

# Fly Through A Pig's Heart: An Educational Computer Game

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## Abstract

Coronary heart disease (CHD) is the number one killer in the United States. Although it is well known that CHD mainly occurs due to blocked arteries, there are contradictory studies about what the basic cause for this disease is. But it is commonly accepted that certain factors, such as a cholesterol high diet, increase the risk of coronary heart disease. As a consequence, people should be educated to adhere a diet low in low-density lipoprotein (LDL or bad cholesterol). In order for children to become aware of this fact and to familiarize them with the different types of particles within the blood stream, educational computer games can help. This poster describes an educational computer game that serves this purpose. A geometric model of the arterial vascular system of the heart has been developed, which considers vessels of different sizes. An interactive fly-through deploying a standard game controller facilitates the exploration of the interior structure of the vasculature. A blood flow simulation including several different particles within the blood stream allows a player to explore their functionality. This computer game is displayed as an exhibit in a museum for children, where it can be used by kids with proper documentation and guidance by the museum personnel.

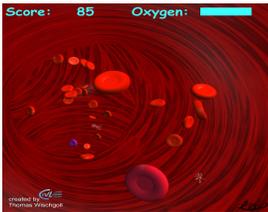


Figure 1: Screenshot showing the main display of the computer game including current score and status.

and backward movement (acceleration and deceleration) with the left joystick while changing the orientation (left, right, up and down) by using the right joystick. Collision detection with the vessel walls ensures that the vasculature cannot be left. On collision with the vessel wall as well as with any of the particles within the blood stream force feedback is provided by using the rumble feature of the input device. In addition, audio feedback with different types of sound allows the player to distinguish between the different types of collision. Consequently, the player has complete manual control over the navigation while visual, audio, and force feedback

The implemented system simulates a submarine-style navigation through the blood stream inside an arterial vascular tree of a heart. The vasculature is based on a computed tomography (CT) scan of a pig's heart. The player has full control over the navigation by using a Logitech® WingMan® Cordless Rumblepad™ as input device. This controller provides two analog joysticks that can be used to achieve six-degrees-of-freedom input. In this application, the player controls forward

provided by the system results in an easy to understand assessment of what is happening. This is especially important since the targeted audience are children at the age of four through twelve years.

During the game, a sufficient supply of oxygen is required in order for the player to survive. The level of oxygen is reduced over time while the player consumes oxygen. The supply of oxygen can be increased by collecting oxygen from the erythrocytes (red blood cells). This can be achieved by simply touching those types of cells. This way, the children can learn about the role of erythrocytes in the human body. In addition, the point score is increased according to how much oxygen is collected. The player wins when a certain point score is reached. In contrast to erythrocytes, leukocytes (white blood cells) as part of the immune system consider the player as an intruder. Consequently, the player's vessel gets damaged when getting in touch with these cells resulting in loss of oxygen.



Figure 2: Visitor playing the game at the Discovery Science Center in Santa Ana, California.

The software is scalable to various virtual environments (VEs). At this point, it is tested on a regular desktop computer and a large projection screen. Especially the projection screen, which was used for the museum exhibit, allows a player to fully immerse herself/himself into the game. Overall, this computer game gives hands-on experience of the functionality of the blood and exposes the player to the different particles within the blood stream. As a museum exhibit, it was very well received by the targeted audience which are kids at the age of four through twelve years, proving its usefulness.

**CR Categories:** J.3 [Medical information systems]; J.3.2 [Computer Applications]: Life and Medical Sciences; K.3.0 [Computers and Education]: General;

**Keywords:** Cardiovascular, Biomedical Visualization, Navigation, Fly-Through, Educational Computer Game

## Acknowledgments

This work was sponsored in part by the National Institute of Mental Health (NIMH) through a subcontract with the Center for Neuroscience at the University of California, Davis (award no. 5 P20 MH60975), by the National Partnership for Advanced Computational Infrastructure (NPACI), Interaction Environments (IE) Thrust (award no. 10195430 00120410), and by the Department of Biomedical Engineering in the Henry Samueli School of Engineering at the University of California, Irvine. The authors gratefully acknowledge Ghassan S. Kassab and Benny Kaimovitz of the Cardiovascular Biomechanics Laboratory at the University of California, Irvine, for providing the data set.

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