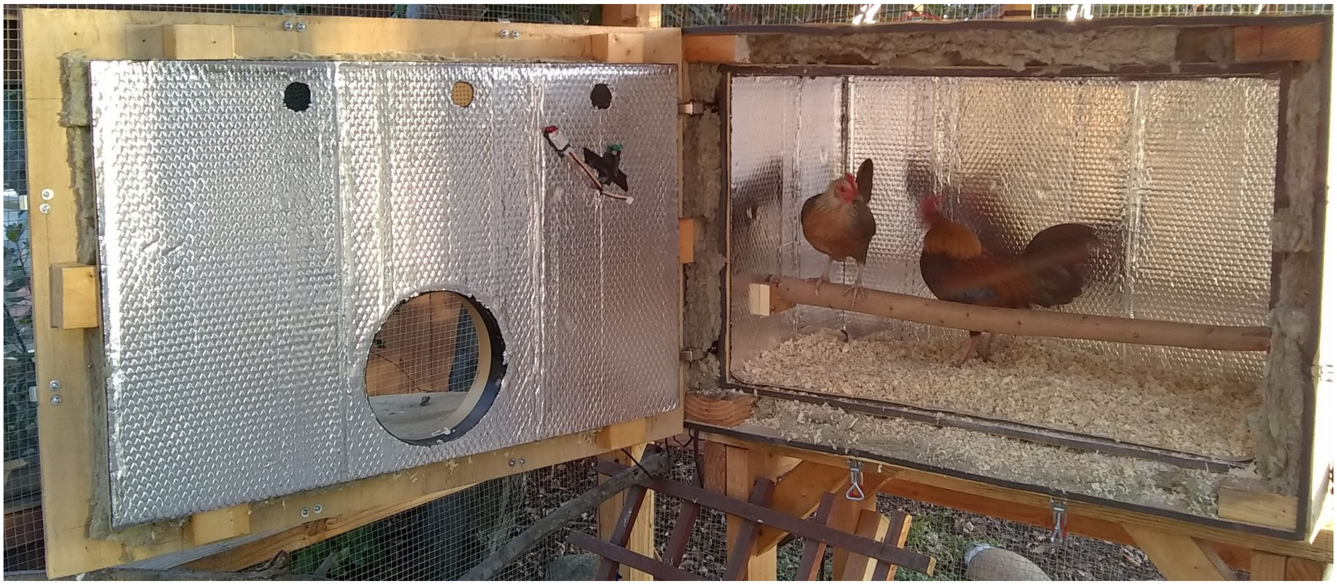
Miracle's Box

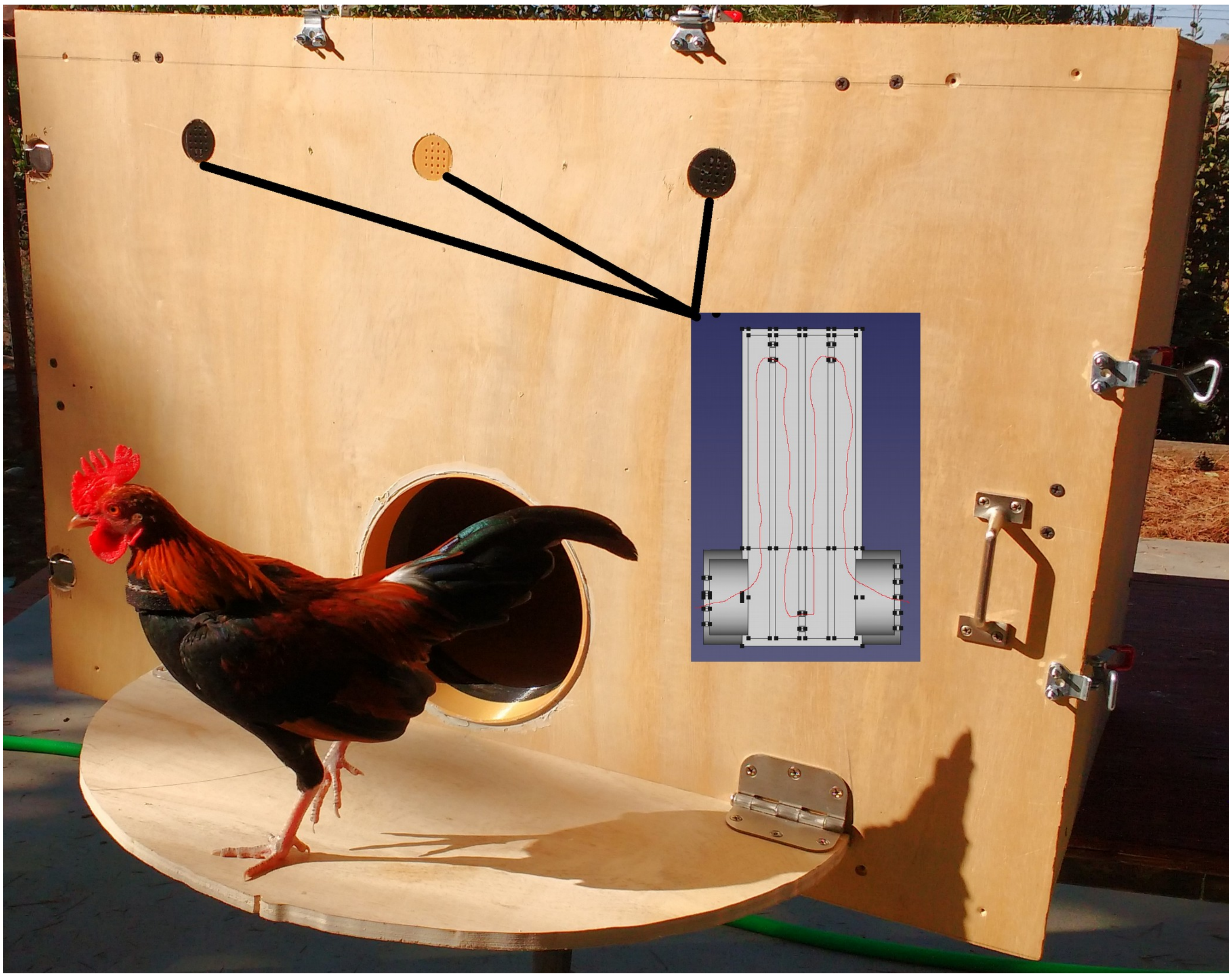
My daughter loves birds, and after an extensive research on chicken breeds, the bantam Old English Game Bantam (OEGB) became the choice. Our next decision was to build our own incubator and hatch the eggs. We hoped for hens only but understood the probability of hatching a rooster. On our first batch, we got one lonely silver duckwing out of six eggs we attempted to hatch. My daughter appropriately named her Lucky. But one hen was not what we expected, and so we proceeded to hatching a second batch of six eggs. This time, we welcomed a bantam Black Breasted Red (BBR) rooster. He cracked half of the egg shell and was not able to come out on his own. After 7 hours, my daughter intervened by cracking the shell open and peeling off the membrane. She appropriately named him Miracle. Now, we had a challenge in our hands. Another extensive research went underway - how to build a sound box.

My daughter quickly found out about rooster collars. The youtube videos we watched showed a significant reduction, or muting, of the crow. We currently use one on Miracle. I looked into sound studio design and learned how sound absorbing material is used to prevent reflections of sound; I looked at how thick walls are built along freeways to reduce the traffic noise; I learned how sheet rock is used in walls to reduce the noise from one room to another. Naturally, I looked into the different solutions posted on Backyard Chickens (BYC). But it was the use of sheet rock in walls that prompted the idea of building a box within a box. The thick wall also made sense, and so I used wood that is ½ inch thick. Initially, for about 3 months, sound absorbing material was not used in the inner box like in a sound studio. But Miracle’s crow got louder and adding the sound absorbing material Noico became necessary.

