CSE 237D Milestone Report

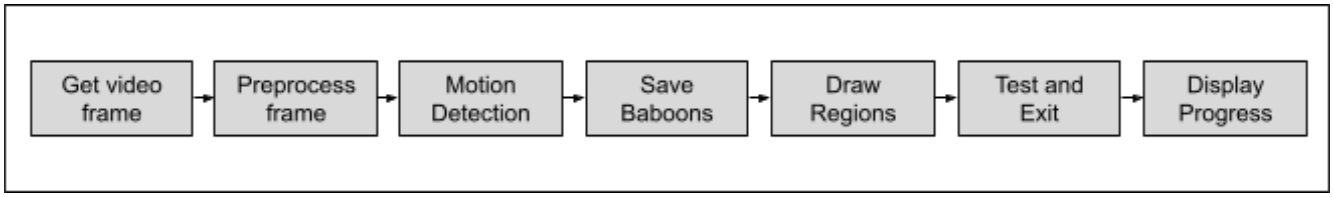
Baboons on the Move

Debaditya Basu, Sananya Majumder, Zhi Wang, Baiqiang Zhao

Milestone 1 (MVP): Port the algorithms to C++ following the CLI Chart

1. Compile a list of stages. Divide the algorithms/stages among group members

   Progress: Done
   Team Member: Zhi, Debaditya, Sananya
   Deliverable: Check if the C++ code is able to detect the baboons for the input video

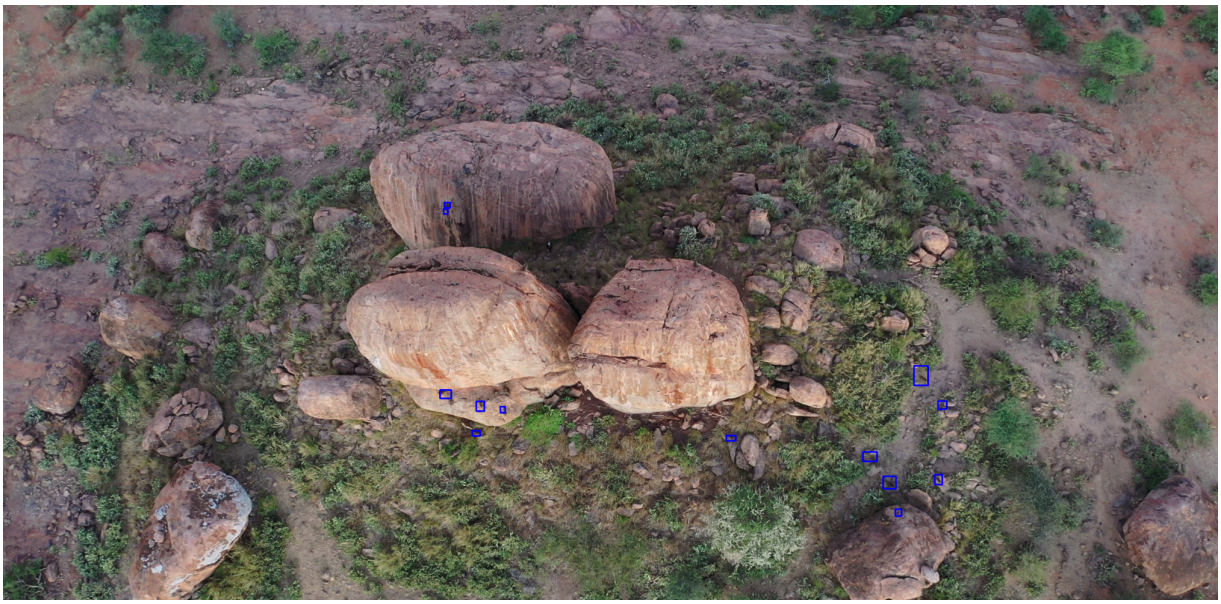


CLI chart, the stages ported

C++ - Frame 9, all bounding boxes (22)

2. Create a testing framework for C++ codebase to ensure functional correctness

   Progress: Done
   Team Member: Debaditya, Zhi, Sananya
   Deliverable: Match the outputs from the Python and C++ code within 50%



C++ - Frame 9, large bounding boxes (13)

Python- Frame 9, large bounding boxes (13)

Python				Cpp			
topleft.x	topleft.y	bottomlef	bottomleft.y	topleft.x	topleft.y	bottomrig	bottomright.y
1418	1246	1456	1270	1417	1245	1453	1272
1520	1370	1542	1387	1518	1370	1543	1387
1526	1280	1555	1310	1530	1280	1556	1311
1602	1297	1628	1320	1605	1296	1621	1316
2306	1382	2344	1408	2308	1385	2338	1402
2731	1433	2776	1467	2733	1385	2778	1465
2792	1505	2841	1551	2796	1510	2837	1549
2837	1611	2858	1633	2834	1611	2854	1633
2887	1167	2933	1227	2892	1171	2937	1232
2953	1506	2983	1542	2957	1505	2981	1536

C++ and Python - Frame 9, coordinates for closely-matching bounding boxes (10)

Percentage of Bounding Boxes that Closely Match (BBCM): 77%
BBCM Average Intersection of Union: 72%

Frame Number	IOU	BBCM %
10	73	81%
11	68	91%
12	70	83%

Sample IOU and BBCM for other frames

Milestone 2 (MVP): Performance benchmarking and optimization

1. Compare the runtime of each stage between C++ and Python code bases

   Progress: Done
   Team Member: Sananya, Debaditya, Zhi
   Deliverable: Show 60% improvement in the runtime for all the mapped stages in Python and C++ code

