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SPORTS MARKETING INNOVATION: INCREASING FAN ENGAGEMENT VIA INNOVATIVE STATISTICS FROM FACIAL EMOTION RECOGNITION

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ABSTRACT: Technology in football is increasingly used for decision making. Adoption, especially in Germany, has been slow. However, the benefits of data analytics for pre-, and post-match analysis have motivated decision makers to pay attention to the data science trend. Nowadays, football clubs from the third leagues or even amateur clubs are using technology to help them gain a competitive edge. Fan experience, both online and offline (home infront of the TV or at the stadium) is driving the next innovation stage in football. The study presented here is focused on testing and evaluation a facial recognition software on images from football coaches, just a few seconds after an important situation during the match has taken place (e.g., win, goal scored). We demonstrated that, in fact, emotion recognition software captures unexpected emotional reactions from coaches which could then be used to calculate interesting statistics and increase fan engagement and entertainment.

Keywords: *Emotion recognition; Football; Soccer; Ffan; Fan engagement; Sports marketing*

1. PURPOSE OF THE PAPER

"Football is a sport that is all about audience engagement" (Pearson, 2013, p. 1). Nowadays, football fans are used to get various statistical information (such as ball possession, passing accuracy or ball contacts) during a game broadcast. Broadcasters have been innovative in applying several technologies to add extra dimensions to the fans'

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TV experience in order to get them more engaged (Pearson, 2013). Since there is an increasing use of data analytics in football broadcasts as well as a rising demand for additional statistics by the spectators (Artmayr, 2002), experts seek to develop interesting new statistics in order to increase the fans' attachment (Engesser, 2016). Since most of the existing statistics are player-related, this study seeks to examine the possibility of providing entertaining new insights into the coaches' emotional states during the match to the spectators. Concerning this matter, especially the information that are surprising and unexpected to the spectators are interesting to them (Silvia, 2008). This means that particularly emotions that are unexpected in a specific game situation serve as a good basis for creating appealing statistical visualizations. Utilizing modern facial emotion recognition software, the relevant data can easily be captured in real-time during the match. Hence, the broadcaster can present the results to the TV spectators in the form of statistics to get them more engaged and offer a better overall experience (Parkinson, 2015).

The purpose of our study is the testing and evaluation of facial emotion recognition software in the context of football matches with a specific focus on the coaches. The evaluation focus is set on the capability of such software to deliver appealing data for producing statistics for entertainment and engagement purposes of football spectators.

To achieve our research goals, we test facial emotion recognition application with video material of football coaches in specific game situations. Afterwards, the application's results are compared to the emotions that are typically expected in that specific game situation to evaluate the system regarding its suitability for delivering interesting facts to the spectator.

2. RELATED WORK

Automatic facial recognition and emotion recognition systems find application in several areas. First, application areas of face recognition technologies are presented. One of the most important fields is *identity verification*. Especially in access control systems, face recognition is used to grant humans access to physical or virtual domains without the need of using physical keys or passwords. In contrast to such verification methods, which can be lost and/or forgotten, the face is always available and cannot be duplicated. Therefore, facial recognition experiences are increasingly used in e-banking and smart home systems (Joshi & Gupta, 2016). Automatic facial identity verification is also important for public security reasons and video surveillance systems. With its help, computer systems can automatically detect and identify potential criminals in a crowd of people as well as identify offenders on CCTV footage of crime scenes (Owusu, Zhan, & Mao, 2014; Zhao,

Chellappa, Phillips, & Rosenfeld, 2003). One last example of face recognition software in identity verification purposes is video and image indexing (Hjelmås & Low, 2001) as it can be observed in iOS 10 (Wright, 2016). Other exemplary application areas of face recognition technology are digital cosmetics and gender classification (Yang, 2015), video conferencing systems (Hjelmås & Low, 2001) as well as marketing research (Dospinescu & Popa, 2016; Heuberger, 2016).

Secondly, application areas of facial *emotion recognition* are described. One important field is the development of smart Human Computer Interfaces (HCI). Hereby, the goal is to develop computer systems that can sense human emotions and adapt their reactions accordingly to the emotional state of the user (Brand et al., 2012; Pantic, 2015). Another important application area is medicine where emotion recognition technology can detect signs of pain in facial expressions, which is especially useful for patients being unable to express themselves verbally (Heuberger, 2016). It is also possible to capture pulse rates of patients via webcams (Keller, 2013; Poh, McDuff, & Picard, 2011), which tremendously supports modern Ambient Assisted Living concepts. Moreover, emotion recognition systems can ease interpersonal communication for handicapped people having difficulties to understand emotional states from facial expressions, such as persons with autism spectrum disorder (Smitha & Vinod, 2015). This technology is applied in customer research as well where knowledge about customers' emotions towards certain products can help companies prioritize their marketing investments. In the financial sector, this knowledge can be used to understand internal customer data, particularly in trading companies (Binali & Potdar, 2012). Other application areas are multimedia (e.g., gaming, music, and television), automobile safety (Bettadapura, 2012), as well as education (Binali & Potdar, 2012).

