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Development of Micro Controller Based Positioning Control of DC Motors for Industrial Applications using Proteus Software

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Abstract: Industrial loads require operation at wide range of speeds. Such loads are termed as variable DC motors current of the position can be controlled, these DC motor demand precise amendment of over the complete speed range (Current range). Therefore controlling of DC motor speed is necessary for all industrial applications. This paper developing the Micro controller Based for controlling the DC motors for various industrial applications using Proteus software.

This micro electronics based controllers are useful in trade based on their strong performance and in their trouble-free hardware circuit functions. However, the proposed approach is used in set of applications such as (1) Railway Gate Controller (2) Automatic water-level Indicator and filling. Here, conventional controller functions are compute with Proteus functional key element techniques by using DC motor model. These developed models will be used for simulation of the Proteus software is preferred based on development time of construction of hardware circuits. The results were carried out by simulated circuit of Proteus.

Keywords: Positioning control of dc motors, Dynamic system models, AT89C51 Microcontroller, Proteus VSM simulation software.

1. INTRODUCTION

In a good number of the industrial process like electromechanical etc., need for higher efficiency is placing new demand on associated with motors. That is why control is needed to achieve stability. The position control of a motor is to be widely implemented in machine automation. The output is fed back to input for control the error signal and acts as command signal for controller motor position.

A. Scope and Objective

The objective of this paper is control the position of a controlled motor to obtain desired output more precisely and reliably. Here we use Microcontroller based conventional Controllers by using Proteus software. The simulation and control of position of the DC motor and comparison of the approaches of controllers have been performed for different Industrial applications.

B. Electrical to Mechanical Energy Conversion

An Electrical to mechanical energy conversion occurs due to magnetic flux connecting a coil, allied with mechanical motion. The input is electrical energy (From supply source), and the output is mechanical energy (to the load) as shown in Figure 1.

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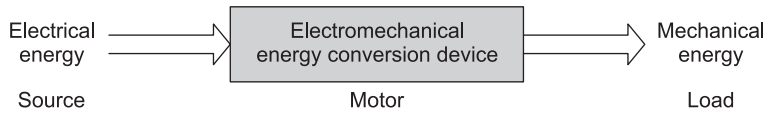

Figure 1: Energy conversion

C. Mathematical Model of Dc Motor

The battery source applied to the field (v_f) and armature (v_a) sides of the motor at an inertial load as shown in Figure 2. The R_f, L_f, R_a and L_a are represented as resistances and inductances of the field and armature part of the motor. In a field-current controlled motor, the armature current (I_a) is held constant by generator the motor, and the field current is controlled through the field voltage (V_f).

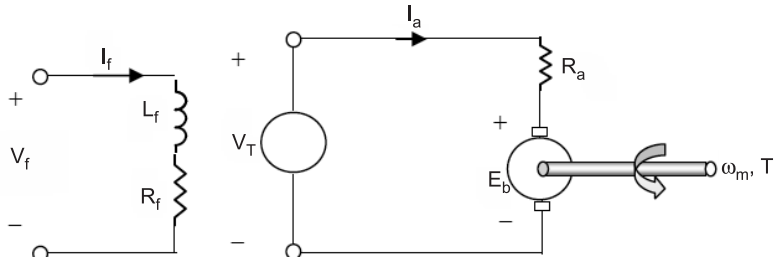

Figure 2 : Excited DC motor

In this case, the motor torques augment linearly with the field current. We write the following equations for understanding the behavior of the motor.

$$T_m = KI_f I_a \text{ and } \frac{T_m(S)}{I_f(S)} = K_{mf} \tag{1}$$

For the field side of the motor the relationship is

$$\begin{aligned} V_f &= V_R + V_L \\ &= R_f I_f + L\left(\frac{di_f}{dt}\right) \end{aligned} \tag{2}$$

The Transfer Function (T_f) (From above equations).

$$\frac{T_m(s)}{V_f(s)} = \frac{T_m(s)I_f(s)}{I_f(s)V_f(s)} = \frac{\left(Km_f \big/ L_f\right)}{\left(R_f \big/ L_f\right)} \tag{3}$$

Thus, the T.F by simplifications, we get

$$\frac{\omega(s)}{T_f(s)} = \frac{\left(\frac{1}{J}\right)}{s + \left(\frac{c}{J}\right)} \tag{4}$$

Finally, the T.F as 3rd order system (Eqn.5) and model of motor speed response by step signal as shown in Figure 3 based on the values of $K_{mf} = 1$, $T_f = 0.1$ sec , $T_m = 1$ sec (for simplicity we assume the values)

$$\frac{\theta(s)}{V_f(s)} = \frac{\theta(s)}{\omega(s)} \frac{\omega(s)}{V_f(s)} = \frac{\left(Km_f \Big/ L_f J \right)}{s(T_f s + 1)(T_m s + 1)} \tag{5}$$

