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State of the Art of Television Broadcasting for Sports Events

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ABSTRACT

The aim of this paper is to present the television broadcasting for sports events and the different techniques in use. In fact, a review on the different applications of the artificial vision and the augmented reality, on the one hand and an application of image processing techniques for television broadcasting for sports events, on the other hand are presented. Then, many research applications of image processing techniques for the various sports events are developed. In fact, broadcast television systems are encoding or formatting standards in order to transmit and receipt the terrestrial television signals. Originally all broadcasting was used analog transmission techniques but more recently broadcasters have used digital transmission. Broadcasting is the distribution of audio and/or video content to a dispersed audience via any electronic mass communications medium, but in general one using the electromagnetic spectrum (radio waves), in a one-to-many model. Augmented reality is one of the fields of artificial or computer-assisted vision. It is a rapidly emergent research area thanks to its original principle allowing the mixing of the real and virtual worlds.

Keywords: *TV Broadcasting, Augmented Reality, Image Processing, Sports events*

1. INTRODUCTION

Broadcasting began with amplitude modulation radio broadcasting which sprang up spontaneously around 1920. Before this, all the forms of electronic communication, radio, telephone, and telegraph, were "one-to-one", with the message intended for a single recipient. In fact, Amplitude modulation (AM) broadcasting is the process of radio broadcasting using amplitude modulation. AM was the first method of impressing sound on a radio signal and is still widely used. Today, AM competes with frequency modulation (FM), as well as with various digital radio broadcasting services distributed from terrestrial and satellite transmitters [1].

Broadcasting is usually associated with radio and television, though in practice radio and television transmissions take place using both wires and radio waves. The receiving parties may include the general public or a relatively small subset; the point is that anyone with the appropriate receiving technology can receive the signal. The field of broadcasting includes a wide range of practices, from relatively private exchanges such as public radio, community radio and commercial radio, public television, and commercial television.

In many countries the higher levels of interference experienced with AM transmission have caused AM broadcasters to specialize in news, sports and talk radio, leaving transmission of music mainly to FM and digital broadcasters [2] [3].

FM broadcasting is a VHF broadcasting technology, pioneered by Edwin Howard Armstrong, which uses frequency modulation (FM) to provide high-fidelity sound over broadcast radio [4]. The term "FM band" describes the frequency band in a given country which is dedicated to FM broadcasting. This term is slightly misleading, as it equates a modulation method with a range of frequencies.

Transmission of radio and television programs from a radio or television station to home receivers over the spectrum is referred to as over the air or terrestrial broadcasting and in most countries requires a broadcasting license. Transmissions using a combination of satellite and wired transmission, like cable television (which also retransmits over the air stations with their consent), are also considered broadcasts, and do not require a license. Transmissions of television and radio via streaming digital technology have increasingly been referred to as broadcasting as well, though strictly speaking this is incorrect [5].

The aim of this paper is to present the different techniques in use of TV broadcasting, on the one hand and the various researches done of different applications of artificial vision and augmented reality, on the other hand.

2. MATERIALS AND METHODS

In this part, a review on the TV Broadcasting and the artificial vision and augmented reality and the different techniques in use is presented.

In fact, digital television is the transmission of audio and video by digitally processed and multiplexed signal, in contrast to the totally analog and channel separated signals used by analog television [6] [7]. Digital TV can support more than one program in the same channel bandwidth. It is an innovative service that represents the first significant evolution in television technology since color television in the 1950s [8].

Augmented reality is a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented by a computer. As a result, the technology functions by enhancing one's current perception of reality [9] [10]. By contrast, virtual reality replaces the real world with a simulated one. Augmentation is conventionally in real-time and in semantic context with environmental elements, such as sports scores on TV during a match. With the help of advanced

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augmented reality technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable. Artificial information about the environment and its objects can be overlaid on the real world.

