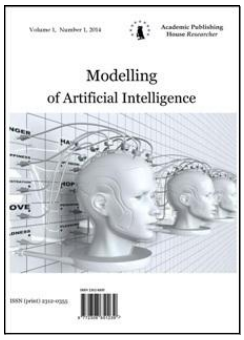

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Arbitration Management with Using Artificial Intelligence Technology (the sample: Goal-line Technology in Football)

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Abstract. Today, over time, the various technologies that are in the human service are growing. We are witnessing these types of technologies have their place in our lives. One of these new technologies is that despite being able to show your own good is AI technology. This technology is also used in sports. GLT technology in football is one of the examples Which will enable the jury to the judge managed to play well. This technology from other technologies:GoalRef and Hawk-Eye, etc. have benefited. Despite much criticism, FIFA has approved the technology and it has used. In this article we have discussed this technology.

Keywords: Hawk-Eye; GLT; GoalRef، management، football.

Introduction

Artificial Intelligence is a branch of Science which deals with helping machines find solutions to complex problems in a more human-like fashion. This generally involves borrowing characteristics from human intelligence, and applying them as algorithms in a computer friendly way. A more or less flexible or efficient approach can be taken depending on the requirements established, which influences how artificial the intelligent behavior appears.

AI is generally associated with Computer Science, but it has many important links with other fields such as Math, Psychology, Cognition, Biology and Philosophy, among many others. Our ability to combine knowledge from all these fields will ultimately benefit our progress in the quest of creating an intelligent artificial being.

Computers are fundamentally well suited to performing mechanical computations, using fixed programmed rules. This allows artificial machines to perform simple monotonous tasks efficiently and reliably, which humans are ill-suited to. For more complex problems, things get more difficult... Unlike humans, computers have trouble understanding specific situations, and adapting to new situations. Artificial Intelligence aims to improve machine behavior in tackling such complex tasks.

Together with this, much of AI research is allowing us to understand our intelligent behavior. Humans have an interesting approach to problem-solving, based on abstract thought, high-level deliberative reasoning and pattern recognition. Artificial Intelligence can help us understand this process by recreating it, then potentially enabling us to enhance it beyond our current capabilities.

To date, all the traits of human intelligence have not been captured and applied together to spawn an intelligent artificial creature. Currently, Artificial Intelligence rather seems to focus on lucrative domain specific applications, which do not necessarily require the full extent of AI capabilities. This limit of machine intelligence is known to researchers as narrow intelligence.

There is little doubt among the community that artificial machines will be capable of intelligent thought in the near future. It's just a question of what and when... The machines may be pure silicon, quantum computers or hybrid combinations of manufactured components and neural tissue. As for the date, expect great things to happen within this century!

There are many different approaches to Artificial Intelligence, none of which are either completely right or wrong. Some are obviously more suited than others in some cases, but any working alternative can be defended. Over the years, trends have emerged based on the state of mind of influential researchers, funding opportunities as well as available computer hardware.

Over the past five decades, AI research has mostly been focusing on solving specific problems. Numerous solutions have been devised and improved to do so efficiently and reliably. This explains why the field of Artificial Intelligence is split into many branches, ranging from Pattern Recognition to Artificial Life, including Evolutionary Computation and Planning.

Related works in other sport

1 Hawk-Eye tennis

The Hawk-Eye tennis officiating system is the first and only ball-tracking technology to have passed stringent ITF testing measures. The technology is now an integral part of the ATP, WTA and ITF tennis tours, featuring at over 60 events across the tennis calendar.

The professional game is won and lost on the smallest of margins. Players leave no margin for error in their practice, preparation or play. Why should line calling be any different? The Hawk-Eye Officiating System is not only vital for ensuring that high pressure points do not fall prey to umpiring mistakes; Hawk-Eye brings the fans closer to the action. Spectators watch alongside their heroes and heroines on court as Hawk-Eye show whether a ball was in or out on stadium big screens and televisions at home. Hawk-Eye's graphical representation of statistics bring a whole new dimension to television coverage and fascinates tennis fans worldwide.[8]

2 Hawk-Eye's cricket

As the pioneering sport, Hawk-Eye's cricket systems have been used by host broadcasters at major Test, ODI and Twenty20 matches around the world since 2001. In a similar fashion to the tennis, the accuracy and reliability of the system soon reached a level that meant that it was added as part of the Decision Review System, first used in the New Zealand series late in 2008. This is now used worldwide to assist in one of the hardest officiating decisions across sport: the leg before wicket (LBW) ruling.

