



ANALYZING SPECTATOR EMOTIONS AND BEHAVIORS AT LIVE SPORTING EVENTS USING COMPUTER VISION AND SENTIMENT ANALYSIS TECHNIQUES

YANG XU*

Abstract. It makes the reflection of humans' emotions and intentions from watching live sports events. Watching the event keeps people entertained and changes their mindset from being stressed to joyful. Watching sports events encourages the athletes and the sports persons to participate. Reflection of the live sports event consists of many crowds as the event's audience. This crowd's emotions and intentions directly impact the changes in the event's performance. It provides positive energy to the demotivated sports participants, making them perform better in the event. This study reflects the understanding of the facial emotions of the spectators from the live event. Then, they are decoded in the computer programming language, and an outcome is provided. It understands the emotions and sentiments of the people that affect the event's environment. The representation by the computer analysis makes the understanding of the changes provided by the spectators of the live event. The effect of the audience's emotions and behaviors in the crowd are computed by the utilization of computer software analysis and the effect of those reactions in the event. The collection of data is taken from the secondary sources of data collection, including the collection of information from the article and the journal based on the topic. The gathered data is analyzed by comparing them with their reaction and expressions in the live sports event.

Key words: Audience, Computerized analysis, Facial expression, emotions and behaviors, sentiment analysis techniques

1. Introduction. The work reflects humans' emotions and intentions from watching live sports events. Watching the event keeps people entertained and changes their mindset from being stressed to joyful. Watching sports events encourages the athletes and the sports persons to participate. In reflection of the live sports event it consists of many crowds as the event's audience. This crowd's emotions and intentions directly impact the changes in the performance of the event [11]. The cheering and the crowd's support work as the key encouragement to the athletes and the sportsperson participating in the event. Therefore, it is a crucial factor for the participants' performance. It provides positive energy to the demotivated sports participants, making them perform better in the event. This study reflects the understanding of the facial emotions of the spectators from the live event. Then, they are decoded in the computer programming language, and an outcome is provided. It understands the emotions and sentiments of the people that affect the event's environment. The final representation by the computer analysis makes the understanding of the changes provided by the spectators of the live event [6]. The effect of the emotions and the audience's behaviors in the crowd are computed using computer software analysis. The effects of those reactions in the event are shown in this study.

The major contributions of this work are:

1. The study introduces the concept of facial emotion recognition to understand spectators' emotions. By decoding these emotions through computer programming, the research contributes to a method for objectively measuring audience sentiment.
2. The research showcases how spectators' emotions and sentiments directly impact the sports event's overall environment. This understanding offers insights into creating a more engaging and interactive atmosphere for athletes and the audience.
3. By utilizing computer software analysis, the research demonstrates a method for quantitatively assessing the effect of audience emotions and behaviors during live sports events. This approach provides insights into the audience's reactions and their implications.
4. The research contributes to methodological approaches by utilizing secondary sources of data collection, such as articles and journals, to gather information about audience reactions. The comparison of gathered data with live event expressions enriches the analysis.

*School of Physical Education, University of Sanya, Sanya, 572000, China (yanludevelopment@outlook.com)

Importance of Emotion Recognition of Spectators. Emotion recognition of spectators, especially during events like live sports, holds significant importance due to its various applications and implications. Understanding the emotions of the audience can provide valuable insights that impact multiple domains:

1. **Enhancing Viewer Experience:** Emotion recognition enables event organizers, broadcasters, and content creators to tailor their offerings based on the audience's emotional responses. This customization can lead to a more engaging and immersive experience for viewers.
2. **Content Personalization:** By recognizing emotions, content can be personalized to match the preferences and sentiments of the audience. For example, during live sports broadcasts, emotional cues can trigger instant replays of exciting moments, enhancing the viewing experience.
3. **Real-time Feedback:** Emotion recognition provides real-time feedback on how the audience responds to different aspects of the event. This feedback can guide event organizers in making on-the-fly adjustments to keep the audience engaged.
4. **Understanding Audience Preferences:** Analyzing emotional patterns over time helps event organizers understand which segments of the event resonate most with the audience. This information informs decisions about future content and event planning.
5. **Enhancing Athlete Performance:** Emotion recognition can impact athletes too. Understanding the crowd's emotions can motivate athletes and influence their performance. Positive reactions can boost confidence, while negative reactions can indicate areas for improvement.

