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CESFM: A Proposal to FIFA for a new 'Continuous Evaluation Fuzzy Method' of Deciding the WINNER of a Football Match that Would Have Otherwise been Drawn or Tied after 90 Minutes of Play

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Abstract In this research work the author consider only those cases of football matches for which the penalty shootout is a method for determining a winner, otherwise that would have been drawn or tied after 90 minutes of play. The existing method of penalty shootout is having a lot of criticisms due to its huge demerits. In this research work the author proposes an improved method to FIFA to select the winner by a continuous soft-computing evaluation method. The method is called by CESFM which is basically a fuzzy constructive method. But CESFM does not exclude five penalty kicks by each team as followed presently after 90 minutes of play. The result of five penalty kicks is one of the many components in the method of CESFM. This proposed fuzzy method can easily extract the real dominant team out of the two tied teams using a software called by CESFM-software with inputs from the Referee where some inputs are given by the Referee using his fuzzy pocket machines M. It is claimed that if FIFA implement this method of CESFM in World Cup Football, it will be a true justice to the football world, to the fans, to the players, to the teams (in particular to the looser team) and consequently it will give enormous justice to the 'football' if considered as a subject. CESFM is not to be applicable if the football game ends after 90 minutes with a result (not draw).

Keywords: *fuzzy set, FIFA, CESFM, positive parameters, negative parameters, CES-Score (CS), fuzzy pocket machine, CPS, CESFM-software*

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1. Introduction

The penalty shootout is a method of determining a winner in Football matches that would have otherwise been drawn or tied after 90 minutes of play. A penalty shootout is normally used only in situations where a winner is needed and where other methods such as extra time and sudden death have failed to determine a winner. It avoids the delays involved in staging a replayed match in order to produce a result. The term *golden goal* was introduced by FIFA in 1993 along with the rule change because the alternative term, 'sudden death', was perceived to have negative connotations. Following a draw, two fifteen-minute periods of extra time are played. If any team scores a goal during extra time, that team becomes the winner and the game ends at once. The winning goal is known as the 'golden goal'. If there have been no goals scored after both periods of extra time, a penalty shootout decides the game.

The shoot-out is thus a test of individuals which may be considered inappropriate in a team sport; Football is a team sport and penalties is not a team, it is the individual. Inferior teams are tempted to play for a scoreless draw, calculating that a shoot-out offers their best hope of victory. The1990 FIFA World Cup was notable for many teams playing defensive football and using time wasting tactics, including a team of very high caliber, who scored only 5 goals but reached the final by winning two shootouts. Hence a common complaint about penalty shootouts is that they only determine the better team in the one, rather narrow, discipline of taking penalty shots, rather than fairly determining the better team in overall play. As a way to decide a football match, shoot-outs have been seen variously as a thrilling climax or as an unsatisfactory cop-out. The result is often seen as a lottery rather than a test of skill. Only a small subset of a footballer's skills is tested by a shoot-out. In this research article we propose a new soft-computing method for deciding the winner of a football match that would have otherwise been drawn or tied after 90 minutes of play.

This method is called by CESFM which stands for "Continuous Evaluation System for Football Matches". The proposed theory of CESFM uses fuzzy logic to compute the winner for such a draw or tied case.

2. About Fuzzy Set Theory

Since our proposed method of CESFM (Continuous Evaluation System for Football Matches) is based on fuzzy logic, we present here a preliminaries of fuzzy set theory [1,2,3,4,5] which will be used in this research article.

In the real world the human reasoning in most of the cases involves the use of variable whose values are fuzzy sets. Description of system behavior in the language of fuzzy rules lowers the need for precision in data gathering and data manipulation. Essentially, in a Fuzzy Set (FS) each element is associated with a point-value 'membership value' selected from the unit interval [0,1], which is also termed the 'degree of belongingness' or 'grade of membership' of the element in the fuzzy set.

If X be a universe of discourse, a fuzzy set A in X is a set of ordered pairs

$$A=\left\{\left(x,\mu_A(x)\right):x\in X\right\}$$

where μ_A: X → [0,1] is a function called by "membership function" of the fuzzy set A. Thus, $0 \le \mu_A(x) \le 1 \ \forall\ x \in X$.

