# Work It

MADELINE MIANZO SARAH TAN ZIXUAN ZOU Making at home workouts more enjoyable! 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 N	/DLA	2x NVDLA	N/A			
Memory	8GB LPDDR4 (51.2 G	X, 128-bit bus BB/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			
Al Perf.	21 TOPS	14 TOPS	32 TOPS	N/A			
Dimensions	45mm >	k 70mm	100mm x 87mm	45mm x 70mm			
TDP	15W	10W	30W	10W			
Price	\$3	99	\$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 Constructi on	4P	4P	4E+IR	6G+IR	6G+IR	1G4P+IR	/
Distortion	<1%	<1%	<7.6%	<14.3%	< <b>14.3</b> %	<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



#### Tasks & Division of Labor

#### Phase 1 (setup)

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

#### Phase 2 (tracking)

Get OpenPose working on nx (Sarah)
 Create workout sequence (Maddie)
 Pose alignment/calibration (Zixuan)
 Pose comparison (Zixuan)
 Score generation (Sarah)
 Extend video library (Everyone)

#### Phase 3 (MVP)

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

#### Final

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

# Schedule (Gantt Chart)

Everyone	Current Date: 2/17	IMPOR	TANT DATES: Proposal Slid	es - U 2/21; Proposal Present	tation - W 2/24	IMPORTANT DATES: Design Slides - U 3/7; Design Presentation - W 3/10									IMPORTANT DATE	S: Final Slides - U 5/2
Maddie															Final Presen	tation - W 5/5
Sarah	Sarah			February			March					April			May	
Zixuan		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
		M T W R F S	UMTWRFS	UMTWRFS	UMTWRFS	UMTWRFS	UMTWRFSI	UMTWRFS	UMTWRFS	UMTWRF	SUMTWRFS	UMTWRFS	UMTWRFSU	M T W R F S	UMTWRFS	UMTWRFS
Task	Status	1 2 3 4 5 6	7 8 9 10 11 12 13	14 15 16 17 18 19 20 3	21 22 23 24 25 26 27	28 1 2 3 4 5 6	7 8 9 10 11 12 13 1	14 15 16 17 18 19 20	21 22 23 24 25 26 27	28 29 30 31 1 2	3 4 5 6 7 8 9 10	11 12 13 14 15 16 17	18 19 20 21 22 23 24 2	5 26 27 28 29 30 1	2 3 4 5 6 7 8	9 10 11 12 13 14 15
Planning																
determine preferable board (compare specs)																
find compatable camera																
Phase 1	wk 4-5															
set up xavier board																
input images from camera to board																
process images																
subtask: scaling images to standardize																
openpose on laptop (python API)																
subtask: sample full body tracking																
subtask: sample pose comparison																
construct starter video library																
subtask: find usable videos for arms, core, legs																
subtask: pull the videos and separate by exercise																
subtask: grab one repetition to loop for each exercise																
subtask: rank difficulties of exercises																
design UI																
subtask: choose performance indicator (moving bar/score)																
subtask: score screen																
choose algorithms																
subtask: workout creation																
subtask: image processing																
subtask: scoring																
subtask: levels/difficulty																
Phase 2	wk 6-8 (buffer 9)															
program xavier board/test openpose code on board																
create the UI																
subtask: model exercises for the user																
subtask: finish performance indicator																
subtask: implement setup/break/ending screen																
use openpose to track the user's accuracy																
subtask: process # frames/sec from user video																
subtask: process # frames/sec from workout library																
subtask: configure accuracy comparison to numerical data								<u></u>								
subtask: provide initial scoring metric for exercise																
implement workout construction algorithm																
subtask: evaluate user ability																