MotiHomeT (Motivate Home Training)

Final Presentation Slides

Team 2
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Recap on the Project

Motivation

- Gym
  - Far to the gym/travelling/corona
  - Gym is expensive
- Home exercising
  - Harder with motivation(lots of distractions)
  - Lacks social training possibilities

Approach & Novelty

- Mobile app
- Count push-ups with DL pose estimation and heuristic algorithm
- Compete with friends

Approach & Novelty

- Existing solutions
  - Manual
  - Different sensors
  - Badly working
  - Static exercises

Demonstration

Use Cases

Various Error Cases

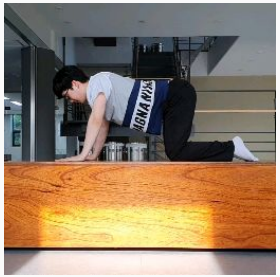
Good

Stand

Angle (45°)

Bad form

Knee on ground



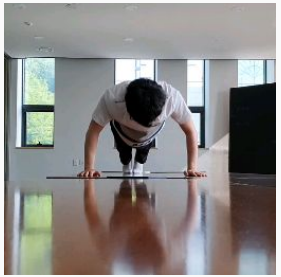
Lying on ground

Not enough

Nooot enough

Wall

Frontal



Rear

Using table

Technical Details

Expected Challenges

- Counting
- Push-up Pose

New Challenge

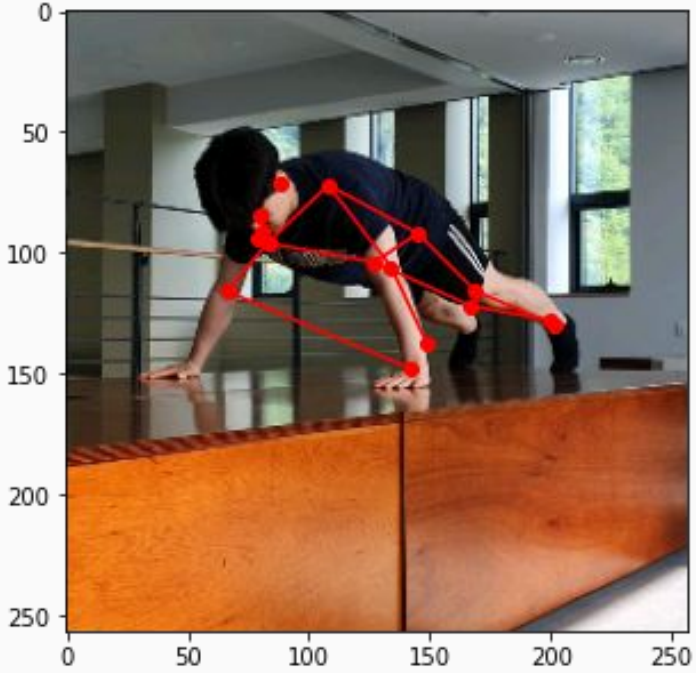
- Pose estimation model is not accurate.

System Design

- Counting
- Pushup Pose
- Posenet Model

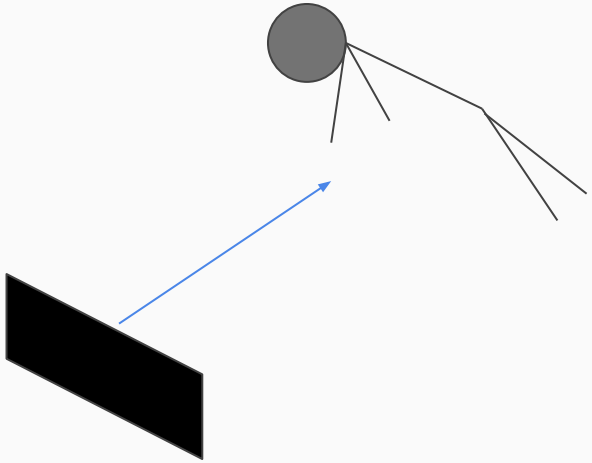
Confidence Error

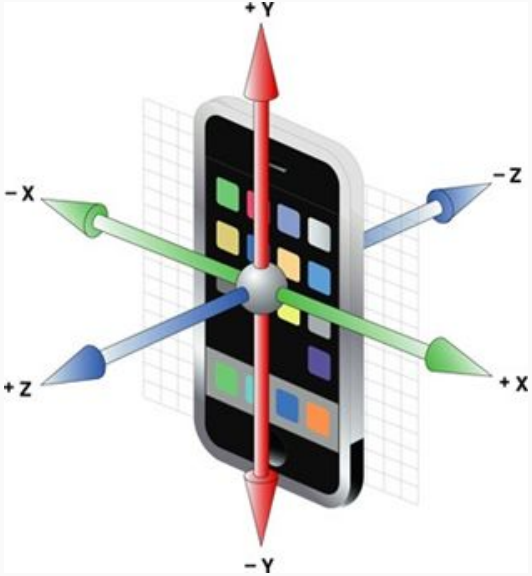
- Posenet Model’s are not always correct
- Drop frames with low confidence



