HOW A WEARABLE CAMERA CAN BENEFIT SOCCER PLAYERS

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Abstract

The advancements of technology in sports have played a crucial role in the progressive changes from an athlete performance standpoint. For example, there are many sports, like soccer that have seen many technological advances and devices introduced. In soccer, Video Assistance Review (VAR) is one of the more recent means of technology that is aimed at assisting officials, such as referees, to make the most correct decisions, according to the rules, on and during the field of play (Carlos, Ezequiel, Anton, 2019). This specific form of technology could possibly have changed the referee's decision for Diego Maradona's famous "Hand of God" goal for Argentina against England in the 1986 FIFA World Cup when he scored a clear goal with his hand and the referee failed to call a handball, against him (Britto et al., 2014). The result of that match resulted in an Argentina team win. Argentina went on to eventually win the FIFA World Cup that year. Thus, it is better late than never that this form of technology was implemented so that further incidents where referee human errors can be avoided. Goal-line technology is another example of a revolutionary mean of technology that has positively integrated in the sport of soccer. England's fate at the 2010 FIFA World Cup could have changed when England midfielder, Frank Lampard's strike from outside the penalty box crossed over the goal line against Germany in the Round of 16 of the tournament. The referee failed to rule in favor of the goal for England, and were eventually eliminated that game, losing to Germany. Since goal-line technology had been introduced to the sport of soccer in 2012, referees across different professional soccer leagues have instant alerts on whether the ball has entered the net (Brockhoff, Huff, Maurer, Papenmeier, 2016). The following paper explores the idea of how technology, and wearable cameras can improve the performance of professional soccer players by providing them with the first person perspective of what they are faced with on the field.

Keywords: *wearable technology, wearable camera, soccer, player performance, player development, cognitive thinking*

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Introduction

The Importance of Player Development

       Player development is an important feature in the sport of soccer and the best

nations in the world provide funding in this specific area so that they can bring exposure,

develop and produce quality players that will represent their country to bring success at

the international level. In Spain, the national governing body responsible for funding the

development of Spanish soccer players on the national team is the Royal Spanish

Football Federation (Morgan, Whitehead, 2018). In France, the Institute National du

Football de Clairefontaine serves as a national soccer center that focuses strictly on

training French soccer players representing the national teams (Morgan, Whitehead,

2018). Despite not qualifying for two World Cup tournaments in the 1990's, France still

achieved much success through their national team during this decade by winning a

World Cup in 1998, the most prestigious international soccer tournament in the sport of

soccer, which only occurs every four years. They also won a European Championship,

the most prestigious European nations tournament from a national level standpoint in

2000. During this decade France was also able to produce world-class athletes with the

likes of Zinedine Zidane, Thierry Henry, Patrick Vieira and Lillian Thuram. Following

the success of France during this specific decade, the British government took action

upon themself and attempted to achieve similar success by spending approximately US

$170 million in developing St. George's National Football Centre in an effort to compete

against other successful national teams and become more competitive on the world soccer

scene (Morgan, Whitehead, 2018). The main priority of this facility is to serve as the

base for all coaching and development work initiated by the EFA (English Football

Association) and the main preparation and training ground for all of the levels and age groups of the England national football teams (Morgan, Whitehead, 2018). Club teams such as Benfica in Portugal, Ajax in the Netherlands and Olympique Lyonnais in France are just a few clubs that have emphasised the importance of player development as many teams try to produce home grown talents in order for them to grow and be integrated in the first team or sold at a high profit (Morgan, Whitehead, 2018). An example to support this claim is Benfica, which has produced through their academy exceptional players such as, João Felix, Ederson and even Bernardo Silva (Sprung, 2019). Having developed these players and integrated them in their first team allowed them to gain exposure, experience to the point where major clubs around the world were willing to spend millions of euros or pounds for them (Sprung, 2019). João Felix is a prime example that was brought into Benfica's Under 17 (U17) team on a free transfer from FC Porto in 2015 (Transfermarkt, n.d.). A few years later and having been developed, integrated into Benfica's first team and performing at an extremely high level, Felix was sold for €126 million (Transfermarkt, n.d.). The fact that a professional soccer team like Manchester City in England spent US $300 million to create a state of the art facility to support player development in their system shows just how much some teams are willing to spend in order to challenge other clubs in being the best both domestically and internationally (Morgan, Whitehead, 2018).

The Importance of Identifying and Ranking Players Based Off of Their Performance

How is one able to compare top, up and coming soccer players especially those in the youth system based on their performances? Comparing players in soccer by having a

ranking system is definitely a way for coaches, players, scouts and those in director positions to understand what promising talents there are in one's soccer federation (McHale, Scarf, Folker, 2012). However ranking soccer players can be difficult because there are several positions on the field and each role is unique in it's own way. Seeing that every team has a goalkeeper, defender, midfielder and forward, it is difficult to draw a comparison between players that play in these different positions (McHale, Scarf, Folker, 2012). For example, comparing players that play in different positions such as a defender who might have stronger traits through physicality, heading of the ball and tackling with a forward that has better shot accuracy and power, dribbling and speed, is difficult to draw a conclusion on who is better (McHale, Scarf, Folker, 2012). That being said it is still possible to compare players that play within a specific position and these comparison can be easier in distinguishing who is better (McHale, Scarf, Folker, 2012). For example there are different types of midfielders in soccer, one can be a center-defensive midfielder, a center-attacking midfielder, a regular center midfielder and even a left or right midfielder (McHale, Scarf, Folker, 2012). A player's position might also be subject to change from the start of the match to the end depending on the result of the game. To support this claim, if a team is down a goal late in a match a midfielder may be taken off for another forward/striker or even be told to play closer to the other forwards/strikers in order for the team to get an opportunity of scoring a goal and tying the match. An on-field formation is also subject to change, all depending on a manager/coach's decision. However a reason why a ranking system is difficult to determine for individual players in soccer is because if a team has a strong midfield and attacking unit that are dominating a match against a weaker side, the team's own

defenders as well as goalkeeper may have a quieter game due to the other positions dictating the match for them (McHale, Scarf, Folker, 2012). This results in these players not having a strong contribution on a match (McHale, Scarf, Folker, 2012).

EA Sports Player Performance Index

England's national governing body has developed a way to create their own efficient player ranking system through the EA Sports Player Performance Index (McHale, Scarf, Folker, 2012). This ranking system is used in the Premier League, England's first division of soccer and the Championship, England's second division of soccer (McHale, Scarf, Folker, 2012). Ranking players are based on six subsidies consisting of modeling match outcome, point-sharing index, appearance index, goal scoring index, assist index and clean sheet index (McHale, Scarf, Folker, 2012). Having a system like this is beneficial for those in managerial and director positions in soccer, also referred to as football, when analyzing the current talents as well as up and coming players that have great potential to succeed in the sport. The Premier League, Football League, Football DataCo and the Press Association partnered up to create the EA Sports PPI (McHale, Scarf, Folker, 2012). The Premier League is focused on managing the first tier of soccer in England, whereas the Football League manages the second tier of soccer in England (McHale, Scarf, Folker, 2012). The data produced by the professional soccer competitions in England belong to Football DataCo (McHale, Scarf, Folker, 2012). Lastly, the Press Association is the official new agency for the UK (McHale, Scarf, Folker, 2012). The intentions of developing the EA Sports PPI is so that statistics and hard driven data are used in ranking and comparing players that play in different

positions while eliminating the barrier of subjective opinions (McHale, Scarf, Folker, 2012). For example a subjective opinion cannot possibly overrule a comparison between two goalkeepers, where one has more clean sheets, minutes played and penalty saves than the other. The hard-driven facts and statistics are able to prove that one player is better than the other, again based on data. Having a quantitative system perform in this manner is beneficial for everyone including non-statisticians and the general fan base who are able to clearly understand how specific points are rewarded (McHale, Scarf, Folker, 2012).

Importance of Wearable Cameras in Soccer

Wearable cameras have been used as an important and revolutionary research tool in many fields. The origins of wearable cameras started through the research efforts in the field of lifelogging (Doherty et al., 2013). Lifelogging is a term that describes digitally capturing the first-person perspective of one's everyday activities in a discreet and passive manner (Doherty et al., 2013). Data storage and miniaturization, which is a way to describe the reduction in weight, size and/or power required in processing data, are some of the objectives achieved during early stages of this area (Doherty et al., 2013). Wearable cameras are a beneficial tool in answering countless research questions because they record the situations one encounters both at an extensive and convenient rate (Doherty et al., 2013). Specifically in soccer, where a minimal action or behaviour can occur that plays an impactful role on a match, having a wearable camera can assist in measuring them. On October 14, 2014, a company called First V1sion (known for its wearable broadcast system that captures the footage from the first person point of view)

with the help from Spanish La Liga BBVA club, Córdoba CF completed a trial to test a wearable camera on the pitch (Trenholm, 2015). They became the first soccer club in the world to wear a wearable camera on the player's jerseys (Trenholm, 2015). Soccer is relatively a low-contact sport and as a result it is suitable for using wearable technology (Trenholm, 2015). Córdoba CF player Luis "Luso" Eduardo Delgado Pacheco commented on the wearable technology following the trial stating, "at the beginning you are thinking about the device, but then you forget that you are wearing it. And also, with First V1sion, you look stronger" (Trenholm, 2015). Overall, this is a great sign seeing that a player spoke highly of this technological device. Once more teams begin to use this form of technology, then more feedback from players on other teams and leagues will be available and changes on the wearable cameras can be made according to their reviews. Having more technology available to players can help them increase their performance on the pitch.

Literature Review

In Nicolas A. Brown, Andrew B. Blake and Ryne A. Sherman's paper, *A Snapshot of the Life as Lived: Wearable Cameras in Social and Personality Psychological Science*, the authors indicate many advantages in using this form of technology (Brown et al., 2017). For example, rather than carrying large hand held or shoulder mounted cameras, wearable cameras are convenient because of their size and even weight (Brown et al., 2017). A wearable camera is light in weight and also small, making it easy to wear on one's shirt or even a blouse (Brown et al., 2017). This statement is important because it demonstrates that players playing on the pitch would

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not wear something that could negatively impact them. Wearable cameras are frankly simple to operate and are able to capture images at regular intervals (Brown et al., 2017). There are wearable camera available in the market that can be wireless and capture video in HD quality, 1080p resolution, up to 12 million pixels (4032x3024), while also being chargeable, with battery life lasting several hours.

A professional soccer match lasts 90 minutes and is divided by two 45-minute halves. At the end of the first half, teams are rewarded a 15 minute intermission before the second half resumes. In a soccer match there are a total of 22 players on the pitch, 11 players from each team and each player is given a specific position to play. Each team is allowed one goalkeeper and the rest of the players are divided amongst defenders, midfielders and attackers. The objective of the game is to score as may goals as possible and avoid conceding them. The team that scores the most goals after 90 minutes wins the match. If both teams score the same amount of goals or if the score is tied at 0-0 after 90 minutes, the result of match is determined as a draw. Soccer is a sport where scenarios on the pitch can change instantly One moment one player or team may be dominating and causing pressure against their opponent and the next moment they may give up possession of the ball and the opposing team scores on a counter attack. It is important that players remain as focused as possible for the full 90 minutes, which is the duration of a professional soccer match. The primary goal for every attacker/forward player in soccer is to score goals. In order to score goals smart and nimble decisions need to be made in the final third of the pitch, whether it is making the final key pass that sets up a goal, a dribble past a defender that provides a clear shot on goal, or even timing a run perfectly in order to receive a cross from the wing and attempt to score a header. It is simple to

describe attacking approaches on paper however executing them on the field of play is not as easy and things can change in a nano-second. One of the best players that has played the game and revolutionized the sport of soccer, Dutch legend, Johan Cruyff, once said a famous statement saying, "playing football, is very simple, but playing simple football is the hardest thing there is" (The Times, 2016). Therefore, as a coach and as a player it is important to constantly analyze a player's behavior and performance on the pitch in order for them to improve and execute certain plays and movements the best way possible.