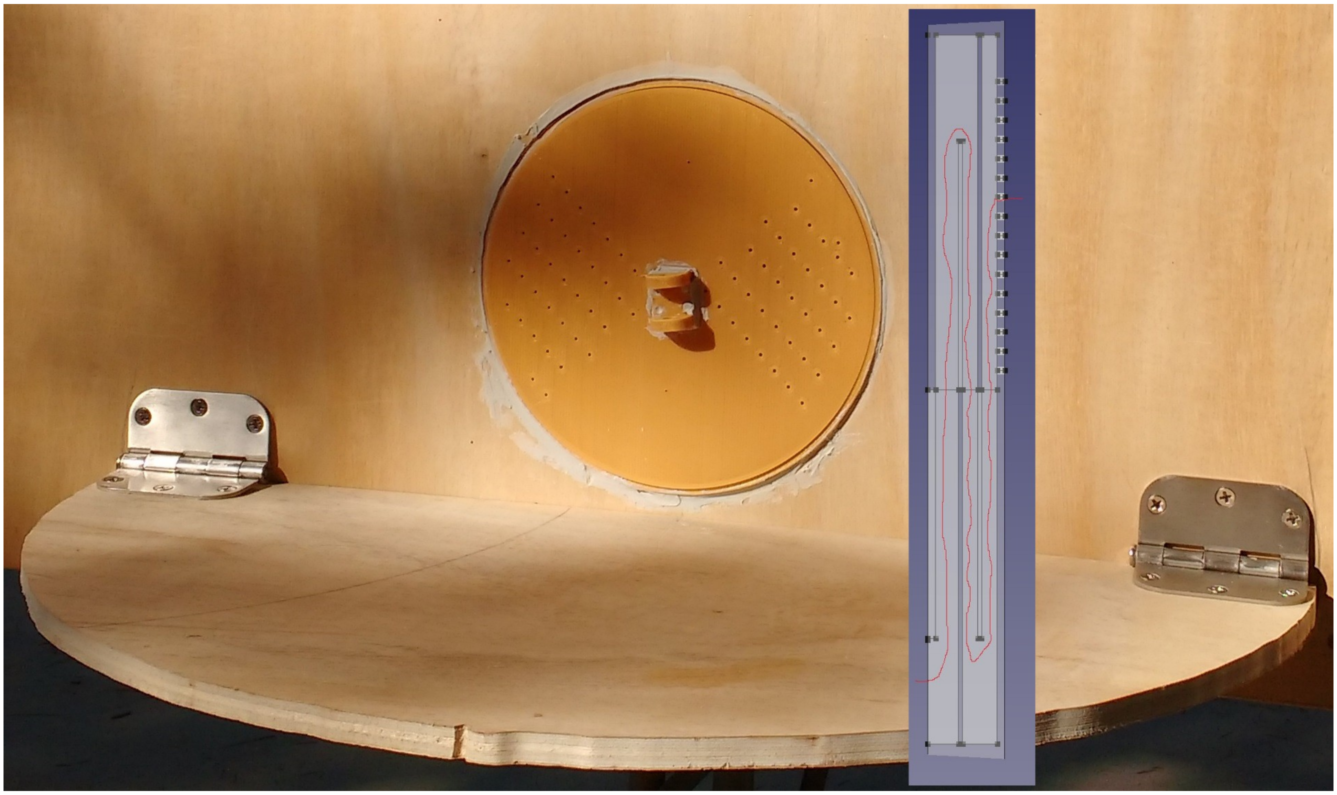
In order to make the box easy to clean, it became necessary to make one side to open completely. Making one side a door also meant that it could have air leaks and thus sound leaks. So clamps and weather strips came in handy to ensure air tightness. Adjustable hinges were also added for ease of use.



