OOP6 FA16

Solar Powered Attic Fan

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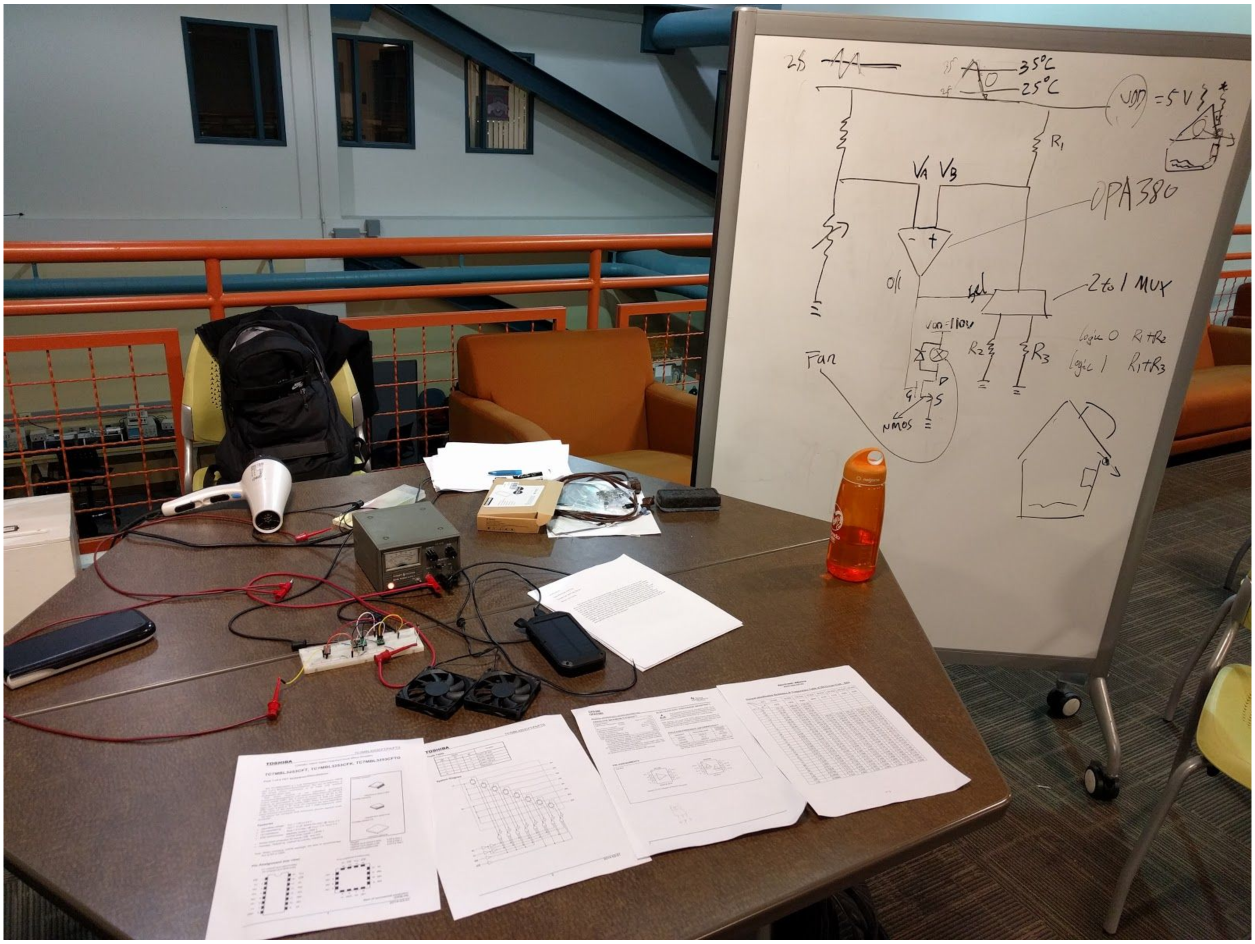
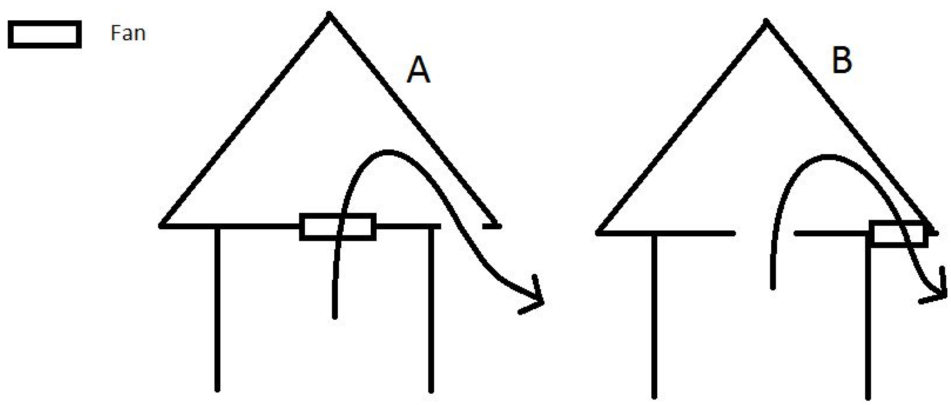
Mentor: Art Lizotte

