

IMPROVING YOUR COVER KOREA DANCE



BADS 7203
Image and Video Analytics

MEMBERS



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OUR AGENDA FOR TODAY



Introduction

Objective

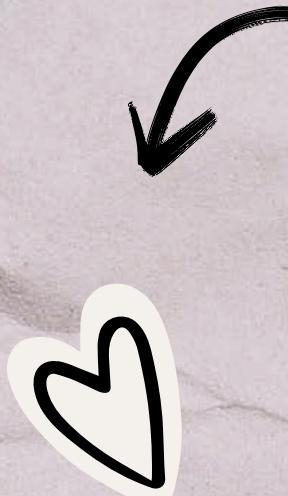
Methodology

Demo

Conclusion

Future Plan

L O V E



INTRODUCTION

- Korean music (K-pop) has been a trend in Asia, growing in popularity. More people would like to learn K-pop dance (cover) for contests and auditions. It is difficult to do in COVID-19 outbreak situation.

latest *
NEWS *



OBJECTIVE

To develop real-time application
for those who would like to learn
and practice K-Pop dancing during
COVID-19 outbreak.



METHODOLOGY

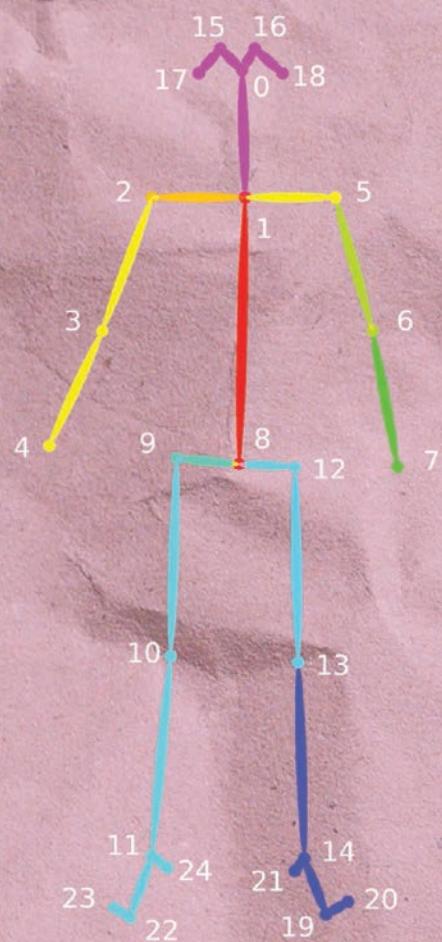
- Human Pose Estimation
 - OpenPose
 - BlazePose
- Pose Comparison
 - Cosine Similarity
 - Cosine Similarity + L2 Normalization
 - Angle Difference



HUMAN POSE ESTIMATION #1

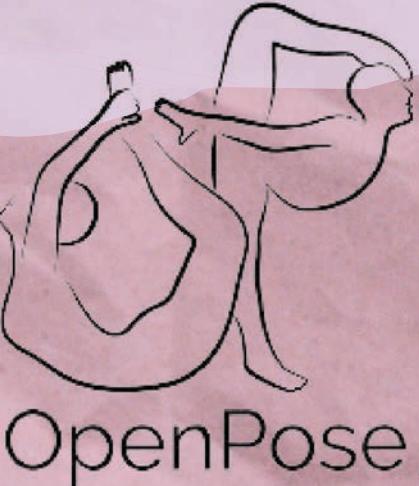
OPENPOSE

- A Real-time human joints detection system by deep learning.
- Can detect the human pose of large groups of humans (Multi-person) in real-time using Convolution Neural Network (CNN).
- Input: Image, Video, Webcam
- outputs: Image + keypoints display



Our Limitations

- Installation difficulties
- Poor computer hardware
- Very bad FPS, not applicable for use



HUMAN POSE ESTIMATION #2

BLAZEPOSE ❤

- Real-time Inference (can process videos faster FPS)
- Developed by Google
- Can compute coordinates of 33 skeleton keypoints.
- Consists of two machine learning models:
 - Detector cuts out the human region from the input image
 - Estimator takes image of the detected person as input and outputs the key points.



