

Conclusion

The proposed control approach for the pulp gas phase parameters on the basis of high-energy ultrasound allows to implement the effective management of pulp gas phase composition, enhance the concentrate quality and efficiency of the mineral processing technological process.

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Design of an Intelligent Vehicle Control System Based on LabVIEW

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Abstract

Compared with the traditional intelligent vehicle control system has the following deficiencies: complex image processing algorithm and not flexible cable communication mode, and not real-time traffic monitoring and control, the design by use of LabVIEW which has a wealth of signal processing functions and graphical

programming features and NI myRIO which has powerful hardware system, the intelligent vehicle control system is more flexible and convenient. Firstly, the system by NI myRIO transfer the camera collect image information; Secondly, the image information via Wi-Fi communication to LabVIEW visual analysis module and deal with it by the algorithm; Finally, according to the image information analysis results, NI myRIO by PWM control algorithm of the FPGA module control the rotation of the motor and servo, realizes the automatic tracking and storage, and other functions of intelligent vehicle.

Key words: LabVIEW, INTELLIGENT VEHICLE, NI MYRIO, SYSTEM CONTROL.

Introduction

With the rapid development of control theory and technology in the transport sector, research on vehicles and vehicle electronics is increasingly being concerned about the people. Intelligent vehicle as a typical number of high-tech integrated carrier, mainly related to the theory and technology of real-time image processing, pattern recognition, artificial intelligence, automatic control, sensor technology, and other disciplines [1]. It combines with the latest research results of information science technology and artificial intelligence and is an important part of the current national focus on the development of intelligent transport system [2]. Intelligent vehicle control system has a wide range of theoretical value and practical significance. The identification methods of intelligent vehicle not only determine its own performance, but also affect the cost of development and use of the systems [3]. Early on, identification methods of intelligent vehicle is mainly based on electromagnetic induction guide technology, but due to the small range of electromagnetic induction, does not apply to a wide range of complex environments [4]. Advantages of the image sensor and the combination with the feasibility of the current image processing technology, has become an important subject of intelligent vehicle path identification technology. The intelligent vehicle control system also still in the use of various sensors, through C language programming of traditional design level. However, this control method has the following questions: firstly, developers must use a variety of sensors to achieve data transmission and transfer; secondly, there is no definite link between the various sensors and data communications, the system can't be achieved comprehensive treatment and integrated treatment of the accident unexpected situations.

Now, with the constant development of automotive technology, Research on intelligent vehicle control system has made great progress. On abroad, such as the intelligent vehicle control system of VERTIS in Japan, the intelligent owners have 23 ITSZ sub-system is mainly used for vehicle communication, information processing, environmental exploration, and auxiliary control (autopilot) function. In addition, Renault developed the intelligent vehicle can not only

make vehicles aware of their surroundings, such as road conditions, distance of nearby vehicles and driving speed, etc. Also can make promptly corrected adjustments to the speed, direction and other reactions according to specific circumstances [5]. Although, intelligent vehicle research starts relatively late in our country, but it develops rapidly. For example, Tsinghua University developed the autonomous mobile robot test vehicle THMR-V, which has been able to travel on the more complex environment by itself [6]. In this system, they used a laser radar and camera for vision system, and the use of their existing advanced image processing technology to identify and process information, and then intelligent control, to achieve intelligent vehicle movement.

The design of the system in the original theory, based on a method of combining hardware and software, the application of virtual instrument technology to develop intelligent vehicle control system. The Control platform based on LabVIEW, will not only make the complex redundant programming become visualization, simplicity. And with the help of the LabVIEW rich signal processing functions, the signal analysis and processing become more simplification. Furthermore, the NI myRIO as the core of hardware system, by control the camera, motor, servo, buzzers and other hardware, implement the intelligent vehicle's monitoring traffic information, automatic tracking, reversing warehousing and other functions. By WIFI wireless communications, intelligent vehicle control system not only real-time monitoring, but also through graphics, pictures in one of the wireless background operation, making the operation more convenient and intuitive. The system also can use WiFi communication function of NI myRIO display the traffic and motion information and control intelligent vehicle motion on the iPad. That makes the control system more diversified and intelligent.

