Valencia Team

IEEE Orlando Section

Progress Report 1: January

Project Addressing Climate Change:

Solar Powered Ventilation with Controlled Airflow for Parked Cars

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Introduction:

This brief report covers important project developments from November through January. A review of spent budget and added costs will be given, followed by build progress.

Spent Budget and Added Costs:

When it was time to order materials in December, some of the proposed materials were out of stock, so they were swapped for others which met the group's needs. During the design and build process, some materials had to be ordered that were not originally accounted for. The updated budget includes the swapped materials and a new section for "Added Materials". All materials on the sheet have been ordered, so the full grant amount has been spent. However, the group has yet to request reimbursement through Concur. This will be done in February.

Progress:

Before the winter break, the group wrote their Proposal Report and gave a presentation to a board of industry professionals, who gave excellent feedback on the project. After revising their engineering requirements and specifications, the group ordered all materials. Once materials were received, the group got to work on the design and build.

Control Module Setup

Ian began by planning the pinout for the control module. Next, he set up the Raspberry Pi Pico with the PCF8575, an I2C GPIO expander. Ian wrote a test program to control a relay from the Pico's GPIO.

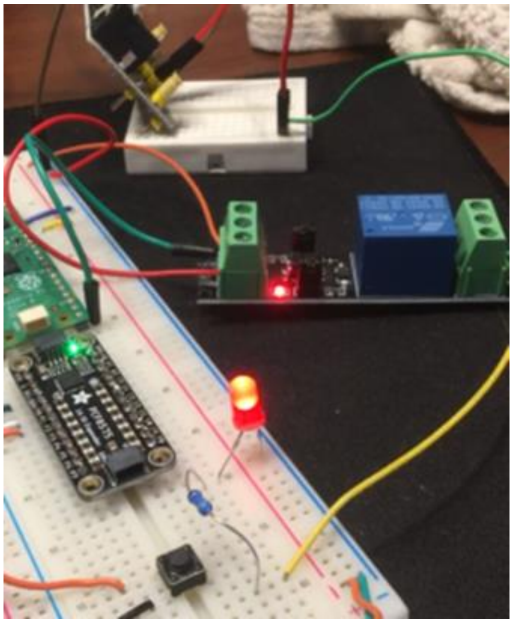

Figure 1 - Relay test circuit

Battery Voltage Sensor and Battery Mode Program

Daniel designed a voltage divider circuit for the car battery which would produce a maximum of 3.3V for the MCU's ADC when the car battery's voltage is maxed out at 15 V. With values that Daniel measured, Ian made the table below. The battery modes given in the table will be used to switch the number of active fans. Ian wrote a program to read the divider voltage at the Pico's ADC0 and change the battery mode based on the reading.

Table 1 – Battery voltage to divider voltage and corresponding battery modes.

Battery Voltage	Divider Voltage	Battery Mode	Battery Mode Name
12.6	2.750	3	HIGH
12.3	2.684	2	MED
12.0	2.618	1	LOW
11.7	2.552	0	OFF

Temperature Sensor

Daniel designed a thermistor divider circuit for the temperature sensors. Ian wrote a program that measures the temperature. The group tested the thermistor program and verified that it successfully read the temperature by comparing it to a known good temperature sensor.

Until this point, the group had not yet devised a method for reading multiple thermistor circuits from the same ADC. The output of each thermistor circuit must be isolated. Daniel had the idea to use photocouplers to isolate the outputs, and had a few PC817 ICs laying around, so he tested them and verified that they were a viable option. Ian then designed a new temperature sensor circuit, tested it with the temperature program and verified that the outputs of multiple thermistor circuits were isolated.