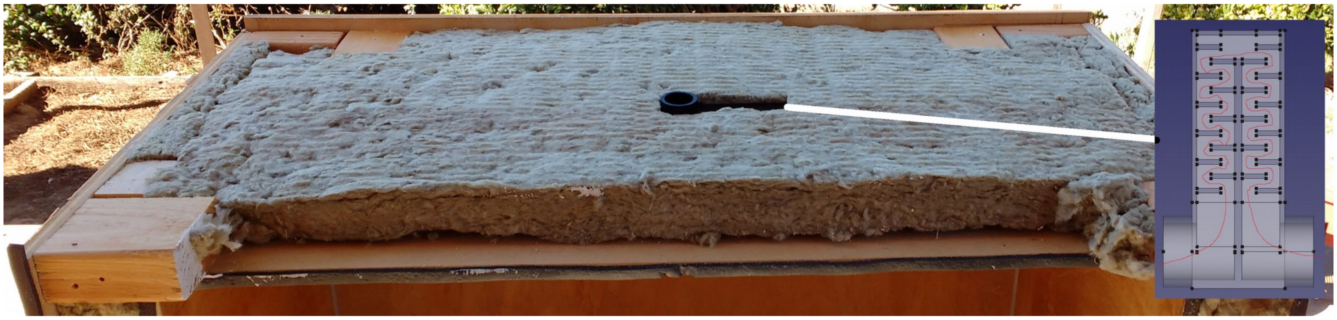
Sound studios address ventilation by implementing zigzag structures with sound absorbing material. This allows air flow while minimizing the sound level that is heard outside the studio or the sound level from the ventilation system that gets into the room. Mufflers on our vehicles are made of tubes with lots of small holes that lower the pressure by distributing the air flow through the holes into a large container. The air flow then continues into another tube with lots of small holes and out with acceptable sound levels. Without the muffler, we would hear the explosions of the pistons, and for some the sound is a form of music but for most an unbearable sound. I was able to combine these two implementations into a custom muffler as shown on the image below. The red trace shows the air path. Freecad was used to design this muffler, and later it was printed with a 3D printer. Three of these mufflers serve as the outflow of hot air and are placed above the door to complete the passive system. These mufflers have lots of 2 mm holes towards the inside box, internal walls, and outside box with zigzags.



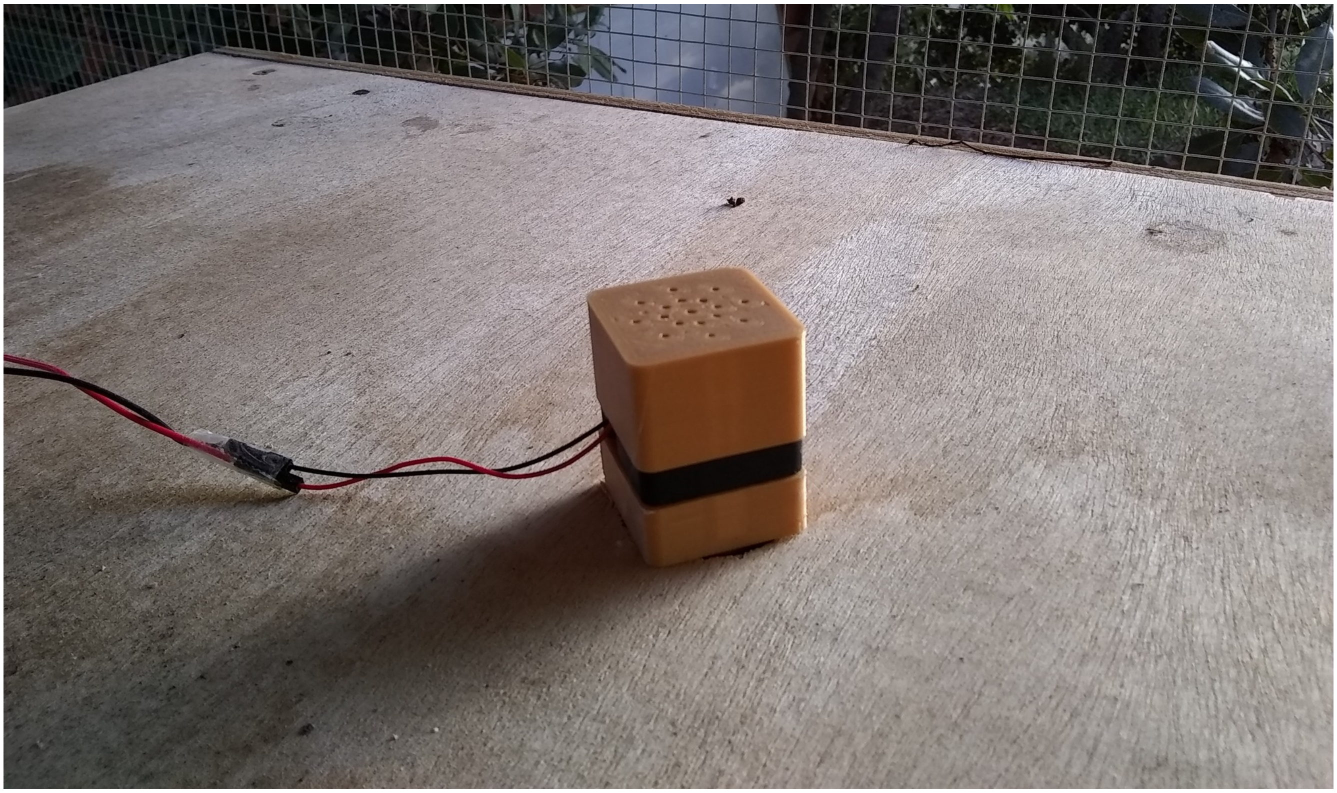
Sound studio doors are basically air tight and thick. For practical reasons, they are rectangular in shape. Doors or gates on ships are water tight. They are thick and semi-oval in shape to withstand the water pressure. Corners would be weak points and cause of leaks. Some vault doors are circular in shape and their frames are cone-shaped. This circular and cone-shaped combination also works in making the door air tight. And so the design of a circular door with a cone-shaped frame became the choice. I might have also been drinking wine and playing with the cork when I conceived the idea. The door is also the air intake of the passive ventilation system. Two quadrants were peppered with lots of 2 mm holes. Zigzags in each half of the circle help in dampening the sound. See the cutout view of the door on the picture below. The red trace shows the air path.



