Stepper Motor Control using LabVIEW and NI-myRIO

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Abstract— In the current scenario, stepper motors are being used for diverse applications due to its flexibility and ease of control. This paper deals with the control of stepper motor using NI myRIO, because it is less complex to work with LabVIEW programming, which is pretty simple. The pulse required to run the stepper motor is generated using NI myRIO and interfaced with LabVIEW with the help of code generated in the system. The supply voltage is given to the motor through a voltage driver circuit and the motor's speed is controlled by varying the time delay in the LabVIEW program simulation specifications. Here, unipolar stepper motor is taken into consideration and wave drive or full step drive method is used, since this type of method is easy to implement. Position sensors may get affected by EMI and temperature so we are going in for sensor less control. This mechanical motion obtained using the stepper motor can be used in various industrial and real time applications as well.
Key words: Stepper motor, LabVIEW, NI myRIO, EMI

I. INTRODUCTION

Traditionally position control is done using DC motor, AC servo motor, Synchronous motor, Stepper motor, etc. Even though DC motor is easy to control it has some disadvantages like effects of overheating of armature windings, and also torque to inertia is low.

Considering the above reasons positioning is nowadays done using stepper motor because it has precise position control due to its integrated step movement and it can be easily controlled using open loop. Hence no feedback circuit is required. Nowadays they are being used in many versatile robotic applications such as Industrial robots, Space robots& Medical robots.

The use of LabVIEW is on the increase in universities and industries especially for data acquisition and process control. Frequently, there is a need to develop LabVIEW application software to work with foreign hardware, like a Slo-Syn stepper motor. Unfortunately, simple and clear procedures to develop motion control routines are not easily available. This paper describes a method develop to control a stepper motor using the LabVIEW software and the National Instrument hardware NI-myRIO.

II. BLOCK DIAGRAM

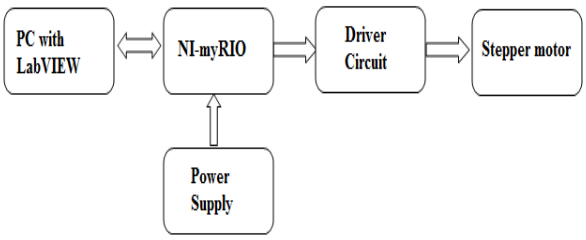

Fig. 1: Schematic block diagram of stepper motor control loop

III. STEPPER MOTOR

Stepper motor also called Step motor in which single rotation is fragmented into several steps. These motors are primarily used in measurement and control applications. The commutator and brushes of conventional motor are some of the most failure inclined components and they create electrical arcs that are undesirable or dangerous in some environments. Stepper motors are brushless and it is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments, when electrical command pulses are applied to it in the proper sequence. Stepper Motors come in a variety of sizes, and strengths, from tiny floppy disk motors, to huge machinery steppers. There are two basic types of stepper motors, bipolar and unipolar. The motor which is used in this paper is a unipolar stepper motor. A unipolar stepper motor is really two motors sandwiched together. Each motor is composed of two windings. Wires connect to each of the four windings of the motor pair, so there are eight wires coming from the motor. The commons from the windings are often ganged together, which reduces the wire count to five or six instead of eight.

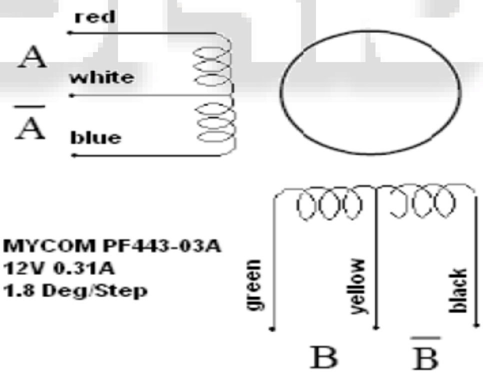

Fig. 2: Schematic diagram of unipolar stepper motor winding

IV. STEPPER MOTOR DRIVER

The driver circuit consists of Dual H Bridge. H Bridge enables a voltage to be applied in either direction for a motor. This H Bridge powers the unipolar motor.

