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The Latest Exploration of Wiimote-Based Control

MAO Hongyin[1,*]; HUO Hu[1]

[1]Beijing Forestry University, 100083, Beijing
[*]Corresponding author.

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Abstract
Based on point positioning and motion sensing capabilities of wiimote, the present study used bluetooth and wireless communication device as an information channel of wiimote-controlled intelligent vehicle to send the control commands according to the wiimote pointed position. And then the motor drive was controlled by MC33886 chips and PID algorithm. Ultimately, the synchronous induction of intelligent vehicle with human pointing movements was achieved. In the meantime, a wireless video was facilitated in the intelligent vehicle to achieve real-time monitoring of the vehicle. This paper provided the hardware and software design of the control system and described with flow charts. The tests results showed that the interactive remote control of intelligent vehicle can be achieved by using a wiimote control handle.

Key words: Wiimote; Interactive Remote Control; PID Algorithm; Microcontroller

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In 2006, the Japanese company Nintendo launched a new generation of game console, nunchuck. It not only brought an experience of a new interactive game for players but also provided the majority of electronic enthusiasts a new idea of how to achieve human-computer interaction. The most unique game control handle wiimote had a revolutionary space sensing, which no doubt made wii a pioneer of operation mode for 3D game consoles. Wiimote no longer inputs signals by a key code, but by changing the spatial location and point positioning. This operation mode promotes the mobilization from whole body, thereby enhancing the interaction between players and games.

From the inspiration of innovative wiimote control, we developed the practical application of wiimote in control aspect and broaden the research direction in human-computer interaction. Based on the point positioning and motion sensing capabilities of wiimote[1], we designed a human-computer interaction system by using intelligent vehicle as a controlled object and wiimote as an operating subject. This paper introduced the hardware and software design for the synchronous control of wiimote-based intelligent vehicle.

1. THE SYSTEM HARDWARE DESIGN

1.1 The Mechanisms of Wiimote

Wiimote is the main controller of game console Wii produced by Nintendo. In addition to a button-control operation as a general remote control, it has other two functions: point positioning and motion sensor. The former can control the cursor on the screen and the later can detect three-dimensional movement and rotation. The combination of these functions can help to achieve the synchronous sensor of wiimote. The main components of Wiimote include a 3-Axis Accelerometer chip and a multi-axis gyroscope. The 3-Axis Accelerometer chip has a variable capacitor. It can perceive the moving direction and acceleration of the handle by changing the capacitance and the capacitor voltage in capacitor, which are achieved by moving the electrodes to change the interval or covering area between the upper and lower plates. The multi-axis gyroscope has a feature to detect a larger movement and to bear wrestling hit. It can also accurately detect quick movement of the hand. These two mechanisms enable wiimote to accurately detect the movement and transmit the information to the host via a

Bluetooth so as to complete a further analysis of the data.

1.2 The System Structure

The diagram of the system design is shown in Figure 1. When the button on the left analog control handle of nunchuck is pressed, the computer will receive the signals from wiimote via a Bluetooth. These signals will be extracted by the computer and converted into a signal parameter that can be sent by wireless communication port. This parameter reflects the coordinate transformation of wiimote. The intelligent vehicle communicates with the computer through a wireless signal receiver port, which receives the real-time data converted by the computer. And then the microcontroller in the vehicle handles the serial signal and converts it into a current signal to control the vehicle motor. Meanwhile, the wireless video facilitated in the vehicle feedbacks the information about the surrounding environment to achieve a real-time monitoring in front of a display.

