Work It

MADELINE MIANZO
SARAH TAN
ZIXUAN ZOU

Making at home workouts more enjoyable!

B5

Introduction & Motivation

USE CASE

- Full body motion tracking
- Personalized workouts
- Real-time scoring
- User profiles and graphics to allow progress tracking

- Areas: Software & Signals

Metrics, Testing, & Verification

Requirements	Testing	Metrics
Hardware Performance	Time how long it takes to analyze sets of images	< 1 min time limit
OpenPose Detection	Analyze runtime and accuracy for different image sizes/poses	90% accuracy
Pose Alignment	Analyze comparison results over different body types	90% accuracy
Pose Comparison	Test with similar poses/workout exercises	90% accuracy
Score Computation	Analyze the scores over different levels of completion	Score should reflect user's completion and accuracy

Technical Challenges

- Latency vs. Accuracy
- Hardware/physical components:
  - Performance requirements vs budget
- Real Time processing
  - Image/Data Collection: Take frames from regular intervals (not collecting every frame)
  - Rest breaks: to allow image collection/processing catch up
  - Final score screen: to provide further buffer for image analysis

Requirements

- Pose alignment: Detect key points of user's form
  - Differentiate side-view and front-view
  - pose alignment for different body types (calibration)
- Generate score based on accuracy

- Test:
  - analyze pose comparison results over various poses
    - side-view and front-view poses
    - Similar poses, but different exercise
    - Different body types
  - test with different thresholds and parameters

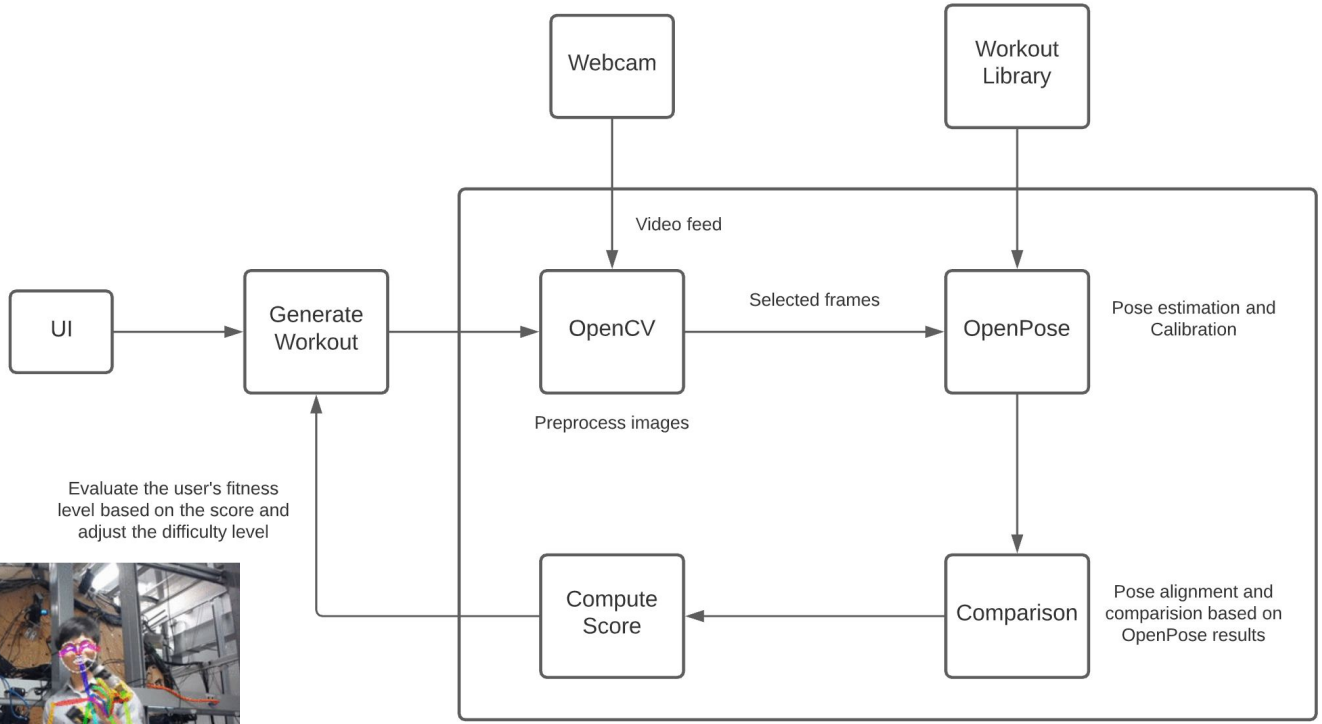
Hardware comparison (board)

