

# TEAM

## Tennis Emotion Analysis for Mates

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# Overview

- Context
- Why double tennis?
- Approach
- Economic Relevance
- Scientific Relevance
- Timeline



# Context

**Emotions drive performance**, shaping decisions, focus, and resilience on the court.

Unveiling the **link between emotions and team interactions** can unlock untapped **potential for training**.

Current systems actually miss the mark—focusing on **team dynamics** or **individual emotions**, but never both.



# Why Double Tennis ?

1

## **Manageable Number of Players**

Helps track each player individually with precision.

2

## **Interpersonal Dynamics are Amplified**

Demands close synchronization

3

## **Simplified Visual Environment**

Tennis court is a controlled and less chaotic environment

This expresses a part to whole relationship

# Approach

We divide our project in 5 keysteps:

**1**

**Body and Facial  
Expression  
Recognition**

**2**

**Emotion  
Mapping**

**3**

**Chemistry  
Evaluation  
Between  
Players**

**4**

**Match Event  
Detection**

**5**

**Correlation of  
Events with  
Emotions**

# Body and Facial Expression Recognition

- Extract information about players' **body movements** and **facial expressions**
- **YOLO** isolates the face and body in each frame. (Detection)
- **OpenPose** to maps skeletal joints (Body Analysis)
- **CNN** focuses on fine-grained facial features (Facial Analysis)





# Emotion Mapping

- Map **physical characteristics** from the previous step **into emotional states** with a multimodal framework
- **Positive** : Confidence, Determination, Satisfaction
- **Negative** : Frustration, Disappointment, Anger
- **Neutral** : Focus, Calmness, Fatigue



# Chemistry Evaluation Between Players

$$\begin{aligned} &\text{Synchronization of Movements} \\ &+ \\ &\text{Emotional Congruence} \\ &+ \\ &\text{Interaction Quality} \\ &= \\ &\textbf{Chemistry score} \end{aligned}$$



$\alpha, \beta, \gamma$  depends on the **specific priorities of the analysis** the coach/match analyst wants to highlight





# Match Event Detection

- Detect key **match events** and their **relative timestamps**
- **SlowFast** architecture: Fast and fine-grained actions. Slower and contextual movements.
- Model trained with specific tennis dataset: THETIS.





# Correlation of Events with Emotions

- Combine all outputs from previous steps into an interactive dashboard.
- Dashboard that integrates **match events**, **emotional states**, and **chemistry dynamics**
- It ensures that **patterns** are **contextualized** and **linked** to both individual and team dynamics.
- Analyze how **events influence emotions** and team dynamics, highlighting possible **triggers**



# Economic Relevance

**Direct application** for professional **organization or sports teams** in order to **improve** athletic **performances** and **team dynamics**

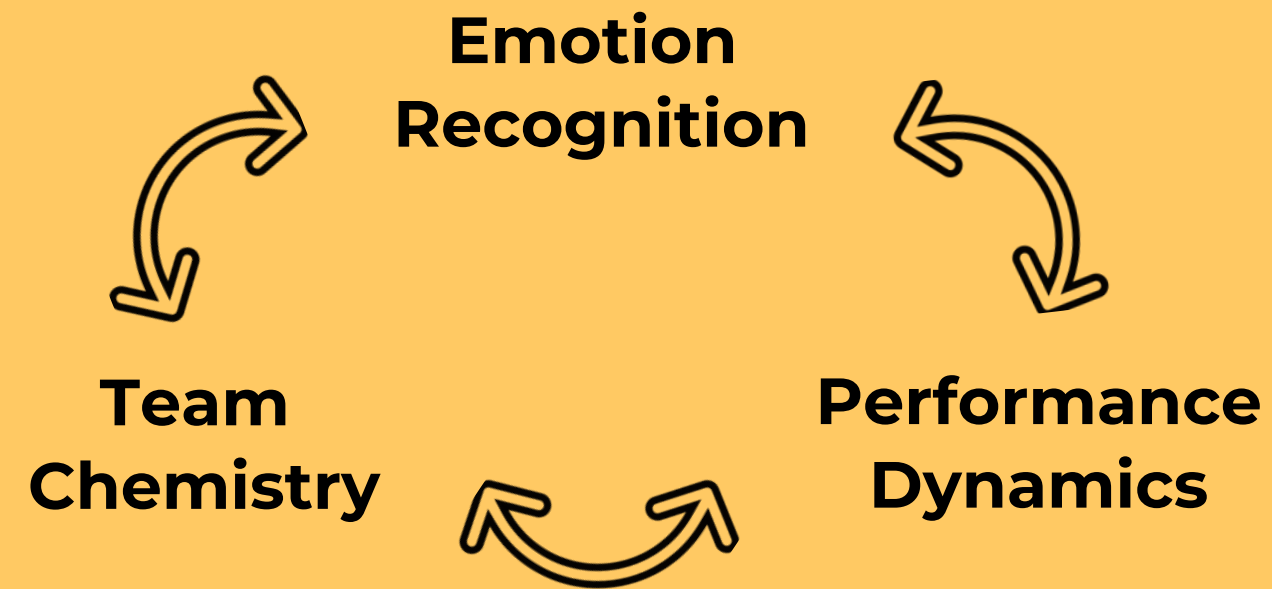
**Coaches** and **analysts** can develop **ad hoc** training sessions

