Master Thesis

FIFA 2022 GAME ANALYSIS USING MACHINE LEARNING & COMPUTER VISION

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Overview

- Motivation and problem statement
- Data preparation
- Methods
- Results and discussion
- Conclusion
- Future work

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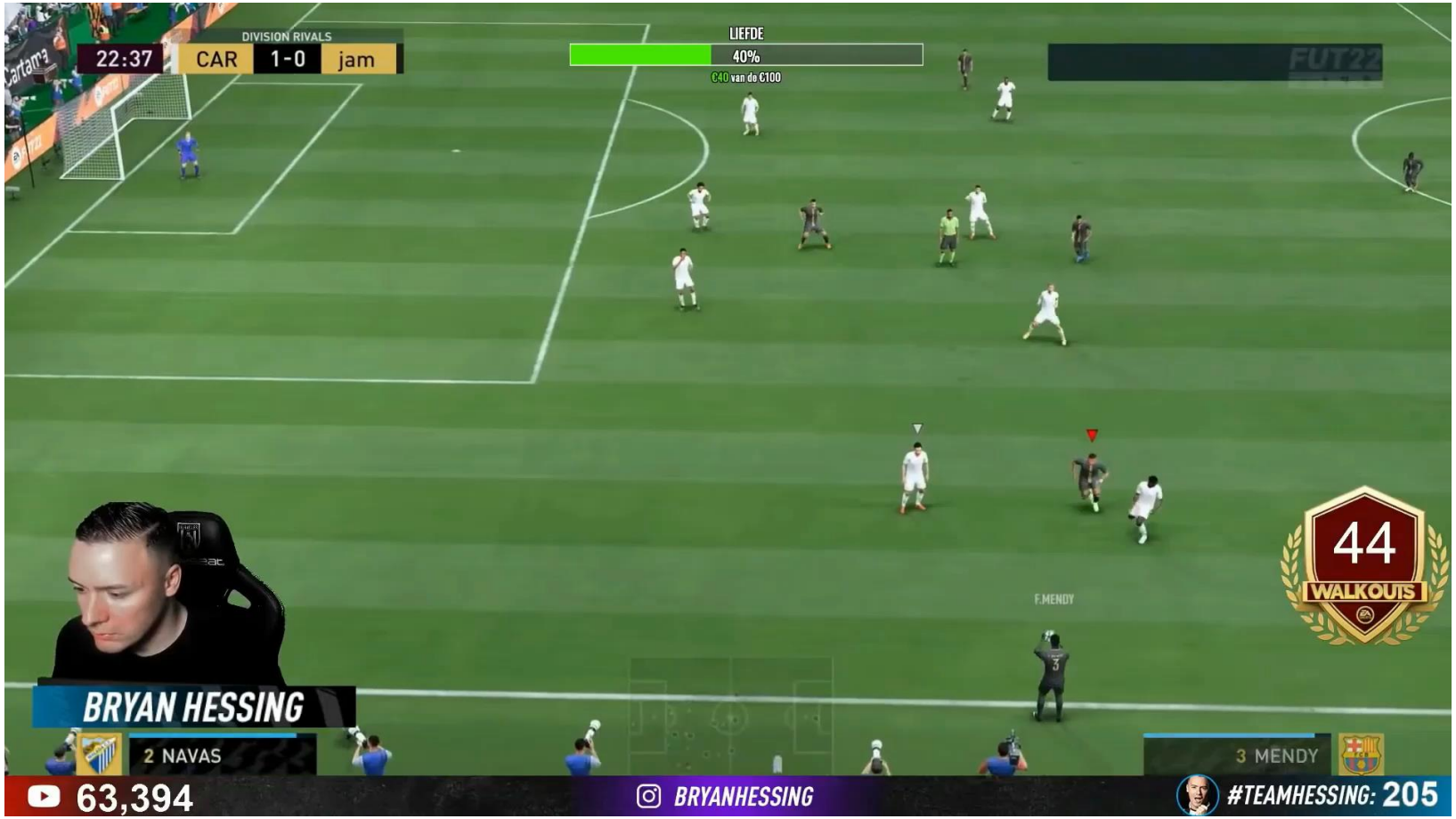
What is an eSports FIFA?

- eGame version of football.
- One eSports gamer for the whole team.
- Gamer controls one player at a time from his team.

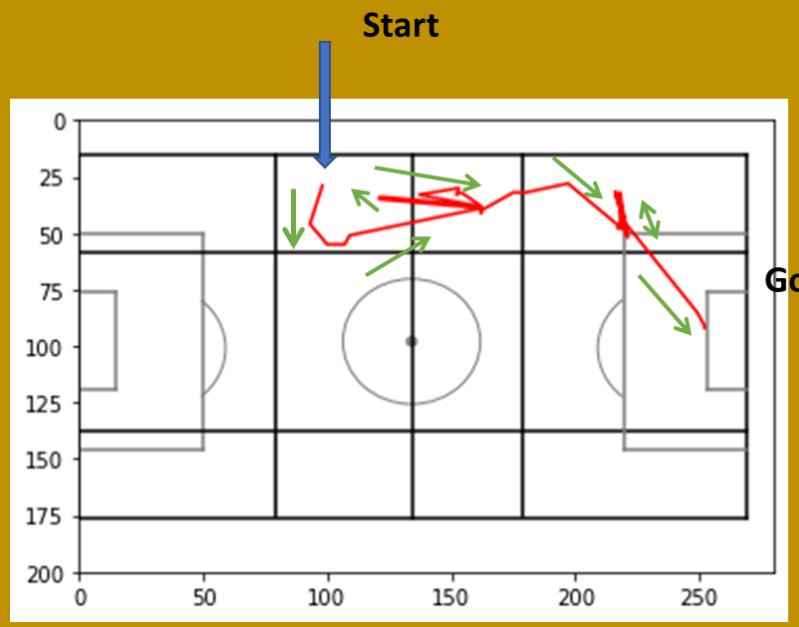
How does the screen look?

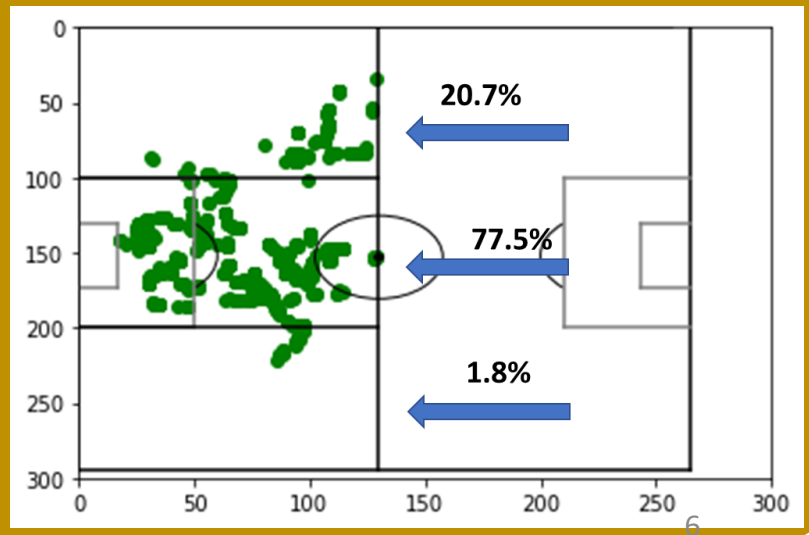


Why analysis of an eSports FIFA?

- Gaining popularity
- Increasing interest in learning about gamer tactics and strategies
- To facilitate game prediction by knowing the strengths and weaknesses of the gamers

Expected Results





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How to analyze an eSports FIFA?

- Need data related to ball and player position/passes etc.
- API can’t provide this type of data and eSports FIFA does not have API anyway.
- Machine learning and computer vision techniques are required to collect the data from the game video.

