DrawBuddy

Lisa Mishra, Denise Yang, Ronald Gonzalez

An app to vectorize hand-drawn diagrams and work as a platform for virtual collaboration

Use Case Requirements

Virtual whiteboard to vectorize *black & white line drawings* that can be *modified by the user* and *sent to peers*

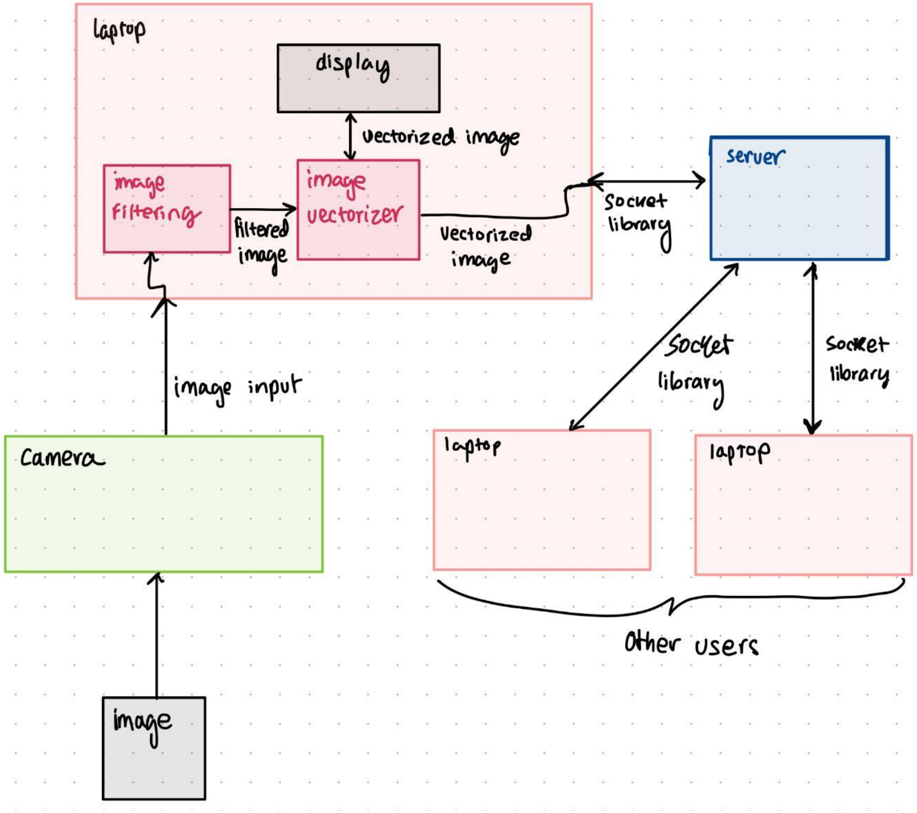
- Latency to render simple diagram (< 50 primitives): < 2min
- Update Latencies: < 100ms
- Accuracy: 9/10 average based on polling users
- Writing utensil: 0.4 - 1.0 mm
- Capture distance: 1-3 feet

Dabrowski, Robert, et al. WORCESTER POLYTECHNIC INSTITUTE, 2014, *The Effects of Latency on Player Performance and Experience in a Cloud Gaming System*, https://web.wpi.edu/Pubs/E-project/Available/E-project-050514-142618/unrestricted/The_Effects_of_Latency_on_Player_Performane_and_Experience_in_a_Cloud_Gaming_System.pdf. Accessed 6 Feb. 2022.

