

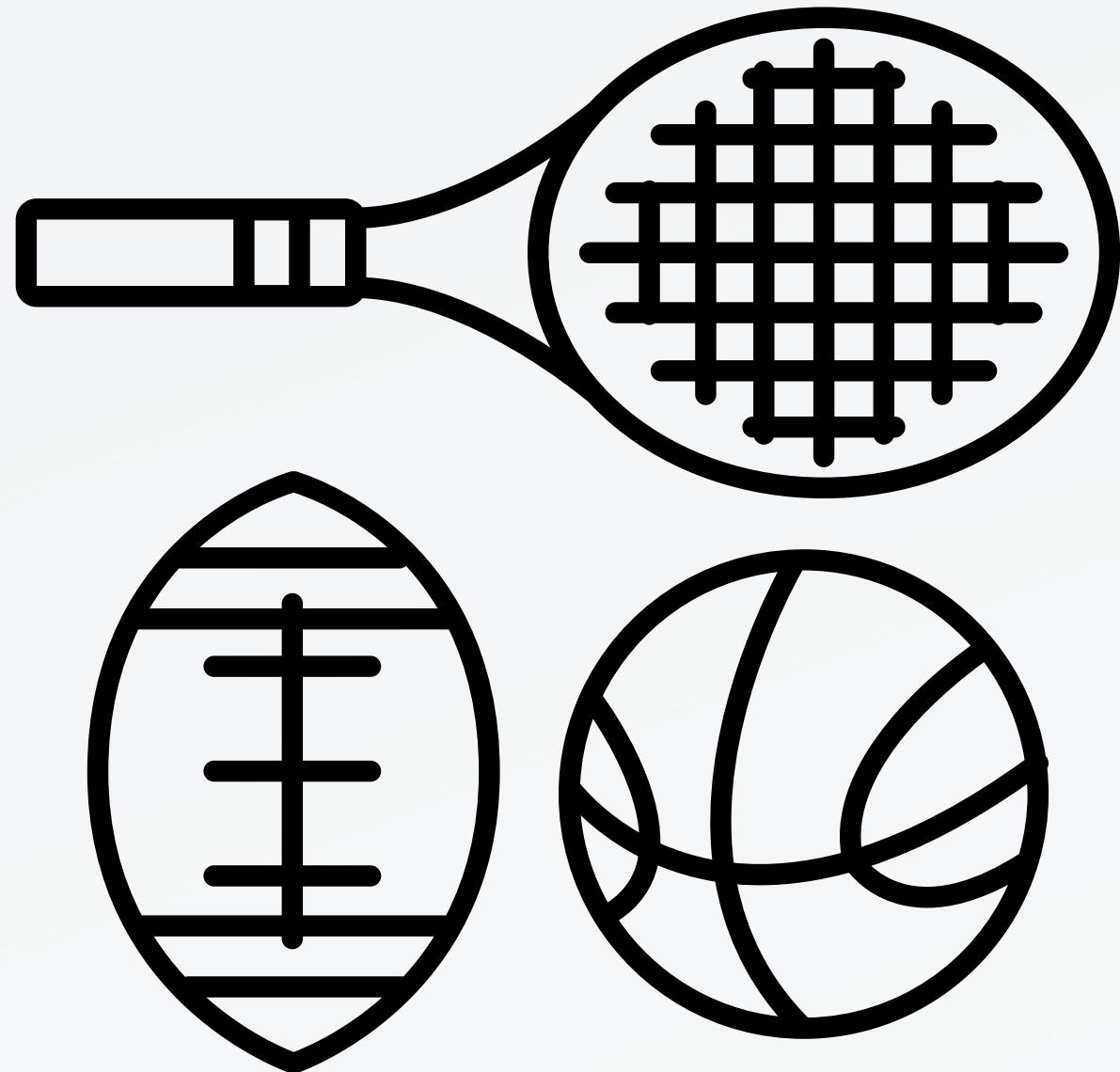
# **ADVANCED HCI PROJECT**

**PART 3: FINAL PRESENTATION**

# SPORTS CLASSES

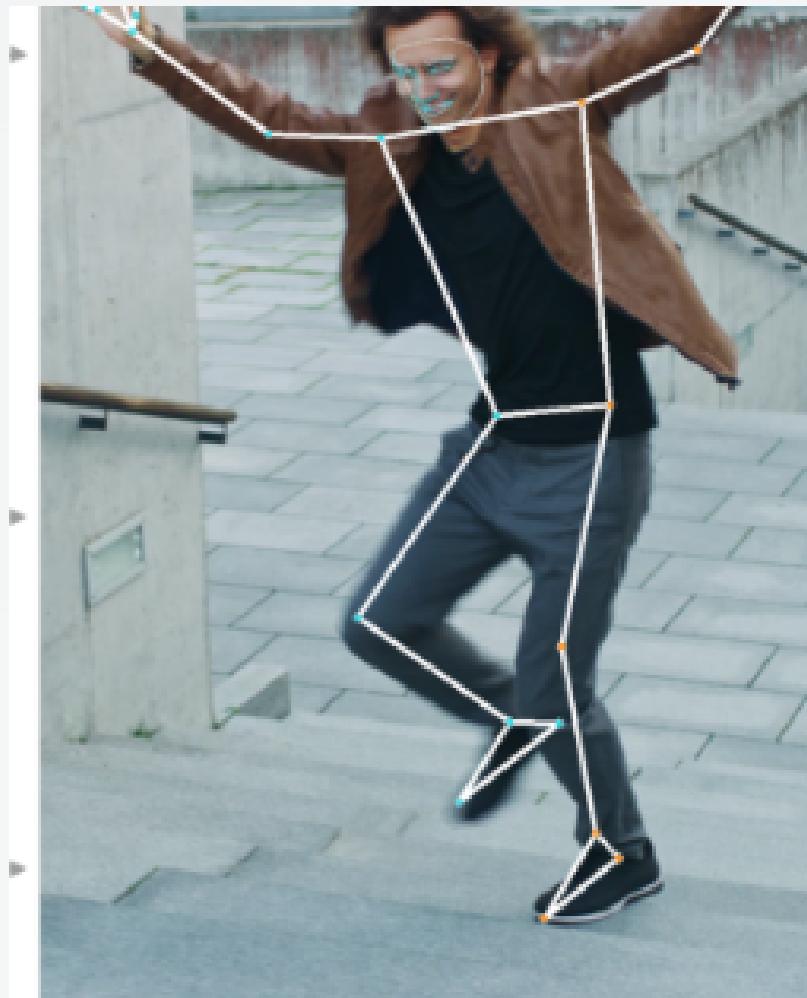
Physical exercise and activity are positively correlated to overall health and physical education is important for introducing Children to it already at a young age.