Fast

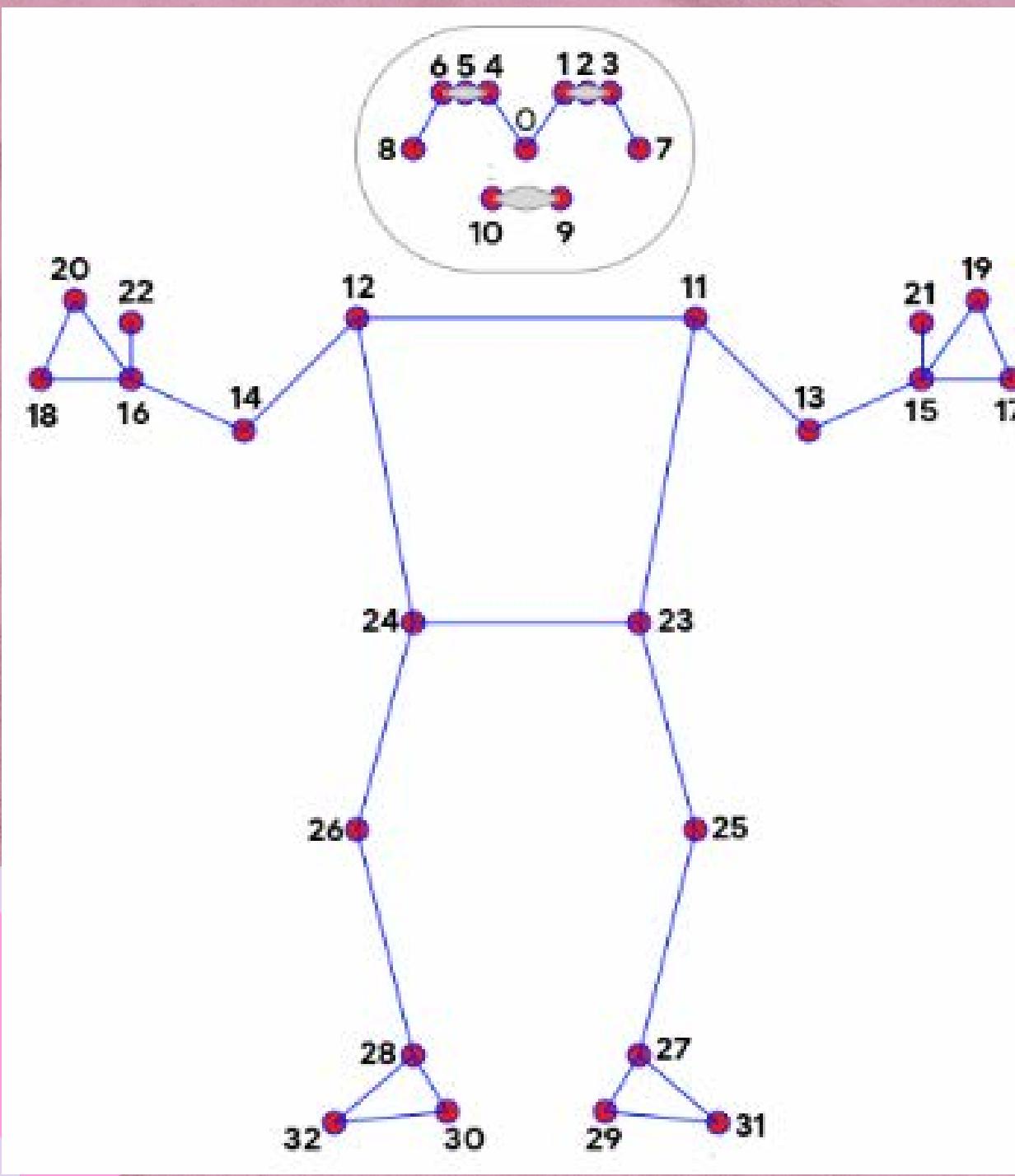


Accurate



Simple

Landmarks



- 0. Nose
- 1. Left_eye_inner
- 2. Left_eye
- 3. Left_eye_outer
- 4. Right_eye_inner
- 5. Right_eye
- 6. Right_eye_outer
- 7. Left_ear
- 8. Right_ear
- 9. Left_mouth
- 10. Right_mouth
- 11. Left_shoulder
- 12. Right_shoulder
- 13. Left_elbow
- 14. Right_elbow
- 15. Left_wrist
- 16. Right_wrist
- 17. Left_pinky
- 18. Right_pinky
- 19. Left_index
- 20. Right_index
- 21. Left_thumb
- 22. Right_thumb
- 23. Left_hip
- 24. Right_hip
- 25. Left_knee
- 26. Right_knee
- 27. Left_ankle
- 28. Right_ankle
- 29. Left_heel
- 30. Right_heel
- 31. Left_foot_index
- 32. Right_foot_index

HUMAN POSE ESTIMATION #2

BLAZEPOSE

- Our Limitations

1. Single person evaluation
2. compute (x,y,z) coordinates
3. runtime provides faster inference speed on desktop, laptop and android phones.

