SYSTEM AND METHOD FOR ANALYZING VIDEOS IN REAL-TIME

RELATED APPLICATIONS

[0001] This application claims the benefit of Indian Patent Application No. 202041006309, filed on February 14, 2020, the content of which is incorporated by reference herein in its entirety.

BACKGROUND

[0002] The present invention relates to a system and a method for analysing a video stream. More particularly, the present invention relates to a sports analytics system and a method for analyzing a live video broadcast stream of a sporting event.

[0003] Broadcasting sporting events is a very common practice where spectators are able to experience the events which they missed to attend in person. This also enhances the potential viewership to a wider group of audience, thereby providing significant benefits for broadcasters, teams and sports franchises. Real-time contextual overlays for live broadcast feeds are traditionally done by inserting and presenting contextual information relevant with the potential viewers to augment viewership. However, for sporting events, it requires complex data tracking and analysis to present contextual interactive content in real-time to actively engage the audience with the live broadcast feed. Hence, there is a need for a system and method for analyzing the live video broadcast stream of the sporting event to deliver real-time contextual interactive content for the audience.

[0004] Real-time motion capturing and object tracking is indispensable when it comes to analyzing sporting events. The major aspect in analyzing the live broadcast feed of the sporting event is the recognition of the players in real-time by actively tracing and tracking the players over time to get meaningful insights before presenting it to the audience. Motion capture methods using optical systems, various sensors to measure

three-dimensional (3D) location of the organs of the players and using various pattern recognition techniques are existing in the prior art. However, they require a complex system comprising an array of sensors and dedicated hardware to identify and locate the measurements accurately. Further, this makes it more difficult to perform analytics and deliver the contextual interactive content with accuracy in real-time on the live broadcast feed. Hence, there is a need for a system and method for analyzing the live video broadcast stream of the sporting event to recognize players in a multifaceted technique to deliver contextual interactive content for the audience.

[0005] In a sporting event, the scene is mostly dynamic as the players maneuver themselves alongside other objects based on the nature of the game and circumstances. The existing tracking technologies are inclined towards providing qualitative data on the players and objects but this requires sophisticated techniques and manual efforts to bring the contextual interactive content onto the live broadcast feed. However, the accuracy of the data is not certain and effective. Systems using numerous cameras, sensors and identifiers are used to fetch the useful information. However, these techniques require cumbersome solutions for performing analytics to extract the contextual interactive content from the acquired data which further increases the cost and time spent. Optical 3D measuring techniques fail to provide accurate data due to insufficient viewing angles and distortions as a result of dynamic images. Aforementioned drawbacks lead to aggravation of complications in performing analytics to retrieve useful insights and metrics. Hence, there is a need for a system and method for analyzing the live video broadcast stream of the sporting event to perform accurate sports analytics to deliver contextual interactive content with lot of insights and metrics for the audience.

[0006] The live events usually generate significant revenue for the broadcasting companies and advertisers. When live events such as sports are augmented with contextual interactive content, it will extend their business further followed by higher revenue generation. Sports teams perform lot of analytics to conduct studies on their players and their games to formulate strategies and decisions using extraction of accurate data and an advanced analytics module. Similarly, the broadcasting companies seek such

techniques to augment the monetization potential of the live broadcast feed. The audiences for sporting events expect more engagement with the game and hence there is a need for a system and method for analyzing the live video broadcast stream of the sporting event to deliver more contextual interactive content in real-time. Traditional techniques require complex hardware for implementation and additional cameras either in the playing field/court or elsewhere are needed to capture the data which leads to expensive system requirements.

[0007] A live video broadcast stream consists of a series of frames. Frames per second (fps) indicates the number of frames that exist in a timeframe of 1 second. The duration of a single frame is referred to as frame persistence duration or frame duration (1000ms/fps). For example, in a 25 fps video, each second will consist of 25 frames and each frame will persist on the screen for a total of 1000/25 = 40 ms. To provide contextual interactive content to the audience in real-time, all the processing activities should occur within this timeframe in order keep up with the live broadcast feed. Otherwise, by the time one frame is processed, subsequent frames will be lost. Hence, there is a long felt but unresolved need for a system and a method for analyzing the live video broadcast stream within the frame persistence duration or the frame duration.

[0008] Hence, there is a long felt but unresolved need for a system and a method for analyzing a live video broadcast stream of a sporting event to deliver contextual interactive content for the audience in real-time to enhance their viewership and augment the monetization potential of existing content for the broadcasting companies and advertisers.

SUMMARY OF THE INVENTION

[0009] This summary is provided to introduce a selection of concepts in a simplified form that are further disclosed in the detailed description of the invention. This summary is not intended to determine the scope of the claimed subject matter.

[0010] The sports analytics system and the method disclosed herein address the above recited need for analyzing a live video broadcast stream of a sporting event to deliver contextual interactive content for the audience in real-time to enhance their viewership and augment the monetization potential of existing content for the broadcasting companies and advertisers. Furthermore, the sports analytics system and the method disclosed herein exploits the phase difference between real time messaging protocol stream and a hypertext transfer protocol live stream to complete the processing activities. The sports analytics system incorporates a computer server for analyzing a live video broadcast stream of a sporting event. The sport analytics system comprises a video demuxer, a non-transitory computer readable storage media, and at least one processor. The video demuxer receives the live video broadcast stream of the sporting event from a video capture device and splits the received live broadcast stream into a real time messaging protocol stream and a hypertext transfer protocol live stream. The non-transitory computer readable storage media stores computer program instructions defined by modules of the sport analytics system. The processor is communicatively coupled to the non-transitory computer readable storage media, and the processor is configured to execute the computer program instructions defined by the modules of the sport analytics system. An analytics module analyzes the real time messaging protocol stream within a predetermined time interval. The predetermined time interval corresponds to a phase difference between the real time messaging protocol stream and the hypertext transfer protocol live stream. The predetermined time interval is less than a frame persistence time of a frame. The analytics module comprises a detection module, a tracking module, a recognition module, a comparison module and a transmission module. The detection module detects one or more persons present in a frame of the real time messaging protocol stream, using one or more cues selected from a first set of cues comprising a facial detection, a head detection, a person detection, and a jersey number detection based on availability of the first set of cues.