But, physical education is often focused too much on **grown-ups' sports and competition**. While this can be much fun for many children it can **exclude** less athletic children and give them an **aversion** to anything sports-related which is not only a pity in itself but it can also lead to problems in their adult life.





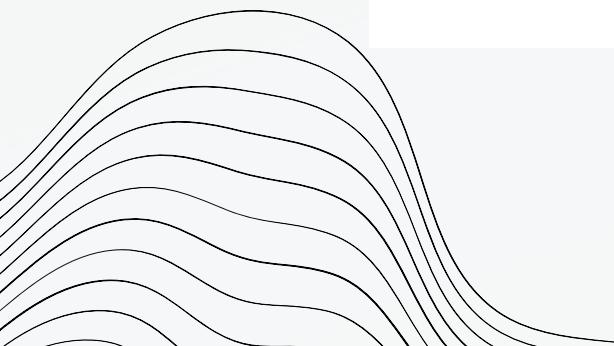
# LITTLE DANCE COPIERS



A serious game for  
encouraging children to  
move by playfully  
dancing and copying  
each others moves.

Modalities used:

Gesture/Movement, Speech, Facial  
recognition



# PERSONA



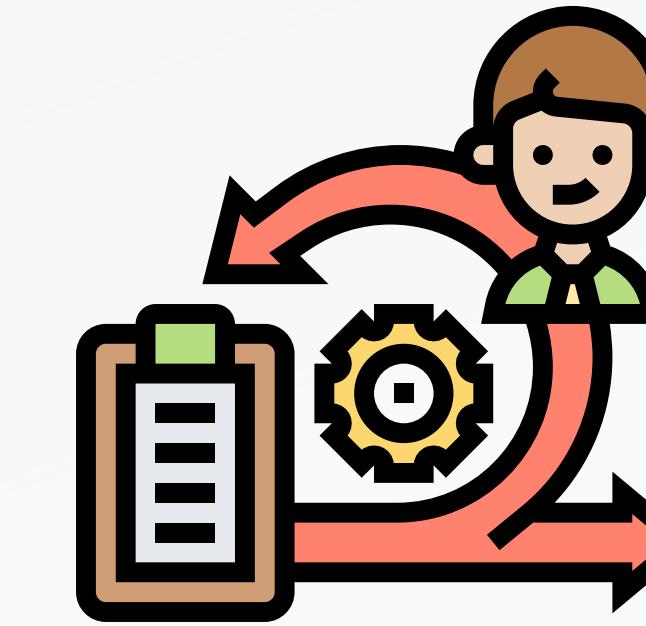
## Alex Harper

Alex, a 9-year-old, is a playful and imaginative child attending elementary school. While not drawn to competitive sports, Alex loves playful activities and games. Sometimes hesitant in conventional PE classes, he is friendly, empathetic, and always up for cooperative play.

## METHODOLOGY

to identify needs and goals

1. User Research
2. Goal Definition
3. Iterative Design
4. Stakeholder Involvement

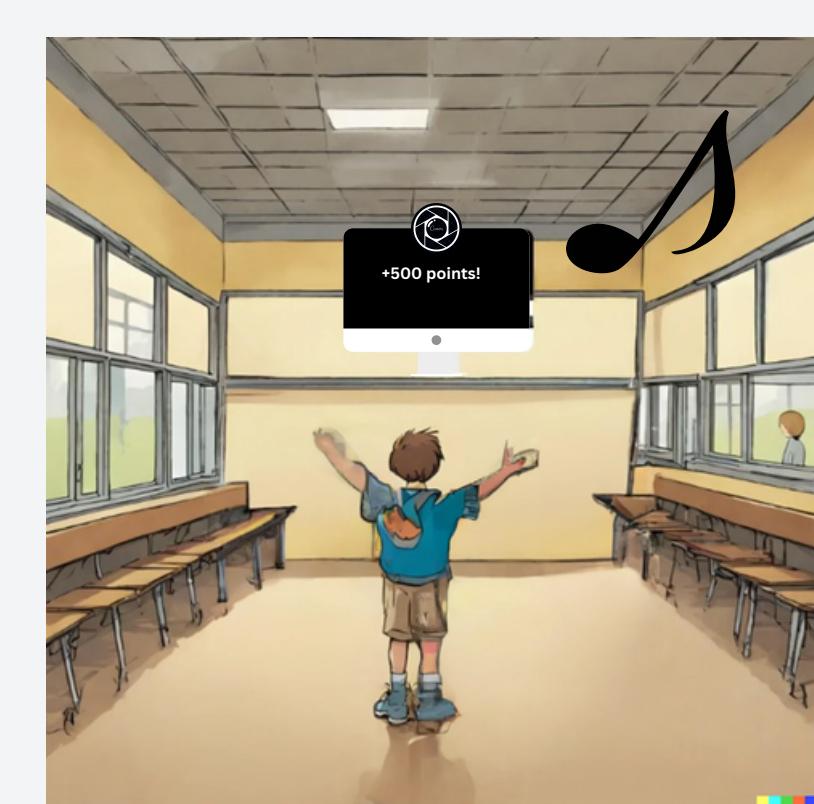
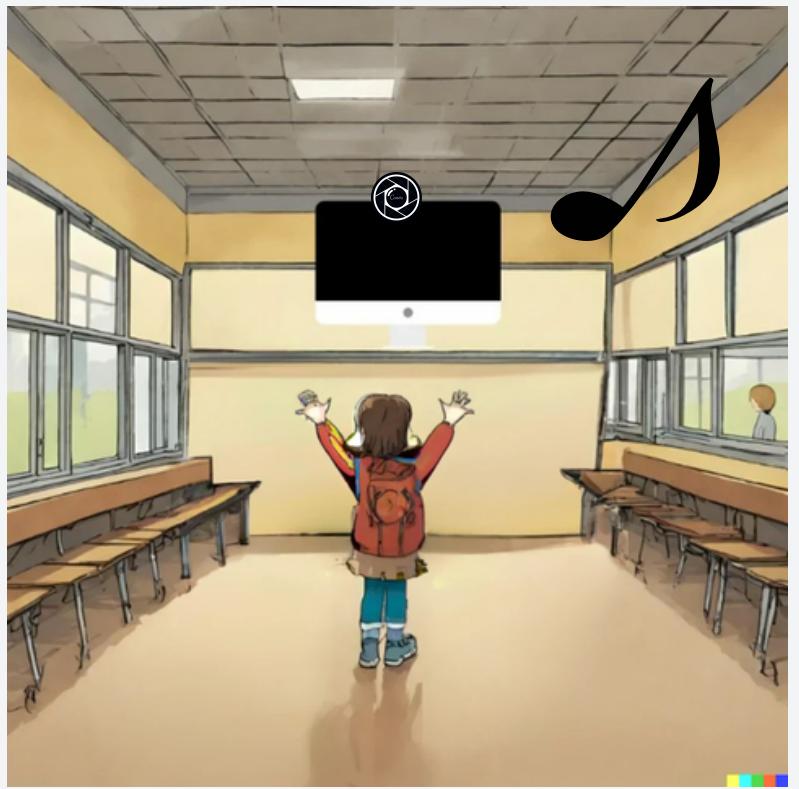


# SCENARIO

- 1.** Alex is in gym class but is not participating. The other kids are running around and Alex just shyly stands away from them and observes. The teacher sees this with concern.
- 2.** The teacher tries something new. She splits the kids into groups of three. Alex is in a team with Lily and Jake. She gives each team the game "Little Dance Copiers" and lets them play independently
- 3.** Lily, an outgoing child starts and makes a simple 5 movement dance which the game tracks via camera and plays a tone to each move.
- 4.** Jake tries to copy her dance but makes some mistakes. The previous melody is reproduced where he copies her move well but where he makes a mistake an error sound is played. They all laugh.