Original



Cover



COMPARISON PROCESS

POSES COMPARISON

Cosine
Similarity

Cosine
Similarity
+ L2

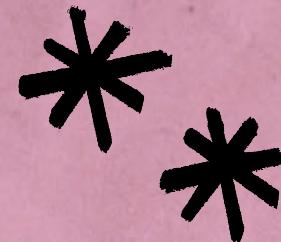
Angle

POSE ESTIMATION

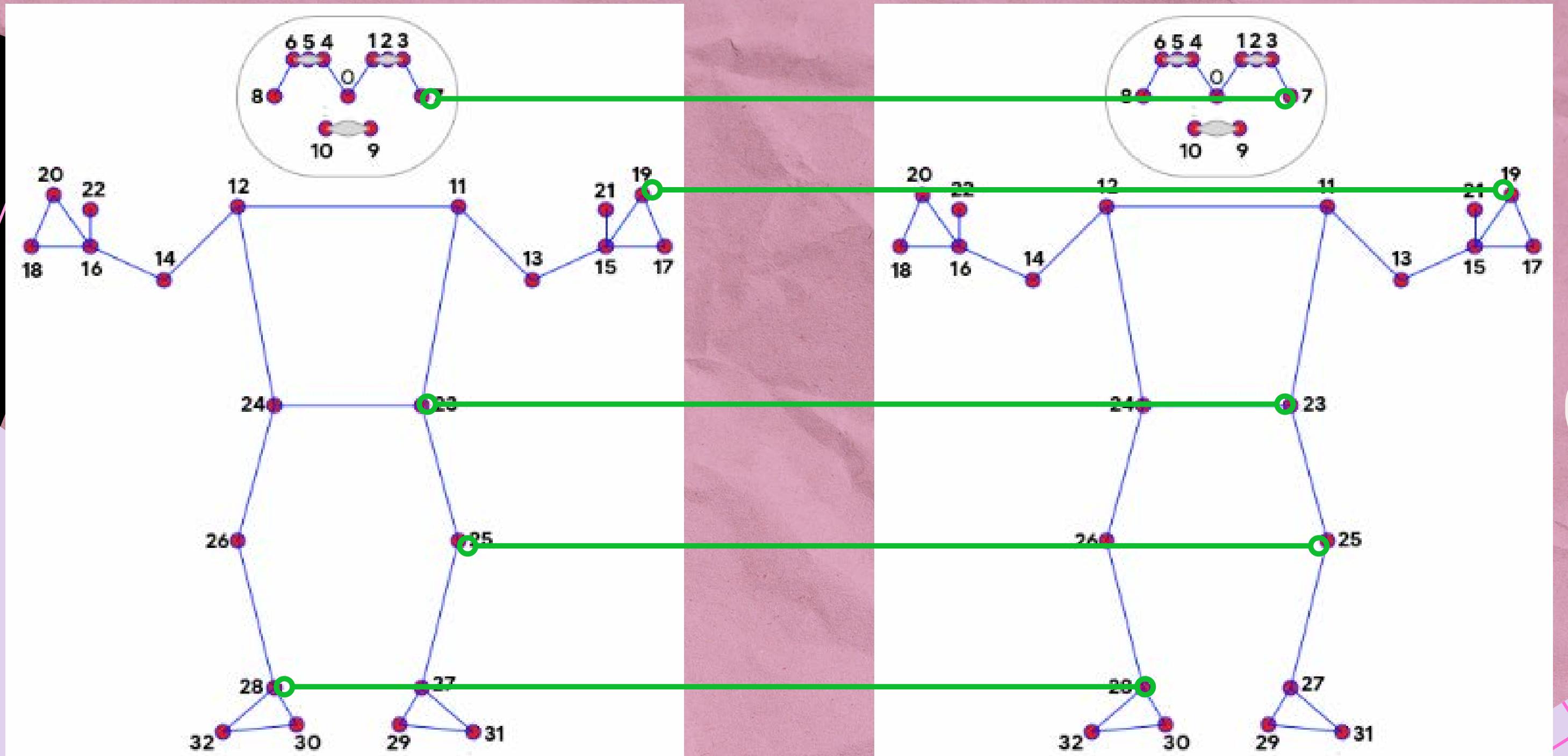
BlazePose

SIMILARITY SCORE

POSE COMPARISON #1



COSINE SIMILARITY



POSE COMPARISON #1

COSINE SIMILARITY

- Converted 33 key points into vectors.
- Find Cosine similarity between Original and Cover video.
- cosine similarity score from each frame
- Calculate the 'MEAN' of the collected cosine similarity score to get Final Similarity Score.

$$\cos \theta = \frac{\vec{A} \cdot \vec{B}}{||\vec{A}|| ||\vec{B}||}$$