Applications of Emotion Recognition of Spectators. The applications of emotion recognition of spectators are broad and diverse, spanning across various industries:

1. **Entertainment and Sports:** In live sports events, emotion recognition can be used to gauge audience reactions to different game situations, players' performances, and overall event dynamics. This data can shape commentary, replays, and content creation.
2. **Market Research and Advertising:** Advertisers can use emotion recognition to assess viewer reactions to commercials and advertisements. This data helps tailor marketing campaigns to resonate better with the target audience.
3. **Healthcare:** Emotion recognition has applications in mental health monitoring. It can help identify individuals experiencing stress, anxiety, or other emotions, facilitating timely interventions.
4. **Education:** In online learning environments, emotion recognition can gauge students' engagement levels and adjust instructional content accordingly. This promotes effective learning outcomes.
5. **Human-Computer Interaction:** Emotion recognition can enhance the interaction between humans and machines, making user interfaces more intuitive and responsive. For instance, virtual assistants can adapt their responses based on users' emotional states.
6. **Customer Experience:** Businesses can use emotion recognition in customer service interactions to assess customer satisfaction and tailor responses accordingly, leading to improved customer experiences.
7. **Security and Surveillance:** Emotion recognition can be used in security systems to detect suspicious behaviors or emotional states that may indicate potential threats.

2. Objectives. This study properly examines and elaborates on some of the basic objectives. This includes the basic concept of the computer technology used in analyzing the emotions and the intentions of the spectator from the live sports event. That provides for the understanding of the effect of audience behaviors during the watching of the live event is a very crucial factor for the performance of the participant [7]. It provides positive energy to the demotivated sports participants, making them perform better in the event. This study reflects the understanding of the facial emotions of the spectators from the live event. Then, they are decoded in the computer programming language, and an outcome is provided. It understands the emotions and sentiments of the people that affect the event's environment. Some of the objectives of using the techniques of digital computer vision and software-based sentiment analysis in the making of the sports performance development in the sports event are as follows:

1. To elaborate on the concept of the live sports event cheering by the crowd
2. To examine some of the impacts of intention and the expression of the audience from a live sports event

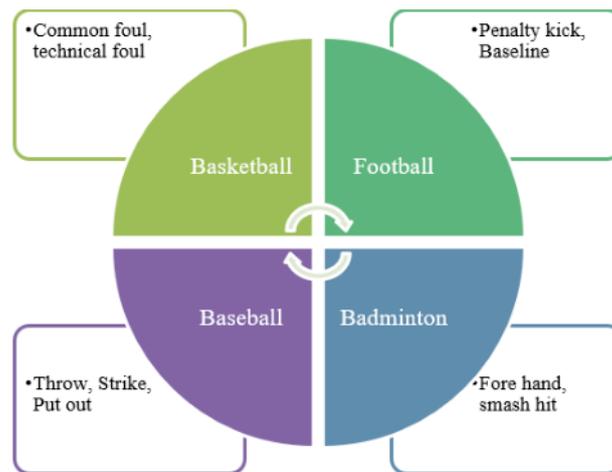


Fig. 4.1: Encouragement by the audience in the sports event

3. To state some of the challenges faced due to the changes in emotions and expression in the live sports event
4. To implement techniques of computer-based facial expression analysis for examining the event's audience intentions
5. To describe some of the methods of computer analysis for the examination of the facial expression and intention of Human
6. To state some of the effects of computer face expression analysis on making crucial changes in the environment of the event