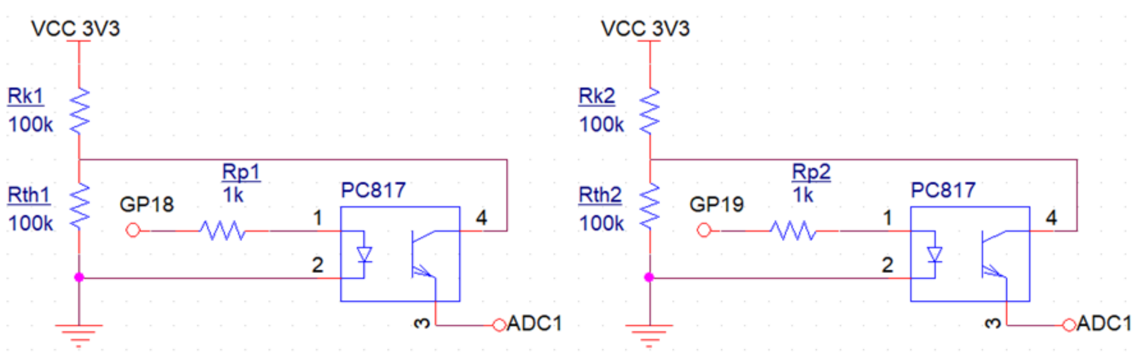

Figure 2 - Temperature sensor schematic

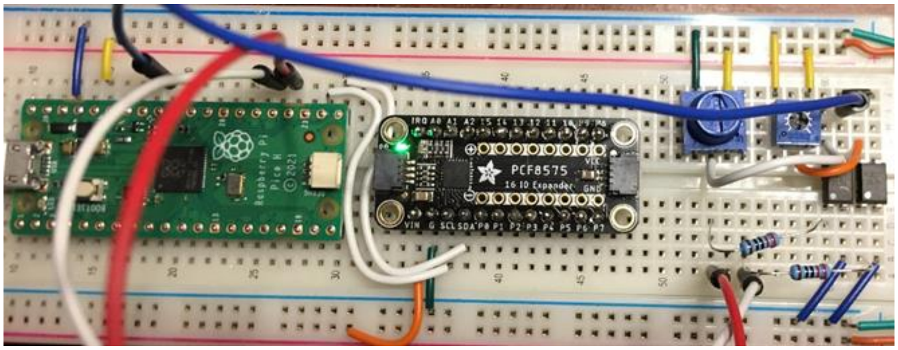

Figure 3 - Using photocoupled potentiometers to test output isolation.

IR Proximity Sensor

An IR proximity sensor will be used to sense when the car's windows are up. Ian designed a circuit using IR LEDs and IR photodiodes to measure the collective status of all four windows. Next, he wrote a program that reads the proximity of an object to an LED photodiode pair and tested it. The proximity value increases as an object approaches an LED photodiode pair.

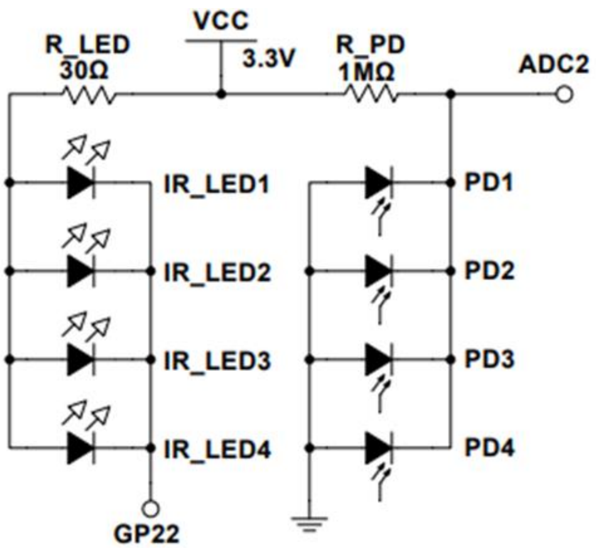

Figure 4 - IR Proximity Sensor Schematic

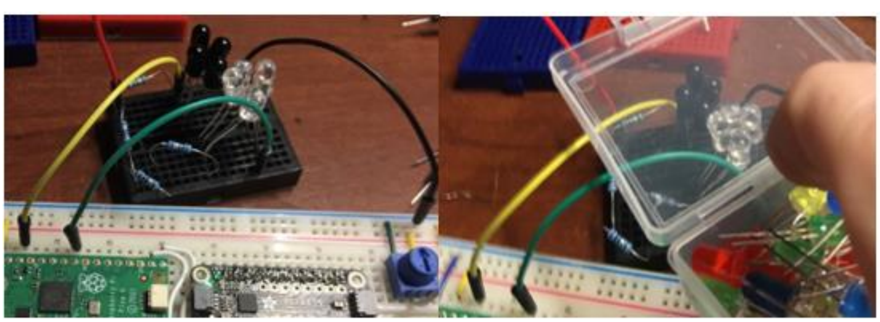

Figure 5 - Testing the IR Proximity Sensor

Control Module PCBs

With all sensors designed and tested, Ian planned out the control module PCBs and then soldered them together.