Having tracked every ball bowled in any given innings, the virtual reality system is able to provide the broadcast easily digestible statistics to enhance the viewing experience, and understanding of the game.[8]

Goal-Line Technology

One of the challenges for referees is that the human eye can handle only approximately 16 images per second, which means the ball needs to be behind the line for at least 60 milliseconds.

However, in some cases the ball is only behind the line for a few milliseconds before a player kicks it back or it rebounds back into the field of play, with the result that the human eye cannot see whether the ball has crossed the line. The ball can only be detected by the human eye at a speed of 12km/h or less, whereas nowadays players are able to shoot at a speed of over 120km/h. Another challenge is the vantage point. When viewed from certain angles, it is easy to misjudge the ball's position. Cameras placed at different angles can mislead viewers when showing images "proving" whether or not the ball has crossed the line, which is why only technology dedicated to evaluating such incidents can support the referee in the decision-making process and contribute to a fair game.

In association football, goal-line technology (sometimes referred to as a Goal Decision System) is a method used to determine when the ball has completely crossed the goal line with the assistance of electronic devices and at the same time assisting the referee in awarding a goal or not. The objective of goal-line technology (GLT) is not to replace the role of the officials, but rather to support them in their decision-making. The GLT must provide a clear indication as to whether the ball has fully crossed the line, and this information will serve to assist the referee in taking his final decision. In the wake of controversial calls made in the Premier League, 2010 World Cup and the Euro 2012, FIFA (previously against the technology) is testing potential candidates for goal-line technology. Nine systems were initially tested, but only two remain. [1]

On 5 July 2012, IFAB officially approved the use of goal line technology. The two systems approved in principle were involved in test phase 2: GoalRef and Hawk-Eye. In December 2012, FIFA announced it would introduce goal-line technology in a competitive match for the first time at the 2012 FIFA Club World Cup in Japan. Starting in 2013, in the United States technology has been used in Major League Soccer. However MLS's Canadian teams do not use them in their home games due to the lack of money. (Fig 1 and Fig 2)[2]. In December 2012, FIFA announced it would introduce goal-line technology at the 2012 FIFA Club World Cup in Japan. Hawk-Eye technology was employed at Toyota Stadium, while GoalRef was used at International Stadium Yokohama. [3]

In April 2013, FIFA announced that GoalControl, a camera-based system, would be used at the 2013 Confederations Cup and, if successful, would be implemented at the 2014 FIFA World Cup, in October 2013, FIFA confirmed the use of GoalControl at the 2014 FIFA World Cup Its system, GoalControl-4D, uses 14 high-speed cameras located around the pitch and directed at both goals. Later in April the Football Association announced that Hawk-eye would be used in the 2013-14 Premier League season. On 16 December 2013, it was announced that Hawk-Eye will be used in three of the four quarter-finals and any subsequent matches in the League Cup. The system was used when on the very next day, when on the Sunderland – Chelsea quarter-final goal from Frank Lampard was allowed. The first goal to be decisively awarded using goal-line technology in the English Premier League was Edin Dzeko's goal for Manchester City against Cardiff City on 18 January 2014. [3]

Fig 1. Goal-line Technology

Fig 2: Goal-line Technology

1 Cairos GLT system

Produced by a German company Carios Technologies AG, alongside Adidas, the GLT system used a magnetic field to track a ball with a sensor suspended inside. Thin cables with electrical current running through them are buried in the penalty box and behind the goal line to make a grid. The sensor measures the magnetic grids and relays the data to a computer which determines if the ball has crossed the line or not. If the ball does cross the line a radio signal is sent to the referee's watch within a second. Adidas designed a ball that could suspend and keep a sensor safe and intact even when the ball is struck with great force. Cairos claims the process is practically instantaneous, addressing critics' concerns that the technology might slow down the game. An older system developed by Cairos was trial led at the 2005 FIFA U-17 World Championship, but was found not to be fast or accurate enough. [6]

On February 25, 2013 FIFA granted a license to Cairos Technologies AG, enabling them to provide goal-line technology for use in FIFA-sanctioned competitions.