Since there is a lack of research done on using wearable cameras in soccer it is an important opportunity to look at what other authors have researched in this specific sport and how the idea of using wearable cameras can enhance their studies further. There are different types of camera angles that are currently used in the sport whether it is the broadcasting angle or bird-eye view but having a wearable camera can be a beneficial tool for players and coaches because it would capture visual data from the first person perspective of what the players themselves are faced with on pitch. Andreas Fink, Jürgen U. Bay, Karl Koschutnig, Katharina Prettenthaler, Christian Rominger, Mathias Benedek, Ilona Papousek, Elisabeth M. Weiss, Anna Seidel and Daniel Memmert conducted a study in their article, *Brain and Soccer: Functional Patterns of Brain Activity During The Generation of Creative Moves in Real Soccer Decision-Making Situations*, where brain activity was examined as individual players had to imagine creative movements in actual soccer decision-making scenarios (Fink et al., 2018). The researchers collected their data using thirty active male soccer players between the ages of 18-32 that have been playing soccer for at least ten years (minimum once a week) (Fink et al., 2018). Using videos of

the Australian and German soccer league, the participants used an adjusted version of the SVT-S (standardized video task in soccer) to mentally create moves with the overall intention of scoring a goal in a provided soccer decision-making situation (Fink et al., 2018). The participants were required to find as many solutions as possible that they believed would lead to a goal (Fink et al., 2018). The answers that they submitted were then ranked based off of the first pass the participants thought to execute (Fink et al., 2018). A maximum of four soccer experts with a UEFA A license, which is the highest soccer qualification in the sport, reviewed the participants answers, with the corresponding video, and rated the overall originality on a scale of 1-5 (Fink et al., 2018). Collecting images or scenarios from a specific player's perspective on the field through a wearable camera can enhance this specific study further. This study was effective because the idea of analyzing decision making in soccer is important as it allows further discussion to be developed in order for players to improve their performance by not making the same mistakes or executing them in the same or similar manner in another situation. A player's cognitive mental awareness is one of the most important features in soccer and being able to read the game and the space around one's surrounding can lead to positive decisions on the pitch.

The lack of evidence of using wearable cameras in the sport of soccer in 2020 is understandable seeing that FIFA only passed a standard to allow wearable technology and EPTS's in the field of play in 2015 (FIFA, 2016). FIFA's announcement on allowing wearable technology to be used during a match came unexpectedly (Svetlik, 2017). Approximately a month before the 2015/16 English Premier League campaign began, FIFA announced that as long as the major leagues around the world allowed wearable's,

clubs were allowed to use EPTS devices (Svetlik, 2017). That being said, using other sports to draw similarities on the benefits that wearable cameras could play can be discussed based on previous research that has been documented. The most interesting approach to this issue has been proposed by Sayuri Umezaki, Noriyuki Kida, Teruo Nomura in their article, *Assessment of the Visual Behavior of Volleyball Players While Blocking the Ball: A Study Using a Wearable Camera* (Umezaki, 2017). There were two pilots studies and a main one that were examined throughout this research paper (Umezaki, 2017). The first pilot was focused on identifying the criteria for line-of-sight estimations and observing their accuracy (Umezaki, 2017). The second pilot was focused on examining the effectiveness of line-of-sight estimation whereas the main study focused on estimating the line-of-sight when a player is blocking on the volleyball court (Umezaki, 2017). The purpose of the first pilot was to determine the judgment criteria that is used for line-of-sight estimations when it comes to volleyball players executing blocking movements and examining their accuracy all through a simulated experiment with the use of a wearable camera (Umezaki, 2017). The purpose of the second pilot was to observe the effectiveness of both accuracy and precision for analyzing line-of-sight estimations from the first pilot study by redoing the experimental environment that copied the movement of a volleyball from toss to spike, by using the data from the multiple participants (Umezaki, 2017). The purpose of the main study was to quantitatively study the gaze shift pattern of individual volleyball players and detect the differences in time and patterns that are applied to real game situations (Umezaki, 2017). The overall findings in this research article show that through pilot studies one and two, the use of the wearable camera appropriately measured the ball pursuit and initial spiker

fixation time intervals (Umezaki, 2017). For the main study it was concluded that the gaze shift pattern can be classified in "gaze shift" and "ball pursuit" categories indicative of skill-based differences (Umezaki, 2017). In conclusion, the results depict that estimating visual behaviour when a player is forced to block the volleyball using a wearable camera as opposed to an eye tracker is possible (Umezaki, 2017).

Consequently, this article opens up the possibility for other team sports beyond volleyball, to also experiment with wearable cameras and see the opportunities that can benefit the athletes. This study used wearable cameras to analyze areas such as gaze shift and ball pursuit, which can assist in improving the minor details that volleyball players need. Although there is an insufficient amount of research that has been done with wearable cameras on improving player performance in soccer, the concepts can be adopted and used to study ways that attacking players approach scoring scenarios, player positioning and attacking tactics from their perspective.

Technology Examples

Technology in general has served as an impactful resource in the sport of soccer by assisting referees in order for the game to be played fairly as well as players in improving their development and performance. Video Assistance Review (VAR), goal-line technology and electronic performance and tracking systems (EPTS) are some of the major forms of technology that are used during the duration of the match. All these forms of technology are fairly new to the sport with VAR introduced in some of the top tier leagues during at the start of 2018/19 season, goal-line technology in 2013 and permission for EPTS to be used was granted in 2015. These technologies have been

successful thus far and it is important to understand the long process of allowing wearable technology and EPTS's to be introduced in the field of play. In order to become a provider of Electronic Performance and Tracking Systems (EPTS) and aspire to experiment and certify an EPTS, in this specific case a wearable camera to the FIFA standard, it is required to follow the FIFA Quality Programme application process (FIFA, 2020). In order to ensure that the product is of FIFA quality, it is mandatory to go through a five-step certification process (FIFA, 2020).

The first stage of the process is, *Requesting The Test*. In order to request a test, the EPTS provider must submit information such as the product and company details that would want to be tested to FIFA through the following email, quality@fifa.org (FIFA, 2020).

The second stage of the process is, divided into two parts a) *Impact Test* and b) *WFSGI Pledge* (FIFA, 2020). For the *Impact Test*, the provider must send the outlined number of wearable items to the Accredited Test Institute in agreement with the test protocol (FIFA, 2020). The specific connection will be provided by FIFA upon the completion of step one (FIFA, 2020). The *Impact Test* could also start before termination of the license agreement although the product approval is subject to the agreement that is to be signed (FIFA, 2020). Once the test is completed and the test fee has been paid to the Test Institute, the Test Institute will deliver the final test report to FIFA (FIFA, 2020). For the *WFSGI (World Federation of the Sporting Goods Industry) Pledge*, FIFA requests all the manufactures involved in the wearable EPTS devices to offer a pledge (valid for a two year period) from the WFSGI, which will certify that the production

aligns with industry standards (FIFA, 2020). According to FIFA, they recommend 2-3 months for this specific process (FIFA, 2020).

The third stage of this process is *Product Liability Insurance (PLI)* (FIFA, 2020). Proof of the PLI is required before countersigning the agreement and needs to show that it is valid for the entirety of the certification (FIFA, 2020). This makes it a crucial part of the License Agreement (FIFA, 2020). PLI is mandatory for all EPTS providers whether wearable or optical and the insurance is mainly in the interest of the licensee because it guarantees protection in case there is any accusation in connection with this use of the product (FIFA, 2020).

The fourth stage of this process is *Validation of The Reliability and Accuracy of The Data,* in a simpler term, the performance test (FIFA, 2020). FIFA along with the Accredited Test Institute host an annual Performance Test event. For this event, each provider is obligated to partake on the site of the event along with their tracking system(s) that they hope to authorise (FIFA, 2020).

The fifth and final stage of this process is *FIFA Certification* (FIFA, 2020). One has two options if they are licensed and receive the certification for the EPTS system(s). They can either sign for a non-commercial agreement or a commercial agreement (FIFA, 2020). The non-commercial agreement insures the Impact Certification for wearable technologies, which is obligatory under the Laws of the Game for usage of all official competitions (FIFA, 2020). The commercial agreement insures both the Impact Certification (if needed) as well as the Performance Certification (FIFA, 2020).

It is also important to look at other sports and see as well as understand how or if wearable cameras have played an impactful role on the sport. Not every sport has the

capability of using wearable cameras but it certainly can help revolutionize those sports that decide to adopt this form of technology. The sport of hockey is one where fans have seen glimpses of the first-person perspective of a person on the ice. In 2014, the NHL (National Hockey League) experimented by using referees to capture the first-person perspective of what they see on the ice, allowing fans to also see plays and goals along with perspective from the wide-angle replays from the aerial camera (NHL, 2014). Known as the RefCAM, the camera works by showing officials getting into various positions to make different calls, and providing a new angle on player goals (NHL, 2014). They were able to use this for training the officials and improving calls made on the ice. The NHL's video streaming package; NHL GameCenter Live gives subscribers the options to view a game using the aerial and referee cameras for select games (NHL, 2014). In 2017, the NHL RefCAM was also used in portions of NBC's broadcast of the NHL All-Star Game in Los Angeles, California (BRK, 2017).

2015 also saw revolutionary changes to the sport of basketball, with the Euro League becoming the first professional basketball league to allow wearable cameras in the sport (Leung, 2015). The wearable cameras were used during the whole broadcast between Lithuanian team, Žalgiris Kaunas who wore the wearable cameras created by the company FirstV1sion against their opponents Real Madrid (Lomas, 2015). Žalgiris Kaunas players, center Robertas Javtokas and guard Edgaras Ulanovas became the first players to wear the wearable cameras during a professional match (ThePostGame, 2015). Prior, to the game however the wearable cameras received positive reviews from Žalgiris Kaunas players in practice (ThePostGame, 2015).

In 2019 a tech start-up known as ActionStreamer captured the first person perspective from some star NFL players using customized helmets with a built in camera at the NFL Pro Bowl practices (Lemire, 2017). Seattle Seahawks star quarterback; Russell Wilson was the first player to wear the on-field QBCam (Lemire, 2017). Other notable star players such as Green Bay Packers receiver Davante Adams, Denver Broncos linebacker, Von Miller were other Pro Bowlers to wear the ActionStreamer cameras (Lemire, 2017). The cameras are equipped so that they weigh less than 100 grams and are able to capture footage at a 1080p resolution as well as 60 frames per second (Lemire, 2017). The benefit about having these types of cameras is that they'll be able to capture the point of view of the players on the field, whether they are throwing and catching passes or even when players are playing defence (Lemire, 2017).

Methodology

1.1 Selecting the Team to Analyze

An investigation on analyzing attacking player decisions over the course of five individual matches was conducted in order to determine how having an additional camera angle could assist players when they review film during video sessions in preparations for upcoming matches and improving mistakes. The attention of this study focused on Italian Serie A club, Internazionale or formally referred to as Inter, for many reasons. The first reason why this team was selected for this study was because they use what is referred to in the sport as a 3-5-2 formation. Attacking minded teams, like Inter, that tend to use an extra center midfielder to control the tempo of a game and provide an additional player to join in on the attacks often uses this formation. Another reason why Inter was selected in

this study was because they have what is referred to as many striking options, and they have four. Striking options are players who's primary objective is to score goals and help create and be involved in as many attacking scenarios as possible. They have a player, 22-year old Lautaro Martinez from Argentina who has been at Inter since the summer of 2018. Despite being at Inter for almost two years and collecting 52 appearances, Martinez had his outbreak this season playing and starting more consistently. In addition to Martinez, Inter added 27-year old, Belgian striker, Romelu Lukaku from Manchester United last summer and has so far collected 28 appearance for Inter. Inter's third striking option is 31-year old, Chilean forward Alexis Sanchez, who is on loan at Inter this season from Manchester United. Sanchez has collected a total of 12 appearances for Inter this season. Inter's last striking option is 17-year old, Italian and Inter Academy promising talent, Sebastiano Esposito, who has made 5 appearance for Inter's first team this season. These 4 players have combined for 33 out of Inter's 56 goals in Serie A this season leading up to this study. Thus it is important to note that aside from Lukaku and Sanchez, these 4 players are linking up on the same team together for the first time in their careers so they do not have a lot of experience playing together as opposed to some of the other top clubs in Italy that tend to use 2 attackers. Lastly, the use of the 3-5-2 formation that Inter plays with on the field is due to the decision that their manager believes to be the best for his club because the manager in this case as he is able to add an extra midfielder to help control the match in the center of the pitch, while having his wingers capable of joining the attacks and coming back to support the three defenders at the back. Manager, Antonio Conte is another reason why Inter was selected as the team to analyze in this study because this is also his first season at the club so it is important to

see how his players react to his tactics and system that caters to two attacking players up top.   Conte has proven in his managerial career to bring out the best from his players through his intense training and winning mentality. He has won many league titles prior to joining Inter with trophies in Serie A and the English Premier League.

1.2 Method of Experimentation

Applying wearable cameras in soccer can answer uncertainties especially for attacking players when it comes to decisions made on the field during play. Since there is no evidence of wearable cameras used in professional matches, using the broadcasting angle can assist in proving why capturing a player's first person point of view in the future can help a player improve their decision making on the pitch. By analyzing the entirety of each of the five matches that Inter played and solely focusing on how the players execute attacking chances for their club could determine the need for wearable technology to help improve decisions on the pitch. Screenshot were captured from all of the Inter games on the Telelatino Network (TLN) or Radiotelevisione Italiana (RAI Italia), which is the international service of Rai Internazionale, a subsidiary of RAI, Italy's public national broadcaster. The screenshots were captured from these two broadcasting networks because they are both available to viewers in Canada, which is where this research was conducted. There are three legitimate questions that need to be answered in order to provide validity for this study, (i) Why were the specific games depicted in the study chosen? (ii) Why were the series of screenshots from the specific games selected for this study? (iii) What is it from the series of screenshots that can assist

in proving why capturing a player's first person point of view in the future can help improve their decision making on the pitch?