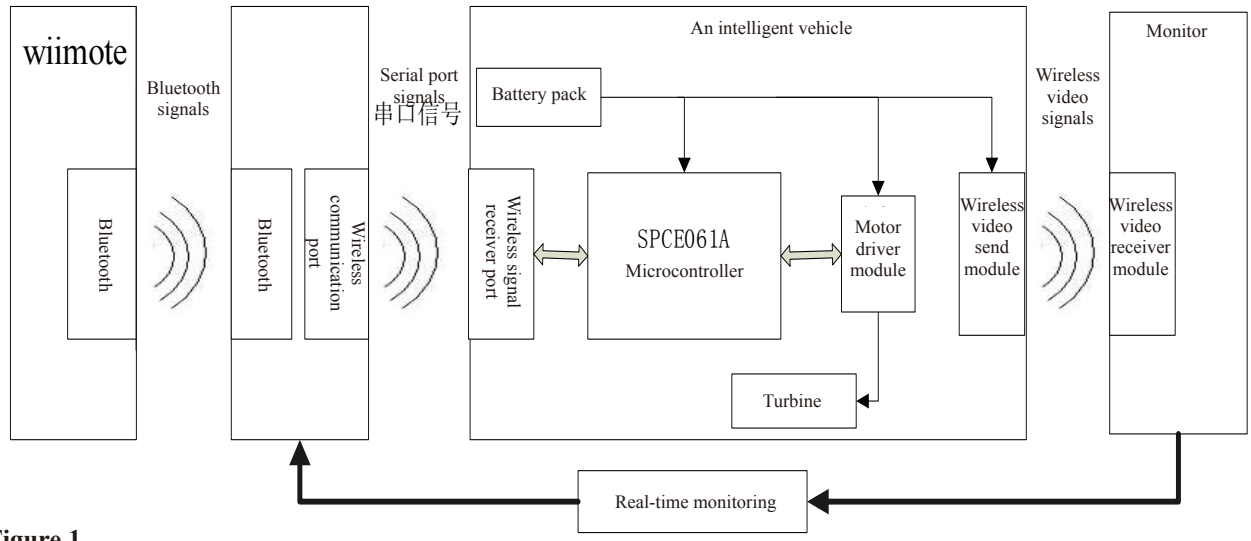

Figure 1
The System Diagram

In the present design, two bidirectional DC motors are used to respectively control two left wheels and two right wheels of the intelligent vehicle. They can control the speed and positive-negative rotation of the motor by changing the current rate and direction through the armature. H-bridge switching circuit is employed in this DC motor drive system[2], which consists of three parallel MC33886 chips. On one hand, such kind of connection can reduce the resistance, improve the motor ability, and greatly improve the heat generation of MC33886 chips. On the other hand, it can reduce the effect of the over-current protection circuit inside MC33886 chips on starting and braking of the motors.

2. THE SYSTEM SOFTWARE DESIGN

The whole system control programs consist of main program, PID controller subroutine, Bluetooth-serial adaptor subroutine, and intelligent vehicle motion subroutine, etc. The flow chart of the main program is shown in Figure 2, which includes the system clock setting, Nunchuk button initialization, Wiimote button initialization, motor initialization, COM port initialization and the initial coordinate setting for Wiimote.

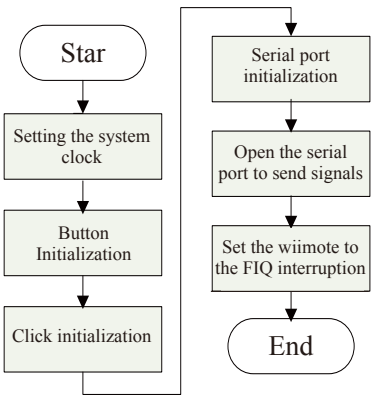

Figure 2
The Flow Chart of Main Program

2.1 Motor Drive - PID Algorithm

PID closed-loop control system is used to control the motors[3]. As shown in Figure 3, the PWM duty cycle can be adjusted promptly according to different load conditions. The greater the PWM duty cycle is, the greater the initiating current of motor rotation is. According to different PWM duty cycles, the intelligent vehicle can quickly track the target speed. In order to maximize the vehicle speed, the present design sets the highest target speed and speed control when driving straightly, and

adjusts the setting to the cornering speed limit when turning.