3. Methodology. In the methodology section, the study collects information about the impact of the audience in the sports event. This work represents all the collection of data from the effect of human intention in the sports event and the examination of those expressions with computer technologies for solving the problems occurring in an environment of the live event, especially in the live sports event. This work makes the presentation of all the positive effects of computer technologies. It examines the behaviors of humans during live sports events and the technological factors affecting the improvement of problems created in the event's performance and getting the visual solution [1]. The representation by the computer analysis makes the understanding of the changes provided by the spectators of the live event. The effect of the audience's emotions and behaviors in the crowd are computed by the utilization of computer software analysis and the impact of those reactions in the event. Data collection is taken from the secondary sources of data collection, which includes the collection of information from the article and the journal based on the topic [9]. The gathered data is analyzed by comparing them with their reaction and expressions in the live sports event. This includes observing the impact of computer analysis for understanding the facial expressions of the crowds in sports events.

As this study was done based on the secondary qualitative data collection method, it has helped a lot by giving various hints related to the topic. Previous articles are available beforehand, which help identify the portion that still needs more definition [10]. In various journals, scholarly articles were available there that were done by other researchers. In this way, it was easy to identify the covered portion, and after collecting the information, the data was needed to analyze, which is one of the essential parts.

4. Encouragement by the crowd in the sports event. The performance of the crowd changes the intention of the players and the participants of the sports event, as shown in figure 4.1. This includes the performance change of that particular sport on the field [3]. The performance of the sports persons in the event depends on the player's mental stability, concentration, and confidence during the event. The above-represented

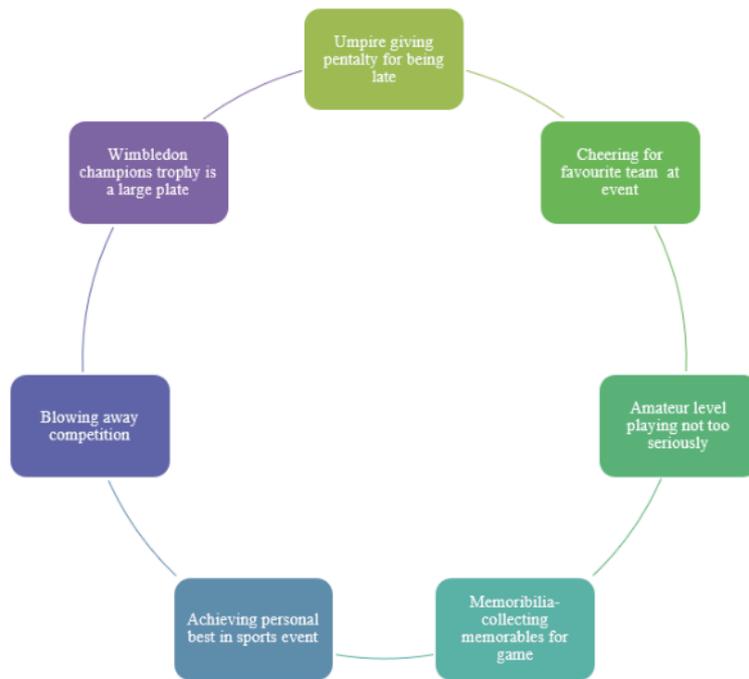


Fig. 4.2: Encouragement by the audience in the sports event

Figure 4.1 shows the impact of the cheering and the crowd's support as the key encouragement to the athletes and the sports person participating in the sports event.

Recognition of Input Data: Recognition of input data refers to the process of identifying and categorizing information from various sources or inputs. This process often involves applying algorithms and techniques to analyze data and extract meaningful patterns, features, or characteristics. In the context of your abstract, recognizing facial emotions from spectators during live sports events involves capturing facial expressions, processing these visual cues, and determining the emotions conveyed by individuals in the crowd.

