Spring 2021 - Team E7

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Application Area

Most professional card games analyses are not automated

Our system

- Images cards as they are dealt
- Provides a web interface to visualize hands
- Does not require card deck preparation

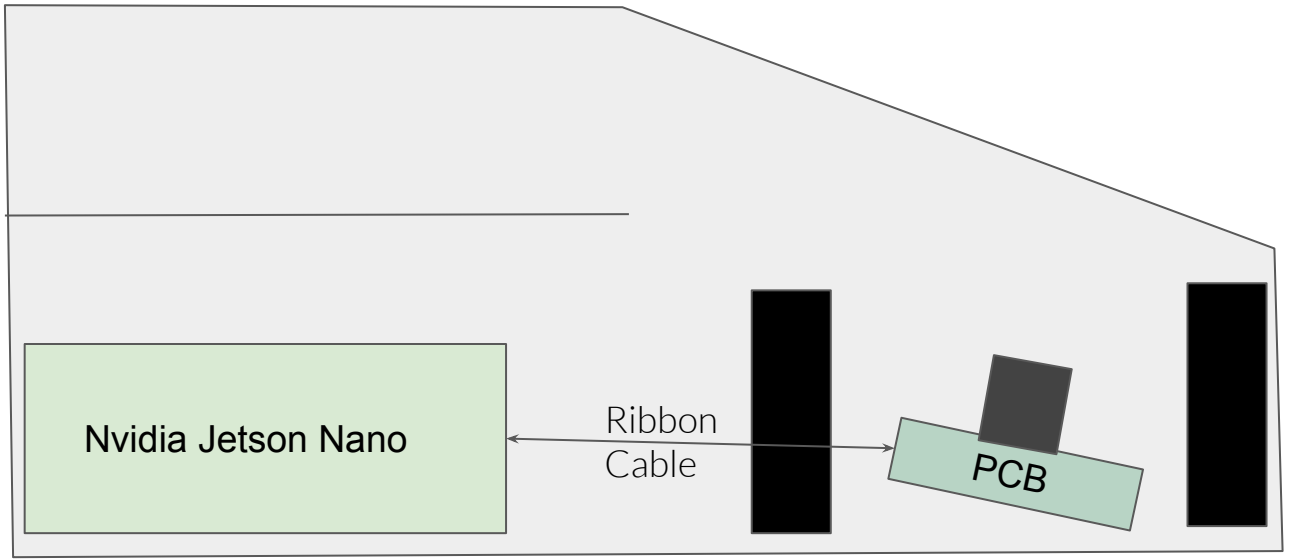
Application

- Commentators/Analysts
- TV spectators

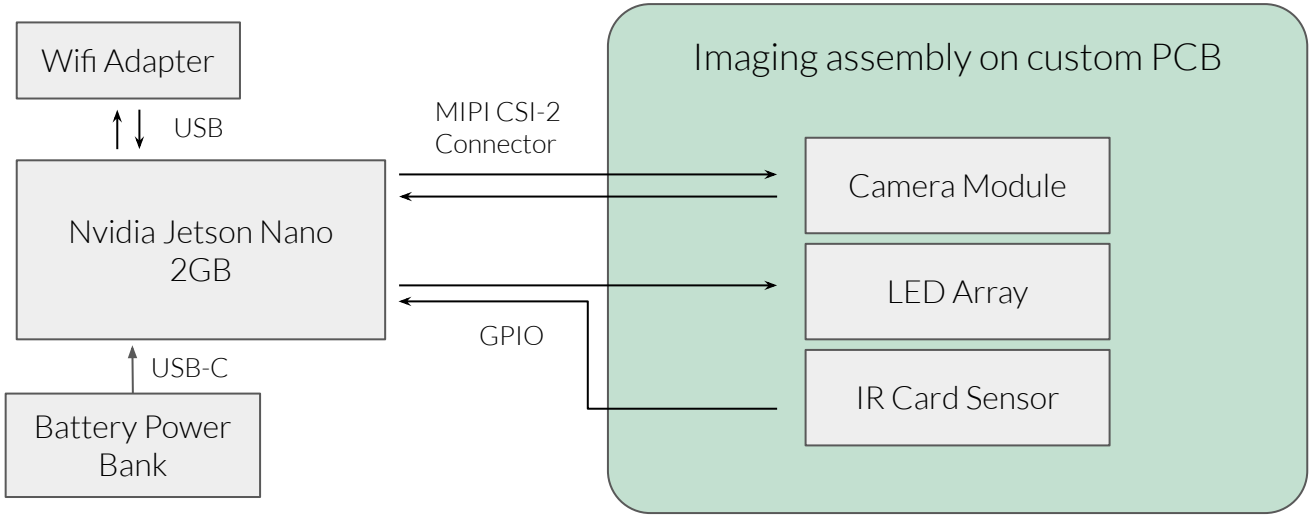
Solution Approach

- Camera System and Image Processing
  - Lens distortion correction
  - Controlled lighting
  - Segmentation and edge detection
- Software
  - OpenCV and PyTorch on Jetson Nano
  - Host web app on AWS
- Hardware
  - SBC and camera module eval board
  - PCB Daughter Board containing all external sensors/hardware

