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# 3D Heart Model for Mapping RF Ablation Sites

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MECHANICAL AND NUCLEAR

# 3D Heart Model

## *for Mapping RF Ablation Sites*

CAPSTONE DESIGN EXPO 2016

## Radiofrequency Ablation

Radiofrequency ablation is a procedure that destroys selective tissue in the heart to help restore the heart's regular rhythm. The procedure begins by inserting a catheter through the patient's groin, arm, or neck. The ablation catheter is then guided to your heart through a blood vessel. Once the catheter has made contact with the heart, there is a generator that provides energy to burn the affected tissue that causes the irregular heartbeat.

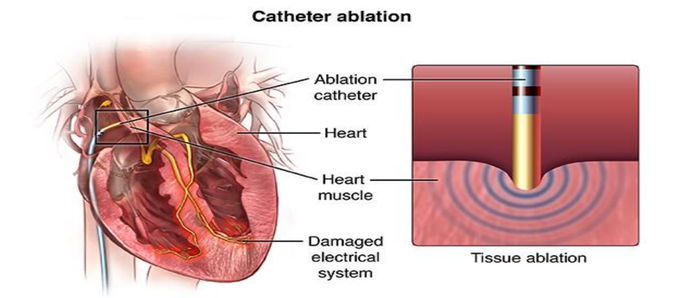


**Figure 1. Catheter Ablation**

Current problems with training cardiologists to be proficient with radiofrequency ablation surgery are:

- Takes an average of 50 surgeries for cardiologists to become proficient
- No way to practice except on human patients
- Maximum of 90% success rate in 2015

To address these issues the goal of the project was to create a model for beginner cardiologists to practice performing radiofrequency ablation on. This would reduce the amount of human trials needed before becoming proficient and increase the success rate over time.

## The Process

To begin the project, we received a copy of a patient's CT scan from our medical contact, Dr. Karoly Kaszala. These files were images of the patient's heart in slices ranging from 0.5-2 cm. The purpose of the CT scan was to segment the DICOM files, which we would then use to construct a life-like replica of the heart. The heart model would be printed using the Objet Eden260VS, in a material known as Tangoplus, which is a flexible, rubber-like material.

While attempting to segment the DICOM files, it required to fill in each individual layer in order to cover the entire heart. At the end of segmenting the files we had a heart model (**Figure 2.a**), but there were some clear issues with the model:

- Very porous surface of the model
- Not accurately hollowed out
- Invalid volume geometry when imported into a solid modeling software

The focus of project was then switched to focus on practicing how to maneuver the catheter through the superior vena cava.

- A realistic heart model was downloaded from TurboSquid (**Figure 2.b**) and confirmed with our medical contact.
- A touch sensor circuit was constructed to provide feedback to cardiologist
- 12 different nodes were placed throughout the heart under the guidance of our medical contact that simulates different "affected tissue" areas around the heart
- The touch sensor-circuit consists of 12 LED's, 12 1kOhm resistors, wires, and AA batteries as the power source
- Once the catheter enters the heart and comes in contact with the node, the circuit will be complete and the LED will light up
- If the LED lights up, the cardiologist successfully reached the "affected tissue"

## Future Improvements

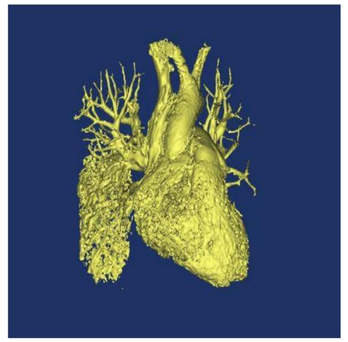

**Figure 2.a**
**Porous Heart Model**

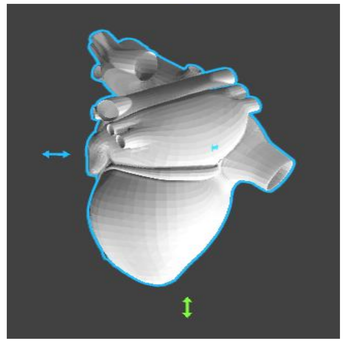

**Figure 2.b**
**Successful Heart Model**

To further improve the design, we would input the printed heart with the circuit and tubing within a mannequin. This would give the user a more realistic feel when using the created instrument. There would also be a network of tubing within the mannequin to replicate human veins, which would make the process of mimicking RF ablation slightly difficult for the user. However, this difficulty would be necessary when imitating the network of veins to further illustrate the network of the human body and increase the experience of the trainee.

Another improvement that would create a more realistic simulation would be the ability to use materials that would be visible through many X-Ray machines, which would make the apparatus more versatile depending on what machine the institution possesses. This feature would encourage trainees to utilize their institution's machines to gain confidence in using them during the procedure.