Camera Angle Error

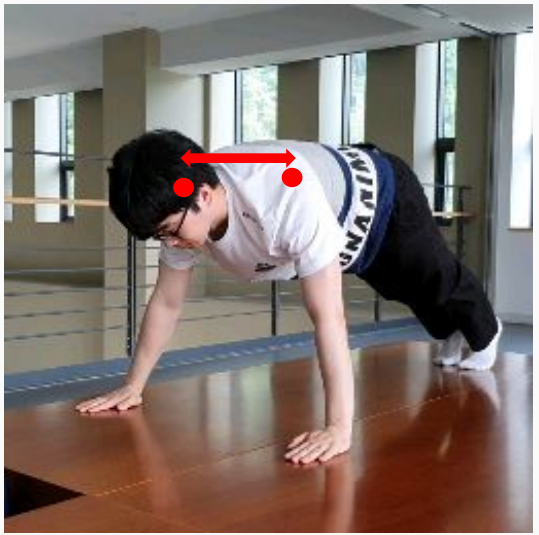
- Fix camera angle using Accelerometer



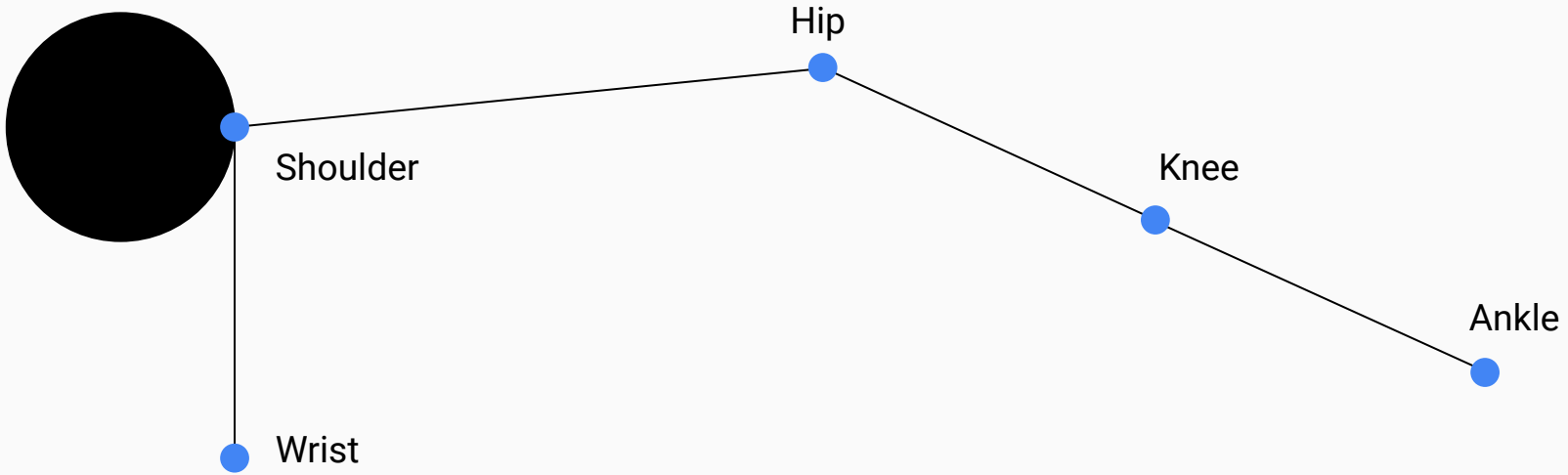


Shoulder Distance Error

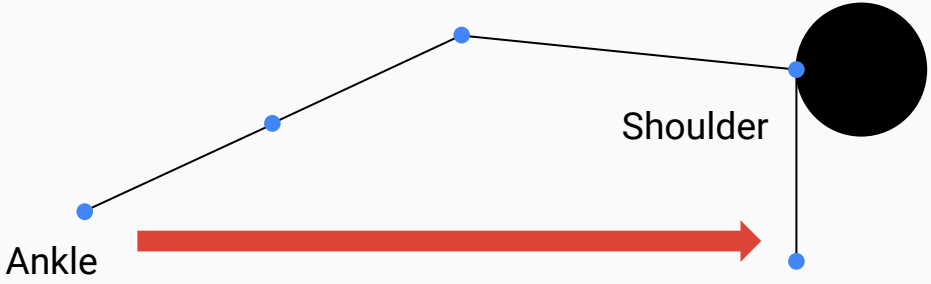
- Fix camera position next to the person