Our project will be to design and prototype a solar powered attic fan. As hot air rises above cold air, the attics of homes become significantly warmer than the rest of the home. When the rest of the house is too warm for comfort during the summer, the common solution is to turn on the AC. While this works, it is not the most efficient, as warm air still remains in the attic. The goal of our design is to take warm air from the attic and push it outside the house, letting the average temperature of the house drop with less energy than cooling the warm air with the AC. During the day when the sun is out, temperatures of the house rise, so our fan will be solar powered to counteract the rising temperature by fanning it out, keeping the house temperature cooler. We will most likely have a down scaled model to make the design process faster and cheaper. We hope our design is quiet while still being able to move a large quantity of air and still be able to work by only solar panels. We want the user to be able to easily turn it off and on and make the attic fan automatic.



This project idea was given to us by Art Lizotte when we were searching for a project to participate in the OOP. We decided this would be a project that would fit our skill level and provide plenty of challenges while allowing us to finish successfully. Our first decision about the circuit design was whether it should function purely on an analog circuit or if it should function digitally through a microcontroller. We chose the analog circuit, and because Kevin was more knowledgeable about analog circuits, he lead the design while Lane assisted. In the end, we have achieved our goal of creating an automatic solar powered attic fan prototype and we can continue to develop with this circuit until we have a full scale design. The major problems going forward would be the diminishing solar power vs air flow ratio and not getting all the power we need cheaply from solar panels. We have decided not to continue working on this project.

Figure 1



We are considering different ways to place our fan and ventilation system such as (A) in between the insulation between the house and the attic, or (B) have a ventilation there and have the fan on an underhang of the roof (See Figure 1). We may build a model house with cardboard or something similiar to contain rooms of different temperatures and try out each fan placement and test our results once our downscaled fan is finished. With the model house, we can also experiment with different thermoresistor placements to account for the attic having different temperatures at different areas. We are considering different ways to build our circuit and how it will activate the fan after the required temperature has been reached (See Figure 2).

Our original thought is to build a circuit that the fan directly attached to the output of the OpAmp which shows in the left part of figure 2. But we find out that the OpAmp Ti380's drive strength is too weak to drive a big current fan. So we decided to attach another fan control circuit that use relay and diode to show and control the fan is turn on or off. With this fan control circuit we can use much more powerful fan in the actual design. In other words, we can make our design much more efficient. And figure 3,4 shows the Ti380 OpAmp's internal circuit and pin assignment.