Limitation:

- If the distance between the camera and dancer in Original and Cover video are different, the similarity score will inaccurate.

POSE COMPARISON #2

COSINE SIMILARITY + NORMALIZE L2

- Converted 33 key points into vectors.
- Normalize Vector using Normalization L2
- Find Cosine similarity between Original and Cover video.
- Collect cosine similarity score from each frame
- Calculate the 'MEAN' of the collected cosine similarity score to get Final Similarity Score.

POSE COMPARISON #2

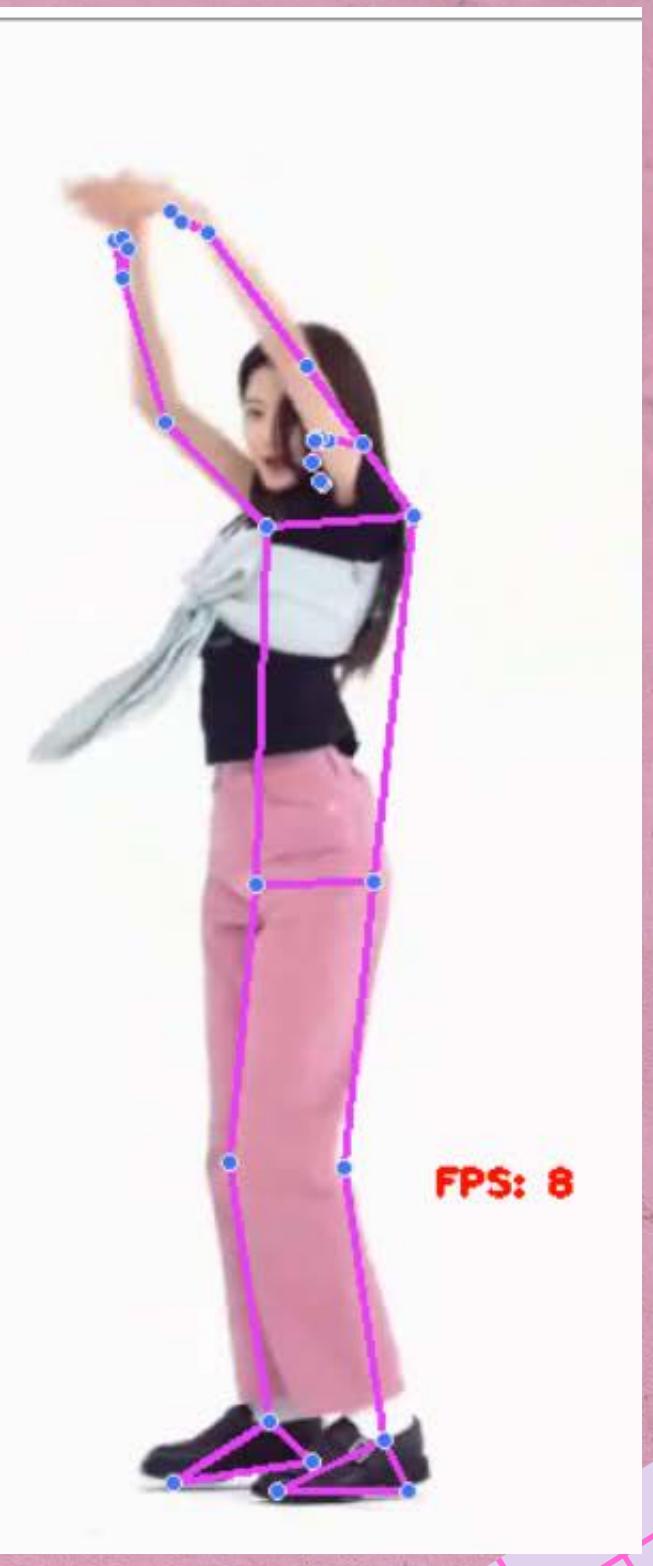
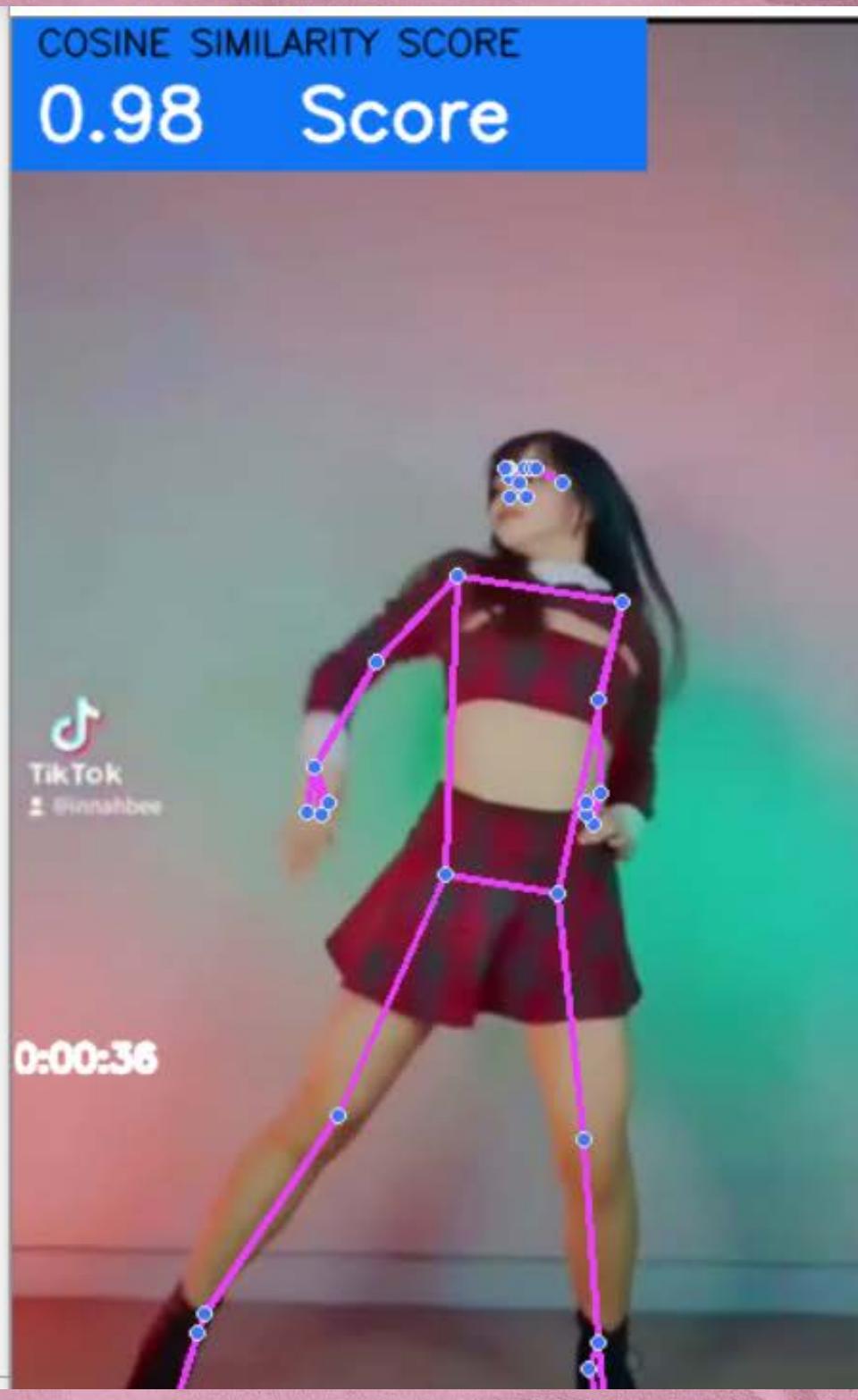
* COSINE SIMILARITY + NORMALIZE L2

