Design and Implementation of Dangerous Goods Handling Robot

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Abstract. Design and implementation of intelligent robot for dangerous goods handling. the mechanical arm use is AS-6 DOFB six degrees of freedom of mechanical arm, use and steering gear control board and computer as a way to control system, joints are available in within the prescribed scope of the sport, through the operation PC control software, to servo control instructions sent steering gear control signal, so AS to realize the mechanical arm space in precise work, the task completion in mechanical arm through installation camera feedback image, if install it to mobile platform, and substitute personnel in the harmful environment visible assignments, revise control instruction, accurate completion of each task. Experiments show that, this design is correct and feasible, and can meet the requirement

Introduction

With the development of science and technology, automation, intelligent level has been further improved; development of a new generation of vehicle has attracted more and more attention at home and abroad. Because there are some items with high risk, which cannot be used directly for artificial handling due to high risk, we design the dangerous goods handling robot system that can be used. There is manual control used to regulate the robot handling, to avoid direct contact with dangerous goods, it is suitable for handling toxic and explosive materials in practical application of great significance.

The Functional Requirements of the Handling Robot System

The system is divided into two parts: vehicle remote control system and the monitoring platform. The vehicle remote control system operates according to the control command issued by the monitoring platform to perform an action, real-time video images are collected from the monitoring platform; which the monitoring platform constantly receives from the car. Instead of people came to the dangerous area of intelligent robot system, we can use intelligent robot system. It will greatly reduce the occurrence of accident [1-2]. With the images and information getting from remote control system, We can remotely control the robot. According to the situation to achieve master-slave remote control, the system has the function of:

(1) Wheeled walking mechanism, control performance is good, flexible, fast, stable, high reliability;
(2) Has the function of video monitoring, can see the surrounding environment;
(3) With a flexible manipulator, smooth and fast to clamp the dangerous goods and carry to the designated location.

According to the characteristics of the functional requirements of the dangerous goods handling robot, the performance requirements of the system are summarized:

(1) Robot walking straight and turning;
(2) USB camera image acquisition;
(3) mechanical arm with 180 degrees tilt, rotation range;
(4) AS-6DOFB six degrees of freedom manipulator, used to grab items.

The system uses ARM processor S3C6410 as the core, with 6410 development board as the motherboard. Each module is controlled by the development board. The robot is mainly composed
of hardware system and software system. The hardware system includes: ARM processor, peripheral interface circuit, a six DOF Manipulator, camera, car body and power supply, wherein the software includes: ARM processor; embedded LINUX operating system, device driver and LINUX application program. The system work flow is: the robot moves through the control before and after, when the camera saw in front of dangerous goods, dangerous goods handling robot of by controlling the manipulator [3-4].

According to the actual situation, the system implements the following modules, as shown in Figure 1.

![Figure 1. Functional block diagram of dangerous goods handling robot system.](attachment:image.png)

1. Robot control: mainly by the motor switch control, motor control, motor speed control combined.
2. Video surveillance: mainly by the video switch control, set the video image attributes, access to video image attributes, video image data transfer composition.
3. Mechanical arm control: by the mechanical arm to turn, mechanical hand open close control of the control.

**The Hardware Design of the Handling Robot System**

**Hardware Block Diagram of the System**

S3C6410 is a 16/32 bit RISC microprocessor is designed to provide a cost-effective, low power consumption, high performance processor application solutions, using the 64/32 internal bus architecture. Hardware diagram of dangerous goods handling robot as shown in Figure 2, the camera is in the charge of image acquisition, USB hub to the 6410 processor after. The central controller 6410 for controlling the movement of the manipulator, DC motor and steering, so as to control the robot.

![Figure 2. Block diagram of hardware system](attachment:image.png)

**DC Motor Drive Module**

The driver board mainly adopts double Ha bridge DC motor drive chip, we use the ST company's
L298N typical double H bridge DC motor driver chip for driving DC motor or bipolar stepper motor drive circuit chip peripheral circuit is mainly used by the diode bridge circuit composed of two groups of motor parallel connection.

The robot is driven by the L298N chip mobile terminal, and respectively on the left and right sides of DC motor terminal; EA, I1, I2 and EB, I3, I4 respectively for the control signal input interface, which is about EA and EB respectively enable two motor control interfaces, high efficiency, can be used for PWM control. Table1 shows the interface using the truth table for different input signals corresponding to the motor running state.

| EA | EB | I1 | I2 | I3 | I4 | Left motor | Right motor | Status       |
|----|----|----|----|----|----|------------|-------------|--------------|
| 0  | 0  | ×  | ×  | ×  | ×  | stop       | stop        | stop         |
| 1  | 1  | 0  | 0  | 1  | 1  | forward    | reverse     | left-handed  |
| 1  | 1  | 1  | 1  | 0  | 0  | reverse    | forward     | Right-handed |
| 1  | 1  | 0  | 0  | 0  | 0  | forward    | forward     | forward      |
| 1  | 1  | 1  | 1  | 1  | 1  | reverse    | reverse     | reverse      |

Here I1, I2, EA control of the left motor, EB, I3, I4 control of the right motor, EA, EB for the PWM speed control interface, plus to a high level for full speed. This interface is a single four wire two phase stepper motor interface, but also can drive 2 DC motor.

**Mechanical Arm**

In order to ensure the flexibility of robot manipulator design, by the waist, big arm, small arm, gripper, altogether has 3 joints (waist-arm, arm-arm, small arm-gripper) 7 degrees of freedom (waist 1DOF, arm 1DOF, arm 1DOF, 4DOF wrist). The waist-1 degrees of freedom rotation, Mounted on the robot car chassis, in front of the body as the base, can rotate 135 degrees to the left and right respectively, both ends of the limiting device to avoid collision. Self-controlled by hydraulic pressure, a compensation apparatus feedback accurate position to ensure the control precision in the large bottom; big arm and small arm–all 1 degrees of freedom, respectively, relative to the superior articular moving up and down, to the level of body surface as the base, the arm can move upward 45 degrees, 30 degrees downward, upward movement of small arms can be 25 degrees, 60 degrees. The downward movement of the hydraulic control movement, compensation apparatus feedback. Ensure accurate joint position; -gripper with 4 degrees of freedom respectively, bobbing, rotation, stretching, clamping arm movement, to extend the line as a benchmark, the gripper can swing up and down ±90 degrees and small arm as the reference axis rotation ±180 degrees, and 1 meters, adopts the servo motor to provide power. Pass a gear box reducer to ensure power demand, controlled by the servo motor controller. A feedback encoding disc, ensure accurate position. The waist size of the arm, the hydraulic circuit with, pressure sensor with stable oil pressure protection device.

**Camera Module**

The server in the video acquisition, video image receiving property parameters, set the video capture device. After returning to the information embedded video equipment embedded system is set up, you can use the embedded operating system kernel provides the interface to the development of video monitoring software module. It runs on the server side can be run independently without external network conditions. This module implements video capture, playback and other functions, the client and server data interaction as shown in Figure 3.
Summary

The test shows that the robot can complete the basic requirements of the experiment and play a better part, through the discussion and try various programs, then experienced a series of hardware and software combined with the overall debugging, to optimize the system constantly, dangerous goods handling robot can complete all kinds of functions. In the control strategy, the manual control of robots. Change in direction, so that it can secure tracing traveling, the motor has a PWM duty cycle change robot running speed, avoid out of range. Through a wireless network vehicle remote control system and the monitoring platform combined with hardware system design is reasonable, compact, flexible, compact structure, good real-time; module design of software system, test results show that the robot system works reliably; dangerous goods can meet the processing requirements of the task.

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