1.3 Methodology Behind the Series of Questions

(i) Why were the specific games depicted in the study chosen?

Due to the recent Covid-19 pandemic, that depicted a halt to the 2019/20 Serie A campaign, the league was forced to stop due to regulations set in place by the government in order to control and diminish the number of cases in the country. The Serie A campaign resumed on June 20, 2020 for the first time since March 9, 2020 (BBC, 2020). The following games that were analyzed by Inter were against Sampdoria on June 21, 2020, Sassuolo on June 24, 2020, Parma on June 28, 2020, Brescia on July 1, 2020 and Bologna on July 5, 2020. These five games were selected for this study and were chosen based on the fact they all occur consecutively based off of Inter's schedule and they are the first set of matches for Inter since the end of the pause caused by the Covid-19 outbreak in Italy. Inter's schedule in these five matches are well balanced and consist of matches that should be won against weaker clubs, and other mid-table capable of causing Inter difficulties defensively.

(ii) Why were the series of screenshots from the specific games selected for this study?

The screenshots depicted in the following section were selected because they are able to demonstrate some attacking scenarios that Inter was able to successfully execute that with the assistance of a wearable camera can show players what they did correctly from their perspective to the most precise level of detail. This could assist players and

develop their cognitive thinking further by using photo memory in future situations where they can use those precise details to replicate those successful plays in the closest manner as possible. The same idea is proposed for the screenshots that show attacking scenarios that were not executed correctly or could have been done better. Proposing the idea of a wearable camera can show what the player that made what may be considered a mistake sees from their perspective and using their photo memory, from the video taken from the wearable camera, in the future in order for them to improve and not make the same errors again.

(iii) What is it from the series of screenshots that can assist in proving why capturing a player's first person point of view in the future can help improve their decision making on the pitch?

From a series of screenshots for each of Inter's five games, there are many aspects that were analysed from their attacking scenarios. Areas such as: the time in which the play occurred; the current score; players involved in the attacking situation; player body position; perceived line of site; and even the final outcome of the play. From the data collected, an analysis of each play was determined in order to indicate what a player see's but from the broadcasting angle of a match and whether the decisions made by players can be supported or corrected with the use and integration of wearable cameras. The entirety of this experiment is conducted from a naked eye perspective and is analyzed on how attacking scenarios appear to a viewer from video/tv. The screenshots selected are some of Inter's most clear, simple as well as complex attacking scenarios over the course

of their five consecutive games. The plays selected shows patterns of consistency and similar results that concluded the plays.

Analysis

The results of the experiment mentioned from the methodology section are thoroughly explained below.

Tables 1.1, 2.1, 3.1, 4.1 and 5.1 depicts the match details such as the team that Inter played against, the date and time of the match, whether the match was played at home for Inter or away, as well as the match difficulty based off the Serie A standing for that week. The match difficulty is determined by the current position of Inter's opposition for that week. Thus, any team ranked in the first five positions in the league received a level 4 for difficulty, league standings 6th-10th receive a level 3, 11th-15th receive a level 2 and 16th-20th receive a level one.

Inter's Matchup

Teams	Match Details	Home or Away Match	Match Difficulty

Table 1.2, 2.2, 3.2, 4.2 and 5.2 depicts the attacking players, manager Antonio Conte decided to play and their contribution to the match. Individual stats such as minutes played, goals scored, assists, ball touches, passes completed and shots on and off target were recorded.

Attacking Player Statistics

Inter Strikers
Minutes Played
Goals Scored
Assists
Ball Touches
Passes Completed
Shots (On Target)

Table 1.3, 2.3, 3.3, 4.3 and 5.3 provides a quantitative breakdown of the attacking scenarios that support the qualitative analysis through the use of images as seen in the use of figures.

Attacking Scenarios

Scenario
Current Score
Time of Occurrence
Frames
Players in Attacking Positions
Players in Defensive Positions
Opportunities Available
Play Outcome

Lastly, figures 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2 and 5.3 provide a detail breakdown of some of the most interesting attacking scenarios created by Inter using three different frames. The green shaded elliptical shape indicates

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an Inter player involved in the play. The number next to the player is used to track the player's movement and decisions that they make during the attacking scenario. The yellow shaded area is the perceived line of sight of the player with possession of the ball based off of the naked eye and what the viewers see's from a broadcasting camera angle. The fuchsia shaded area is the perceived line of the player's body position on the field and the direction the player with the ball is facing on the pitch. The cyan colour lines provide the options available by the player with the ball on the field. However the solid lines depict passing options and shot directions whereas the dotted lines depict the option of a player to continue dribbling on the pitch.

Inter-Sampdoria (Match 1) Analysis

The first league game Inter played following the restart of the Serie A campaign was against Sampdoria on Sunday, June 21, 2020, 3:45 p.m. EST, at the Giuseppe Meazza Stadium in Milan, Italy. Tables 1.1 and 1.2 depict quantitative data of the match details and individual attacking player statistics.

Table 1.1 – *Match #1: Inter's Matchup*

Teams	Match Details	Home or Away Match	Match Difficulty
Inter-Sampdoria	Sunday, June 21, 2020 - 3:45 p.m. EST	Home	1

Table 1.2 – *Match #1: Attacking Player Statistics*

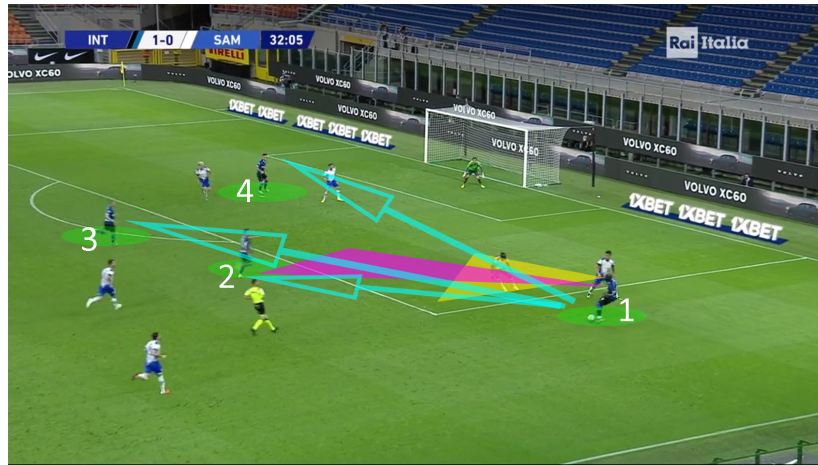| Inter Strikers	Romelu Lukaku	Lautaro Martinez	Alexis Sanchez	Sebastiano Esposito
Minutes Played	90	83	7	0
Goals Scored	1	1	0	0
Assists	0	0	0	0
Ball Touches	39	43	13	0
Passes Completed	20	27	10	0
Shots (On Target)	4(1)	1(1)	1(0)	0(0)

Attacking Scenario #1

Figure 1.1 (*INT-SAMP: Attacking Scenario #1: Frame 1*)

Figure 1.1 depicts the first attacking scenario highlighted from this match. Player number one (Romelu Lukaku) and player number four (Lautaro Martinez) are the Inter forwards present in this attacking scenario. At the 32nd minute of the match, player number one is seen on the right wing just outside of the penalty box with the ball at his feet in search of a teammate to pass to. Player number one has two defenders in front of him that are leaving a large gap of space in between them, which provides a view of the

oppositions net. Based off the clear image, player number one's body position is facing

the direction of player number two and player number three who are running into the

penalty box and pose as possible passing options for player number one. Player number

four is not a wise option to pass to in this instinct because he has two defenders beside

him and player number one has a defender on his left side, which is close to him and can

block the cross. One thing that is important to note in this frame is the yellow shaded

area, which appears to be player number one looking at the gap between the two

defenders. He notices and a wearable camera would capture footage that player number

two is pointing at that space in between the two defenders for player number one to pass

it through. As a result, player number one makes the correct play because he passes it in

the space where his teammate can run and get the ball and is therefore closer to the
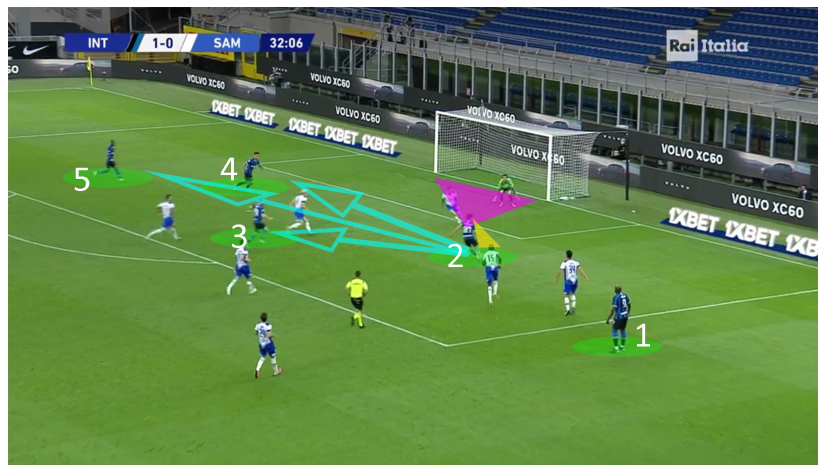
opposition net.

Figure 1.2 (*INT-SAMP: Attacking Scenario #1: Frame 2*)

Figure 1.2 depicts the second frame with player number two with possession of

the ball, ready to make a pivotal decision. Player number two is in a position with four

options around him. He has the option of taking a shot as his body is in line with the net

and line of sight is on the ball so that his coordination is correct. The other three options

available are to pass it to players' number three, four or five. Passing to player number

three would not be the correct decision because he is positioned behind player number

two and is also marked by a defender. Player number four is in a great position to pass to

in this situation because he is located by himself between two defenders, with an empty

net in front of him, while in an onside position and head of player number two. Player

number five is the last option available but he is not inline with player number two and in

this situation it would not be appropriate to pass the ball to him where player number four
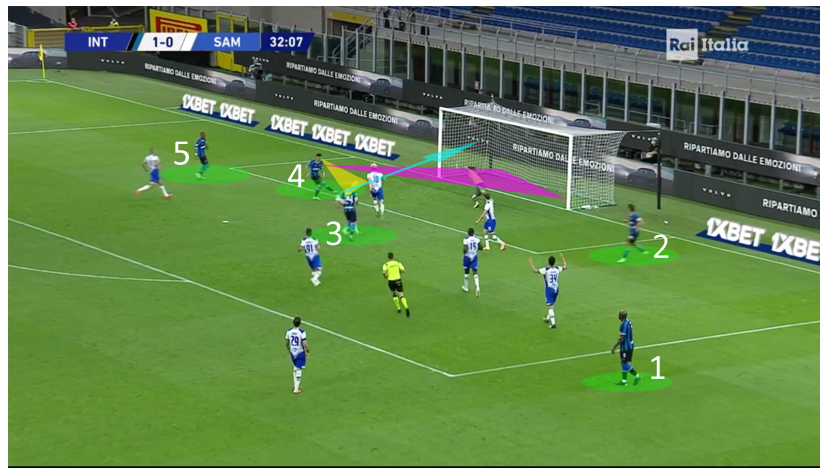
is better positioned.

Figure 1.3 (*INT-SAMP: Attacking Scenario #1: Frame 3*)

Figure 1.3 depicts the third frame consisting of player number two completing the

pass to player number four who score the empty net goal. Player number four's body

position is correctly in line with the net and can place it wherever he wants and does so
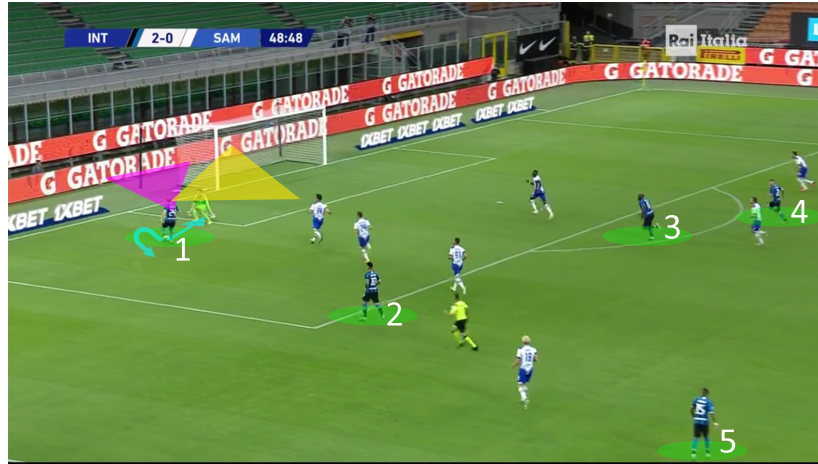
where the goalkeeper cannot reach.