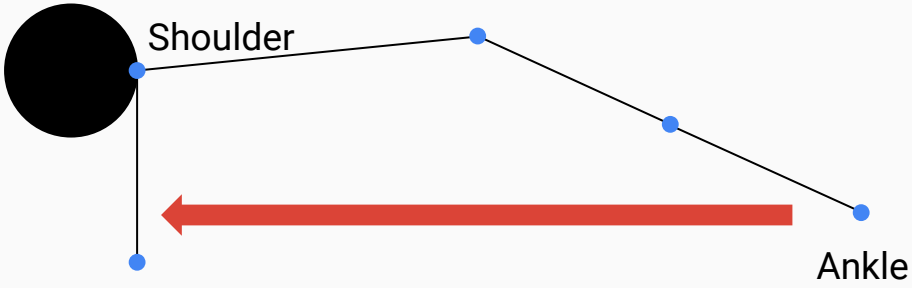


Push-up Pose



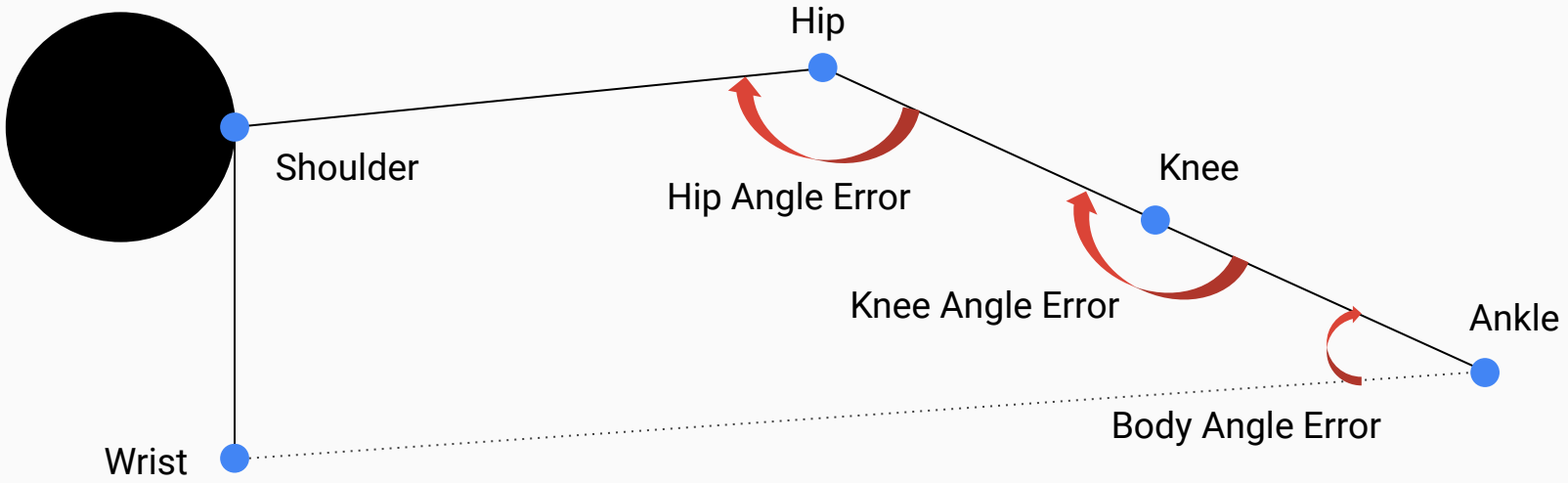
Body Direction





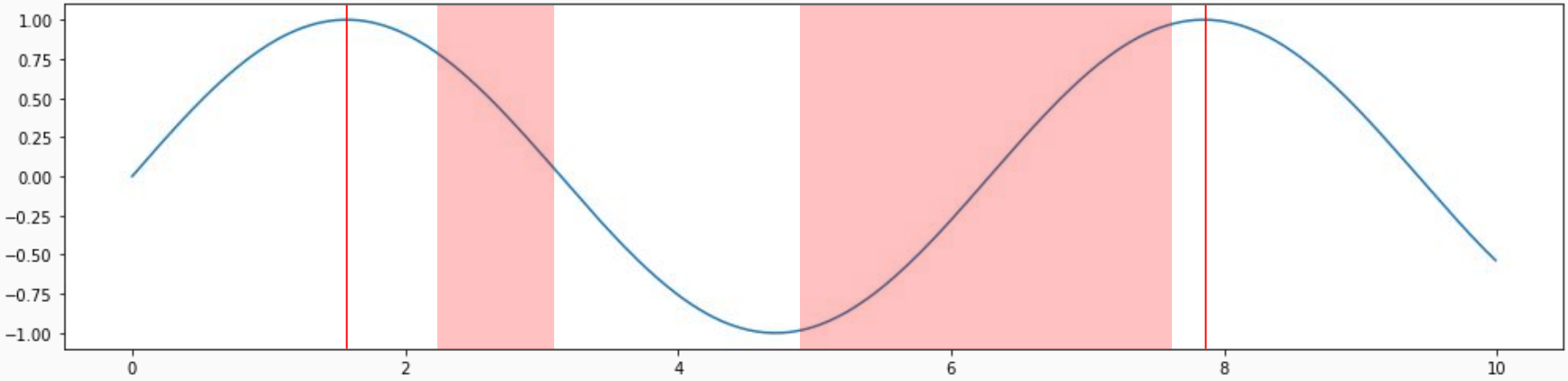
- Closer body parts have higher confidence score
- Figure out body direction using the relative position of ANKLE and SHOULDER

