IMPROVING YOUR COVER KOREA DANCE

BADS 7203
Image and Video Analytics

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OUR AGENDA FOR TODAY

- Introduction
- Objective
- Methodology
- Demo
- Conclusion
- Future Plan

latest NEWS

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.

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 Similairty + 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

MediaPipe

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

Light Weight

Accurate

Simple

BLAZEPOSE

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

BlazePose keypoints (Source: https://developers.google.com/ml-kit/vision/pose-detection)

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.

COMPARISON PROCESS

Original

Cover

POSE ESTIMATION

BlazePose

POSES COMPARISON

Cosine Similarity

Cosine Similarity + L2

Angle

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.

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

<u>Limitation</u>:

- 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 Normlization 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

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 :0:00:33 , Sim : [0.9829]
Datetime :0:00:33 , Sim : [0.9829]
Datetime :0:00:33 , Sim : [0.9829]
Datetime :0:00:33 , Sim : [0.9829]
Datetime :0:00:34 , Sim : [0.9829]
Datetime :0:00:34 , Sim : [0.9829]
Datetime :0:00:34 , Sim : [0.9829]
Datetime :0:00:34 , Sim : [0.9829]
Datetime :0:00:34 , Sim : [0.9829]
Datetime :0:00:34 , Sim : [0.9829]
Datetime :0:00:34 , Sim : [0.9829]
Datetime :0:00:34 , 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 : [0.9829]
Datetime :0:00:35 , Sim : [0.9829]
Datetime :0:00:35 , Sim : [0.9829]
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 : [0.9826]
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]
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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

K P O P

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

Result

excess threshold = red circle

Save Incorrect to improve

00:22 s

00:53 s

01:10 s

IMPROVE YOUR DANCE

CORRECT DANCE

INCORRECT DANCE (Red circle)

INCORRECT DANCE (Red circle)

TIME PERIOD

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)

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

K P O P

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.

감사합니다
THANK YOU