We present some studies the TV Broadcasting, the artificial vision and augmented reality that have been presented in various researches:

Researchers Jianmin & al. [11], have presented a new dissimilarity measure for the detection of dynamic overlays in football games from TV broadcasting. The detection of the dynamic overlays is used for finding the replays in the input video that are to be removed for further processing. The replays' detection and removal is part of the first module of the system ACE-Football for the automated interpretation of association football games, which is being developed at the PRIS-lab.

Researchers Kruger [12], has presented the shot classification algorithm used to classify the scenes from football TV broadcasting, to extract only the far view scenes. The far-view scenes are important for the segmentation and tracking of the players during the game, required for devising an abstract model for the interpretation of the game. The system for developing such a platform is named ACE-Football, and is currently being developed at the PRIS-lab.

Researchers Seong-Oh & al. [13], have proposed a new mobile augmented-reality system that will address the need of users in viewing baseball games with enhanced contents. The overall goal of the system is to augment meaningful information on each player position on a mobile device display. To this end, the system takes two main steps which are homography estimation and automatic player detection. This system is based on still images taken by mobile phone. The system can handle various images that are taken from different angles with a large variation in size and pose of players and the playground, and different lighting conditions. They have implemented the system on a mobile platform. The whole steps are processed within two seconds.

Researchers Stricker & al. [14], have presented several results from the research department "Augmented Vision" of the German Research Center for Artificial Intelligence. The driving idea of this work is to move from traditional Augmented Reality (AR) systems, which are often limited to visualization and tracking components, to AR cognitive systems, which have or gradually build knowledge about the situation and intentions of the user. Such systems will basically be much more unobtrusive and adapt the information presentation to the users' actual needs. To reach this goal, strong progress must be done in several areas, starting with 3D scene digitalization and analysis, body modeling and motion capturing, and action and workflow recognition. An overview of current results and work-in-progress of the Augmented Vision group in those areas is presented and finally discussed.

Researchers Rui & al. [15], have discussed the vision-based registration techniques for augmented reality (AR) systems which have been the subject of intensive research recently due to their potential to accurately align virtual objects with the real world. The downfall of these vision-based approaches, however, is their high computational cost and lack of robustness. To address these shortcomings, a robust pose estimation algorithm based on artificial planar markers is adopted. This algorithm solves the problem of camera pose ambiguities and is able to draw a unique and robust solution. Experiments show the robustness and effectiveness of this method in the context of real-time AR tracking.

Researchers Lourakis & al. [16], have presented in their work the camera matchmoving witch is an application involving synthesis of real scenes and artificial objects, in which the goal is to insert computer-generated graphical 3D objects into live-action footage depicting unmodeled, arbitrary scenes. This work addresses the problem of tracking the 3D motion of a camera in space, using only the images it acquires while moving freely in unmodeled, arbitrary environments. A novel feature-based method for camera tracking has been developed, intended to facilitate tracking in online, time-critical applications such as video see-through augmented reality and vision-based control. In contrast to several existing techniques, which are designed to operate in a batch, offline mode, assuming that the whole video sequence to be tracked is available before tracking commences, the proposed method operates on images incrementally, as they are being acquired.

Researchers Ji Hoon Choi & al. [17], have introduced a method for personalized data broadcasting service using TVA metadata. Appropriate metadata structure for personalized data broadcasting is explained by comparison with package metadata and data broadcasting contents. New scenario and contents structure for personalized data broadcast is described. Therefore the system and data flow mechanism for personalized data broadcasting service is presented. In fact, the number of broadcasting channels and contents are increasing with the arrival of digital broadcast and various broadcasting medium. However, there is a limit on searching of the program by using conventional program guide.

3. RESULTS

In this part, the results of automatic analysis of sports videos are presented. In fact, many techniques that enhance television sports broadcasts use algorithms for tracking objects, such as the ball, to create informative, graphical visualizations embedded into the broadcast image. Objects like field lines and players are important for semantic analysis in soccer video [18].

The system uses ambiguous learning labels, from a video and subtitles, the system can locate and recognize faces from the front, where there are nearly 1 to 2 faces per image. Figure 1 shows the facial recognition. In this image, limit frames show the location of the faces, and the texts show the name of the character.