# SCENARIO

LETS SPLIT UP  
IN GROUPS OF 3



# SCENARIO

5. After seeing the others do it, Alex feels encouraged to try it himself.
6. He copies Lily's simple dance and gets a better score than Jake. He gets bonus points for smiling a wide smile.
7. Jake is fully convinced now and wants to create a dance himself. He sets the game to 10 moves via voice command.
8. They keep playing like this and don't notice how the time passes. Afterwards, they will have done some physical exercise while having fun and socializing with the other group members

# HARDWARE COMPONENTS

## needed

common laptop with

- webcam
- microphone
- speaker
- internet connection



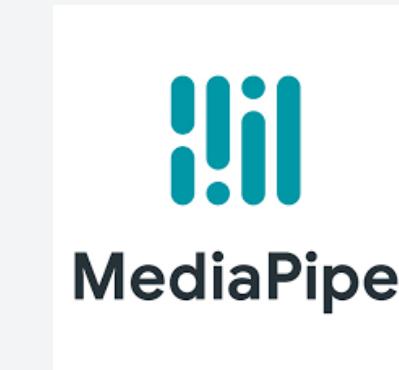
e.g.

HP 350 G2

- webcam camera 708230-2B1
- Realtek high definition audio
- Realtek high definition audio
- Realtek RTL8723BE 802.11 bgn Wi-Fi Adapter

# TOOLS USED

- **Mediapipe**
  - pose landmark extraction
  - face landmark extraction
- **openCV**
  - draw/show/save frames
- **pygame**
  - play sounds
- **threading**
- **tkinter**
  - user interface



# TOOLS USED

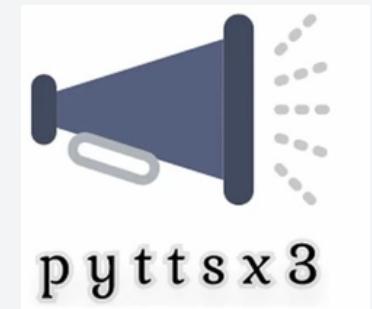
- **os**
  - read/save/delete files
- **word2number**
  - written out number to numeric
- **time**
  - get current millis
- **matplotlib**
  - plot data
- **speech\_recognition**



**matplotlib**

# TOOLS USED

- **csv**
  - save/read data
- **random**
  - generate random number
- **pyttsx3**
  - text-to-speech
- **numpy**



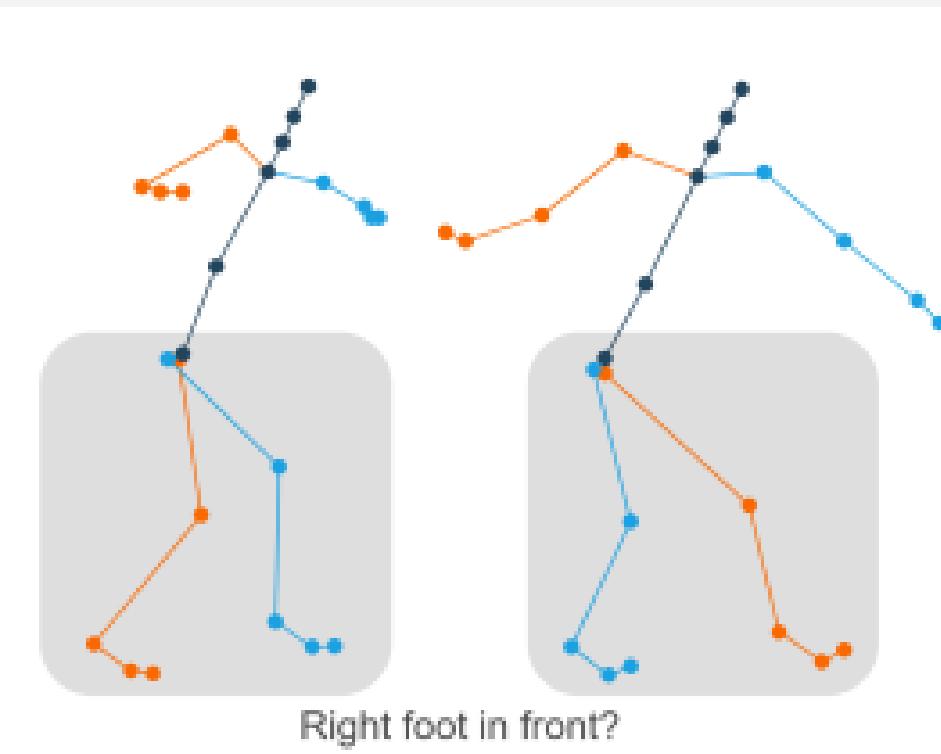
# GESTURE FEATURE: "SQUARED DIFFERENCE"

AFTER RECORDING THE POSE WE SUBTRACT THE MEAN AND DIVIDE BY THE STD DEV

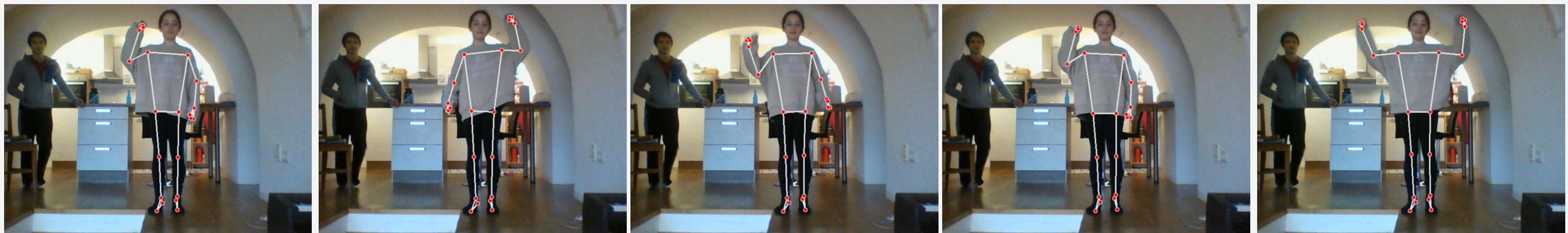
$$\mu = \frac{1}{N} \sum_{i=1}^N x_i \quad \sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2}$$

