quality.

4. Terminal control system

The operator can use the display screen of the terminal control system to intuitively see the environment and attitude of the car, make a judgment according to the real-time terrain conditions and carry out the next operation, in order to achieve the ultimate goal of improving the efficiency of search and rescue.

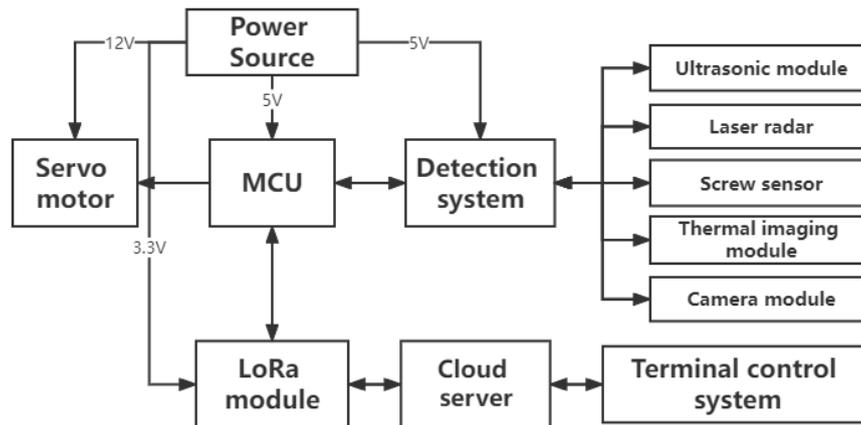


Fig.3. Block diagram of all-terrain remote control rescue and exploration vehicle system based on STM32

2. Conclusion:

We through the STM32 MCU to control the whole system, using the ultrasonic module, laser radar and other equipment for terrain scanning, expand the scope of real-time detection and reduce the error caused by a single sensor measurement to improve the precision of topographic maps are drawn, low latency over a long distance by LoRa communication protocol and low power consumption of the human-computer interaction function, While ensuring the timeliness of information, the endurance of the vehicle is greatly improved, which provides great help for search and rescue and exploration.

References:

- [1] The design of high precision ultrasonic ranging system based on STM32 microcontroller [J]. Yuan Jie, Chang Taihua Electronic Design Engineering 2011(15)
- [2] Design of multi-functional intelligent Search and Rescue vehicle [J]. Li Zhengqing, WANG Jian Shanxi Electronic Technology 2016(04)
- [3] Design and implementation of intelligent navigation Obstacle Avoidance Car based on STM32F103 [J]. Jiang Zhongyu, He Zhenpeng, Hu Jin Experimental Science and Technology 2019(03)
- [4] Research and Design of ultrasonic ranging System based on MICROcontroller [J]. Sha Aijun Electronic Technology 2009(11)
- [5] Research on Autonomous Navigation of Mobile Robot on Uneven Terrain [D]. Gu Jiajun, Shanghai Jiaotong University, 2010
- [6] Motion and path planning of a novel multi-mode mobile parallel robot based on chessboard-shaped grid division[J] . Wang Zhaotian, Li Yezhuo, Yao Yan-An. The Industrial Robot . 2018 (3)