TPMC

Three Phase Motor Controller
ELECOMP Capstone Design Project 2017-2018

Sponsoring Company:

Bay Computer Associates
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https://baycomp.com

BCA is continuing their support of the Program they initiated last year:
http://web.uri.edu/elecomp-capstone/past-projects-2016-2017/bca/

Company Overview:

BCA is a full-service custom software, firmware, electronics, and website contract-design company. Our permanent staff of 25 engineers have been designing complicated electronics and software-based devices for over 27 years, and medical product design is one of our specialties.

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Project Motivation:

BCA originally designed a Three Phase Motor Controller for use in a power-assisted wheelchair. The product was later integrated into an electric bicycle. Eventually, BCA would like to create a versatile product that is capable of powering larger vehicles of various types, like an Electric Golf Cart or Scooter. The new motor controller should also be easily integrated into any application involving movement, such as Robotic Arms. It would also offer features for non-mobile applications, such as the precise movement involved in XY Tables or an X-Ray machine.

In order to develop this product, the existing motor controller will need 3 upgrades. First, the Electronics need to produce more current; at least 80 Amperes. Second, a position control feature needs to be fully implemented in Firmware to allow the product to have precise and accurate movements. Third, an application in Software should be completed, which would allow tuning of the motor controller into any application.

In general, BCA has consistently participated in the Capstone Design Program at the University of Rhode Island, because our company is committed to giving back to engineering education, specifically to new engineers who are genuinely curious and eager to learn. BCA hopes to provide you with the guidance and tools you need to earn hands-on experience with a unique company, learn as much as possible, and have fun doing it!
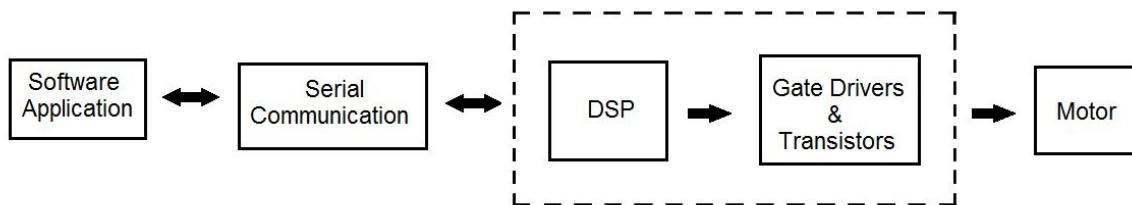
Anticipated Best Outcome:

Ideally, the best outcome for this project is to create an "off the shelf" product with all of the aforementioned features successfully integrated in the device. Realistically, BCA hopes to have an updated schematic and layout with all existing and upcoming changes implemented. We would like the existing Firmware code to be finished and ported to the hardware for testing. Lastly, we would like the auto-tuning routines in software to be completed and tested, such that it is able to graph velocity, current, and position information.

Project Details:

The electronics design combines analog and digital circuitry to produce three phases of current at the output of the Gate Driver and Transistor stage, which is then delivered to the motor. The "brain" of the design is controlled by a specialized microprocessor called a Digital Signal Processor (DSP), and the Firmware is written in the Standard C language. The software application lives separately on a PC and it is written in C# using the .NET framework. The DSP gathers the data that is produced by the electronics and transfers those bits of information to the PC via serial communication.

The overall goal of the Electrical Engineer is to produce a minimum output current of 80A by redesigning the Transistor Stage to include parallel MOSFET's. In order to accomplish this task, the Engineer must continue evaluating the entire circuit design, which includes efficiency, footprint, and cost. The responsibility of the Firmware Engineer is to implement a fully functional position control feature. The Engineer will need to evaluate the existing code, port it to the hardware, and test it for efficiency and functionality. The Software Engineer will be responsible for completing the Auto-Tuning algorithm on the PC. This Engineer will also need to evaluate the previously written code and test it for verification. A successful application should be able to graph concise voltage, current, and position values.

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Composition of Team:

1 Electrical Engineer.
1 Computer Engineer with Electrical/Firmware interests.
1 Computer Engineer with Software interests.|

Skills Required:

Electrical Engineering Skills Required:

- Basic Circuit Analysis
- MOSFET Circuits
- Interest in analog/digital circuit design.

Computer Engineering Skills Required:

- C#
- .NET Framework a plus
- Interest in algorithms and software development.

Firmware Engineer Skills Required:
- Standard C
- Interest in microcontrollers and digital signal processing.

Anticipated Best Outcome's Impact on Company's Business:

An off the shelf product that is able to be integrated into various applications provides an excellent way of showcasing the capabilities of our company. Specifically, the Three Phase Motor Controller is a testament to the wide range of skills we offer from electronics design to firmware and software development.

Broader Implications of the Best Outcome on the Company's Industry:

BCA is a unique in our industry in that we have the capacity and knowledge to continue to develop new products and be a "one-stop-shop" for our customers. Our team of 25+ Engineers are always working on new and exciting applications. We are never stale and we are never bored. Increasing our portfolio of projects and in-house products makes us outshine our competition and reflects the versatility that is Bay Computer Associates.

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