COMPARING DANCE POSE AT TIMESTEP  $i$  WITH COPY POSE AT TIMESTEP  $i$

$$sqd = \sum_i^I ((x_{i1} - x_{i2})^2 + (y_{i1} - y_{i2})^2 + (z_{i1} - z_{i2})^2)$$



# GESTURE FEATURE: "SQUARED DIFFERENCE"



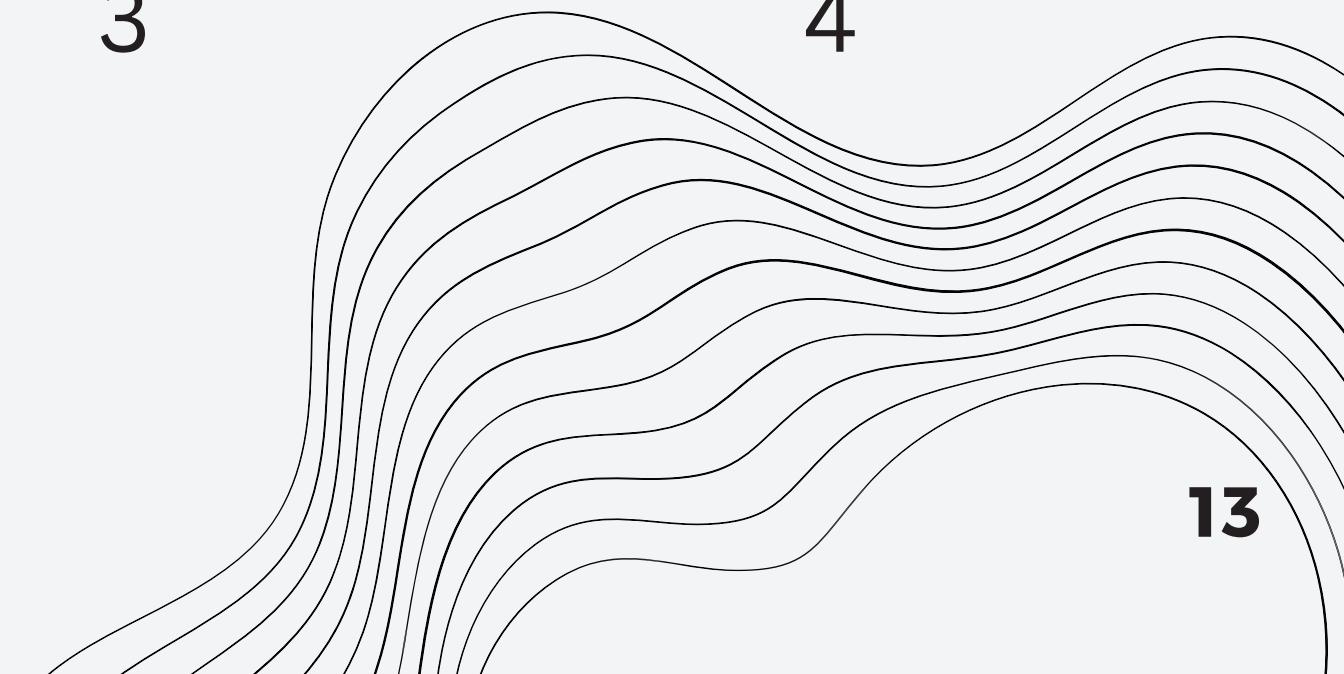
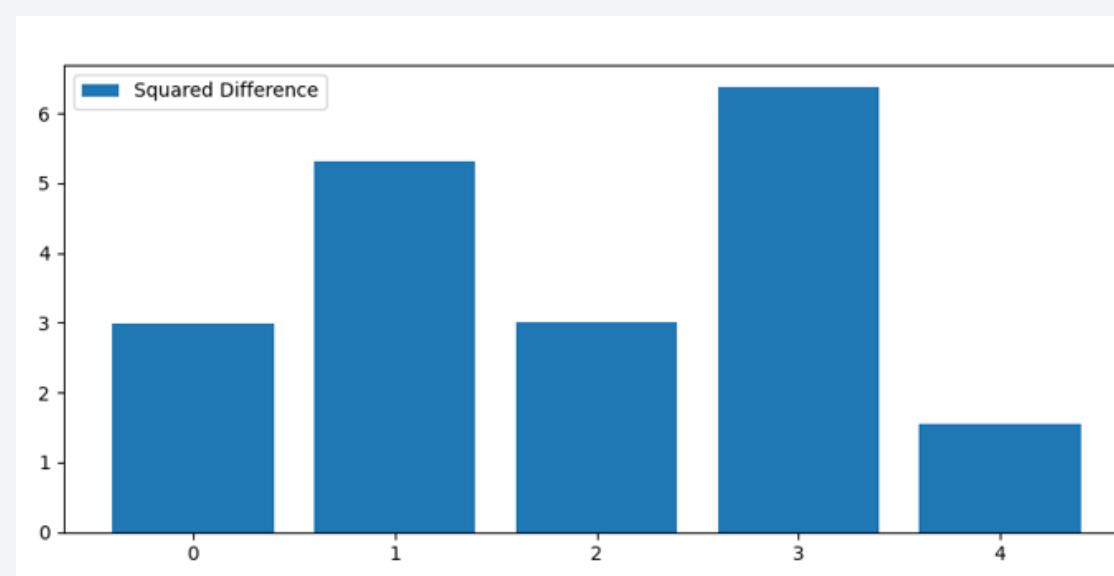
0