[0011] The tracking module tracks the detected persons in the frame, by analyzing one or more preceding frames of the real time messaging protocol stream. The recognition module recognizes the tracked persons in the frame using one or more cues selected from

a second set of cues comprising a facial recognition, a person recognition, a jersey recognition, a live score feed of the sporting event, and a commentary of the sporting event based on availability of the second set of cues. The jersey recognition comprises one or more of jersey number classification and team recognition. Individual weights are assigned to each of the facial recognition, the person recognition, and the jersey recognition when the facial recognition, the person recognition, and the jersey recognition are performed in the frame. The individual weights are determined based on clarity of each person recognized in the frame. If any of the facial recognition, the person recognition, and the jersey recognition is unavailable, the recognition module uses one or more of the live score feed and the commentary for the identification of one or more players in the frame. The comparison module identifies one or more players in the frame by comparing the assigned weights for each of the recognized persons with pre-existing data of all players. The transmission module transmits the hypertext transfer protocol live stream and analysis data comprising contextual interactive content of the identified players to a client application provided on a user device by the sports analytics system within the predetermined time interval. The live video broadcast stream is transformed into an interactive video comprising the contextual interactive content of the identified players. The client application comprises an interaction module for providing user interaction with the interactive video.

[0012] The contextual interactive content of the identified players is displayed on the user device without the contextual interactive content of the identified players overlapping existing graphics of the hypertext transfer protocol live stream. The contextual interactive content of the identified players comprises a dynamic display of one or more of a scorecard, a player information, and match statistics and the contextual interactive content of the identified players can be customized and shared on social media. The user can interact with one or more of the identified players in the interactive video. The sports analytics system augments the implementation of on-demand enhanced content by recognizing players of interest and displaying the key metrics of the recognized player such as player's bio, season, career statistics, social media posts and related videos for the user device. The sports analytics system also provides rich content

for users to see the head-to-head comparison of statistics of the players of interest. The sports analytics system further helps to engage the users with the live video broadcast stream by embedding game experience and augments the monetization potential of the existing content for various broadcasting companies and advertisers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The foregoing summary, as well as the following detailed description of the invention, is better understood when read in conjunction with the appended drawings. For illustrating the invention, exemplary constructions of the invention are shown in the drawings. However, the invention is not limited to the specific methods and components disclosed herein.

[0014] FIG. **1** exemplarily illustrates a sports analytics system incorporating a computer server for analyzing a live video broadcast stream of a sporting event.

[0015] FIG. **2** exemplarily illustrates the architecture of a computer server employed by a sports analytics system for analyzing a live video broadcast stream of a sporting event.

[0016] FIG. **3** illustrates a method for analyzing a live video broadcast stream of a sporting event.

[0017] FIG. **4A** exemplarily illustrates a person detection in a frame of a hypertext transfer protocol live stream.

[0018] FIG. **4B** exemplarily illustrates a head detection in a frame of a hypertext transfer protocol live stream.

[0019] FIG. **4C** exemplarily illustrates a face detection in a frame of a hypertext transfer protocol live stream.

[0020] FIG. **4D** exemplarily illustrates a jersey number detection in a frame of a hypertext transfer protocol live stream.

[0021] FIG. **4E** exemplarily illustrates a person detection, a head detection, a face detection, a jersey number detection, and their association in a frame of a hypertext transfer protocol live stream.

[0022] FIG. **5** exemplarily illustrates tracking of a detected person in a frame, by analyzing one or more preceding frames of a real time messaging protocol stream.

[0023] FIG. **6A** exemplarily illustrates a face recognition using extracted embeddings.

[0024] FIG. **6B** exemplarily illustrates a jersey number classification.

[0025] FIG. **6C** exemplarily illustrates a team recognition by extracting embeddings.

[0026] FIG. **6D** exemplarily illustrates a live score feed and a commentary for identifying one or more players in a frame.

[0027] FIGS. **7A-7D** exemplarily illustrates a screenshot of an on-demand enhanced contextual interactive content overlaid on a hypertext transfer protocol live stream of a sporting event.

[0028] FIG. **8** exemplarily illustrates a screenshot of rich contextual interactive content overlaid on a hypertext transfer protocol live stream.

[0029] FIGS. **9A-9B** exemplarily illustrates a screenshot of contextual interactive content overlaid on a hypertext transfer protocol live stream for engagement and game experience for users.

[0030] FIGS. **10A-10D** exemplarily illustrates a screenshot of contextual interactive content overlaid on a hypertext transfer protocol live stream for augmenting monetization potential of existing content.

[0031] FIG. **11** exemplarily illustrates a screenshot of user engagement for enhancing and augmenting monetization potential of existing content at the consumer end.