It can be used for reversing the polarity and braking of the motor. This circuit is connected with the required voltage of 12 volts to power the motor. The triggering is given by the myRIO digital output port. Digital output port generates 3.3V as triggering pulse. Basically there are three types of driver for a stepper motor, Full drive, half drive and wave drive. In this we have run the stepper motor using wave drive triggering. In this type only one wire is energized at a time as shown in the truth table.

Steps	A	B	C	D
0	ON	OFF	OFF	OFF
1	OFF	ON	OFF	OFF
2	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	ON

Fig. 3: Triggering Sequence

V. LABVIEW

Laboratory Virtual Instrumentation Work Bench abbreviated as LabVIEW is a Virtual programming language. LabVIEW is a highly productive, development environment for creating custom application that interact with the real world signals in fields such as science and engineering. LabVIEW is unique because it makes this wide variety of tools available in single environment. LabVIEW is a development environment for problem solving leading to accelerated productivity and continual innovation. G-Programming being a central tool in LabVIEW has been widely used to interlink data acquisition, analysis and logic operations. It is a high level data flow graphical programming language designed to develop application that are interactive, executing in parallel and multi-core. It is commonly used for industrial monitoring, control and Automation. Programming is done using 3 panels as follows front panel, Block diagram and connector panel, where front panel serve as user interface where controls and indicators are placed and monitoring is carried out, Block diagram consists of functional blocks in which inputs are been wired and connector panel is used to generate sub VI's. Compared to other programming languages LabVIEW is user friendly because programming is done by picking and placing blocks rather than typing a lengthy code and error correction is very easy.

Nowadays LabVIEW based programming environment is the leader in the field of computer based measurement and data acquisition

VI. NI-MYRIO

It is a hardware developed by National Instruments, Texas used to acquire and process real time signals. It is a portable reconfigurable input / output abbreviated as RIO. It consists of a processor and FPGA embedded in it and it is compact. It consists of two expansion port (MXP) connectors A and B carry identical set of signals and both have 34 pin outs and a mini system port (MSP) called Connector C. In both the cases there are certain pins which carry primary and secondary functions. Signals can be acquired and processed in LabVIEW and the generated signals can be used in real time. NI-myRIO has 3.3v, 5v, +/- 15v power output. It provides connectivity with the host computer either over USB or wireless connectivity. It has an inbuilt accelerometer and special functions like Pulse width modulation, UART, Audio input and output terminals. The following figure shows the pin out diagram of mini system port from which we have generated digital signals to trigger stepper motor.

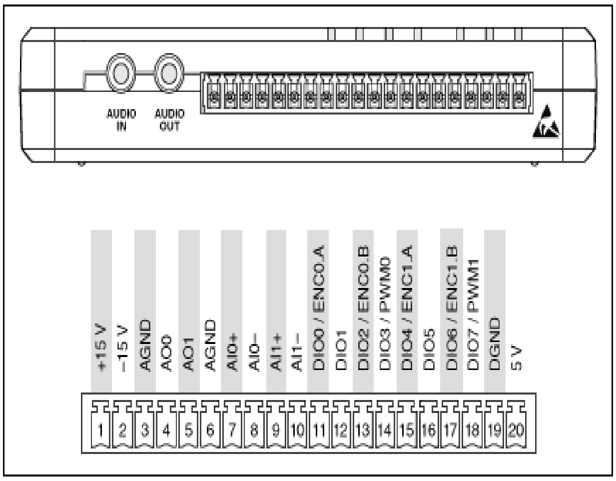

Fig. 4: Pin out diagram of NI-myRIO mini system port

VII. EXPERIMENTAL SETUP

The below figure shows the experimental setup of stepper motor interfaced with LabVIEW using NI-myRIO