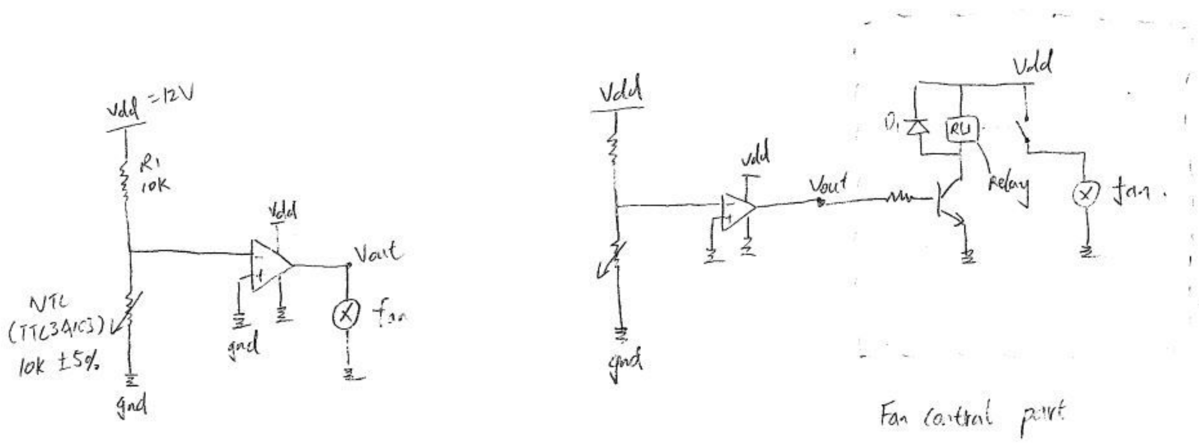
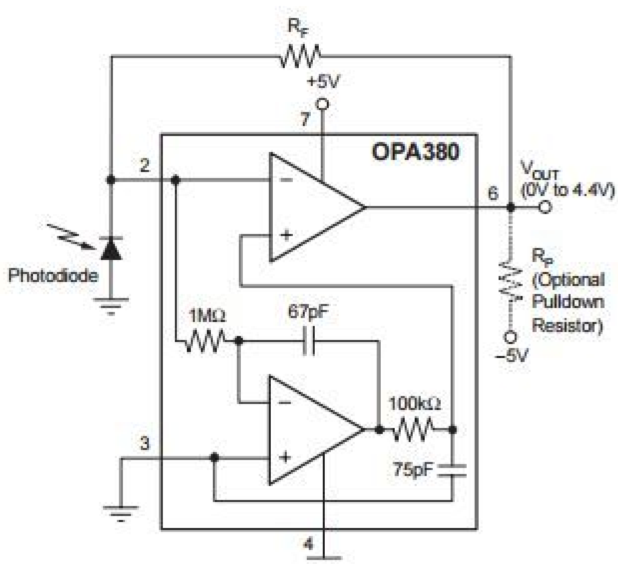


Figure 2



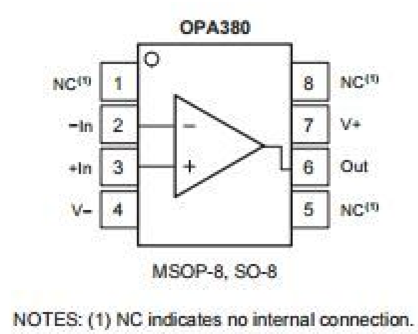


Figure 3

Figure 4

We chose the MF52 thermistor to detect the temperature of the surrounding air. We chose this thermistor because it was very cheap while also being accurate enough (+/-3% error) for our purposes. The data sheet (Figure 5) shown below gives us the resistances of the thermistor at the given temperature in Celsius. We chose room temperature 25 degrees and hot room 35 degrees to be our floor and ceiling threshold of the hysteresis system. When the temperature goes above 35 degrees, the fans will turn on and begin moving air. The fans will stay on until the temperature reaches 25 degrees at which point they will turn off. By changing reference resistors, we can change the temperatures at which the fans turn on and off.

Electronic Alliance
www.eaa.net.au

Normal specification Resistance & Temperature Table of MF52-type (Unit：KΩ)