DETAILED DESCRIPTION OF THE INVENTION

[0032] FIG. **1** exemplarily illustrates a sports analytics system **100** incorporating a computer server for analyzing a live video broadcast stream of a sporting event. As used herein, "live video broadcast stream" refers to a live feed of a video broadcast of a sporting event. The sports analytics system **100** comprises a video demuxer **101**, a non-transitory computer readable storage media **202**, and at least one processor **201** as exemplarily illustrated in FIG. **2**. The video demuxer **101** receives the live video broadcast stream of the sporting event from a video capture device (not shown) and splits the received live broadcast stream into a real time messaging protocol stream **101b** and a hypertext transfer protocol live stream **101a**. The real time messaging protocol stream **101b** is routed to an analytics module **102** for analyzing the sporting event. The hypertext transfer protocol live stream **101a** is encoded for broadcasting to any consumer device platforms such as a web, any iOS device, any android device, or other integrated platforms. Furthermore, an offset based frame synchronization logic is implemented to achieve frame level synchronization across the split streams. The non-transitory computer readable storage media **202** stores computer program instructions defined by modules of the sports analytics system **100**. The processor **201** is communicatively coupled to the non-transitory computer readable storage media **202** and configured to execute the computer program instructions defined by the modules of the sports analytics system **100**. The analytics module **102** analyzes the real time messaging protocol stream **101b** within a predetermined time interval. The predetermined time interval corresponds to a phase difference between the real time messaging protocol stream and the hypertext transfer protocol live stream. The predetermined time interval is less than a frame persistence

time of a frame. The analytics module **102** comprises a detection module **103**, a detection/comparison queue **104**, a tracking module **105**, a recognition module **106**, a comparison module **107**, configuration data module **108** and a transmission module **109**.

[0033] The detection module **103** detects one or more persons present in a frame of the real time messaging protocol stream **101b**, using one or more cues selected from a first set of cues comprising a facial detection **103a**, a head detection **103b**, a person detection **103b**, and a jersey number detection **103c** based on availability of the first set of cues. As used herein, "jersey" refers to any type of garment worn by the persons in the frame. The sports analytics system **100** is capable of detecting the persons in the frame from various angles and orientations. The detection module **103** using a first set of pre-trained models **103d** to detect various cues in the frame. The facial detection **103a** comprises detecting faces of the persons in the frame and creating bounding boxes around the detected faces such that the faces are tightly cropped by the bounding box as illustrated in FIG. **4C**. The person detection **103b** comprises detecting bodies of the persons in the frame in various complex situations such as when the body of the person is either partially visible or fully visible, or when the body of the person overlaps with another person's body. The person detection **103b** comprises creating bounding boxes around all detected bodies of people in the frame as illustrated in FIG. **4A**.

[0034] Similarly, the head detection **103b** comprises detecting heads of the persons in the frame in situations like head either partially visible or head fully visible or head in various orientations and poses. For example, the person's head may be seen from behind, from the front, from the bottom or top or from either side. In some cases the person's head may overlap with another person's head. The output of the head detection **103b** comprises creating bounding boxes around all the detected heads in the frame. Each detected head is associated with a body and the bounding box is made as close to the head as possible and inside the associated person's bounding box, as illustrated in FIG. **4B**. The jersey number detection **103c** comprises detecting jersey numbers on one or more of back, front, shoulders, and other locations on the jersey of the persons in the frame as illustrated in FIG. **4D**. Furthermore, a jersey number detection **103c** comprises

detecting each digit on the jersey individually (even if they act as a part of a multi digit number) using a pre-trained model **103d**. The hierarchy of the detection sequence is a face bounding box contained within a head bounding box which in turn is contained within a person bounding box as illustrated in FIG. **4E**. The output of the detection module **103** is fed into a shared detection/comparison queue **104** for further processing.

[0035] The tracking module **105** tracks the detected persons in the frame, by analyzing one or more preceding frames of the real time messaging protocol stream **101b** as illustrated in FIG. **5**. The tracking module **105** associates the detected person across a contiguous collection of frames, essentially capturing the movement of that person. Furthermore, the tracking module **105** employs a hybrid tracking algorithm to track the detected persons in the frame using a multi-object tracking approach. The detected persons are tracked in the frame continuously in real-time and the frames are processed independently to identify numerous objects in the particular frame. The hybrid tracking algorithm implements a learning technique to track the detected persons using Kalman filter prediction **105a**, feature tracking **105b** and Intersection Over Union (IOU) **105c** using a second set of pre-trained models **105d**.

[0036] The recognition module **106** recognizes the tracked persons in the frame using one or more cues selected from a second set of cues comprising a facial recognition **106a**, a person recognition **106b**, a jersey recognition **106c**, a live score feed of the sporting event **106d**, and a commentary of the sporting event **106d** based on availability of the second set of cues. The recognition involves processes such as classification, extraction of embeddings, computation of similarity features using metrics like cosine distance, square euclidean distance, etc. Each recognition has a confidence value associated with it and only if the confidence value of a predicted recognition exceeds a previously set threshold confidence value, the prediction is considered. This decreases the possibility of false positives, and makes the recognition more accurate.

[0037] The facial recognition **106a** comprises extracting embeddings from a detected face and they are compared to another array of embeddings obtained from a previously

collected static set of high resolution images as illustrated in FIG. **6A**. The facial recognition **106a** is based on similarity between the embeddings. Furthermore, parameters such as pose, size of face, colour of skin, and orientation towards camera do not affect the facial recognition **106a**. The jersey recognition **106c** comprises one or more of jersey number classification and team recognition. The jersey number classification is used to classify each of the detected digits of the jersey into one or more classes as illustrated in FIG. **6B**. Furthermore, multiple digits that belong to the same jersey number are associated with each other based on either their relative position or font. The jersey number classification maintains a queue system to minimize the possibility of isolated cases of false positives. The team recognition comprises extracting embeddings from the person bounding box and comparing against an array of previously computed embeddings as illustrated in FIG. **6C**. The team recognition uses jersey colour as the distinguishing parameter and performs recognition based on the similarity between the embeddings.