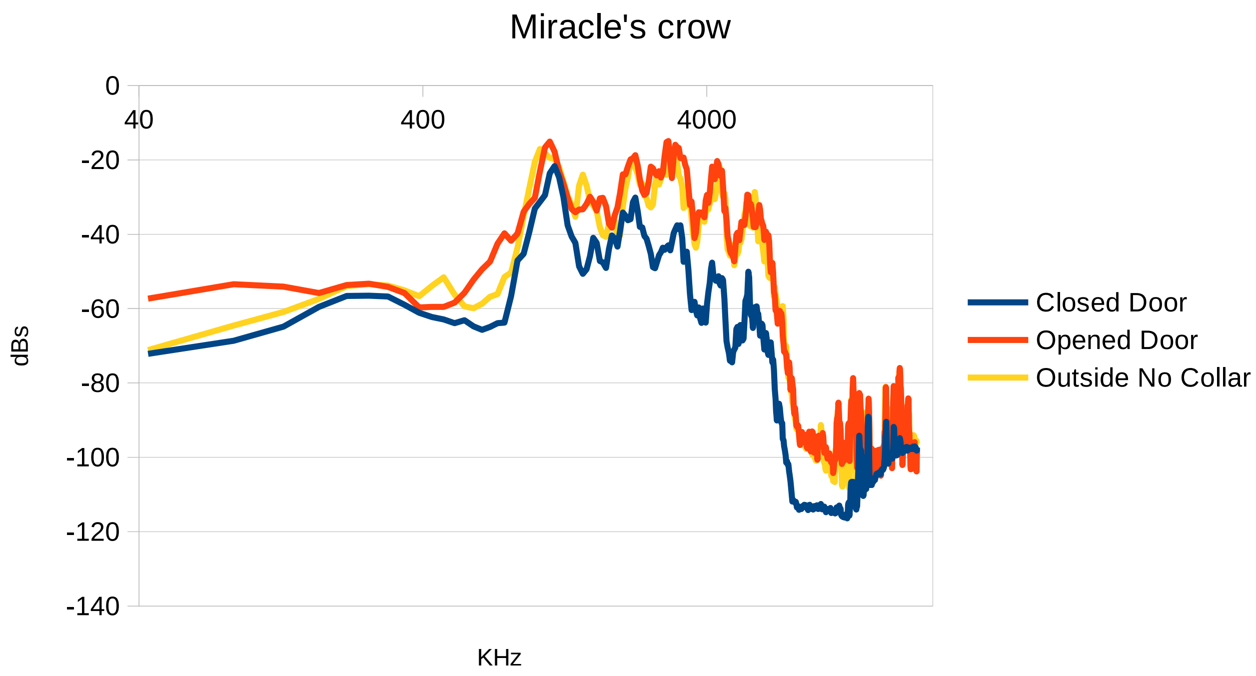
On the top side of the box, one muffler is place in the center. This muffler has zigzags but lacks small holes so that air flow can increase. It also provides a place for a fan that can suction air out. For about two months there was no fan. But after adding a gas sensor that showed ammonia levels high during the night, it became necessary to add a fan.