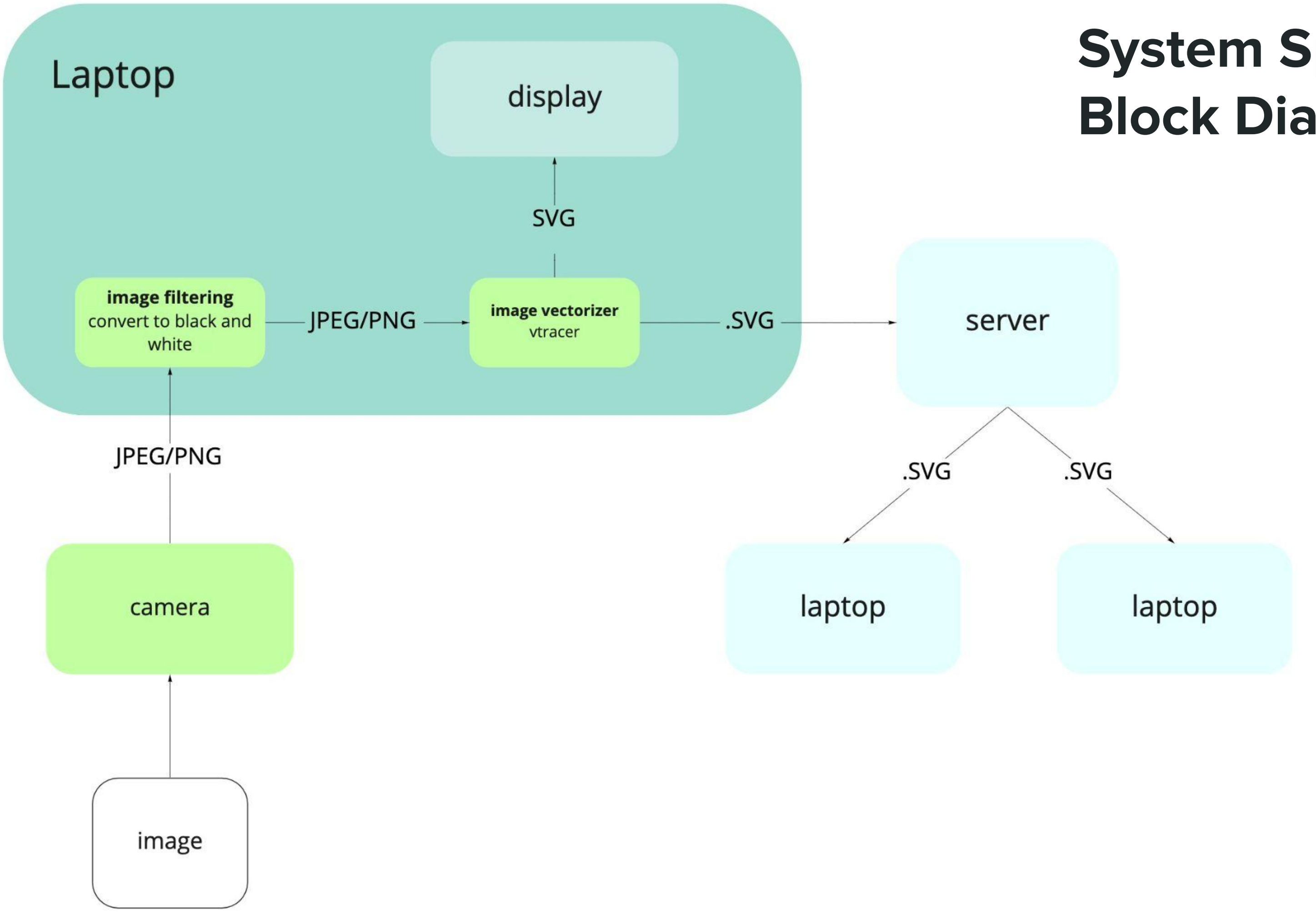
Solution Approach

MVP: Vectorizes *black & white line drawings* that can be *modified by the user* and *displayed to peers*

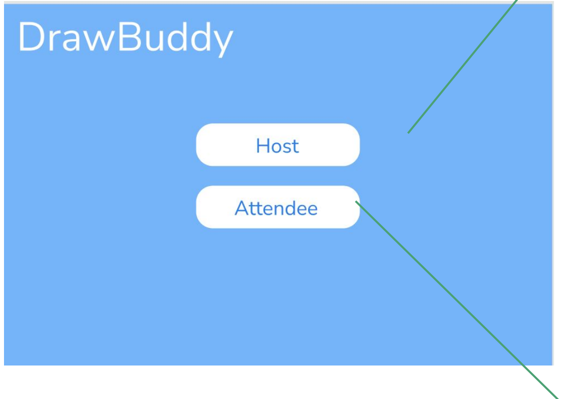
- Capture image
- Vectorize image
- Render
- Allow for translations and scaling
- Broadcast rendered image to connected users

