Journal of Advanced Research in Wireless, Mobile and Telecommunication
Volume 6, Print Issue 1 - 2023, Pg. No. 16-19
Peer Reviewed Journal

Research Article

High-Speed Stepper Motor Control: A PC-Based Approach with Wired Communication for Precise Motion Control

Vallabpant Mate

Student, Mechanical Engineering Department, Vellore University.

I N F O

E-mail Id:
matevallaphpant@gmail.com
Orcid Id:
https://orcid.org/0009-0002-5073-542X
How to cite this article:
Mate V. High-Speed Stepper Motor Control: A PC-Based Mate V. Approach with Wired Communication for Precise Motion Control. *J Adv Res Wire Mob Telecom* 2023; 6(1): 16-19.

Date of Submission: 2023-03-22
Date of Acceptance: 2023-04-20

A B S T R A C T

Modern society's ubiquitous household goods and devices use stepper motors in a wide range of applications. In numerous industrial driving applications, the problem of sensing variables for control, such as position, velocity, or current, commonly arises. Given the high cost or environmental restrictions, it may be challenging to detect signals that precisely represent system variables, such as the absolute shaft position. When this happens, we are compelled to estimate all or some of the missing variables using a small quantity of data that could be noisy. The purpose of this project is to plan and construct a circuit that employs a microcontroller to fulfil the task of controlling the stepper motor through a keypad. As a result, the microcontroller's circuit can regulate both the step angle and the speed of the stepper motor. whenever the user types one of the keypad's many commands. This project describes in full how to link an extremely sensitive personal computer system with a high-voltage electrical device or a direct current/alternating current motor. We will be able to create the graphical user interface that will monitor and control the stepper motor's speed using the technology that has already been built. The project may be disassembled into its two constituent elements, the hardware and the software. Hardware for the suggested system, as well as how it will link to a computer through an RS232 serial connection port. We are creating an RS-232 connection between the PC and the controller to establish communication.

Keywords: High Stepper Motor, R$232, PC, MAX 232

Introduction

The stepper motor was created to address a particular gap in the motor control literature. The most common uses for these motors are in measuring and control applications. Some examples of potential applications include volumetric pumps, CNC machines, inkjet printers. In general, stepper motors share a number of traits that make them especially well-suited for the tasks listed below. Stepper motors employ brushless motors. Traditional motor parts with the highest failure rates are the commutator and brushes. They also produce electrical arcs, which in some circumstances can be undesirable or even dangerous. The stepper motor won't revolve at a speed no matter how much resistance it is receiving from the load as long as the load does not exceed the torque rating of the motor. When stepper motors are in operation, their open-loop positions move in predetermined steps. The shaft can be kept in its current

position thanks to the holding torque property. From the motors used in floppy discs to those used in large machinery, stepper motors are available in a wide range of sizes and powers. Utilising the microcontroller's Pulse-Width-Modulation (PWM) feature, it is possible to regulate the duty cycle of the stepper motor driving. The percentage of a single cycle that happens within the duty cycle of a constantly occurring train of pulses is referred to as the "duty cycle" in this context. Since the power is off for the most of the time when the duty cycle is low, a low duty cycle translates to a low amount of electricity. The term "duty cycle" describes the ratio of "on" time to the typical interval or "period of time." The duty cycle is expressed as a percentage, with 100 percent denoting full operation of the instrument.[1,2]

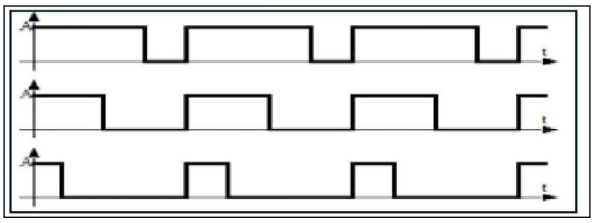

Figure 1.Wave at Different Duty Cycles

Hardware Development

The following illustrates, in block diagram form, the proposed system:

Modules for the Power Supply

This module's primary purpose is to deliver 5 volts at a current of 500 milliamps. This consists of a transformer, which is used to step down the AC voltage, IN4007 diodes, which are used to form a bridge rectifier in order to convert AC to DC, a capacitor of 1000uF, which is used as a filter circuit, 7805 regulators, which are used to obtain 5V at the output of the regulator, 330-ohm resistance, an LED as an indicator.