Push-up Pose


Hip
Shoulder
Hip Angle Error
Knee
Knee Angle Error
Ankle
Body Angle Error
Wrist

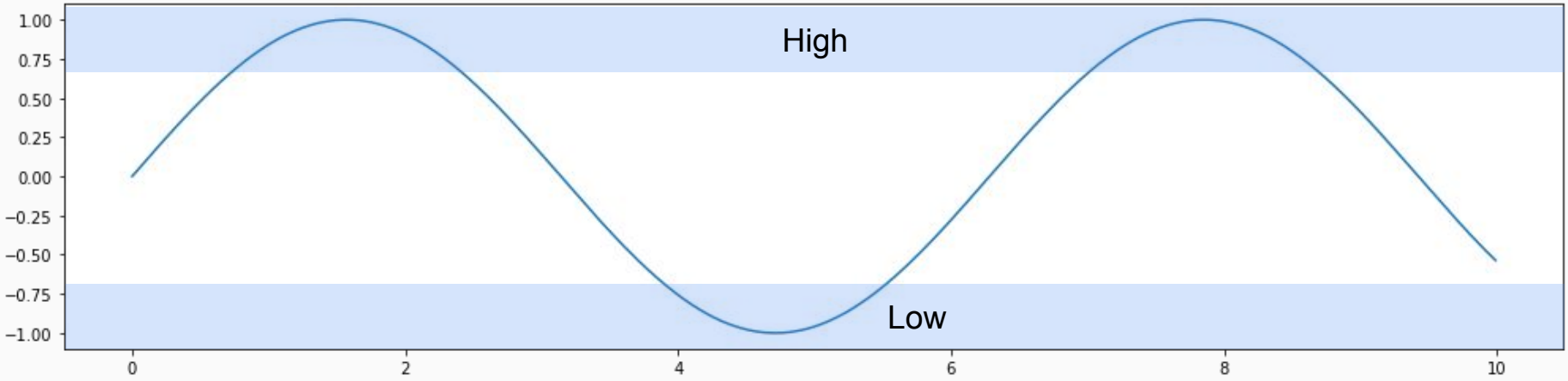
Error Rate

- If error frame rate is too high, don’t count



Counting

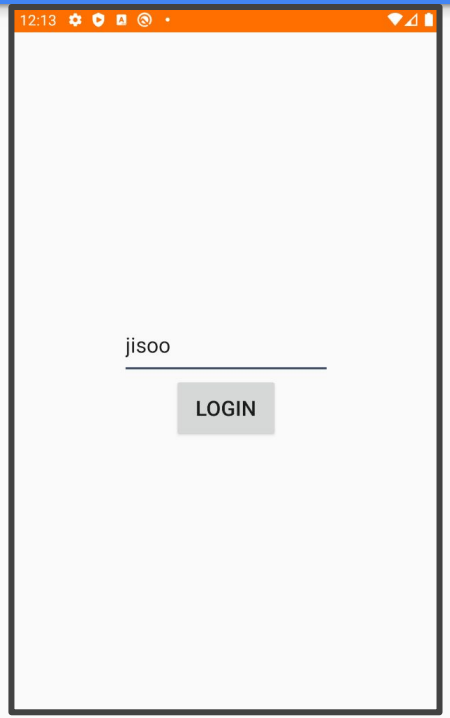
- State Machine



User Interface

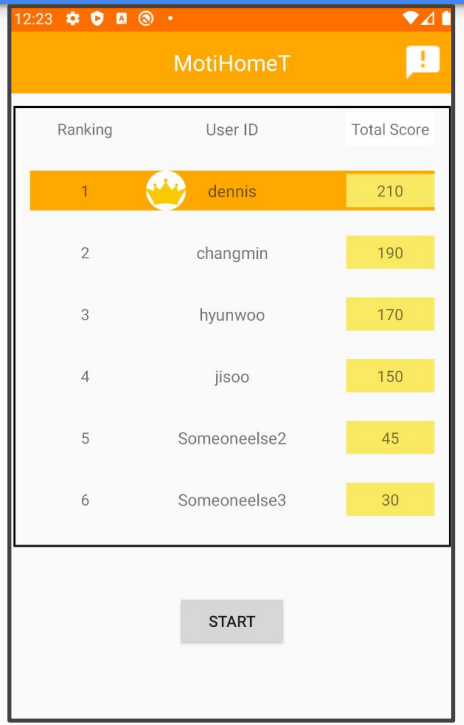
Login

- Typing your ID into the EditView
- Check whether the ID is in the database or not
  - If there is, synchronize the state
  - If not, create new account in the database



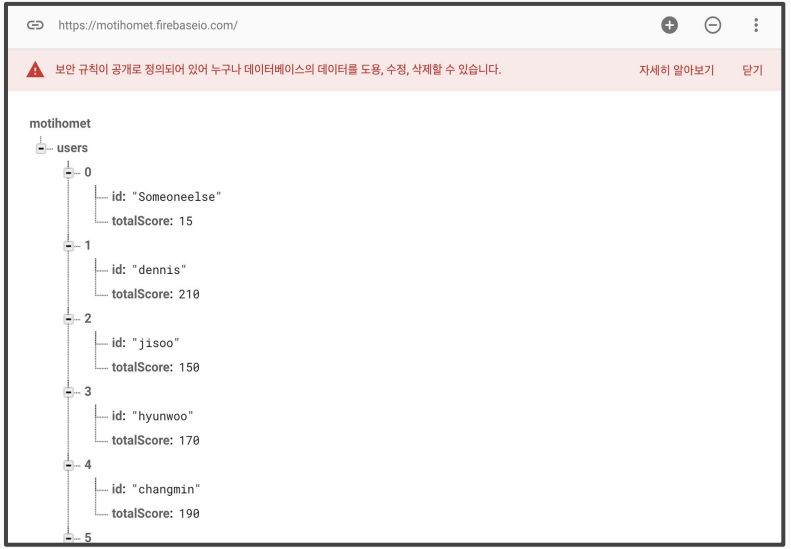
Ranking

