A design of hexapod robot control system based on 430 MCU

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Abstract. This paper presents a new multi-functional hexapod robot control system. The basic framework includes the steering gears and the brackets, the wireless controller remotes signal to the main control board, and servo control board outputs multiplex PWM waves to respectively control steering gears. Front-facing camera and WIFI wireless module can realize video image and ultrasonic obstacle avoidance. By experimental verification, hexapod robot is stability, the gait algorithm controls accurately. It can move stably on the ground, and across small obstacles and slopes.

Introduction

Robot is senior integration cybernetics, theory of mechanical principle, automatic movement principle, electronic, computer science and the principle, material science and comprehensive product of bionics. Robotics since the last century has been one of the top academic and industrial research and development. This design scheme is based on the application of robot, Design of six legged gait driving robot, and Front-facing camera, By WIFI real-time transmission to the computer, and using wireless remote control can make the robot work in a variety of environments, Such as the ruins after the earthquake, underground pipelines, coal mine, forest and other complex environment, Can realize the investigation, detection and other functions.

System scheme hardware circuit

In nature and everyday life there are some places where people are hard to reach or there may be unknown or even special occasions that may be harmful to life, not suitable for human detection is an urgent need for exploration and detection. Based on this starting point, this paper presents a as shown in fig. 1 multi-functional hexapod robot design.

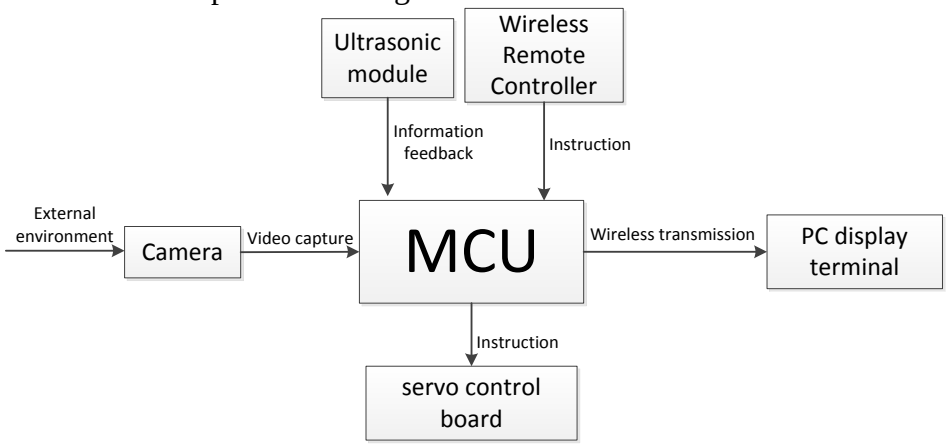

Fig.1 Design scheme

The hardware circuit of the system is mainly composed of four parts, the power part, the main control part, the camera and the transmission part and the sensor.

Power schemes

The power supply of the system is mainly controlled by the main control MUC board, servo drive and video transmission parts, Due to the steering gear need larger electric current, and in order to prevent the current shunt and the fluctuation of the steering gear control, So master MUC and video transmission parts use the same power supply, steering gear drive part separate power supply. The working current of the steering gear used by the robot is 30-50mA, 12 steering gears at the same time the maximum required current is 0.6A, the voltage required is 5 v to 12 v, based on the above requirements, Voltage regulator chip select TPS54340 switching regulator IC, TPS54340 can maintain a large current output of 3A, with a 4.5V~42V wide voltage input range, and high stability, low power consumption, is not easy to heat, fully meet the needs of power supply.

Scheme of robot drive control device.

For the special environment mentioned in the introduction, the terrain is rugged and irregular. Due to track multi legged robot is the discrete point of a series of rules, and compared with the continuous rut tracked or wheeled, with the ground contact area is small, and in the terrain containing gravel, sand, cracks and other discontinuities can also be free to move forward, Based on the above consideration, this paper proposes the scheme with six foot movement patterns, hexapod robot uses its three sets of two foot movement pattern to make its mechanical center of gravity always falls in the center position, has the good stability and the smooth, not easy to fall, flexible to adapt to a variety of terrain and slope.

The mechanical foot is mainly composed of a steering gear and a supporting frame, each foot is provided with a steering gear with a control level and a vertical direction movement, and a total of twelve steering gears are arranged.

Hexapod robot movement, the mechanical foot is divided into two groups of three feet alternating movement. Therefore, the output of the servo control board with multiple output PWM wave is 12 independent PWM wave to control the twelve steering gears [1].

Video transmission scheme

The video transmission module as shown in fig. 2, raspberry pie will be sent by the camera to capture video data through wireless LAN WIFI wireless transmission to the PC, on the PC side by the software realization of video receiving and processing and control of video signal acquisition of raspberry pie.