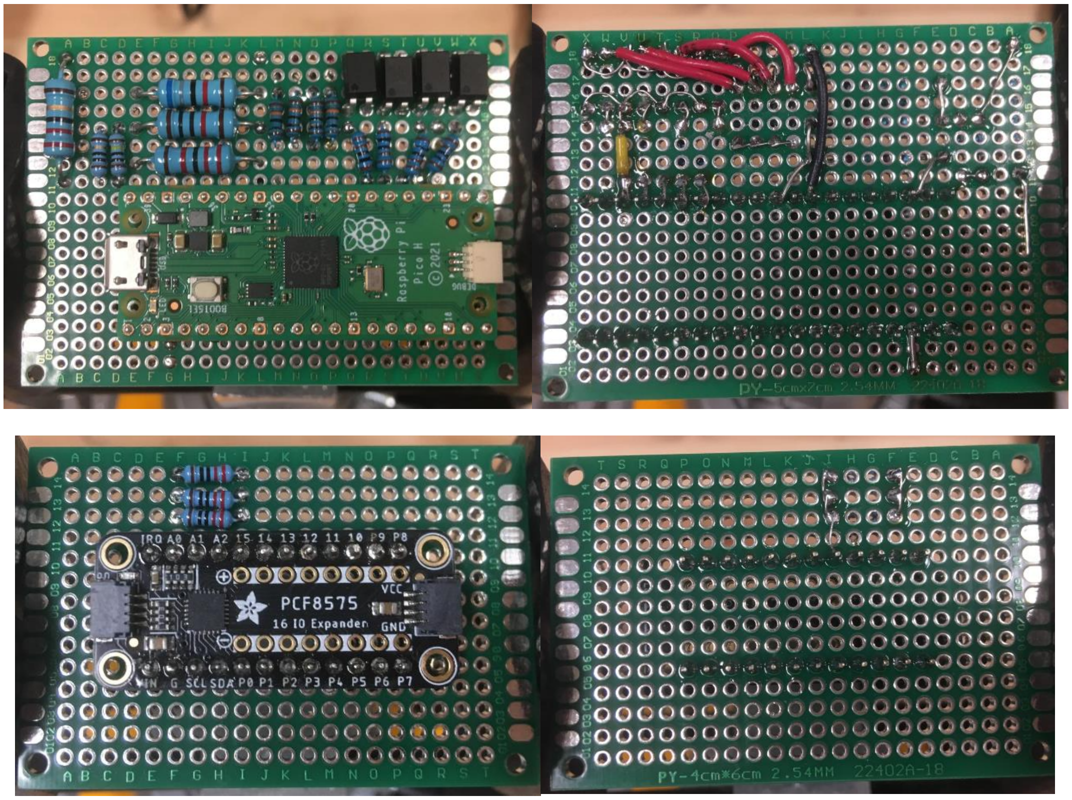

Figure 6 - Control Module PCBs

Figure 7 - IR LED and IR Photodiode pairs on PCB cutlets.

Vent Visor Fan Build

Daniel attached the 12 V fans to the vent visors. Luckily, the vent visors came with door mounting hooks so that they can be attached and removed from the vehicle easily. In the coming month, Ian will be designing 3D printed nozzles to direct intake fan air into the vehicle.

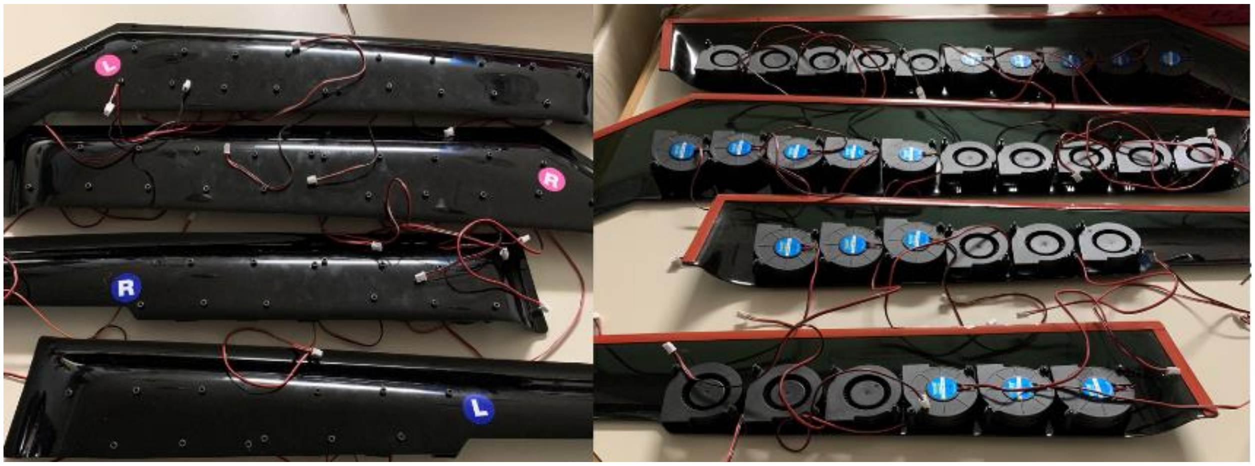

Figure 8 - Vent Visor Fan Assembly

Revisions

Due to the space limitations of the vent visors, the number of fans had to be reduced. The rear window visors could only fit six fans, while the front window visors fit ten.

Using relays to drive the fans proved to take up a lot of space and drew more current than anticipated, so the group investigated using transistors instead. With 2N3904s on hand, Daniel designed a circuit which provides 12 V to the fans when 3.3 V is supplied to the base of the transistor. The transistors also drew much less current than the relays, making them an obvious choice.

While testing the PWM charge controller, Daniel recognized that the unit has no load voltage control. The load terminal voltage is the voltage of the battery. Since our fans need 12 V, the PWM controller load output must be regulated. A buck/boost converter was ordered and tested.

To make wiring easier and cleaner, the group decided to wire the fans using two 4-pin IP65 cables per window. Similarly, all the sensors for each window will run on a single 5-pin IP65. Therefore, three cables will run from each window to the control module.