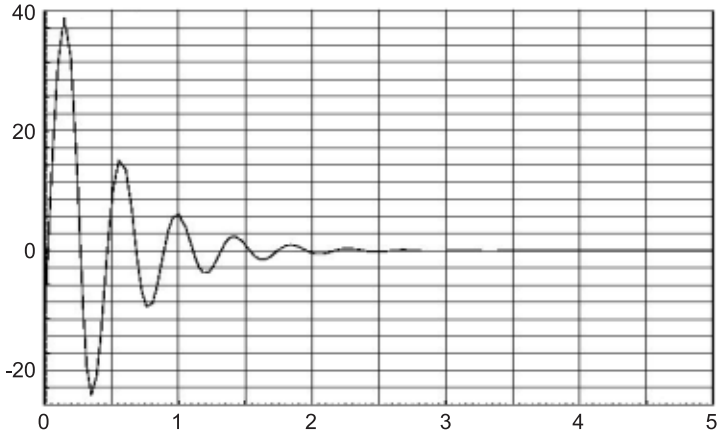

Figure 3: Speed response of a DC motor

2. DEVELOPMENT OF THE DC MOTOR DRIVE IN PROTEUS VIRTUAL SIMULATION MODULE

The closed loop control system scheme is proposed for development of the proposed industrial applications as represented in Figure 4.

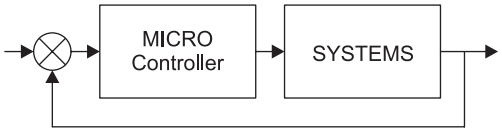

Figure 4: Closed loop control systems

The Microcontroller (MC) may be called workstation on chip, which is used for implementation of following experimental Industrial applications by Proteus VSM software, like home appliances and heart of electronics control systems such as (1) Railway Gate using DC Motor (2) Automatic water-level Indicator and filling DC motor.

1. ***Railway Gate using DC Motor:*** The AT89C51 (Micro controller) carry out the absolute operation that is gate closing and opening by sensors. It avoids manual errors and thus grants eventual safety to road users based on the system is completely automated. There is no a lot of complexity needed in the circuit due to simple principle of the mechanism as shown in Figure 5.
2. ***Automatic Water-Level Indicator and Filling:*** It's AT89C51 (Micro controller) used for the absolute operation of Automatic water-level controller by pre-fixed low level(on-point) and position off the motor when water level rises up to pre fixed-high level (off point) motor also switches off as shown in Figure 6.

3. RESULTS AND DISCUSSION

The Proteus software based results shows its capability and usefulness in designing virtual simulation model, The DC motor drive model was developed both in response model and virtual model for industrial applications. Therefore, the simulation results has been carried out by using VSM software and shown in Figure 5-6 for the proposed industrial purposes.