2 Goalminder

The Goalminder system has two co-founders, Harry Barnes and Dave Parden, who first thought of the system after their favorite team, Bolton Wanderers, was relegated due to a wrongly disallowed goal. The technology was not picked up at the time, but after Frank Lampard's disallowed goal in the 2010 World Cup, interest in goal-line technology spiked causing FIFA to investigate the possibility of sanctioning goal-line technology. The technology uses high-speed cameras built into the goal posts and cross bar to record images at 2000 frames per second and deliver visual evidence to the referee, in less than five seconds, to settle goal-line controversy. With this technology there is no calibration: just visual evidence. The system is thought to be cheaper because less expensive cameras will be needed and the field will not have to be dug into. [2]

3 GoalRef

GoalRef features a passive electronic circuit embedded in the ball and a low-frequency magnetic field around the goal. Any change in the field on or behind the goalline is detected by coils embedded in the goal frame, which determine the scoring of a goal. By producing low magnetic fields around the goals, GoalRef creates the radio equivalent of a light curtain [6]. As soon as the ball has wholly crossed the goal line between the posts, a change in the magnetic field is detected. A goal alert is then instantaneously transmitted to the game officials using an encrypted radio signal, with a message displayed on their wristwatches. (Fig 3)

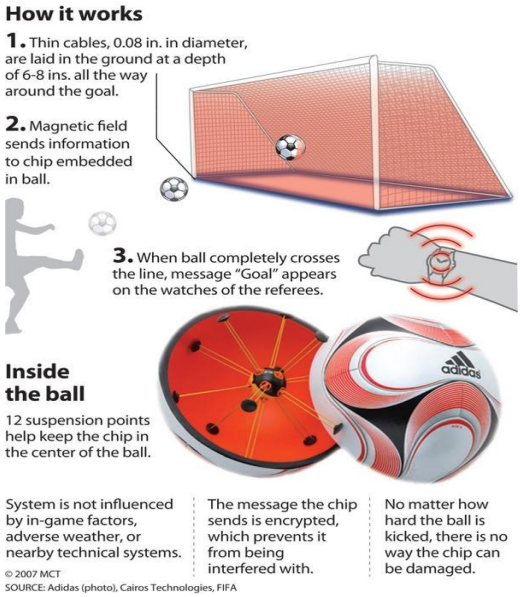

Fig 3: How it Works

4 Hawk-Eye

The Hawk-Eye system was first developed in 1999. Hawk-Eye is an existing technology currently used in cricket, tennis and snooker. It is based on the principle of triangulation using the visual images and timing data provided by high-speed video cameras at different locations around the area of play. The system uses high frame rate cameras to triangulate and track the ball in flight. The software calculates the ball's location in each frame by identifying the pixels that correspond to the ball [4]. The software can track the ball and predict the flight path, even if several cameras are being blocked. The system also records the ball's flight path and stores it in a database that is used to create a graphic image of the flight path, so the images can be shown to commentators, coaches and audiences. The data from the system can also be used to determine statistics for players and analysis trends. The proposal involves placing seven cameras for each goal mouth around the stadium. The system is near real-time and referees will be notified on their encrypted watch in less than one second from the ball crossing the line. Critics of the system claim the system will slow down the game and that the statistical margin of error is too large. Both Roger Federer and Rafael Nadal have criticized the accuracy of the system in tennis (though Roger Federer now supports the use of the system in football. (Fig 4 and Fig 5). [5]