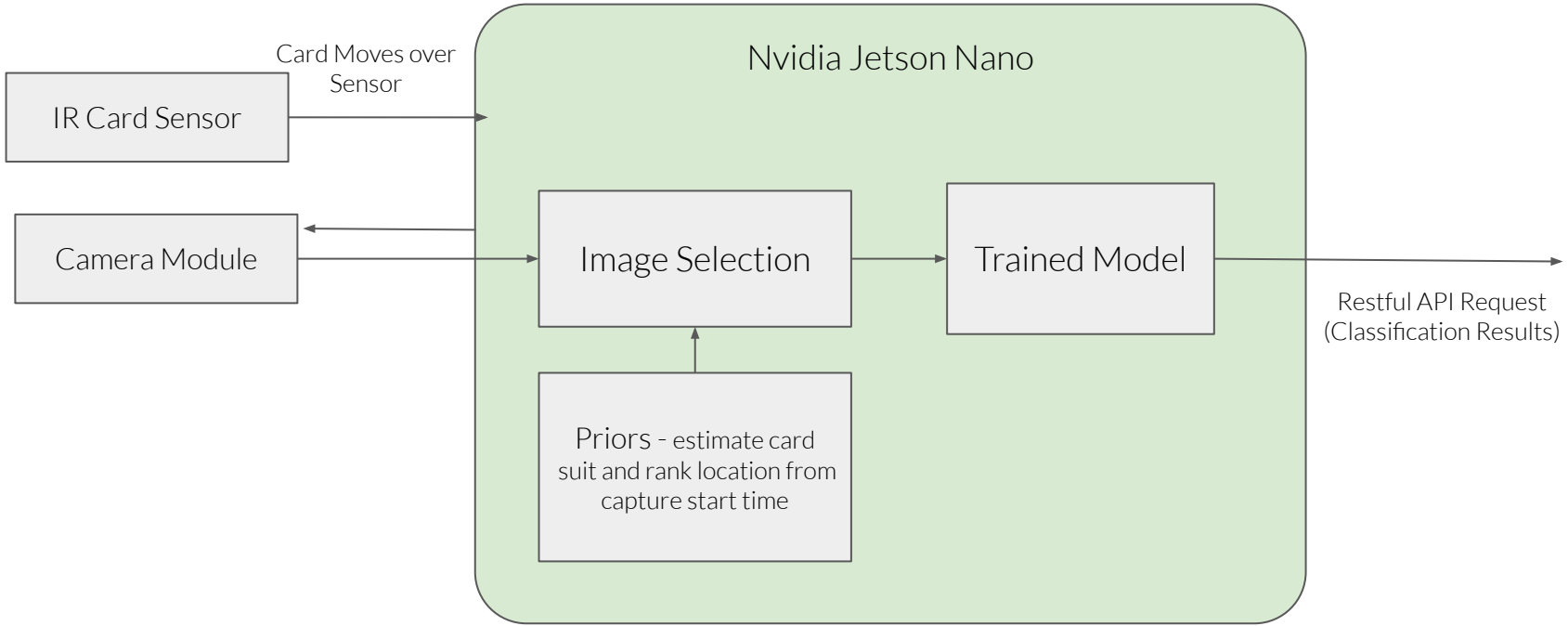
Cardshoe



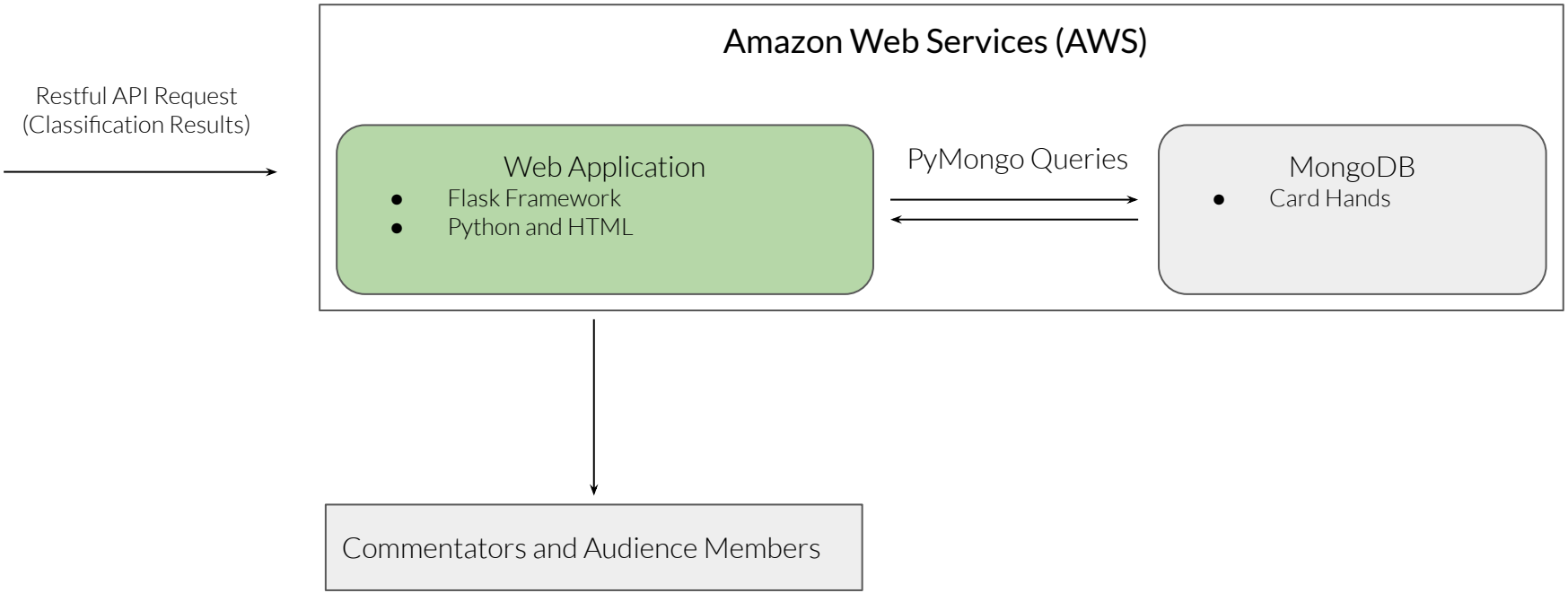
System Specification Hardware



System Specification Imaging Pipeline



System Specification Web App



Implementation Plan Imaging System

Camera Module

- Purchasing sensor & lens module with adequate FOV and focal range.
- Planned module provides .058mm resolution of object 30mm away at 120fps.

