Behind Density Lines

CS 4624: Hypertext/Multimedia
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Virginia Tech, Blacksburg VA 24061
November 14th, 2023

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Outline

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Project Background

- Web-based game that allows multiple users to color and segment SEM images together
- Users’ segmentations is compared to a reference for scoring
- Display at Virginia Tech Science Festival to increase awareness and engagement towards bioengineering
Monet Roberts, Ph.D.

- Segmented SEM images manually as a bioengineering researcher
- Sourced SEM images
- Looking to draw attraction to VT's bioengineering department
About the Clients

Yinlin Chen, Ph.D.

- Researcher in Digital Libraries, Machine Learning, and CS Applications
- Interested in how machine learning can be leveraged in the biomedical field
About the Clients

Tanner Upthegrove

- Immersive Audio Specialist
- Integrating and displaying our project to VT's The Cube
- Interested in integrating community outreach in our project
Deliverables

- Web application that includes:
  - SEM image painter
  - Image/GIF export
  - Multiplayer server
Timeline

August
- Next.js skeleton
- THREE.js painter functionalities

Stage 1

September
- Segment splitting algorithm
- Adjustable brush
- Eraser

Stage 2

October
- Socket.io setup
- Scoring microservice

Stage 3

November
- Complete web UI
- Simultaneous painting for multiple users
- GIF export microservice
- Display at Virginia Tech Science Festival

VT Science Festival
Features

- Multiplayer
- Painter Interface
- Scoring
- GIF Export
Feature: Multiplayer

Behind Density Lines

Choose one of the images below to start collaboratively segmenting:

Room 1: Surface of cervical cancer cell that has a high production of a specific protein involved in breast cancer.

Room 2: Surface of cervical cancer cell that has a high production of a specific protein involved in breast cancer.

Room 3: Surface of cervical cancer cell that has a high production of a specific protein involved in breast cancer.

Room 4: Fluid secreted during the response from the immune system to an infection.
Feature: Painter

Painter UI
Feature: Multiplayer/Painter

- Next.js for the UI and fullstack framework
- Socket.io to synchronize state
- Painter built with THREE.js to render image and overlay
- Developed mobile-first to support iPads
Feature: Scoring

Score: 14%
Feature: Scoring

Input segments are associated with reference segments to determine correctness.
Feature: GIF Export

Example exported GIF
Feature: GIF Export

Room \{i\} on GIF encoder:

1. Draw Event
2. Update Internal State
3. Add frame to GIF
System Architecture

Scoring Microservice

GIF Encoder Microservice

Server

Client

State

Join

Room ID
Score
Room ID/
Draw Events
State/
Image
Room ID
GIF
Demo
Demo: VT Science Festival

The team standing on the display at the Cube
Future Work

1. Scaling the application
2. Automated Segmentation
3. Researcher Features
Future Work: Scaling

- Scale the application to support tens to hundreds of simultaneous users
- Had a maximum of 10 users at the VT Science Festival, so not immediately necessary
Future Work: Automatic Segmentation

- AI automated segmentation and analysis
- Attempted but unsuccessful this semester
Future Work: Researcher Features

- Dashboard of segmentations
- Database of images
- Attempted but dropped due to focus on VT Festival exhibit
Acknowledgements

- Monét Roberts
- Yinlin Chen
- Tanner Upthegrove
- Mohammed Farag
Questions?