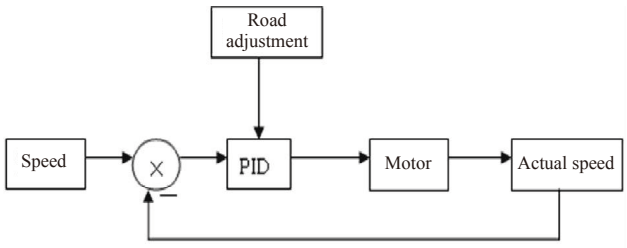

Figure 3
Motor Control Chart

2.2 Intelligent Vehicle Motion Subroutine

The intelligent vehicle motion subroutine is shown in Figure 4. It sets a Regulate_Car () function with X, Y as return values, in which X represents the speed and Y represents the direction. After nunchuck button is pressed, the program receives X and Y values continuously emitted by wiimote and takes the dynamic average values as the current location of the remote control. The value is also used as a reference point. This subroutine sets a signed variable, temp, to show the difference between the current coordinate value and average value of wiimote. When the remote control is rotated with a constant three-dimensional X-axis (X - horizontal, Y - vertical, and Z - depth or perspective), same value of temps are provided to the left and right motors according to the deflection angle so as to maintain a straight movement of vehicle. When the remote control is rotated with a constant Y-axis, the temp is reduced for the left motor and increased for the right motor to generate a speed difference between two motors so as to achieve the purpose of turning around. To avoid an excessive turning curvature of the vehicle, the present design has also set an experience value, car_turn_modulate = 2 for temp after many tests.

$$temp=(wii\_spostion\_x-X)/car\_turn\_modulate \quad (1)$$

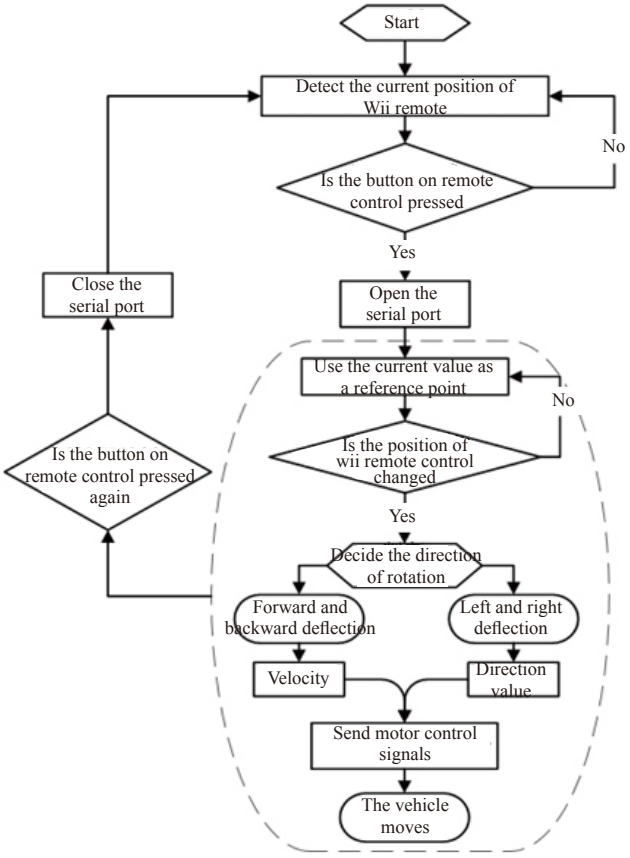

Figure 4
The Flow Chart of Intelligent Vehicle Program

3. RESULTS AND CONCLUSIONS

The present design of wiimote-controlled intelligent vehicle motor system has provided a reasonable structure consisting of simple and reliable drive and control circuits and a PID closed-loop control system. Therefore, it can meet the need of speed control when the intelligent vehicle is driven straightly or turning. Meanwhile, three parallel MC33886 chips connection enhances the motor drive capability.

By using the point positioning of wiimote, the movement commands of human arm can be sent from computer to the vehicle so that the vehicle can complete the same motion. The present design has developed a practical application of wiimote in the control field. It applies an interactive game experience to the development of artificial intelligence so as to achieve human-computer interactive remote control. Therefore, it provides a new research direction for synchronous induction system.

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