Implementation of Conventional and Neural Controllers
Using Position and Velocity Feedback

Functional Description

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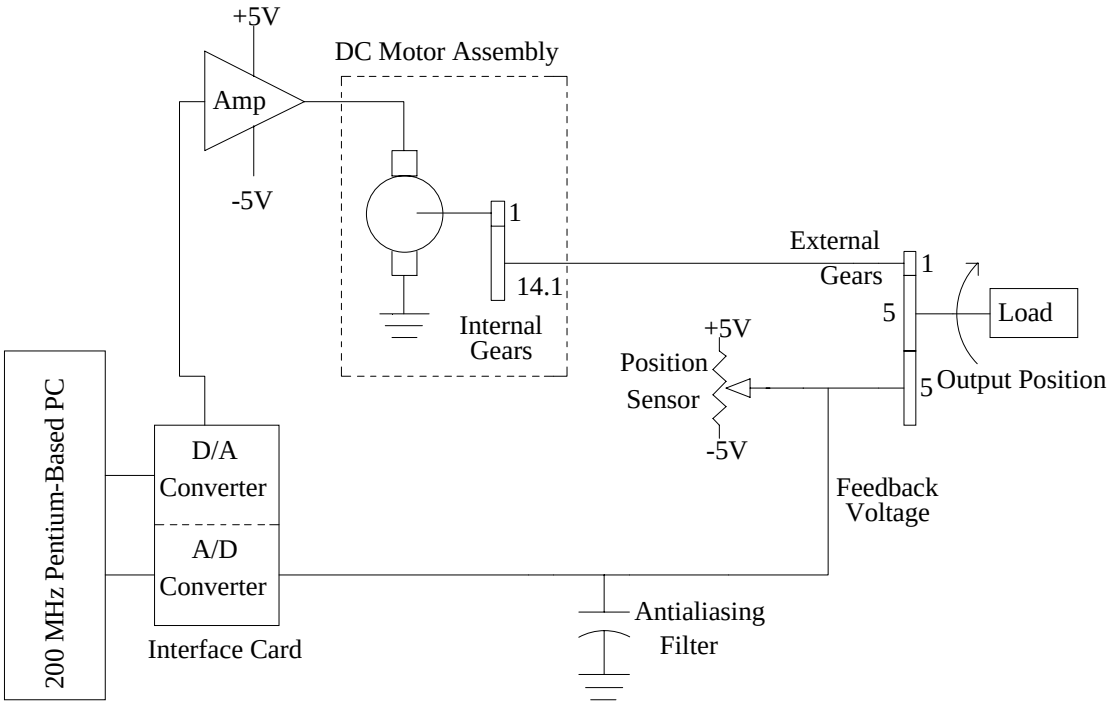


Fig. 1. System Block Diagram

Overview:
Our project objective is to design and evaluate different controllers for a small robot arm-motor platform from Quanser Consulting. Our main effort will be to work in a software environment on a 200 MHz or higher Pentium Computer to develop the controllers and signal processing algorithms in C language. An internal A/D and D/A converter card is connected to the external plant as shown in Fig. 1. The plant consists of a power amplifier, DC motor, gear train, external load, and potentiometer for the position sensor (also from Quanser Consulting). The feedback signal will be passed through an antialiasing filter, to the A/D converter, into the computer. The feedback voltage signal is proportional to the position of the robotic arm. The arm position is the primary output of the system, although arm velocity will also be of interest.

Modes of Operation:
Two modes of operation will be incorporated into the product. An option of connecting a joystick to one A/D channel will allow the user to control (command) the robot arm position. An external digital input can be used to signal the software that a joystick is present. The other mode (default) will use an internal software command signal to control robot arm position. The user via keyboard will be able to change the set point (desired final position) and the slope of the command signal (velocity).

The signals that are important in this system are described below. They are separated into three categories that include signals that are external to the computer, either (1) inputs or (2) outputs, and (3) internal signals to the computer that are important for controller evaluation and testing.