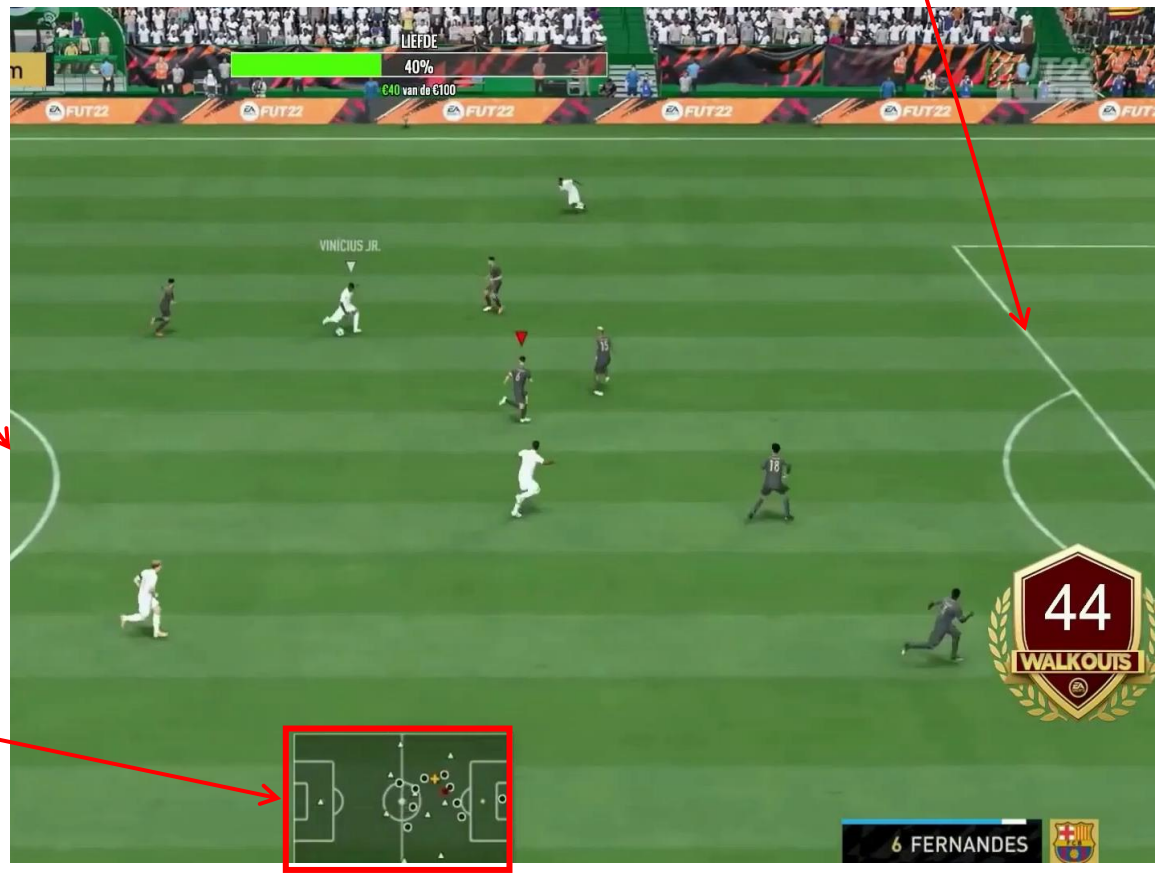
Components of eSports FIFA

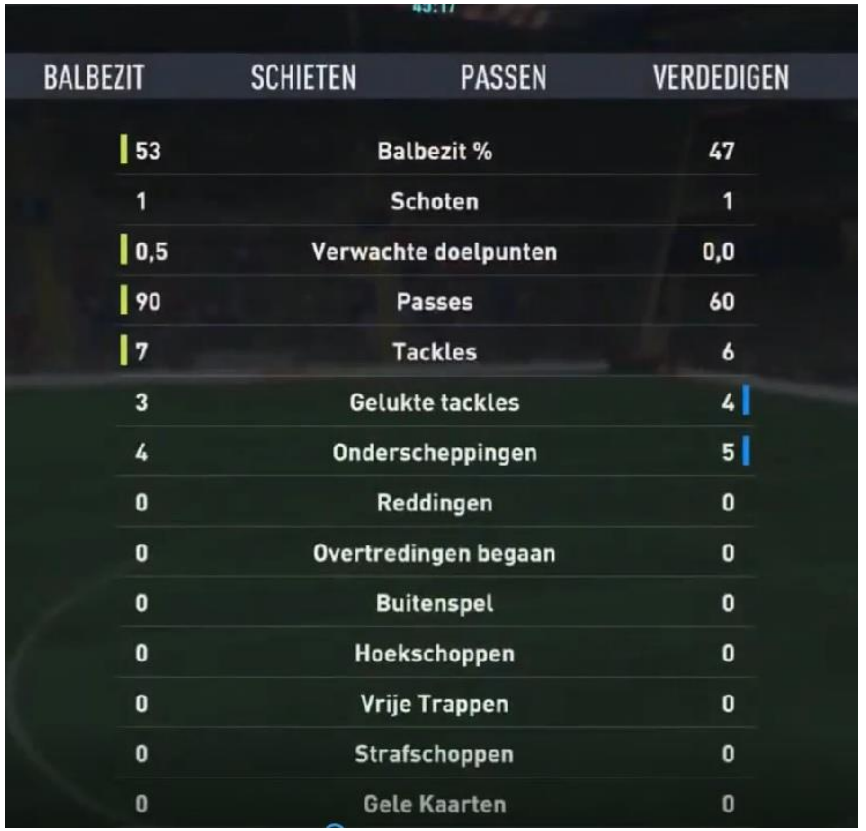
Playfield

Game Statistics

Bigger field

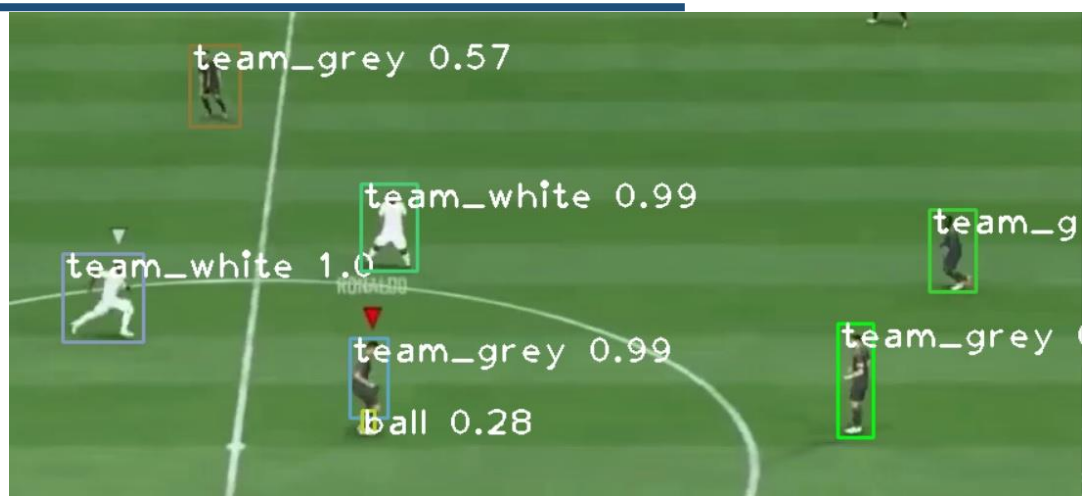
Mini-map





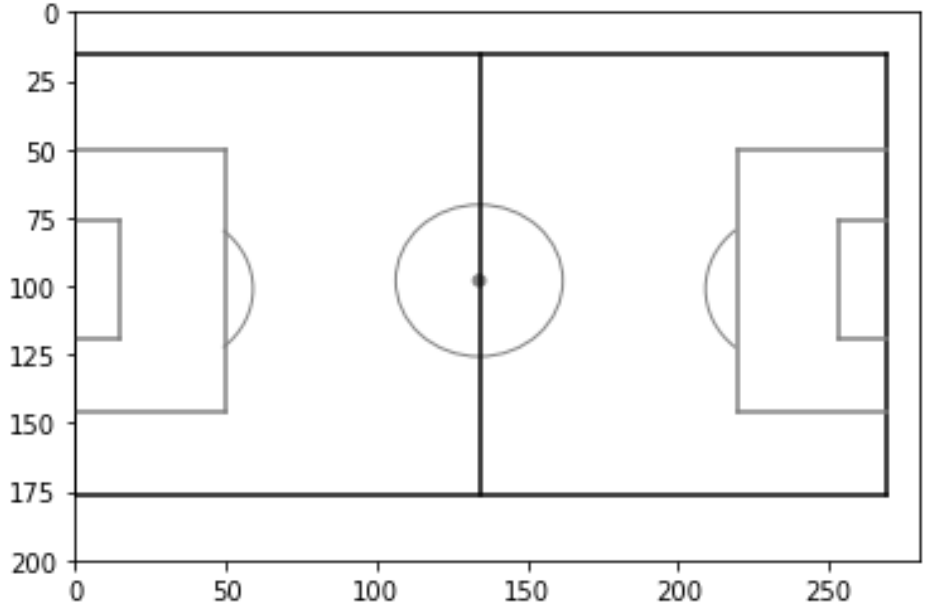
Requirements for the game analysis

- Detect and track the ball and the players.



- Playfield mapping

Mini-map



Challenges

- Ball detection and tracking
  - ✓Fast-moving and small object
  - ✓Occlusion
- Player detection and tracking
  - ✓Occlusion
  - ✓Jersey color detection
- Playfield mapping
  - ✓Movement of Camera
  - ✓Disappearance of mini-map during the game

Research Questions

Research question 1: How to accurately detect and track ball and players in an eSport FIFA 2022 game video?

Research question 2: How the extracted data can be used to determine the game tactics and strategies of the player?