New channel meet

POSE COMPARISON #2

```
Datetime :0:00:32 , Sim : [0.9827]  
Datetime :0:00:33 , Sim : [0.9827]  
Datetime :0:00:33 , Sim : [0.9828]  
Datetime :0:00:33 , Sim : [0.9828]  
Datetime :0:00:33 , Sim : [0.9829]  
Datetime :0:00:34 , Sim : [0.9829]  
Datetime :0:00:35 , Sim : [0.983]  
Datetime :0:00:35 , Sim : [0.983]  
Datetime :0:00:35 , Sim : [0.983]  
Datetime :0:00:35 , Sim : [0.9829]  
Datetime :0:00:35 , Sim : [0.9829]
```

```
Datetime :0:00:35 , Sim : [0.9828]  
Datetime :0:00:36 , Sim : [0.9828]  
Datetime :0:00:36 , Sim : [0.9827]  
Datetime :0:00:36 , Sim : [0.9826]  
Datetime :0:00:36 , Sim : [0.9825]  
Datetime :0:00:36 , Sim : [0.9825]
```



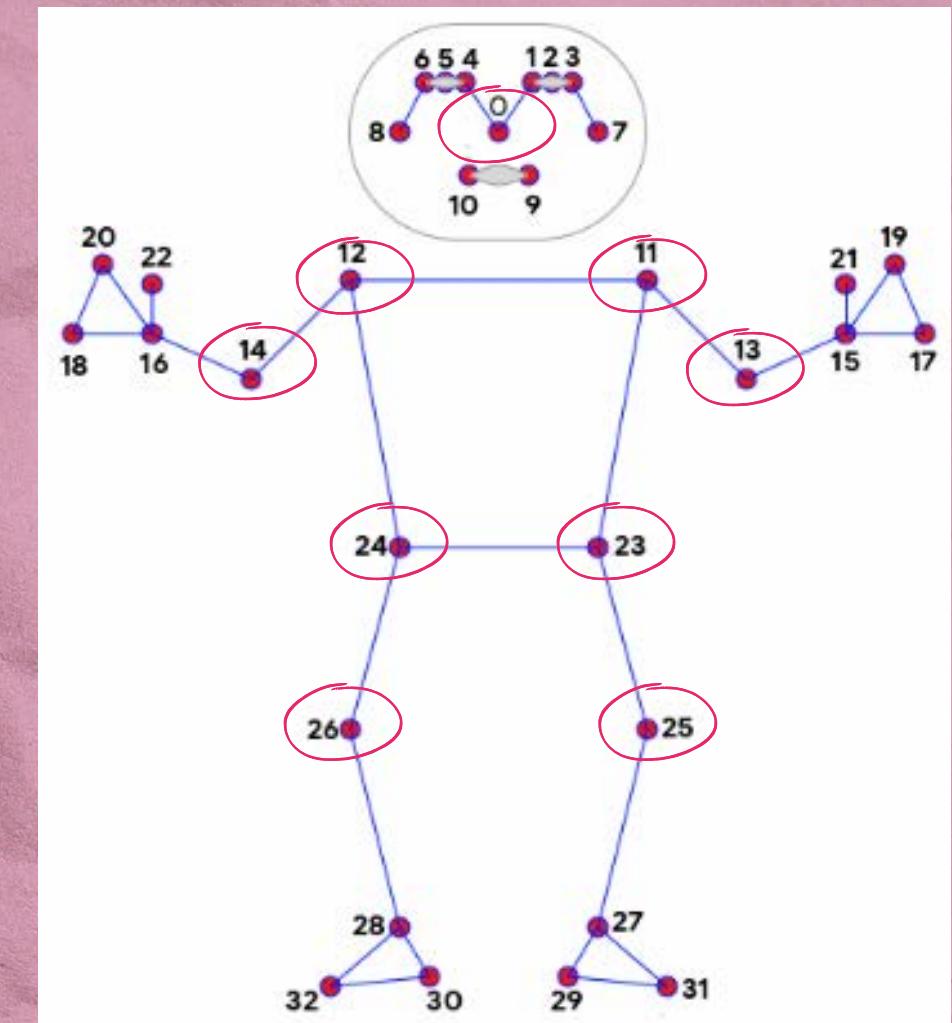
POSE COMPARISON #3

ANGLE DIFFERENCES

- Get 9 Angles from 13 key-points.

- nose (0)
- elbow_Left (13)
- elbow_Right (14)
- shoulder_Left (11)
- shoulder_Right (12)
- hip_Left (23)
- hip_Right (24)
- knee_Left (25)
- knee_Right (26)

- This comparison can help problem for distance of the camera and different positions of original dancer and cover dancer.