1

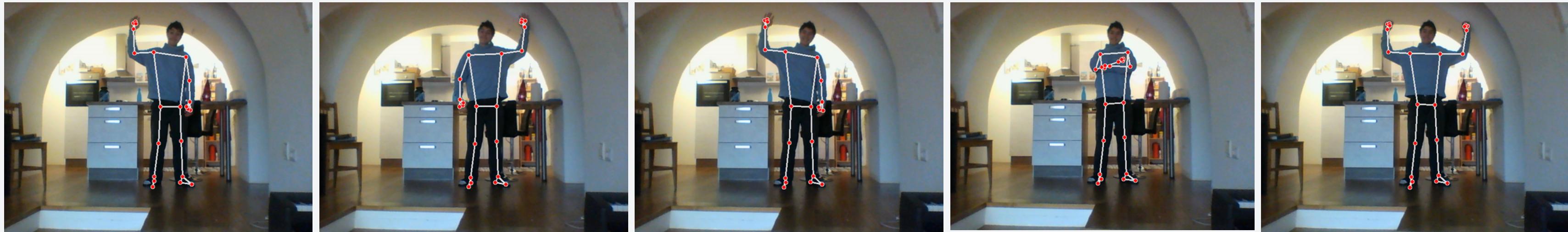
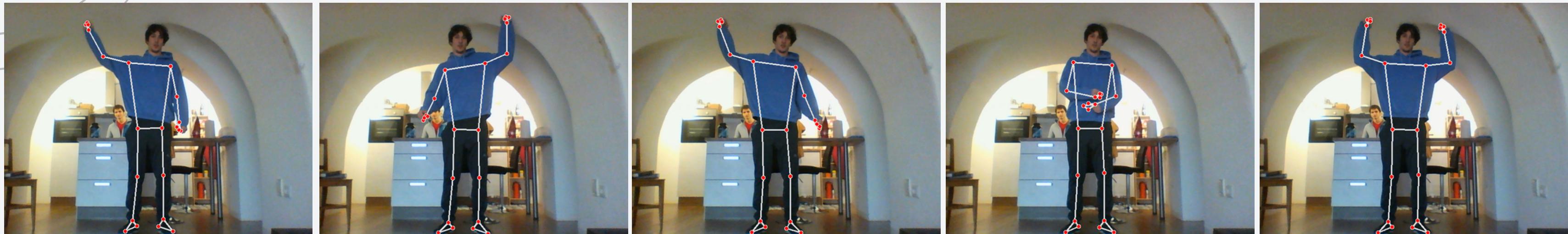
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3

4



# GESTURE FEATURE: "SQUARED DIFFERENCE"



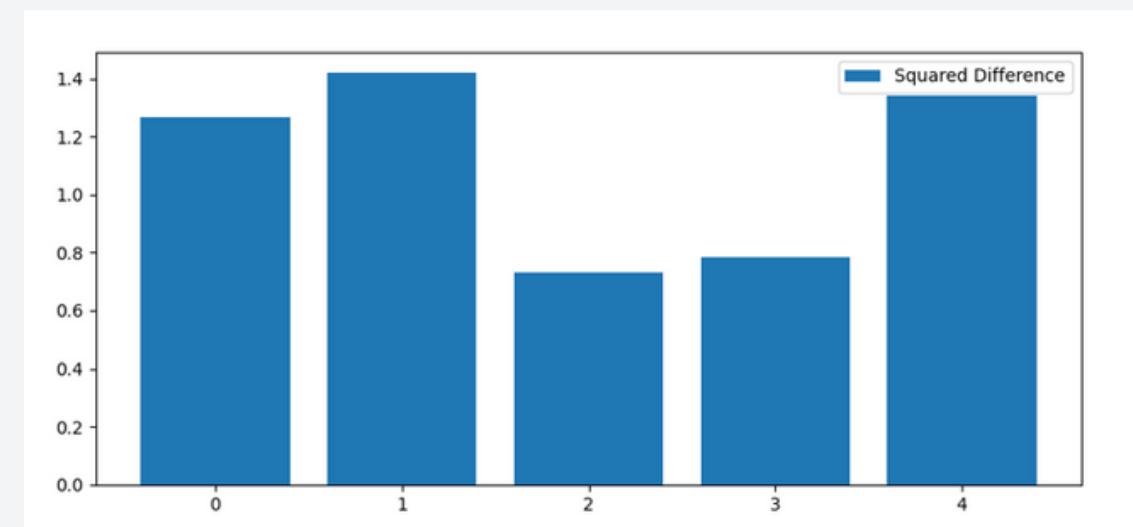
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1

2

3

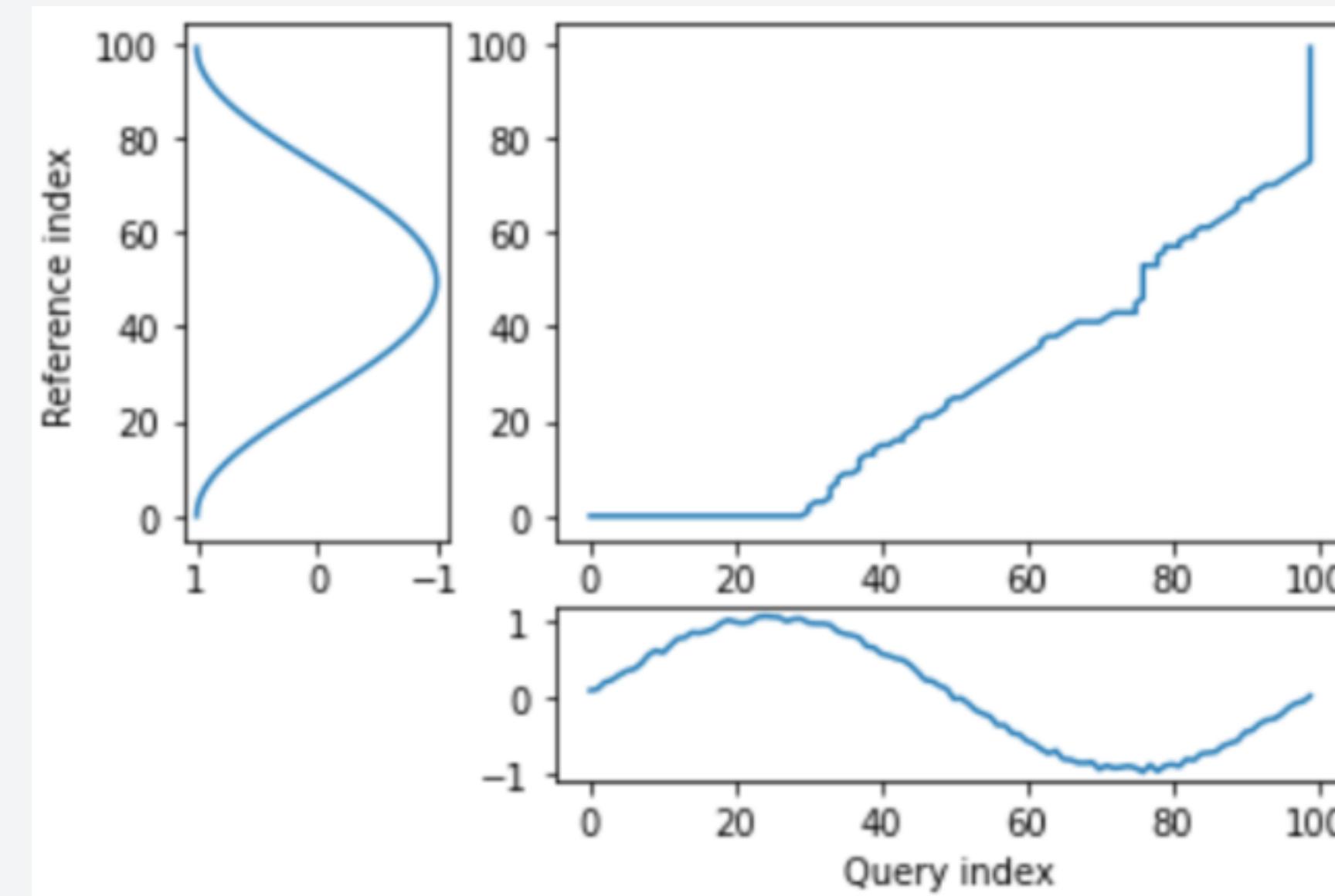
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# GESTURE FEATURE: "DYNAMIC TIME WARPING"