Here X is the universe of discourse, or universal set, which contains all the possible elements of concern in each particular context of applications. The membership function μ_A maps each element of X to a membership grade (or membership value) between 0 and 1.

Consider a decision parameter α[0,1]. An α-cut of a fuzzy set A is a crisp set Aα that contains all the elements of X that have membership value in A greater than or equal to α. i.e. $A_\alpha = \{x \mid A(x) \ge \alpha\}$.

A strong α-cut of a fuzzy set A is a crisp set $A_{\alpha+}$ that contains all the elements of X that have membership value in A strictly greater than α. i.e. $A_{\alpha+} = \{x \mid A(x) > \alpha\}$.

For details about the famous fuzzy set theory discovered by the great philosopher Prof. Zadeh [4], one could see any good book available in libraries/markets [1,2,3,4,5].

3. Theory of CESFM

Our proposed method of CESFM (Continuous Evaluation System for Football Matches) is applicable only to such cases of football matches that would have otherwise been drawn or tied after 90 minutes of play. This method is developed to replace the existing penalty shootout method. In the existing system, a penalty shootout is used to decide somehow a winner of a football match where the other methods such as extra time and sudden death have failed to determine a winner. The penalty shootout method has a lot of demerits, it does not give satisfaction to the looser. The spirit of the sport is not translated to the result, instead it becomes equivalent to a lottery game in many situations. The probability that the better team will win is not high, because it becomes like that 'the better goalkeeper will win, not necessarily the better team'. This is a genuine unsolved problem to the world football fans and teams and players, and thus to the football sport if considered as a subject of study and research.

In our work here we propose a new method CESFM based on continuous evaluation scores. The CESFM is a multi-criteria based decision making process. A team's performance, merits and demerits, can be evaluated on the basis of certain significant attributes.

3.1. Philosophy behind CESFM

For a draw/tied case, the main problem is : 'How to choose the better?'. It is fact that we must develop a new method such that the better team should win, not the weaker team by any chance.

The "Winner" must be

(i) the overall dominating team,

(ii) the overall better team by continuous performance shown by the team

who has contributed more substance of the subject 'football' in today's game by way of quality and performance.

The existing penalty shootout method of taking decision on the basis of the results of 5 penalty kicks to find the better or dominating team for declaring the 'Winner' is a weak method as it is a test for one player (Goalkeeper) only against one player of the opponent team (five players, one after another, of the opponent team for five penalty kicks). It does not give justice or satisfaction to the football world.

While a football match goes on, each team plays well revealing its merits in various criteria/attributes continuously at every second. It is very difficult to evaluate every second the merit-performance of both the teams. But each team also happens to commit mistakes during play, which are not happening continuously but in discrete moments of time. For example, a team commits one foul after 23 minutes, another foul after 12 minutes, then shown yellow card to one player of the team by the referee after 18 minutes, etc. These events if quantified by good mathematical techniques (using hybrid of soft-computing and hard-computing methods) can surely indicate the amount of discredits, amount of poor performance etc. of the concerned team. These events are well recorded in a database by the organizer for statistical analysis. In our proposed CESFM we input such discrete negative-events in a continuous manner during the 90 minutes of play, in addition to the positive events. Finally we compute the Continuous Evaluation System Score or CES-Scores or CS (in short) of both the teams comparing which we understand which team is the better performer today, i.e. which team is the dominant team. The team with higher CES-Score (CS) will be the winner. To compute the CS score of a team we compute CS values of few input parameters corresponding to the team.

3.2. Parameters in CESFM

FIFA World Cup is one of the most prestigious events happens on this earth! But for the draw cases under consideration here, what are the parameters on which one can decide the Winner? Can it be just one parameter (results of 5 penalty kicks at the penalty-shootout)?

Theory of CESM consider the following 16 parameters as its components for inputs to its software called by

CESFM-Software. The CESFM does not exclude penalty-shootout kicks (after 90 minutes of play) as one of its component inputs. But instead of existing practice of 5 kicks, theory of CESFM introduces 10 kicks with the following rule.