Whole scheme design

NI myRIO is the core of intelligent vehicle control systems. Design of the system is divided into three parts: acquisition the traffic information, process the image information, control intelligent vehicle motion. Firstly, NI myRIO transfer camera collect image information; Secondly, the image information via

Software system

Software system is the emphasis and difficulties of the design. The software program is mainly composed of hardware configuration, algorithm processing and hardware exit part. Hardware configuration including servo motor, buzzer and cameras, a serial port configuration, servo and motor PWM configu

ration, camera transfer and image acquisition. Algorithm processing mainly includes image processing algorithm and control algorithm of servo motor and buzzer. The image processing algorithm include the binary, filtering, edge detection, establish the coordinates, angle measurement Software system flow chart shown in Figure 3:

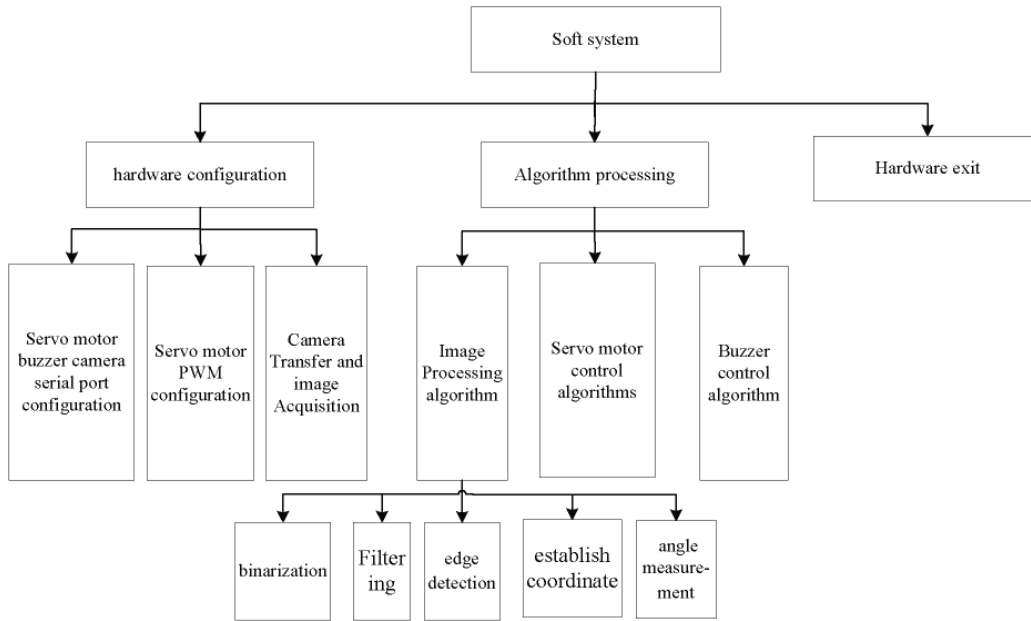


Figure 3. Software connection diagram

1) NI myRIO hardware configuration

By configuring I / O port of NI myRIO to achieve communication between the NI myRIO and PC computer. The servo and motor I / O port directly configu-

re to PWM port. While configure to the camera USB port directly connect to myRIO. Rear panel of the hardware configuration is shown in figure 4.

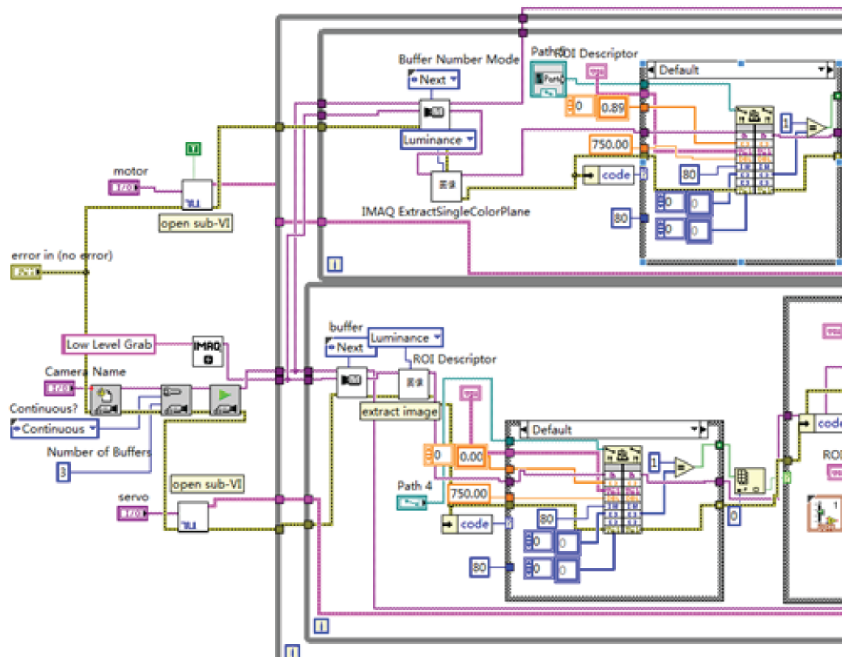


Figure 4. Rear panel of the hardware configuration

In this transfer PWM sub-VI, it sets that transfer the NI myRIO parameters and the PWM input signal.