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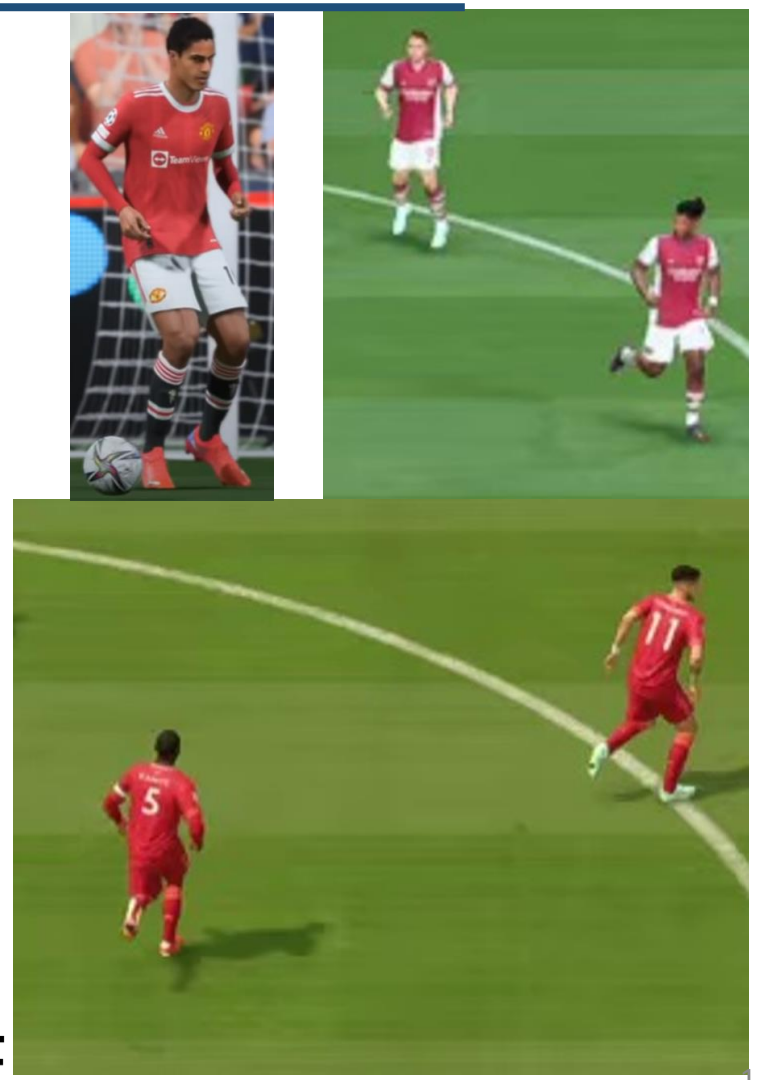
Data preparation

- Data requirement varies with model
- Color-based detection – no separate data needed
- Template-based detection – templates for ball and players needed
- YOLO-based detection – customized data is used for training the model

Customized data set for YOLO-based Model

- Data size - 2200 frames.
- Jersey color
  - Red includes orange, pink, red & white
  - White
  - Grey
  - Green-all kinds of green
  - Blue-all kinds of blue



Drawback

To annotate 2200 frames ~ 75 hrs. are required

Customized data set for YOLO-based Model

- More flexibility in color detection (don’t need to be precise as was in color-based detection)
- Yolo can identify both jersey colors as blue.
- Left is the training image
- And right is the test image
- As our objective is to differentiate

  between two teams

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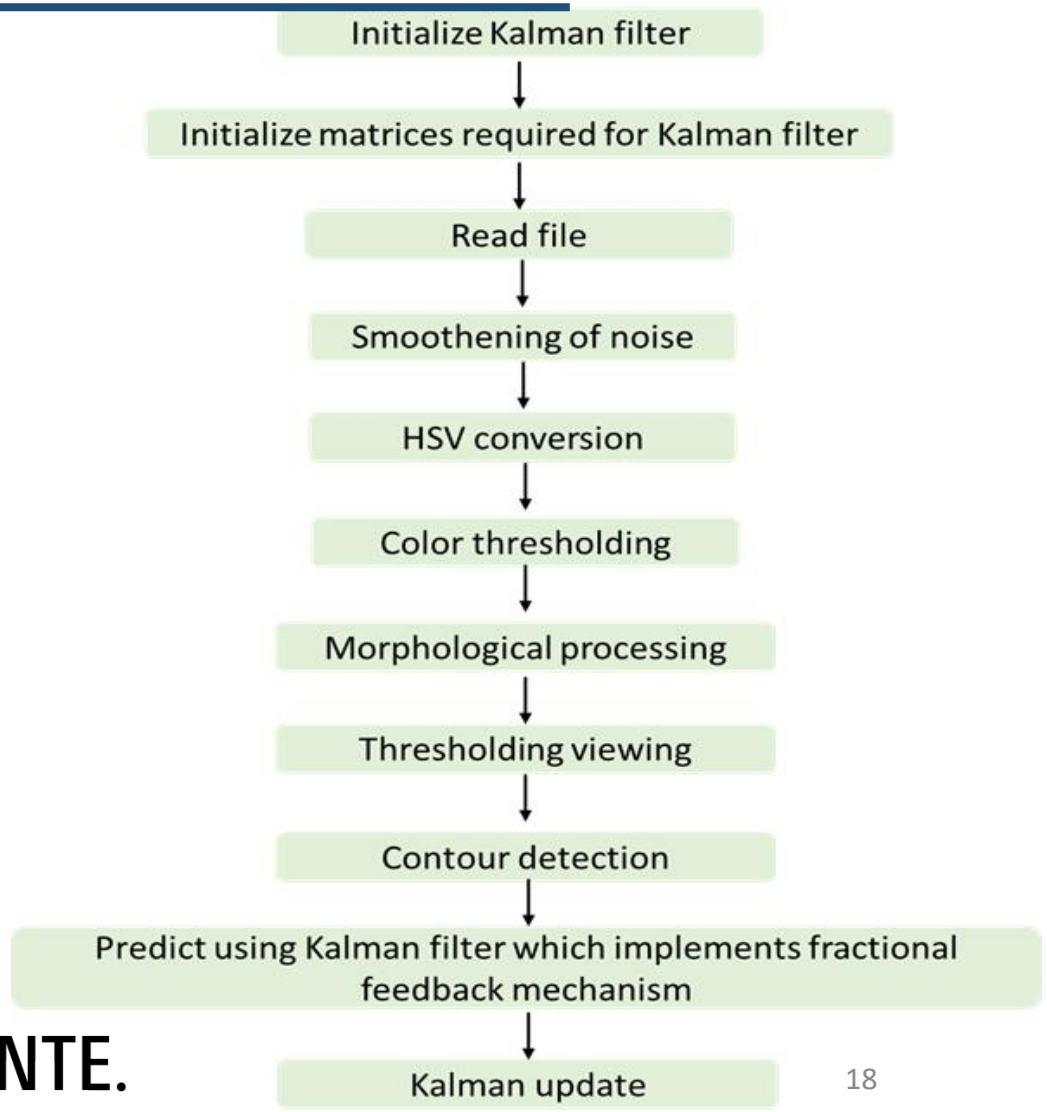
Methods

- Three different models are developed
  - Color-based object detection
  - Template-based object detection
  - Customized YOLO-based object detection
- Best performing models are used for data extraction
- Developed a combined model