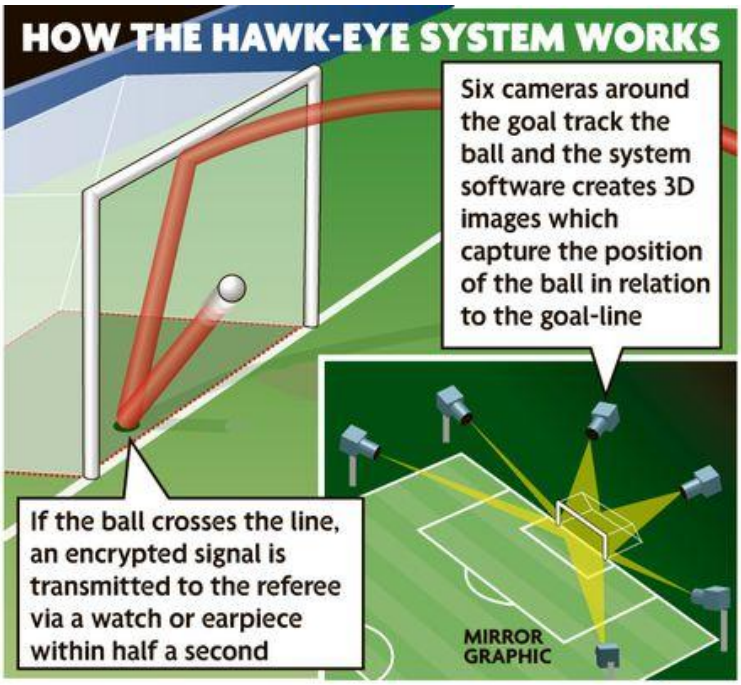

Fig 4: How Haw-Eye works

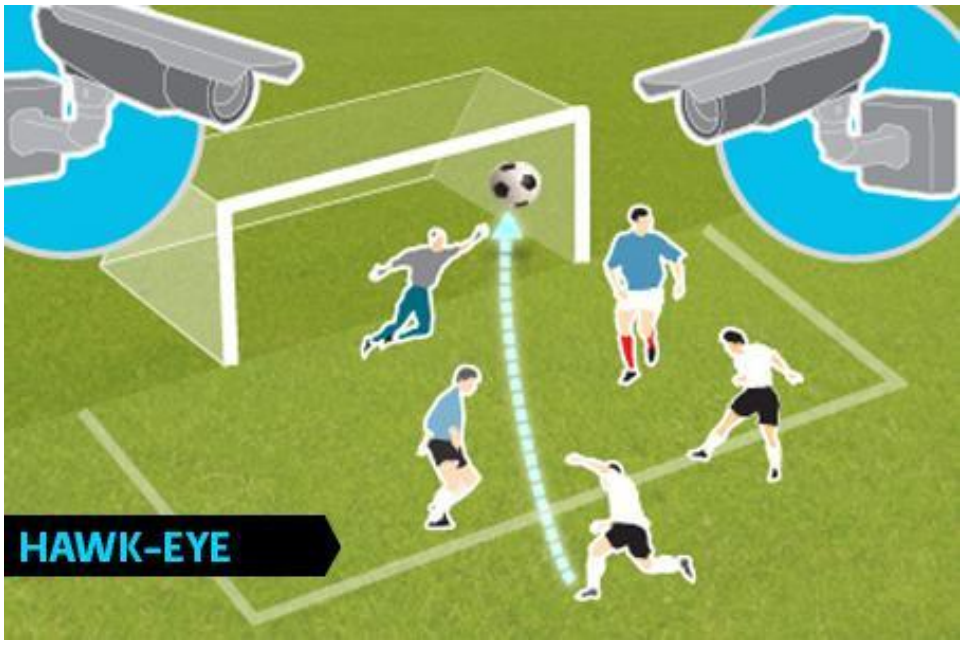

Fig 5: Hawk-Eye

GLT System test

To ensure the highest possible quality in the field of goal-line technology, any approved system must successfully pass a series of system tests as well as an installation test before it is approved for use in official matches:

1 System Test

Consisting of field, laboratory, training and live tests, the purpose of these system tests is to give football leagues, clubs, associations and confederations intending to install goal-line technology the total assurance that the system complies with the Laws of the Game. These tests are conducted under the expert eye of the independent FIFA-accredited test institute EMPA, based in St. Gallen, Switzerland.

While the purpose of the laboratory tests is to examine the components of each technology, e.g. the referee's watch, the field tests aim primarily at evaluating their robustness in different weather scenarios and match situations. Only if the system fulfills all the necessary criteria will it be registered by FIFA as a licensed goal-line technology system. [6]

2 Final installation test

This final step in the process verifies the proper installation of the licensed goal-line technology system. The installation test aims to establish the perfect functionality of the system by certifying that the technology performs to the same level in the stadium as it did during the system test. Following a successful installation test and approval by the customer (e.g. the competition organizer), the GLT system will then appear on the official FIFA list of certified installations.

3 Aftercare

Once the system has been tested, the challenge is to maintain the upkeep of its quality and functionality. Aftercare is an essential part of the sustained quality assurance of the GLT system, which is why its service provider must commit to performing regular post-installation maintenance.