R_{25}	10 KΩ	50 KΩ	100 KΩ	50 KΩ	50 KΩ	100 KΩ	100 KΩ	150 KΩ
B / T(℃) Rt	3950	3950	4000	4050	4150	4150	4300	4500
-30	181.70	908.30	1790.00					
-25	133.30	666.50	1321.00					
-20	98.88	494.50	984.70					
-15	74.10	370.50	740.80					
-10	56.06	280.30	562.30					
-5	42.80	214.00	430.50					
0	98.96	164.80	332.30	168.80	172.00	344.10	352.40	576.70
5	25.58	127.90	257.50	131.30	132.20	264.30	270.00	433.20
10	20.00	99.98	201.10	101.00	102.40	204.80	208.30	328.40
15	15.76	78.79	158.20	79.28	80.03	160.10	161.90	250.90
20	12.51	62.55	125.40	62.78	63.00	125.00	136.70	193.30
25	10.00	50.00	100.00	50.00	50.00	100.00	100.00	150.00
30	8.048	40.24	80.29	39.98	39.76	79.51	78.35	117.30
35	6.518	32.59	64.87	32.16	31.89	63.77	62.37	92.28
40	5.312	26.56	57.72	26.10	25.73	51.45	49.94	73.11
45	4.354	21.77	43.10	21.35	20.88	41.76	40.22	58.28
50	3.588	17.94	35.42	17.72	17.04	34.08	32.56	46.74
55	2.974	14.87	29.26	14.36	13.99	27.97	26.40	37.71
60	2.476	12.38	24.30	11.92	11.53	23.06	21.53	30.58
65	2.072	10.36	20.27	9.938	9.541	19.08	17.69	24.94
70	1.743	8.717	16.99	8.317	7.929	15.86	14.62	20.45
75	1.473	7.364	14.31	6.991	6.621	13.24	12.20	16.85
80	1.250	6.248	12.10	5.906	5.552	11.10	10.05	13.94
85	1.065	5.324	10.27	5.012	4.674	9.348	8.376	11.60
90	0.911	4.555	8.758	4.271	3.950	7.900	7.004	9.680
95	0.7824	3.912	7.495	3.654	3.349	6.698	5.894	8.118
100	0.6744	3.372	6.438	3.316	2.849	5.698	4.978	6.836
105	0.5836	2.918	5.550	2.701	2.438	4.875	4.215	5.780
110	0.5066	2.533	4.801	2.336	2.093	4.186	3.580	4.904

Figure 5

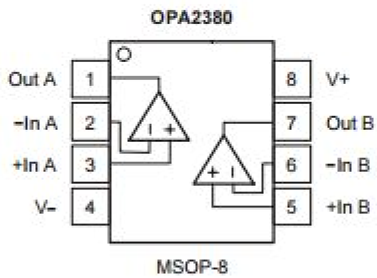


Figure 6

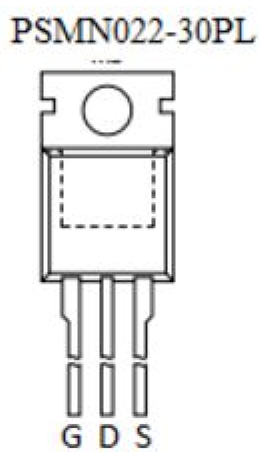


Figure 9

Truth Table

Inputs			Function
$\overline{OE}$	S1	S0	
L	L	L	A port = B1 port
L	L	H	A port = B2 port
L	H	L	A port = B3 port
L	H	H	A port = B4 port
H	X	X	Disconnect