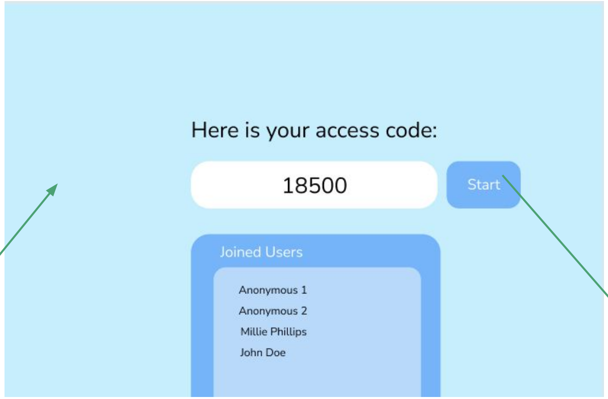


System Specification/ Block Diagram



The User Interface (GUI)

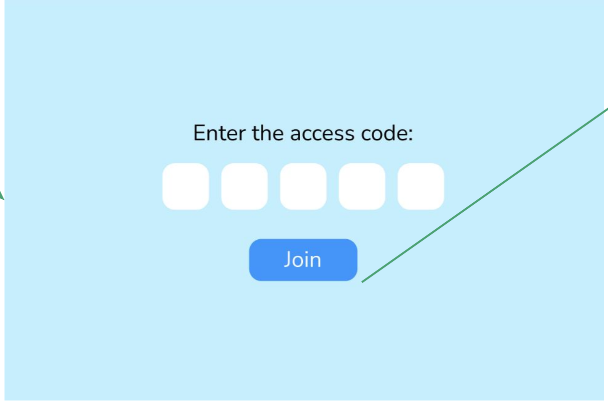



Here is your access code:

18500

Joined Users

Anonymous 1
Anonymous 2
Millie Phillips
John Doe


Enter the access code:

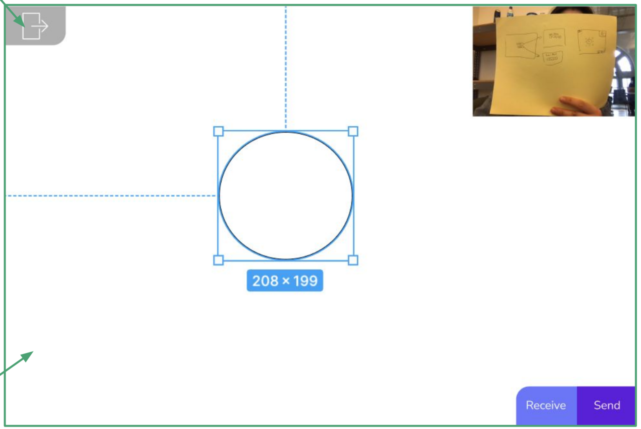


Image Filtering and Vectorizing

Image Filtering

- Use computer vision algorithms to read, convert to black and white, and apply a Gaussian Blur on the image

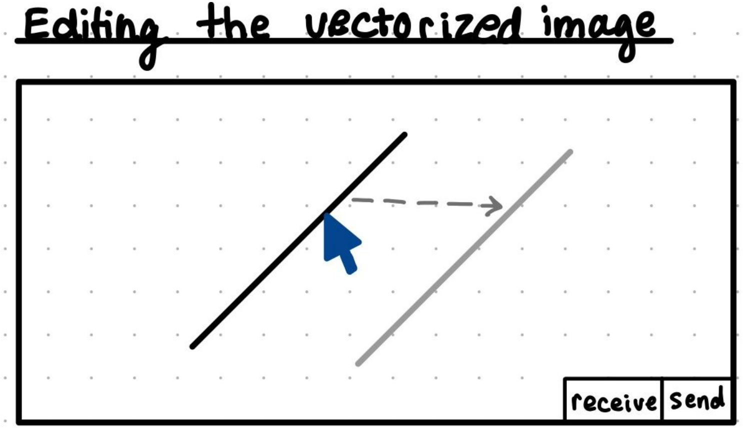
Image Vectorizing

- **VTracer -** converts jpg/png to an svg
- Other solutions we considered:
  - Using OpenCV for line detection and obtaining line endpoints
  - Using **potrace**, which converts a bitmap to an svg