A cotton ball is placed between the fan and the muffler. The cotton is used to dampened the pressure of the sound. This is similar to how motorcycles' mufflers are designed. The fan gets turned on and remains on when the ammonia level is higher than 15 ppm.

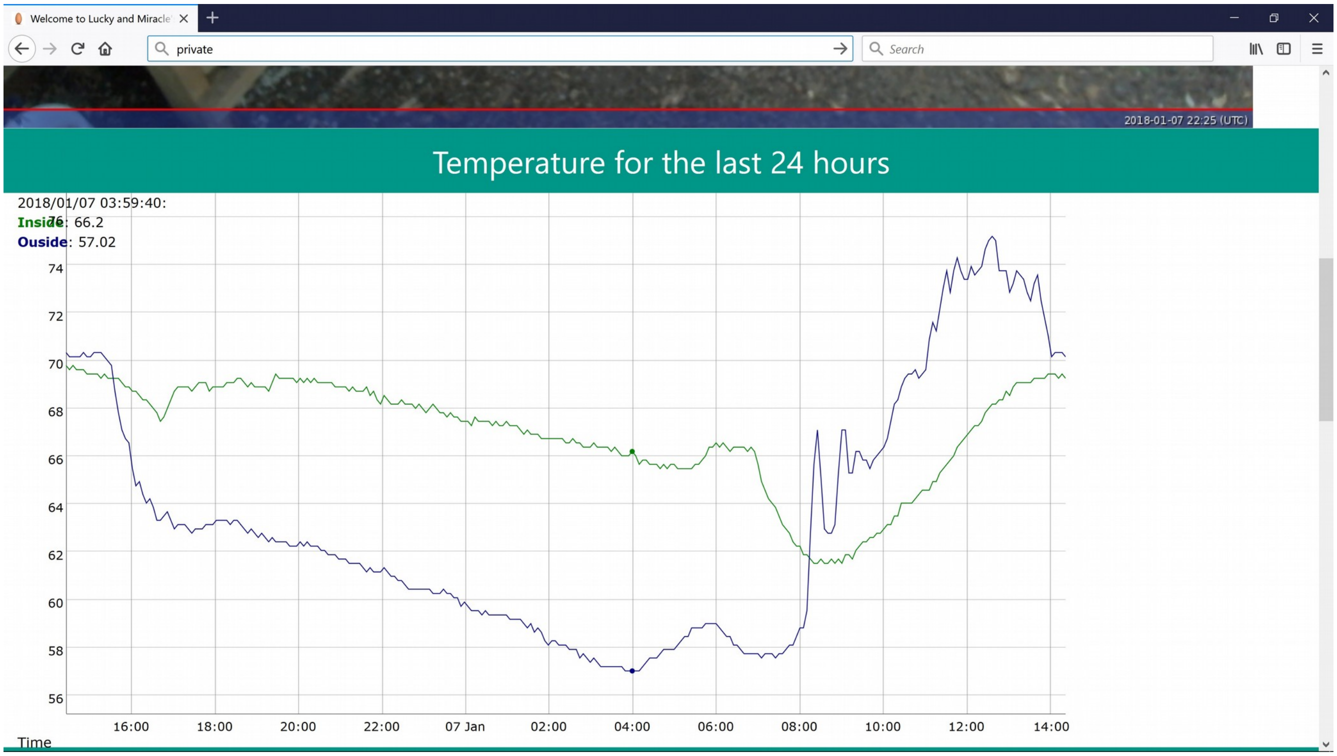


Sound, or Miracle's crow, was recorded with the microphone of my Asus laptop running the program Audacity. The laptop was placed about a meter away from the door. For the first recording, Miracle was placed inside the box and with the door closed. For the second recording, the door was opened. For the third recording, Miracle was placed outside and on top of the box. The spectrum of his crows are shown in the graph below. The results showed an average difference of 11 dBs.