Players **gain awareness** of their **emotional state** during match

It is the framework that can **lead the way** for all other **team sports**

# Scientific Relevance

How individual emotions can impact team interactions ?



How team dynamics can shape individual emotions during critical match phases ?

How team synergy can influences match outcomes ?

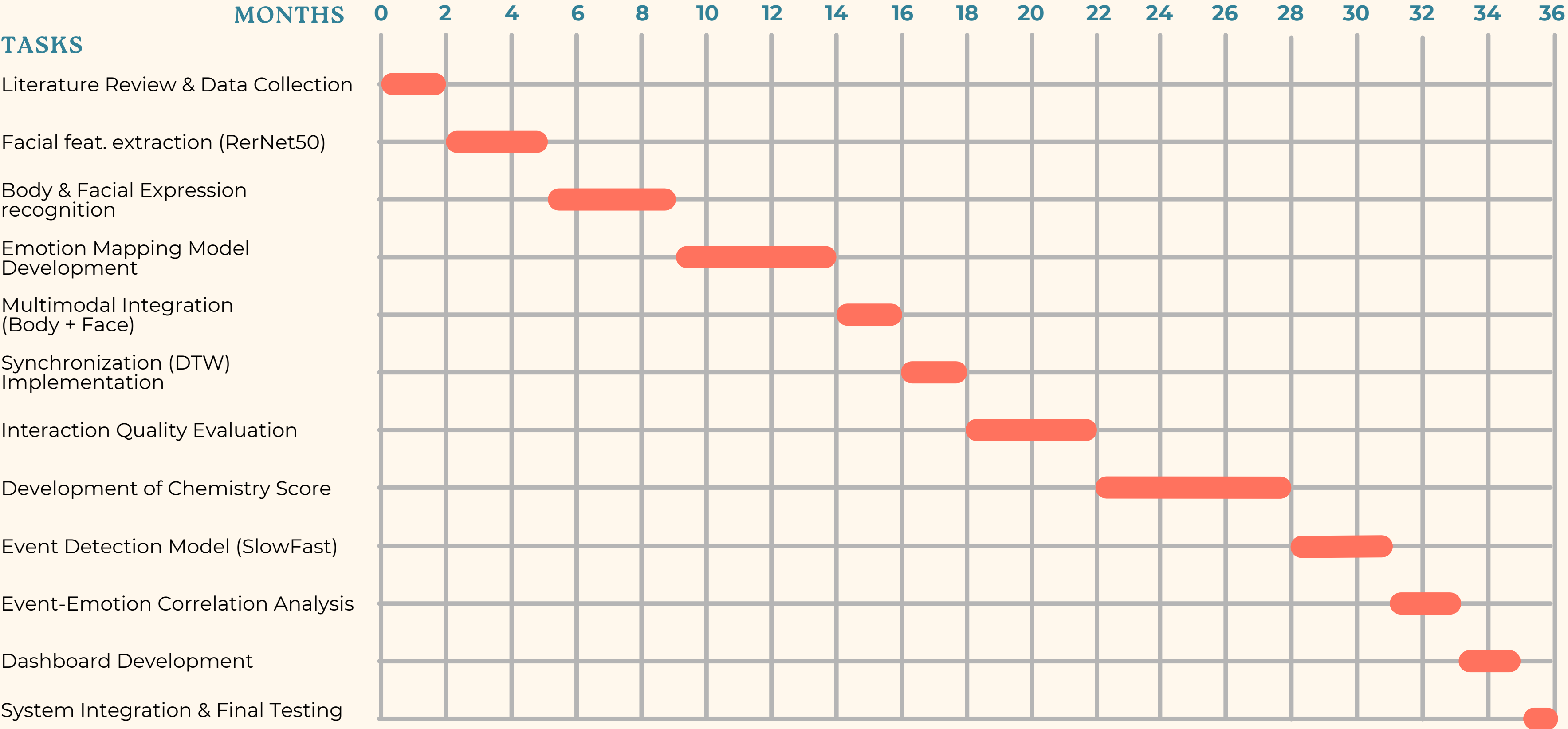
**Bridge  
gaps**

**Impact beyond  
sports**

**Innovative  
framework**



# Project Timeline



# Thank you



Any question ?

**Additional slides**

# References

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- [5] Bodapati & Garg, 2021 - Deep learning for facial emotion recognition.
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- [9] Liu et al., 2020 - Emotion recognition using body gestures.
- [10] Redmon et al., 2016 - YOLO: Real-time object detection.
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- [15] Jakauc, 2022 - AI-based emotion detection in single-player sports.





# Emotion mapping

## Positive Emotions:

- **Confidence:** Relaxed facial muscles, upright posture, steady gaze, and fluid movements.
- **Determination:** Tightened facial features (e.g., focused eyes, slight clenching of the jaw), leaning-forward posture, and purposeful movements.
- **Satisfaction:** Relaxed facial expressions, small smiles, and open gestures, often following a successful rally or point.

## Negative Emotions:

- **Frustration:** Tensed facial muscles (e.g., furrowed brows), abrupt gestures, and slumped shoulders.
- **Disappointment:** Drooping facial features (e.g., downturned mouth), slow movements, and a passive stance after errors or missed opportunities.
- **Anger:** Tightened lips, flared nostrils, rapid, forceful gestures, and aggressive postures.

## Neutral States:

- **Focus:** Neutral facial expression, steady body posture, and consistent eye direction, often observed during preparation for a serve or rally.