When we configure the PWM port, if the parameters are inappropriate that will cause the PWM signal

is invalid; by transfers the FPGA module to improve the program processing configuration and ensure the successful of the operation. As shown in figure 5 is the PWM sub-VI.

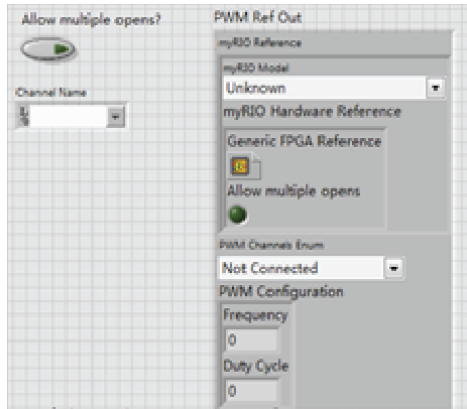


Figure 5. The PWM sub-VI

2) NI myRIO control algorithm

Automatic tracking and storage algorithm is important part of the control program. Where in the automatic tracking is processed and analyzed images on LabVIEW vision module, included the image cache, image color transfer binarization processing, edge detection, establish the coordinate and angle measurement. After the addition of the color image recognition, identify system by check the color of the image on the road surface, control the angle of servo rotation and the speed of motor. The storage algorithms include NI myRIO motors, servos, cameras, buzzer control algorithm.

The following describes the algorithm for the servo motor, buzzer and cameras processing functions: firstly, the algorithm of servo including simple manual servo parts, as shown in figure 6.

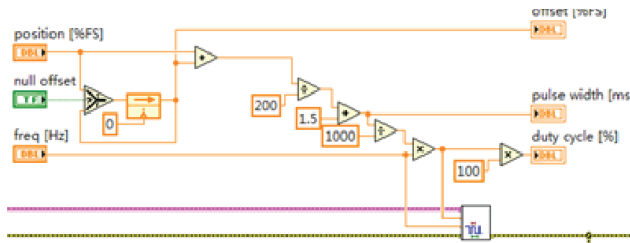


Figure 6. Simple manual servo algorithm

The algorithm program of camera angle measurement and automatic storage of servo rotation angle block diagram as shown in figure 7 and figure 8.

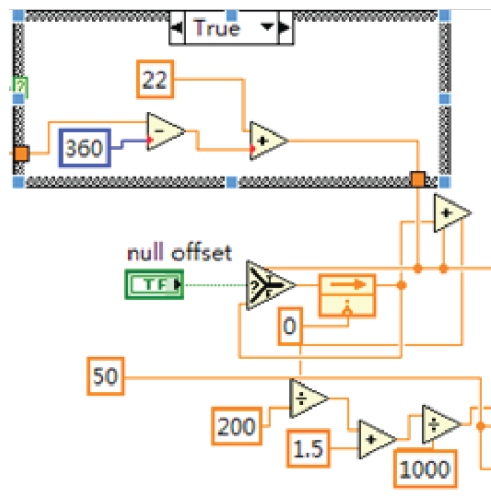


Figure7. Angle measurement algorithm

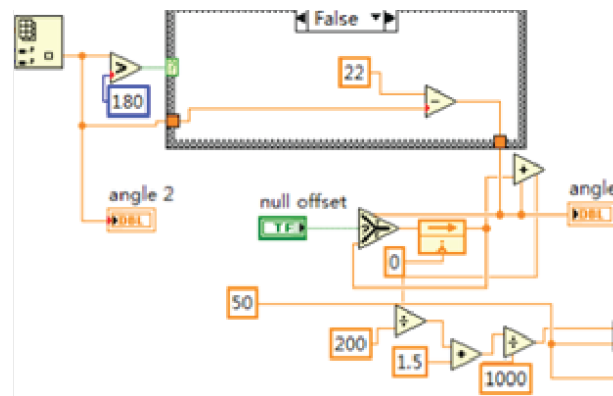


Figure 8. Automatic storage algorithm

Secondly, the motor control algorithm. The motor control algorithm much simpler than the servo, just some simple PWM value control, it is easy to implement in the LabVIEW program. But given the color recognition and triaxial acceleration sensor, the motor control algorithm needs to add some algorithm processing. The algorithm of PWM motor control is shown in figure 9 below.

