Prediction and Classification of Fouls in Soccer Game using Deep Learning

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Outline

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Introduction

- Computer Vision research in sports is lacking. There are few studies which seem to attention specifically on image classification combined with reinforcement learning or Q-learning and producing agents that can play the game.
- By considering this, They decided to push the partial examination done by applying object detection to video games.
- They applied a real-time detection model to organize and track video game characters from the popular fighting game Super Smash Brothers Melee and constructed a basic bot, capable of measure based on tracked locations of a secondary character on screen.

Related works

- There are some methods try the object tracking.
- Such methods lack in meaningful representation of in between events.
- This urges us to begin from the essential structure squares and recreate a framework that grants abusing the semantic information around event, which can be used to distinguish the high-level and intermediate type of events.

Proposed Work

- They defined the category of events that happen in Soccer game.
  - Low-Level events
  - High-Level events
    - Logical Events
    - Temporal Events

I would explain them individually.

Low-level Events

$SE = (I, simpleEventType, t, (role1, oTypei), \ldots, (rolen, oTypen))$

- I is the attribute that identify each event.
- simpleEventType is the just string like “throwing_the_ball”.
- t means duration of time that event take place
- role1…, rolen (n = 1, nmax) are the task that dissimilar objects play in type of event.
- Ex) The definition of “Throwing the ball”

$(12, Throwing\_the\_ball, t, (throwing\_Player, obj02), (throwed\_Object, obj01))$

High-level Events

- High-level events are built for the purpose of more accuracy. High-level events are detected by the simple events.
- We can use temporal and logical operators to detect high-level event. The hierarchy events are definite by low-level event to high-level event.
- In the following they have two types of complex event one is logical event and another one is temporal event.

Logical Events

$$LCE = (I, complexEventType, t, L =< e1\ op\ e2\ op\ \ldots\ op\ en >)$$

- A logical event originates from the function of logical operators such as NOT, OR, AND to a set of events which might be complex or simple.
- complexEventType is the high-level type of event
- (such as "The goal is valid only if there is no foul“)
- L is the lower-level set of events e1. . . . . en joined by op logical operators (i.e. NOT, AND, OR).

Temporal Events

$$TCE=(I, complexEventType, t, L =< e1\ THEN\ e2\ \ldots\ THEN\ en >)$$

- complexEventType is the high-level type of event (such as “player 1 passes the ball to player 2“.
- L is the arrangement of simple events,e1,en that should follow in the order.
- For precedent,e1, e2, e3, e4 may be, correspondingly,
  - “player1 possesses the ball",
  - “player1 kicks the ball",
  - “the ball approaches player 2",
  - “player2 gets in possession of the ball".

Event Types

- They are explaining a tiny event which is the most complex event in soccer game which are in continuous frames.
- For instance the ball possession and the player stroking the ball found on the distance among the bounding boxes and the rules which is a mix of logical and temporal operations is set for each and every event.
- They divided event types into two types :
  - Ball possession Event
  - Kicking the ball Event

Ball possession Event

- Player ball possession starts when a player starts to kick the ball at initial point and it ends when the ball halt in the field.

  $(I, PlayerBallPossession, t + \overline{k}, (PossPlayer, pi\ ), (PossObject, b))$

- The PBP takes place at the time interval t + k and when the distance D between the ball b and the player pi at time t(pi , b, t) is below the threshold Th and D(pj , b, t) is the distance among any one player pj and the ball b is more than D(pi , b, t)