As a final precaution, additional system checks must be carried out by the match officials prior to every official match. (Fig 6)

Fig 6: GLT system Test

Analysis GLT

1 The Current Rules

Law 10 of the FIFA Laws of the Game1 defines a goal as being when the "whole of the ball passes over the goal line…" [6]. However, establishing whether the ball has completely crossed the line is not as easy as it seems. Football is played at high speed and the measurements involved are relatively small, take for example Law 1 of FIFA Laws of the Game 'the field of play' that states that the goal line must not be more than 12cm thick and Law 2 'the ball" that states that the ball must have a circumference between 60cm – 70cm. The margin for error when awarding a goal is significant and the question of their validity will always be vital to the outcome of the game.

2 New Rules

On the 3 August 2012, the amendments to the Laws of the Game were set out in a FIFA Circular 1315. 10Law 10 – The Method of Scoring

Goal Line Technology (GLT) - GLT systems may be used for the purpose of verifying whether a goal has been scored to support the referee's decision. The use of GLT must be stipulated in the respective competition rules.

Principles of GLT:

GLT applies solely to the goal line and only to determine whether a goal has been scored; The GLT system must be in accordance with the FIFA Quality Programmer for GLT; The indication of whether a goal has been scored must be immediate and automatically confirmed within one second; The indication of whether a goal has been scored will be communicated by the GLT system only to the match officials (via the referee's watch, by vibration and visual signal); and Requirements and specifications of GLT - If GLT is used in competition matches, the competition organizers must ensure that the system meets the requirements set out in the FIFA Quality Programmer for GLT Testing Manual. This manual must be approved by the International Football Association Board. An independent testing institute must verify the accuracy and functionality of the different technology providers' systems according to the Testing Manual. Further additions were made because IFAB approved the use of Goal Line Technology either via installation on the field of play (i.e. in the goal) or inside a match ball.

Law 5 – The Referee

Where goal-line technology (GLT) is used (subject to the respective competition rules), the referee has the duty to test the technology's functionality before the match. The tests to be performed are set out in the FIFA Quality Programme for GLT Testing Manual. If the technology does not function in accordance with the Testing Manual, the referee must not use the GLT system and must report this incident to the respective authority.

Law 1 – The Field of Play

Where goal-line technology (GLT) is used, modifications to the goal frame may be allowed. They must be in accordance with the specifications stipulated in the FIFA Quality Programme for GLT and according to the above description, "Goals".

Law 2 – The Ball

Where goal-line technology (GLT) is used, balls with integrated technology are allowed, but they must either be "FIFA APPROVED", "FIFA INSPECTED" or "INTERNATIONAL MATCHBALL STANDARD" [8]

3 The value and fairness of decisions

The views articulated by Platini and Blatter focus on the purity, nature and ultimately the appeal of football. However, there is a more commercial angle to consider. Football is now big business. There are now numerous stakeholders who have a huge amount, especially from TV money, riding on the outcome of games. It is essential that objective decisions, such as whether or not the ball has crossed the goal line, are fair and correct. Put simply, GLT will help those that are officiating at games to make the correct decision when it matters most. [7]

Instant replays and ubiquitous media coverage mean that every decision is scrutinized and referees can become the focal point of frenzied post-match analysis. If the fans and the media have the luxury of viewing the incident immediately, from multiple angles and at a slower speed, why should the referee be at disadvantage when it is their decision that ultimately counts? As Arsene Wenger argued in 2008: "when you love football you like justice to be respected. You should use what is available in order to be right in decision-making. Why should a team be allowed a goal that wasn't in?" [7]. With the ever increasing amounts of money riding on the outcome of games, GLT can help to ease the pressure on referees and at the very least ensure the correct decisions are made as to whether a goal has been scored or not.

4 The impact of GLT

It cannot be argued that at the very least GLT will help referees to make fair decisions. However, are goal line decisions of such fundamental importance that they completely change the outcome of a game? In the article "The Fallacies of the Assumptions Behind the Arguments for Goal Line Technology in Soccer" Tamba Nlandu disagrees.6 There are in thousands of situations that could potentially lead to a goal including, offside; out-of-bounds situations; player cautions. Winning a game of football involves multiple elements. Nlandu explains that it is a myth that referees' decisions (or non decisions) and actions affect the outcome of games more than players' and coaches/managers' decisions and actions. Nlandu calls it the 'illusion of infallibility'. Her paper suggests that players and other participants need to be educated to take greater responsibility for the stewardship of the game. The technology is one step that can be taken to help referees, but educating players and those involved in the game could help to change people's attitude towards the referee and stop the idea that he is solely to blame for the result.[7]

5 Comparison between Hawk-Eye, Goal-Ref

Below we have a comparison between the two technologies: Hawk-Eye, Goal-Ref. (Fig 7)