For example, in the study mentioned, the recognition of facial emotions could involve using computer vision techniques and machine learning algorithms to analyze video footage of the crowd. These algorithms might detect facial landmarks, expressions, and other visual cues to classify emotions such as happiness, excitement, or disappointment. This recognition process allows researchers to quantify and understand the emotional dynamics of the audience.

Usage of Multicasting: Multicasting is a communication technique used in computer networks to transmit data from one sender to multiple recipients simultaneously. Unlike broadcasting, where data is sent to all devices on the web, multicasting targets a specific group of recipients who have expressed interest in receiving the data. This method benefits scenarios like streaming live sports events to a large audience.

The above figure 4.2 shows that Sometimes some of the distractions and the under-confidence provided by related factors make the performance quality low. In that case, creating stability in the player's version becomes crucial. The encouragement of the crowd is the key factor in increasing the player's confidence level [16]. It provides the constructing mental stability to the participant for making a more effective decision in the event. It also creates positivity among the players and tends them to make better team collaboration for better-qualified performance.

Table 4.1 shows the necessity and the impact of encouragement by the crowd audience in making environmental changes to the live event. That includes the change of the performance of the sports persons in the event depending on the mental stability, concentration, and confidence of the player by the audience's motivation

Table 4.1: necessity and impact of crowd encouragement in a sports event

Necessity	Impact
Making effective decisions for the event	Providing of the constructing mental stability to the participant for making a more effective decision in the event
Collaboration of team members	It also makes positivity among the players and tends them to make better team collaboration for better-qualified performance

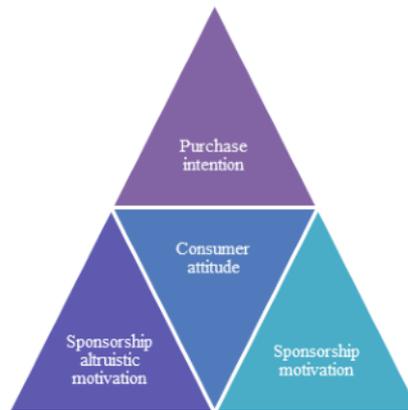


Fig. 5.1: Impact of crowd intention in making changes in the live sports event

and cheering.

5. Impact of crowd intention in making changes in the live sports event. The benefits of the crowd cheering help in making the confidence level of the participants in the sports event. For example, in the live sports event of a cricket match, the environment can be changed by the audience’s expression and intention. That sports event consists of 11 players of the team fielding on the ground and two players batting from the opponent team [13]. That becomes a mental condition of the player to be changed by the opponent fielders. In that condition, the crowd’s audience’s support and cheering are the key encouragement in providing confidence to the batsman. That makes them perform better in the match. The above figure 5.1 shows the changes in the development of the sports participant involved in the event [8]. It provides positive energy to the demotivated sports participants, making them perform better in the event. These behaviors and intentions of the crowd reflected the understanding of the facial emotions of the performer from the live event. Therefore, it can be stated that it is one of the key factors in constructing better decision-making ability for the performer of the sports event that gets reflected in their performance on the ground.

The intention of crowd to make changes in live sports events can have a positive impact from various sides. The crowd is helping to encourage the players, and along with that, it will create a positive environment [14]. The spectator’s presence always motivates and boosts the players’ morale and enhances the overall performance. As much as the spectators get interested from the match, they will visit repeatedly, enhancing the fans’ experiences. They can encourage their favorite players by waving flags, cheering, showing banners, and many more ways. The crowd can enhance the player’s mind and influence them for better performance [4]. It is important to remember that their safety and security matter most while crowds are increasing. It is one of the duties of the organizers to maintain every side.