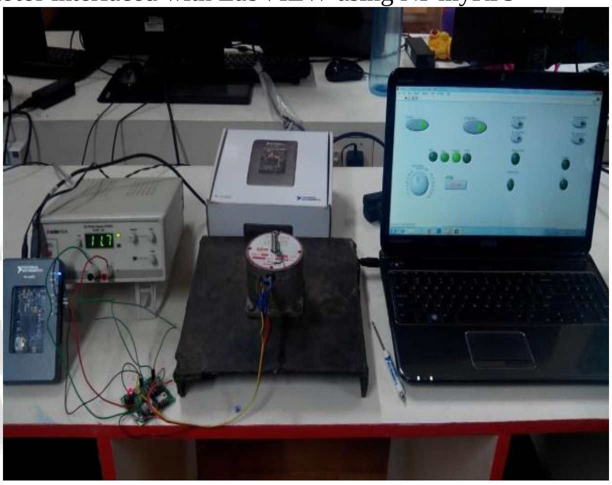

Fig. 5: Experimental setup

VIII. INTERFACING

The software used for the project is LabVIEW, version 2014.We have configured our program in such a manner that the RIO powers the driver circuit. my-RIO can only give a digital pulse of 3.3 volts not more than that, so we have utilized this digital pulse to trigger the driver circuit so that it will route the 12 volts connected to it to drive the stepper motor. We have programmed the motor to run in both forward and in reverse direction too. By introducing a time delay we have also controlled the speed of the motor.

For the Forward direction in a particular sequence the digital output comes from the sequence structure and similarly in the opposite direction the sequence is given in the reverse order, for which Enum, case structures and while loop has been utilized. The four windings of the motor are assigned separate cases of Enum. The wires to be triggered in case of forward movement are in the following sequence- red, green, orange and blue. For reverse direction it should be powered in the opposite direction.

IX. SIMULATION AND RESULTS

The following depicts the block diagram and front panel window of the simulation.

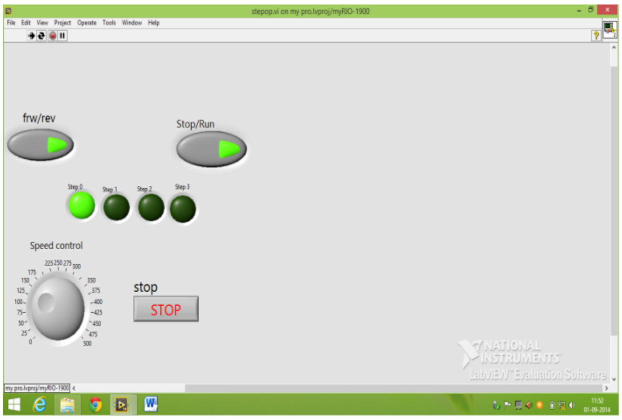

Fig. 6: Front panel of LabVIEW Stepper control.vi

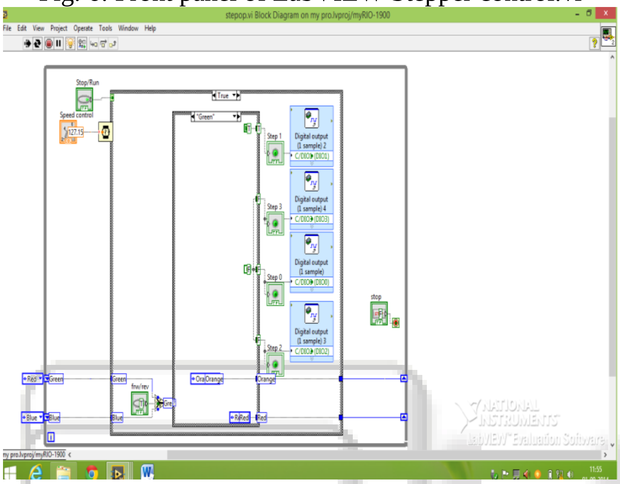
Fig. 7: Block diagram off LabVIEW Stepper control.vi

By using shift registers and case structures we have given the sequence in which the motor must run in case of forward and reverse directions, so that it moves in the required direction accordingly. The usage of while loop along with case structure with shift registers and enum is called as a State machine architecture in LabVIEW.

The front panel consists of LED's that indicate the direction of the motor, sequence of the powering of windings, and a dial for the speed control of the motor. As the time delay increases the speed of the motor decreases and vice-versa.

X. Conclusion

Thus the stepper motor control module has been implemented successfully using LabVIEW and my-RIO. The effectiveness of the project can be put to profitable use in any in any kind of environment that doesn't require or forbade the involvement of humans like in hazardous environments, mining, and many such industrial, medical fields. Its application can thus be extended to any field with simple changes to make it act as a robotic arm.

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