[0038] Individual weights are assigned to each of the facial recognition **106a**, the person recognition **106b**, and the jersey recognition **106c** when the facial recognition **106a**, the person recognition **106b**, and the jersey recognition **106c** are performed in the frame. The individual weights are determined based on clarity of each person recognized in the frame. The recognitions predicted by the recognition module **106** have an associated confidence measure based on which a final inference is made. Then the recognitions are then pushed to the detection/comparison queue **104** where the predictions with a low confidence measure are retained to reflect on future decisions. As used herein, “individual weights” refers to a score generated for the detection of one or more of the second set of cues. For example, the sports analytics system **100** actively recognizes the tracked persons in the frame of a live cricket video and assigns individual weights to each one of them depending on one or more of the second set of cues determined for the persons in the frame.

[0039] If any of the facial recognition **106a**, the person recognition **106b**, and the jersey recognition **106c** is unavailable, the recognition module **106** uses one or more of the live

score feed **106d** and the commentary **106e** for identifying one or more players in the frame as illustrated in FIG. **6D**. The recognition module **106** uses a third set of pre-defined models **106f** to perform recognition. For example, when a player A exists in the frame wherein the jersey number is slightly occluded but the face is clearly visible, the weightage given to the "face recognition" is higher than that given to the "jersey number recognition". On the other hand, when a player B exists in the frame wherein the jersey number is clearly visible and the face is slightly occluded, the weightage given to the "jersey number recognition" is higher than that of the "face recognition". Furthermore, the sports analytics system **100** backfills the detections using player tracking. For example, if a person's detection cues such as face detection **103a,** and jersey number detection **103b**, are not visible to provide enough confidence to uniquely detect the player at some point of time "t" in a particular track, but become available at some other point of time "t+n" in the same track, using backfilling and tracking, the system is able to identify the person throughout the extant of the track as illustrated in FIG **5**.

[0040] The comparison module **107** identifies one or more players in the frame by comparing the assigned weights for each of the recognized persons with pre-existing data of all players. The detections, tracks, and recognitions, along with various confidence levels extracted from the detection module **103**, tracking module **105** and recognition module **106** are fed into the decision/comparison queue **104**. The sports analytics system **100** uses the extracted output from the independent modules to make the final inference to greatly reduce the false positives predicted to improve the system output. In terms of player recognition, each sport comprises its own characteristics in terms of markers available for the various modules to use in order to perform recognitions. For example, American Football players' faces are not available as markers to recognize as the players wear helmets, while Golfers do not have numbers on their playing uniforms. So the system considers weights **107a** of various available cues that are imperative in the context of recognition of sports players. In addition, the knowledge of previously made inferences **107b** is also used to arrive at the final prediction and processed in an output monitoring unit **107c** via a buffer **107d.**

[0041] The sports analytics system **100** processes the output from various modules and generates contextual interactive content within the predetermined time interval. The sports analytics system **100** exploits the phase difference between the real time messaging protocol stream and hypertext transfer protocol live stream to deliver contextual interactive content. The predetermined time interval is less than the frame persistence time of the frame. The sports analytics system **100** uses the inherent time-gap in order to service the additional time buffer required by its various modules. Furthermore, each module in the sports analytics system **100** can be configured with configuration data **108** via a network **110**. The configuration data **108** could be at least one of machine learning models, game specific data, video/stream specific data, etc. Furthermore, the configuration data **108** can be updated in real-time during the processing of the real time messaging protocol stream **101b**. In an embodiment, a dashboard is configured to control and monitor the processes performed by the sports analytics system **100**.

[0042] The transmission module **109** of the sports analytics system **100** is configured to transmit the hypertext transfer protocol live stream and analysis data comprising contextual interactive content of the identified players to a client application **111a** provided on a user device **111** by the sports analytics system **100** within the predetermined time interval. In effect the sports analytics system **100** transforms the live video broadcast stream into an interactive video comprising the contextual interactive content of the identified players and makes the interactive video available on the user device **111**. The client application **111a** comprises an interaction module **111b** for providing user interaction with the interactive video. As used herein, “client application” refers to an application installed on the user device that is used for user interaction. Also, as used herein, “user device” refers to any device used for user interaction, but not limited to, mobile communication devices, cellular phones, personal digital assistants (PDAs), digital cameras, laptop computers, tablet computers, and netbooks.

[0043] The contextual interactive content of the identified players is displayed on the user device **111** without the contextual interactive content of the identified players overlapping existing graphics of the hypertext transfer protocol live stream. The

contextual interactive content is transmitted as on-demand enhanced content to the live video broadcast stream in real-time to enhance the user interaction and increased viewership. The contextual interactive content of the identified players comprises a dynamic display of one or more of a scorecard, player information, and match statistics and the contextual interactive content of the identified players can be customized and shared on social media. The contextual interactive content of the identified players also includes information about the player, player statistics and player biography. The contextual interactive content of the identified players could be customized according to the requirements and optionally shared on any social media platforms. In some embodiments, the contextual interactive content of the identified players can be customized to a particular season and corresponding player statistics in that season. In another embodiment, one or more social media posts of the players and teams are provided as on-demand enhanced content. In another embodiment, head-to-head statistics of customized players are provided as rich content especially for the users to enhance their viewing interaction. The interaction module **111b** provides rich content for the users in real-time, more engagement and a game experience platform for interested users and augments monetization potential of existing content for various broadcasting companies and advertisers. The user can interact with one or more of the identified players in the interactive video. As used herein, "user" refers to any end user of the application, for example, a sports fan watching a game on one of the aforementioned devices.