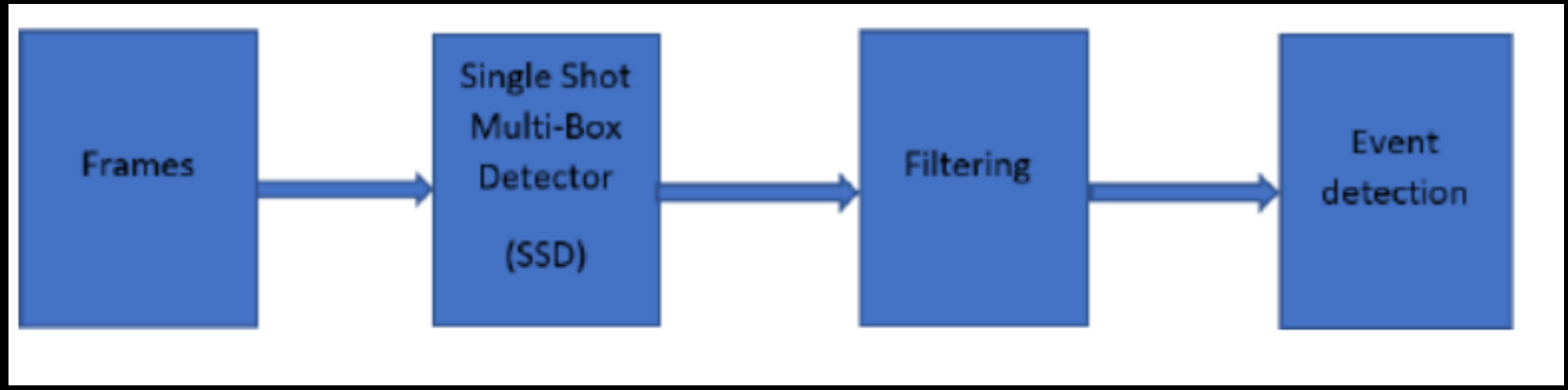
Kicking the ball Event

- The distance among the player and the ball is less and then later the distance among the player and the ball is more for certain number of frames and after certain period of time the interaction between the player and the ball can no longer happen and so we can define the type of event “kicking the ball” as follows:

$$(I, KickingTheBall, t + \overline{k}, (KickingPlayer, pi), (KickedObject, b))$$

- The above expression can hold as long as the distance among the player and the ball raises after the player interact with the ball. In soccer game there are many types of kicks. They are Corner kick, Penalty kick, Goal kick, Free Kick, and so on.

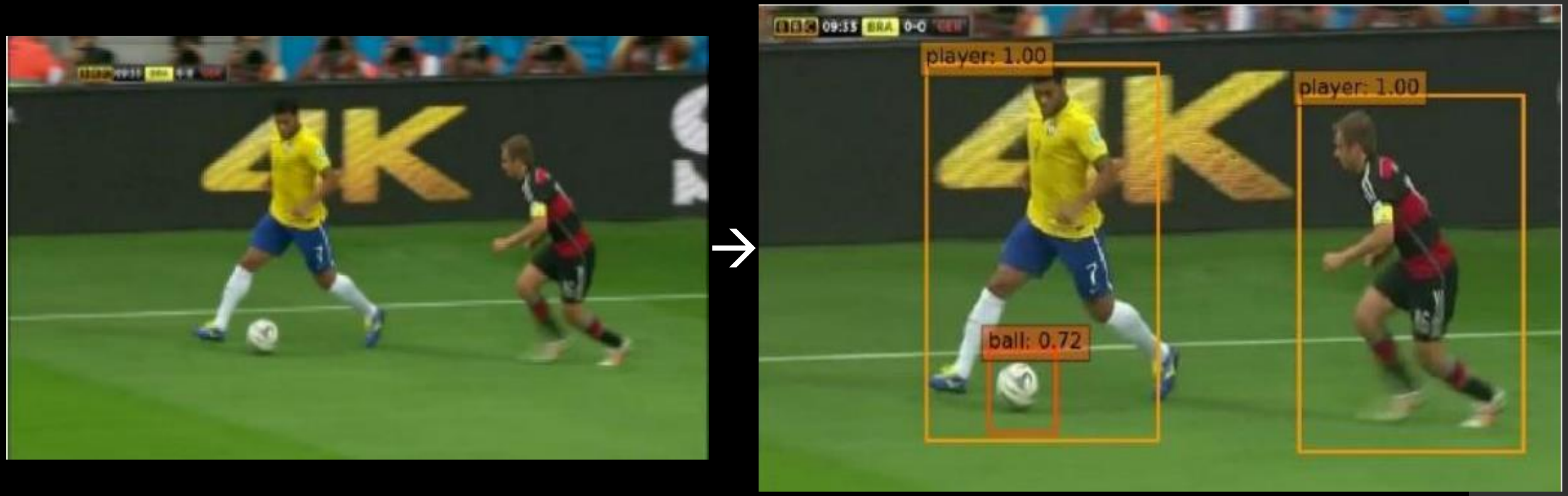
Methodology



1. Frames : Each and every frame consists of bounding box set.
2. SSD : contains two main tasks classifier and region proposal.
3. Filtering : can be done by the particular threshold value of the object detected from the single shot multi-box detector.
4. Event detection : detection and a collection of simple low-level events is done.