- After login, you can see whole user's score and their ranking
- Ranking 1 is highlighted to motivate users



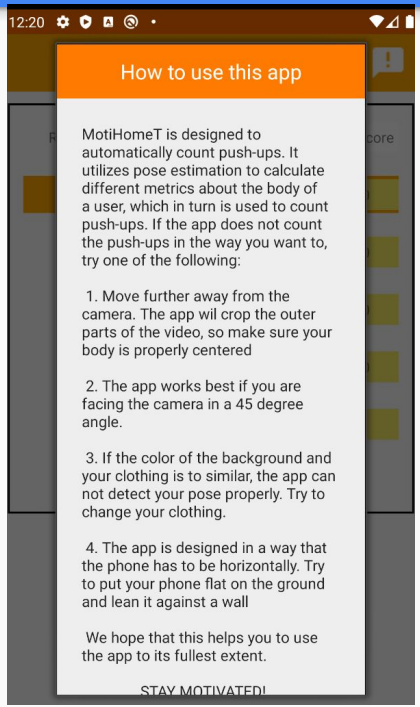
Ranking

- Data is based on the database called firebase
- Every push-up you make in the application will be accumulated here



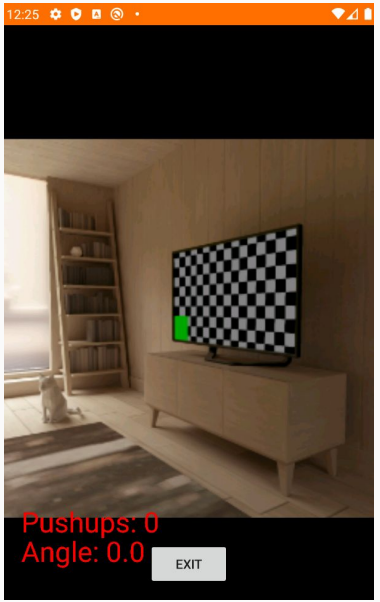
Ranking

- The application also provides some guideline to explain how the application works



Posenet

- After you click the start button, the application activates camera
- When the modified posenet model detects push-up, It will count up the Pushups
- We noticed that this is not enough