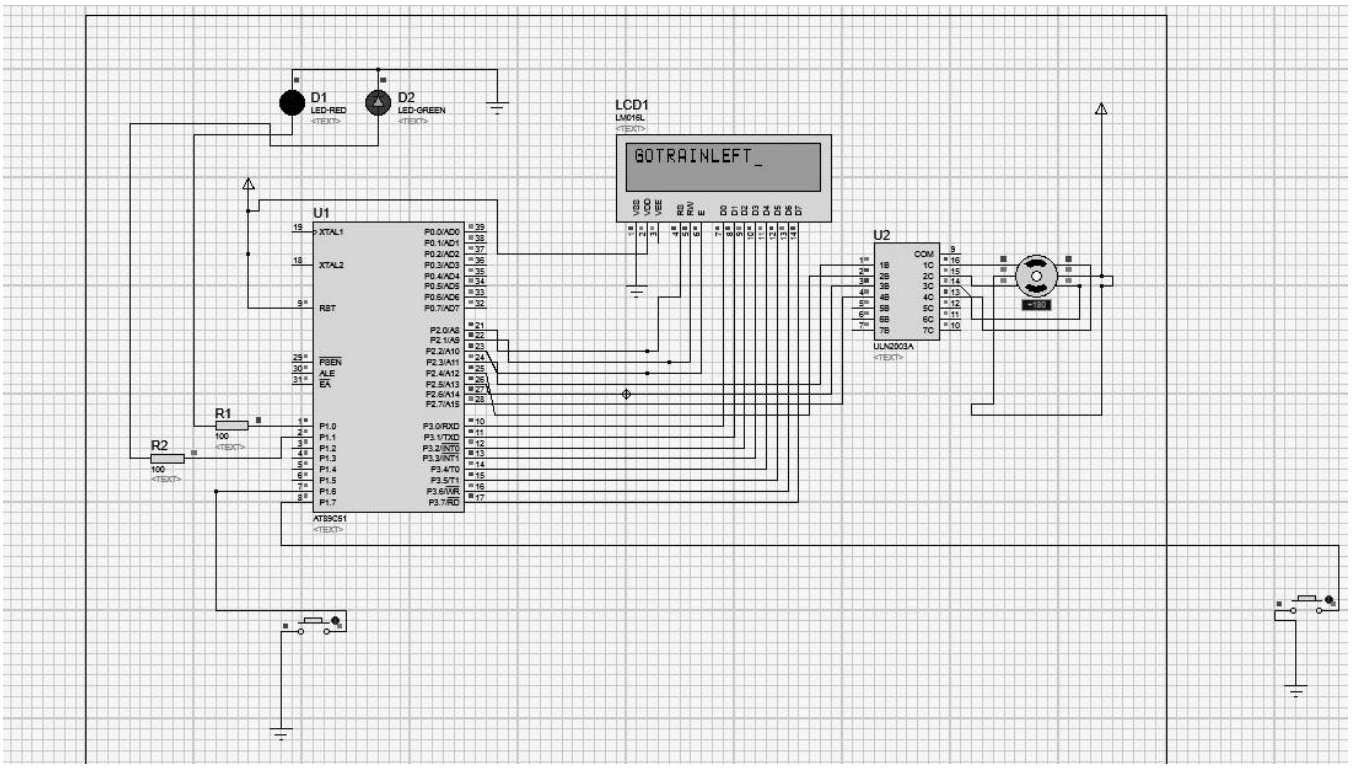

Figure 5: Circuit Diagram of Railway Gate Control

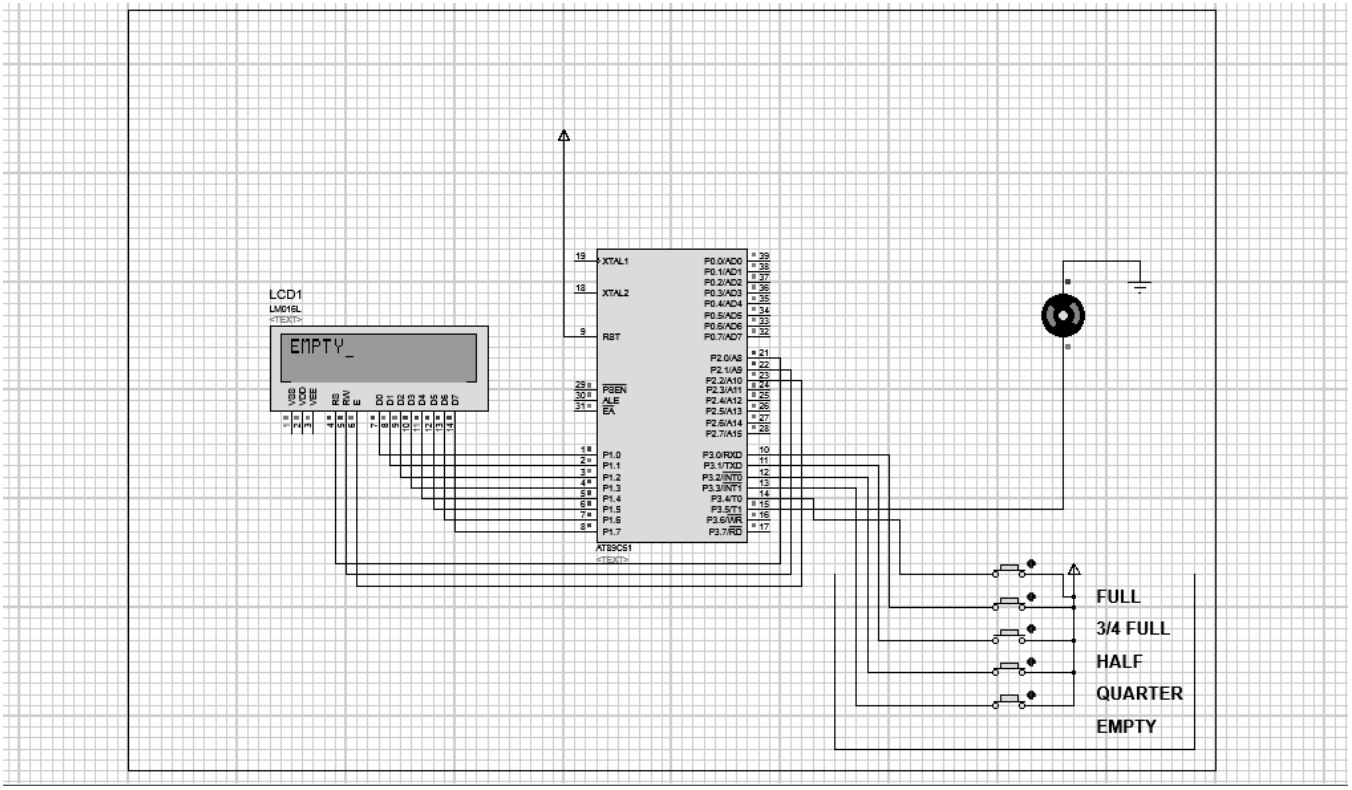

Figure 6: Automatic Water-Level Indicator and Filling

4. CONCLUSION

The micro electronics based controllers of trouble-free virtual hardware circuit functions are shows good performance. Hence, the designed Industrial applications are Automatic water-level Indicator and filling

and Railway Gate Controller are shown from Figure 5-6. Here, the conventional controller functions are compute with Proteus functional key element techniques by using DC motor model. However, the developed models will be used for synthesis and as well as preparing the hardware models based on simulation of the Proteus VSM simulation.

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