System Diagram

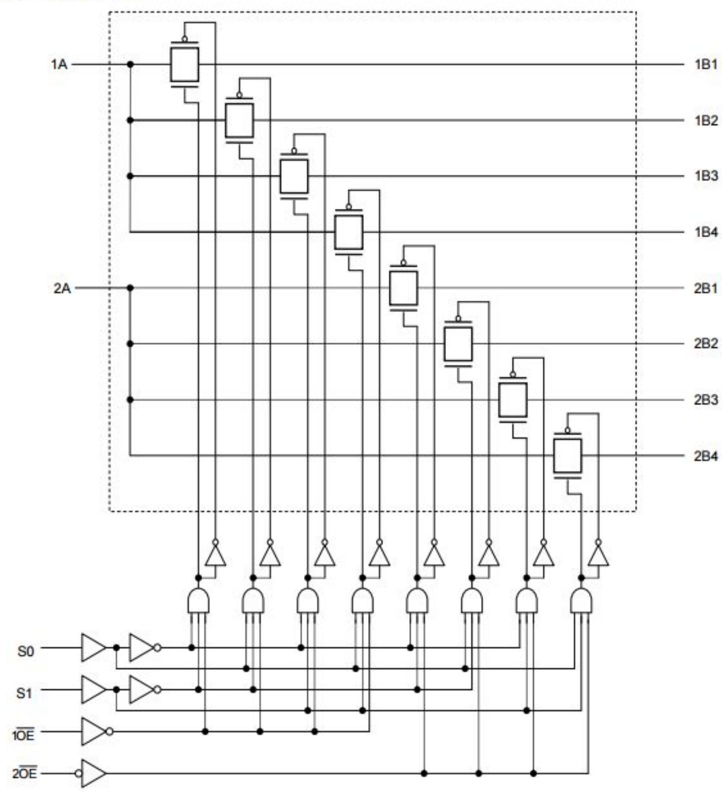


Figure 7

The circuit (Figure 8) works by comparing the voltage difference between 3 different voltage dividers, one that includes the thermistor and two that includes a reference resistor to create the hysteresis. The voltages are input into a OPA2380 op amp (Figure 6). If the voltage input from the thermistor is greater than the voltage from the 35 degree resistor, a logic 1 will be sent to a transistor'(Figure 9) gate that turns on our fan directly(Ids) connected to our 5V source. The logic one also is sent to a multiplexer (Figure 7) that switches the 35 degree reference resistor with the 25 degree reference resistor. The fan will remain on until the thermistor detects lower temperature and inputs a lower voltage in the op amp than the voltage of the 25 reference resistor. When this happens, a logic 0 is sent to the transistor and the multiplexer that turns off the fan and switches the reference resistor back.

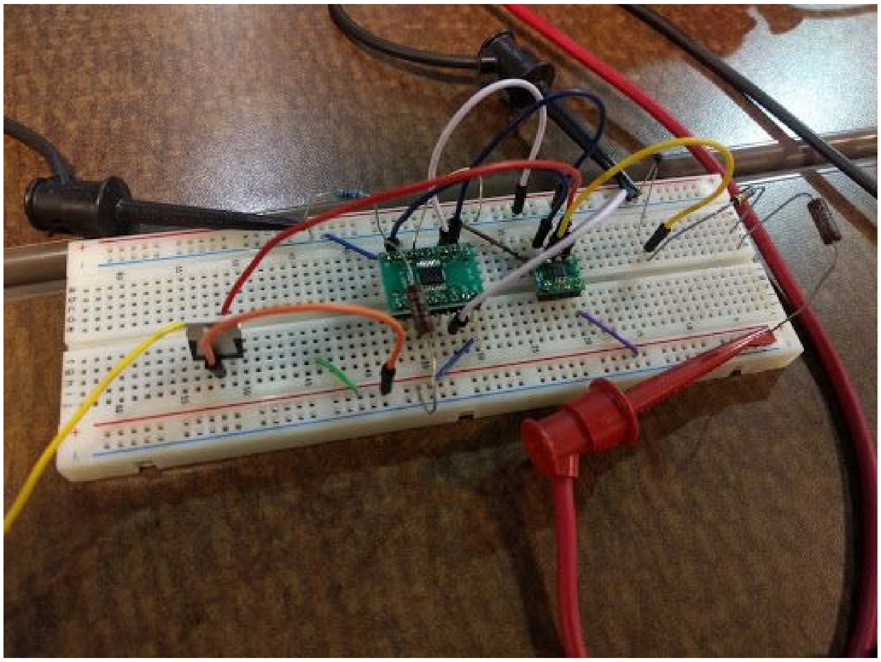


Figure 8

Estimated Date	Goal
10-8	Research and buy parts for fan
10-17	Circuit (schematic) design done and buy solar panel part
11-2	Start to assembling and debug the circuit part
11-18	Start to test the prototype (include solar panel part)
12-4	Finish assembling and testing

Mr. Art Lizotte was an appropriate EiR mentor for our team.

Appendix A:

-We have borrowed the following equipment from the ECE 105/107 lab: Voltage generator, several resistors, banana plug cables, NMOS, 5v fans.

-We have used data sheets with their corresponding products from these companies: Texas Instruments, Electronic Alliance, and Toshiba