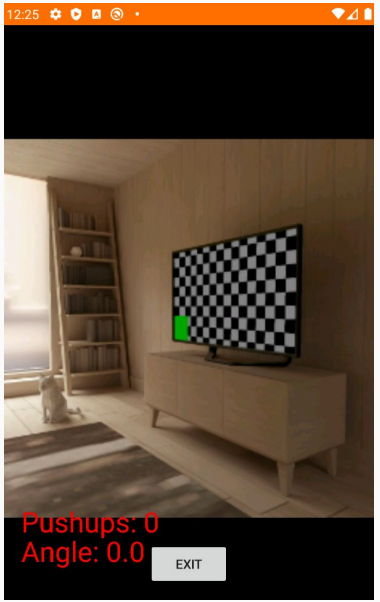


Sound interface

- Instructions on how to place the phone when opening the camera using TTS(Text-to-Speech)
- Count the push-ups out loud using TTS
- Motivational announcements after certain milestones(10,100,1000)

Posenet

- Finally, if you click EXIT button, push-up counts will be added to current user’s previous push-up counts in the database



Evaluation & Deliverables

Various Error Cases

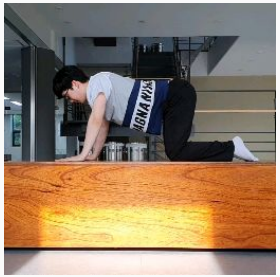
Good

Stand

Angle (45°)

Bad form

Knee on ground



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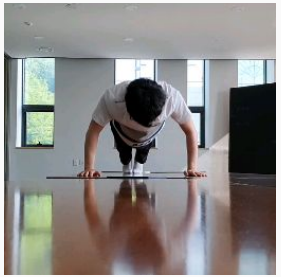
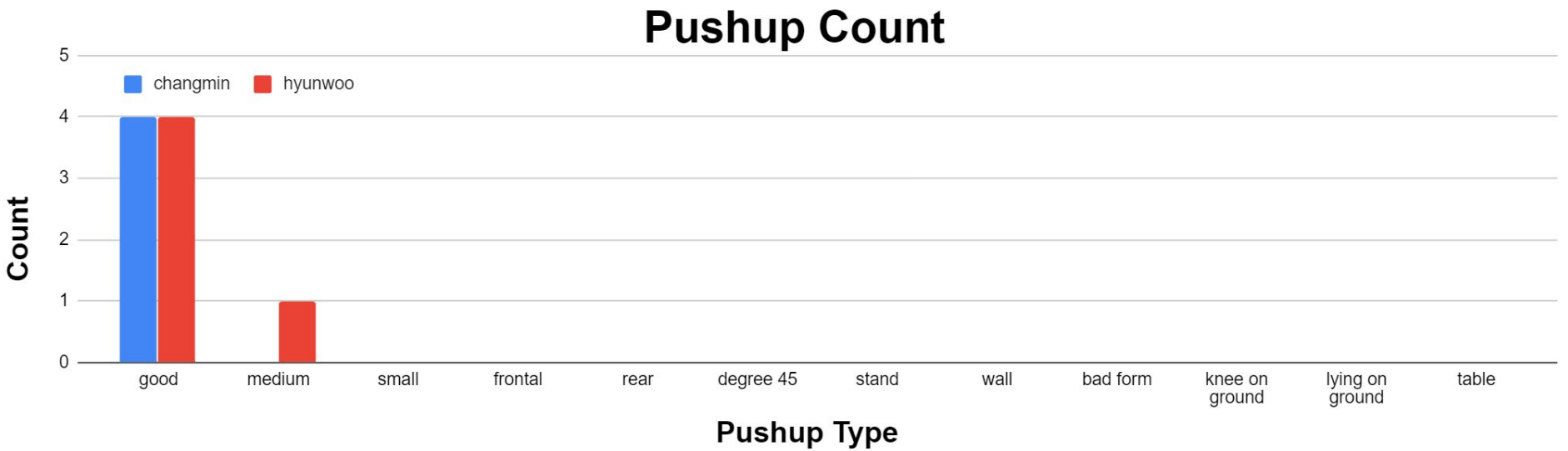