Figure 2.1 (*INT-SAMP: Attacking Scenario #2: Frame 1*)

Figure 2.1 depicts the first frame on the second attacking scenario highlighted

from this match. At the 48th minute, player number one finds himself through past the

defence on the left side of the penalty box with only the goalkeeper left to beat. Due to

the close pressure created by the goalkeeper player number one has two options available

for him. The yellow shaded area depicts his view of the space between him and the

goalkeeper as well as the net he is trying to score on. The way his body is positioned

through the fuchsia shaded area depicts that he does not have the correct body position to

attempt a shot on his preferred right foot. The only clear available options would be to

try attempting a difficult shot on a tight angle, with his left foot between the goalkeepers

legs or to turn around to see if there is another teammate that is in a better scoring
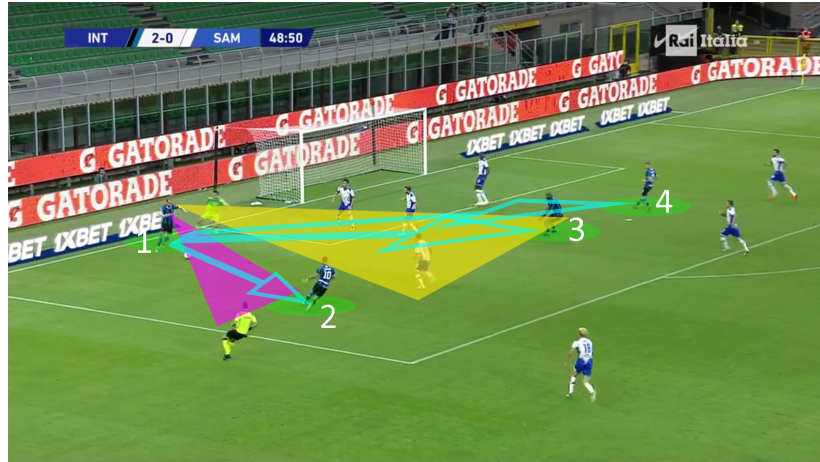
position.

Figure 2.2 (*INT-SAMP: Attacking Scenario #2: Frame 2*)

Figure 2.2 depicts the second frame from this play. Player number one decides to not take the risk and plays the safer option by turning around and finding another teammate in a better scoring position. Player number one now finds himself with three possible options to pass to. Player number two is only a few feet away from player number one and has space to work with if he receives the pass. Player number three is the second option that is positioned in the center of the penalty box and directly in the perceived line of site portrayed in the yellow shaded area. Player number three realizes that he as to be ready to receive the pass and does so, in order to quickly attempt a shot on net. Player number four is another option however he is not the best available option because there are three defenders that interject the view of player number one.
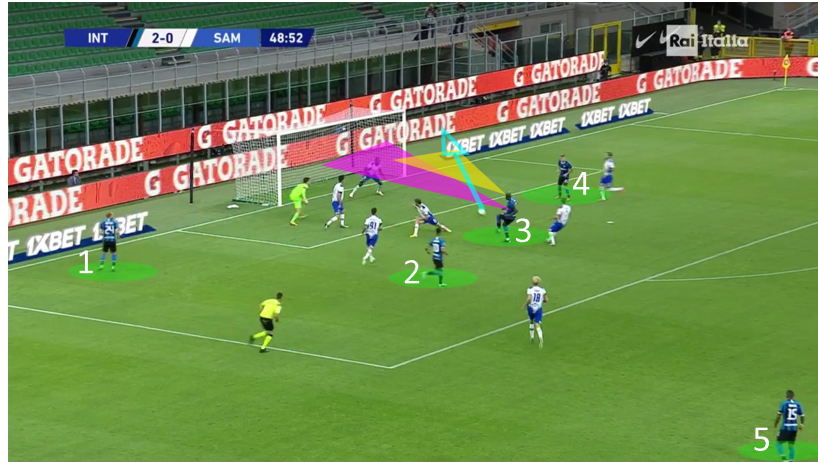
Figure 2.3 (*INT-SAMP: Attacking Scenario #2: Frame 3*)

The third and final frame demonstrated in figure 2.3 depicts player number one making a perfect pass to player number three, who shoots the ball immediately however not accurately and off target. His body position is facing the net, which is correct, but his coordination while shooting the ball was not precise. Thus, despite the great decisions made during this play, the lack of precision is what halted Inter from making this game 3-0 from this point on. Table 1.3 depicts the quantitative data of the two attacking scenarios identified from this match.

Table 1.3 – *Match #1: Attacking Scenarios*

Scenario	1			2		
Current Score	INT 1-0 SAMP			INT 2-0 SAMP		
Time of Occurrence	32'			48'		
Frames	*Frame 1*	*Frame 2*	*Frame 3*	*Frame 1*	*Frame 2*	*Frame 3*
Players in Attacking Positions	4	5	5	5	4	5
Players in Defensive Positions	7	8	8	8	8	8
Opportunities Available	3	3	1	2	3	1
Play Outcome	Goal			Shot Off Target		

Inter-Sassuolo (Match 2) Analysis

The second league game analyzed that Inter played following the restart of the Serie A campaign was against Sassuolo on Wednesday, June 24, 2020, 1:30 p.m. EST, at the Giuseppe Meazza Stadium in Milan, Italy. Tables 2.1 and 2.2 depict quantitative data of the match details and individual attacking player statistics.

Table 2.1 – *Match #2: Inter's Matchup*

Teams	Match Details	Home or Away Match	Match Difficulty
Inter-Sassuolo	Wednesday, June 24, 2020 – 1:30 p.m. EST	Home	2

Table 2.2 – *Match #2: Attacking Player Statistics*

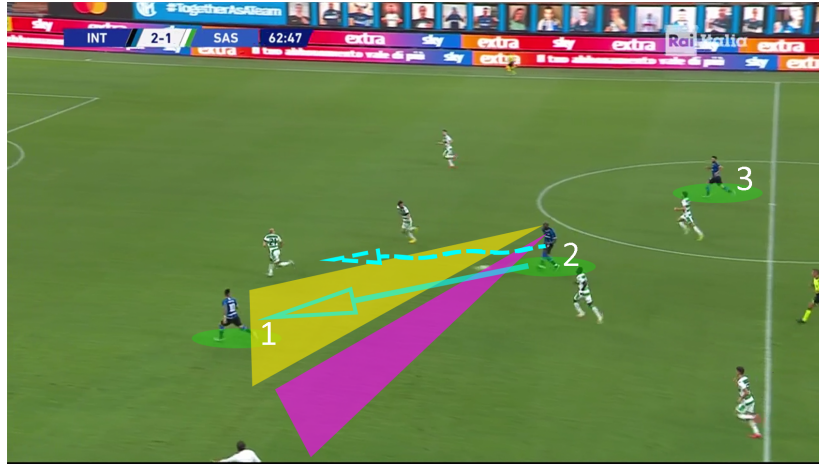| Inter Strikers	Romelu Lukaku	Lautaro Martinez	Alexis Sanchez	Sebastiano Esposito
Minutes Played	90	28	62	0
Goals Scored	1	0	0	0
Assists	0	0	1	0
Ball Touches	32	12	29	0
Passes Completed	24	6	16	0
Shots (On Target)	4(2)	2(1)	1(0)	0(0)

Figure 3.1 (*INT-SAS: Attacking Scenario #1: Frame 1*)

Figure 3.1 depicts the first image from first attacking scenario highlighted from this match. Player number one (Lautaro Martinez) and player number two (Romelu Lukaku) are the Inter forwards present in this attacking scenario. At the 62nd minute, Inter finds three of their players leading a counter attack. Player number two who has possession of the ball has lots of space around him and no defenders posing as a threat. Player number three is not a passing option for player number two because there is a defender tracking back that can intercept the pass. Player number three is not a wise option to pass to in this scenario also because player number two's body position is facing player number one's direction both indicated from his perceived body position (fuchsia shaded area) as well as perceived line of site (yellow shaded area). Player number two's options would be to continue dribbling towards the net as no defenders are near him and or attempting to make a tackle or he can pass it to player number one who would find himself with a one on one situation with the defender closest to him.
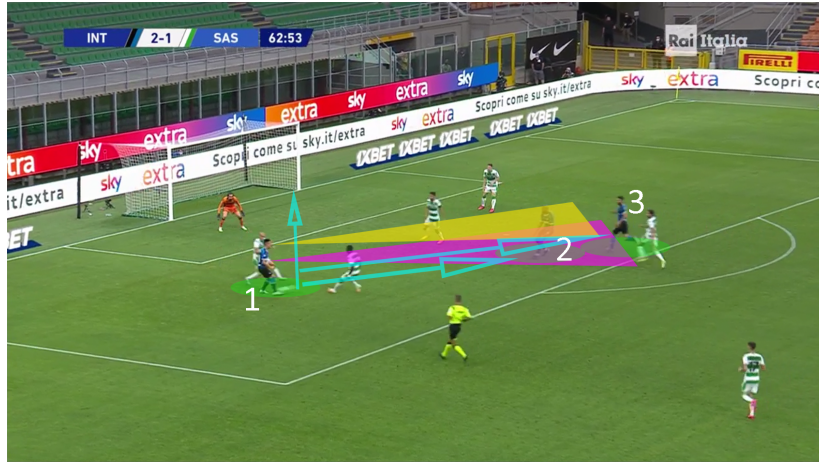
Figure 3.2 (*INT-SAS: Attacking Scenario #1: Frame 2*)

Figure 3.2 shows the second frame from this play and indicates player number one who receives the pass from player number two and is now situated with a defender in front of him with five other Sassuolo defenders that have tracked back into a defensive position. Player number one has three options available in this situation, he can either attempt a shot in hopes the defender does not block the shot, he can pass to player number two who is in a good position to have a shot on net if he gets the ball because there are no defenders marking him. The last option in this scenario would be to pass it to player number three, who is running into the center of the penalty box. A reason why passing to player number three would not be the correct choice in this situation is because he is running behind player number two and has a defender following him, ultimately making this a difficult pass that would need perfect execution.
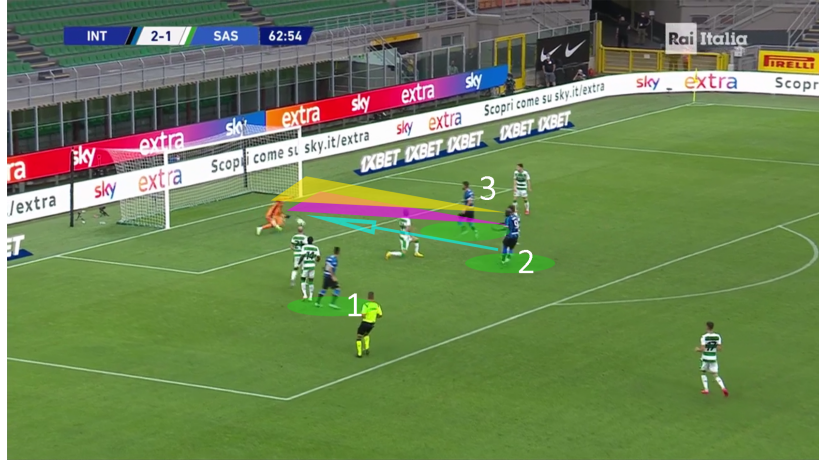
Figure 3.3 (*INT-SAS: Attacking Scenario #1: Frame 3*)

Thus, figure 3.3 shows the final execution when player number two receives the pass from player number one and immediately has a shot on net. Obviously player number two should have done better and found the back of the net in this scenario however, the goalkeeper deserves credit as well for a making a great save. Player number two was positioned correctly; shot it where he intended based off of his perceived line of site and the direction in which the ball. That being said, minimal adjustments could have made a difference for player two not scoring a goal on this play.
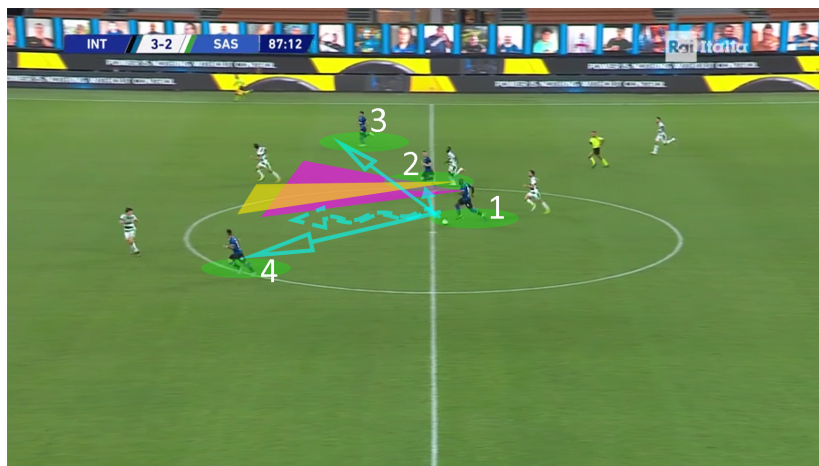
Attacking Scenario #2

