PEOPLE COUNTER

Team CO: David Feng, Brian Li, Gary Qin

Use Case

➔ Sorrells Library

◆ Estimation
- Total Max Capacity 300
- 2 Doors (96″× 40″ each)

◆ Prediction

Use Case Requirements

→ ~**90%** estimation accuracy

→ Info updated to user every **1 minute**

→ Ability to predict with categorization:
  - **Almost empty** (0-14.9%) - 0 to 44 people
  - **Not busy** (15-39.9%) - 45 to 119 people
  - **Busy** (40-69.9%) - 120 to 209 people
  - **Almost full** (70% and above) - 210+ people

→ If deployed to cloud, OpenCV's FPS >= **20fps**

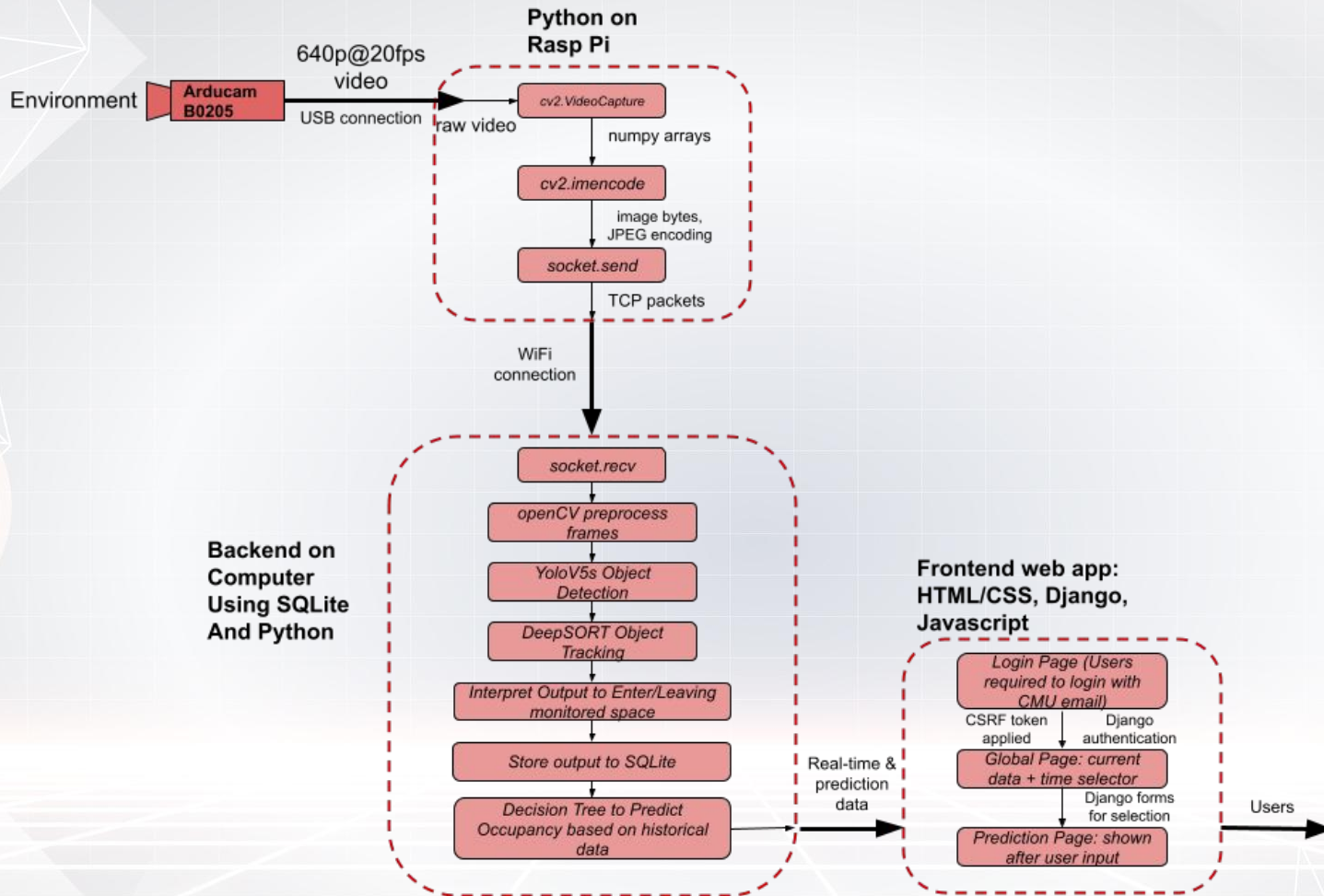→ **2** cameras - integrated live video feed