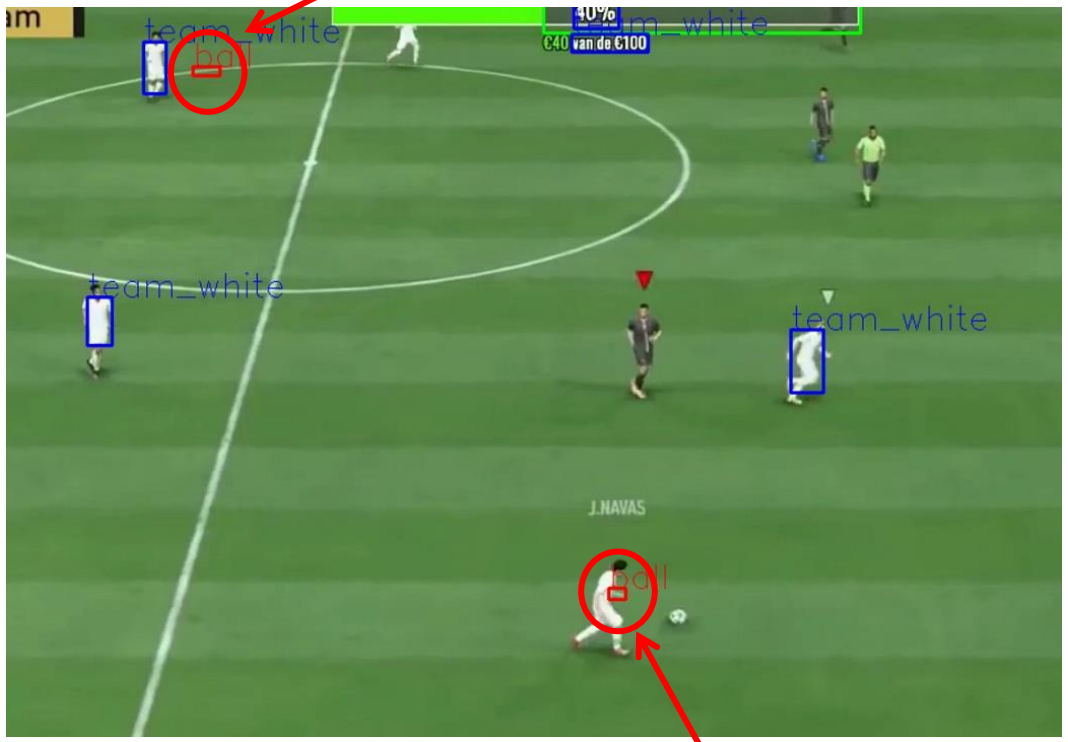
Methods: Color-based detection

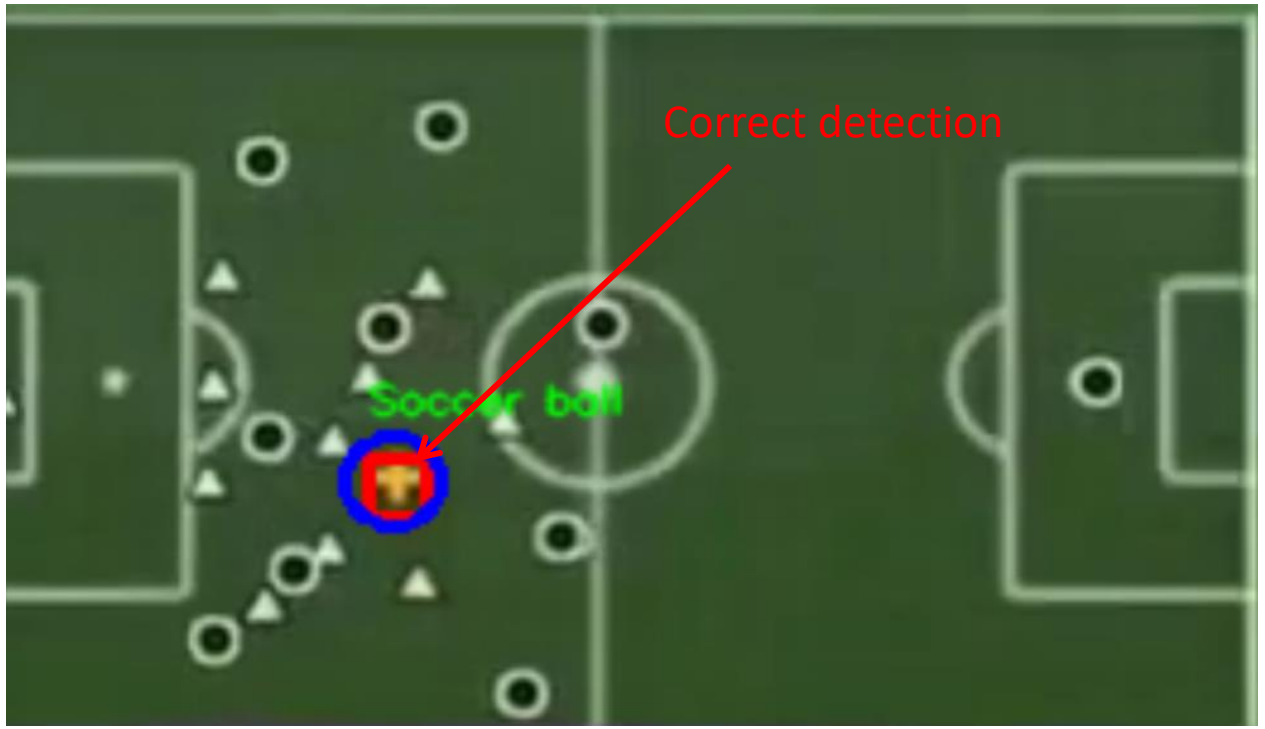
- Used for ball and player detections
- In the bigger field, both ball and players are detected
- In mini-map, only ball is detected



Output from color-based detection

False detection





False detection

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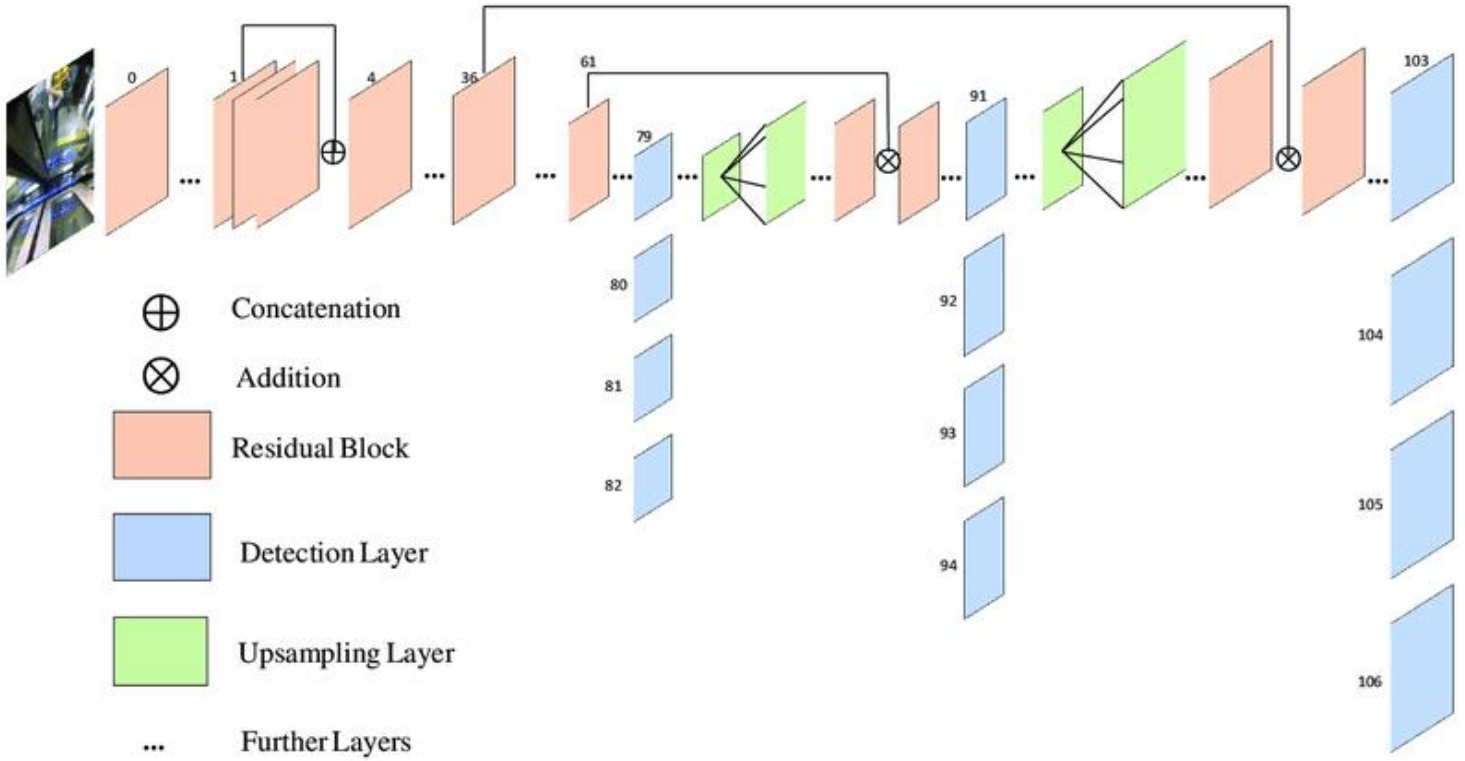
Methods: Customized YOLO-based detection

- Trained the last layer of YOLOv3 with 2200 frames

- For the detection of players and ball on the bigger map.



Methods: Final model

- Detect the ball and the player at the bigger field frame-wise.
- Calculate the player in the possession of the ball
- Now at that frame look for the ball position on the mini-map.
- Final output - ball and player location and player in possession

Model Validation

- The color-based model has high precision but low recall.
- The recall is low because the mini-map keeps fading in between the game.
- Yolo model has high precision and relatively high recall

	Precision	Recall	F1 score
Color-based model	0.88	0.57	0.69
Yolov3 based model	0.96	0.71	0.80