COMPARING EACH FRAME FROM “COPY” WITH EVERY FRAME FROM “DANCE”  
(USING SQUARED DIFFERENCE)

PUT VALUES IN A MATRIX AND CHOOSE THE CONNECTED PATH FROM POSITION  
1, 1 TO N, N WITH THE LEAST COST



# GESTURE FEATURE: "DYNAMIC TIME WARPING"



0.2

0.4

0.6

0.8

1.0

**DTW Cost: 19.97**

# GESTURE FEATURE: "DYNAMIC TIME WARPING"



0.2

0.4

0.6

0.8

1.0

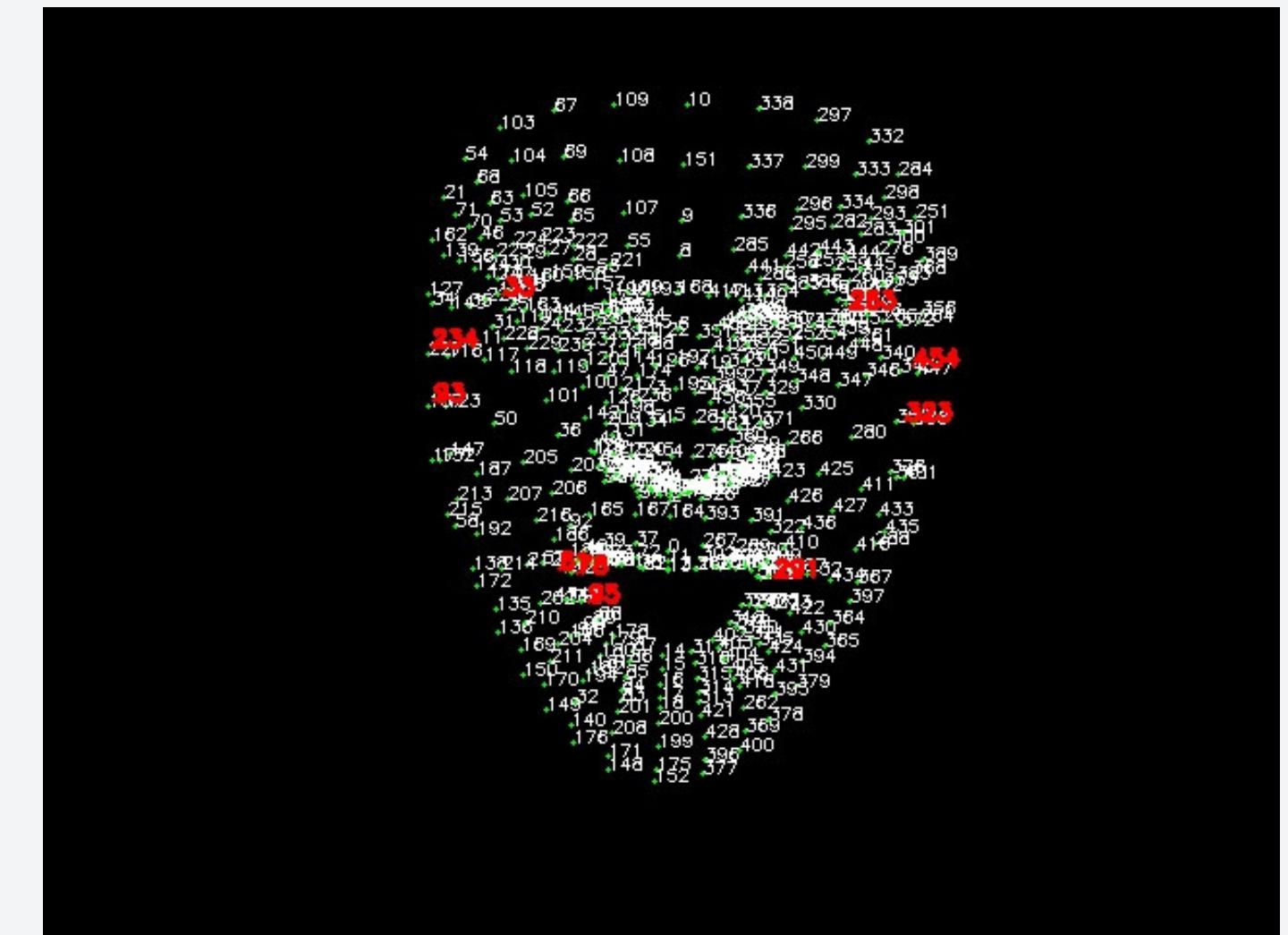
**DTW Cost: 22.53**

# FACE FEATURE: "HAPPY FACE"

DIFFERENCES OF LANDMARKS AND SUM THEM UP

distance between  
lm a and lm b

$$d = \sqrt{(a_x - b_x)^2 + (a_y - b_y)^2}$$



