

AI-Based Sports Highlight Generation for Social Media

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Social media plays a significant role for sports organizations with millions of active fans [1-8], but social media publishing is often a tedious manual operation. With the development of AI, new tools are available for content generation and personalization to engage audiences [9-22]. We present an AI-based multimedia production pipeline for automatic soccer and ice hockey highlight sharing on social media, which ingests a broadcast (VoD / stream) and performs event detection, clipping, smart cropping (aspect ratio retargeting), thumbnail generation, summarization, and social media sharing.

Event detection: Automatic event detection from soccer broadcasts suffers traditionally from high latency and low accuracy, making it challenging to operate at the live edge. We present an algorithm to detect events in soccer videos such as goals, cards, substitutions in real-time, using 3D convolutional neural networks [23,24]. Tested on three datasets including SoccerNet [25], our algorithm can detect events with high recall, low latency, and accurate time estimation. Sports broadcasts contain both video and audio streams, but detection approaches often focus solely on the visual modality. We evaluate the possibility of increasing detection performance by utilizing both modalities.

Clipping: The most time-consuming and expensive operation is the extraction of highlight clips, since manual annotations and trimming (where human operators define the start and end of an event and trim away the unwanted scenes) are traditionally used. We automate this process using scene boundary detection, logo detection, and optional cheering removal. We experiment with different neural network architectures and present two models that have been evaluated both quantitatively and qualitatively with a user study [26]. Our AI-based solution can identify appropriate event intervals, e.g., scene changes, game turnovers, logo transitions, cheering, and replays.

Cropping: SmartCrop is a tool for cropping videos to fit desired aspect ratios which are supported by different social media platforms, based on tracking Points of Interest (POI), with the soccer ball / hockey puck serving as the primary POI. If the ball / puck isn't visible, outlier detection and interpolation are used. It segments videos using the TransNetV2 model and employs object detection through a custom YOLOv8-medium model [27], which has been retrained on a novel soccer and hockey dataset. For

instances where the ball or puck isn't visible, the system utilizes outlier detection methods (average, IQR, Z-Score). Interpolation techniques (linear, polynomial, ease-in-out, heuristic) are applied to enhance the video quality and accuracy. Frames are then cropped either around the POI or the frame's center, based on user preferences and POI visibility. Before sharing, we format the content to meet the unique requirements of social media platforms, ensuring optimal viewing experiences across all channels.

Thumbnail generation: Thumbnails must capture the essence of highlight clips and engage viewers, but are time-consuming to generate. We extend the HOST-ATS framework [28,29], which performs logo detection, close-up shot detection, face detection, blur and image quality analysis on frames, to rank them as thumbnail candidates according to relevance and quality, with a postprocessing module to introduce overlays supporting multimodality.

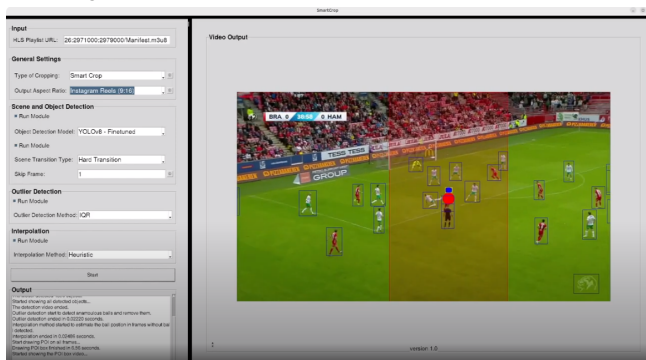
Summarization: We craft a summary (highlight description augmented with metadata) tailored to specific timeframes and priorities [17-19]. To improve the textual output, we rely on multimodal scene understanding based on architecture from [30-33], use modality specific encoders for each multimedia type in the highlight (video, audio, image, text), and adapter layers trained on an instruction dataset (QA), followed by a conversational LLM. We also recommend pertinent hashtags and captions derived from the video content, match specifics, and current trending topics. This strategy ensures that our content is discoverable by a broader audience, thereby increasing fan engagement [34].

Sharing: We can directly publish the generated highlights to various social media platforms [35] through integration with their APIs (TikTok, Instagram). The use of AI not only enhances the production capabilities but also provides valuable insights: analyzing user engagement metrics from shared content allows us to continually refine algorithms, ensuring that the highlights resonate with audience preferences.

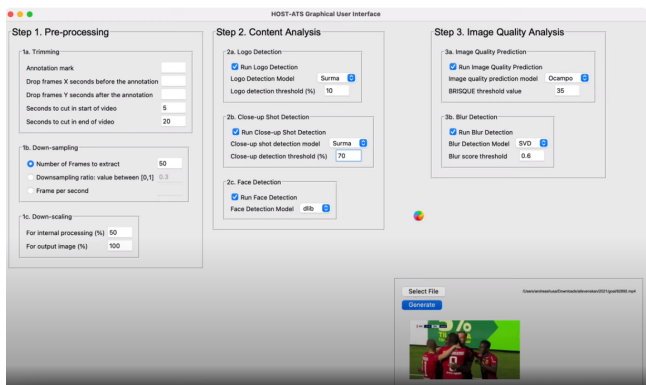
Next steps: We have tested our proposed pipeline on content from Scandinavian soccer and ice hockey leagues, and ran subjective user studies for evaluation, which show that an AI-based automated approach relying on advanced multimodal scene understanding facilitates social media engagement and increases QoE.

APPENDIX - Demonstration

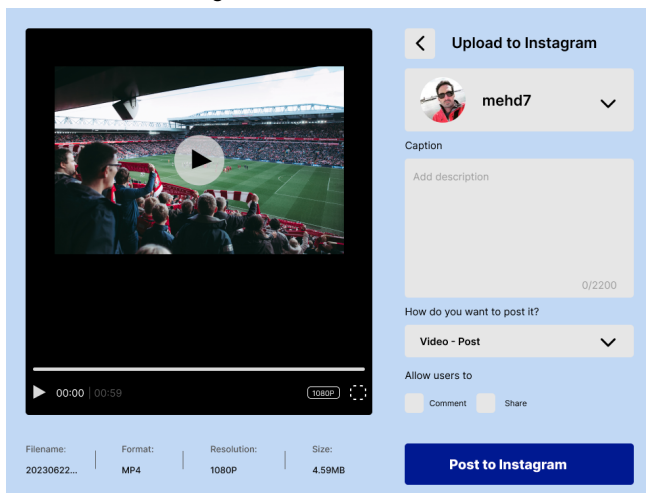
Cropping:



Thumbnail selection:



Social media sharing:



Demonstration videos for individual components are also available (thumbnail selection: <http://youtu.be/HHMCdMucorI>, <http://youtu.be/VZQaEy2VauQ>, cropping: <http://youtu.be/aqqPWfrPmsE>).

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