https://github.com/visioncortex/vtracer

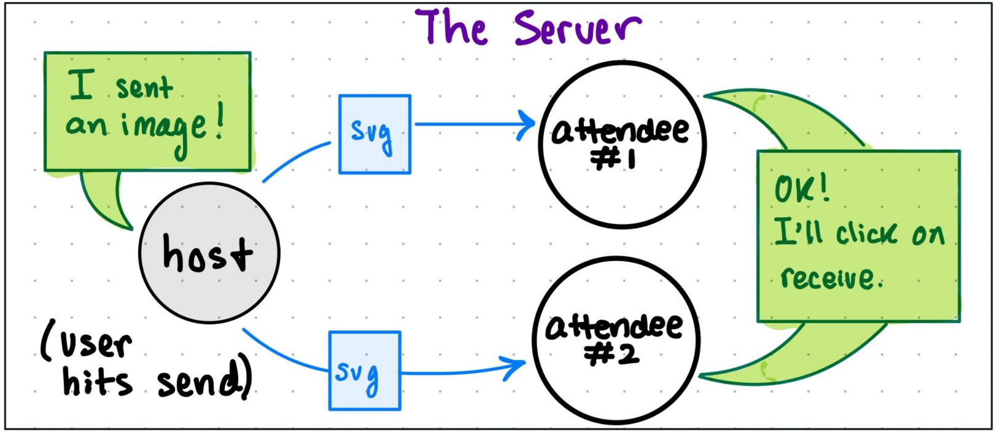
Modifying a Vectorized Image

- We handle translation and scaling
- Calculate transformation based on mouse click/release points
- **SVGutils** will be used to modify svg file within python code



Sending Messages to Other Users

- One person will act as “host” to start the session
- All users must be in the session to send/receive images
- In order to receive an image, the receiver has to click “receive”



Implementation Plan

User Interface
- PyGui

Image Filtering
- OpenCV

Image Vectorization
- Vtracer
- SVGutils

Communication Between Users
- Python Sockets for server
- Python Threading for users

Test, Verification, and Validation

Vectorization

- **Vary drawing utensil:** ballpoint pen and sharpie markers
- **Vary distance:** 1, 2, and 3 feet
- **Image complexity range:** 1, 10, and 25 components
- **Vary lighting:** natural, bright, and dim

User Experience

- **Latency for image to appear on screen**: < 2 minutes
- Users rate the rendered image above 9/10

Risks

- **Inaccurate images:** modify thresholds, CV temporal approach
- **Not within latency bounds:** Douglas–Peucker algorithm