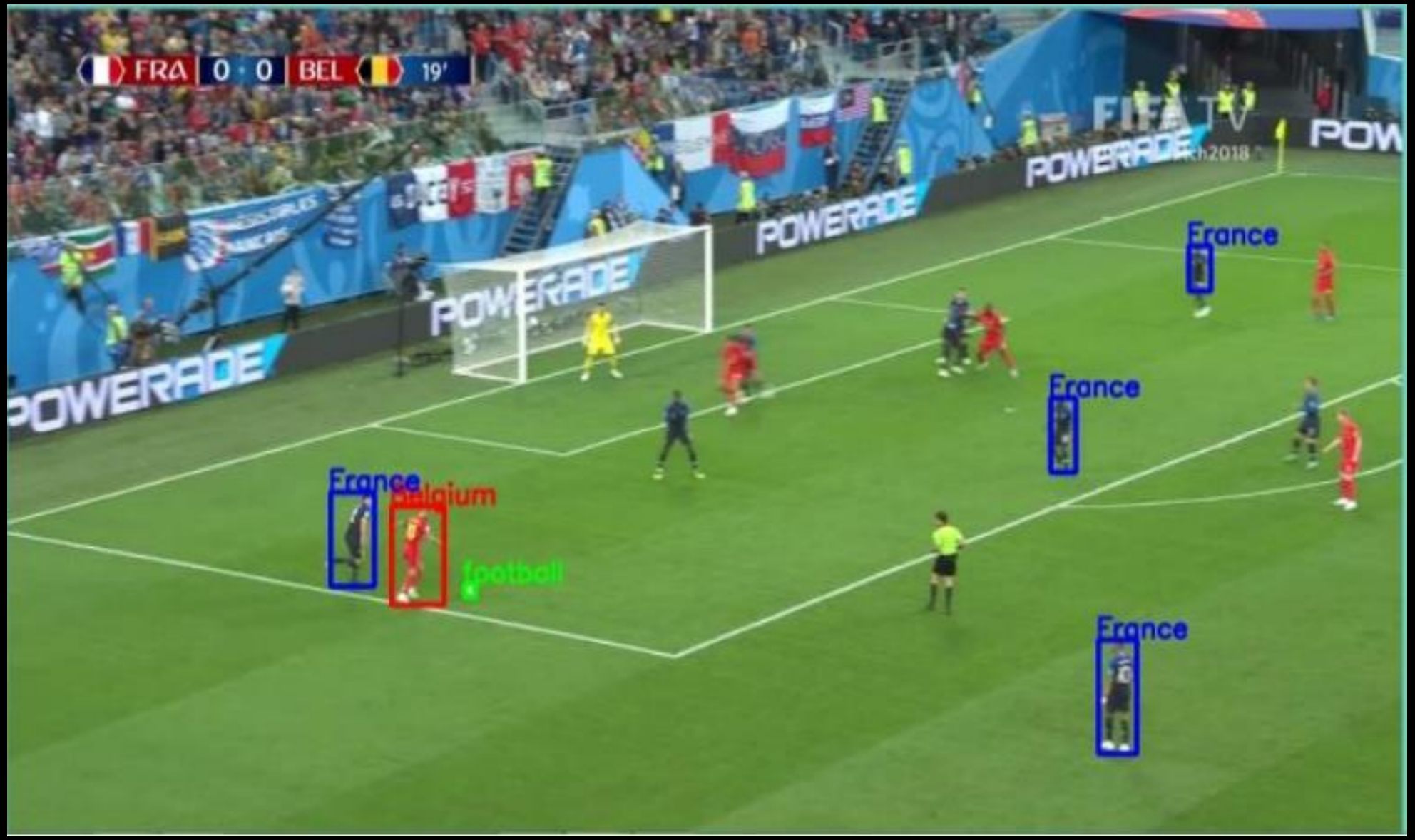
The input data consist of approximately three minutes long video, which consists of about 6200 frames.