Figure 4.1 (*INT-SAS: Attacking Scenario #2: Frame 1*)

Figure 4.1 depicts the first frame from the second attacking scenario highlighted

from this match. Player number one (Romelu Lukaku) and player number four (Lautaro

Martinez) are the Inter forwards present in this attacking scenario. At the 87th minute,

Inter finds four of their players leading a counter attack late in the game hoping to extend

their league by two goals. In the first frame, player number one has possession of the ball

and is dribbling up the pitch, leading the counter attack. Player number one has four

options with the ball. He could pass it to player number four who could find himself in a

dangerous scoring position and a possible one on one situation with the defender closest

to him. He could continue his dribble seeing he has lots of space in front of him with no

defenders closing in on him. Player number two is also beside player number one but

passing the ball to him would slow the counter attack down and could allow the

defenders trailing behind them to intercept the ball. The final option in this frame would

be to pass it to player number three, as he is wide open running down the right wing. The

best decision to make in this situation would be to pass it to player number four and

provide him with a one on one situation. This would still allow players one, two and

three to continue their runs forward in case player number four needs another passing

option. Player number one decides to continue dribbling forward with the ball, which
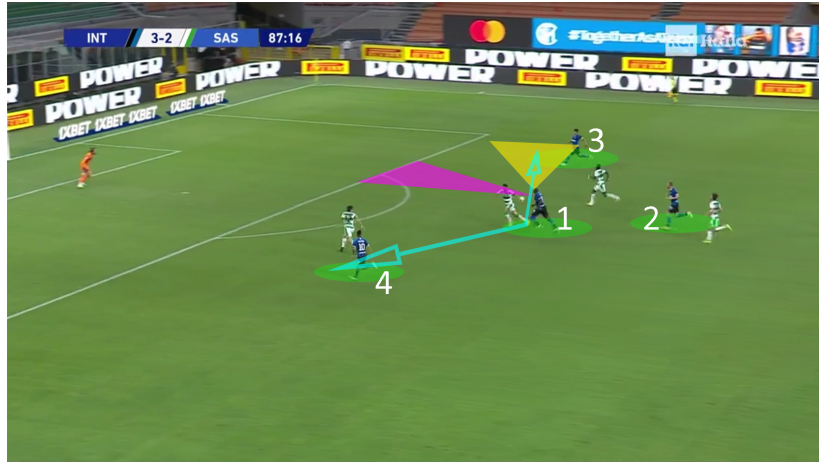
leads to the second frame.

Figure 4.2 (*INT-SAS: Attacking Scenario #2: Frame 1*)

Figure 4.2 shows the Sassuolo defender closing in on player number one, there are now two opportunities available in this situation. Player number one's perceived line of site falls in the same direction as player number three who is wide open and has the opportunity to have a shot on net and could secure the win for Inter if he scores. The second option would be to pass it to player number four, however the Sassuolo defender has now closed the space and can easily intercept the pass. Player number one decides to pass the ball in the direction he is looking and finds player number three in a situation with just the goalkeeper to beat.
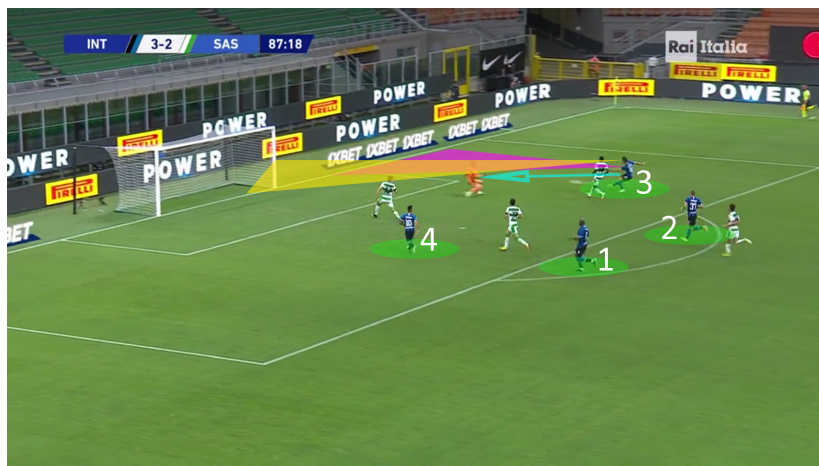

Figure 4.3 (*INT-SAS: Attacking Scenario #1: Frame 3*)

Figure 4.3 depicts the third and final frame from this attacking play. Player number three waits too long to shoot and despite having a great view of the net, he allows the goalkeeper to run up, close the space and not provide player number three a lot of space to angle his shot. Player number three does get the shot off but it is saved, ultimately wasting a glorious chance to secure a win. Table 2.3 depicts the quantitative data of the two attacking scenarios identified from this match.

Table 2.3 – *Match #2: Attacking Scenarios*

Scenario	1			2		
Current Score	INT 2-1 SAS			INT 3-2 SAS		
Time of Occurrence	62'			87'		
Frames	*Frame 1*	*Frame 2*	*Frame 3*	*Frame 1*	*Frame 2*	*Frame 3*
Players in Attacking Positions	3	3	3	4	4	4
Players in Defensive Positions	6	7	7	5	5	5
Opportunities Available	2	3	1	4	2	1
Play Outcome	Goalkeeper Save			Goalkeeper Save		

Parma-Inter (Match 3) Analysis

The third league game analyzed that Inter played, was against Parma on Sunday, June 28, 2020, 3:45 p.m. EST, at the Ennio Tardini Stadium in Parma, Italy. Tables 3.1 and 3.2 depict quantitative data of the match details and individual attacking player statistics.

Table 3.1 – *Match #4: Inter's Matchup*

Teams	Match Details	Home or Away Match	Match Difficulty
Parma-Inter	Sunday, June 23, 2020 – 3:45 p.m. EST	Away	3

Table 3.2 – *Match #4: Attacking Player Statistics*

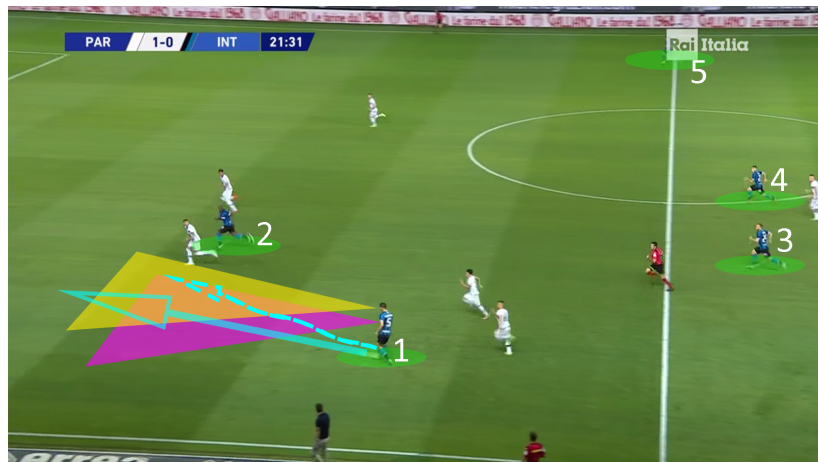| Inter Strikers	Romelu Lukaku	Lautaro Martinez	Alexis Sanchez	Sebastiano Esposito
Minutes Played	90	89	21	0
Goals Scored	0	0	0	0
Assists	0	1	0	0
Ball Touches	44	45	19	0
Passes Completed	30	20	14	0
Shots (On Target)	3(0)	7(2)	1(1)	0(0)

Attacking Scenario #1

Figure 5.1 (PAR-*INT: Attacking Scenario #1: Frame 1)*

Figure 5.1 depicts the first frame from the first attacking scenario that was analyzed from this match. Player number two (Romelu Lukaku) is the only Inter forward present in this attacking scenario. At the 21st minute of the match with the score 1-0 in favour of Parma, player number one who is running into the oppositions half has three defenders in front of him. His perceived line of site (yellow shaded area) as well as his perceived body position (fuchsia shaded area) shows what is in front of him as well as how much space he has to work with. He has two decisions he could make in this situation. He could continue dribbling forwards seeing that there is lots of space in front of him with no defenders ready to challenge him or he could pass the ball in the direction he is looking and facing since player number two is trying to get in behind the defence. Passing the ball to player number two could lead him to the net faster as opposed to player number one dribbling. Players number three, four and five are not possible options for player number one particularly because they are all behind him and he can not see them but also because he would be slowing the pace of the play down if he were to do so. Hence, player number one makes the decision to pass it in space for player number two to run on.
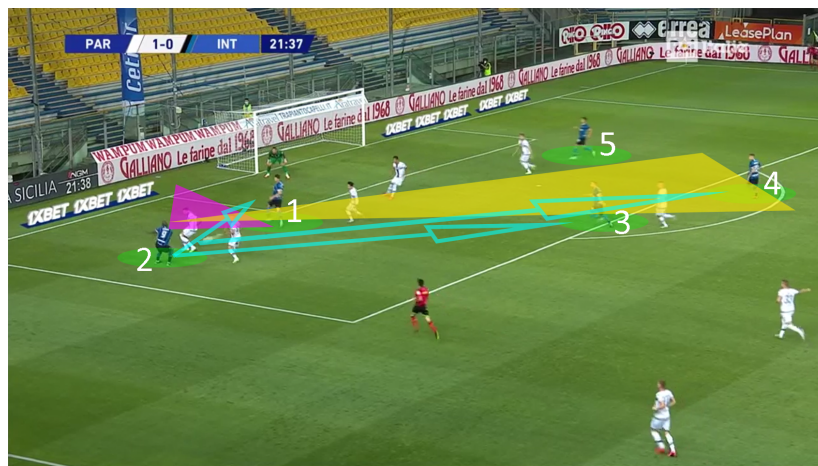

Figure 5.2 (PAR-*INT: Attacking Scenario #1: Frame 2*)

In the second frame as seen in figure 5.2, player number two is on the left side of the penalty box with very little space to work with. Based off of his body position he has player number one cutting in past the defence. The issue with passing it to him in that space would be that the defender in front of him could easily intercept the pass or if he does manage to complete the pass, player number one could be in an offside position. This would result in the opposing team regaining possession of the ball. The other two options are in line with player number two's perceived line of site, which is looking at both player numbers three and four who are running into the penalty box. Both can receive the ball with a diagonal pass completed by player number two, however player number three has a defender behind him that could possibly make a tackle, whereas player number four is wide open. Player number five is not a possible passing option for player number two because there are four defenders in line with him, making it difficult for him to receive a pass.
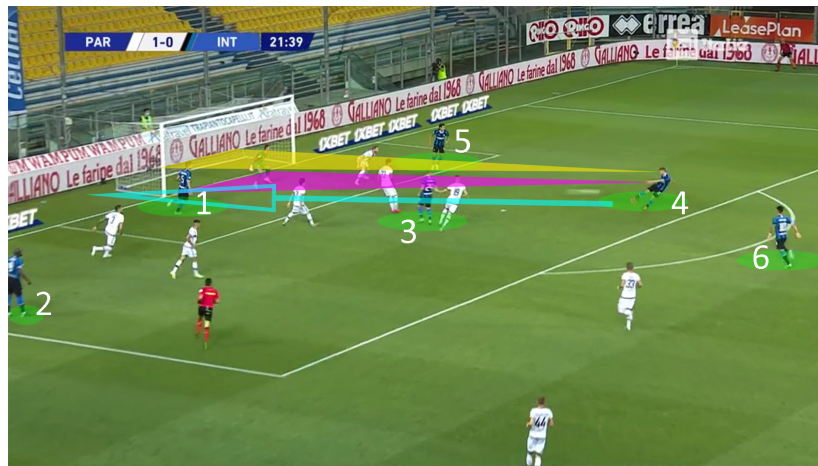

Figure 5.3 (PAR-*INT: Attacking Scenario #1: Frame 3*)

