Project "Trees of Life"

The deeper background of this project

This project aims to demonstrate the inherent connection between the Oxygen producing real trees (Bonsai trees are displayed here), which are essential for life on this planet, and the airway tree of living beings, which are built to absorb Oxygen from the air around us. Trees and airway trees have similar shape and construction, but have the exact opposite function!

How a plan comes together

In November of 2007, the initiative of making a piece of art dedicated to the importance of the natural tree was taken. The objective of the project was to show, in an artistic way, the coherency between the natural tree and the biological lung – both the tree and the human lung have essentially the same function: removal of CO2 and introduction of Oxygen into the ecosystem. For the tree this means Oxygen to sustain life on this planet, while for the airway tree this means transport of Oxygen into the body to sustain living cells.

The first contact was made with Dr. Edwin J.R. van Beek MD, Ph.D and Dr. Eric Hoffman PhD of the Department of Radiology and the University of Iowa's Comprehensive Lung Imaging Center (I-Clic). Under their guidance, a team of other researchers collaborated on this project, including Jered Sieren, a CT-scan Radiation Technologist (but for this project a "CT artist"), and two Graduate Assistants in the department (Dragos Vasilescu and Ahmed Halaweish). Without these people, this project would never have been completed!

I was fortunate with my mentor in the Arts Education department of the University of Iowa, Dr. Steve McGuire, who was an inspiration and who allowed me to develop my plans and supported this project with his insight.

Computed Tomography

Computed Tomography (CT) is a technique, which uses X-rays to generate highly detailed images of objects or the body. We used the CT scan in a variety of ways towards this project. The focus of the I-Clic team is on improving the understanding of the structure and function of the lung. Human volunteers are studied and sophisticated software is used to highlight structure of the airways, the lung structure and even blood flow through the lungs. The emphasis of this work is to generate an atlas of normal and abnormal lungs that can be used by scientists to compare findings in different disease states and the effects of treatment.

The CT system in use is a Siemens Medical Systems Sensation 64, which is capable of creating 0.3 mm (0.15 inch) slices of the object under evaluation. Using this scanner, we were able to reconstruct the airway tree using a digital 3D printing system (Rapid Prototyping) and used this to recreate a 3D model for the human lung (see below).

For the sheep lung, we did a reverse project, where we had obtained a sheep lung, dried it and then performed a casting procedure. This cast was imaged on the CT scanner and the airway was reconstructed.

The Sheep Lung

The sheep lung was a dried lung taken from a sheep some years ago. The lung was casted with orthopedic resin and using centrifugal force. After the cast, the resin needed to harden and after a day, was put in an acid bath to dissolve the lung tissue. Having the complete plain resin airway tract, a hole was drilled in the stem and a copper wire was pushed and glued in place. The next step was to spray paint the cast with a conductive copper paint. After the drying time of the paint, the tree was placed in a tinning solution to ensure good conductivity was obtained for the next process.

The airway tree cast was then suspended in a chemical bath of dissolved copper particles. The cast was attached to a cathode and two copper plates where used as anode. Using a current of approximately 1.5 A, the particles deposited onto the negatively charged airway tree cast and a copper layer gradually developed over a period of several days.

The Human Lung

The human lung came from a research experiment where an unknown normal female volunteer underwent a CT scan for the lung atlas project. The images, which contain 0.6 mm slices, were stacked and placed in a software tool to obtain a 3D representation of the actual airway tree. This 3D-virtual image was transformed into a STL-file for rapid prototyping. Essentially, this process recreates the 3D shape and gradually builds the actual 3D shape for application in a 3D-resin printer, which then reproduced a 3D true to size model of the airway tree in resin. Once this airway tree was available, a similar electro-plating technique was used as for the sheep airway tree.

Differences between the two trees

As one can easily observe, there are significant differences in the shape of the human and sheep airway trees. The animal lung contains an extra lobe, which is shown as an extra airway visible on the lower part of the main airway (trachea).

Another major difference is the branching pattern of the sheep lung, which is more analogous to a real tree. The human lung shows a more dichotomous branching pattern where every branch gives rise to two branches that are relatively similar in size.

Although the process of electro plating was similar for the two airway casts, the color of the copper layer is different due to the differences in resin used. This had an effect on the effectiveness of the electro plating and the human tree has a thicker layer of copper than the sheep tree.

The trees are alive !

As time goes by, the airway trees will undergo changes in color as the copper is oxidized by the Oxygen in the air around us. As a result, the trees as seen today will not be the same as the trees as seen in months or years from now. That is part of the symbolic meaning of this project: these "trees of life" are themselves alive, just as they are in the human body or in the natural world around us. They even change color with the seasons!

The project continues

These two examples of airway trees show the differences between two species: sheep and human. What is interesting to realize is that the lungs of different species are different and even within species there are major differences in the branching pattern of the airways. The lung atlas project has already shown that there are gender differences, racial differences and individual differences in airway tree branching patterns and the way in which lungs have been shaped and formed.

Other species, like pigs and mice similarly have differences depending on the exact species that is studied. A mouse lung atlas is now also under construction for these reasons.

The most important statement in this project is that we think simple about thinks like Oxygen, but it takes a green tree to make it. So unless we are careful with our environment, we will not be able to see this kind of beauty.

Continuing this project will take me to different species and make different body parts, because there is still a lot to discover in my quest to the beauty within.

I hope you all will enjoy this exposition. I did it with a wonderful group of people and with a lot of fun.

With warm regards,

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