Integrating Computer Vision through Medical Imaging in a High School Biotechnology Class

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Purpose

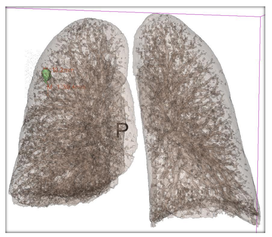
These lessons are designed to introduce high school students to the field of computer vision and guide them to make connections to personalized medicine by using medical imaging to detect and stage lung cancer.

Motivation

Computer modeling is the foundation for scientific experimentation and data collection and interpretation, but high school students are rarely given the opportunity to explore this subject in an integrated manner. This series of lessons hope to address this shortfall by integrating computer vision into a high school biotechnology unit on lung cancer.

Overview

Students are guided through a series of lessons in which they watch videos, read journal articles, and learn to use the open source ware imaging program 3D Slicer to introduce them to the power, potential, and applications of computer vision. Students will learn to segment and build a model of a lung abnormality using archived CT scans.



Students will be able to…

- Define computer vision and describe how it benefits society in a variety of fields
- Understand some of the challenges associated with computer vision.
- Identify some of the current and future roles of computer vision in personalized medicine.

Lessons

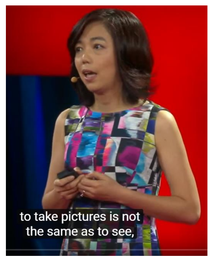


Figure 1

Students learn what is meant by computer 'vision' and how computer vision compares to human vision. They will learn how computers are able to sort through huge volumes of data to pinpoint anomalies.

Students use the UCF CRCV crowd counting demo to make, write, and test their hypothesis of how a computer 'sees' and identify some of the challenges for computer vision.

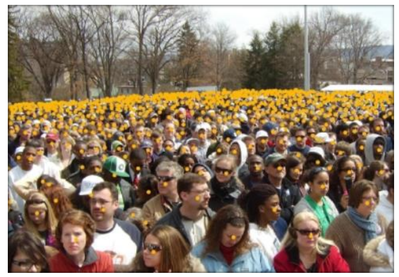
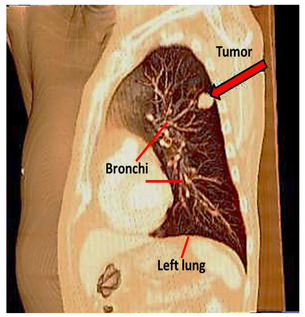


Figure 2



Invasive surgery is one way for doctors to visualize a lung abnormality in patients, but for obvious reasons, is not ideal. Medical imaging (i.e. x-rays, CT scans) are noninvasive methods of visualizing tumors. Radiologists need to be able to sort through a vast number of images for a single patient, but computers can help them do this more quickly and more accurately identify

Students use 3D Slicer to segment out lung tumors by applying what they learned about computer vision and region growing algorithms. Students play the role of a radiologist by analyzing mock patient reports and archived CT scans to make a diagnosis and provide treatment advice for lung cancer 'patients'.

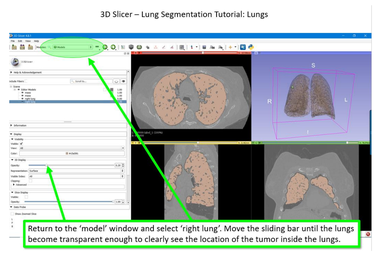


Figure 3

Next Generation Sunshine State Standards (Science 9 - 12)

Body of Knowledge: NATURE of Science
- Standard 1: The Practice of Science
- Standard 3: The Role of Theories, Laws, Hypothesis, and Models

Body of Knowledge: Computer Science Communication Systems & Computing
- Standard 6: Computer Interactions and Artificial Intelligence

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References

1. Li, Fei Fei. TED (2015, March 23). *How we teach computers to understand pictures.* Retrieved from https://www.youtube.com/watch?v=40riCqvRoMs&app=desktop
2. UCF Center for Research in Computer Vision. Retrieved from http://crcv.ucf.edu/projects/crowdCounting/index.php
3. The Cancer Imaging Archive (TCIA). (2014-2018). TCIA Collections. Retrieved from http://www.cancerimagingarchive.net