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VIDEO CAMERA POSITIONING USING CAN PROTOCOL

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Abstract*. The present paper describes an example of CAN protocol application. The control system was used for positioning a video camera to a wheel chair for persons with handicaps. The CAN protocol was used because the communication between devices should be efficient from all points of view thus the system works to its optimum parameters.*
Keywords: *CAN Protocol, wheel chair, TV camera positioning*

Introduction

The device was design to be used on a wheel chair for persons with handicaps. This wheel chair uses a complex decisional system that services to all needs of the patient, including orientation and movement. This system needs two identical video cameras that should receive imagines from two different angular positions. The received imagines will be inside processed. The desired results will be: the recognition of the shapes and objects, detection of the space position of the shapes and objects, the control of the used arm relative to the shape and the objects position.

Design data

The whole system is mainly based on decisions of the computing system and that is why the design data are more particularly than those used in the case of an ordinary positioning system used in supervision. The parameters that determine this system to be more particularly are: two degree of freedom on two normal axes similarly to eye structure; video camera location so that the CCD sensor will be positioned at the intersection of the two rotational axes; a positioning precision high enough to be able to trace the objects located to long distance and, finally, positioning and communication speeds high enough to determine small delays of the decisional system.

The mechanic system

The mechanic system has the following elements (figure 1): a fix platform on which is attached one of the motors, two bearings on which are fixed two guide pulleys; a mobile platform with a structure identical to the fix one; the video camera holder device.

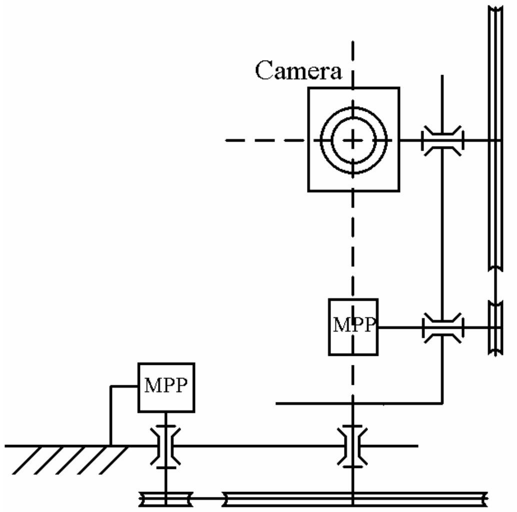

Figure 1 The mechanic system

Transmission is a rope gearing one used to satisfy the stiffness condition. The pulleys diameter ratio determines the transmission ratio, the speed ratio and the precision ratio.

The driving system

To obtain the two-degree of freedom were used step-by-step motors (figure 2). The two motors should satisfy three conditions:

1. driving torque divided to transmission ratio, should be high enough to ensure the acceleration of the inertial system that is needed to obtain the maximum speed, starting from zero speed and vice-versa in the shortest time;
2. precision divided to transmission ratio should be higher or at least equal to that specified in the design data.
3. speed of rotation multiplied to transmission ratio should be higher or at least equal to that specified in design data.

It is needed to be known every moment the position of the motors and, implicit the video camera position. To satisfy this requirement it was used the following driving system:

- position incremental sensors were used on the shafts of the motors;
- four end-stroke sensors were used at each end for each motor;
- it was used, for each motor, an individual microcontroller that could follow the motor displacement using a position incremental sensor and two end-stroke sensors.

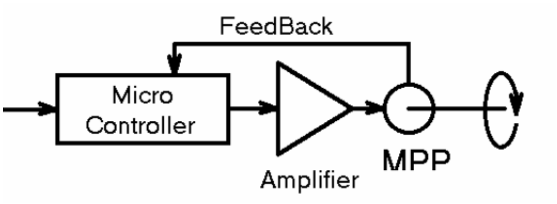

Figure 2 The driving system

Operation of individual motor

When the system starts the microcontroller is in reset status. First task that it has to do is to bring the motor into the extreme left position. This implies to rotate the motor to the left until the end-stroke sensor detects the over-travel. At this moment the motor is stopped and next step is to command the motor to rotate reverse until the sensor doesn't detect the displacement anymore. It is the moment when the motor will be stopped again. This new position can be considered the left end-stroke of the system. After the left end-stroke positioning action is done, the microcontroller sends, on the SPI bus, a message that is ready for new commands.

