Experimental study of protection and control applied to Permanent Magnetic DC Motor

Abstract. A century ago, steam engines, petroleum and power were competing to replace animal power. Whenever it was possible to feed continuously by an external source, moving vehicles, therefore, reserved lanes or shared, is electricity that has prevailed: subway, train, tram, trolley bus. For other autonomous vehicles that require a power source on board, fossil fuels and internal combustion engines have taken almost the entire market for obvious reasons of autonomy but not in the medical field.

Introduction

The DC machine is a rotating electric machine that operates completely reversible, as its name suggests, from a voltage and a direct current. In the context of small engines, it is suitable for electrochemical power sources. For high power, it operates as a motor (traction), converter of electrical energy into mechanical energy or as a generator (braking), and converter of mechanical energy into electrical energy. This machine is an electromechanical converter. If you will consider it an achievement for controlling a DC motor with permanent magnet excitation designated for a wheelchair for disabled.

The power part

Fig.1 Block diagram of the power part

It consists of five elements:

The first element is the continuous supply of trained several batteries. In the embodiment will be in our hands with power is rectified filtered 180V.

The second element is the static inverter which will be a series converter (step down converter) consists of a cell switching power (MOSFET) and a freewheeling diode (LED fast) with galvanic isolation between this part of power and control. [1] [2]

The fig.2 shows clearly different from the side power and choice of components used.

The third element is the engine like PERMANENT dc power of 1HP with armature voltage of 180V and 4.9A current brand LEROYER SOMER.

The fourth element is a load; it will be the resisting torque (the weight of the wheelchair and person with disabilities) as a cross tender.

The power part

Fig.1 Block diagram of the power part

Fig.2 Schematic of the electric power part

Fig.3 Photograph of the power section performed

Fig.4 Engine used in handling

Fig.5 load or load torque used
The fifth element is the speed sensor (stained metric generator) is used here just to observe the change in speed.

![Fig.6 Generator stained metric](image)

The following figure shows the circuit packaging for this size with a filter (R17, C1) to eliminate the noise generated by the mechanism of the mechanical generator.

(1) \[ f_c = \frac{1}{2\pi R_1 C_1}, \quad \text{ith} \quad f_c \approx 10Hz \]

![Fig.7 Schematic electrical packaging speed [6]](image)

![Fig.8 Photograph of part of the packaging speed](image)

**THE CONTROL**

It also consists of three elements:

- The first element is set as a variable resistor (potentiometer) with another fix for not achieving the high speed action in this equation:

\[
V_{\text{contr}} = \frac{R_i + RV_{12}}{RV_{11} + R_i + RV_{12}} \cdot V_{cc}
\]

This set point chosen so that it can vary the engine speed between the total and half of its nominal speed

![Fig.10 Circuit diagram of the set](image)

The second element is the heart of the application, the microcontroller (HCS12) which will acquire the deposit and the generation of PWM. [3] [4] [5]

![Fig.11 Picture Card HCS12](image)

The flowchart of the program used in the microcontroller is as follows:

![Fig.12 The flowchart of the program](image)

The third element is the protection against over current, it is a current sensor with its conditioning circuit (adaptation and adjustment of gain by a resistance trimmer RV2) for observation in the current case or it may exceed its nominal value. [6]
Fig. 13 Circuit diagram of current sensor

Fig. 14 Circuit diagram of current packaging

Fig. 15 Schematic electrical circuit for detecting excess current [6]

Fig. 16 Photo of the part of protection against over current

**Scheme summary of the whole system**

Power DC → Current Sensor → Chopper series DC/DC → D.C. Motor (excitation with permanent magnet) → Load

Protection → Microcontroller → Consign

Fig. 17 Schematic Of complete system

The fig. 17 light assembly of all parts of the system.

**The results of the realization**

After the completion and assembly of various parts of the prototype, we began testing and the following results:

Testing of protection against over current:

In this maniple used a rheostat to resist 7A and our calibration for the arrest was 3.6 A.

CH1 (PWM) CH2 (G du MOSFET) CH3 (signal of protection) CH4 (signal I)

Fig. 18 Assembly complete

Test circuit of attack: After the fig. 21 we see the optical coupler acts as an inverter over its role galvanic isolation.

Fig. 19 Detection of excess power

Fig. 20 Total cessation of MOSFET
We noticed a delay in closing and opening of the optical coupler, this problem does not affect our manipule because it uses a single power cell and not an arm of two cells.

Full system testing:
For a voltage of 180V was them the following results:

**Fig. 21** PWM pulses and the Attack of the MOSFET

**Fig. 22** Result for 0tr/min and 0A

**Fig. 23** Result for 452tr/min and 0.5A

**Fig. 24** Results for 957tr/min and 1A

Noticing from the results we have confirmed the proper functioning of the achievement made.

**Conclusion**

Often in the industry are used in the traction motor current follows the order was easy and the only drawback is the call flow is important due to the variable load.

The engine used in this work is a permanent magnet motor intended for use in a rolling shrine to the endigages and sometimes the weight of the passions raised by this kind of problem is why when added to the order protection for many for him and extended the life of the wheelchair.

**REFERENCES**


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