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MODEL DESIGNING OF DC MOTOR INSTANT STOPPING FOR ROBOTIC AND AUTOMATION

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Abstract

In present automation system i.e. robotic and such proposes gear or non-geared Dc motor are widely used for user friendly and economic. But very high inertia nature makes Dc motor not possible to stop as required immediately. It is observed even though supply cut off speed gradually decrease before it completely stop. Hence in terms of real time position control it cannot provide satisfactory outcome. For our understanding we can take an example of stopping a running motor at 90 degree clockwise, once the supply voltage has been withdraw even we expect it to be stop theoretically, but in practice it continue its decreasing movement and stopped at around 120 degree and that also depends on its inertia, torque and load to the system. This behavior decrease the utility and efficiency of DC motor hence it needs proper and necessary modification through supporting units. This work provide a theoretical study and practical analysis over it which proves a better outcome in terms of controlling of DC motor position compared to existing technology and principle. This also can be adopted for larger capacity of motor and motor with critical operation.

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I. Introduction

A mutual interaction of current in conductor and corresponding magnetic field contribute a mechanical energy ultimately over a conductor if it is lying perpendicular to a magnetic field and supplied with electrical energy Basically it supported with two condition that develop required force on this conductor i.e. current flowing in conductor and it is within a magnetic field. On satisfying both the condition, there will be a force applied to this conductor. This developed force move the conductor perpendicular to the magnetic field and which is the well-defined behavior of DC motors operation.

Developed force and movement express as follows:

F = BIL

Where

B= the density of the magnetic field, L= the length of conductor,

I = value of current flowing in the conductor.

Fleming's Left Hand Rule can describe the direction of motion. 2

II. Basic Operational Principle

Let B is flux density of magnetic field to the coil whose two ends are connected across a DC voltage source, I be the current flow through it. As a result of the interaction of magnetic field and electric current a force will be generated over the coil. It is sufficient to starts moving the coil in the direction of force.

Torque generation of DC motor

As per construction and designing n of Dc motor, rotor has several wound of coils which experience individual forces and altogether it causes a rotation. The rotation mostly depends on force develop and corresponding field strength ultimately the rotation depends on magnitude and phase of the current flow in on the coils.

Since the torque is time and magnitude dependent it occupied different location in magnetic fields. Now change of flux linkage produce preoperational an induce voltage. But induce voltage and voltage for being current flow are in phase opposition and its called as back emf or counter voltage.

Armature Induced voltage

The deviation between counter and applied voltage is responsible for magnitude of current flow on armature winding. According to Lenz's law this current slowing down the rotor.

Torque develops during this operation express as follow. Force on one coil F= I L x B NEWTON.

Hence torque for a multi turn coil with an armature current Where Ia: = armature current of coil with multi turn

Then the torque for this is defined *T* Where, $T = KIa$

Constant *k* depends on structure of coil armature current winding. and flux/pole in Webber.

Mechanical power will be generate due to machine torque and mechanical speed rotation

As per the requirement of motor or as a generator a Dc machine can be modified by reversing the terminals only.

DC machine Reversibility

Once there is rotation of this coil in the magnetic field there is a change of flux linked it induced emf which is, $e = dc / dt$

Since the flux linking the coil, $c = \sin t$ Induced voltage: $e = Cos \ t$

III. Proposed Model Architecture

While working with DC motors it was found out that they generate good amount of emf when DC motor is in motion. It is found that this generation of emf could be controlled (minimized) and the motor can be stopped immediately. This would make the DC motors highly accurate.

The detailed description and schematics of the circuit are given below with required components.

1. Microcontroller (ATMEGA 16)

2. Motor Driver (L298N)

3. BJT (TIP41)

4. Variable Resistance (1k)

5. Relay (SPST, 12v)

6. DC Motor

IV. Description

Microcontroller, motor driver and a BJT (npn) is used for switching the relay is connected to motor as shown in figure.

The relay is energized once both the terminals of the motor are shorted. When logic HIGH ("1") is given from the microcontroller gives a logic high 1 signal to the base of BJT the two terminals of the motor are shorted by relay.

Now generated emf is discharged against its own terminals and the motor stops instantly without moving further.

Safety Precaution

(1) The supply to the motor should be cut-off before locking the motor.