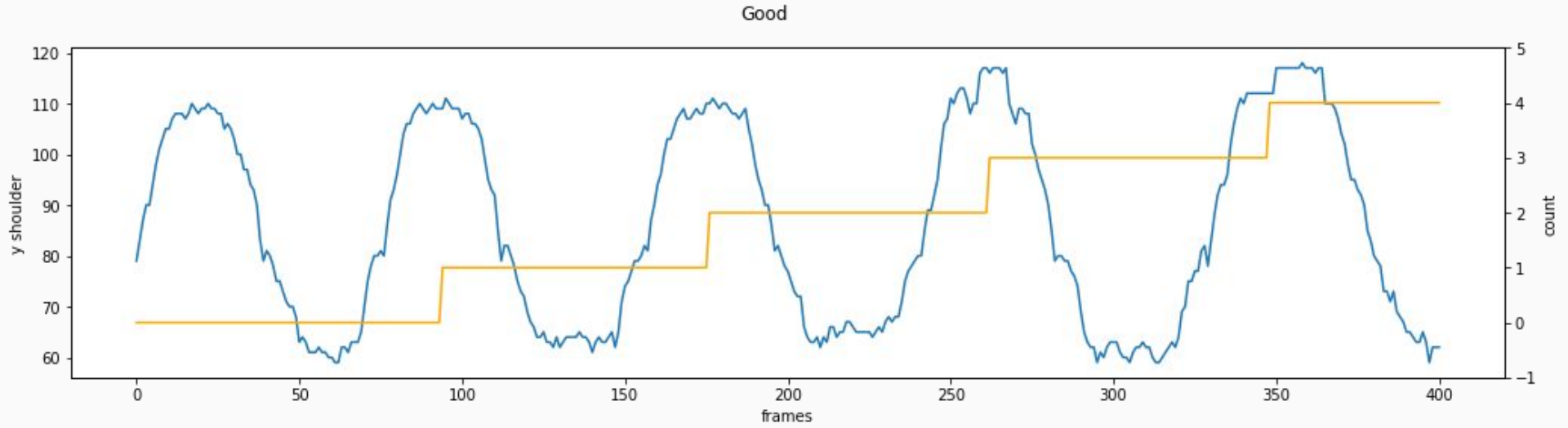
Rear

Using table

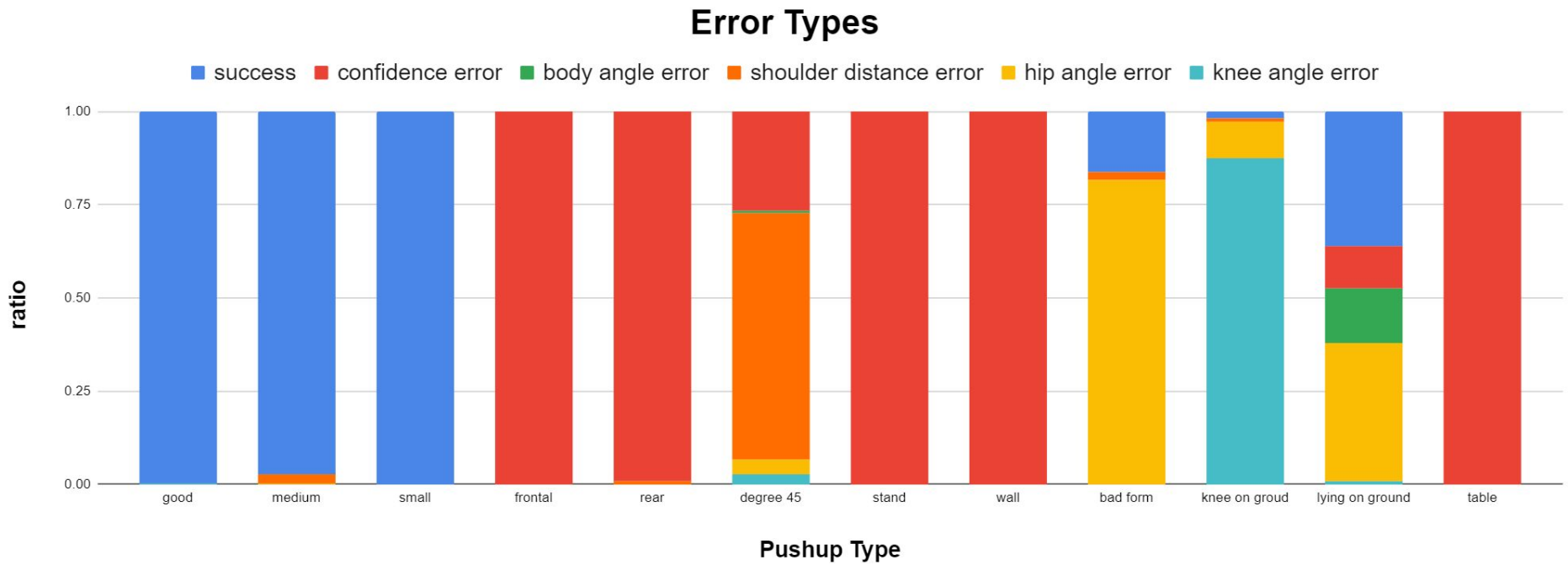
Evaluation Result



Counting


Good
y shoulder
count
frames
120
110
100
90
80
70
60
5
4
3
2
1
0
−1
0
50
100
150
200
250
300
350
400