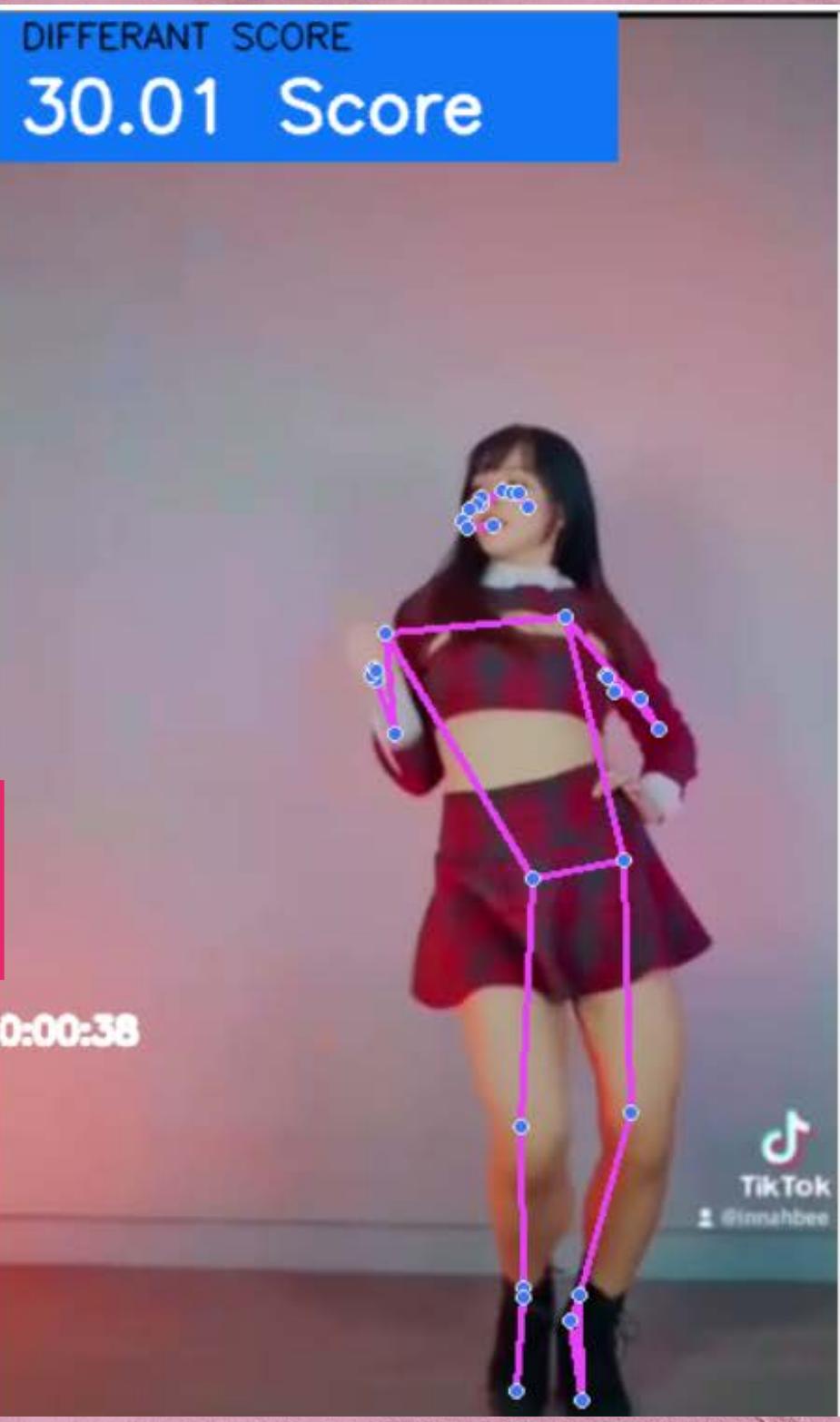


POSE COMPARISON #3

```
Datetime :0:00:34 , Difference : [29.3926]
Datetime :0:00:34 , Difference : [29.4739]
Datetime :0:00:34 , Difference : [29.5431]
Datetime :0:00:34 , Difference : [29.5965]
Datetime :0:00:34 , Difference : [29.6107]
Datetime :0:00:34 , Difference : [29.6375]
Datetime :0:00:34 , Difference : [29.645]
Datetime :0:00:34 , Difference : [29.6732]
Datetime :0:00:35 , Difference : [29.6487]
Datetime :0:00:35 , Difference : [29.6697]
Datetime :0:00:35 , Difference : [29.6792]
Datetime :0:00:35 , Difference : [29.676]
Datetime :0:00:35 , Difference : [29.6749]
Datetime :0:00:35 , Difference : [29.6746]
Datetime :0:00:35 , Difference : [29.7012]
Datetime :0:00:35 , Difference : [29.7217]
Datetime :0:00:36 , Difference : [29.7534]
Datetime :0:00:36 , Difference : [29.8107]
Datetime :0:00:36 , Difference : [29.8304]
Datetime :0:00:36 , Difference : [29.8605]

Datetime :0:00:36 , Difference : [29.9013]
Datetime :0:00:36 , Difference : [29.9276]
Datetime :0:00:36 , Difference : [29.936]
Datetime :0:00:36 , Difference : [29.9248]

Datetime :0:00:37 , Difference : [29.95]
Datetime :0:00:37 , Difference : [29.9544]
Datetime :0:00:37 , Difference : [29.9361]
Datetime :0:00:37 , Difference : [29.925]
Datetime :0:00:37 , Difference : [29.9304]
Datetime :0:00:37 , Difference : [29.9365]
Datetime :0:00:37 , Difference : [29.945]
Datetime :0:00:37 , Difference : [29.957]
Datetime :0:00:37 , Difference : [29.9729]
Datetime :0:00:38 , Difference : [29.9805]
```



COMPARISON PROCESS

Dataset

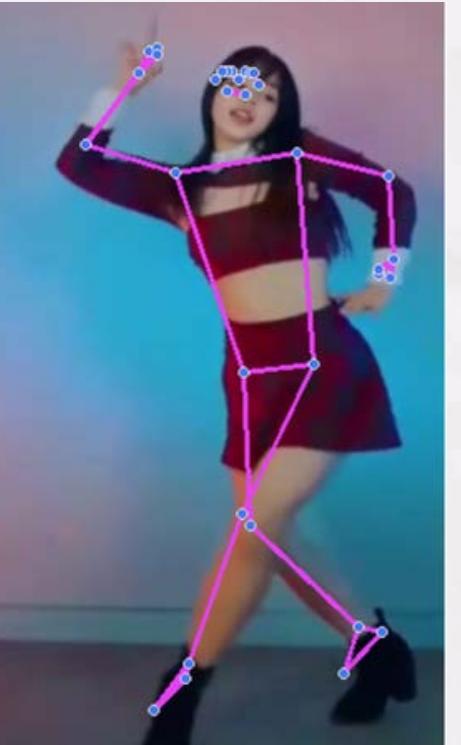
1.Cyclone song



2.Love Dive song



Blaze Pose




Angle Comparison

Diff = Angle2-Angle 1

Choose 9 points for dancing

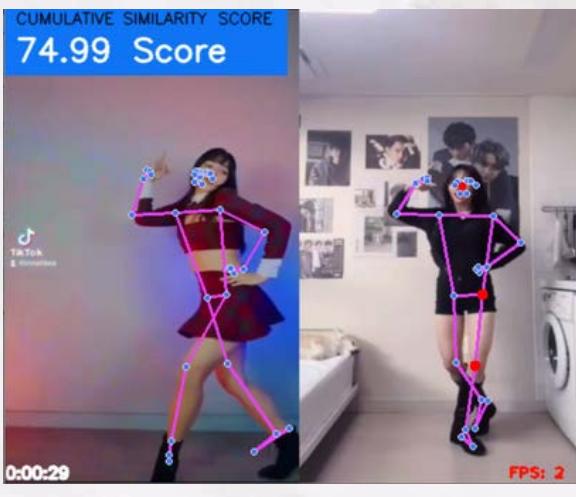
Angle Threshold

Min , Max = Mean (+,-) SD
SD from good CoverDancer

1. Nose : 9	6. Left Hip : 7
2. Left Elbow : 35	7. Right Hip : 7
3. Right Elbow : 35	8. Left Knee : 11
4. Left Shoulder : 26	9. Right Knee : 12
5 Right Shoulder : 26	