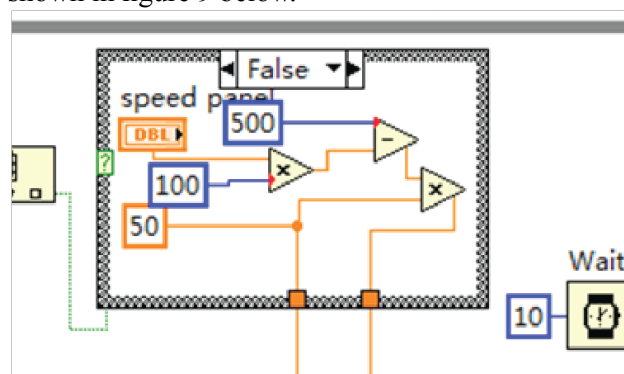


Figure 9. PWM value control algorithm

Thirdly, buzzer control algorithms. When the servo angle more than 10 degrees, the buzzer began to work.

If the color recognition is red, then the buzzer will send out beeps to suggest the dangerous. If the road is not very well, more than the value set by three axis acceleration sensor, the buzzer also beeps, at the same time, the motor will reduce the speed.

Fourth, the camera control algorithms. Camera processing algorithm is the most core part the software program. The camera control algorithms include image cache, image color transfers, image binarization process, image filtering, image edge detection, image processing, image coordinates establish, image angle measurement. The image color recognition is though the way of check the color of the picture on the road surface, judge traffic information and executes the corresponding control commands. Figure 10 is a part of color recognition.

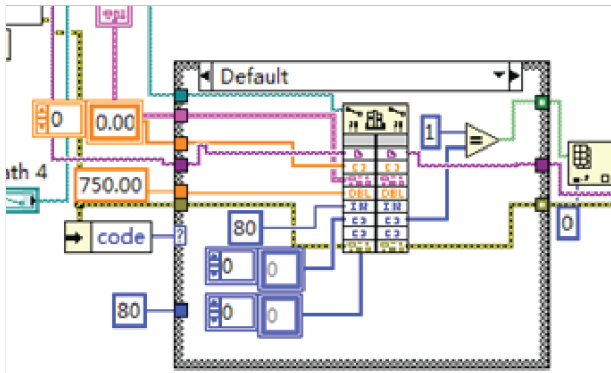


Figure 10. Color recognition program

Fifth, through the variable Z axis acceleration sensor to detect the road information, that can control the different road have different speed .

Three-axis accelerometer control motor programming are shown in figure 11 below.

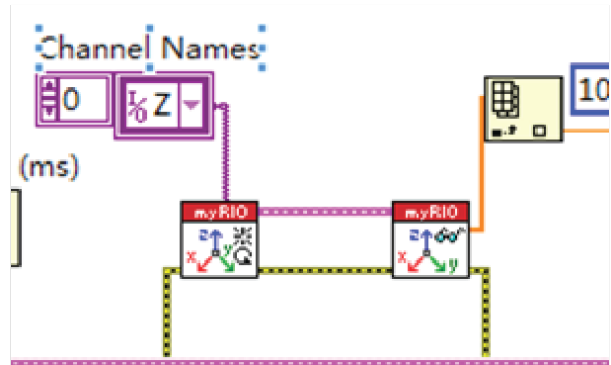


Figure 11. Three-axis accelerometer control motor program

In the storage operation, the system based on the results of color recognition performs the appropriate action. If the road surface detected is green sticker, the servo control vehicle turning while motor control decelerating; If the road surface detected is red sticker, the vehicle stop moving to complete automatic warehouse; If the road surface detected is black sticker, the vehicle proceed automatic tracking.

The whole algorithm processing is executed in a certain order. In order to avoid sequence function causes the function structure of the data stream error, so we have the error cluster instead of the order of the function. So that both avoid redundancy function and reduce errors. Automatic tracking and parking storage algorithm overall program block diagram as shown respectively in figure 12 and 13.

