Whiteboard Pal
Team C8

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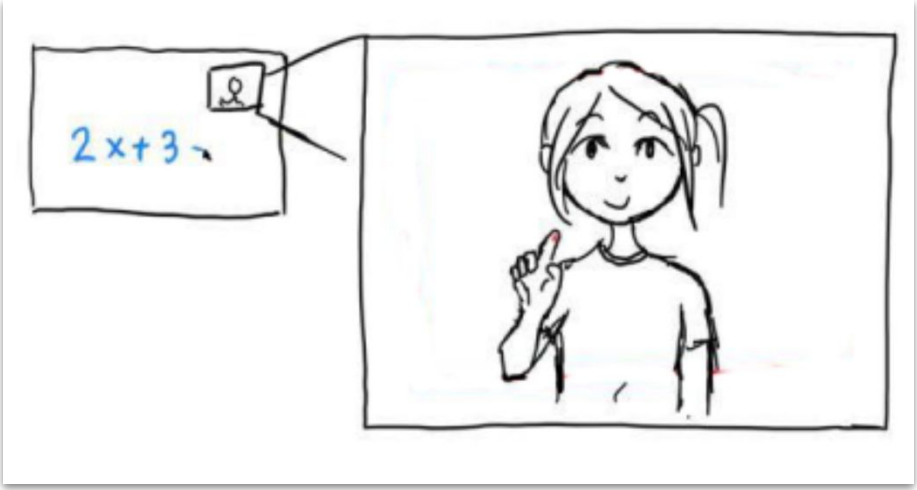
Use Case

Problem Statement
Drawing stuff with a mouse is hard, slow, and annoying.

Our Solution
The Whiteboard Pal, a software module that enables individuals to draw on a “virtual whiteboard” in front of a camera using ML.

ECE Areas
Software Systems + Signal Processing

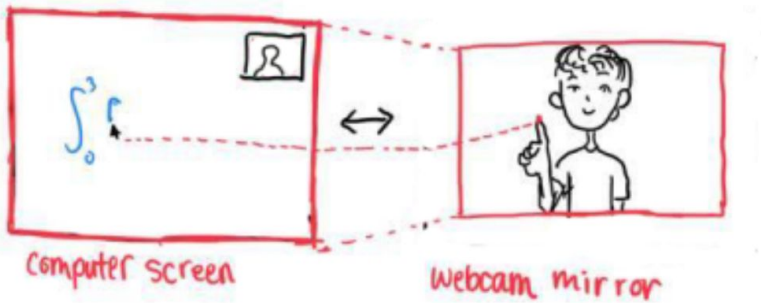
Our Vision



Requirements pt 1

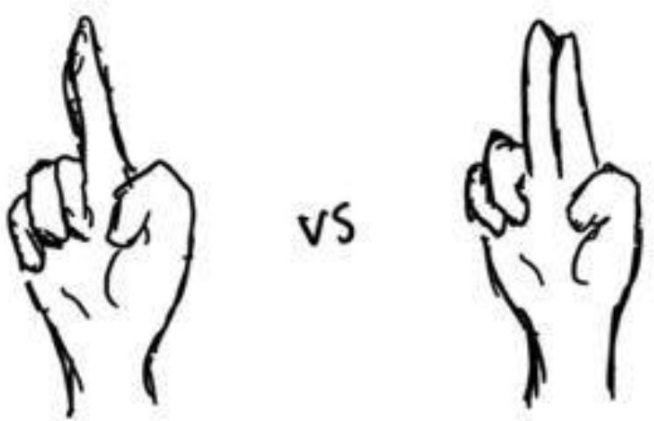
Whiteboard pal needs to meet the following requirements:

- Map the point of a “virtual pen” to a point on the screen
  - <100ms latency from physical movement to movement on screen
  - “jitter” within +- 5 pixels