[0044] In an embodiment, the sports analytics system **100** provides recognition driven interactivity to enable viewers to get information about the identified players. The sports analytics system **100** allows the user to interact with the identified player on the screen of the user device. For example, the when a player is identified, visual cues such as an associated icon and/or marker is displayed on the screen such that the user is notified on the recognized player and thereby opening the gateway for interaction. The contextual interactive content is customized based on the detection of the cues to suit the requirements of the user. In another embodiment, the sports analytics system **100** allows the users to interact with more than one recognized player in the frame by notifying them with an option to choose the interested player from the identified players. For example, if

multiple players are recognized at any point of time, an array of associated icons and/or markers are displayed so that the user is able to choose any player of interest for interaction.

[0045] The sports analytics system **100** provides user interactivity with and around the existing graphical assets in the hypertext transfer protocol live stream **101a**. The sports analytics system **100** dynamically overlays the contextual interactive content layout around the graphics embedded in the hypertext transfer protocol live stream **101a**. As used herein, "graphics" refers to any information such as scorecards, player statistics, player information, etc. displayed along with the hypertext transfer protocol live stream **101a**. The sports analytics system **100** recognizes the co-ordinates of graphical assets on the screen that is part of the hypertext transfer protocol live stream **101a** and ensures that the additional overlays do not overlap with each other so as to provide a good user experience. Furthermore, the sports analytics system **100** provides extensive information for the user as on-demand contextual interactive content on top of the overlaid graphics in the hypertext transfer protocol live stream **101a**. For example, when a user clicks on the scorecard, an extensive version of the scorecard opens up to disclose a variety of information which was previously unavailable. Further, users can also interact and customize the extensive version of the scorecard such that the user will have access to a larger variety of on-demand contextual interactive content in real-time.

[0001] FIG. **2** exemplarily illustrates the architecture of a computer server employed by a sports analytics system **100** for analyzing a live video broadcast stream of a sporting event. The computer system **200** comprises, for example, a processor **201**, a non-transitory computer readable storage medium such as a memory unit **202** for storing programs and data, an input/output (I/O) controller **203**, a network interface **204**, a data bus **205**, a display unit **206**, input devices **207**, a fixed media drive **208**, output devices **210**, etc. The computer server **200** may optionally comprise a removable media drive **209** for receiving removable media. The processor **201** retrieves instructions for executing the modules, for example, **103**, **104**, **105**, **106**, **107**, **108** and **109**, of the sports analytics system **100** from the memory unit **202**.

[0046] FIG. **3** illustrates a method for analyzing a live video broadcast stream of a sporting event. The method disclosed herein employs a sports analytics system **100** comprising at least one processor **201** configured to execute computer program instructions for analyzing a live video broadcast stream of a sporting event. The sports analytics system **100** receives **301**, using a video demuxer **101**, the live video broadcast stream of the sporting event from a video capturing device. The video demuxer **101** of the sports analytics system **100** splits **302** the live broadcast stream into a real time messaging protocol stream **101b** and a hypertext transfer protocol live stream **101a**. The sports analytics system **100** analyzes **303** the real time messaging protocol stream **101b** within a predetermined time interval. The predetermined time interval comprises a phase difference between the real time messaging protocol stream and the hypertext transfer protocol live stream. The predetermined time interval is less than a frame persistence time of the frame. The sports analytics system **100** detects **303**a one or more persons present in a frame of the real time messaging protocol stream, using one or more cues selected from a first set of cues comprising a facial detection, a head detection, a person detection, and a jersey number detection based on availability of the first set of cues.

[0047] The sports analytics system **100** tracks **303b** the detected persons in the frame, by analyzing one or more preceding frames of the real time messaging protocol stream. The sports analytics system **100** recognizes **303c** the tracked persons in the frame using one or more cues selected from a second set of cues comprising a facial recognition **106a**, a person recognition **106b**, a jersey recognition **106c**, a live score feed of the sporting event **106d**, and a commentary of the sporting event **106e** based on availability of the second set of cues. The jersey recognition **106c** comprises one or more of jersey number classification and team recognition. Individual weights are assigned to each of the facial recognition **106a**, the person recognition **106b**, and the jersey recognition **106c** when the facial recognition **106a**, the person recognition **106b**, and the jersey recognition **106c** are performed in the frame. The individual weights are determined based on clarity of each person recognized in the frame. If any of the facial recognition **106a**, the person recognition **106b**, and the jersey recognition **106c** is unavailable, one or more of the live

score feed **106d** and the commentary **106e** is used for the identification of the one or more players in the frame. The sports analytics system **100** identifies **303d** one or more players in the frame by comparing the assigned weights for each of the recognized persons with pre-existing data of all players.

[0048] The sports analytics system **100** transmits **303e** the hypertext transfer protocol live stream **101a** and analysis data comprising contextual interactive content of the identified players to a client application **111a** provided on a user device **111** by the sports analytics system **100** within the predetermined time interval. Therefore, the live video broadcast stream is transformed into an interactive video comprising the contextual interactive content of the identified players. The contextual interactive content of the identified players is displayed on the user device without the contextual interactive content of the identified players overlapping graphics of the live video broadcast stream of the sporting event. The contextual interactive content of the identified players comprises a dynamic display of one or more of a scorecard, player information, and match statistics and the contextual interactive content can be customized for sharing on the social media. The user can interact with one or more of the identified players in the interactive video.