As a result, the final frame in figure 5.3 shows player two passing it to player number four who shoots the ball immediately but misses the net. Here, player number four's shot is well coordinated on a difficult volley seeing as his eyes remain on the ball

and follow it as it leaves his right foot. His body position is in line with the net, making this a great scoring opportunity that has gone to waste. Besides the finish at the end of the play, the decisions that were made in this attacking scenario were executed correctly.
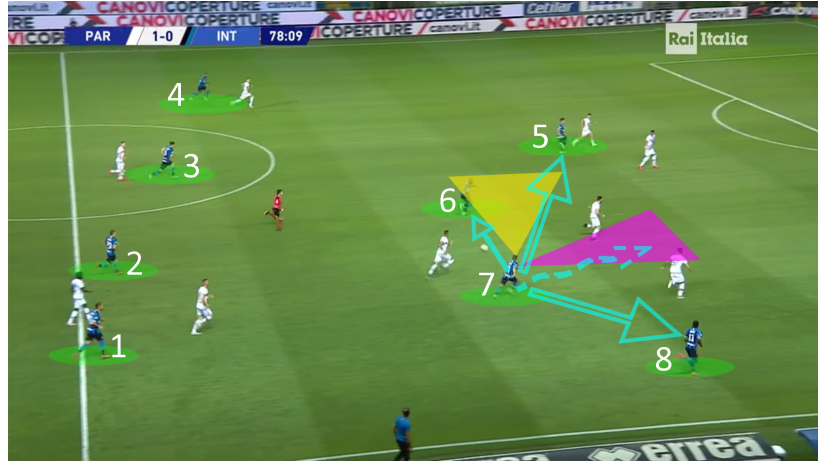
Attacking Scenario #2

Figure 6.1 (PAR-*INT: Attacking Scenario #2: Frame 1*)

Figure 6.1 depicts the beginning of the second attacking scenario that was analyzed from this match. Player number five (Lautaro Martinez), player number six (Romelu Lukaku) and player number seven (Alexis Sanchez) are the Inter forwards present in this attacking scenario. At the 79th minute of the match, while Inter is still trailing Parma 1-0, player number seven decides to pass the ball to player number six who is open in the center of the oppositions side of the pitch. Player number seven passes him the ball because he is open and is inline with his perceived line of site. There is another three other options that player number seven could have taken in this situation. He could have dribbled forward in the direction that his perceived body position is facing, which is forward, however he would encounter two defenders. He could have passed it to player number five who is also in his perceived line of site, but passing it to

him could lead to an easy interception by the defenders since he is close to him. The final option in this frame could have been a pass to player number eight, so he could run with the ball down the right wing and cross the ball into the penalty box. That would also not have ben a wise choice because there are not a lot of Inter players running into penalty box so the Parma defenders would out number the Inter attackers in this situation.
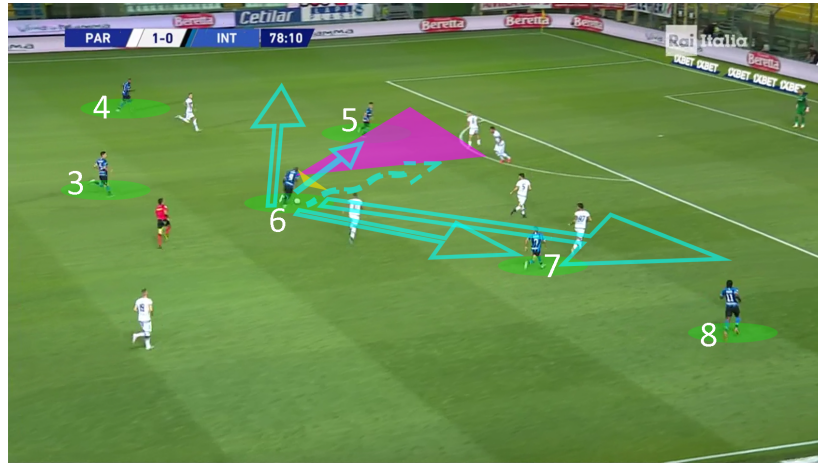

Figure 6.2 (PAR-*INT: Attacking Scenario #2: Frame 2*)

Figure 6.2 depicts what happens following player number six receiving the pass from player number seven. He has five options available for him with the two of them passing to the wings for either player number four or eight to run onto so they could attempt a cross in the box. Another option would be to continue dribbling forward as no defenders are closing in on him. Player number seven is another option to pass to but it would be a difficult choice seeing a defender is tightly marking him. The best option available for player number six, is to pass it to player number five who has lots of space between him and the defender and can have a clear shot on net if he receives the pass. Despite being close to player number six, player number five does not receive the pass as player number six decides to dribble forward.
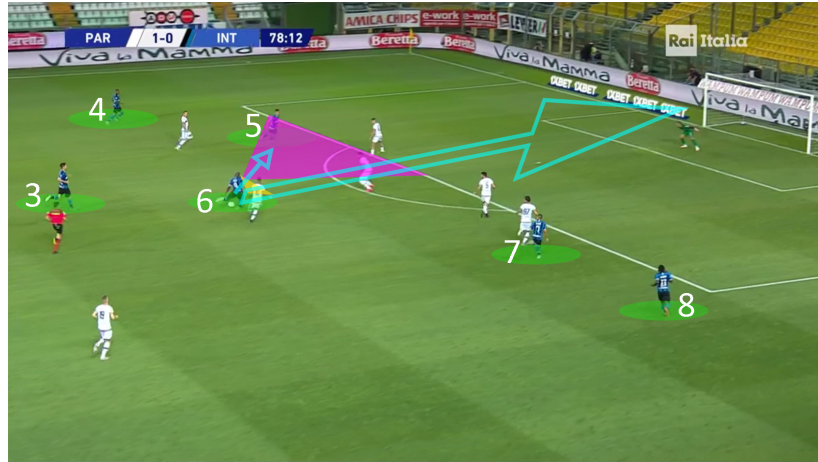
Figure 6.3 (PAR-*INT: Attacking Scenario #2: Frame 3*)

This ultimately leads to the end of the play depicted in figure 6.3, as player number six still chooses not to pass it to player number five and attempts a shot from outside of the box. Unfortunately the shot ends up going just wide and off target. Table 3.3 depicts the quantitative data of the two attacking scenarios identified from this match.

Table 3.3 – *Match #3: Attacking Scenarios*

Scenario	1			2		
Current Score	PAR 1-0 INT			PAR 1-0 INT		
Time of Occurrence	21'			78'		
Frames	*Frame 1*	*Frame 2*	*Frame 3*	*Frame 1*	*Frame 2*	*Frame 3*
Players in Attacking Positions	5	5	6	8	6	6
Players in Defensive Positions	6	9	9	9	7	8
Opportunities Available	2	3	1	4	5	2
Play Outcome	Shot Off Target			Shot Off Target		

Inter-Brescia (Match 4) Analysis

The fourth league game analyzed that Inter played, was against Brescia on Wednesday, July 1, 2020, 1:30 p.m. EST, at the Giuseppe Meazza Stadium in Milan,

Italy. Tables 4.1 and 4.2 depict quantitative data of the match details and individual

attacking player statistics.

Table 4.1 – *Match #4: Inter's Matchup*

Teams	Match Details	Home or Away Match	Match Difficulty
Inter-Brescia	Wednesday, July 1, 2020 – 1:30 p.m. EST	Home	1

Table 4.2 – *Match #4: Attacking Player Statistics*

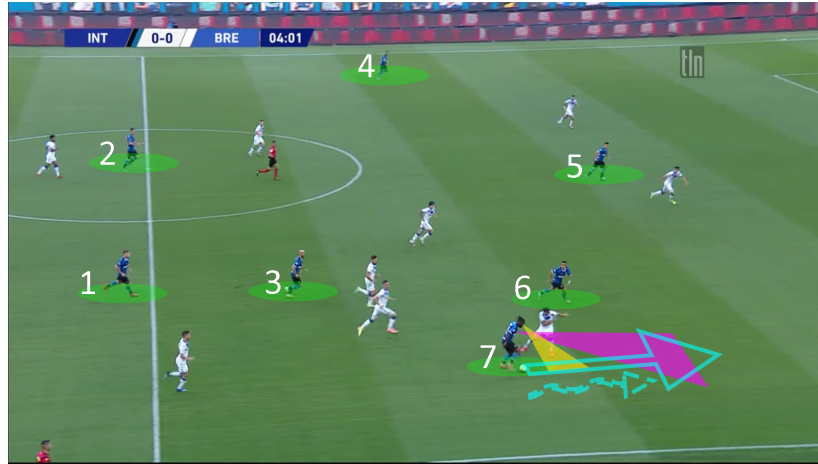| Inter Strikers	Romelu Lukaku	Lautaro Martinez	Alexis Sanchez	Sebastiano Esposito
Minutes Played	22	68	90	0
Goals Scored	0	0	1	0
Assists	0	0	2	0
Ball Touches	11	33	59	0
Passes Completed	6	14	36	0
Shots (On Target)	2(1)	4(1)	2(1)	0(0)

Figure 7.1 (*INT-BRE: Attacking Scenario #1: Frame 1*)

Figure 7.1 depicts the first play of the first attacking scenario that was analyzed from this match. Player number five (Lautaro Martinez) and player number six (Alexis Sanchez) are the Inter forwards present in this attacking scenario. At the 4th minute of the match with the score tied at 0-0, player number seven has possession of the ball with a Brescia defender right in front of him. His perceived body position and line of site are facing the down the right hand flank so there are two possible options for player number seven to do in this situation. He could try and dribble past the defender and force his way down the right hand flank or he could pass it down the right wing for player number six to receive it in order to have more space available to get closer to the Brescia net. Player number seven decides to pass it down the right wing for player number six to run onto, leading to the next frame.
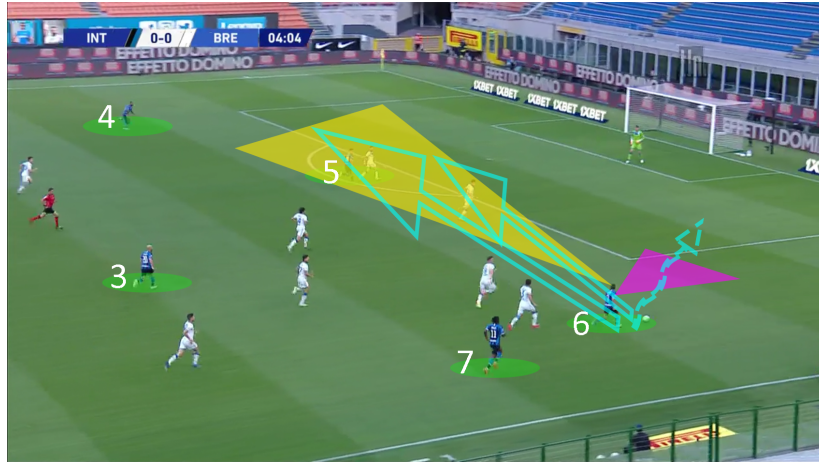
Figure 7.2 (*INT-BRE: Attacking Scenario #1: Frame 2*)

Figure 7.2 shows player number six who now has three options available on the wing. His perceived body position is facing the Brescia net so he can continue his dribble forward or he could decide to cross it to player number four who is running by himself into the penalty area with no defenders around him. This could create a great goal scoring opportunity if he receives a cross from player number six. Meanwhile passing to option five is not the best choice seeing he has two defenders beside him and one in which is marking him tightly.
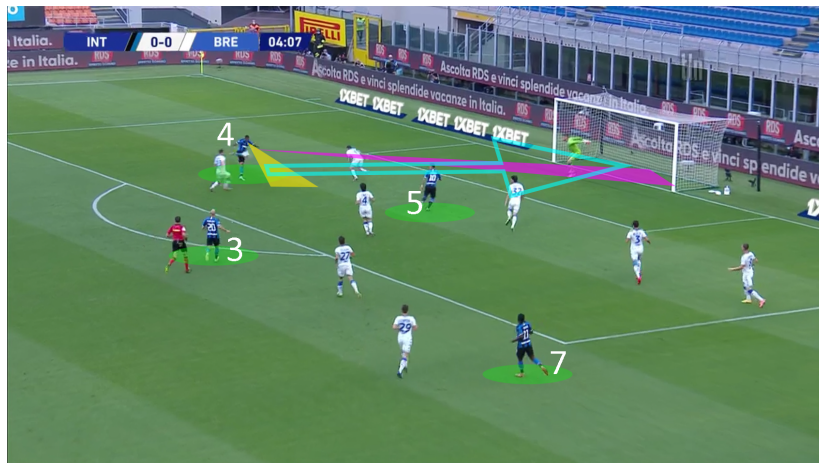

Figure 7.3 (*INT-BRE: Attacking Scenario #1: Frame 3*)