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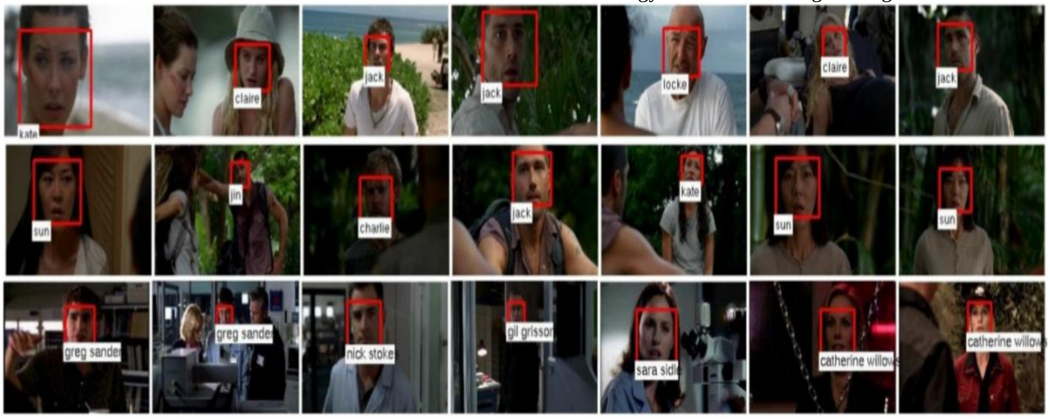

Figure 1: The facial recognition

To perform the monitoring of multiple targets in a video sequence, the best-known approach is to apply multiple and independent mono tracking algorithms target to perform the monitoring of various targets. More specifically, it can initiate a single monitoring procedure target thanks to the initial location of the target, and then ask him to follow the player in the video sequence (Figure 2).

The original location can be identified manually, or by an automatic object detection system. These follow-up procedures are independent because they do not know the existence of other procedures, and however it has no overall coordination between these follow-up procedures. For example, researchers have used the algorithm of mean-shift for the follow-up of football players, as shown in figure 3.

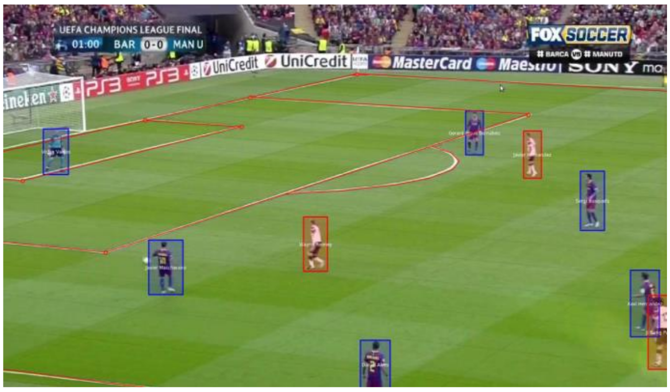

Figure 2: The follow-up of football players by particle filter started

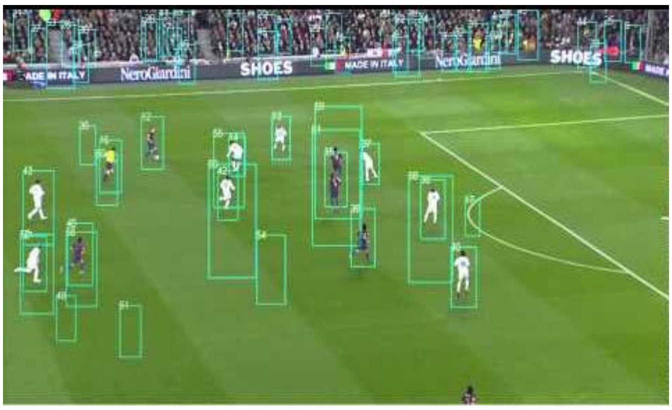

Figure 3: The follow-up of football players by the algorithm of mean-shift

Recently, others researchers have applied the Camshift (Continuously Adaptive Mean Shift) image segmentation algorithm for the follow-up of basketball players, as shown in figure 4.

