VARS: VIDEO ASSISTANT REFEREE SYSTEM FOR AUTOMATED SOCCER DECISION MAKING FROM MULTIPLE VIEWS

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What ?

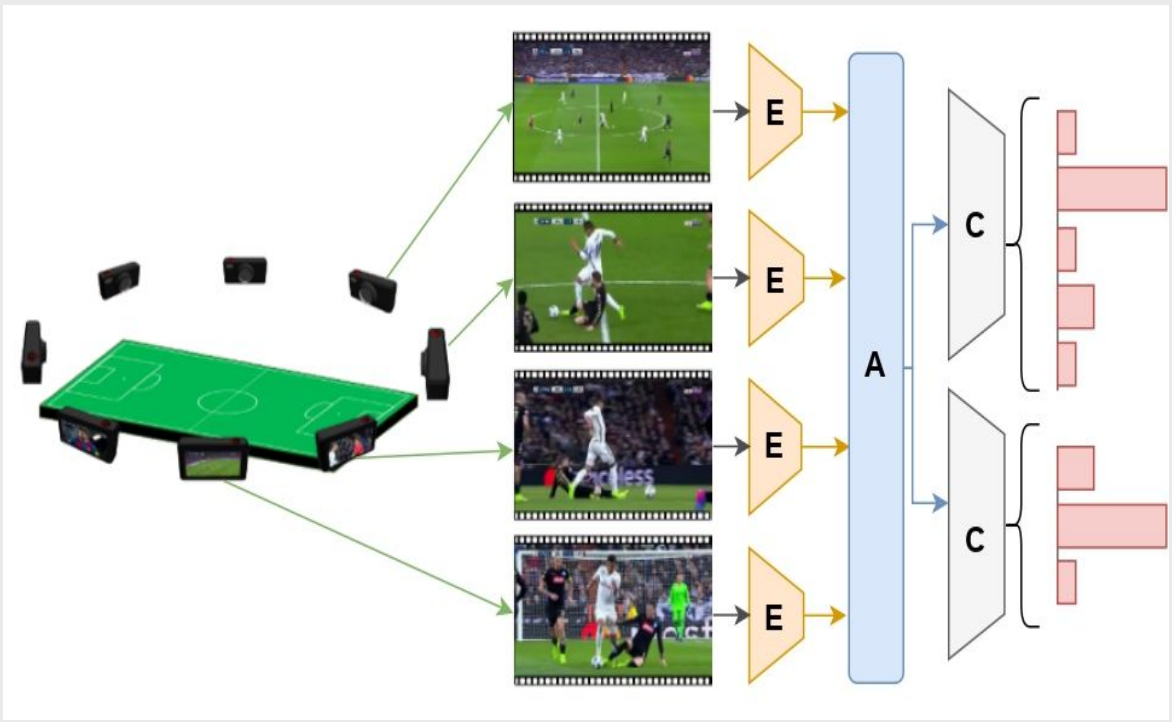
- Automated support for refereeing decision-making in soccer using video data.
- Analysis of foul situations captured from multiple camera views.
- Law-based decision outputs, including: determining whether a foul has occurred, classifying the type of foul, assessing the corresponding level of sanction.

Why ?

- VAR improves refereeing accuracy but is costly and complex, limiting its use to professional leagues.
- VAR decisions may be inconsistent across matches.
- There is a need for an automated decision-support system applicable to all competition levels.

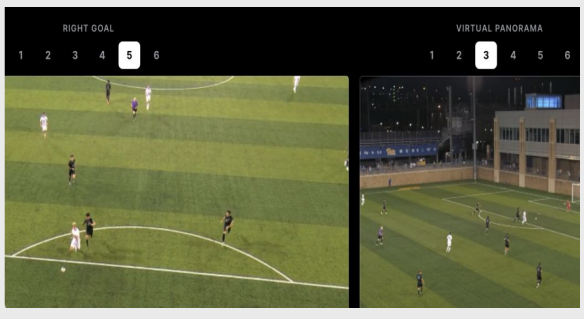
Overview

1. Multi-view video acquisition from multiple cameras around the pitch.
2. Each camera view is independently encoded to extract spatio-temporal features.
3. Features from different views are aggregated into a unified representation.
4. The aggregated representation is used to predict foul-related decisions.
5. Output includes foul occurrence, foul type, and sanction severity.



Description

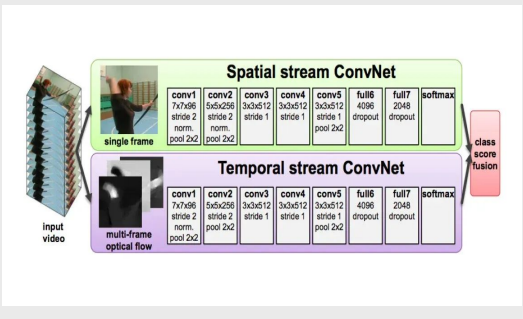
1. Multi-view video acquisition



- One **live-action view** (main camera)
- One or more **replay views**
- Formally, the input is a set of views:

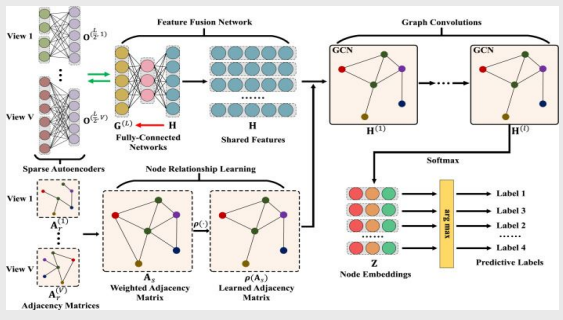
$$\mathcal{V} = \{v_1, v_2, \ldots, v_n\}, \quad n \in [2, 4]$$

2. Feature Encoding



- Each video clip is independently processed by a **shared video encoder** to extract spatio-temporal features

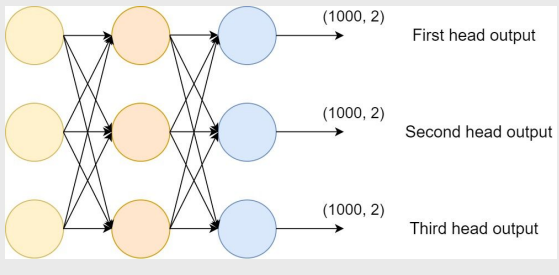
3. Feature aggregation



Aggregation strategies:

- **Mean pooling**: averages information across all views
- **Max pooling** (best-performing): retains the most informative cues across views

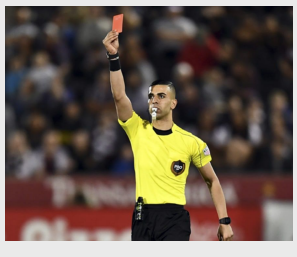
4. Multi-task Decision Heads



VARS performs **joint classification** using two heads:

- Fine-grained foul type classification (8 classes: Tackling, Elbowing, Holding, Challenge, Dive,..)
- Offence severity classification (No offence, Offence + No card, Yellow card, Red card)

5. Referee-support Output



- Predicted foul type
- Predicted offence severity
- Suggested sanction level

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