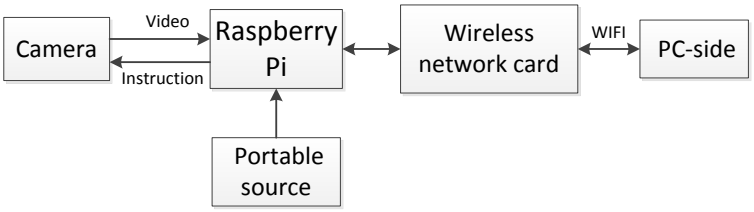

Fig.2 the video transmission module

Raspberry pie by British raspberry PI funds will be developed. The raspberry pie small volume, processing speed, easy development and for the volume and weight of the multi legged robot is more apparent the utility model has the advantages of, so the proposal uses raspberry pie as the video transmission module control board [2][3].

Choose the camera is under the Linux system to avoid drive Logitech C170 camera, it has 500 million pixels, the maximum frame rate is 30fps support USB2.0 interface, can be perfectly compatible with raspberry pie.

Wireless LAN using wireless transmission rate up to 300mbps EDUP wireless network card EP-N1572, EP-N1572 can be real now raspberry pie free driving operation and also provide adequate transmission rate.

Sensor scheme

The scheme of the obstacle detection module consists of a number of HC-SR04 ultrasonic distance measurement devices,Ultrasonic sensor is mainly used for the robot to detect obstacles in the road to determine the distance to achieve automatic obstacle avoidance [4].

Temperature sensor using DALLAS semiconductor production of DS18B20 single wire intelligent temperature sensor as the core component of the temperature module, DS18B20 temperature sensor has the advantages of small volume, convenient temperature measurement, low hardware consumption and other advantages [2][5].

The smoke concentration detection sensor uses the MQ-2 type resistance type semiconductor sensor to collect the smoke concentration signal [6], The smoke concentration signal is converted to a voltage signal by the sensor, and sent to the display module through program calculation [7].

Control system software part

In the system control program, the software needs to configure MSP430 corresponding I/0 port, clock, serial port and timer, etc., to achieve the control of the hardware of the above. Software flow chart of control system is shown in fig. 3.

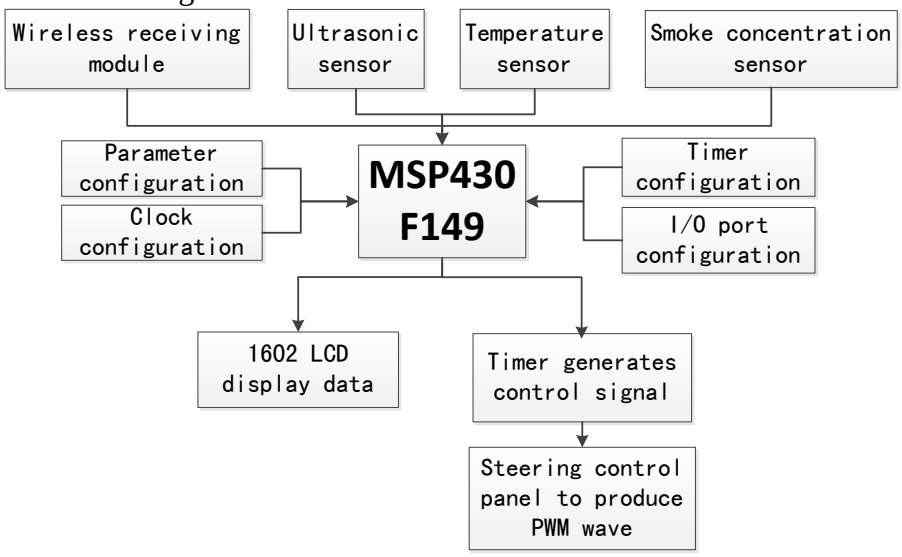

Fig.3 Software flow chart of control system

The software specific process is as follows: the main control board of the wireless receiving module receives the remote control signal, corresponding to the implementation of the corresponding algorithm gait data, the servo control board to produce the same cycle of 12, accounting for different PWM wave; Ultrasonic sensor, smoke concentration sensor, temperature sensor using MSP430 timer interrupt trigger the corresponding conditions, the ultrasonic data after the execution of the preset gait algorithm, to achieve obstacle avoidance, infrared and smoke concentration data after processing algorithm in the 1602 LCD display.

Debugging and experiment

Raspberry pie after the power supply and by PC connected wireless LAN WIFI signal, through the PC operation open the camera, on the screen display real-time video transmission window.

MSP430 and servo power supply, after about 10 seconds of initialization, the system is ready, temperature sensors and smoke concentration sensor data acquisition and display in the 1602 LCD [8][9].

The radio signal is transmitted by the remote controller, the MSP430 reads the receiving terminal level signal and transcoding, and the robot can move forward, backward, turning through a preset gait algorithm;

The remote control robot is close to the obstacle, the position of the distance obstacle is about 20cm [10], the ultrasonic sensor collects the obstacle information, and the feedback MSP430, triggers the automatic obstacle avoidance mode, and the robot changes direction to avoid obstacles.

Conclusions

This article provides a new multi-functional hexapod robot on system design. Through the bionic design, build camera platform, WIFI transmission and multi-function detection module make it with a variety of comprehensive function. Greatly improving the degree of adaptation to the environment of the robot, make it in all kinds of complex environment has wide practical application prospect, also for the research and application of multi legged robots in the future provides a train of thought.

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