Stage	Time (ms)		Speed-Up
	Python	C++	
Get frame	57	1	57
Preprocessing	25	2	12.5
Store History Frame	0.1	0.1	1

Compute Transformation Matrices	4826	1981	2.43
Transformed Frames	714	407	1.75
Quantize History Frames	305	145	2.103
Generate Weights	198	30	6.6
Generate Mask Subcomponents	632	112	5.63
Compute Moving Foreground	47	83	0.56
Apply Masks	15	8	1.875
Erode Dilation	134	18	7.44
Detect Blobs	45	1	45
Save Baboons	0.09	0.065	1.38
Draw Regions	5	0.2	25

Overall improvement = 60.2%

2. Optimize the C++ codebase to ensure minimum performance improvement

   Progress: Ongoing
   Team Member: Zhi
   Deliverable: Show 10% improvement in performance and correctness for specific stages in the C++ code
   Due Date: 5/24/22

Milestone 3 (Early Stretch Goal): Refactoring existing implemented code

1. Perform feasibility study on parallelizable algorithms with CUDA

   Progress: Ongoing
   Team Member: Debaditya, Sananya
   Deliverable: List out stages which can be implemented in CUDA
   Due Date: 5/22/22

Milestone 4 (Long Stretch Goal): CUDA Implementation of the algorithms

1. <u>Divide the algorithms/stages among group members.</u>

   Progress: Not started
   Team Member: Sananya, Debaditya, Zhi
   Deliverable: Check if the CUDA code is able to detect the baboons for the input video
   Due Date: 5/29/22

2. <u>Testing the CUDA implementation for performance benchmarking</u>

   Progress: Not started
   Team Member: Debaditya, Sananya
   Deliverable: Compare the runtime for the stages with the Python and C++ code
   Due Date: 6/3/22

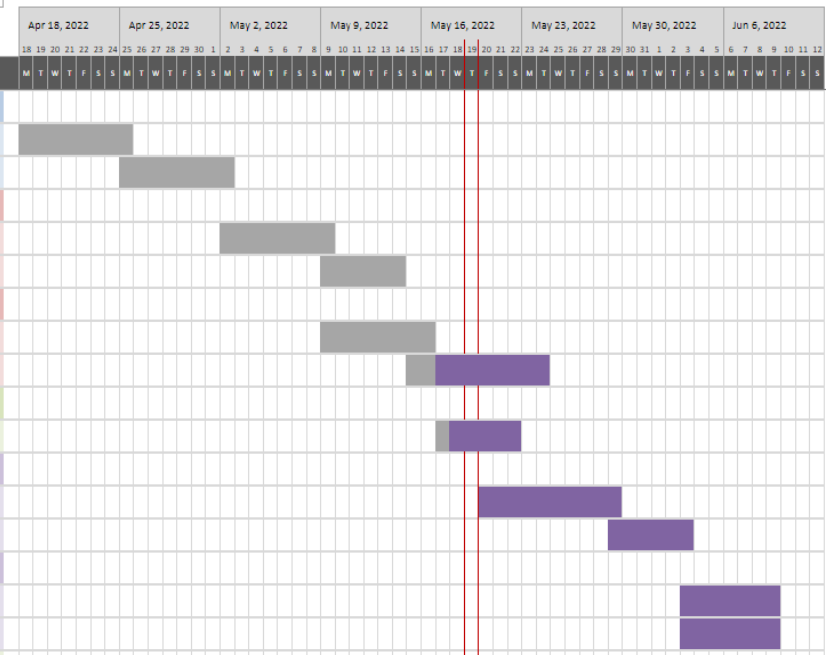
3. ~~Feasibility study of Kalman filter for multi-baboon motion tracking and prediction~~

Gantt-Chart

Baboons on the Move

Project Start: Mon, 4-18-2022
Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Understanding Existing Code				
Understanding Existing Python Code	Whole Group	100%	4-18-22	4-25-22
Literature Survey of Computer Vision	Whole Group	100%	4-25-22	5-2-22
Port Algorithms to C++				
Port Algorithms to C++	Zhi,Debaditya,Sananya	100%	5-2-22	5-9-22
Creating a Testing Framework	Debaditya,Zhi,Sananya	100%	5-9-22	5-14-22
Performance Benchmark and Optimization				
Compare Runtime of Stages	Sananya,Debaditya,Zhi	100%	5-9-22	5-16-22
Optimization of Existing C++ code	Zhi,Debaditya,Sananya	20%	5-15-22	5-24-22
Refactoring Existing Implemented Code				
Feasibility Study of Parallel Algorithms	Debaditya,Sananya	20%	5-17-22	5-22-22
Cuda Implementation of Algorithms				
Different Stages for Cuda Implementation	Sananya,Debaditya,Zhi	0%	5-20-22	5-29-22
Testing the Cuda Implementation	Sananya,Debaditya	0%	5-29-22	6-3-22
Final Presentation				
Video	Whole Group	0%	6-3-22	6-9-22
Report	Whole Group	0%	6-3-22	6-9-22



Revisions

We removed the third part of Milestone 4, feasibility study of Kalman filter for multi-baboon motion tracking and prediction. In our project specification, it was considered an ultimate stretch goal, which we would attempt to complete if time permitted. It was also understood that this part of the project would be research-oriented and open-ended. After carefully examining our progress and planning for the remaining milestones, we decided to not pursue this part of the milestones, and prioritize on completing our MVP and early stretch goals. So our next focus will be on the feasibility study of CUDA implementation of the code, as based on our analysis after benchmarking, parallel execution could increase the performance for some of the stages.