[0049] FIGS. **7A-7D** exemplarily illustrates a screenshot of an on-demand enhanced contextual interactive content overlaid on a hypertext transfer protocol live stream **101a** of a sporting event. The contextual interactive content is displayed without overlapping existing graphics displayed on the hypertext transfer protocol live stream **101a** of the sporting event. As used herein, "contextual interactive content" refers to any on-demand enhanced content that is streamed onto the user device 111 in real-time to enhance the user interaction and increased viewership. **FIG. 7A** illustrates an exemplary screenshot of a rendering of a contextual overlay which renders the contextual interactive content comprising a dynamic display of one or more of a scorecard, player information, and match statistics. **FIG. 7B** illustrates an exemplary screenshot of a rendering of a biography of the batsman in the cricket game. **FIG. 7C** illustrates an exemplary screenshot of a rendering of a player statistics of the batsman in the cricket game. The

sports analytics system **100** renders the contextual interactive content of the recognized player to display the overall statistics of the player across different formats of the games such as total number of matches played, number of catches taken, total number of runs, strike rate, batting average, etc., The contextual interactive content could be customized according to the requirements and optionally shared on any social media platforms. In some embodiments, the user can get access to player statistics for a particular season. In another embodiment, one or more social media posts of the players and teams are provided as on-demand enhanced content as exemplarily illustrated in **FIG. 7D**. This includes interactive information of the player such as photos, videos, etc.

[0050] FIG. **8** exemplarily illustrates a screenshot of rich contextual interactive content overlaid on a hypertext transfer protocol live stream **101a**. A head-to-head statistics of customized players are provided as rich content especially for the users to enhance their viewing interaction. The sports analytics system **100** shows the head-to-head comparison of key players in the match on their statistics and relevance to the game played on the match day. FIGS. **9A-9B** exemplarily illustrate screenshots of the rich contextual interactive content overlaid on the hypertext transfer protocol live stream **101a** for engagement and viewing experience for users. The rich contextual interactive content is customized to improve the engagement and provide an augmented viewing experience for the users. For example as shown in **FIG. 9A**, in a sporting event such as cricket, the rich contextual interactive content is delivered onto the hypertext transfer protocol live stream **101a** in the form of a poll asking the users to select their favourite playing team. Again, this type of rich contextual interactive content improves the engagement of the users significantly for boosting the viewership. In some embodiment, this could be customized as a legal betting game enabling the users to bet on their favourite team or players for exchange of any reward. However, the sports analytics system **100** could be used for other sporting events to achieve desired results.

[0051] In one embodiment as exemplarily shown in **FIG. 9B**, the rich contextual interactive content in the form of a fantasy sports game is overlaid to keep the users actively engaged with the hypertext transfer protocol live stream **101a**.

[0052] FIGS. **10A-10D** exemplarily illustrate screenshots of the rich contextual interactive content overlaid on a hypertext transfer protocol live stream **101a** for augmenting monetization potential of an existing content. The rich contextual interactive content is generated to augment the monetization potential of the existing content for the broadcasting companies and advertisers. The rich contextual interactive content could be at least one of a targeted advertisement, ticket sale and branded merchandise. In another exemplary embodiment as illustrated in **FIG. 10C,** the sports analytics system **100** augments the monetization potential by transmitting the rich contextual interactive content on the branded merchandise relevant to the identified players and teams to invite the users to buy online directly from their portal. Similarly, one or more targeted advertisements could be presented based on the recognition of the cues as shown in **FIG. 10C**. For example, when the sports analytics system **100** recognizes and tracks a player A from a Team A for a predetermined time interval, it can push targeted advertisement for any brand relevant to the player A. In another exemplary embodiment as shown in **FIG. 10D**, the monetization potential is also increased by transmitting a ticket selling platform onto the user device 111 to allow the users to book a ticket for themselves for any subsequent games of the season in the sporting event. For example, when Team A is playing against Team B in a knock out game of a cricket league, the sports analytics team recognizes the cues and detects the players and/or team to transmit the ticket selling platform to give an option for the users to buy tickets for the next game depending on the outcome of the ongoing game.

[0053] The sports analytics system **100** enhances video streams by providing an interactive layer for user-engagement. The sports analytics system **100** introduces interactivity and allows for personalizing content for increasing the viewer engagement by performing multi-faceted video and user analytics. The sports analytics system **100** captures user information about the users accessing the content. Users demographics, favourite brands, social profile, digital spending information, favourite teams and/or players, time spent on the platform to access contextual interactive content, etc. are captured to deliver personalized content delivery thereby augmenting the monetization.

Similarly, the sports analytics system **100** allows the content owners to deliver rich contextual advertisement by recognizing who is on screen and identifying what a user is actually clicking on the contextual interactive content in the hypertext transfer protocol live stream **101a**. As shown in FIG. **11**, real-time recognition is a vital part of this augmentation, as it aids in providing context to make the content more relevant. The sports analytics system **100** is made available on clients' websites through a plugin or can be integrated with clients' applications (Android/iOS) through an SDK. Further, the sports analytics system **100** pumps real-time frame level recognition data into a real-time database, along with other data components such as configuration data, player/team information, live game statistics, games for fans such as polls or fantasy, or an online marketplace. This data is downloaded periodically in the plugin/SDK using which the interactivity layer is presented to consumers. With this setup, users can access/interact with the aforementioned value additions. The sports analytics system **100** accepts video streams in various formats such as hypertext transfer protocol live stream inbuilt in the plugin/SDK. The plugin/SDK also handles the synchronization of the hypertext transfer protocol live stream at the frame level with the recognition data downloaded.