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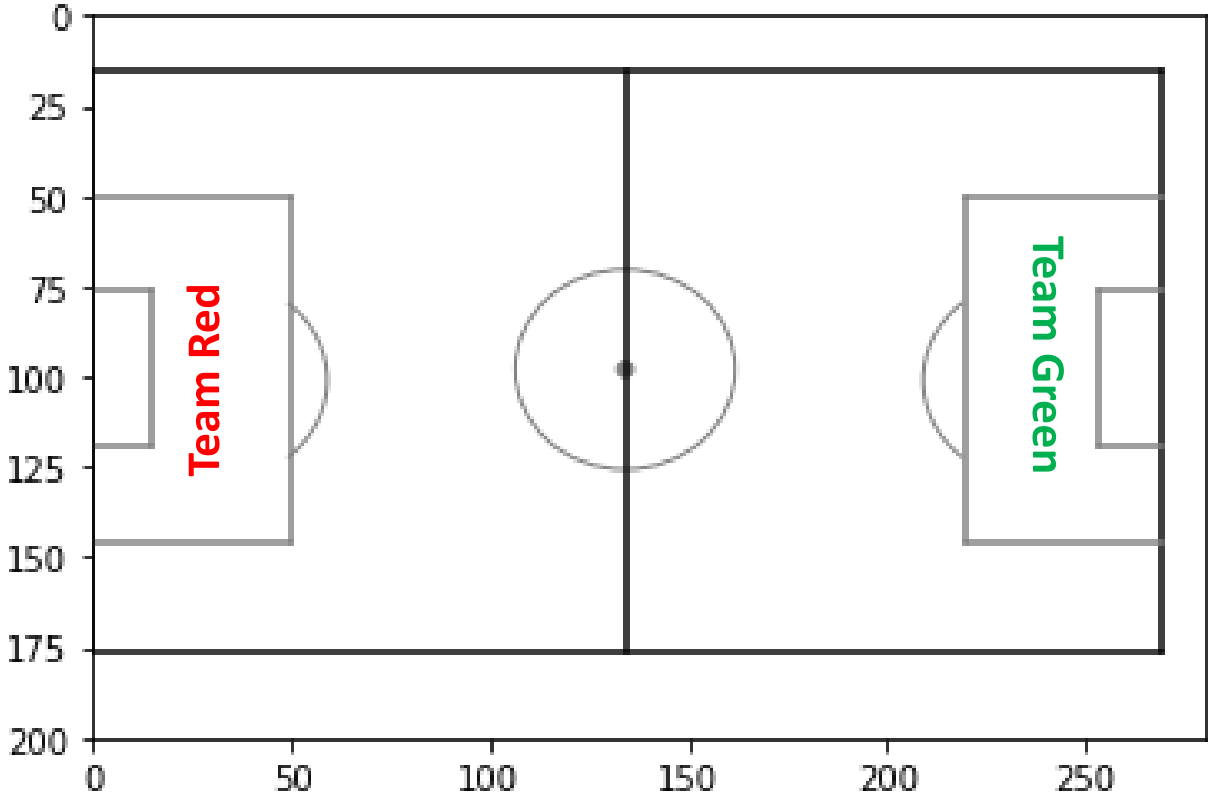
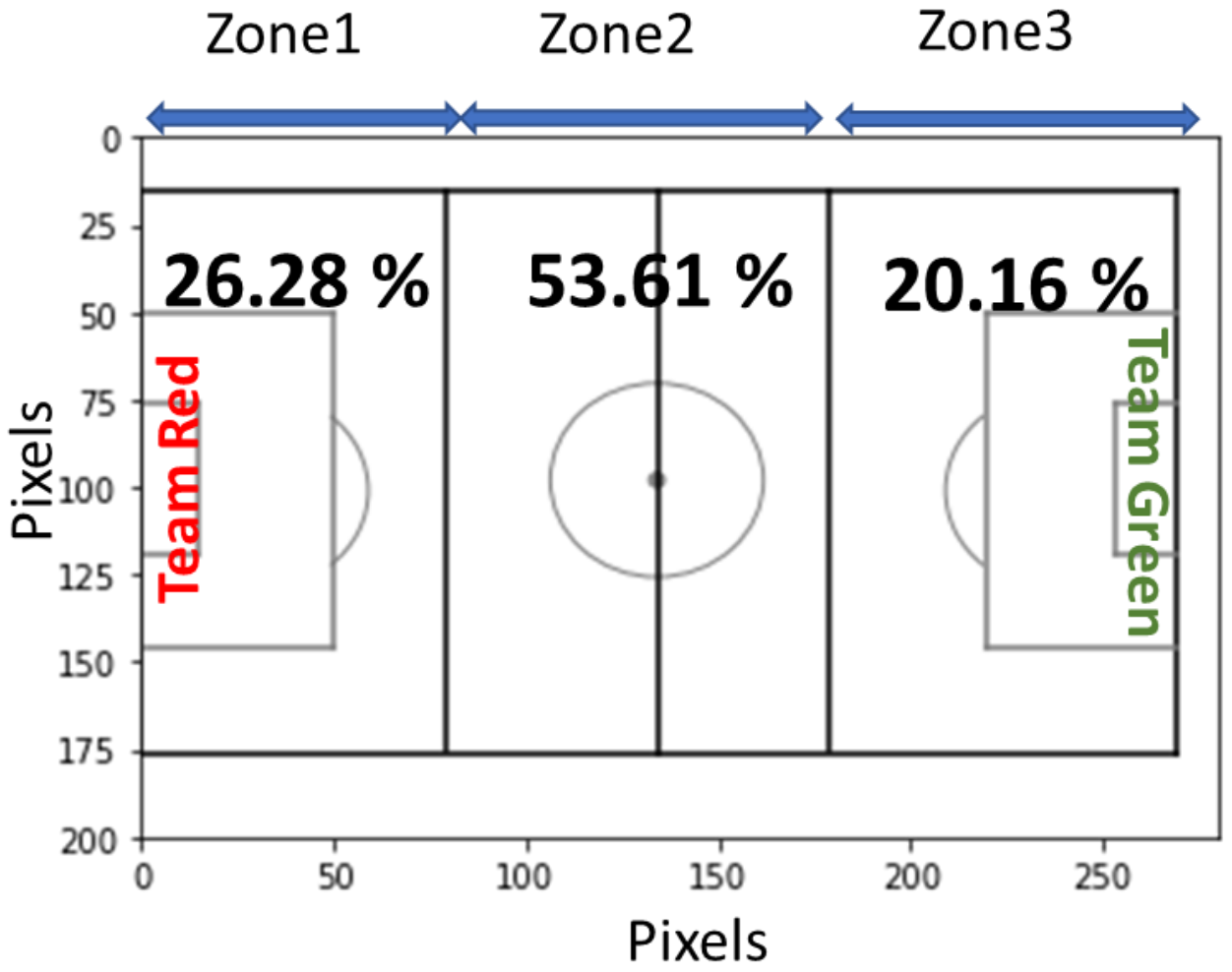
Results

- 1 Video is analyzed.
- Duration: 45 mins
- 2 teams: Team red and Team Green



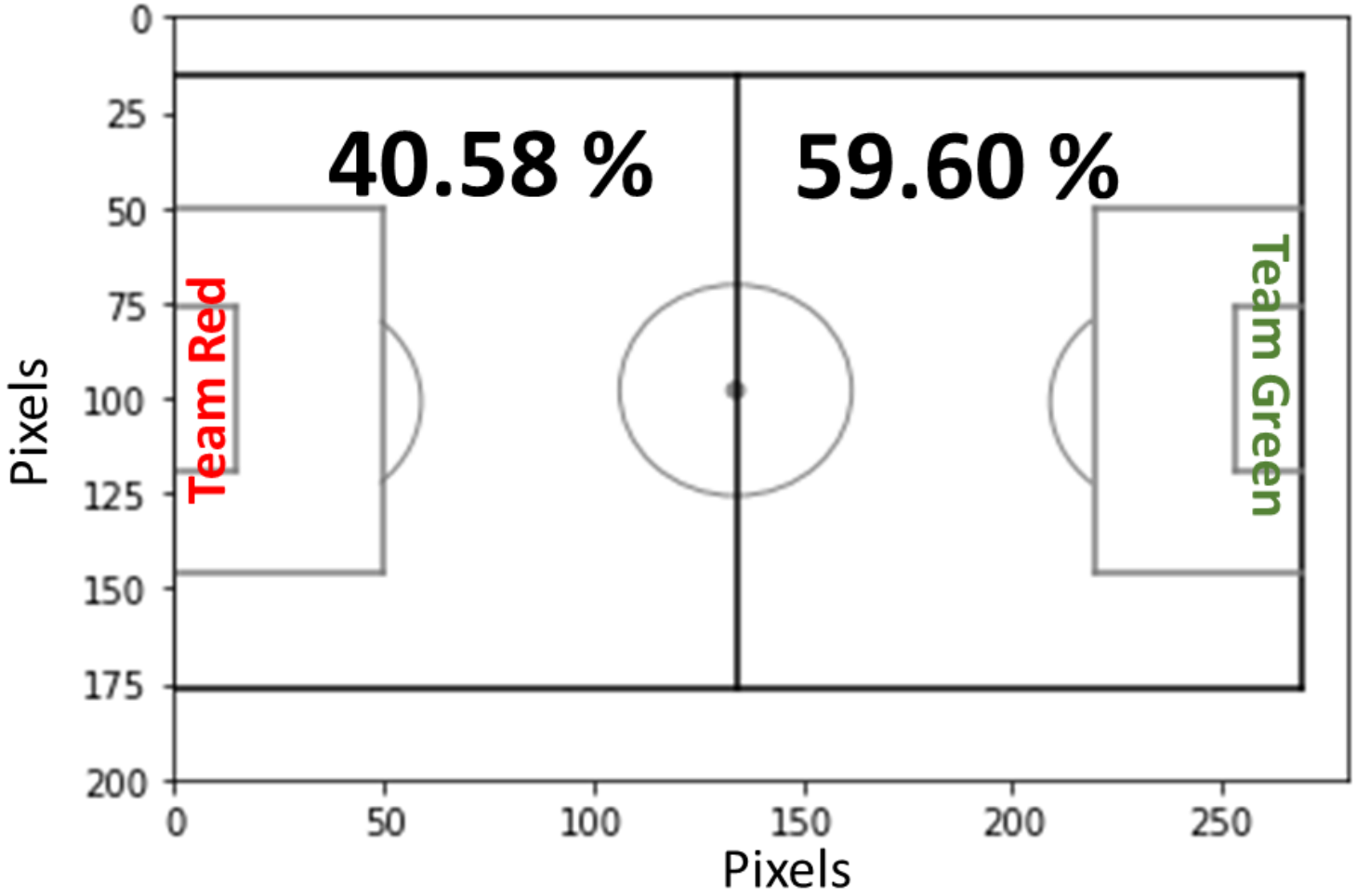
Results – Action Zones

- Field divided into three parts.
- To find out in which area was used the most.
- Most of the match was played in the midfield.



