

Fabrication and Control of 4-DOF, Autonomous Robotic Arm Using Low Cost AVR Controller

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Abstract:

This paper summarizes the design and fabrication of a four degree of freedom autonomous robotic arm using Digital image processing. The robotic arm boasts a high performance, RISC architecture based microcontroller manufactured by Atmel, the AtMega16. Control of the robotic arm has been achieved successfully using five servo motors, each of which incorporates high resolution quadrature encoders. The robotic arm is equipped with a pair of high resolution digital cameras. These cameras transmit real time video to a Pentium based processor. The image processing module searches the video stream for predefined templates and calculates the coordinates of the object to grasp and transmits them serially to the microcontroller. The microcontroller implements inverse kinematics algorithms and then actuates the respective motors through angles so as to reach the coordinates desired in the most efficient manner. The motors are actuated using the internal PWM channels of the microcontroller and power amplifiers using efficient Mosfets. The robotic arm also has the provision of being controlled without the cameras relying on user input for the starting and terminating points. These coordinates are fed to the controller directly using a keypad and LCD module eliminating the Pentium processor. Thus even without a vision system the robotic arm may be defined as being autonomous. The end effector is a two finger gripper. The robotic arm has a load bearing capacity of upto 500gms and a maximum workspace of about two thirds of a meter.