`mouth_width = d between lm 61 & lm 291`

`mouth_height = d between lm 78 & lm 95`

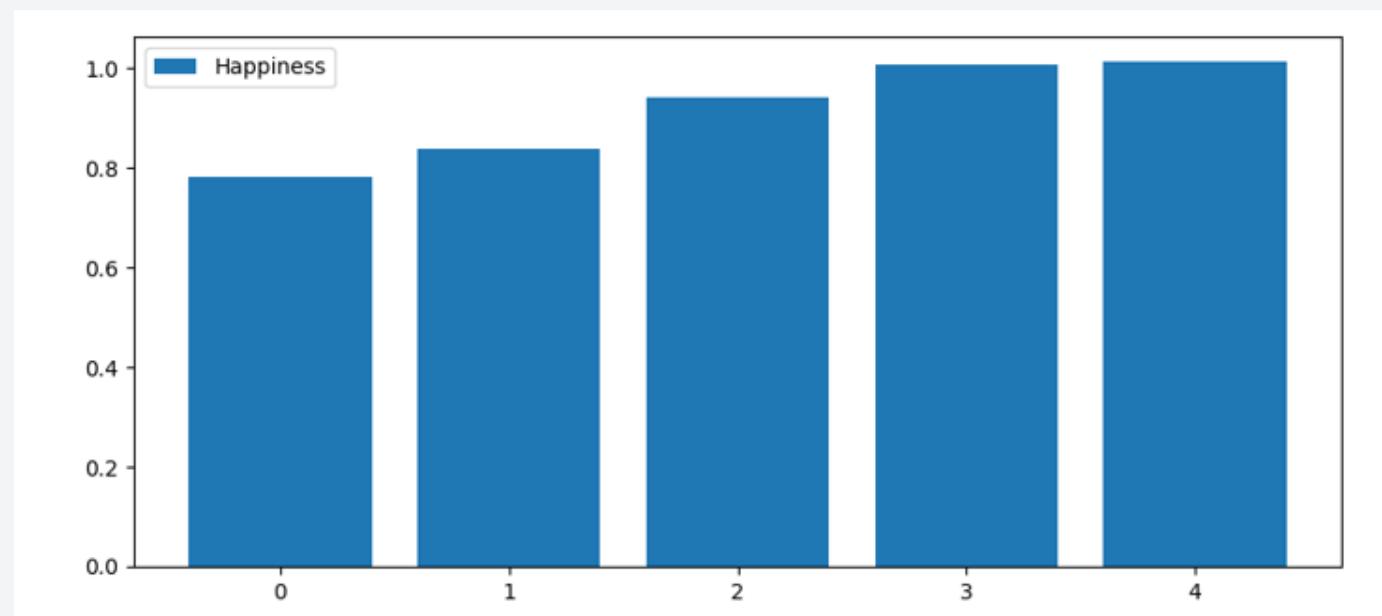
`cheek_distance = average between d between lm 93 & lm 234 and d between lm 454 & 323`

`interocular_distance = d between lm 33 & lm 263`

`happiness_score = (mouth_width + mouth_height + cheek_distance) / interocular_distance`

# FACE FEATURE: "HAPPY FACE"

EXAMPLE OF SCORES



# FACE FEATURE: "HAPPY FACE"

EXAMPLE OF SCORES



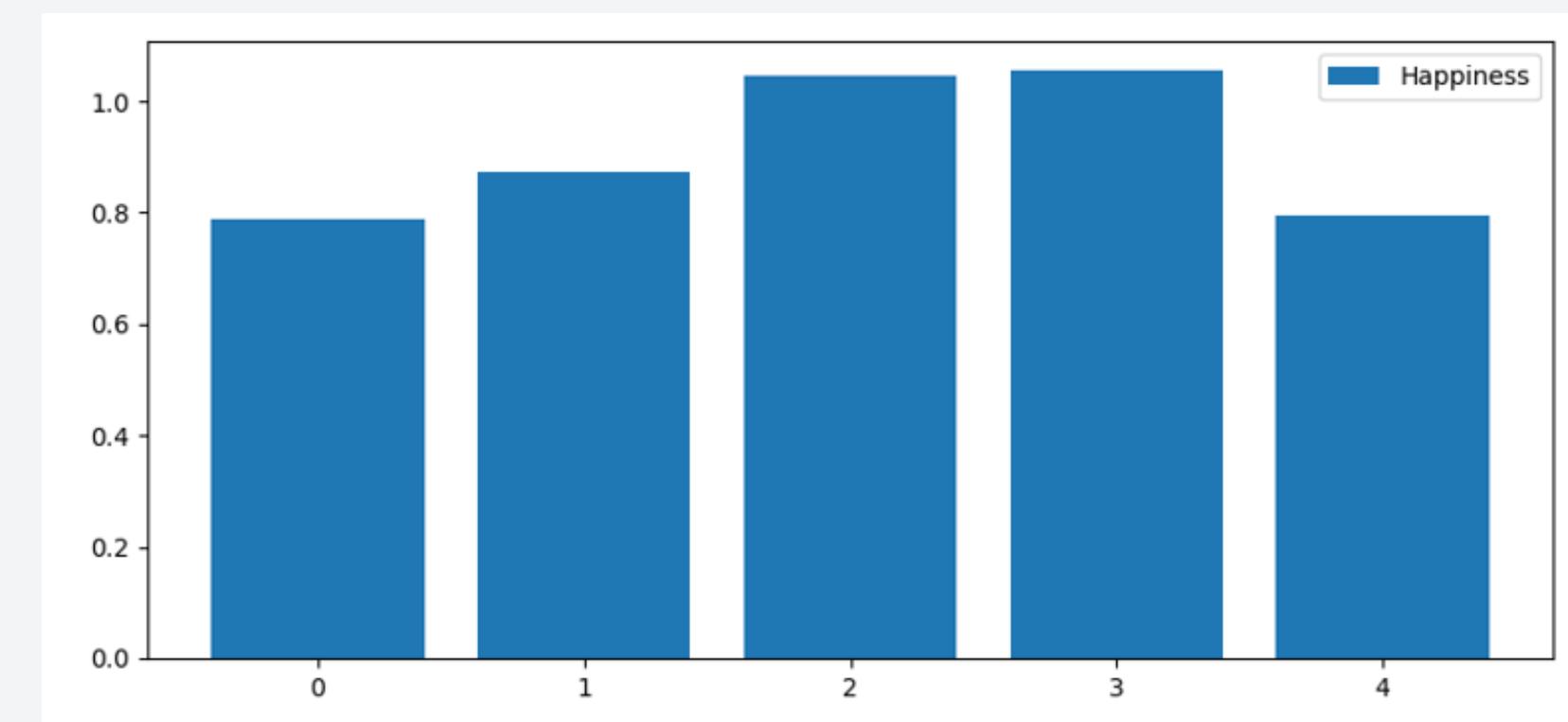
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1