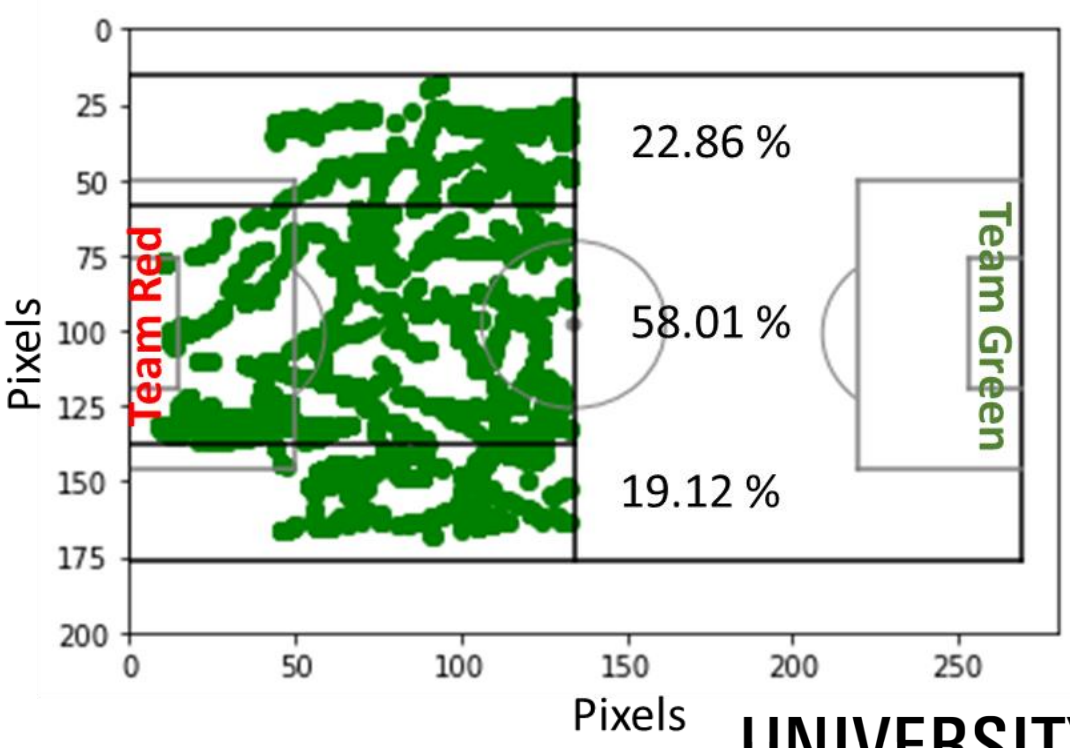
Results – Ball position by halves

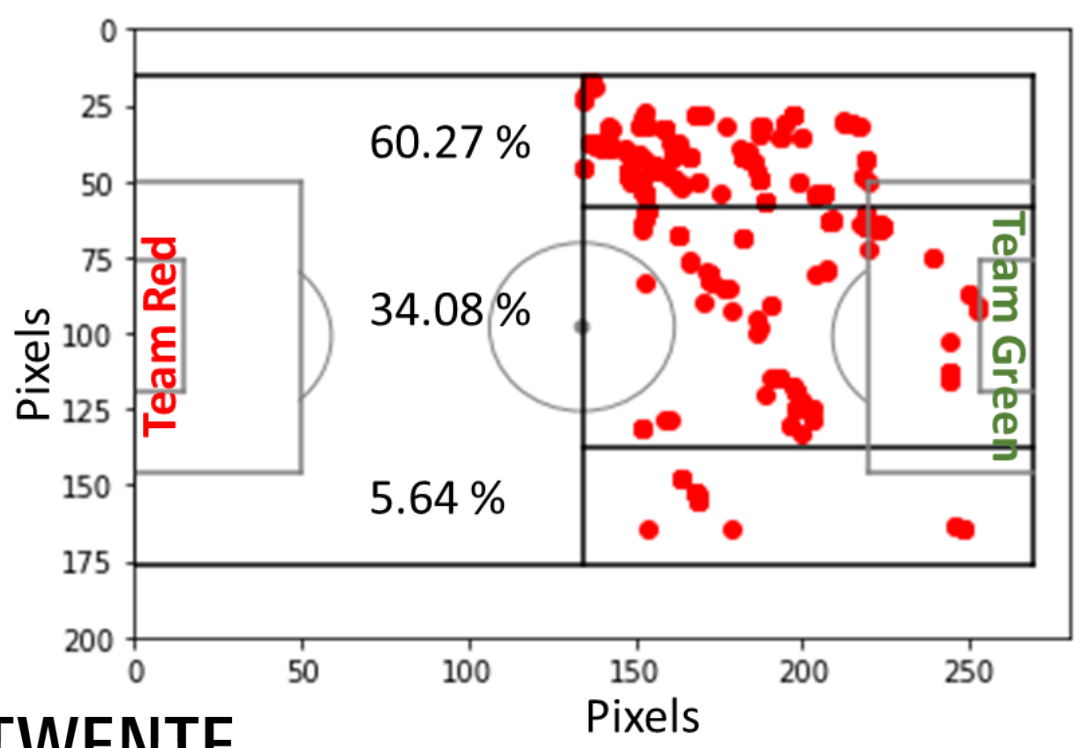
The ball was mostly in the team Green zone



Results – Attack Zones

- Zones used by each team to attack the opponent.
- Team green prefers the mid-zone to attack (left) while team red used the upper zone of the opponent area to attack (right).