6. Challenges faced due to the changes in emotions and expression of the crowd in the live sports event. Since it is known the encouragement of the crowd acts as the key factor in increasing the confidence level of the player. It makes providing of the constructing mental stability to the participant for

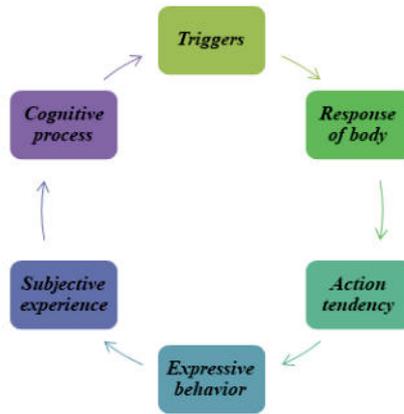


Fig. 6.1: Challenges faced due to the changes in emotions and expression of the crowd in the live sports event



Fig. 6.2: Challenges faced due to the changes in emotions and expression of the crowd in the live sports event

making a more effective decision in the event. It also makes positivity among the players and tends them to make better team collaboration for better-qualified performance. It also faces many challenges that are reflected in the performance of the participants of the sports events [5]. As the support and the cheering from the crowd audience act as the key encouragement in providing confidence, it can also make the supporting participant get demotivated and get distracted from the way to success. The above figure 6.1 shows the challenges the sports participant faces during the live sports event. That includes the performance low-quality performance of the participants [2]. In the case of team performance in a sports event, the team members' collaboration towards getting competitive advantages is crucial. Figure 6.2 shows the better version of one player in the team cannot make the whole team perform better. The under-confidence of the team members cannot make the team achieve more competitive performance. The nervousness and the instability of the mindset act as the key challenge in demoting the better version of the team.

The above table 6.1 shows the challenges and the impacts of the challenges faced by the changes in the intention and expression of sports participants. This includes the changes in the environment of the sports event. The diverse mindset and low confidence level of the sports participants directly impact this.

There are several challenges have been faced due to the changes in emotions and expression of the crowd in the live sports event. One of the most significant risk factors is safety, as overcrowded places with minimal military support can be the reason for life risk. Various suspicious activities can happen then, and sometimes

Table 6.1: Challenges and impacts of challenges in crowd encouragement in sports events

Challenges	Impact
Mismatching of team members' collaboration	Team members cannot make the team perform more competitively performance.
The nervousness and the instability of the mindset of the sports event participant	It becomes a key challenge in demoting the better performance of the team

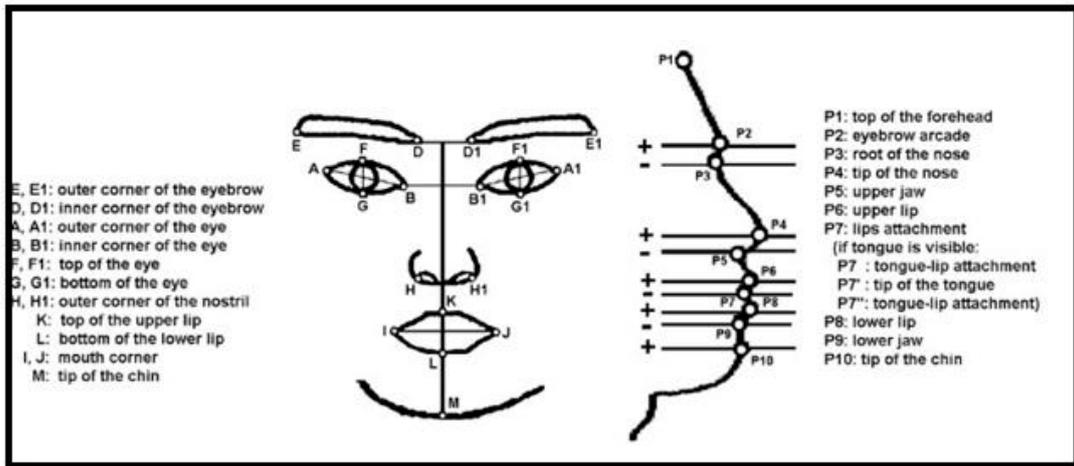


Fig. 7.1: Facial analysis of human expression by computer-based program

it becomes quite challenging to monitor those sides[17]. While it becomes difficult for the management to handle the crowd, it can be the reason for adverse interactions and loss of enjoyment. It is also the reason for reputation loss as many spectators are available in the field who intentionally spread negative information about any part.