Requirements pt 2

- Detect a “lift the pen” gesture
  - >= 95% accuracy wrt labeled data
- Ease of use



Technical Challenges

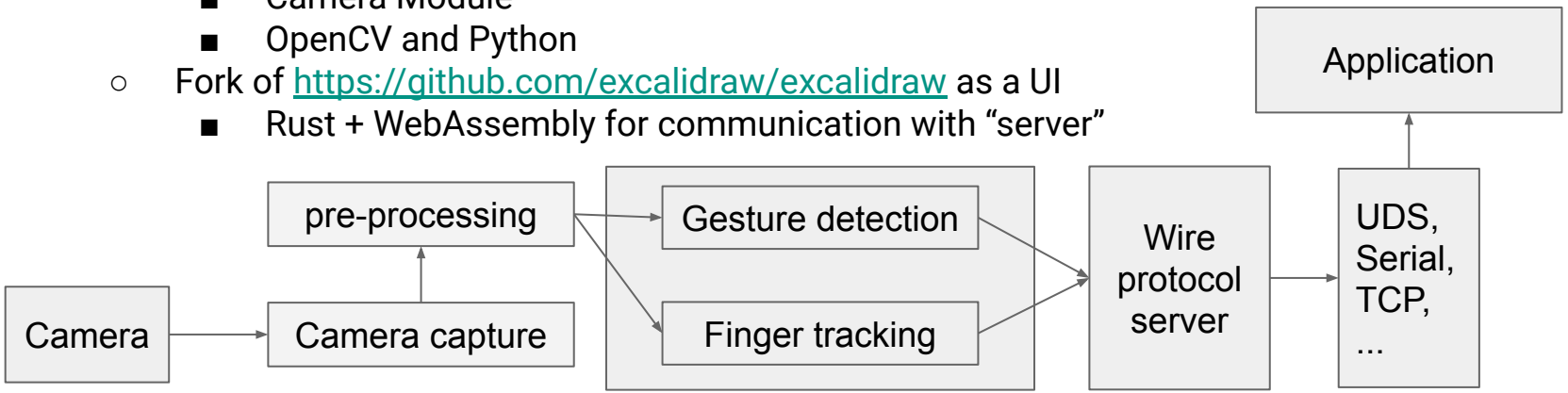
- Finger tracking
  - “Accuracy”
  - Latency
  - Framerate
- Gesture Detection
  - Accuracy
  - Latency
  - Framerate
- Building UI that’s intuitive

Challenges + Risk Mitigation

- 95% accuracy for gesture detection
  - Fall-back: “Push to draw” key
- Accurate finger tracking
  - Fall-back plan: draw a dot on user’s finger

Solution Approach

- Assumptions / Constraints:
  - User's computer has a GPU, Webcam, and is running a UNIX-based OS
- Components:
  - Whiteboard Pal "server"
    - Camera Module
    - OpenCV and Python
  - Fork of https://github.com/excalidraw/excalidraw as a UI
    - Rust + WebAssembly for communication with "server"