Various Errors



Final Deliverable

- Detect and count push-ups automatically and robustly
- Prevent many diverse cheating scenarios
- Give the user audio feedback while using the app
- Motivate the user by being able to compete with their friends

Project Management

Deviations since the midterm

- No other exercise forms -> having a robust model for push-up detection was more important
- Added sound interface -> user can’t look at the phone while doing push-ups
- Improvement of other UI parts -> so user can use the app easier

Overall Timeline

Done | In progress | Left out

DN: Dennis, NL: Nils, CM: Changmin, JS: Jisoo, HW: Hyunwoo

	April - 2	April - 3	April - 4	April - 5	May - 2	May - 3	May - 4	May - 5	June - 1
Searching for Pose Tracking Techniques	DN, CM, JS								
Searching for Gamification Papers									
Implement Pose Tracking		DN, NL, CM	DN, NL, CM						
Designing the Application Interface		JS, HW	JS, HW						
Implement Push-up Classifier				DN, CM	DN, CM				
Collect Data for Push-up Counter				DN,CH,HW	DN,CH,HW				
Implement the Basic Application Interface				JS, HW	JS, HW				
Extension Plan				NL	NL				
Evaluation for Push-up Counter						HW, CM	HW, CM		
Implement Competition Board						JS	JS		
User Study									
Extension								CM,HW	CM,HW

Git Usage Stats

Lessons We Learnt

Lessons We Learnt & Reflection

- Creating a roughly working app is easy - making it robust for many different scenarios is challenging
- Good teamwork is possible, even when almost all meetings are online

Problems

- Lack of motivation to workout from home
  - ⇒ Connect with your friends to keep each other responsible
- However this requires to track the exercises manually, which can be exhausting
  - ⇒ Our app offers a solution

Approach

- Mobile (smartphone) application.
- Home training competition with friends.
- Count push-ups with vision-based 2D pose tracking.
- Show training logs.

Challenges (1/2)

- How much accurate existing real-time 2D pose estimation techniques are?
  - ⇒ solved by using a tensorflow light example
- How to determine the user finished “a push-up”?
  - ⇒ solved by calculating the angle between the elbows
- See if there are any better ways to determine the user finished “a push-up”

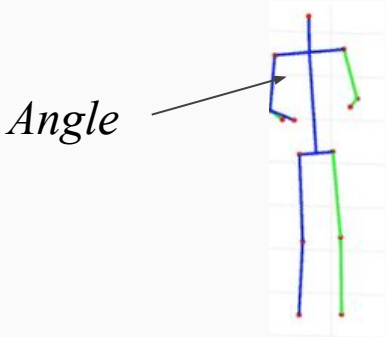
Pose Tracking

- Using 2d deep-learning based pose tracking techniques.
- Tensorflow-Lite PoseNet
- Real time on mobile

Push-up Classification/Counting

Demo model

1. Define what change of elbow angle counts as a pushup
2. Find most distinct elbow
3. Calculate angle around elbow
4. Calculate amount of pushups from the sequence of angles



Challenges (2/2)

- How to handle cheating scenarios?
  - More metrics
- How to support users of different body shapes, and distance from camera?
  - Normalized model/personalized model

- Support other exercises?
  - Generalized model

Competition

- Create a friend system and leaderboard UI to compare your daily/monthly push-ups.

Evaluation strategy

- Calculate accuracy of our model
  - Using existing push-up videos.
    - UCF50 datasets have 106 push-up short videos
  - Recording push-up videos by ourselves…(Really healthy project)
- User study
  - How much are you motivated?
  - Want to use more?

Final Deliverable and Success Criteria

- A working app
  - With better performance
- Users are motivated

Overall Timeline

Done | In progress

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Collect Data for Push-up Counter				ALL	ALL				
Implement the Basic Application Interface				JS, HW	JS, HW				
Extension Plan				NL	NL				
Evaluation for Push-up Counter						DN, NL, CM	DN, NL, CM		
Implement Competition Board						JS, HW	JS, HW		
User Study								HW, CM	HW, CM
Extension								DN, NL, JS	DN, NL, JS

Extension Plan

- Collect/search for push-up dataset.
- Collect cheating push-up data.
- Come up ideas of models safe from the cheatings.

Possible Extension

- Other kind of exercise (Sit-up, pull-up....)
  - Customized exercise
- Pose correction tool

Thank You!