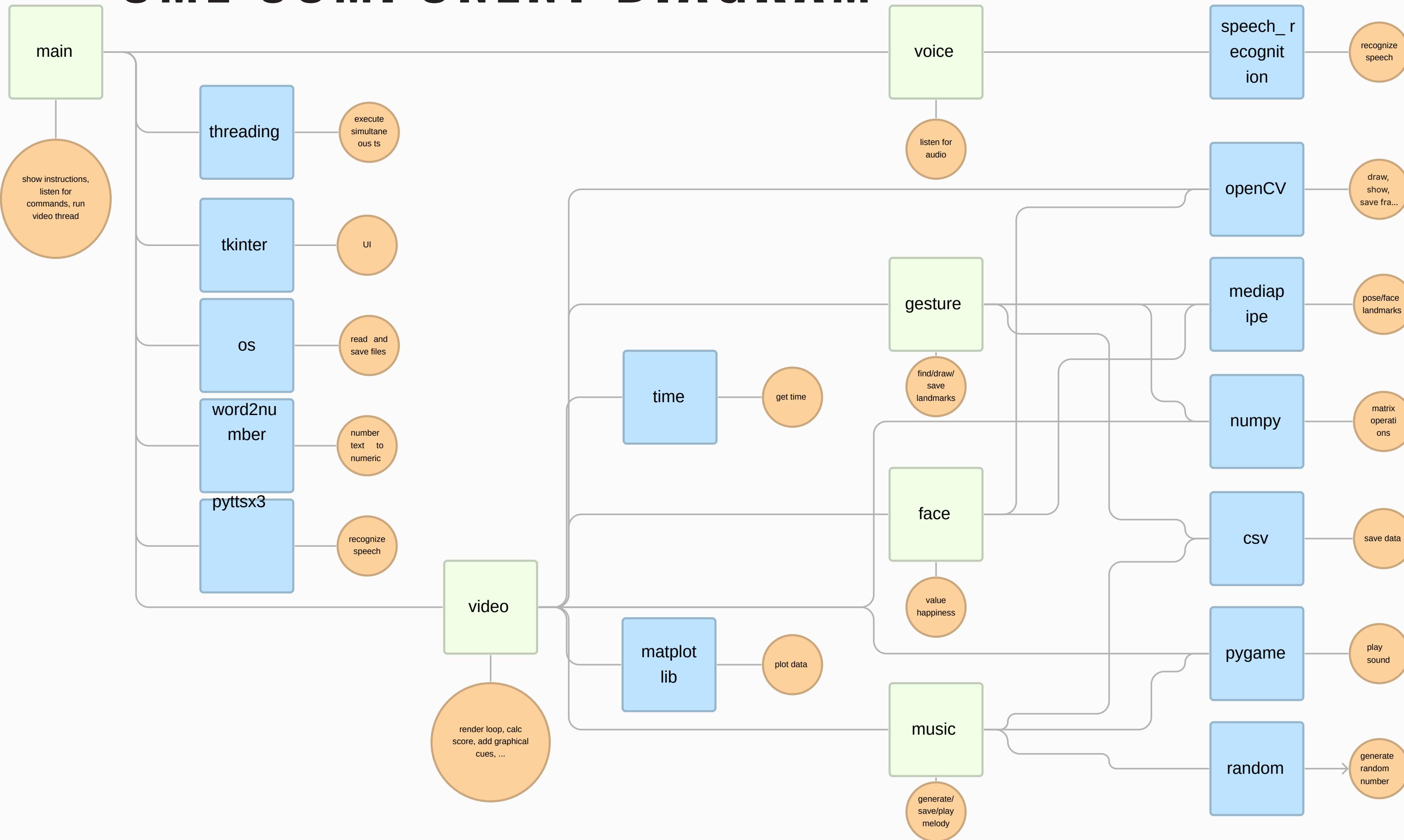
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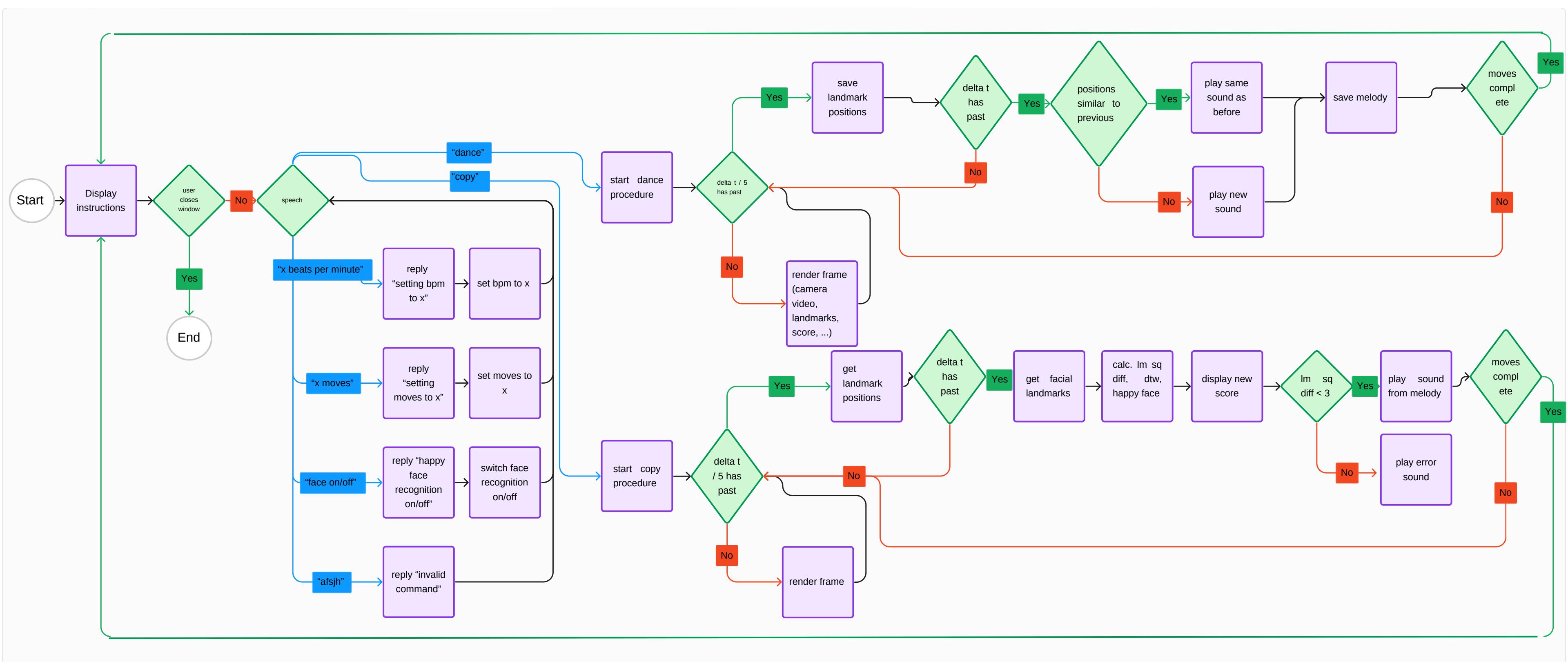
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# UML COMPONENT DIAGRAM



# UML STATE CHART DIAGRAM



# CONCLUSION

The game has the potential to encourage physical activity, foster social interaction, and instill a sense of enjoyment in the school environment.

It combines gesture recognition, dynamic time warping, speech recognition, and optional facial recognition, the game offers different modalities that are each there for their own special use case.

## IDEAS FOR FUTURE WORK

- Add UI elements to better show how the score is comprised.
- “I packed my bag” Game mode where each player copies what the one before did and can add another move at the end.
- Try without fixed timestamps for the moves and let the players dance at their own speeds.

## References

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