The motor setting to a specific position will be done sending absolute position to the individual microcontroller. This is holding the current position to a register. When the microcontroller receives the command to re-position the motor, it will increment or decrement, depending on the situation, the current position until the motor will achieve the desired position. A step of the step-by-step motor is considered done only when the incremental positioning sensor confirms the action.

During the holding-position period of the motor it is possible that a force will act upon it. If this force is greater than that used to hold the position it will determine a displacement of the motor. If the force disappears the motor re-positions itself to the desired position because the microcontroller counts the error steps and determines a decrease of it.

The communication system

In figure 3 is shown the communication system architecture. This structure was adopted because it was requested a minimization of the time given by the calculating system to the video camera positioning system. This architecture has some major advantages:

- the positioning system function independently and it doesn't need a special attention of the calculating system. After the positioning system receives the desired position, it will start the displacement thus the error will be minimized and, when the desired position is achieved the system responds by sending a confirmation message;
- the positioning system determines the message roots using a central microcontroller that assures the process transparency for the calculating system;

- there is the possibility to change the desired position before the end of the previous command;
- there is the possibility of reading, from the positioning system, of the current position anytime for any motor.

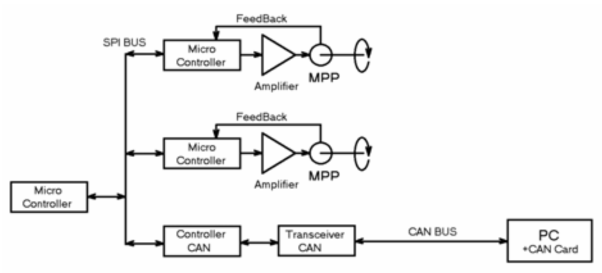

Figure 3 The communication system

CAN protocol for the current application

The main and the most important advantage of the CAN protocol is that, on one single CAN bus it can be connected more positioning devices (in this application were used two) and even more other devices (for example, in the case of the wheel chair it can be commanded the direction and displacement speed of it, position of the service arm, the gripper force, etc.)
The second important advantage is the duplex communication between any of these devices, which determines multiple possibilities (in this case there can be detected the closest moment when the video camera achieved the desired position or the possible positioning, communication or hardware errors that could appear at one moment).
The third main advantage is the high communication speed that minimizes the time spent with the transmission data to the calculating system.
Another important advantage is that the CAN protocol has hardware implemented the concurrent system, arbitration being done automatically and transparent for the whole system.
The automatic detection of the errors and re-transmission of the messages is another advantage. This will determine also, a minimization of the attention paid by the central calculating system to the process.

It is also important to be mentioned the advantage offered by the existence of the multiple transmit-receive buffers that have CAN controllers and also the fact that the transmission medium is immune enough to the disturbances because the transmission is done by current impulses and the line has impedance adaptors to both ends.

