



UPPSALA
UNIVERSITET

Project in Embedded Systems (15 hp)

Electron gun vacuum system control

Microcontroller based control system interfaced

with industrial grade electronics

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Report - Phase 2

Summary

During this phase, work has been divided between writing some additional code for the ATmega microcontroller as well as testing mechanical relays and starting the PCB design.

Additional coding

The additional code written for the microcontroller consists of several parts. Firstly, a numerical input interface has been written where the user can input decimal numbers. Secondly, a simple PID-interface has been written where the user can use the numerical interface to choose the Kp, Ki and Kd feedback gain values. Thirdly, code for reading the ADC has been written, this will constitute the feedback signal from the system. Fourthly, code for outputting a voltage level using pulse-width modulation (PWM) in conjunction with an external low-pass (LP) filter has been written. Fifthly, some basic handling of fixed-point decimals has been implemented. This should make the implementation of the PID-controller more efficient as compared to using floats.

Interface to industrial grade electronics

To interface the microcontroller to the industrial grade electronics it is required for the microcontroller, which operates at a 3.3V level, to interface with a 24V level. One way to achieve this is to use mechanical relays. Compared to having a direct transistor coupling to the 24V side a mechanical relay offers additional separation from the higher potential. During this phase, mechanical relays were tested for use as both inputs and outputs. After this testing was completed, it was realized that it is preferable to use optocouplings for the inputs rather than mechanical relays. This nullifies the potential risk of a too high or too low voltage to the relay coil which would result in the coil burning or the relay not switching on.

PCB Design

Also during this phase, design of the PCB was started. A schematic for the final device is started as well as the component placement for the final device. The software being used for the PCB design is KiCAD, a free open-source electronic CAD tool. With my previous experience in Altium Design, it was not particularly difficult to get started with the new tool. The design is to incorporate 8 mechanical relays for digital outputs and 8 optocouplers for digital inputs. There will also be terminal blocks for connecting analog inputs and or outputs as well as power.

Conclusion and plan for the next phase

During this phase, work has been split up between different areas. Compared to the time schedule, there's still a bit of lag (as was also the case at the end of the last phase), but I think the project should still be manageable to finish on time. The software has some slight work to be done, but I think focus at the start of the next phase should be put on finishing the PCB and getting that to work. When the PCB is finished, the software can be further tinkered with.