7. Computer-based facial expression analysis for examining the event’s audience intentions.

The crowd’s encouragement provides positive energy to the demotivated sports participants, making them perform better in the event. This examination of the crowd’s emotions reflects the understanding of the facial emotions of the spectators from the live event. The collection of expressions and emotions is collected digitally. Then, they are decoded in the computer programming language, and an outcome is provided [4]. It understands the emotions and sentiments of the people that affect the event’s environment. The final representation by the computer analysis makes the understanding of the changes provided by the spectators of the live event [9]. The effect of the emotions and the audience’s behaviors in the crowd are computed using computer software analysis. The impact of those reactions in the event is shown in this study. These all are represented in the above figure 7.1, including the behavioral changes of the audience.

The above table 7.1 shows the need and importance of computer-based analysis for examining the sentiments and emotions of the crowd during the watching of a live sports event. These expressions are collected and reflect the impact of those making the environmental changes

8. Methods of computer analysis for the examination of the facial expression, emotion and intention of Human.

The decoding of the collected data in the computer programming language and an outcome is provided. It makes us understand the emotions and sentiments of the people that affect the event’s environment. The last representation by the computer analysis makes the understanding of the changes provided by the spectators of the live event. The computer-based analysis methods represent the digital

Table 7.1: Necessity and impact of crowd encouragement examined digitally through computer software

Necessity	Impact
Examination of the crowd’s emotions reflects the understanding of the facial emotions	The final representation by the computer analysis makes the understanding of the changes provided by the spectators of the live event
Digital collection and understanding of humans emotions	It also makes the understanding of the behavioral changes of the audience.

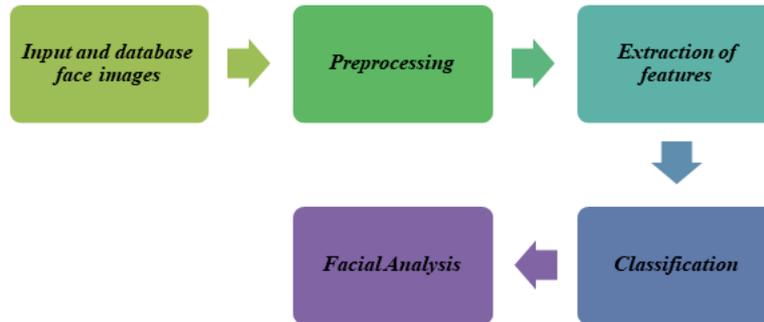


Fig. 8.1: Methods of computer analysis for the examination of the facial expression, emotion, and intention of Human

analysis of the mindset of participants and the crowd. Examination through an automatic emotion detector is typically performed by measuring various parameters of the human body or types of impulses done through electric waves in the nervous system. It also examines the changes in intention and expression [7]. The majorly preferred methods of reviewing the choice and expression of humans are electroencephalography, skin resistance measurements, blood pressure, heart rate, eye activity, and motion analysis. The above figure 8.1 shows the methods of examining information collection in developing emotions that can hamper the health condition of the audience and the sports event participants [12].

9. Impact of computer face expression analysis on making crucial changes in the environment of the live event. The cheering and the empowerment of the crowd change the intention of the players and the sports event participants. This includes the performance change of that particular sport on the field. The performance of the sports persons in the event depends on the player’s mental stability, concentration, and confidence during the event. Sometimes, some of the distractions and the underconfidence provided by related factors make the quality of the performance low. In that case, creating stability in the version of the player becomes very crucial [15]. The examination of the crowd’s emotions reflects the understanding of the facial emotions of the spectators from the live event. This helps in getting the test of all the encouragement by the audience to the sportsperson participating in the sports event. The collection of expressions and emotions is collected digitally as represented in figure 9.1.

