CE420 Final Project

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The Problem

A persistence of vision (pov) fan is a device for displaying a large round image using very few LEDs. The problem with the existing products on the market is powering the part that is spinning.

Cheap pov fans use a battery attached to the fan itself. This makes the fan heavy and hard to balance. It also means that the fan can be run for no more than a few minutes before it needs to stop and recharge.

Another common solution is to use complicated slip rings to power the fans. The problem with this is that slip rings are complicated and wear out quickly, or they are expensive.

The Solution

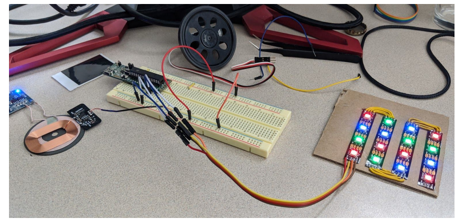
The solution involved a technology made commonplace by cell phones; wireless charging. A pair of Qi standard charging coils and associated circuitry can be purchased for roughly $15. The 5v standard of USB charging also makes Qi wireless power more compelling. While these charging coils are not usually used while moving significantly, the co-axial nature of the motion should not interfere with the operation of the coils.

The microcontroller chosen to sit on the fan is a PIC24. The fan is made from a PCB I designed and assembled myself[1]. To communicate with the fan while it is in motion, there is a SH-M08 BLE serial uart chip. The LEDs are RGB SK9822 5050 LEDs controlled over SPI. To calibrate the position of the fan while it is spinning, I am using a hall effect switch. The fan is spun by a brushless motor originally intended for a quad copter. The entire project is mounted on a 3d printed housing.

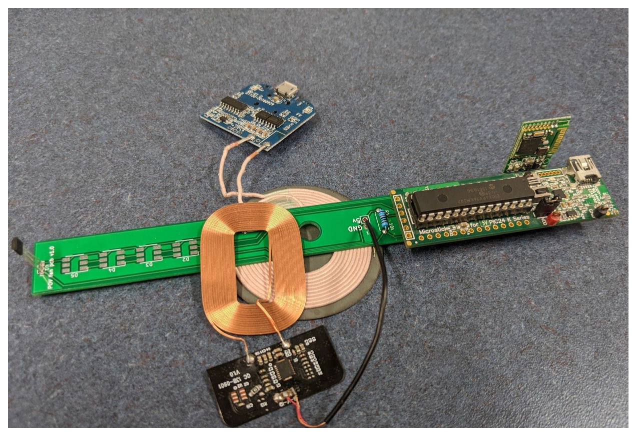
[1] PCBs ordered from jlcpcb.com

evaluation

I chose the pic24 for my micro because I have previous experience with it, and already own several. It is probably overkill for this project, but not by much. Early testing was done on a breadboard, just to see if the wireless power was a viable approach. The wireless charging coils were able to power more than I had anticipated. I this picture they are powering 16 LEDs, the pic itself, and a servo motor.

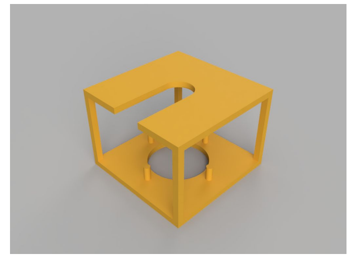


The most involved part of my project was the PCB design. This is the first PCB I have ever designed, and it took two versions before I got it to work at all. The first iteration had several flaws, but the worst was probably the lack of ability to program the pic in circuit. When I got the boards I realised this would be a problem, and left the pic mounted in its dev board. This was too bulky for it to spin properly. A second version of the PCB rearranged some of the components, and added a debug header for the pickit3.



Though the second revision of the PCB is not bug free. It does not connect one of the uart pins on the pic to the bluetooth chip properly, and it is still not balanced mechanically. Assembly of the PCB was done in the SMT lab in the ECE department. The solder paste dispenser and reflow oven made attaching the LEDs and especially the 0602 resistor and capacitor much easier.

The second most difficult part of the project was the 3d printed housing. It went through several revisions on its own, the first was just a best guess made without careful measuring, mostly just to get a feel for how to mount the motor.



The second revision (pictured here) was difficult to print due to the large overhanging surface. But it did bring an important innovation; to use small 3d printed pegs instead of holes for nuts and bolts. Those pegs could then be melted down to form a kind of rivet. It was also impossible to actually mount the motor because the top was too low to get the motor inside. The third revision took the top off and fastened it via the same heat staking method.

Conclusion

Overall, this project was a lot of work, but it was also highly educational. I learned about PCB design, spending several days doing little else but work on the PCB. I also learned more about designing for 3D printing, implementing for the first time the heat rivet method. In the coming months I will spend more time on it. I plan to redesign the PCB for balance, and also redesign the housing to hold the magnet as well as the motor. The software will also get an update, to support true dynamic content on the display.