LED array

- LEDs (purchasing) on custom PCB (designing/developing) to ensure images are properly exposed

Hardware trigger

- Photoresistor/ IR sensor (purchasing)

Image processing

- Python OpenCV for image preprocessing
- PyTorch or scikit-learn for image classification, model-dependent

Implementation Plan Software

- Web App
  - Designing and developing
  - Utilizing MongoDB
- Amazon Web Services (AWS) EC2
  - Purchasing
- ML models
  - SVM, fully-connected neural networks, and convolutional neural networks

Metrics and Validation

- Test setting
  - 4-person poker game, dealing one unopened Bicycle Standard card deck
  - One team member records ground-truth labels as cards are dealt
  - Configure system to record all classification labels and latency times
- Evaluation
  - ML/Software
    - Confusion matrix will give classifier accuracies (≥ 94%)
  - Hardware
    - Record latency between card trigger, classification, and web app (≤ 2 seconds)
    - Verify no false triggers using ground-truth labels
    - Ensure Jetson Nano has enough memory to classify an entire card deck in 104 seconds
    - Ensure sufficient battery life

Risk Factors and Unknowns

- Achieving classification accuracy
  - Purchasing high frame rate camera to mitigate blur
  - Controlling card positioning with narrow card housing
- Image Selection from Priors
  - Estimating suit and rank image from sensor time may not be robust
- Shipping time/turnaround time
  - PCB revision 2 requires fast turnaround
  - Performing tasks in parallel
  - Prioritizing tasks in critical path

Task Division/Project Management

PokerCam Schedule

Group Member	Task	2/22 - 2/26					3/1 - 3/5					3/8 - 3/12					3/15-3/19					3/22 - 3/26					3/29 - 4/2					4/5-4/9					4/12 - 4/16					4/19-4/23					4/26-4/30					5/3 - 5/7				
		M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F
Jeremy																																																								
	Determine camera geometric/optical/electrical requirements																																																						
	Determine lighting requirements																																																						
	Finalize and purchase camera evaluation board and LED options										Stop																																											
	Test camera geometry, resolution, and blurring while moving playing cards																																																					
	Research and implement lens distortion correction																																																					
	Prototype lighting setup. Determine if multi-illuminant lighting is neccessary																																																					
	Create card segmentation																																																					
	Implement corner & edge detectors to crop card's rank and suit																																																				
	Build and test camera and lighting system beneath card shoe with custom hardware																																																				
	Test camera geometry and lighting changes based on preliminary ML results																																																				
	Verify final housing produces images of similar quality and lighting																																																				
	Slack time																																																					
Sid																																																						
	Develop static web app components																																																					
	Set up MongoDB cluster and connect web app with cluster																																																				
	Make web pages dynamic/interactive to HTTP requests																																																				
	Migrate web app from local machine to AWS																																																				
	Test RESTful API requests from Jetson Nano																																																				
	Research OpenCV, tensorflow, PyTorch, and other ML algorithms for low latency and sufficient accuracy																																																				
	Collect and preprocess training/validation/testing dataset																																																				
	Train with second dataset																																																				
	Train SVM, fully-connected networks																																																				
	Train convolutional neural network (if necessary)																																																				
	Integration																																																				
Ethan																																																					
	SBC Selection + Board Ship Time										Eval Board Ship Time																																											
	Camera Module Selection										Eval Board Ship Time																																											
	Lighting/Card Detection System																																																				
	Power System Design																																																				
	Order Parts/Housing										Parts Shipping						Parts Shipping																																					
	Build Test Bed																																																				
	PCB Design + Fab Time																1st Revision					Fabrication Time					2nd Rev.					Fabrication Time																					
	Work on Camera Drivers																																																				
	Integration/Assembly																																																				
	Slack Time																																																				
Team																																																					
	Prepare design presentation																																																				
	Prepare design review report																																																				
	Prepare final presentation																																																				
	Prepare final video																																																				
	Prepare final report																																																				