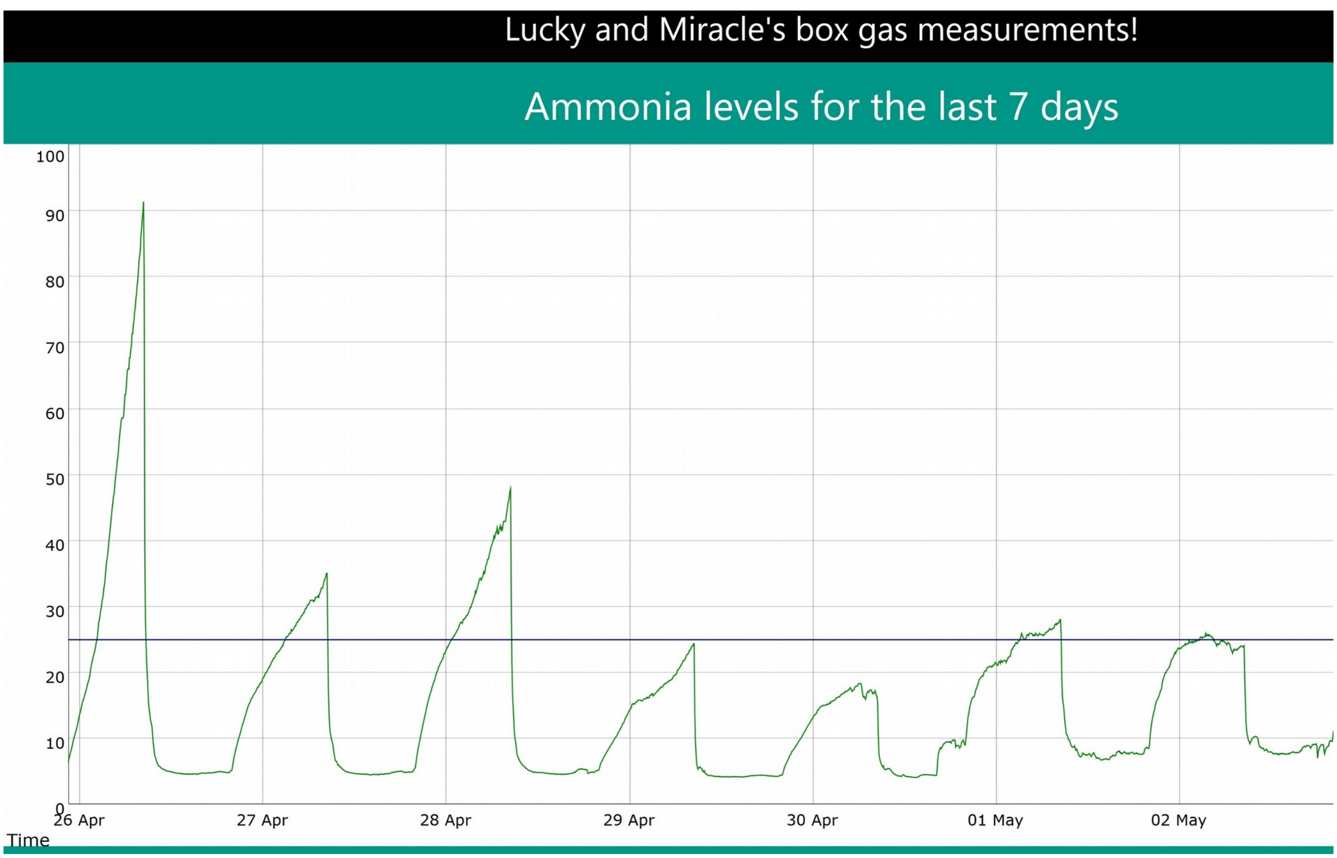


Ventilation was tested by lighting six candles and placing them inside the box with the door closed for half hour. After half hour, the candles were still lit. During this test, the top muffler was not placed or installed. The top did not have any openings. Presumably, six candles would burn or require more air than Lucky and Miracle combined. After this test and the audio results, we felt confident with the design and moved Lucky and Miracle's sleeping quarters to their coop. We had them sleeping inside the house since we hatched them, their first six months of life. Since the beginning of 2018, Miracle and Lucky have spent their nights sleeping in their box with the door closed. They go in by themselves.

