I. INTRODUCTION

The purpose of a motor controller is to control the torque, speed, and position of a motor. Because the torque generated by the motor is proportional to the amount of current flowing through it, directly torque control is rarely used. In most applications, cascade control structure is used, as shown in Fig. 1.

In other words, the electronic drives that controls the electrical energy supplied to the motor receives the control signal from the current controller, which receives its setpoint from the speed controller. The current controller is called the drive-specific because its operation is considerably affected by the type of motor. The position and speed controllers are called task-specific because they are considerably affected by the machine driven by the motor.

II. FUNDAMENTALS OF MOTOR CONTROLLERS

It is not necessary to use all three controllers in all applications. In some applications, position or speed controller is not required; however, current controller is used in all applications. This is because the current controller not only ensures stable and controlled torque but limits the current supplied to the machine, thereby protecting the motor from overload [3]. The three controllers operate at different speeds. For example, the current controller is considerably faster than the speed controller.

Feedback values of the controllers have to be measured. Current can be measured using a shunt resistor or a Hall effect current transducer. For speed and position measurements, quadrature encoders can be used [7][10]. For position control, usually proportional (P) or rarely proportional–differential (PD) controllers are used. Proportional–integral (PI) controller is commonly used as a speed controller. We

Comment [A1]: Singular nouns take singular verbs. In this sentence, the noun is "purpose;" therefore, the correct verb is "is."

Comment [A2]: Writers use tense shifts to convey a desired meaning to the reader. These tense shifts must be a logical progression of ideas. It is common to see the present, present perfect, and past tenses in the same sentence or paragraph. However, unnecessary shifts in tense can confuse a reader and may not suit the context of the article.

Comment [A3]: In American English, "that" is used to introduce a restrictive clause and "which" a nonrestrictive clause.

Comment [A4]: Introductory phrases are separated from the main clause using a comma.

Comment [A5]: The en dash is used in place of a hyphen in cases where the paired elements carry equal weight or represent a parallel relationship such as Carbon–Magnesium bond or Bose–Einstein statistics.

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~~can get the current control with proportional-integral~~ (PI) _or_ hysteresis ~~hysteresys~~ controllers can be used for current control [8~~-~~].