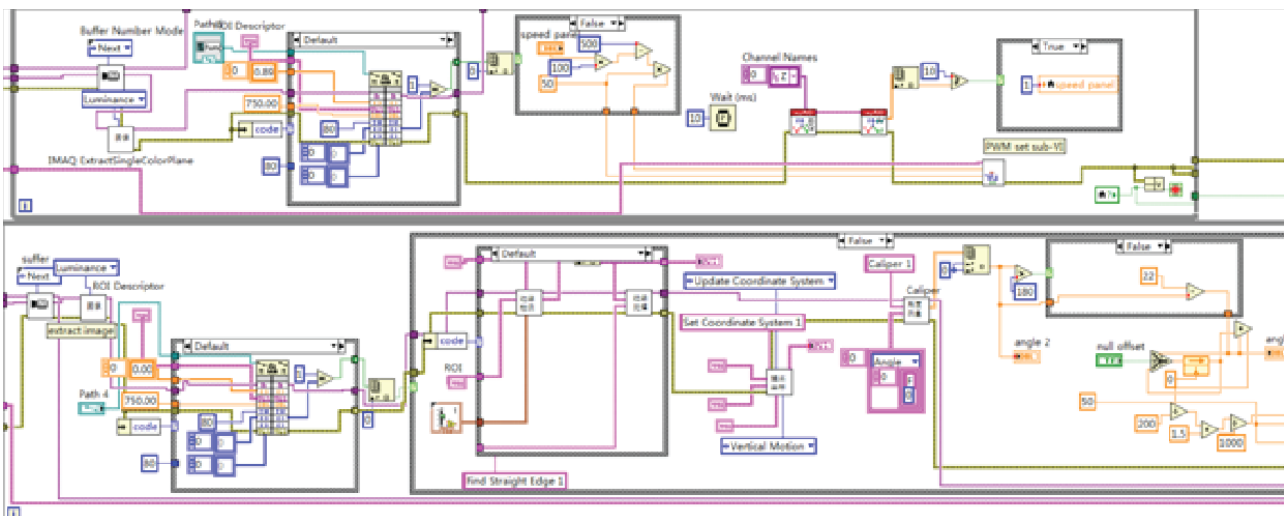


Figure 12. Automatic tracking algorithm

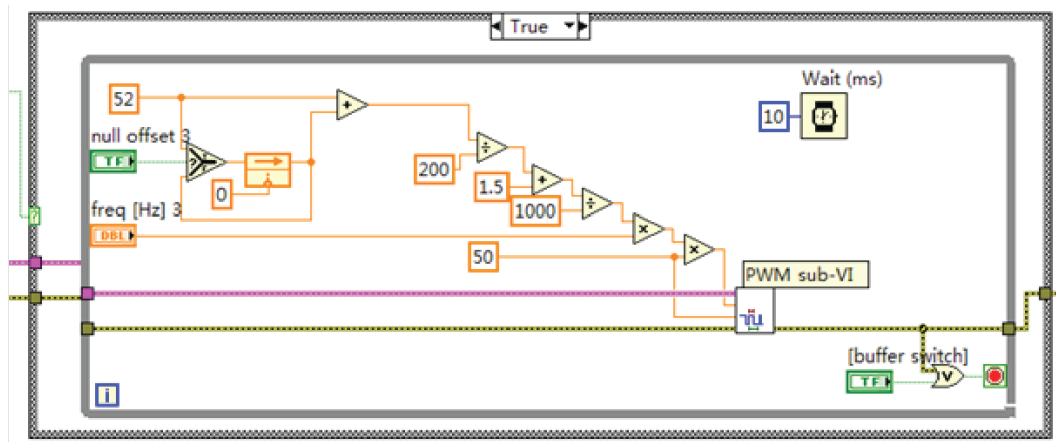


Figure 13. Storage algorithm



Figure 14. Intelligent vehicle physical diagram

Conclusion

Intelligent vehicle control system based on LabVIEW to meet the needs of intelligent vehicles, in addition to achieve tracking and storage operation, but also has the following characteristics: (1) the operation system is simple and convenient. And though the way of wifi network, the movement of intelligent vehicles become more flexible;(2) compared with the traditional intelligent vehicle the development cost is greatly reduced;(3)compared with the traditional intelligent vehicle use several sensors, the system only use of camera reduce redundancy and the difficulty of debugging program. Physical map of intelligent vehicle is shown in figure 14.

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