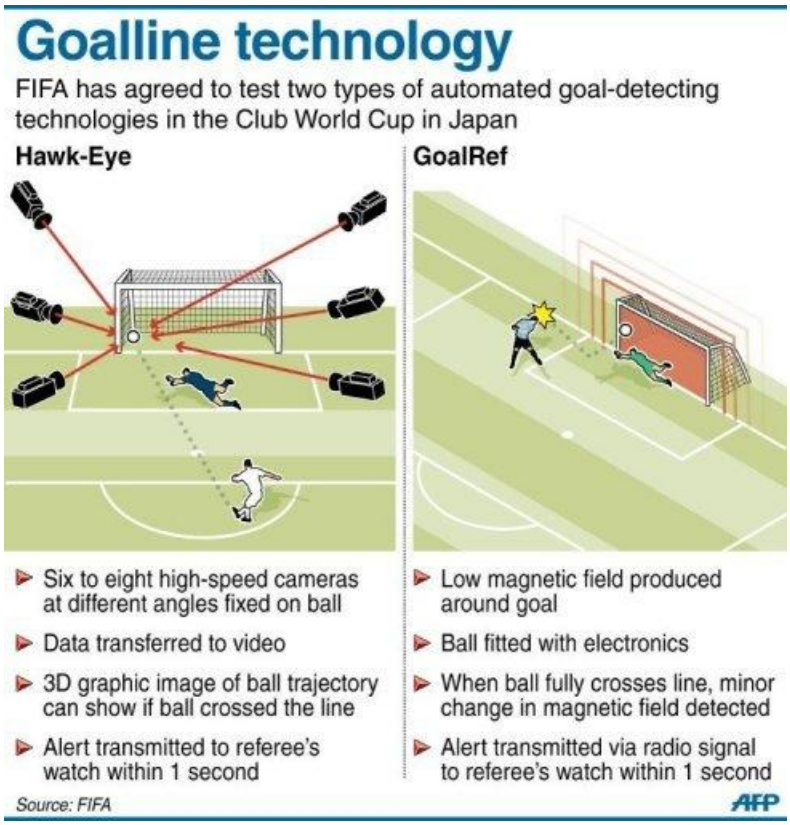

Fig 7: Howk-Eye and GoalRef

Criticism

While advocates for goal-line technology maintain that it would significantly reduce refereeing errors during play, there are also criticisms of the technology. Much of the criticism comes from within FIFA itself including FIFA president Sepp Blatter. Apart from the criticisms revolving around the technical aspects of the two proposed technologies, critics point out that such technology would impact on the human element of the game and remove the enjoyment of debating mistakes. Sepp Blatter has been quoted as saying "Other sports regularly change the laws of the game to react to the new technology. ... We don't do it and this makes the fascination and the popularity of football". [1]

A study suggested that in the 2010–11 Premier League season "errors took place nearly 30% of the time that video replays could help prevent", but some people claim that instant replays would interrupt the flow of the game and take away possible plays.

Other critics believe it would be prohibitively expensive to implement the technology at all levels of the game and particularly for smaller/poorer football associations. FIFA officials have expressed a preference for 'better refereeing' as well as more match officials over implementing the technology. Advocates in turn cite the many examples of incorrect goal-line decisions deciding important games and point out that the technology has improved much since the initial trials carried out by FIFA. Advocates contend that any extra help for the referee should outweigh arguments that it would lead to non-uniform rules (since not all football associations would be able to implement it).

Blatter had been opposed to goal-line technology until Frank Lampard's disallowed goal in the 2010 World Cup. He now says that the technology could be in place by the 2014 World Cup in Brazil. UEFA president, Michel Platini will likely oppose the plan, and instead propose additional referees beside each goal. [6]

The introduction of the so-called "fifth official", i.e. the extra assistant referee standing beside the goal-line, was partly in order to facilitate in such situations.

Conclusion

Nowadays, the use of modern technology Particularly, artificial intelligence are located in all parts of our life. One area that has been present is sport. We use technology in football GLT Which consists of other technology is called: Hawk-Eye, Goalminder, GoalRef. Use of this technology reduces error rate Arbitration and sports management and judgment are become better But even though FIFA has approved this technology but Critics reject it and believe that the Judgment error is a part of the game and attractiveness of the game depends on it. In the Future this technology should show that it is effective or not.

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