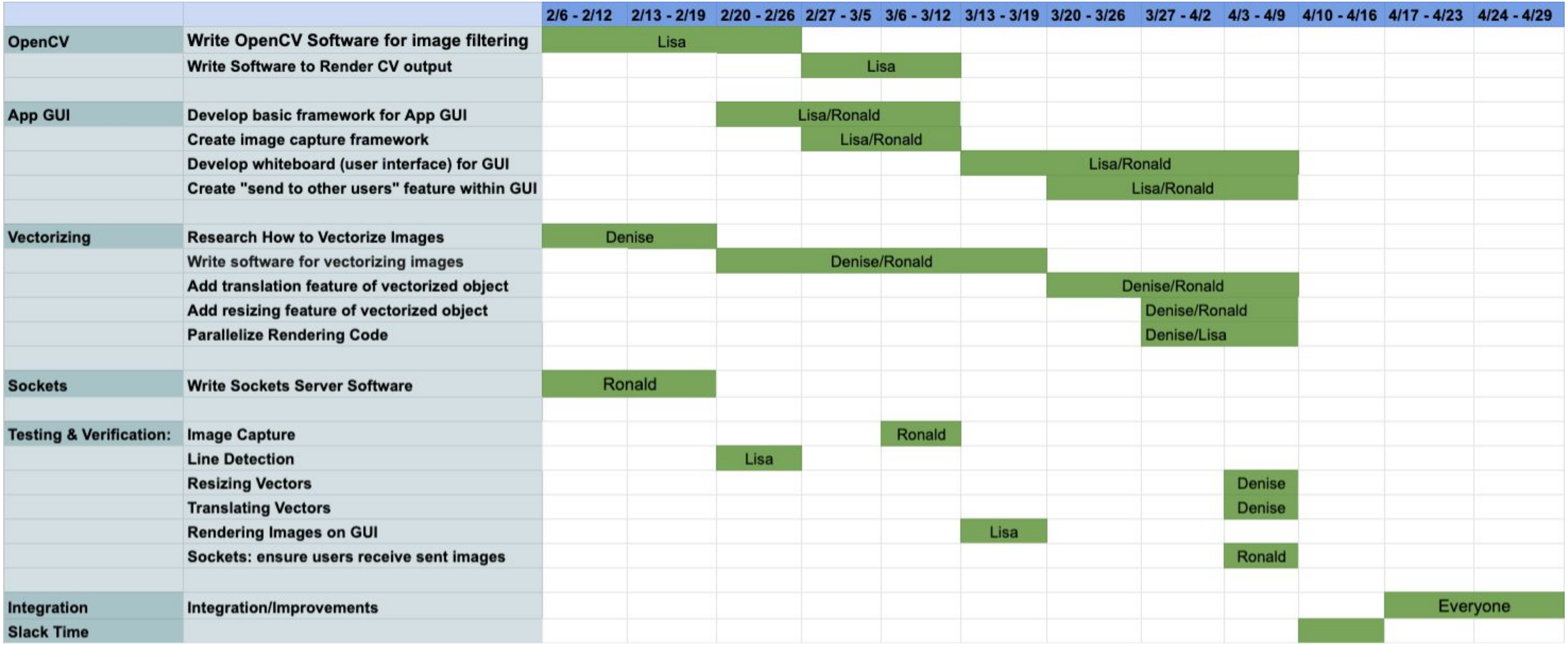
Test, Verification, and Validation

Communications

- Measure the average latency when sending vectorized images to 1 other user, and repeat for 2, 3, and 4 other users
- Average of 150 ms delay from sending vector to receiving it for all users
- If use case latency requirement not met, look into other ways of sending vectors that might be faster or look into compressing the files

Dabrowski, Robert, et al. WORCESTER POLYTECHNIC INSTITUTE, 2014, *The Effects of Latency on Player Performance and Experience in a Cloud Gaming System*, https://web.wpi.edu/Pubs/E-project/Available/E-project-050514-142618/unrestricted/The_Effects_of_Latency_on_Player_Performane_and_Experience_in_a_Cloud_Gaming_System.pdf. Accessed 6 Feb. 2022.

Project Management



		2/6 - 2/12	2/13 - 2/19	2/20 - 2/26	2/27 - 3/5	3/6 - 3/12	3/13 - 3/19	3/20 - 3/26	3/27 - 4/2	4/3 - 4/9	4/10 - 4/16	4/17 - 4/23	4/24 - 4/29
OpenCV	Write OpenCV Software for image filtering	Lisa	🟩	🟩									
	Write Software to Render CV output				Lisa	🟩							
App GUI	Develop basic framework for App GUI			Lisa/Ronald	🟩	🟩							
	Create image capture framework				Lisa/Ronald	🟩							
	Develop whiteboard (user interface) for GUI						Lisa/Ronald	🟩	🟩	🟩			
	Create "send to other users" feature within GUI							Lisa/Ronald	🟩	🟩			
Vectorizing	Research How to Vectorize Images	Denise	🟩										
	Write software for vectorizing images			Denise/Ronald	🟩	🟩	🟩						
	Add translation feature of vectorized object							Denise/Ronald	🟩	🟩			
	Add resizing feature of vectorized object								Denise/Ronald	🟩			
	Parallelize Rendering Code								Denise/Lisa	🟩			
Sockets	Write Sockets Server Software	Ronald	🟩										
Testing & Verification:	Image Capture					Ronald							
	Line Detection			Lisa									
	Resizing Vectors									Denise			
	Translating Vectors									Denise			
	Rendering Images on GUI						Lisa						
	Sockets: ensure users receive sent images									Ronald			
Integration	Integration/Improvements											Everyone	🟩
Slack Time											🟩		