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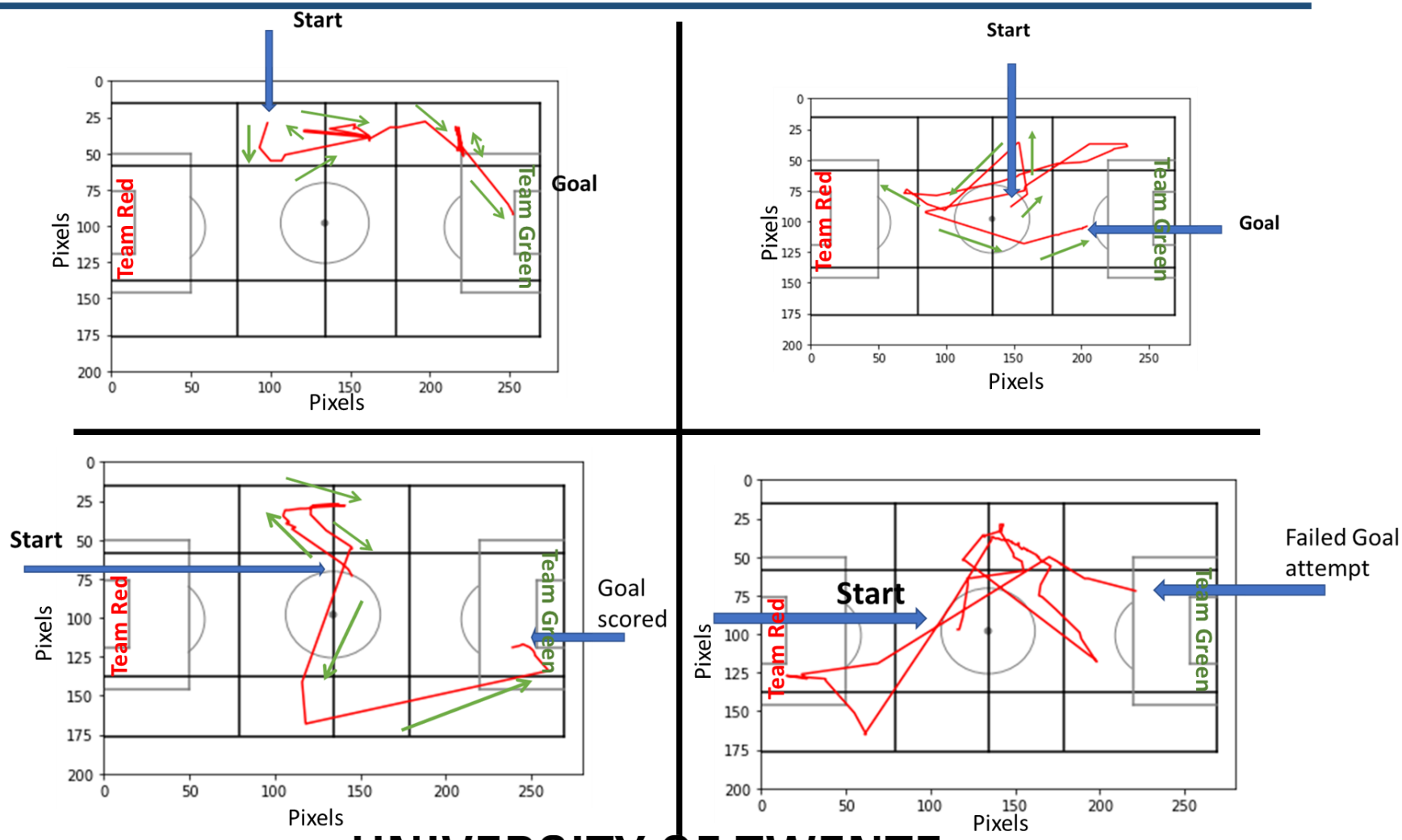
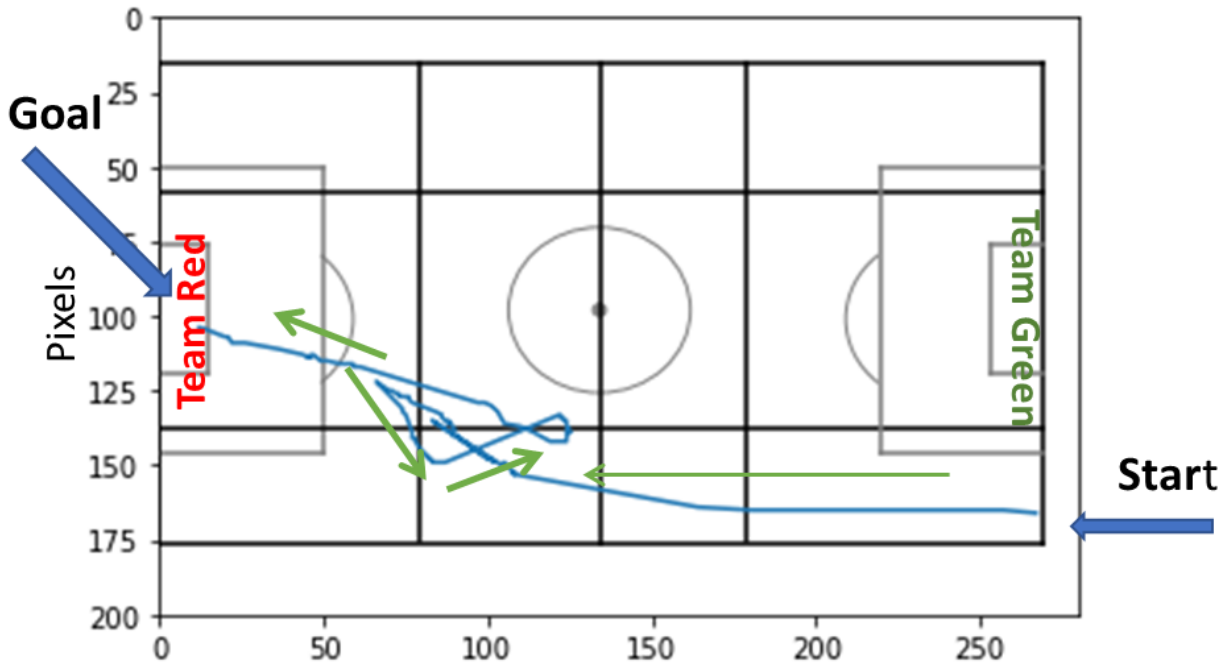
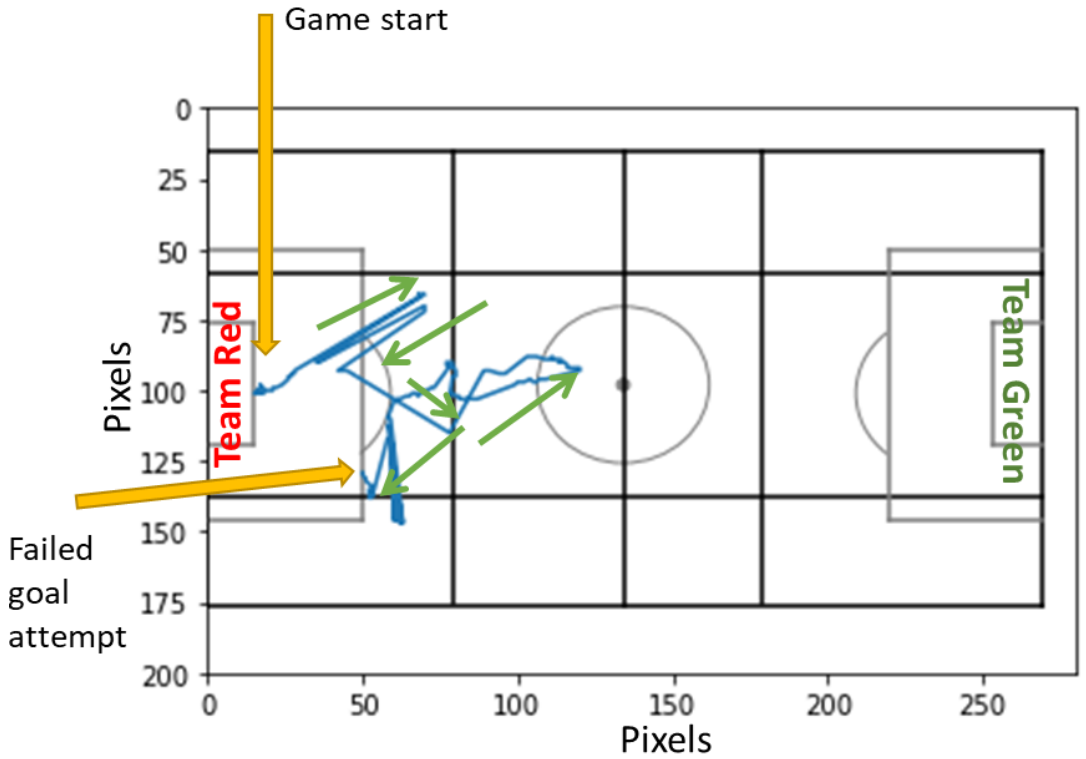
Goal attempts by red team