3.2.1. What is 'CESFM Penalty Shootout' (CPS)?

The 'CESFM Penalty Shootout' (CPS) consists of 10 penalty kicks by each team in the existing manner, with the condition that each player (except goalkeeper) of a team will kick once. None can kick twice. The CPS is one mandatory component in CESFM method in a football match. Replacement of Goalkeeper is allowed by a team as many times the team wants during CPS.

The philosophy behind this new norm of CPS is that it becomes a game of 11 players for each team upto certain extent. This philosophy is missing in the existing practice of penalty shootout in the FIFA rules.

3.2.2. What is 'Half-ground of the Opponent' for a Team?

We explain it by a figure. The Figure.1 shows that team X on the left hand side and team Y on the right hand side. For the team X, the Half-ground of the Opponent is shown by arrow mark. Similarly, for the team Y, the Half-ground of the Opponent is also shown by arrow mark. These two half-grounds are the partition of the complete ground into two equal halves by the middle half-line.

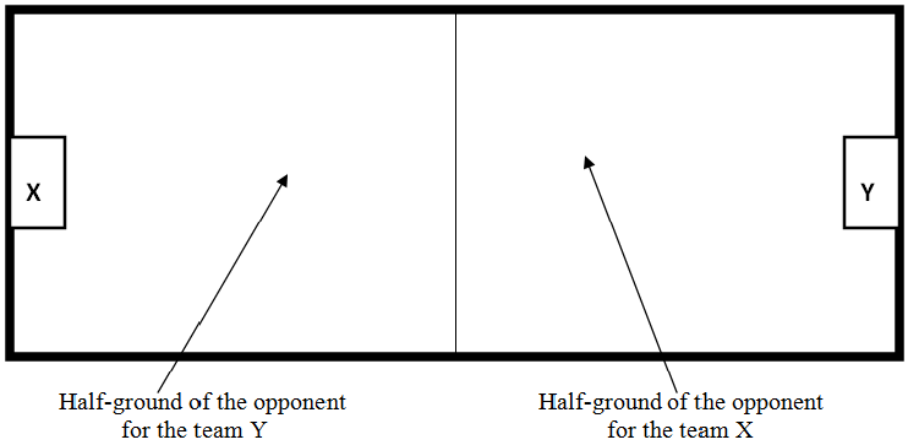

Figure 1. Half-ground of the Opponent for team X and team Y

3.2.3. Positive and Negative Parameters

There are 16 parameters in the theory of CESFM. Few of them are called negative parameters and rest of them are to be called positive parameters. There are seven negative parameters and nine positive parameters which are listed below (however, more number of decision contributing parameters, positive as well as negative, can be added in the theory of CESFM if decided).

Negative Parameters:

(i) F1 = Number of Simple Fouls committed (Not shown any card) during the 90 minutes of play.

(ii) F2 = Number of Yellow Cards shown by the Referee during the 90 minutes of play.

(iii) F3 = Number of Red Cards shown by the Referee during 90 minutes of play.

(iv) O = Number of Offsides committed during the 90 minutes of play

(v) H = Number of Handballs during the 90 minutes of play.

(vi) BPK = Number of Bad Penalty Kicks during CPS play. (by a 'bad penalty kick' of CPS we mean that the kicked ball goes outside the goalpost without touching the goalkeeper or barpost).

(vii) R = Number of Replacement of players made by the Coach (who are not injured) during 90 minutes of play.

Positive parameters:

(i) G = Number of Goals scored (during CPS only).

(ii) BPC = Percentage of Ball Possession at the complete ground during the 90 minutes of play.

(iii) BPH = Percentage of Ball possession at the half-ground of the opponent during 90 minutes of play.

(iv) SCB = Number of Shots which Collide at Barpost without scoring Goal during 90 minutes of play.

(v) CK = Number of Corner-kicks (CK) during 90 minutes play.

(vi) T = Number of Throws during 90 minutes of play.

(vii) 2G = Consecutive two goals scored (without any goal scored by the opponent in-between) during 90 minutes of play.

(viii) 3G = Consecutive three goals scored (without any goal scored by the opponent in-between) during 90 minutes of play.