Implementation Plan

Using:

- 2× Arducam 1080P USB cameras
- 1× 8GB Raspberry Pi 4
- OpenCV Python for object detection

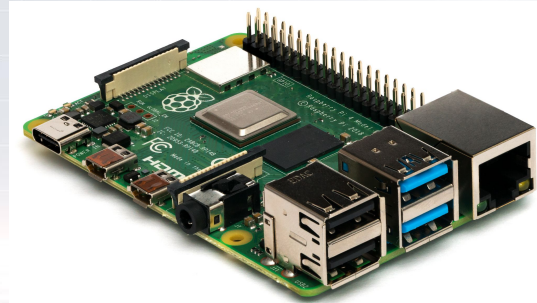**Building from Scratch:**

- Training model for prediction
- Database
- Web application for end users

Solution Approach

- **Hardware:**
- Arducam B0205:
    - 640p @ 30fps YUY video
    - 54x41 deg FOV
    - Low cost
- Raspberry Pi:
    - Sends video over wifi to backend
    - Powered via outlet
    - Only encodes images before sending

Solution Approach

- **Backend:**
- Image Processing:
    - OpenCV
- Object Detection:
    - Yolov5s
- Object Tracking:
    - DeepSORT
- Backend:
    - Database
    - SQLite
- Prediction:
    - Based on collected historical data

Solution Approach

➔ **Web App**
  ◆ Login Page
    ● registered users only
  ◆ Global Page
    ● time submission feature
  ◆ Prediction Page
    ● prediction shown based on selected time

PEOPLE COUNTER
Sorrells Library - CMU

Logout

Real-Time Occupancy:

83 people out of 300 max capacity

Select a time for predicted occupancy:

01 : 30 AM / **PM** Submit

Testing

➔ **Stage 1** - Baseline Tests

   Test connectivity & CV processing using only 1 camera on 1 of the 2 doors at Sorrells

➔ **Stage 2** - Accuracy Tests

   Test accuracy over 10 hour period

➔ **Stage 3** - Prediction Accuracy Tests

Validation & Verification

→ Accuracy: >= **90%** estimation maintained over 10 hr uptime = pass
→ Latency: Changes occupancy reflected in < **1 min** = pass
→ Categorization: Predicted **category** matches actual occupancy 30 min later = pass
→ Framerate: No dropped frames between hardware & backend @ **20fps** = pass
→ **2** cameras: Changes occupancy reflected regardless of doorway = pass

Project Management

David	Gary	Brian
- Configuring camera module with Raspberry Pi - Calibrating camera configuration to testing environment - Connecting video feed to CV backend over Wifi	- Web App: connecting backend data with server side with Django, HTML, Javascript, and CSS - Sanitize data to prevent web-based security attacks - CV testing	- Computer Vision system to detect and track people - Translate CV output to occupancy data - Prediction based on historical data

Updated Schedule

Category	Task	Week 4 2/6-2/12	Week 5 2/13-2/19	Week 6 2/20-2/26	Week 7 2/27-3/5	Week 8 Spring Break	Week 9 3/13-3/19	Week 10 3/20-3/26	Week 11 3/27-4/2	Week 12 4/3-4/9 Interim Demo	Week 13 4/10-4/16	Week 14 4/17-4/23	Week 15 4/24-4/30
Design	*Aquire components*												
	Design Review												
	Research camera libraries												
	Research CV Libraries /Deployment methods												
Hardware	*Access camera from Pi*												
	Calibrate camera to test environment												
	Connect video feed from camera to Pi												
	Connect sample video from Pi to backend												
	Assemble full video pipeline												
Backend	*Implement People Detection & Tracking*												
	Processing Time Benchmark												
	Convert CV Output to Occupancy Data												
	Occupancy Predicion Algorithm												
	Error Check / Refine												
Web	*Web application wireframes*												
	Create local app with HTML and CSS placeholders												
	Integrate backend data to web and test locally												
	Create Django application that runs on server-side												
	Data accuracy, latency, and web security testing												
Integration	*Video Feed & Backend*												
	Backend & WebApp												
	Full integration												
Deliverables	*Proposal Presentation*												
	Design Review												
	Design Review Presentation												
	Design Review Report												
	Ethics Assignment												
	Interim Demo												
	Final Presentation Slides												
	Final Presentation												
	Final Report												
Misc	*Slack*												

Legend: David · Gary · Brian · All