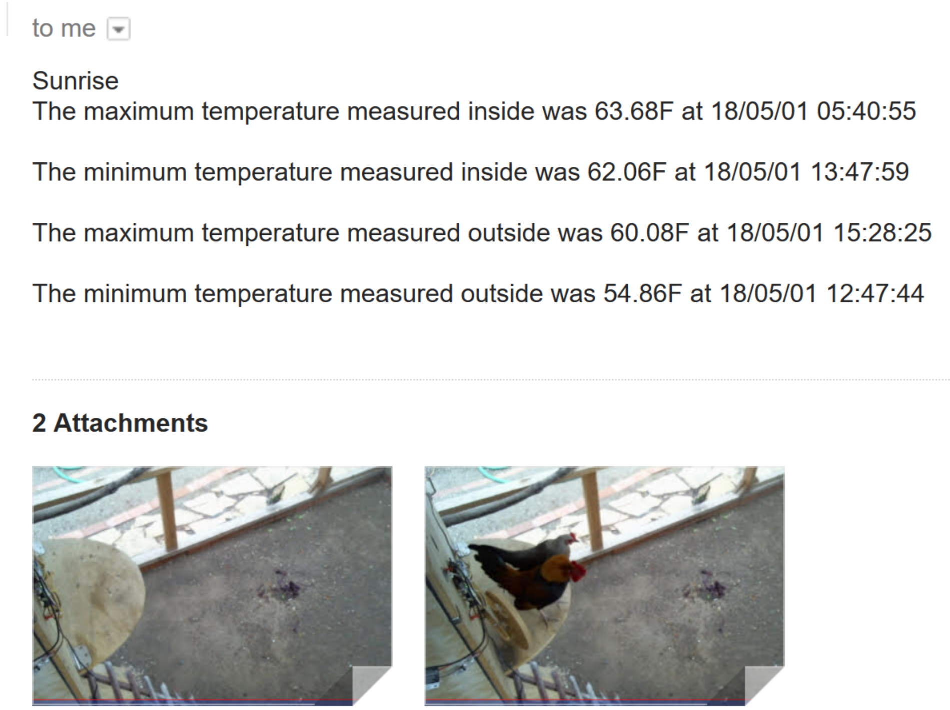
A 24-hour view of the temperature inside and outside the box, shown on the image below, shows a similar performance of that of a thermos. During the day, the outside is hotter than the inside, when the door is opened. At night, when the door is closed, the temperature stays high inside and slowly drops due to ventilation. The hot air exhaled by Lucky and Miracle exits through the top and side mufflers and gets replaced by the cool air coming in through the door.



A seven day view of ammonia levels tells us how diligent we've been at cleaning the poop. The gas sensor is not that accurate and is susceptible to temperature. At 25 ppm Miracle and Lucky should be dead. The high value shown below took place on a hot night, > 70 F. The rest of the week was in the low 50s F.



The door can open and close programmatically, with the push of a button, or manually, see image below. A servo is programmed to open the door at 8:30 AM and to close it an hour after sunset. A 96boards (Snapdragon 410C) with an Arduino and sensors is also able to collect data on temperature, humidity and harmful gases such as ammonia. A web cam also gives us a snapshot of the coop when we access its website. At sunrise and sunset, a picture is taken before opening or closing the door, and then a second picture is taken after opening or closing the door. The max and min temperature of the inside and outside for the night or day are sent via email along with the pictures. While the main stream acronym is IOT (Internet Of Things), I would like to call this IFC (Internet For Chickens).



to me

Sunrise
The maximum temperature measured inside was 63.68F at 18/05/01 05:40:55

The minimum temperature measured inside was 62.06F at 18/05/01 13:47:59

The maximum temperature measured outside was 60.08F at 18/05/01 15:28:25

The minimum temperature measured outside was 54.86F at 18/05/01 12:47:44

2 Attachments