Figure 4: The follow-up of basketball players by Camshift image segmentation algorithm

We present some studies on the use of image processing techniques sports meeting that have been presented in various researches:

Researchers Maalej & al. [19], have presented a new strategy for observing and analyzing a basketball match using video processing techniques to identify the game systems of a team is described. The system tracks players' positions during the match. At the outset, three video streams from three fixed cameras are available, each processed separately to deliver measures of the players' positions from different available views. Each treated view includes foreground detection and a bounding-box tracker designed to contain the pixels representing each player. During the multi-view process, measurements from different views are synchronized to enable identification of the same player when the player is visible simultaneously on several cameras.

Researchers Battikh & al. [20], have presented a procedure to estimate the position, orientation and focal length of a camera in a soccer field. These parameters are then used in real-time overlay of graphics on a soccer pitch. The method uses court model composed by arcs and lines. A means of automatically initializing the tracking process is also presented which uses Hough transform with a combination of a non-linear least squares optimization method. For the tracking of camera parameters, two cases arise: the center of the pitch and the 18 m

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area. A combination of automatic court model recognition with the Kanade-Lucas-Tomasi (KLT) algorithm is also used.

Researchers Ben Abdelkrim & al. [21], have examined the demands of competitive basketball games and the study of the relationship between athletes' physical capability and game performance. In fact, physical and physiological game demands and the association of relevant field test with game performance were examined in 18 male junior basketball players. Computerized time-motion analysis, heart rate, and blood-lactate concentration measurements were performed during 6 basketball games. This study showed that basketball players experience fatigue as game time progresses and suggests the potential benefit of aerobic and agility conditioning in junior basketball.

Researchers Jabri & al. [22], have experienced a procedure which uses GPS for identifying the positions of football players during a test match. Four defenders were requests from this experiment. We have noted the positions of these players 10 times per second throughout a match. We were thus able to measure total and specific traveled distances. We could also trace the trajectories of the players and determine the velocity and acceleration in function of time. We got through this testing a database of the match which can be exploited in various ways: technical, physical, tactical and so on. Specific treatment may be developed according to the needs of the target population: coaches, players, managers, etc.

Researchers Jlassi & al. [23], have proposed a variety of algorithms contributing to the resolution of the major problem appearing in the automation of team identification to which each player belongs relying on visual data provided by a camera video and digitized by a device processing image. The developed system was tested on a match of the Tunisian national competition. In fact, to refine their strategy of play such as football, handball, volley ball, Rugby... the coach needs to have a maximum of technico-tactics information about the on-going of the game and the players.

Researchers Battikh & al. [24], have described a video-data processing solution for determining the positions of all players during the course of a team sporting event. Signals received from three fixed cameras that cover the entire playing area are treated by modelling of the background and extraction of the positions of the players in motion. The gathered data makes it possible to measure the physical performance of each player (expended effort and its distribution per period of play) as well as the tactical performance based on the polygons formed by players of the same team or the same section. The laws of perspective projection are exploited to represent the positions of the players on the field.

Researchers Maalej & al. [25], have presented the different planning approaches, the main stages of the OOPP (Objectives Oriented Project Planning) method and the method MISDIP (Method Integrated for Specification, Development and Implementation of Project) which is an extended version of the OOPP method. Then, a case study of an application of graphics on TV of an athletic event is presented and analyzed using the OOPP method. This systemic analysis will allows us to well organize and prioritize the various activities of the realized computer application.

Researchers Cheikhrouhou & al. [26], have presented a system solution thanks to which virtual graphics, the projection of advertising images, logos, match scores and the distance measurements of players on the field may be overlaid on the plan of the different types of sports fields of real tested images. This solution relies on a study of the artificial vision and the Augmented Reality applied to TV broadcasting of sporting events where the authors have as input the original image to be processed, the image to be projected and the coordinates of the overlay position of the objects on the plan of the field. As an output, they have the overlaid objects in the processed image at the selected position in a more realistic way and in the background.