Result

CUMULATIVE SIMILARITY SCORE
74.99 Score

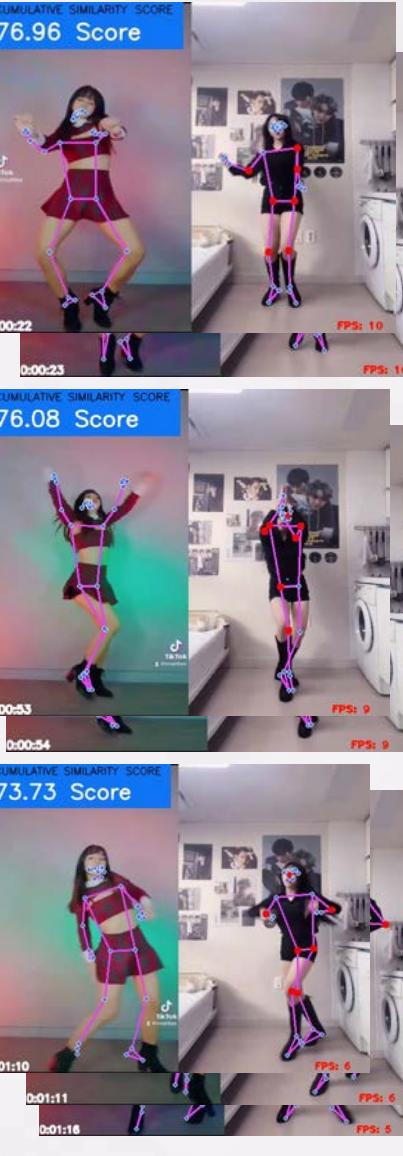


excess threshold = red circle

k P o / p

Save Incorrect to improve

00:22 s



00:53 s

01:10 s

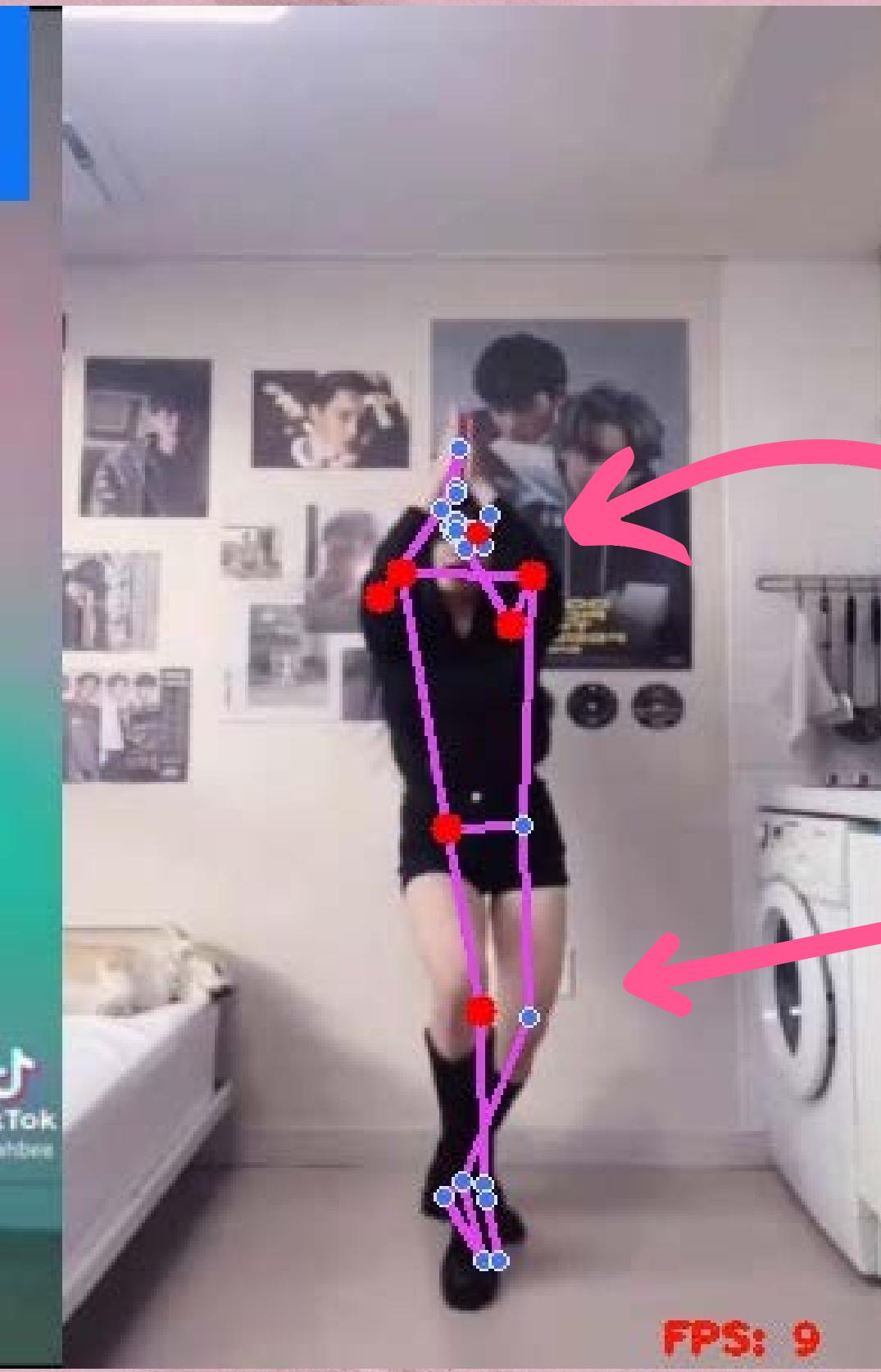


IMPROVE YOUR DANCE

CORRECT DANCE



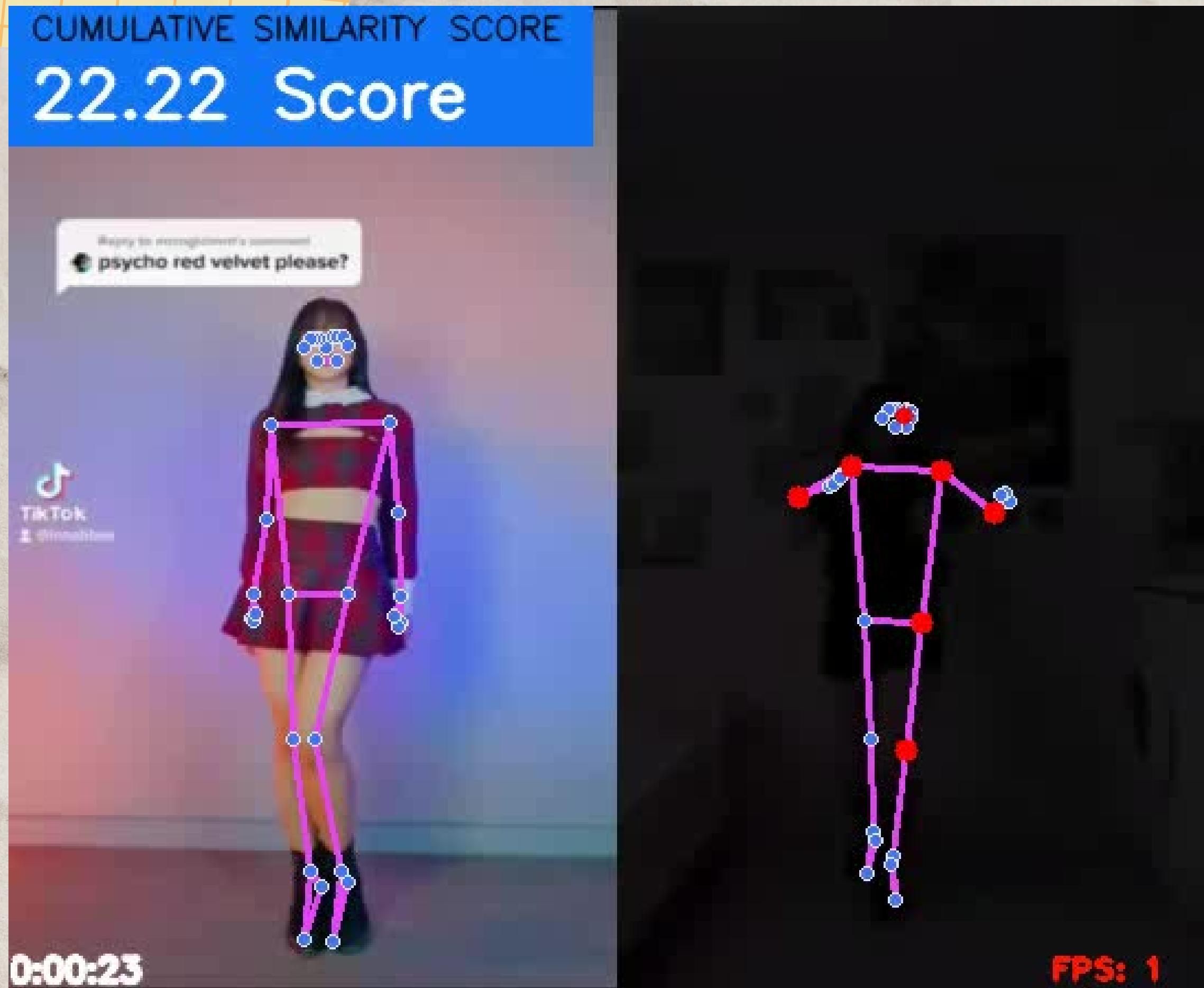
TIME PERIOD



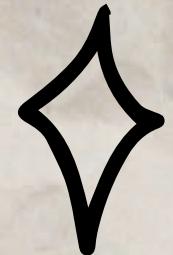
INCORRECT DANCE (Red circle)

INCORRECT DANCE (Red circle)

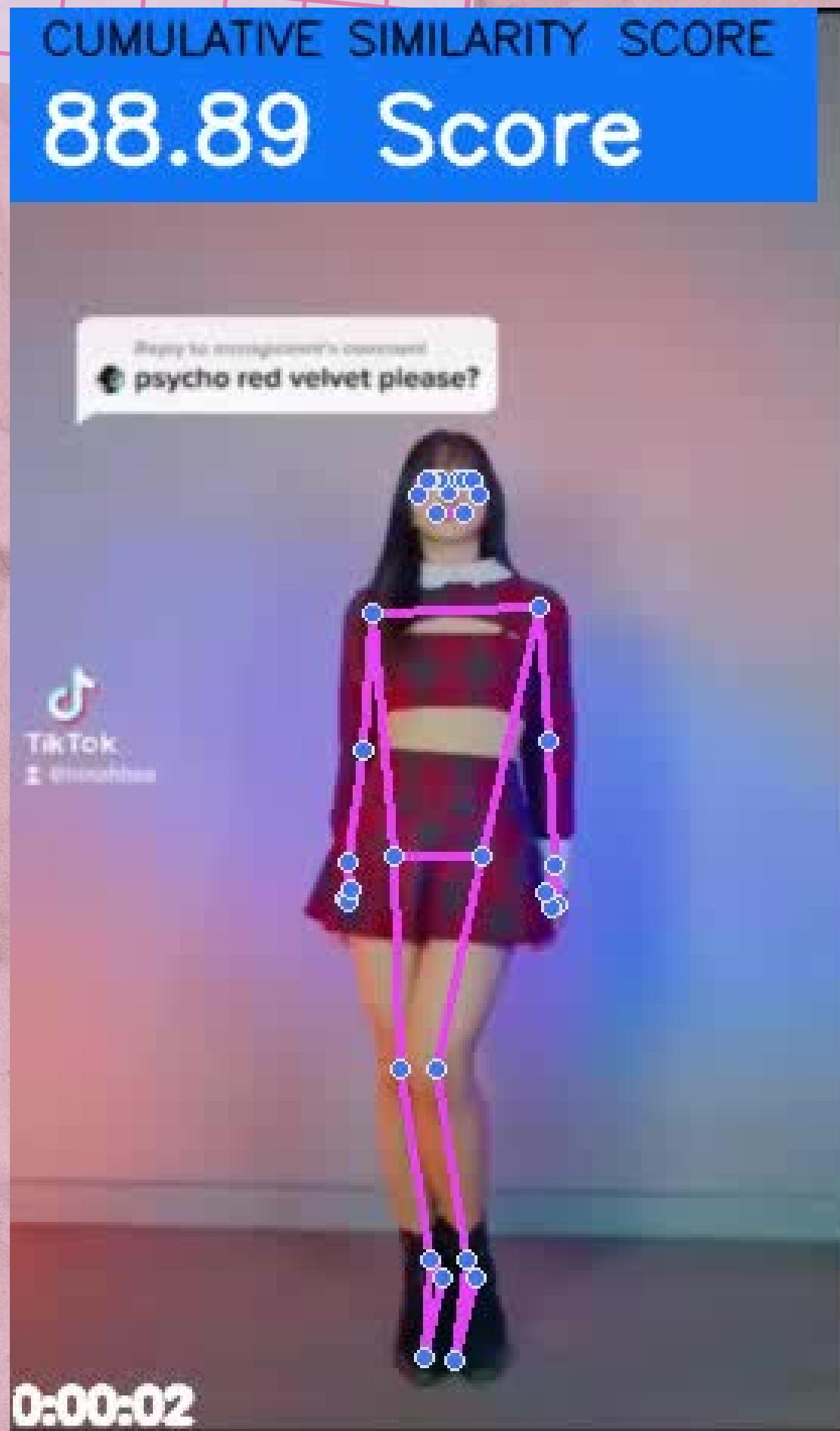
LIVE DEMO #1 (SIMILAR)



Special thanks to my favorite idols for the extra challenge. See you fellow fans at our next K-Pop presentation party!



LIVE DEMO #2 (DIFFERENT)



FPS: 2

Special thanks to my favorite idols for the extra challenge. See you fellow fans at our next K-Pop presentation party!

IMPROVE YOUR DANCE PROJECT

FUTURE PLAN

1. Evaluating original and cover video by Dynamic Time Wrapping (DTW) as when both videos are not opened at the same time, they would not be synchronized in frame per second.
2. Adding more key points and testing with more various datasets.
3. Fixing when the key points are missing points ex. 90-degree turns, fast turn around.
4. Finding standard dance score.

A photograph of four female performers on stage, likely a K-pop group, singing into microphones. They are all wearing matching light-colored, textured blazers over white tops and shorts. The background is dark with blue and purple stage lights.

감사합니다

THANK YOU