Then, they are decoded in the computer programming language, and an outcome is provided. It understands the emotions and sentiments of the people that affect the environment of the event [16]. The above figure 9.2 shows the crowd’s facial expressions and feelings are important in the communication process as they produce a positive or negative energy to the participant in the live event. It helps to understand the collector gathers significant information about the expression and the changes. In the case of collecting the face of the audiences of the live sports event it makes the understanding of the factors that can change the environment and the performance of the participants in sports events. The application of digital methods makes the representation of actual intention, and the crowd’s behavior impacts the live activity sportspersons involved in the sports



Fig. 9.1: Impact of Computer face expression Analysis for analyzing the facial expression of human

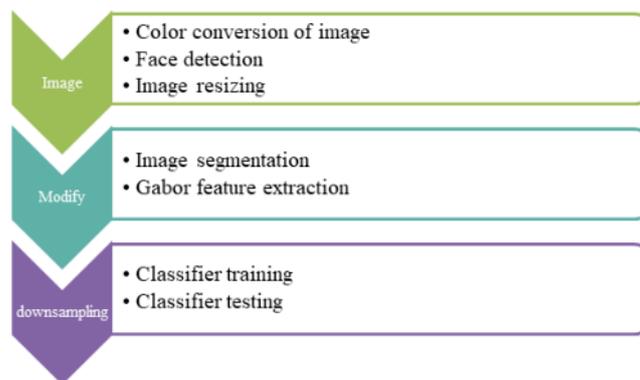


Fig. 9.2: Computerized facial expression process

event.

Table 9.1 shows the causes and impacts of analyzing the facial expression of the crowd attending the live sports event. This includes the collection of information through digital human presentation examining techniques.

Automatic facial expression analysis is vital as it can identify the '**human-computer interaction**' and it has become an exciting area over the past decades.

10. Results. Crowd emotions play a crucial and essential role in the outcome of sports games in all levels. The emotions connected to particular sports are very big to measure. Still, from research statistics it can be said that different ranges of emotions that are displayed by the different age group audiences heavily affect the sporting events.

From figure 10.1 it can be seen that between different sports fan attendances millennial age group attendance is the most. The millennial age group people are the ones who were born in the 1990s, and they are the most active sports fans throughout sporting events because they were born and brought up in an era where the internet wasn't that popular. However, Gen Z shows the second-largest attendance rate in different sporting events. Crowd emotions play a crucial and essential role in the outcome of sports games at all levels. The feelings connected to particular sports are enormous to measure. Still, from research statistics, it can be said that different ranges of emotions displayed by the other age group audiences heavily affect sporting events. The emotions shown by a higher number of audiences will also impact the players and might be instrumental in deciding the game's outcome.

From figure 10.2 it can be said that from the year 2012 to 2022, the numbers of frequent viewers, sports

Table 9.1: Causes and impacts of analyzing the facial expression of the crowd attending the live sports event

Causes	Impact
Collecting facial expressions and the emotions of the crowd	They help produce positive or negative energy to the participant in the live event it helps to understand the collector gathers the significant information about the expression.
collecting the expression of the audiences of the live sports event	It makes the understanding of the factors that can change the environment and the performance of the participants in sports events.

