PRODUCT INTERVIEW REFLECTION PAPER

Team: Electron Wranglers

Project Name: Textron Aviation Cooling Fan Circuit

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Senior Design EE 585

Textron Aviation Cooling Fan Project

INTRODUCTION

This project is to develop a small circuit board that will monitor the tachometer output of a brushless DC cooling fan, and then control a discrete (ground/open) output to indicate if the cooling fan is functioning as intended. The intent is for the circuit board to be small enough that it can be installed in the aircraft wire bundle with zip ties to support aftermarket and late point definition installations with minimal impact to the aircraft and/or maintenance crew.

BODY

Interview 1: Robert Evans

Robert is a research engineer for NIAR in the robotics laboratory and holds a bachelor's in electrical engineering. He currently works on defense projects through NIAR. Based on his personal work experience, we picked up some interesting, new information based on his perspective. He first mentioned that we should be more specific with the types of circuits we are using (ie. If we are using a filter, specify that it is a low pass filter). This gives the reader an easier and more direct understanding of the overall circuit. He also mentioned that we should try and find out what kind of wires we will being running this circuit next to, as these wires could create more noise in our signal. While we already have filtering to counter act this, we may have to raise our values on our filters in order to add a larger cushion for error. He said it would be quite important it to label all components, including cables, inputs/outputs, and the parts on the PCB board itself, as this will make the jobs of the technicians far easier.

One of the most important points he brought up is that many aircraft circuits are "potted", meaning that the entire PCB board with all the components soldered on is encased in a layer of epoxy. This epoxy could push our design beyond the required size constraints, and he did not seem to think that we would be able to fit that size if we are required to pot our circuit.

Overall, Robert was able to give us good first had knowledge on standards of aircraft parts. We should be more descriptive with our overall circuit by adding more labeling and be specific with our circuit sections. We will need to get into contact with Textron again and see if we can get more information regarding the wires we'll be installing this bundle next to, and whether we will be potting this circuit.

Interview 2: Andy Stallard

Andy is a professor at Wichita State University who is currently our Senior Design I professor. He is a former aircraft-based engineer who has several years of aircraft experience. He brought up some good points regarding other parts that we can add into our circuits. Regarding our voltage regulation for the power bus, he brought up how a snubber circuit, or a metal oxide varistor could work better for our voltage regulation as they will better account for large spikes in the voltage signal. Looking into both, the metal oxide varistor seems like it would be a practical solution for us that would also be compact for our

size constraints. He did say that in the case that we use a relay to transmit this information, that we may need to investigate using a free-wheeling diode for diode suppression.

Like Robert, Andy mentioned the need for labels on our circuit, and specified that this is an FAA regulation. Regarding these regulations, he also told us that it would be to our benefit to investigate FAA regulated materials for our packaging as resin, which we have investigated, is flammable and not FAA regulated.

Overall, we can take away from this interview that we need to look some more into FAA regulations on these parts and materials. We have begun to investigate MOV's, and we think this will be a great solution to our power bus voltage regulation. It will also be important for us to reach out to Textron and get more information regarding where the output will go.

Interview 3: Arun Kaarthick Manoharan

Arun is a current graduate student at Wichita State University specializing in power electronics. From our interview, it seems that Arun believes our design can accomplish this task. He also recommended a snubber circuit like Andy did for voltage regulation as it will better accommodate the high spikes we might receive. He did bring up that we should consider what the output voltage is to know whether we will be able to sink the 1 A required by Textron.

An important consideration he brought up was that we need to know how the fan is controlled if we wanted to use a voltage to RPM relationship. Getting more information about both questions will greatly help us to create a relationship between the input RPM reading and what the output will/should do.

Overall, our most important take away from this interview is to find out how our fan voltage to RPM relationship isn't as simple as we thought it would be. Having better knowledge on this subject will not only give us the relationship we mentioned, but it will also give us a better understanding of how our design works as well.

Summary:

One thing that we learned from our interviews was that we should stick with using the tachometer as our input signal to compare to as that would better fit our product requirements to know whether our fan is spinning less than or larger than our threshold. This is because at times our fan could have an input voltage but isn't spinning as fast as it should be because of some fault in the motor. The tachometer would make sure that this would be addressed as its output frequency is done by measuring the spin of the rotor. We believe that our block diagram is still valid after the completing the interviews. We learned that we need to look into MOV and snubber circuits as they could be better than a voltage regulator for our input bus. We learned that we should use nonflammable housing materials and labeling is very important as an aid to the maintenance staff , and to provide clarity as to its purpose within the wire bundle.

The interview process was very educational, and the group learned a lot from this experience. As engineers, we should, and must, commit to lifelong learning. The interview process helped the team to grow and provided an insight into learning process of a practicing engineer. It also illustrated some blind

spots within our original design. Interviewing people to ask them their expectations for a product is very important for the engineering profession. All engineers should ask questions to help them learn who they trying to help, and how they should do it.