(1) Input signals to computer
The letters in brackets refer to the letters in Fig. 2:

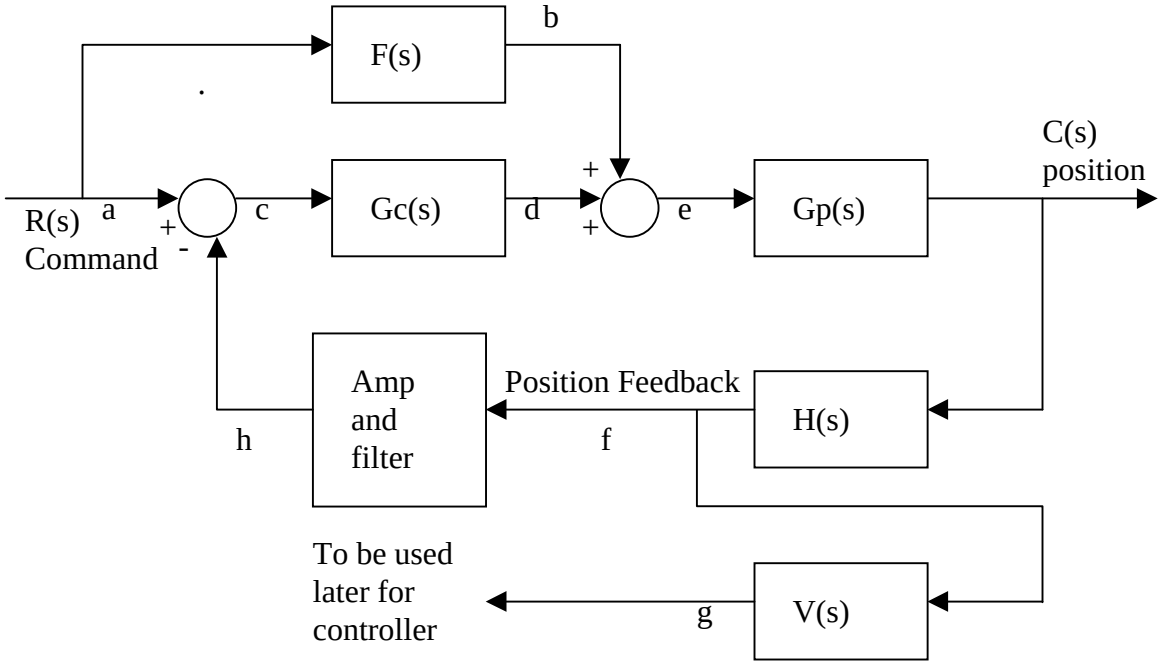
Voltage from position sensor (proportional to position)[f]	Used to help create the new control signal
Voltage from joystick	Used to create the command signal[a]
Digital input	Used to signal if joystick is present

(2) Output signals from computer:

Control (Actuating) Signal[e]	Used to drive the robot arm
Calculated velocity from robot arm[g]	Used to help create the new control signal

(3) Internal signals (in software, each will be displayed on computer monitor)
The letters in brackets refer to the letters in Fig. 2:

Command Signal[a]	Desired signal of robot arm position
Feed-Forward Signal[b]	The signal output from the feed-forward compensator
Error Signal[c]	The difference between the desired position and the calculated actual position
Conventional Controller Signal[d]	The signal output from the PID-type controller
Control (Actuating) Signal[e]	The signal created by the feed forward signal and the PID controller signal
Filtered and amplified position sensor output[h] signal[f]	The filtered and amplified position signal
Calculated velocity signal[g]	The signal that is calculated by using the filtered position output signal



F(s) is the feed-forward compensator
Gc(s) is the PID-type controller
Gp(s) is the plant
H(s) is the position sensor
Amp is an amplifier
V(s) is an algorithm to be determined
C(s) robot arm position output
R(s) command generated in software

Fig .2 Control Block Diagram