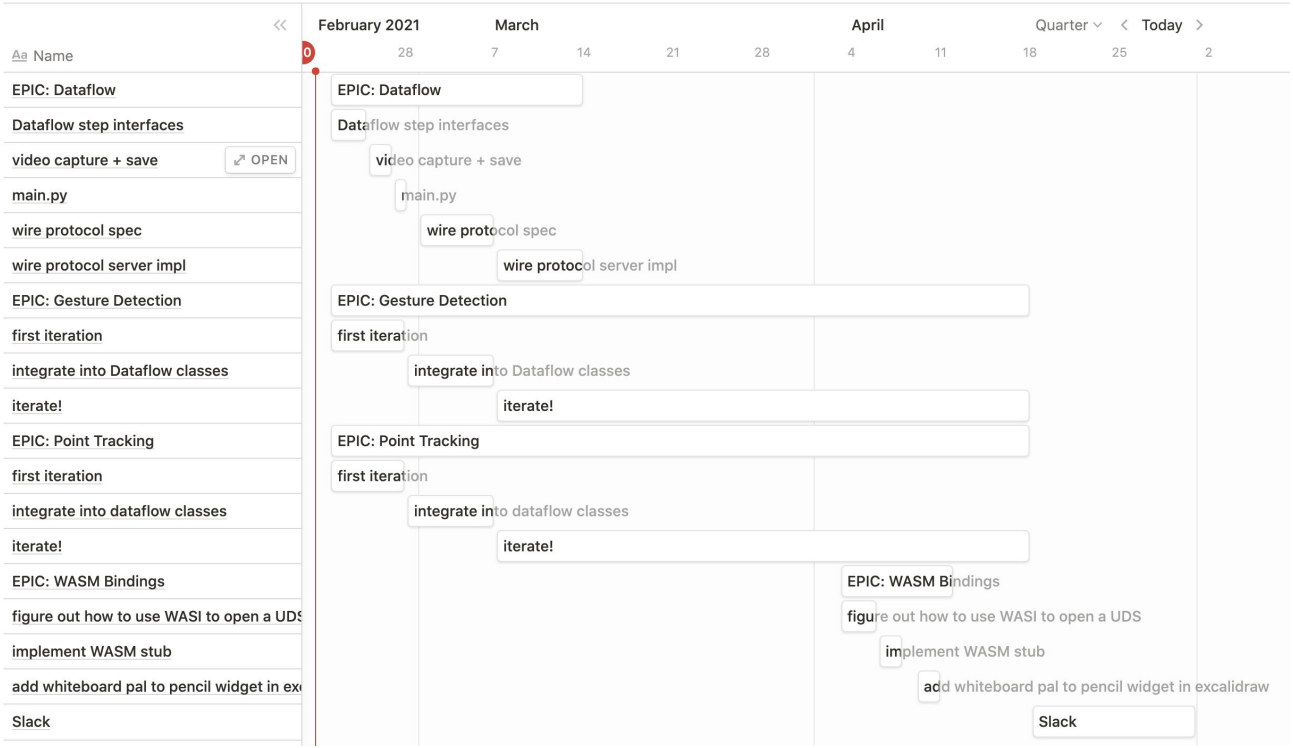
Testing, Verification, Metrics

- Finger tracking
  - latency from new frame -> coordinate for that frame
- Gesture detection
  - discrepancy between “push to draw” and gesture detection
- Efficiency
  - CPU + Memory utilization
- User testing with other students/TA’s
  - Acceptance (does it work?)
  - Usability (unmoderated “copy this drawing”)

Tasks and Division of Labor

- Computer Vision tasks (Jenny primary, Zaccheus, Sebastien secondary)
  - Given raw camera feed
  - Iterate on model and associated preprocessing for both tasks
- System tasks (Sebastien primary, Zacchaeus secondary)
  - test, train, data collection automation
  - Dataflow (Camera feed -> CV -> Wire Protocol)
  - WASM Bindings

Schedule


February 2021
March
April
Quarter
Today
Name
28
7
14
21
28
4
11
18
25
2
EPIC: Dataflow
Dataflow step interfaces
video capture + save
OPEN
main.py
wire protocol spec
wire protocol server impl
EPIC: Gesture Detection
first iteration
integrate into Dataflow classes
iterate!
EPIC: Point Tracking
first iteration
integrate into dataflow classes
iterate!
EPIC: WASM Bindings
figure out how to use WASI to open a UDS
implement WASM stub
add whiteboard pal to pencil widget in excalidraw
Slack

Conclusions

- In the post-whiteboard era it has become far harder to have customized explanations of complex topics
  - There is a great need for unique solutions to the problem of teaching hard ideas virtually
- The Whiteboard Pal is an easy to use replacement for the teaching resource we knew and loved so dearly
- Questions?