Example of SSD input and output

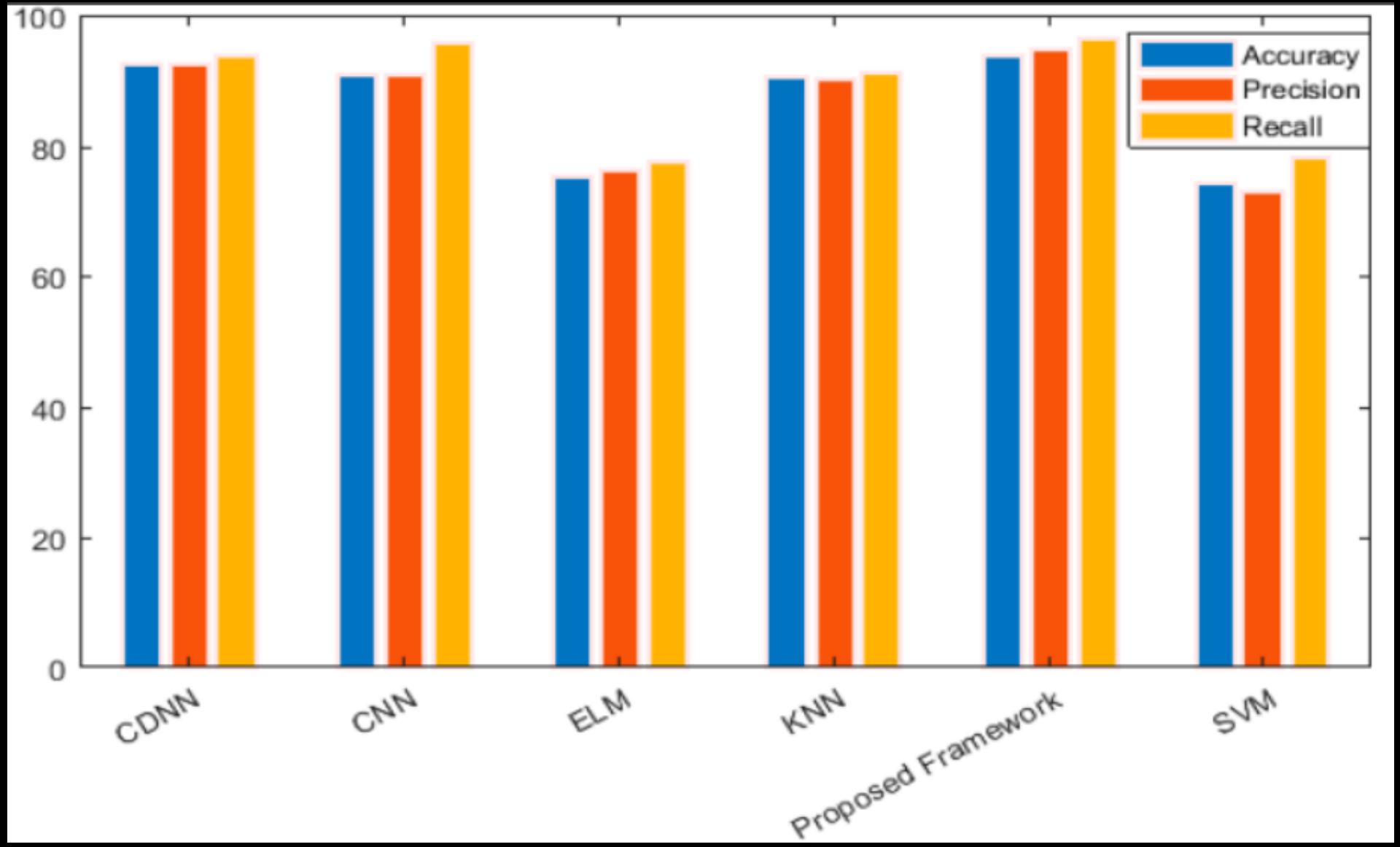


SSD detects the objects with confidence score.

The detection of teammates by color



Comparisons with existing algorithms



Experimental Results

Detected Events	Total	Missed Detection	Accuracy
Ball Possession	10	9	92%
Kicking the ball	15	13	81%
Pass the ball	14	11	84%
Shot on goal	8	7	93%

- This proposed work classify the four events of the football games.
- Kicking the ball : 13 out of 15 events were successfully detected
- Pass the ball : 3 events were missed because when the player kick the ball it reaches another player less than 3 frames.
- Ball possession event we have taken 10 events, 9 events were detected correctly. In missing cases the 2 players are very close to one another. Event detection happen when the players were met in an appropriate number of repeated frames.

Conclusion

- There are numerous events present in the football games and the proposed work tends to classify the four events of the football games.
- The implemented work attains the accuracy of 87.63% with the reduction in the sensitivity and the specificity range of 72.5 and 86.2%.
- For each mass category, the bounding boxes related with a confidence score taken as input for event detection.
- The low-level complex events are successfully detected by the system such as: "Ball possession" and "Kicking the ball ".
- The final results indicate the effectiveness and validity of the proposed technique.