Researchers Lakhoua & al. [27], have presented the participative methods in use to enhance participation in Information System (IS) planning and requirements analysis in the one hand and the Objectives Oriented Project Planning method in the other hand. They have presented a review on different applications in a sports meeting using image processing techniques. In fact, they have exploited this method in order to analysis an athletic event. This method is a structured meeting process based on four essential steps: problem analysis, objectives analysis, alternatives analysis and activities planning.

4. DISCUSSION

In comparison with existing TV content production technologies, the LIVE TV broadcasting format could achieve a range of significant advantages, which can be highlighted as: (i) real-time interaction between TV content production team and viewers to ensure the best possible entertainment experiences and to allow viewers not only to view but also to participate, to influence and to control; (ii) the traditional concept of TV content director can be changed to a TV content conductor, where live TV broadcasting can be conducted on real-time bases and existing content materials can be conducted into multi-streams of TV broadcasting, providing variety of choices to allow the audience to make their own preferences in watching TV programs; (iii) introduction of significant intelligence in terms of content analysis and behavior analysis etc. to further improve the quality of services based on the fundamental concept of LIVE project .

Augmented reality has become common in sports telecasting. Sports and entertainment venues are provided with see-through and overlay augmentation through tracked camera feeds for enhanced viewing by the audience. Examples include the yellow "first down" line seen in television broadcasts of American football games showing the line the offensive team must cross to receive a first down. Augmented reality is also used in association with football and other sporting events to show commercial advertisements overlaid onto the view of the playing area. Sections of rugby fields and cricket pitches also display sponsored images. Swimming telecasts often add a line across the lanes to indicate the position of the current record holder as a race proceeds to allow viewers to compare the current race to the best performance. Other examples include hockey puck tracking and annotations of racing car performance and snooker ball trajectories.

5. CONCLUSION

In this paper, a state of the art of TV broadcasting for sports events is presented. In fact, a review on different applications of artificial vision and augmented reality is presented, on the one hand and the applications of image processing techniques of TV broadcasting for sports events is analysed, on the other hand. Some results of automatic analysis of sport videos are presented (the follow-up of players by particle filter started; by the algorithm of mean-shift; by Camshift image segmentation algorithm…).

Staring from this study on TV broadcasting and the augmented reality which is one of the fields of artificial or computer-assisted vision discussed in this paper, work is in progress to develop some applications of image processing techniques for the various sports events.

REFERENCES

[1] Junghak K., Jeounglak H. and Bumsuk C., "Design and Implementation for Interactive Augmented Broadcasting System, IEEE Transactions on Broadcasting", 2014, Vol.60, Issue: 2, pp. 217-226.

[2] Morel C., Arapoglou P.-D. and Angelone M., "Link Adaptation Strategies for Next Generation Satellite Video Broadcasting", IEEE Transactions on Broadcasting, 2015, Vol.61, Issue: 4, pp.603-614.

[3] Yun H.B, "Queuing Analysis of Deadline-Constrained Broadcasting in Wireless Networks", IEEE Communications Letters, 2015, Vol.19, Issue: 10, pp. 1782-1785.

[4] Yun H.B., "Optimal Retransmission-Based Broadcasting Under Delivery Deadline Constraint", IEEE Communications Letters, 2015, Vol.19, Issue: 6, pp. 1041-1044.

[5] Khisti A. and Tie L., "Private Broadcasting Over Independent Parallel Channels", IEEE Transactions on Information Theory, 2014, Vol.60, Issue: 9, pp. 5173-5187.

[6] Siles I.F., "Detection of dynamic overlays for association football from TV broadcasting", 14th ISCII, 2013, pp. 63-68.

[7] Siles F., "Shot classification for association football from TV broadcasting", 12th ISAMII, 2014, pp. 67-71.

[8] Graham M., Zook M. and Boulton A., "Augmented reality in urban places: contested content and the duplicity of code", Transactions of the Institute of British Geographers, 2012.