[0054] A non-transitory computer readable storage medium having embodied with computer program codes comprising instructions executable by at least one processor 201 in the sports analytics system **100** for analyzing a live video broadcast stream of a sporting event. The computer program codes comprise a first computer program code for receiving the live video broadcast stream of the sporting event from one or more video capturing devices; a second computer program code for splitting the live broadcast stream into a real time messaging protocol stream and a hypertext transfer protocol live stream; a third computer program code for analyzing the real time messaging protocol stream within a predetermined time interval, wherein the predetermined time interval comprises a phase difference between the real time messaging protocol stream and the hypertext transfer protocol live stream, and wherein the predetermined time interval is less than a frame persistence time of a frame; a fourth computer program code for detecting one or more persons present in a frame of the real time messaging protocol stream, using one or more cues selected from a first set of cues comprising a facial detection, a head detection,

a person detection, and a jersey number detection based on availability of the first set of cues; a fifth computer program code for tracking the detected persons in the frame, by analyzing one or more preceding frames of the real time messaging protocol stream; a sixth computer program code for recognizing the tracked persons in the frame using one or more cues selected from a second set of cues comprising a facial recognition, a person recognition, a jersey recognition, a live score feed of the sporting event, and a commentary of the sporting event based on availability of the second set of cues, wherein the jersey recognition comprises one or more of jersey number classification and team recognition, wherein individual weights are assigned to each of the facial recognition, the person recognition, and the jersey recognition when the facial recognition, the person recognition, and the jersey recognition are performed in the frame, wherein if any of the facial recognition, the person recognition, and the jersey recognition is unavailable, one or more of the live score feed and the commentary is used for the identification of the one or more players in the frame, and wherein the individual weights are determined based on clarity of each person recognized in the frame; a seventh computer program code for identifying one or more players in the frame by comparing the assigned weights for each of the recognized persons with pre-existing data of all players; and an eighth computer program code for transmitting the hypertext transfer protocol live stream and analysis data comprising contextual interactive content of the identified players to a client application provided on a user device by the sports analytics system within the predetermined time interval.

[0055] The computer program codes further comprises a ninth computer program code for providing user interaction with the interactive video. The contextual interactive content of the identified players is displayed on the user device without the contextual interactive content of the identified players overlapping existing graphics of the hypertext transfer protocol live stream. The contextual interactive content of the identified players comprises a dynamic display of one or more of a scorecard, a player information, and match statistics, wherein the contextual interactive content of the identified players can be customized and shared on social media. Similarly, the system allows the users to share

their favourite moments of the game online in real-time in one or more social media platforms.

[0056] The computer program codes are executed to display the contextual interactive content without overlapping existing graphics displayed on the live video broadcast stream of the sporting event. The contextual interactive content also includes any interesting information about the player statistics and bio. The contextual interactive content could be customized according to the requirements and optionally shared on any social media platforms. In some embodiments, the contextual interactive content could be customized to particular season of the game and the corresponding player statistics in that season. In another embodiment, one or more social media posts of the players and teams are provided as on-demand enhanced content on the live video broadcast stream to more insights of the player and team activities outside the sport. In another embodiment, head-to-head statistics of customized players are provided as rich content especially for the users to enhance their viewing interaction. In another embodiment, the contextual interactive content is customized to improve the engagement and provide enhanced game experience for the users.

[0057] The computer program codes are stored in a computer usable or computer readable memory capable of directing a computer or other programmable data processing apparatus to implement the functionality in a particular manner. The computer program codes may also be executed by an article of manufacture containing instruction means for performing the functions described in each block or flowchart of the flowchart. The computer program instructions may be loaded onto the computer or other programmable data processing equipment so that a series of operating steps may be performed on a computer or other programmable data processing equipment to execute the instructions for the sports analytics system **100**.

[0058] The sports analytics system **100** for analyzing the live video broadcast stream of the sporting event provides significant benefits for end users, content owners, advertisers, broadcasting companies, sports companies, sports franchise, teams, etc., in a multi-

faceted manner. The users can simply interact with the contextual content displayed around the players and share their favourite moments of the game online in one or more social media platforms. This platform also allows the users to buy tickets for the interested games and purchase the merchandise sold by the relevant teams or franchise. The sports analytics system **100** allows the content owners to capture users demographics, brands followed by the users, social profile, digital spending information, favourite teams and/or players, time spent on the AI powered contextual interactive content delivery platform, etc. Further, this information could also be used deliver personalized content delivery and monetization. The sports analytics system **100** helps to generate incremental revenue through pay per fan interaction mode and does not require any additional hardware such as cameras and sensors for implementation. The existing hardware is sufficient to implement the system in a cost-effective and hassle-free manner. The sports analytics system **100** enables the content owners to choose from a wide range of interactivity options and offer them to the users and allows them to deliver contextual advertisement based on who is on screen and based on what a viewer is actually clicking on. The users get significant benefits by following their favourite player, statistics and their social media updates at one place and get more rich information to enjoy the game and be more interactive with the live video broadcast stream.

[0059] The foregoing examples have been provided merely for explanation and are in no way to be construed as limiting of the method and the sports analytics system **100** disclosed herein. While the method and the sports analytics system **100** have been described with reference to various embodiments, it is understood that the words, which have been used herein, are words of description and illustration, rather than words of limitation. Furthermore, although the method and the sports analytics system **100** have been described herein with reference to particular means, materials, and embodiments, the method and the sports analytics system **100** are not intended to be limited to the particulars disclosed herein; rather, the method and the sports analytics system **100** extend to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims. While embodiments described herein are directed to analyzing a live video broadcast stream of a sporting event, the embodiments can also be

directed to analyzing a pre-recorded video stream of a sporting event as recited in the claims.While multiple embodiments are disclosed, it will be understood by those skilled in the art, having the benefit of the teachings of this specification, that the method and the sports analytics system **100** disclosed herein are capable of modifications and other embodiments may be effected and changes may be made thereto, without departing from the scope and spirit of the method and the sports analytics system **100** disclosed herein.

