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Overview

The study evaluates the impact of **tempo and multi-scale division of the beat** on the ability of **motion** (finger and arm) **synchronization**.

We present here an innovative and robust model that generates a **synchronization score** between music beats and body movements.

The objective is to **enhance synchronization** abilities across various domains, including dance, sport training, and Parkinson's rehabilitation.

Rhythm dataset

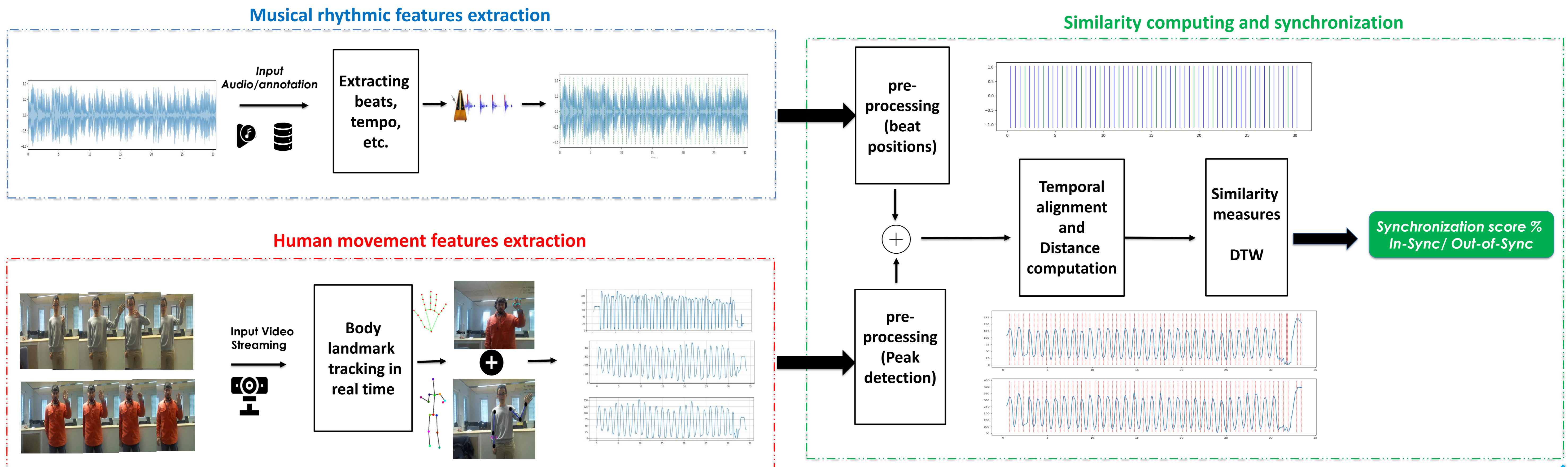
The dataset is a subset of the GTZAN-Rhythm corpus:

- ❑ 30 seconds audio clips,
- ❑ 3 division of the beats: **binary, swing, ternary**,
- ❑ 3 ranges of bpm: [80,90], [100,110], [120,130]

Parameters		Tempo	Danceability	Nbr beats	Genre
No swing	Clip_1	89,46	0,45	43	Disco
	Clip_2	104,94	0,53	53	Disco
	Clip_3	122,71	0,59	62	Disco
Swing	Clip_1	81,84	0,26	41	Country
	Clip_2	106,61	0,44	54	Jazz
	Clip_3	122,25	0,36	61	Reggae
Ternary	Clip_1	81,84	0,31	42	Classical
	Clip_2	106,61	0,45	53	Blues
	Clip_3	122,25	0,34	65	Classical

Method and Contributions

1. **Extraction of musical rhythmic features:** tempo, beats, danceability, and genre
2. **Extraction of human movement features:** motion of arm or fingers, joint angles, joint distances, velocity, and accelerations
3. **Similarity computing and synchronization:** pre-processing on the motion signal's raw data, peaks picking, alignment of beats with the motion peaks, dynamic time warping (DTW) distance and relative phase



Experiments

- ❑ Participant asked to tap their two index or to move their arm as regular as possible to the beats.
- ❑ Stimuli delivered over headphones, based on Swing, No-swing and Ternary rhythm with different tempo range.
- ❑ 2 types of audio test (+/- an additional metronome).
- ❑ Motions gestures tracked from live webcam 30 fps.

Conclusion

A **pilot study** was carried out on 20 participants. Early analysis indicates that:

- ❑ participants performed good during the audio pulses beat test.
- ❑ average synchronization score decreases proportionally to the tempo range level.
- ❑ ternary rhythm impacts the ability of synchronization,
- ❑ overall best performances were achieved with the additional metronome.

Future work will include new and innovative multi-scale music features as well as exploring the impact of other types of body motion on the synchronization results.