- **Calmness:** Relaxed posture, smooth and controlled movements, with minimal facial tension, usually seen during lulls in the match or before executing a familiar action.
- **Fatigue:** Slouched shoulders, slower movements, drooping eyelids, and lack of engagement, typically emerging late in a match.

# Chemistry Score

$$\text{Sync} = 1 - \frac{\text{DTW}(\text{player1}, \text{player2})}{\max(\text{DTW})}$$

## **DTW - Dynamic Time Warping.**

Measures similarity between two temporal sequences: players during match and non-synchronized situation.

$$\text{Emotional congruence} = \frac{E1 \cdot E2}{||E1|| \cdot ||E2||}$$

**Cosine similarity** since are Emotional states **vector** for both players E1 and E2, extracted from the emotion recognition model.

$$\text{Interaction} = \frac{\text{Number interactions}}{\text{Number Events}}$$

**Number of non verbal interactions** between the players during the match (e.g. high-fives, hugs, and finger-pointing) and the **number of events during the match.**

# Match event list

- **Winning a Point:** Detected through celebratory gestures (e.g., fist pumps) and a relaxed posture, validated by scoreboard updates.
- **Losing a Point:** Recognized via frustration gestures (e.g., slumped shoulders, racket slams) and opponent celebrations, confirmed by the scoreboard.
- **Unforced Errors:** Identified by abrupt stops, inefficient postures, and ball trajectory showing the ball landing out of bounds.
- **Forced Errors:** Observed through defensive postures, rushed movements, and ball trajectories under high-pressure situations.
- **Aces and Double Faults:** Aces occur with no opponent response to a serve; double faults result from two consecutive serving errors, confirmed by the scoreboard.
- **Breakpoints:** Key moments identified by specific scores (e.g., 40-30) and focused pre-serve behaviors.
- **Rallies:** Long exchanges of shots detected by continuous player movements and rally duration exceeding 10 seconds.
- **Celebrations/Reactions:** Analyzed through exaggerated movements and facial expressions linked to preceding events.