WHAT IS CLAIMED IS:

1. A sports analytics system, comprising:

   a video demuxer for receiving a live video broadcast stream of a sporting event from a video capture device and splitting said received live broadcast stream into a real-time messaging protocol stream and a hypertext transfer protocol live stream; and

   one or more processors that

      identify one or more players in a frame of said real-time messaging protocol stream using pre-existing data of a plurality of players, and

      transmit said hypertext transfer protocol live stream and contextual interactive content of said identified players obtained from the pre-existing data to a client application provided on a device of a user, wherein said live video broadcast stream is transformed into an interactive video comprising said contextual interactive content of said identified players overlaid on said hypertext transfer protocol live stream and wherein said contextual interactive content includes one or more embedded graphics that, when the user clicks on the one or more embedded graphics, produce on the device in real-time information from the pre-existing data related to the one or more embedded graphics that was previously unavailable.

2. The sports analytics system of claim 1, wherein the one or more embedded graphics are overlaid in the hypertext transfer protocol live stream without overlapping existing graphics displayed in said live video broadcast stream and split into said hypertext transfer protocol live stream.

3. The sports analytics system of claim 2, wherein the one or more embedded graphics are overlaid in the hypertext transfer protocol live stream beneath existing graphics

displayed in said live video broadcast stream and split into said hypertext transfer protocol live stream.

4. The sports analytics system of claim 1, wherein the one or more processors identify one or more players within a predetermined time interval.

5. The sports analytics system of claim 4, wherein the time interval corresponds to a phase difference between said real-time messaging protocol stream and said hypertext transfer protocol live stream.

6. The sports analytics system of claim 1, wherein the one or more embedded graphics comprise one or more of a scorecard, player statistics, player information, and ticket information.

7. The sports analytics system of claim 1, wherein the one or more processors identify one or more players using one or more of facial detection, head detection, person detection, and jersey number detection.

8. A method for analyzing video of a sporting event, comprising:

receiving a live video broadcast stream of a sporting event from;

splitting said live broadcast stream into a real-time messaging protocol stream and a hypertext transfer protocol live stream;

identifying one or more players in a frame of said real-time messaging protocol stream using pre-existing data of a plurality of players; and

transmitting said hypertext transfer protocol live stream and contextual interactive content of said identified players obtained from the pre-existing data to a client application provided on a device of a user, wherein said live video broadcast stream is transformed into an interactive video comprising said contextual interactive content of said identified players overlaid on said hypertext transfer protocol live stream and wherein said contextual interactive content includes one or more embedded graphics that, when the user clicks on the one or more embedded graphics, produce on the device in real-time information from the pre-

existing data related to the one or more embedded graphics that was previously unavailable.

9. The method of claim 8, wherein the one or more embedded graphics are overlaid in the hypertext transfer protocol live stream without overlapping existing graphics displayed in said live video broadcast stream and split into said hypertext transfer protocol live stream.

10. The method of claim 9, wherein the one or more embedded graphics are overlaid in the hypertext transfer protocol live stream beneath existing graphics displayed in said live video broadcast stream and split into said hypertext transfer protocol live stream.

11. The method of claim 8, wherein the one or more players are identified within a predetermined time interval.

12. The method of claim 11, wherein the time interval corresponds to a phase difference between said real-time messaging protocol stream and said hypertext transfer protocol live stream.

13. The method of claim 8, wherein the one or more embedded graphics comprise one or more of a scorecard, player statistics, player information, and ticket information.

14. The method of claim 8, wherein the one or more players are identified using one or more of facial detection, head detection, person detection, and jersey number detection.

15. A non-transitory computer-readable storage medium having embodied thereon, computer program codes comprising instructions executable by one or more processors for analyzing video of a sporting event, comprising:

a first computer program code for receiving a live video broadcast stream of a sporting event;

a second computer program code for splitting said live broadcast stream into a real-time messaging protocol stream and a hypertext transfer protocol live stream;

a third computer program code for identifying one or more players in a frame of said real-time messaging protocol stream using pre-existing data of a plurality of players; and

a fourth computer program code for transmitting said hypertext transfer protocol live stream and contextual interactive content of said identified players obtained from the pre-existing data to a client application provided on a device of a user, wherein said live video broadcast stream is transformed into an interactive video comprising said contextual interactive content of said identified players overlaid on said hypertext transfer protocol live stream and wherein said contextual interactive content includes one or more embedded graphics that, when the user clicks on the one or more embedded graphics, produce on the device in real-time information from the pre-existing data related to the one or more embedded graphics that was previously unavailable.

16. The non-transitory computer-readable storage medium of claim 15, wherein the one or more embedded graphics are overlaid in the hypertext transfer protocol live stream without overlapping existing graphics displayed in said live video broadcast stream and split into said hypertext transfer protocol live stream.

17. The non-transitory computer-readable storage medium of claim 16, wherein the one or more embedded graphics are overlaid in the hypertext transfer protocol live stream beneath existing graphics displayed in said live video broadcast stream and split into said hypertext transfer protocol live stream.

18. The non-transitory computer-readable storage medium of claim 15, wherein the one or more players are identified within a predetermined time interval.

19. The non-transitory computer-readable storage medium of claim 18, wherein the time interval corresponds to a phase difference between said real-time messaging protocol stream and said hypertext transfer protocol live stream.

20. The non-transitory computer-readable storage medium of claim 15, wherein the one or more embedded graphics comprise one or more of a scorecard, player statistics, player information, and ticket information.