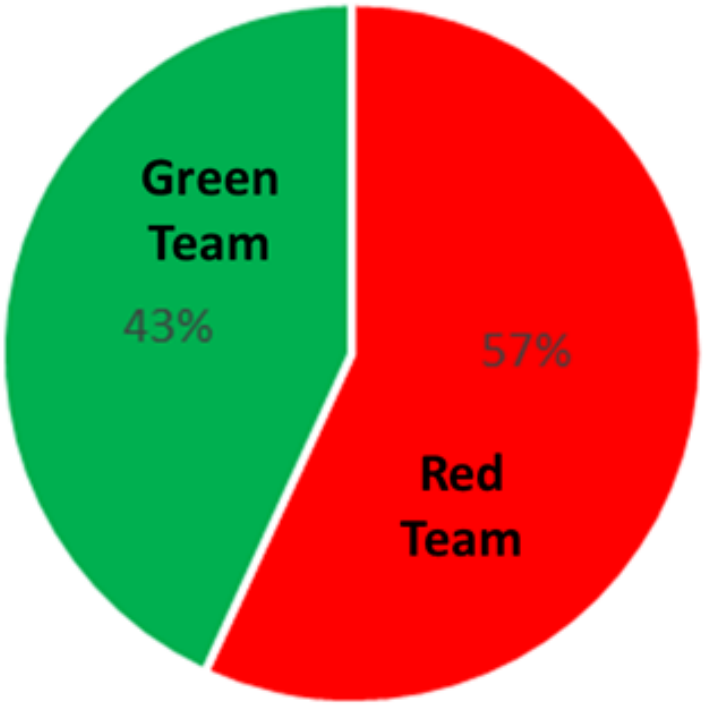
Goal attempts by green team



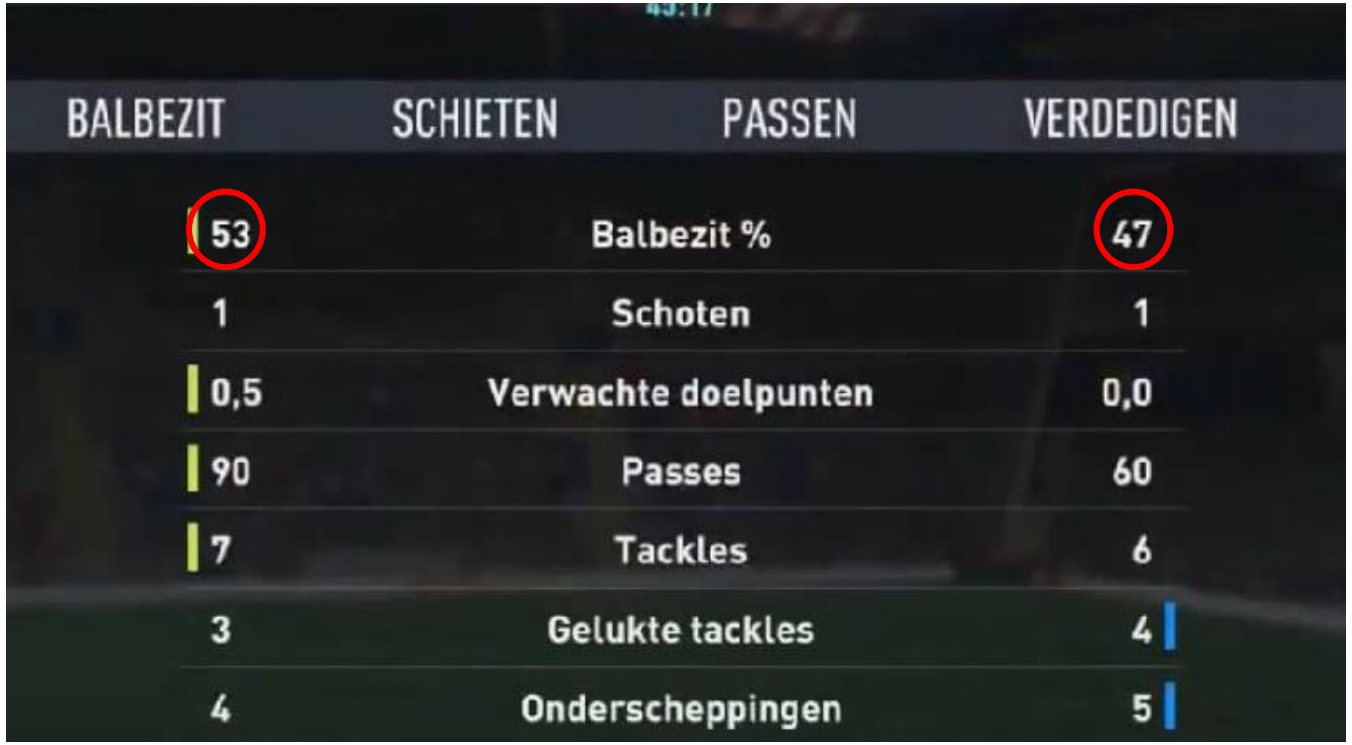


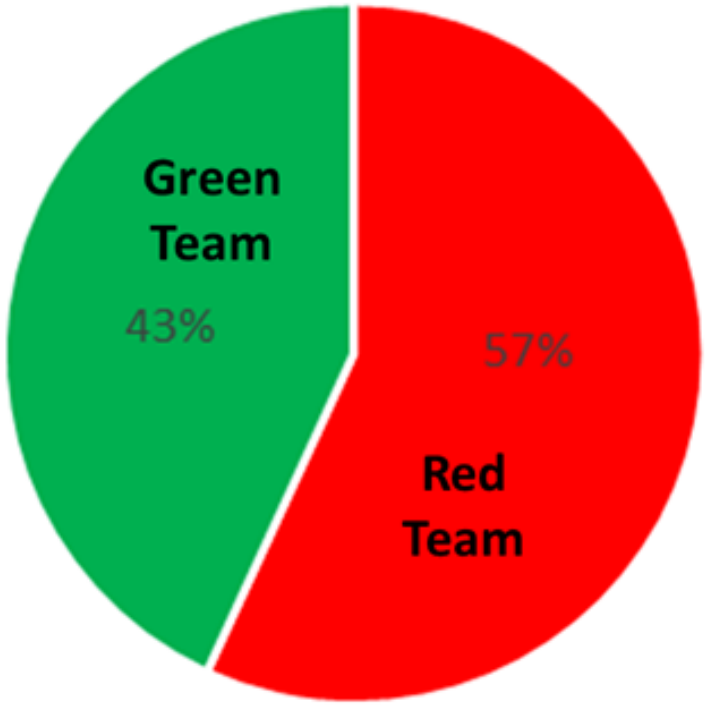
Ball possession

- The red team is mostly in the possession of the ball.
- Also red team score more goals as compared to the team green
- Indicate the red team was in attacking mode



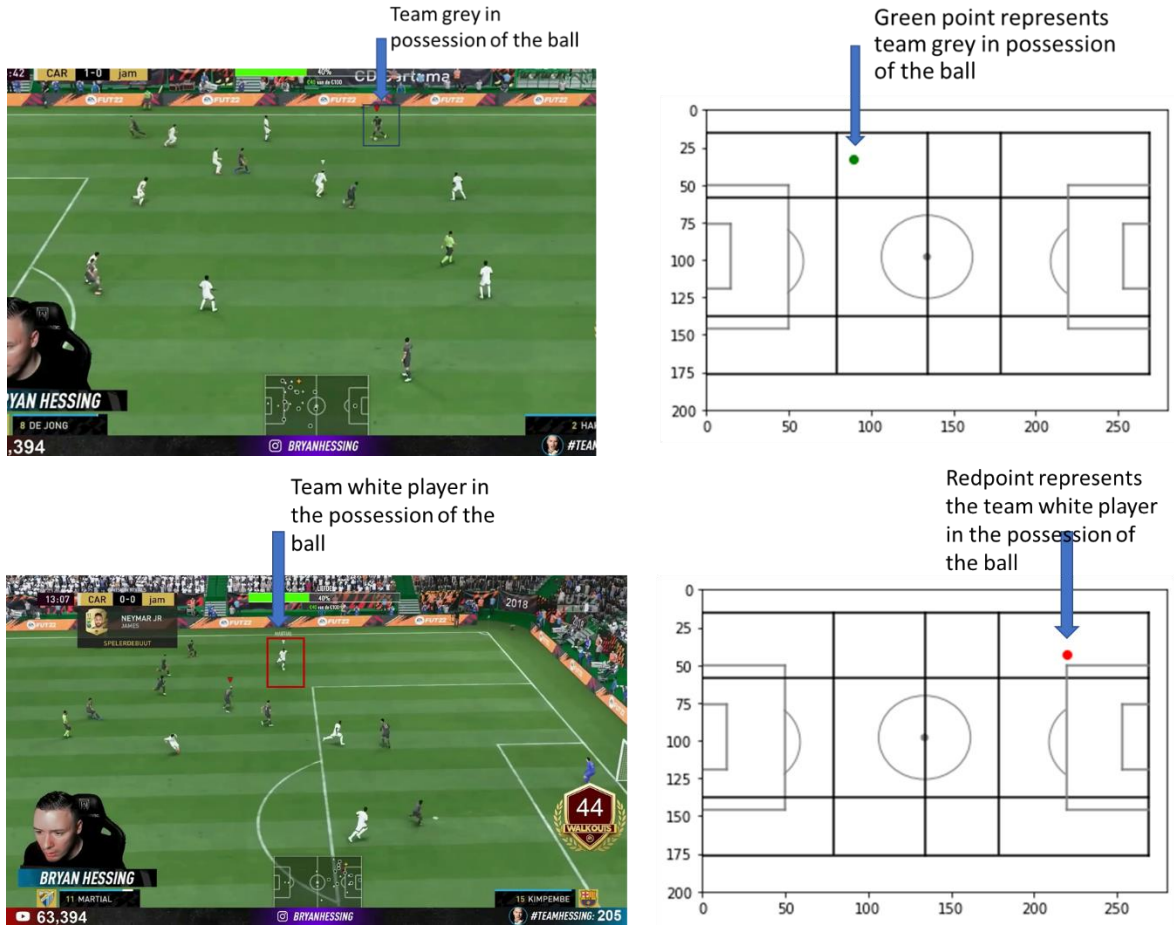
Ball possession





Results from the combined model

- Image shows the location of the ball on the bigger field and the location of the ball on the modeled field.
- Green dot on the upper modeled field shows that the ball is in the possession of the team green player
- The red dot on the lower field shows that the ball is in the possession of the team red player



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Conclusion

Research question 1: How to accurately detect and track ball and players in an eSports FIFA 2022 game video?

- Developed models (Color-based and Yolo) for this purpose.
- Models are capable of detecting and tracking the ball and the players with the precision of 88 % (color-based) and 96 % (Yolo).

Conclusion (contd.)

Research question 2: How the extracted data can be used to determine the game tactics and strategies of the player?

- Successfully able to find the action/attack zones of each team using the extracted data.
- Determined the ball possession by each team during the match.
- Ball path tracking is achieved which can provide strategies of the gamer.
- Can find the playing behavior (aggressive/defensive) of the gamer.

Conclusion (contd.)

Model shortcomings

- Can’t find minute details such as type of kicks.
- Can’t differentiate between players within a team.
- Occlusion can’t be handled.

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Future work

- For better understanding: need to analyze several videos.
- Field modeling from the bigger field.
- Use just one model to increase the operational speed and accuracy.
- Use a larger dataset to train the Yolo model.
- Player specific detection by using techniques such as optical character recognition to read the name on the jersey of the player.