(2) The lock must be released by giving logic low ("0") from the microcontroller at the base of BJT Before starting the motor again.

Manual Control

A DPDT relay in this circuit behaves as two relays switching at the same time. Pin NO 2 of the relay is connected to one of motor terminal. The positive terminal of battery is connected to other end of motor terminal through the diode in forward bias operation. The negative terminal of battery is connected to SW2 pin of the relay. Using SW1 and NC1 pins of relay the two terminals of the motor are shorted. From the same source, motor and the relay are energized.

Motor terminals are shorted using SW1 and NC1 pins of the relay Initially. When supply is given to the relay, SW1 and NC1 get open once supply big given to it, and SW2 and NO2 gets connected. So now, there is a close circuit and motor starts. Again, when the supply is cut off, the two terminals of the motor gets shorted and it stops instantly

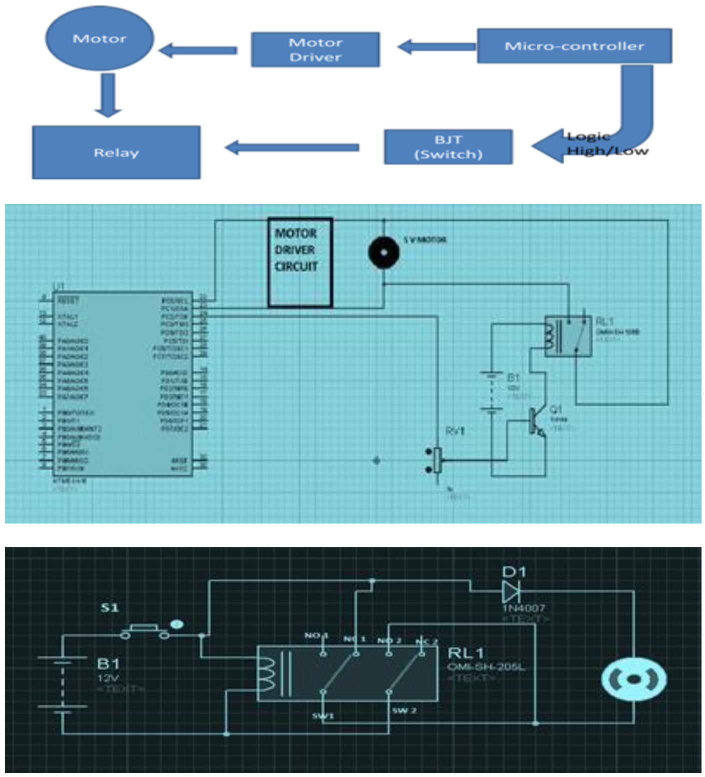

Figure 1. Block and circuit diagram of proposed model with automatic and manual control.

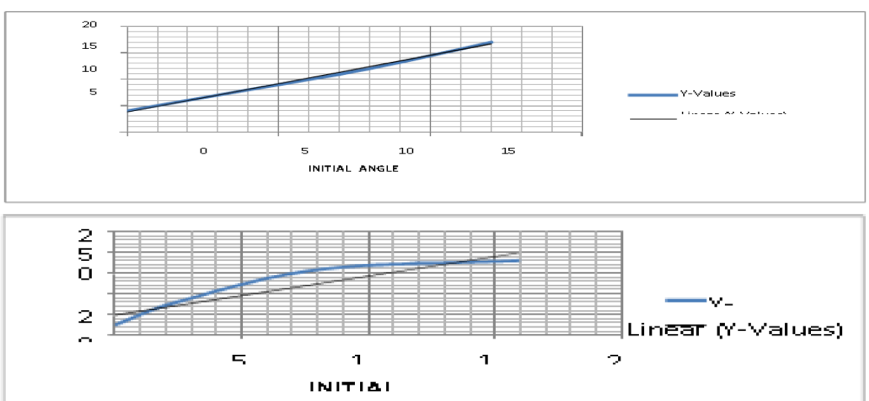

Figure 2. With stopping and without stopping mechanism.

V. Result Analysis Conclusion

Performance analysis of proposed design of instant stopping, accuracy and precision of the DC motor are improved to a great extent and fulfill the needs of robotic and automation process .This principle and technique provide a linear operational behavior to speed regulation and control.

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