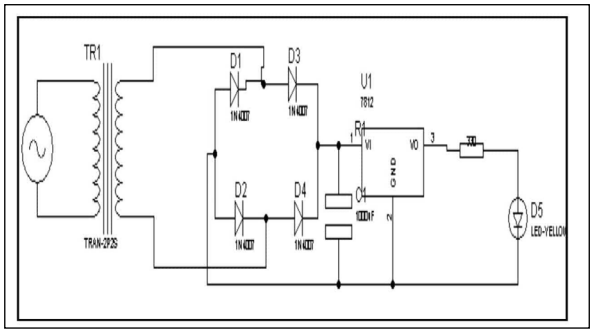

Figure 2.Diagram of Supply Section

Microcontroller (ATmega16)

Microcontrollers are widely available. Due to its built-in ADC interface and variable frequency, the ATMEGA16 from the AVR series was chosen for this project. AT megal6, a low-power CMOS 8-bit microcontroller, uses AVR RISC architecture. The ATmegal6 executes powerful instructions in a single clock cycle to achieve high throughput. This allows the system to optimise power usage and processing performance. It also reduces LAN costs.[3]

Model C USB-to-Serial Cable

This node interfaces with the coordination node and other nodes.

(level converter IC)

The MAX232 dual driver/receiver IC produces EIA-232 voltage levels from a single source via a capacitive voltage generator.

5 V. Each receiver converts EIA-232 to 5 V TTL or CMOS. Receivers have a 1.3 V threshold. 0.5 V hysteresis, 30 V inputs. Each driver converts TTL/CMOS to EIA-232. We should be able to get this functioning with a few capacitors.

Liquid Crystal Display

The LCD (liquid crystal display) device accepts 8-bit character codes from a microprocessor or microcomputer, latches them to its display data RAM (80-byte) DD RAM for storing 80 characters, then displays the characters on its LCD screen. Liquid crystal display (LCD) We are 16x2 LCDs and have 16 hardware pins. Pins 1, 3, 16 are grounded, pins 2 and 15 are +5v, pins 3, 4, enable are RS, RW, enable, the enable pin is always low. Display uses LCD data pins 11,12,13,14 for parallel four-bit transmission.[4]

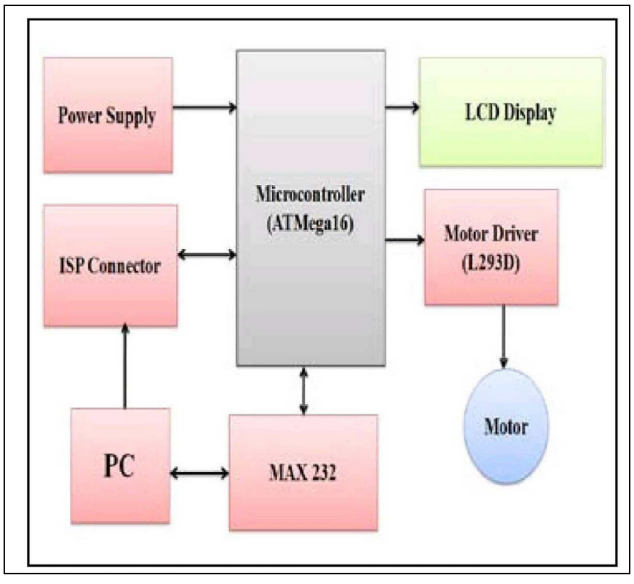

Figure 3.Block Diagram of System

DB9

The connector has 9 male and 9 female pins. In DB9, the number 9 refers to the total number of pins, the letter D refers to the two rows of pins that are parallel to one another and are shaped like the alphabet.

L293D (Motor Driver IC)

This integrated circuit is a high-voltage, high-current, four-channel driver that is designed to take DTL or TTL logic. This has the capability of delivering an output current of 600 mA per channel, as well as providing 1.2 peak output current (non repetitively) per channel, it also has built-in safety against internal overheating. It is made up of a Half H Bridge, which allows for a large current to be supplied in order to drive motors.[5]

RS-232

An RS-232 port was originally a common component of a personal computer, it served as a connection point for various peripheral devices such as modems, printers, mouse, data storage devices. The PC and the controller will communicate with one another using RS-232 cables.[6]

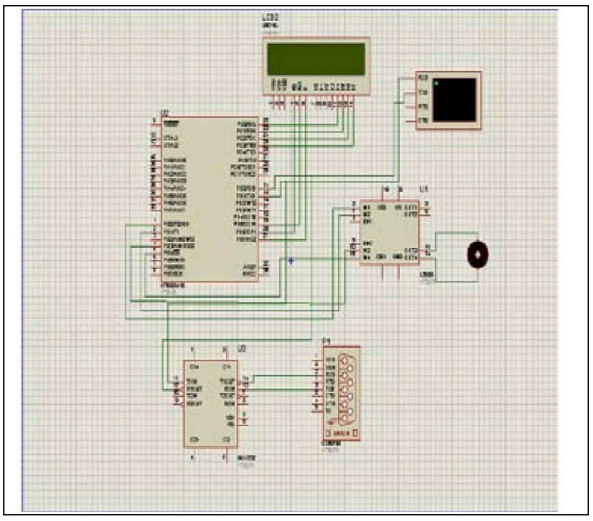

Figure 4.Simulation Diagram of System

Software Development

Microcontroller, when it is used to operate as a wireless network involves following steps:

Coding/ Debugging

In a high-level language, coding and debugging are essentially the same thing (such as c or java). The use of a compiler for a high-level language helps to shorten the amount of time needed for production. C was the programming language of choice when utilising WinAVR[2] to write programmes for the microcontrollers. The source code has been commented in order to make any potential future maintenance and enhancements more manageable. WinAVR is a collection of open source software development tools that are executable and are hosted on the Windows operating system. These tools are designed for use with the Atmel AVR series of RISC microprocessors. It comes with the GNU GCC compiler, which may be used for both C and C++. WinAVR incorporates all of the necessary tools for coding on the AVR platform. This consists of things like the AVR-gce compiler and the AVR-gdb debugger, among other things.

Compiling

Following the compilation of the programme, the code is then transformed into a machine-level language consisting of 0s and 1s. This file, which is saved with the extension. Hex, is referred to as the Hex file (Hex). In addition, the compiler will cause mistakes to be produced in the programme, which will need to be fixed before the programme can be run correctly.[6]

Burning

Using a specific programmer that connects to the peripheral of a personal computer (PC), it is possible to write the machine language (hex) file directly into the programme memory of the microcontroller. The serial port on the personal computer has been utilised for this purpose. In order to accomplish this goal, the Ponyprog programmer was utilised to write the machine language file into the programme memory of the microcontroller. Pony prog is a piece of serial device programming software that runs on Windows 95/98/ME/NT/2000/XP as well as Intel Linux. It features an intuitive graphical user interface. Its function is to read and write data from and to all serial devices. It is compatible with the Atmel AVR and Microchip PIC microcontrollers, as well as the I'C Bus and Micro wire communication protocols. Using a high speed-programming mode, the microcontrollers were each programmed in about two seconds' time. The programme memory is of the Flash kind, just like the EEPROM, it has a certain amount of time that it may be used. Atmega16 Programmer (ISP), which is used to burn the programme into AVR microcontrollers, allows it to be reprogrammed an unlimited number of times on AVR microcontroller family without the risk of data damage. This can be done up to a thousand times.

Assessment

If the system functions as required by the user and all jobs efficiently and effectively, the software development process is over and the project is ready to be installed as a LAN. If errors occur, the process is repeated. Microcontroller programming is difficult because of restricted resources. Unlike microcontrollers, PCs have limitless RAM and processing speed. Microcontroller code should be as resource-efficient as feasible, but it should also be cost- and power-efficient. The system's programming. Uses.c and.h files.

ICD.C

This c file controls the LCD module. Code controls LCD initialization, data writing, cursor movement, attributes,

location. It allows character-by-character or string-by-string LCD data entry. The software is based on the LCD's Hitachi HD44780 IC command set. Initlcd(), remove(), display(), displayint are in this file ().

Programming functions

The controller's code includes:

I programme delay

Void delay (unsigned char value) _delay ms(1);

Motor control

Motor dead (char data)

{

Switch(data)

Case 'a':

motor at 100%;

Break;

Case 'b':

motor at 75%;

Break;

Case 'c': motor at 50%;

Break;

Case 'd':

motor at 25%;

Break;

Break; motor at 0%

}

Conclusion

Industrial, office, medical, automotive applications all make use of stepper motors. Due to its simplicity, cheap cost, high dependability, capacity to be controlled in an open-loop system, this study was successful in designing a system to control the speed of a stepper motor through a PC. The work advances the use of industrial stepper motors.

References

1. A.R.Alae, M. M. Negm, M. Kassas,"A PLC Based Power Factor Controller for a 3 Phase Induction Motor", IEEE Transactions on Energy Conversion, USA, 1065-1071,2000.
2. M. G. loannidis, Design and Implementation of PLC-Based Monitoring Control System for Induction Motor, IEEE Transactions on Energy Conversion, 19, No. 3, USA,2004
3. M.G. Loannidis, "Design and Implementation of PLC-Based Monitoring Control System for Induction Motor", IEEE
4. Transactions on Energy Conversion, 19, No. 3, USA, 2004
5. Bashi SM, Aris I, Hamad SH. Development of Single Phase Induction Motor Adjustable Speed Control Using M68HC1IE-9 Microcontroller *Journal of Applied Sciences* S(2): 249-252.
6. Kumara MKSC, Dayananda PRD, Gunatillaka MDPR, Jayawickrama SS,"PC based speed controlling of a dc motor", A final year report University of Moratuwa llinious USA, 2001102
7. Chiasson J. Nonlinear Differential Geometric Techniques for Control of a Series DC Motor IEEE Transactionson Control Systems Technology. 1994; 2: 35-42.
8. Tipsuwan Y, Chow M. FuzzylLogie microcontroller implementation for DC motor speed control IEEE Transactions on Power Electronics 11(3): 1999; 1271-1276.