Player number six as seen in figure 7.3 completes an exceptional cross to player number four who coordinates his body correctly and is able to shoot the ball on a first-

time volley and score Inter's first goal of the match. This is another play that shows

excellent decisions made based of the players involved and their body positions as well as

view of other teammates on the pitch.
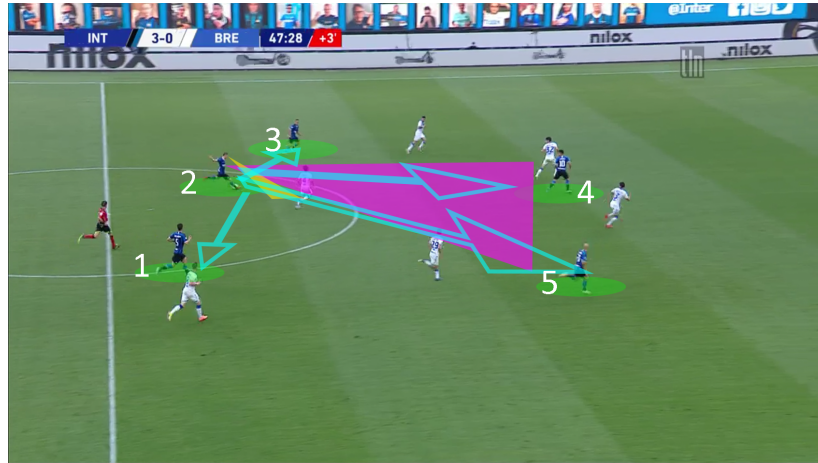

Attacking Scenario #2

Figure 8.1 (*INT-BRE: Attacking Scenario #2: Frame 1*)

Figure 8.1 depicts the first frame of the second attacking scenario created by Inter

that is analyzed. Player number three (Alexis Sanchez) and player number four (Lautaro

Martinez) are the Inter forwards present in this attacking scenario. At the 45th +2 minutes

of the first half, Inter decides to search for a goal on the counter-attack with player

number two leading the charge. He has four options available to him but notices player

number five with the most space out of all of his passing options. Player number five

falls into player number two's perceived body position so receiving a pass from him can

be completed quickly and precisely. Player number two looks down to coordinate his

pass in order to create a dangerous attacking opportunity. The other passing options

would not be smart for player number two to make because although players one and

three are open, passing it to them would slow the play down. Passing to player number

four is also not a good choice despite being in front of player number two because there are two defenders around him that could easily try and tackle him or intercept the pass.
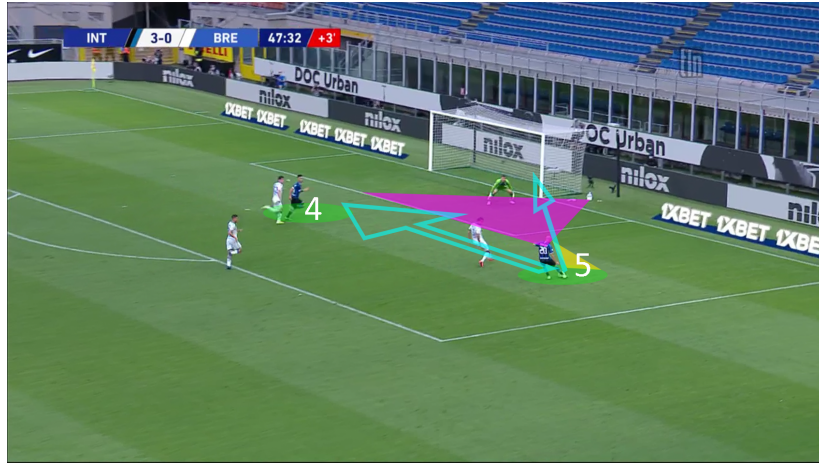
Figure 8.2 (*INT-BRE: Attacking Scenario #2: Frame 2*)

Thus, figure 8.2 shows player number five with a two on two situation inside the penalty box. He is aware player number four is running ahead of the defender that is marking him and is in an onside position. Player number five can either shoot the ball on the first post (angle closest to him) but this shot can be difficult seeing that the goalkeeper is covering the net well, or he could pass it across to player number four who could receive the ball right in front of net and place the shot in any corner.

Figure 8.3 (*INT-BRE: Attacking Scenario #2: Frame 3*)

The final frame as seen in figure 8.3 depicts the execution of player number four receiving the pass from player number five but his poor finishing allows the keeper to make the save. Table 4.3 depicts the quantitative data of the two attacking scenarios identified from this match.
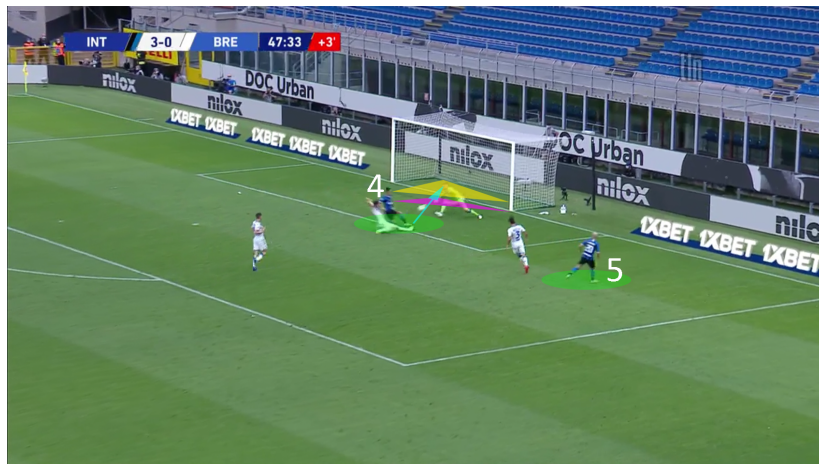
Table 4.3 – *Match #4: Attacking Scenarios*

Scenario	1			2		
Current Score	INT 0-0 BRE			INT 3-0 BRE		
Time of Occurrence	4'			45' +2		
Frames	*Frame 1*	*Frame 2*	*Frame 3*	*Frame 1*	*Frame 2*	*Frame 3*
Players in Attacking Positions	7	5	4	5	2	2
Players in Defensive Positions	9	9	9	6	4	4
Opportunities Available	2	3	1	4	2	1
Play Outcome	Shot Off Target			Goalkeeper Save		

Inter-Bologna (Match 5) Analysis

The fifth and league game analyzed in this study that Inter played was against Bologna on Sunday, July 5, 2020, 11:15 a.m. EST, at the Giuseppe Meazza Stadium in Milan, Italy. Tables 5.1 and 5.2 depict quantitative data of the match details and individual attacking player statistics.

Table 5.1 – *Match #5: Inter's Matchup*

Teams	Match Details	Home or Away Match	Match Difficulty
Inter-Bologna	Sunday, July 5, 2020 – 11:15 a.m. EST	Home	2

Table 5.2 – *Match #5: Attacking Player Statistics*

Inter Strikers	Romelu Lukaku	Lautaro Martinez	Alexis Sanchez	Sebastiano Esposito
Minutes Played	90	85	15	5
Goals Scored	1	0	0	0
Assists	0	0	0	0
Ball Touches	47	42	18	1
Passes Completed	32	18	11	1
Shots (On Target)	2(1)	7(1)	3(1)	0(0)

Attacking Scenario #1
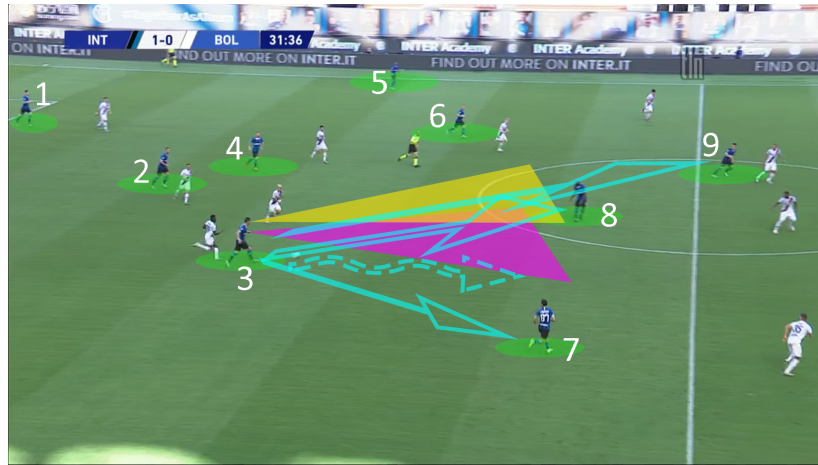
Figure 9.1 (*INT-BOL: Attacking Scenario #1: Frame 1*)

Figure 9.1 depicts the first attacking scenario that was analyzed from this match. Player number eight (Romelu Lukaku) and player number nine (Lautaro Martinez) are the Inter forwards present in this attacking scenario. At the 31st minute of the match with Inter leading Bologna 1-0, player number three has possession of the ball with three teammates in front of him. Player number three can continue his dribble up the pitch or pass to players number seven or eight who are wide open in front of him. Player number

nine appears to want to make a run but the defender beside him is marking him closely.

The best option in this situation would be to open up the pitch more and pass it to player

number seven. Passing the ball to player number seven would cause the defenders to

open up and provide more attacking spaces for the attackers. When a team is defending it

is in their strategy to stay more compact so that it is easier to recover the ball and regain

possession. However player number three advances it in the direction he is facing and

passes it to player number eight, which is understandable. Perhaps player three could

have scanned his surroundings better and would have realized player number seven open

as well.
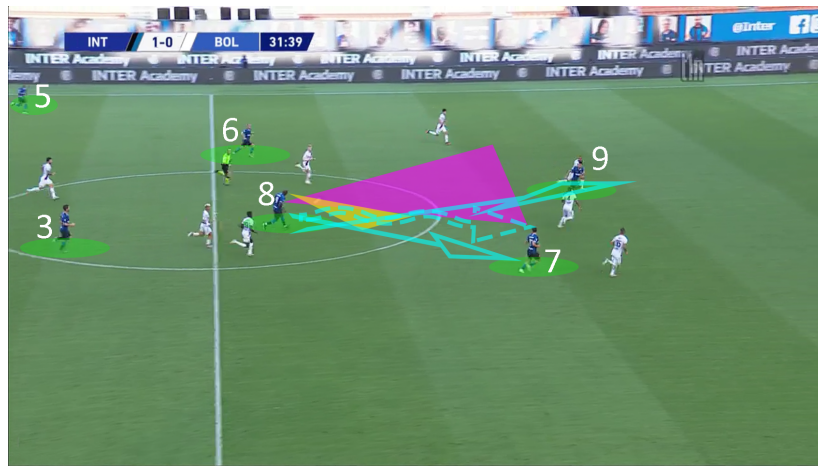
Figure 9.2 (*INT-BOL: Attacking Scenario #1: Frame 2*)

The second frame depicted through figure 9.2 shows player number eight with

possession of the ball. Since he still has lots of space in front of him he could continue

dribbling towards the opposition net or pass it without any pressure to either player

number seven or nine. Launching the ball ahead of player number nine to run onto could

lead to a breakaway and shows creativity. It would also be considered a great effort

because his perceived body position is in line with player number nine and his perceived

line of site is on the ball so that he can coordinate his pass correctly. Passing the ball to

player number seven is also not a bad choice either but there is a risk the defender that is in front and closest to him steps forward to intercept the pass. Player number nine is in more of an advanced position so player number eight decides to lob it over him.
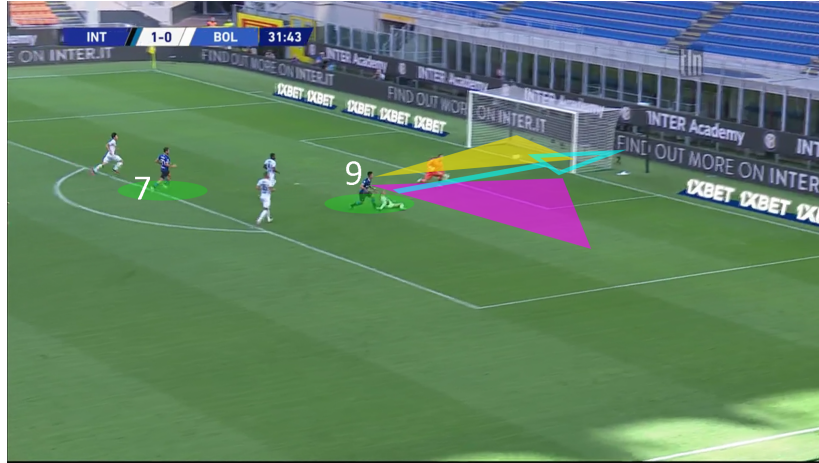

Figure 9.3 (*INT-BOL: Attacking Scenario #1: Frame 3*)