In summary, face recognition and emotion recognition technologies have a broad field of application. Nevertheless, their use in the field of sports has not been researched thoroughly. Therefore, our study tries to fill in this research gap.

3. METHODOLOGY

3.1 Formulation of hypotheses

As mentioned, situations are perceived as interesting when they are surprising or unexpected (Silvia, 2008). Our goal is to test whether a facial emotion recognition application delivers such unexpected results. Therefore, the following considerations are made.

Firstly, when a match develops in favor of the coach's team, for example, when his team scores a goal or wins the match, it is expected that the coach has positive

emotions. When the software unexpectedly recognizes negative emotions, the results represent interesting facts to the spectators and can therefore be used as valuable statistics. Hence, hypothesis 1 (H1) can be stated as:

H1: There are cases where the software recognizes negative emotions (anger or sadness) on the coach's face even though there is a positive game situation (goal or win).

Secondly, the unexpected occurrence of positive emotions of a coach in negative game situations (e.g., goal against or loss) would also serve as an interesting statistic for the spectators. Thus, hypothesis 2 (H2) is declared as:

H2: There are cases where the software recognizes positive emotions (happiness or surprise) on the coach's face even though there is a negative game situation (goal against or loss).

The above mentioned situations are interesting for this study, as there is no added value by presenting facts to the spectators that are obvious to them. Thus, for example, the information that a coach is happy after his team scored a goal is quite natural to the fans and therefore perceived as rather boring. Statistical illustrations are valuable when they contain interesting data which would be the case if H1 and H2 are confirmed.

3.2 Research design

Our study follows the steps below:

1. Suitable video material was extracted from online sources, and videos were screened for positive game situations (goal or win) as well as negative game situations (goal against or loss).
2. Within a few seconds after the specific game situation, an image of the coach (with visible face) was captured using a screenshot tool. That way, 16 images of coaches' facial expressions in positive game situations and 16 images of coaches' expressions in negative game situations were captured, which serve as a basis for the emotion recognition analysis. Thus, the 32 image files were imported into the SHORE application, which recognizes the facial expressions and determines the emotional state of the coach.
3. The application's results were compared to the expected emotional state according to the game situation.

3.3. Tools

3.3.1. The SHORE software of Fraunhofer IIS

The software used for analysis is called SHORE, an acronym for Sophisticated High-speed Object Recognition Engine, and was developed by Fraunhofer IIS (Ruf, Ernst, & Küblbeck, 2011). In general, SHORE offers a flexible framework for detection tasks of objects consisting of a typical structure, whereby the focus lies on face detection and analysis, which is also used in this study (Ruf et al., 2011). SHORE offers robust, multiplatform-capable, real-time detection and tracking of in-plane (up to 60°) and out-of-plane rotated faces (up to 90°). Providing a face detection rate of over 90%, it represents a highly reliable technology (Heuberger, 2016).

Offering different engines, the software can be used for plain face detection or for more complex tasks such as gender classification, age estimation or emotion recognition (Ruf et al., 2011, p. 238). The latter engine is relevant for this work and is precisely called "Face + Eye Detection & Gender + Age + Expression Analysis". Working with still images, movies or live video streams, SHORE visualizes a bounding box of each face found in the specific frame as well as the location of the eyes. Most importantly, the software also calculates scores for four of the six basic emotions recognized on the face. These four recognizable emotional states are angry, happy, sad and surprised which serve as a basis for this research (Wagner, Andre, Lingenfelser, & Kim, 2011, p. 210).

3.3.2. Video material

The videos are from the UEFA European Championship 2016 in France and were obtained from the ZDF media library (ZDF, 2016). The reason behind choosing this source is that these so-called coachcam videos consist of three windows: one for each coach and one for the corresponding game situation. In this way, a clear assignment of the coach's facial expression and the specific game situation is possible, and the results are comparable because all videos are from the same tournament. The only problem that occurred in the video acquiring process was that the videos are not downloadable from the media library and are of really poor quality when acquired through other resources (if any). Thus, since SHORE can work with still images as well, a screenshot tool was used to capture the coaches' facial expressions in the particular game situation. The images were captured within a few seconds after the game situation, to ensure that the coach's emotion is related to the in-game events. Finally, around 40 videos were analyzed, which resulted in 32 images that were used for testing.

4. ANALYSIS

We tested two **positive situations**:

1) own team scoring a goal, and

2) winning the match;

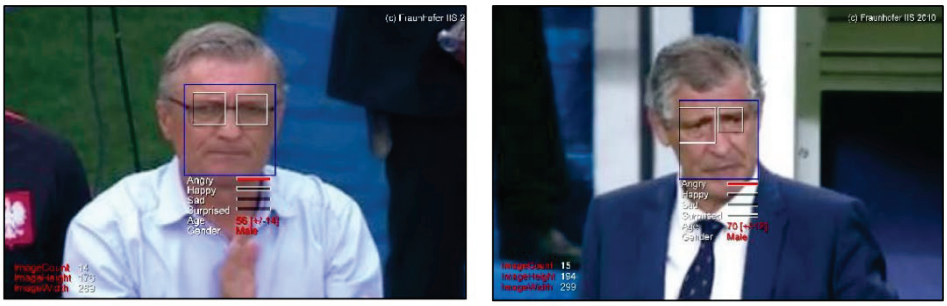
as well as two **negative situations**:

1) when a goal is scored against own team and

2) when own team loses the match.