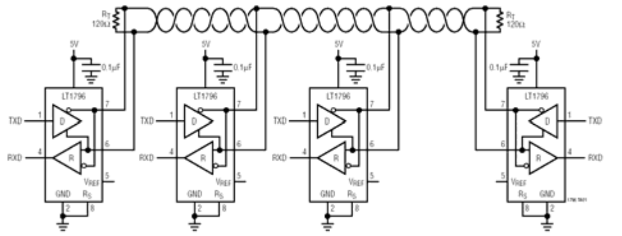

Figure 4 Physical communication

Hardware implementation of the CAN protocol

To implement to whole system were used four types of integrated circuits (figure 4): the command buffers of the step-by-step motors that have TDA2030 power amplifiers, but they were not detailed in this paper; the PIC16C84F Microchip programmable microcontroller, which has RISC architecture with EEPROM program memory of 1kB and with two input-output ports one of 8 pins and the other of 4 pins that is able to execute one instruction per microsecond; Microchip MCP2510 CAN controller that implement the whole functions of the CAN protocol and the LT1797 transceiver that implements the communication medium.
The PIC16C84F microcontroller is assembly language programmed and, through other things, it will set up the CAN communication controller to all the communication parameters (communication frequency, temporization periods, sampling periods, working modes, transmission addresses, receiving filters, transmission data, etc.)
In the following will be briefly described the two types of circuits with CAN direct application.
The Microchip Technology Inc. MCP2510 is a Full Controller Area Network (CAN) protocol

controller implementing CAN specification V2.O A/B (figure 5). It supports CAN 1.2, CAN 2.0A, CAN 20B Passive, and CAN 2.0B Active versions of the protocol, and is capable of transmitting and receiving standard and extended messages. It is also capable of both acceptance filtering and message management. It includes three transmit buffers and two receive buffers that reduce the amount of micro controller (MCU) management required. The MCU communication is implemented via an industry standard Serial Peripheral Interface (SPI) with data rates up to 5 Mb/s.

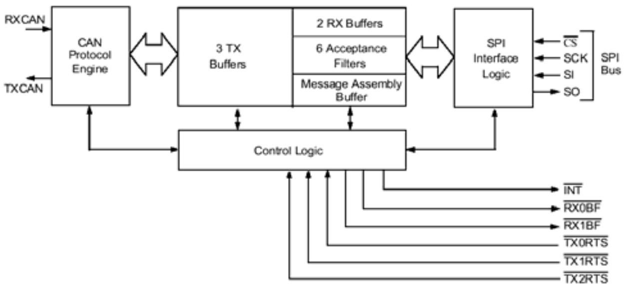

Figure 5 CAN controller

The LT 1796 CAN transceiver (figure 6) provides built-in fault tolerance to survive in industrial and automotive environments. Discrete protection devices are not needed. Bus interface pins can withstand voltage faults up to ±60V with respect to ground with no damage to the device. Faults may occur while the transceiver is active, shut down or powered off. On-chip ESD protection withstands up to ±15kV air discharges and ±8kV contact mode discharges tested per IEC-1000-4-2. Loss of power or ground connections does not damage the IC. The circuit operates with data rates up to 1Mbaud. A slew control pin allows control of transmitted data pulse edges to control EMI and reflection problems on imperfectly terminated lines.

High output current drive allows the use of inexpensive PVC cable with impedance as low

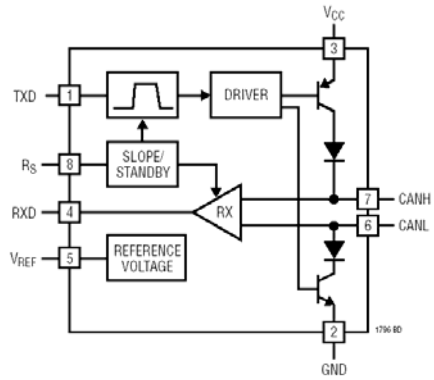

Figure 6 CAN transceiver

as 72Ω. The 100kΩ input impedance allows up to 256 transceivers per data network. The LT1796 is available in 8-lead PDIP and SO packages.

References

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[3] *** *Microchip PIC16F8X 18-Pin Flash/ EEPROM 8- Bit Microcontrollers DS 30430C* - 1999 Microchip Technology Incorporated

[4] *** *TDA2030 14W Hi-Fi Audio Amplifier* - SGS Thomson Microelectronics

[5] *** *Linear Technology* Initial Release – Final Technical Specification – LT1796 Overvoltage Fault Protected CAN Transceiver – Dec. 2001