Figure 9.3 illustrates the result of this play as player number nine misses his chance on the breakaway and shoots it just wide, missing the net. Obviously in this situation he should have done better and been more accurate with his finish.
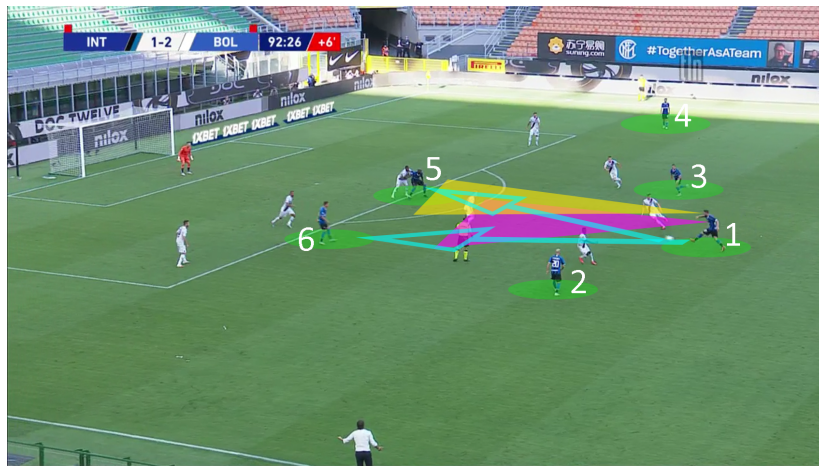
Attacking Scenario #2

Figure 10.1 (*INT-BOL: Attacking Scenario #2: Frame 1*)

Figure 10.1 depicts the final play analyzed from this match. Player number three (Alexis Sanchez), player number five (Romelu Lukaku) and player number six (Sebastiano Esposito) are the Inter forwards present in this attacking scenario. At the 92nd minute with Inter now trailing by one goal, they are desperate to find an equalizer with seven attacking players just outside the opposition's penalty box. Bologna deserves massive credit for staying compact as possible in the first frame while providing player number one who has possession of the ball with only two passing options. A gap between the two defenders allows player number one to pass it to player number five or six. Player number one is in a position where he can see both players who are expecting the ball. Player number five is backing up on his defender and is positioned just outside the center of the penalty box. There is space for him if he were to receive the pass to turn with it and go left or right because there is only one defender on him. If player number six were to receive the pass there is a slight chance the defender behind him, anticipates the pass seeing he is trying to get closer to him. Player number one decides to pass it to player number five, leading to the next frame.
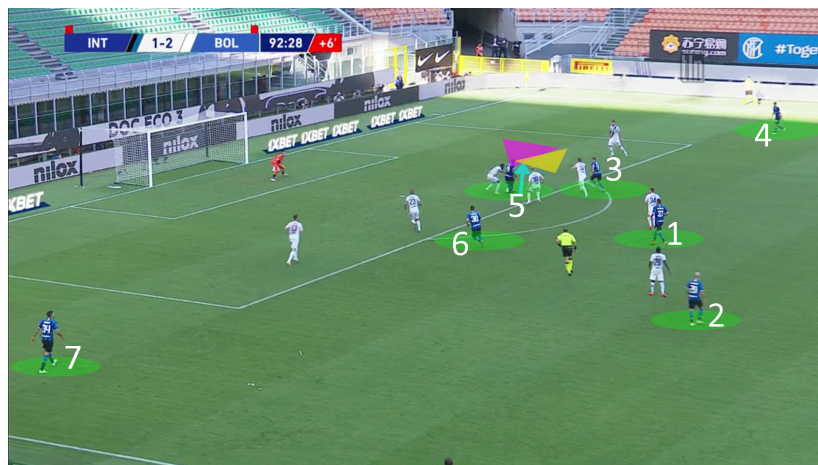
Figure 10.2 (*INT-BOL: Attacking Scenario #2: Frame 2*)

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In figure 10.2, player number five turns his body left and notices player number three sprinting in to receive the pass. Player number three does an exceptional job in realizing player number five has no support and provides him with the only option. Player number five is positioned so he can see player number three running and not show the defender the ball in case he is trying to make a tackle. If the defender does decide to make a tackle this can result to a penalty kick for Inter.
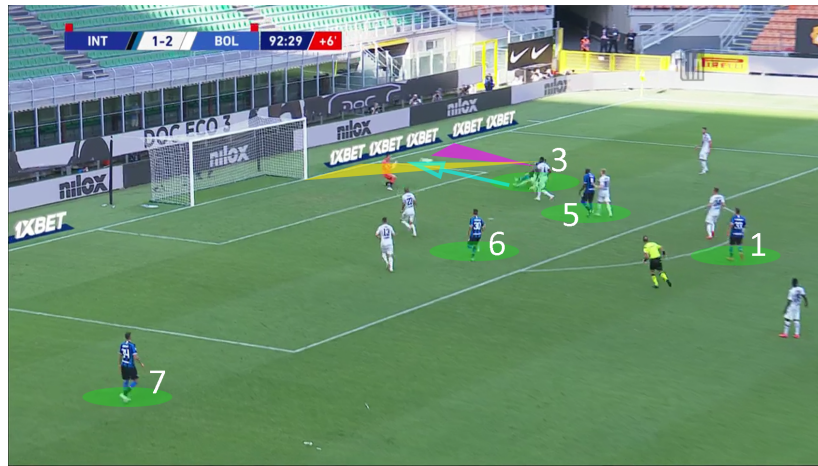
Figure 10.3 (*INT-BOL: Attacking Scenario #2: Frame 3*)

Figure 10.3 shows player number five lay it off for player number three and despite the excellent build up, the following frame depicts a the goalkeeper making an exceptional save. Player number three does lose body control and stumbles as he shoots the ball. Nonetheless, this great breakthrough should have been executed more efficiently. Table 5.3 depicts the quantitative data of the two attacking scenarios identified from this match.

Table 5.3 – *Match #2: Attacking Scenarios*

Scenario	1			2		
Current Score	INT 1-0 BOL			INT 1-2 BRE		
Time of Occurrence	31'			90' +2		
Frames	*Frame 1*	*Frame 2*	*Frame 3*	*Frame 1*	*Frame 2*	*Frame 3*
Players in Attacking Positions	9	6	2	6	7	5
Players in Defensive Positions	10	8	5	9	9	9
Opportunities Available	4	3	1	2	1	1
Play Outcome	Shot Off Target			Goalkeeper Save		

Discussion

The purpose of this paper was to figure out how wearable cameras can benefit soccer players on and off the field. Incorporating wearable cameras in soccer is a new concept with lots of research that still needs to be done. The theoretical approach to how the wearable cameras would work, were demonstrated in the analysis. Particular attention was focused on the games analyzed and why they were chosen. Seeing that the Lega Serie A had to conclude the campaign by August 2nd, so that the UEFA Champions League and UEFA Europa League could resume, Serie A teams had to play on shorter rest with multiple games during the week as opposed to once every weekend. That being said, the games that were analyzed were selected primarily because they provided consistency. Having analyzed five consecutive games as opposed to five random games was beneficial because it helped depict whether or not mistakes from attacking scenarios were fixed from one game to the next or if well executed plays were replicated in a similar manner. Whereas analyzing five random matches over the course of the campaign lacks in determining whether tactics and addressing player decisions were

fixed from one game to the next. Further particular attention was paid to the reasons for selecting the screenshots from the five matches. There were many attacking scenarios that were replicated in similar manners with identical results. Looking at the second attacking scenarios from both Inter vs. Sassuolo and Inter vs. Brescia. Over the three frames highlighted both identify the same number of options from the start of the attacking play to the end. In the first frame from each of the respective plays there are four options available, the second frame identifies two options available and the final frames each offer one available option. Although the number of offensive and defensive players from the respective plays differs, the build-ups are quite similar with excellent passing and overall decisions made, with a lack in finishing. In both plays, the final shots should have found the back of the net, however both resulted in the opposition goalkeepers making great saves. This ultimately demonstrates that the issues evident in these types of build up plays aren't focused on the passes and decisions that were made, but rather the execution by the player who is shooting on target. Having a wearable camera would indicate what the players that shot the ball see from their point of view. Figures 4.3 and 8.3 indicate that the player that shot the ball perceived body position (fuchsia shaded area) and perceived line of site (yellow shaded area) fall in the same path as the opposition net. Having the wearable camera could help indicate to the players once they watch the footage from their perspective the best ways possible to find the back of the net, whether it's shooting the ball into a different corner or angling it differently in order to be decisive when it comes to future scoring scenarios.

The purpose of this study was also to prove that players should not solely be focusing from the perspective the wearable camera would capture. Soccer is a team sport

and requires everyone on the pitch to be involved and use each other. Wearable cameras should be used to further assist in what currently is available (the broadcasting angle) as was used during the analysis of this paper. There are many times during a match where a fan may question a player's decision on the field and why they didn't make a certain pass or why they attempted a shot. However the analysis does show that there are times that a players perceived line of site does not fall in the same direction as their perceived body position. It is quite simple to explain the reasoning for these situations because players have to constantly analyze their surroundings by looking to pass to other teammates and scan the overall pitch. Sometimes a player that passes the ball to another teammate who falls in the direction of the perceived body position may not always be best option. There may be another teammate who is positioned in the player's perceived line of site that may be a better passing option and vice versa. Overall, in order to minimize the amount of mistakes on the field the use of wearable cameras can be used to assist the other camera angles that are currently available. Analyzing both qualitative and quantitative data was important for this paper because it helped simplify complex plays and pinpoint the important aspects that make up each frame

From the series of screenshots there were many aspects like the time in which the plays occurred, current score, players involved in the attacking situation, perceived body position, perceived line of site and even the final outcome of the play that were examined from the naked eye. There are many reasons why certain plays contained more players than others. The second acting scenario from Inter's match against Bologna contained at least six players for many reasons. Inter was trailing 2-1 with only four more minutes left of added time and were desperate to score a goal. When a team is trailing late in a match,

it is common to see more players push forward and attack because the goal for them is to tie the game and secure at least a point. However as seen in other plays when it's the middle of a match, one does not tend to see as many players go on the attack because they do not want to risk the opposition scoring on a counter attack. The idea is to try and keep all areas of the field balanced from the defence to the midfielders and finally to the attackers. As depicted in the tables majority of the attacking scenarios contain more players in defensive position than attacking ones because one does not want to risk conceding a goal. It is always still possible to score a goal with as little as three forwards as seen in the tables, however if there are more opposing defenders present, the chances of an attacker from scoring a goal is slimmer.

Future Research

On the basis of the promising findings presented in this paper, physical testing would need to be conducted to determine the legitimacy on the whether soccer players would benefit using wearable cameras. The next stage of this research paper would be experimental confirmation on the theory of how a wearable cameras can benefit soccer players and become a provider of Electronic Performance and Tracking Systems (EPTS) to the FIFA standard and complete the certification process. The second option would be to find a provider of EPTS for wearable cameras that would be willing to help analyze the theoretical concepts identified in this paper in a practical environment and capture individual player perspectives as they play on the pitch. This would ultimately allow the players that are capturing their own point of view to determine whether the footage captured is beneficial to them and can help assist them in improving past mistakes or

continuing to replicate plays to the highest degree in future, when faced in similar situations. The findings from the further research would suggest that the player perspective is just as important as the standard broadcasting angle when analyzing plays.

Limitations:

There were a few limitations from the analysis that could have altered the results of the attacking scenarios and even the outcomes of the match. The first limitation is how would the results differ if fans were present at the stadiums? Home field advantage does not become a factor for home teams anymore because there are not fans that support the home team present at the stadium. Home fans at sport stadiums can help motivate their team and also try their best to stop opposing teams from performing at their highest potential by distracting them and jeering them. The second limitation to this study is whether or not the results would differ if they played on a regular one to two match per week basis. Prior to the Covid-19 outbreak teams would regularly play on weekends and occasionally a match during the week. However once the season resumed, Serie A teams had to play matches every three to four days, which is not the norm. The final limitation to this study is whether the months in which the resumption of the Serie A season occurred served as a negative factor for the players playing? The Serie A seasons regularly ends in May so teams and players are not accustomed to having to play in the middle of the summer and had to adapt to the change.

Conclusion

The fact that the use of wearable technology in soccer was only established in 2015 demonstrates that this is a new area with lots of experiments and research still to be done. This paper was able to highlight the theoretical benefits for allowing wearable cameras to be used in soccer and how it provides another perspective on how to read the game from a player's perspective. The paper suggests that wearable cameras can help in areas such as player performance and player development through the execution of specific movements and cognitive decisions that are made on the pitch. Technology has played an impactful role in the sport of soccer, by not allowing as many mistakes to be made during the field of play from a referee's standpoint, but also constantly analyzing and tracking teams and players and improving their performances as well. The future of the sport is deemed to be innovative and as long as technology assists in ensuring games are played fairly and matches remain entertaining, then the possibilities of what is to come in the sport remains exciting.

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