[9] Ong C. Y., Song J., Pan C., Li Y., "Technology and Standards of Digital Television Terrestrial Multimedia Broadcasting", Communications Magazine, 48(5), 2010, pp.119-127.

[10] Peters J.D., "Communication as Dissemination", Communication as Perspectives on Theory,Thousand Oakes, 2006, pp. 211-222.

[11] Jianmin J. and Kohler J., "LIVE: An Integrated Production and Feedback System for Intelligent and Interactive TV Broadcasting", IEEE Transactions on Broadcasting, Vol.57, Issue: 3, 2011, pp. 646-661.

[12] Kruger L. G., "Digital Television: An Overview. Hauppauge", New York: Nova Publishers, 2001.

[13] Seong-Oh Lee, Sang Chul Ahn, Jae-In Hwang, Hyoung-Gon Kim, "A Vision-Based Mobile Augmented Reality System for Baseball Games", Lecture Notes in Computer Science Vol. 6773, 2011, pp 61-68.

[14] Stricker D., Bleser G., "From Interactive to Adaptive Augmented Reality", International Symposium on Ubiquitous Virtual Reality, 2012, pp. 18-21.

[15] Rui Yu, Tao Yang, Jiangbin Zheng, Xingong Zhang, "Real-Time Camera Pose Estimation Based on Multiple Planar Markers", ICIG '09. 2009, pp. 640-645.

[16] Lourakis M.I.A., Argyros A.A., "Camera matchmoving in unprepared, unknown environments", IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR 2005, Vol. 2, 2005.

[17] Ji Hoon Choi, Jumyeong Jeok, Seong Yong Lim, Hyun-Cheol Kim, Han-Kyu Lee, Jin Woo Hong, "Personalized Data Broadcasting Service based on TV-Anytime metadata", IEEE International Symposium on Consumer Electronics, ISCE 2007, pp. 1-6.

[18] Maalej L., "Vision Artificielle et Réalité Augmentée Appliquées à l'Analyse et à la Retransmission Télévisuelle des Rencontres Sportives", Thèse, ENSIT, Université de Tunis, 2014.

[19] Maalej L., Jabri I. and Battikh T., "Basketball game systems identification by real time video processing", IETE Journal of Research, 2011.

[20] Battikh T. and Jabri I., "Camera calibration using court models for real-time augmenting soccer scenes", Multimedia Tools and Applications, 2011.

[21] Ben Abdelkrim N., Castagna C., Jabri I., Battikh T., El Fazaa S., El Ati J., "Activity profile and physiological requirements of junior elite basketball players in relation to aerobic-anaerobic fitness", The Journal of Strength and Conditioning Research, 2010.

[22] Jabri I., Battikh T. and Charni Y.H., "The use of GPS for measuring the technical and tactical performances of soccer players", International Review on Computers and Software, 2009.

[23] Jlassi M.M., Douik A., Battikh T. and Annabi, M., "Synthesis of classification supervised algorithms for players identification", IEEE ICECS, 2007.

[24] Battikh T., Jabri I. and Annabi M., "Automatic detection of player positions and trajectories during a soccer match for the measurement of physical and tactical performance", Canadian Journal of Electrical and Computer Engineering, 2007.

[25] Maalej L., Lakhoua M.N, Chakir I., Battikh T. and Jabri I., "Planning of a Graphics on TV Project of an Athletics Event", IEEE, CISTEM2014, Tunis 2014.

[26] Cheikhrouhu E., Jabri I., Lakhoua M.N., Mlouhi Y., and Battikh T., "Application of Image Processing Techniques for TV Broadcasting of Sporting Events", International Journal of Advanced Computer Science and Applications, Vol.6, N°6, 2015, pp. 138-148.

[27] Lakhoua M.N., Jabri I. and Battikh T., "Study on the use of Systemic Analysis and Image Processing Techniques in a Sports Meeting", European Journal of Scientific Research, Vol.132, N°1, 2015.

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