For negative game situations, it is expected that the software recognizes negative emotions in the coaches' facial expressions, and vice versa.

An example of an unexpected emotion recognized by the SHORE application in the case of "own team scores a goal", is presented in Figure 1.



a) b)

Figure 1. Unexpected emotion (anger) when own team scores a goal

The results for all images analyzed for all four situations are presented in Table 1.

Table 1. Results of the testing

	Test image	Positive emotion (happy, surprised)	Negative emotion (angry, sad)
Positive game situation (goal)	1	X	
	2	X	
	3	X	
	4	X	
	5	X	

	6	X	
	7		✓
	8		✓
Positive game situation (win)	9	X	
	10	X	
	11	X	
	12	X	
	13	X	
	14	X	
	15		✓
	16		✓

Table 1. Results of the testing (continued)

	Test image	**Positive emotion (happy, surprised)**	**Negative emotion (angry, sad)**
Negative game situation (goal against)	17		X
	18		X
	19		X
	20		X
	21	✓	
	22	✓	
	23	✓	
	24	✓	
Negative game situation (loss)	25		X
	26		X
	27		X
	28		X
	29		X
	30		X
	31	✓	
	32	✓	

The grey shaded cells mark the unexpected outcomes which support the hypotheses, as described in section 3.1.

5. DISCUSSION

The software recognized four negative emotions in 16 examined positive game situations as well as six positive emotions in 16 negative game situations. Therefore, both hypotheses can be confirmed. With coaches showing unexpected emotions, our results show the potential of facial emotion recognition software to deliver interesting information to spectators, which can be visualized in the form of statistics by the broadcaster. The occurrence of unexpected emotions in specific game events could be a sign of unloading pent-up feelings. For instance, when a coach is angry about the playing style of his team, these emotions come up after a goal resulting in an angry facial expression. Another reason why unexpected emotions occur, might be that coaches try to overplay their emotions, for example when their team is outclassed by the opponent, they try to smile in order to hide their real anger. Interestingly, the results indicate that coaches rather tend to show positive emotions in negative situations than the other way around. This supports the idea that the coaches might try to put a good face on the matter. Visualizing such unexpected emotions in the form of statistical illustrations provides an opportunity for engaging the fans since they find surprising facts interesting (Pearson, 2013; Silvia, 2008). In this way, the fans can get an insight into the coaches' emotional states and therefore feel more involved into the match.

6. IMPLICATIONS

Research implications

Further research has to be conducted to validate the result of our study. More data should be tested, and several software applications should be compared. Since this testing used images of the game situations, experiments with real-time video streams have to be performed in order to realistically discuss options for usability during live matches. Furthermore, body language of coaches could be examined simultaneously. Future studies could consider the course of play to enhance the comparability of the results. Finally, market research should be carried out, to confirm the increasing demand for statistics of the coaches' emotional states.

Practical implications

The findings are useful for broadcasters of football matches because they propose a new technology to apply to increase fan engagement. Integrating such facial emotion recognition technology should be fairly easy and not especially costly for broadcasters. Interesting statistics can be calculated like, for example, the development of coaches' emotions during the game and present them to the TV audience. Another application area could be the support of the direction team, for example modified facial emotion recognition software could track the coaches' faces all game long and self-report striking emotional changes to the direction team, which they can then cut and show to the spectators. Since there are much viewed videos of coaches during the match, incorporating their emotions in real-time could make them more fascinating and entertaining. Certainly, the emotion recognition analysis can also be expanded to the players and thus information on their emotional development during the game can be collected and presented to the spectators. Furthermore, since sport gambling and betting has become an accepted part of the sport experience (Wann, Zapalac, Grieve, Partridge, & Lanter, 2015), bookmakers could use such statistics to develop a betting system based on coaches' emotions.

7. SUMMARY AND OUTLOOK

We investigated whether a facial emotion recognition application generates interesting data on the coaches' emotions in specific game situations. The idea is to present such data to the TV audience in the form of visualizations based on statistics for the purpose of increasing fan engagement. We found several unexpected results, with coaches showing positive emotions in a negative game situation and vice versa. Thus, facial emotion recognition technology can indeed be used in the context of sports marketing to increase fan engagement by providing interesting information about the coaches' emotions.

In the future, the use of technologies in football and sports in general will increase because the fans demand innovative entertainment approaches. Broadcasters have to rethink their technology portfolio in order to keep pace with their competitors. The importance of this issue is clarified by the emergence of more innovative technologies in football broadcasts, such as 360°-Streaming (Hoffmann, 2015) or Virtual Reality (Rentz, 2016). Facial emotion recognition applications might be the next big innovation in football broadcasts and might be indispensable in a few years. However, as with many other innovations, it remains open to see how the general audience would value it. This leads to future challenges for sports marketers, researchers, and computer scientists.

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