Bring it to Pitch: Combining Video and Movement Data to Enhance Team Sport Analysis

Presenter: **Zixiao Zhang**

Nov.28th 2017

A Single Frame from a Soccer Match Video

Sample Visualization

In this presentation…

- How designers think from the domain perspective?
- How to visualize from several frames in videos?
- Some techniques applied to this visualization.
- What to do to make the system more applicable?

Soccer Game Analysis

- **Domain Task**

  -Integrate appropriate analytical visualizations within the video context

- **Hardware Limit**

  -One main camera positioned on side of the pitch for tactical view

- **Key Requirement**

  -Extact data from standard video recording

  -Allow the user to overlay visualizations on the video material

Soccer is a team match…

- **Tactical analysis:** Bring it to a normalized pitch
- Abstract the 22 players to the points
- Each player controls certain region
- Events happened on every player can contribute to the result of the match
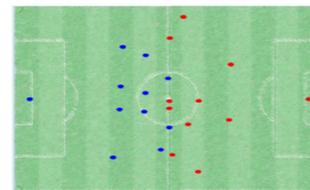
Player Detection

- **Challenge 1:** To allow zooming, the focal length can be different in different frames. And players on the opposite side appear smaller.
- **Challenge 2:** Body pose, proportions and imaging conditions.
- **Low-level appearance models.** Perform the player contour analysis through color histograms.
- Require only minimal characteristics about the search object, making it adaptive to more videos.

Player Detection

- Create color histograms
- Inspect each pixel in the image
- Calulate the centroid of each detected area
- Abstract to boxes using empirical factors

$$h_h = \frac{h}{2} + \frac{h}{2} \cdot s_h$$
$$h_f = \frac{h}{2} + \frac{h}{2} \cdot s_f$$
$$w_a = \frac{a}{2} + \frac{a}{2} \cdot s_a$$
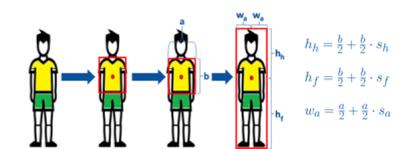
Player Detection
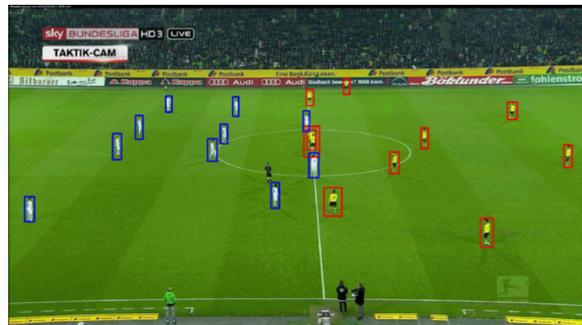
But I only see part of the pitch…

Panoramic View

- **Input:** A set of overlapping images
- Align images; Extract and match SIFT (Scale-invariant feature transform) features
- **Homography—**A tranformation matrix acting on projective image coordinates

Panoramic View

A clean background panoromic view

Bring to Normalized Pitch

- **Map panoramic view onto a user-supplied image using reference points**
- **Calculate player position coordinate on the normalized pitch**
- **A detected player position is registered from frames within a certain time span**
- **New player is initialized for all remaining positions**
- **Incorrect detection**
- **Allow user to manually improve the data gathering**

How to analyze the video?

- **Region-based Analysis**

  -interaction spaces and free spaces

  -dominant region

- **Event-based Analysis**

  -shot on goal, cross and pass

  -for the team, the aim is to lower the risk of **pass**

  -passing behavior of each player

How to analyze the video?

- Analyze on the normalized pitch and integrate the result to the video
- Highlighting the players
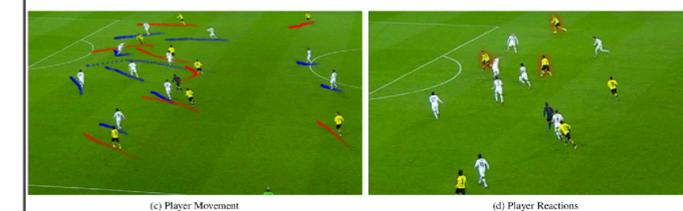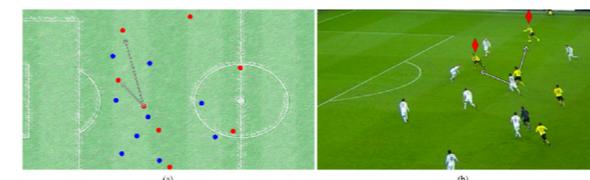
Visual Analysis—Complete and Efficient

Assessment

- **Position Difference:** Average < 2m Standard Devistion 0.5m

- **Time to generate a panoramic view:** 40-50 seconds on average, depending on the size of the view.

Insights from Expert

- natural

- advanced in terms of application in practice

- make the invisible visible

- high refresh rate of free spaces

- can dot represent real person?

Challenges from Implication

- Real-time analysis

- Inaccuracy from distortion etc.

- Potential problems: overplotting, contrast effect or distraction caused by non-match information in the video

- How to match the most interesting area?

Summary

What: Data	Video Recording of a Soccer Match
What: Derived	Players's position, trajectory, strategy etc.
Why: Task	Integrate the analysis result with the video
How: Encode	Highlighting,Tracks with colors, Luminance, Saturation
How: Reduce	Filtering

Summary

- Clearly analyze the domain problem.

- Integrate the visualization with original video stream

- Consider the practical engineering requirement

- Making the analysis results objective

- Avoid interference with analysis of domain experts

- That's what we can learn from this paper

But soccer is a 3D game and full of imagination…

Thanks