	Xavier NX (15W)	Xavier NX (10W)	AGX Xavier	Jetson Nano
CPU	4x/6x Carmel @ 1.4GHz or 2x Carmel @ 1.9GHz	4x/ Carmel @ 1.2GHz or 2x Carmel @ 1.5GHz	8x Carmel @ 2.26GHz	4x Cortex-A57 @ 1.43GHz
GPU	Volta, 384 Cores @ 1100MHz	Volta, 384 Cores @ 800MHz	Volta, 512 Cores @ 1377MHz	Maxwell, 128 Cores @ 920MHz
Accelerators	2x NVDLA		2x NVDLA	N/A
Memory	8GB LPDDR4X, 128-bit bus (51.2 GB/sec)		16GB LPDDR4X, 256-bit bus (137 GB/sec)	4GB LPDDR4, 64-bit bus (25.6 GB/sec)
Storage	16GB eMMC		32GB eMMC	16GB eMMC
AI Perf.	21 TOPS	14 TOPS	32 TOPS	N/A
Dimensions	45mm x 70mm		100mm x 87mm	45mm x 70mm
TDP	15W	10W	30W	10W
Price	$399		$999	$129

Hardware comparison (Camera)

	8MP Camera with 77° FOV	8MP IR Night Vision Camera with 77° FOV	8MP Camera with 130° FOV	8MP Camera with 160° FOV	8MP Camera with 160° FOV	8MP Camera with 200° FOV	8MP 3D Stereo Camera Module
Diagonal Field of View (FOV)	77°	77°	130°	160°	160°	200°	83°
IR LED Modules	None	2	None	None	2	None	None
Aperture	2.0	2.0	1.8	2.35	2.35	2.0	/
Focal Length	2.96mm	2.96mm	1.88mm	3.15mm	3.15mm	0.87mm	2.6mm
Lens Construction	4P	4P	4E+IR	6G+IR	6G+IR	1G4P+IR	/
Distortion	<1%	<1%	<7.6%	<14.3%	<14.3%	<18.6%	<1%
EFL	2.93mm	2.93mm	1.85mm	3.15mm	3.15mm	0.9mm	/
BFL (Optical)	1.16mm	1.16mm	1.95mm	3.15mm	3.15mm	1.41mm	/

Solution Approach



Solution Approach - UI

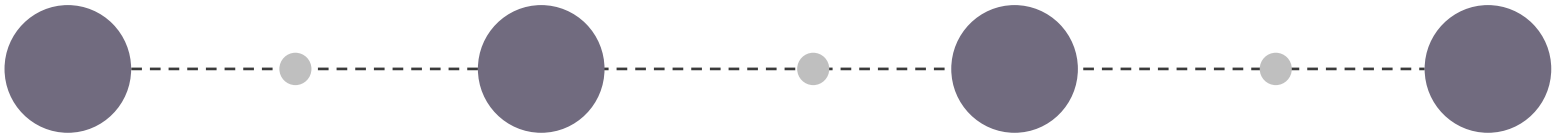
20 push ups

Up next:
15 sec rest

15 sec rest

Up next:
20 squats

Tasks & Division of Labor



Phase 1 (setup)

1. Set up xavier board (Sarah)
2. Process images (Sarah)
3. Construct exercise library (Maddie)
4. OpenPose on laptop (Zixuan)
5. Design UI (Maddie)
6. Choose workout generation algorithms (Everyone)

Phase 2 (tracking)

1. Get OpenPose working on nx (Sarah)
2. Create workout sequence (Maddie)
3. Pose alignment/calibration (Zixuan)
4. Pose comparison (Zixuan)
5. Score generation (Sarah)
6. Extend video library (Everyone)

Phase 3 (MVP)

1. Testing and debugging pose comparison (Everyone)
2. Finish the UI (Maddie)
3. Add authenticated user accounts (Maddie)

Final

Improve the overall speed and design of our game to cater to the user

Schedule (Gantt Chart)