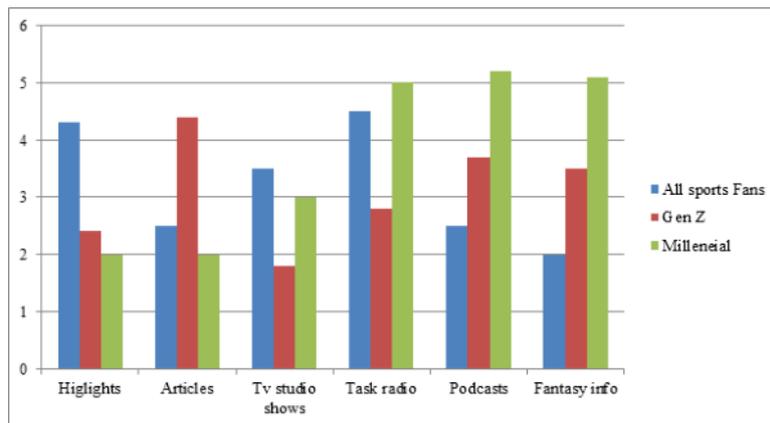


Fig. 10.1: Sports fan viewers from different generations

fans, and occasional viewers have altered quite a lot. Regular viewers are genuine sports lovers who visit the live events or watch on online platforms and make time for these events despite having a busy jobs or responsibilities. Occasional viewers are people who are just trying to have a good time on rare events. The emotion ranges change in frequent and infrequent viewers as there is bound to be more passion for the events in regular viewers, and the numbers reflect that. This crowd’s emotions and intentions directly impact the changes in the event’s performance. As the support and the cheering from the crowd audience act as the key encouragement in providing confidence oppositely, it can also make the supporting participant get demotivated and get distracted from the way to success [18]. That includes the performance low-quality performance of the participants. In the case of team performance in a sports event, the team members’ collaboration towards getting competitive advantages is crucial. The better version of one player in the team cannot make the whole team perform better. The under-confidence of the team members cannot make the team achieve more competitively. This study shows the advantages of computer-based analysis for event audience facial expressions.

11. Conclusion. It concludes all the reflections on the understanding of the facial emotions of the spectators from the live event. Then, they are decoded in the computer programming language, and an outcome is provided. It understands the emotions and sentiments of the people that affect the event’s environment. The final representation by the computer analysis makes the understanding of the changes provided by the spectators of the live event. The effect of the emotions and the audience’s behaviors in the crowd are computed using computer software analysis, and the effects of those reactions in the event are shown in this study.

It can be concluded that many factors are available related to the spectator’s emotions, behaviors, and involvement with life. The spectator’s involvement can be observed with their feelings and visible through their facial expression and body language. Computer vision and sentiment mainly provide all the information on a real-time basis and can be one reason for attending live sports. The spectator emotions and behaviors at live

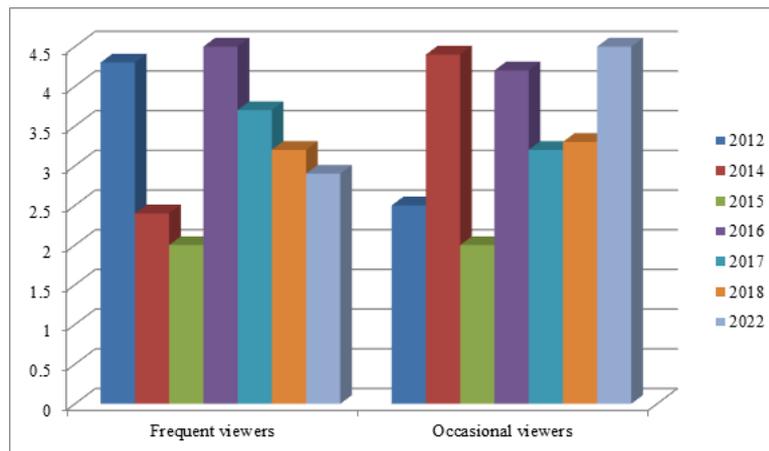


Fig. 10.2: Online and live viewership and emotion range statistics in recent years

sports events using computer vision are increased in various factors. Fan engagement involves their feelings, visible through their facial expression and body language. Computer vision and sentiment mainly provide all the information on a real-time basis. Many people are available on the ground, and the management team looks after their safety and security. In the future, deep learning-based medical image diagnosis can be tested to improve performance.

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