(ix) nG = Consecutive four or more goals (n>3) scored (without any goal scored by the opponent in-between) during 90 minutes of play.

3.3. Categories of Fouls

Fouls in a football match are divided into three categories in our theory of CESFM :

(i) Category F1 : Simple Foul (not shown any card)

(ii) Category F2 : Shown Yellow Card Foul

(iii) Category F3 : Shown Red Card Foul

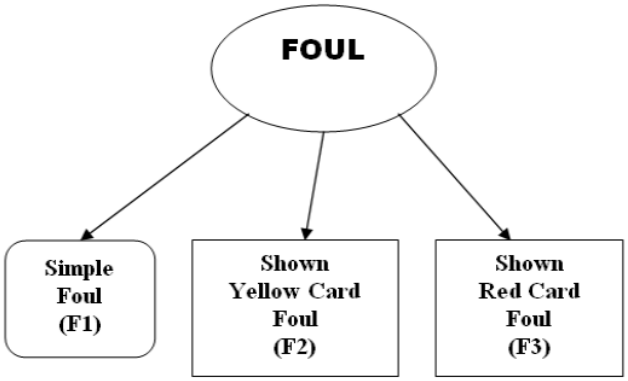

Figure 2. Three categories of Fouls in a football match

The simple fouls may have various amount of foul-gravity. Similarly the yellow-card fouls may have various foul-gravity, and also red-card fouls may have various amount of foul-gravity.

The foul gravity can be estimated by the Referee by his best possible intellectual judgment on the basis of finite number of significant criteria. For instance, FIFA could choose the following criteria to estimate the gravity of any foul (F1 or F2 or F3) :-

(i) 'bad intention mainly for making tactful physical collision',
(ii) 'unfair way of ball possession',
(iii) 'inappropriate body language',
(iv) 'argument with the opponent player(s)', and
(v) 'argument with the Referee'.

3.4. CS Value of a Foul (F1 or F2 or F3)

Fouls are negative parameters in the Theory of CESFM as mentioned in subsection-3.2. The CS value of a foul (F1 or F2 or F3) is a crisp value. But the referee awards a fuzzy value to it by his best possible intellectual judgment depending upon the gravity of the foul. This fuzzy value is then de-fuzzified by one of the three algorithms : Algo-1, Algo-2, Algo-3, to get the CS value of a foul.

For a foul (which could be F1 or F2 or F3), the universal set is the crisp set F given by $F = \{f_1, f_2, f_3, f_4, f_5\}$, where

f_1 = 'bad intention mainly for tactful physical collision',
f_2 = 'unfair way of ball possession',
f_3 = 'inappropriate body language',
f_4 = 'argument with the opponent player(s)', and
f_5 = 'argument with the Referee'.

Note: ***The elements f_i of the universal set F may be modified, number of elements may be increased/decreased and fixed by the FIFA experts. For the sake of hypothetical presentation here, we consider the five membered universal set for the Fouls***.

For every foul (F1 or F2 or F3) committed by a team, the Referee takes a fuzzy action against the team by awarding a fuzzy set A (of the universal set F) to the team. The fuzzy set A will be awarded to the team prior to the foul-kick to be kicked by the opponent team at the cost of hardly ten to twelve seconds.

3.4.1. Fuzzy Pocket Machine M for the Referee

There is a handy small fuzzy pocket machine M for the Referee using which the referee awards a fuzzy set A of F within a maximum of ten seconds. Once the Referee awards the fuzzy set, the data will be stored immediately in the concerned database in the FIFA-Server where there is a software called by "CESFM Software" which will be executed if and only if the situation after 90 minutes is a draw case, otherwise not.

The machine M will have three buttons in the name of F1, F2 and F3 respectively, twelve buttons in the name of : . (dot), 0, .1, .2, .3, .4, .5, .6, .7, .8, .9, and 1 respectively, and two more buttons in the name of 'ENTER' and 'EDIT'. In total there are 17 buttons in the fuzzy pocket machine M (as shown in Figure 3).

