REPORT ON PMSM MOTOR CONTROLLER [Module-2]

Table of Contents

What is a Motor Controller why is it Important?

Motor controller as the name suggests controls the RPM and the torque of a motor in question there are different types of motors available in the market but perhaps the most important and the most complicated motor to control is the permanent magnet synchronous motors. In this case we have to consider the following factors:

- Space vector PWM based RPM control.

- Hall effect based position sensing.

- High voltage gate driver circuit.

- Discharge circuit.

- Capacitor bank for Regenerative braking.

- Signal filter circuit.

Application definition & Requirements

Application

This problem statement requires us to design a motor controller with 10 Khz Space vector PWM signal as output and a high voltage gate driver circuitry of upto 600 to 700V.

Table of Requirements

High Level Requirements

Requirement ID	Design Consideration
HL-1	RPM encoder
HL-2	Thermal Runaway protection (>120 ºC)
HL-3	Under-voltage lockout protection (<50V)
HL-4	Over-current Protection (>500 A)
HL-5	Maximum Voltage (1000 V)
HL-6	Embedded System for SPWM
HL-7	Watchdog system for DAQ

Low Level Requirements

Requirement ID	Low Level ID	Design Considerations
HL-1	LL-1	Shaft mounting
	LL-2	Encoder signal (0-12V)
	LL-3	Error Signal LED
HL-2	LL-1	Use NTC thermistor (10K)
	LL-2	Voltage divider with 10KΩ
	LL-3	Add pump RPM control
HL_3	LL-1	Gate Driver circuit with UVLO
HL-4	LL-1	Use HV Hall Current Sensor
	LL-2	Add High Voltage fuse
HL-5	LL-1	Contactor Shutdown switch
HL-6	LL-1	CANBUS support
	LL-2	Fast floating point calculation
	LL-3	ARAI Approved
	LL-4	Expansion module support
	LL-5	1- 10khz spwm signal
HL-7	LL-1	Monitor the current discharge
	LL-2	Monitor fuse status
	LL-3	Error singal & sequence generation

Block Diagram of the Embedded System
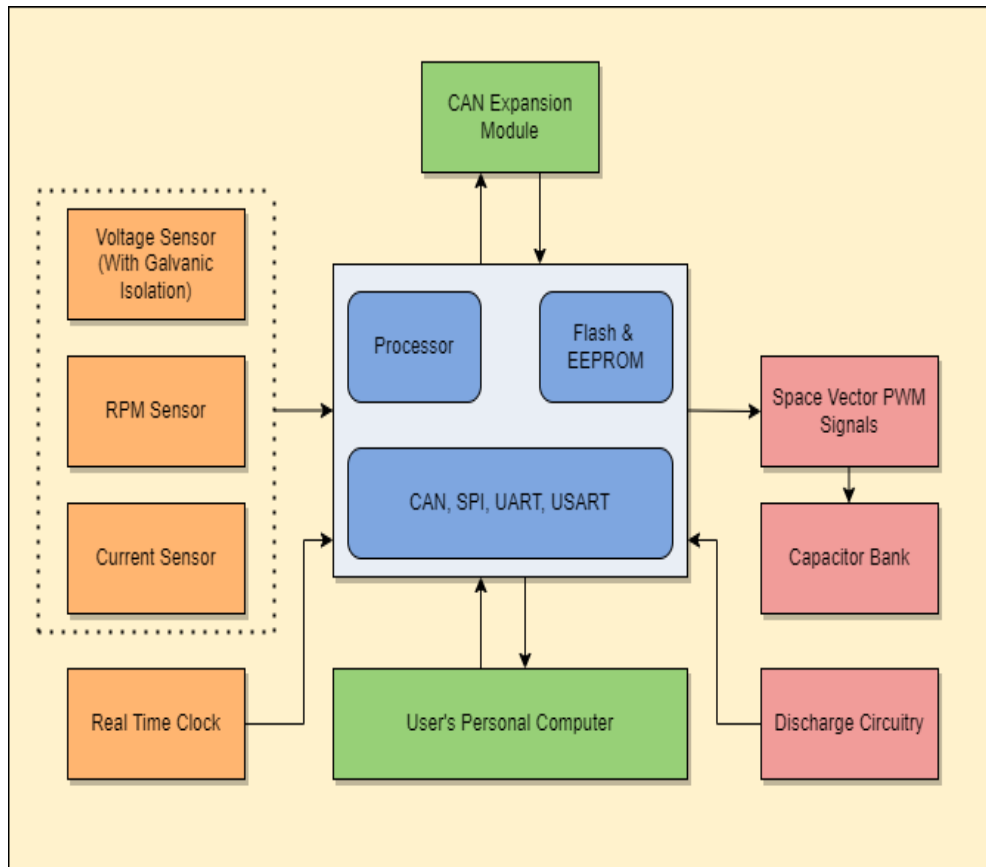
Sub-system Level Design Details

The Battery Management System is a system which requires prompt and real-time monitoring of fuses, voltages, and current.

The different subsystems are as follows:

- Software
  - RTOS for multi-channel and multi-sensor monitoring.
  - Component to Component and User to Component CAN Bus signal enabled.
  - Modularity within the software for Motor parameter variables.
  - Temperature Monitoring
  - PID based parameter generation
  - Motor Controller Error diagnosis firmware.
  - Easy to understand error codes.

- Hardware
  - Galvanic Isolation between the sensor and MCU.
  - Three phase H-bridge gate driver circuit.
  - Fused sensing terminals.
  - Microcontroller SPWM generation
  - PCB traces appropriately calculated for the maximum design current.
  - Buffers and signal conditioning.

Document made by <u>VIGNESH BHAT.</u>
Made on <u>19th February, 2022</u>