The Development of My da Vinci Flying Machine

by Fred Truck



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In the late 1480s, Leonardo da Vinci began thinking about building a flying machine based on what he had observed in flying birds. Such a machine would be powered by human muscle driving flapping wings: an ornithopter.

Contemporary da Vinci scholars are skeptical that an associate of Leonardo's, Zoroastro, actually tried to fly one of his devices, because there is no hard evidence that such an event happened. Only hearsay.

Then, why did Leonardo devote so much time to drawing and writing about man-powered flight?

These same scholars believe he built flying machines for court pageants and theatricals. Maybe so...

...but to me, the most powerful reason Leonardo sought to fly was because of the dream of many human beings to conquer the skies. To rise above the limitations of earth-bound people and generate awe and wonder in those below.



Codex Atl. Leonardo da Vinci

The preceding da Vinci drawing was the first image of Leonardo's "ornitottero" I saw. It was in a book on the history of flight given to me for my birthday or Christmas when I was in the fifth grade.

For a long time, I associated flight with art as a singularity. From middle school through the early years of high school, I spent hours and hours "designing" airplanes. When it became clear to me that I wasn't military material I saw I wasn't aeronautical engineering material either. Aviation corporations go where the money is. I had trouble reconciling my love of designing airplanes with designing killing machines whether they flew or not.

I lost interest in airplanes, flight, model airplanes. Anything technical was out...

...until the early 80s and the microcomputer revolution. It wasn't long before Lorna and I had an Osborne I portable microcomputer followed in 1984 by the first of many Macintoshes.

The first really significant software package I used was Swivel 3D.

Young Harvill authored Swivel 3D, released in 1989, which was a program that allowed users to create 3D objects. Swivel ran on the Macintosh and helped revive my dormant interest in flying machines. The first object I created with Swivel was my version of da Vinci's Ornithopter. I did an animation of "the Great Swan" that flew across the Macintosh's screen with flapping wings.

In 1991, I was at the Banff Centre for the Arts. As luck would have it, the section I was in was given the chance to do projects in Virtual Reality. What we artists were required to produce was an object in 3space. I had the required object, though it was way too large to fit into the Sense 8's small graphics processor. I successfully reduced my project's size, so I at least could test my graphic's possibilities.

This VR project convinced Carl Loeffler (with whom I co-founded The Art Com Electronic Network) that I should come to Carnegie Mellon and build a flight simulator based on the animation.



Carl directed a talented team of programmers in the Studio for Creative Inquiry. In essence, the team created a flight simulator for my da Vinci Ornithopter. The wings flapped and creaked. The pilot could choose from 3 different viewpoints.

It was shown at the Machine Culture art show held by SIGGRAPH in 1993. My contribution to this project was the idea, the basic planform of the flying machine and the environment. The programmers worked out the details. The Sense 8 VR system was the driving engine. I called the project *The Labyrinth* for mythological reasons. Daedalus, inventor of the wings, also invented *The Labyrinth* for King Minos in which Minos imprisoned the Minotaur. Daedalus and his son Icarus were also imprisoned in the maze. They tried to escape *The Labyrinth* by flying away, but only Daedalus succeeded. Icarus fell into the sea because he flew too near the sun.

For many years, *The Labyrinth* was the highpoint of my efforts to recreate the da Vinci Flying Machine. The Sense 8 VR engine was clunky and often crashed. Still, it worked often enough. *The Labyrinth* was a popular exhibit at the Machine Culture show.

Virtual Reality essentially surrounds the viewer with a 360/720 image. It is like a dream. At the time I did *The Labyrinth* project it was extremely expensive to do VR. It required institutional backing to cover the cost.

After the Machine Culture show, I had no backing to continue work in VR.

Rather than seek financial backing, I decided to wait. I was certain the price of VR equipment would come down, as well as its utility and reliability. Of course, the price did come down and reliability went up.

Meanwhile, other options became available. The one that interested me most was 3D printing.

Printing in 3 Dimensions

I got my Ender—3 SI Pro printer almost a year ago. At first, the learning curve was very high, but I stuck with it and now finally I am comfortable with the Ender.

My basic design for the ornithopter was very similar to Leonardo's but differed in significant ways. Instead of pulleys and levers to move the wings, mine featured a bicycle drive.



The cruciform tail was actually designed by Leonardo, but the pilot wore it on his neck. He guided the machine by looking here or there. I thought this way of steering was not good. I added a boom and mounted the tail on that. Also, in this image you can see the sprocket and the pedal on one side for driving the wings as well as the tail.

Here is how I printed the da Vinci Flying Machine:

I began with the base:







The printing process involves much support structure which must be ripped away to reveal the actual object. In this sense, printing a 3D object is like cracking the shell of a hardboiled egg.

Printing the wing was an even more extreme example. Removing the support structure meant eliminating 66% of what had been printed:





The base and the wing took about 7 hours each to print.









Wing and boom free of support structures.



Photo detailing the pedals and sprocket.



Cruciform tail attached.