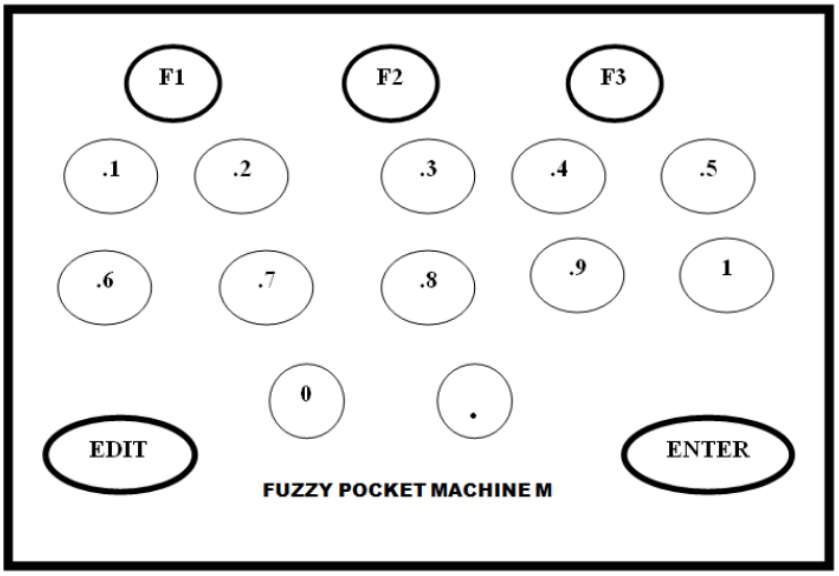

Figure 3. A Fuzzy Pocket Machine M for the Referee

For a committed Foul during play, depending upon the gravity of Foul, the Referee follows the following steps to award a fuzzy set A to the concerned team:

Step-1 : Referee press one of the buttons F1 or F2 or F3, and then the button 'ENTER'. (This signifies which of the three categories of fouls is awarded by the Referee).

Step-2 : Referee inputs one membership value from the closed interval [0,1] using one or more buttons : **.** (dot), 0, .1, .2, .3, .4, .5, .6, .7, .8, .9, and 1,

and then the button 'ENTER'. (This is the membership value of the element f_1 for the fuzzy set A by best possible intellectual judgment of the Referee).

Step-3 : Referee inputs one membership value from the closed interval [0,1] using one or more buttons : . (dot), 0, .1, .2, .3, .4, .5, .6, .7, .8, .9, and 1, and then the button 'ENTER'. (This is the membership value of the element f_2 for the fuzzy set A by best possible intellectual judgment of the Referee).

Step-4 : Referee inputs one membership value from the closed interval [0,1] using one or more buttons : . (dot), 0, .1, .2, .3, .4, .5, .6, .7, .8, .9, and 1, and then the button 'ENTER'. (This is the membership value of the element f_3 for the fuzzy set A by best possible intellectual judgment of the Referee).

Step-5 : Referee inputs one membership value from the closed interval [0,1] using one or more buttons : . (dot), 0, .1, .2, .3, .4, .5, .6, .7, .8, .9, and 1, and then the button 'ENTER'. (This is the membership value of the element f_4 for the fuzzy set A by best possible intellectual judgment of the Referee).

Step-6 : Referee inputs one membership value from the closed interval [0,1] using one or more buttons : . (dot), 0, .1, .2, .3, .4, .5, .6, .7, .8, .9, and 1, and then the button 'ENTER'. (This is the membership value of the element f_5 for the fuzzy set A by best possible intellectual judgment of the Referee).

Referee can use the EDIT button to change his membership value. But after editing, he has to enter the modified data using ENTER button in order to save the modification in the memory of the FIFA-server. Using the fuzzy pocket machine M, the inputs of the Referee are transmitted to the server directly from the playground at real time.

3.4.2. Three Algorithms Algo-1, Algo-2 and Algo-3 for De-fuzzification

Corresponding to three categories of fouls, there are three cases which are explained below.

Case-1 : If the Foul is a Simple Foul

Consider a foul of category F1. The CS value of a foul F1 denoted by CS(F1) will be always one of the numbers 2, 3 and 4. Let A be the fuzzy set awarded by the Referee corresponding to this foul committed by a team. Then the following algorithm called by Algo-1 will be applicable on the basis of α-cut of the fuzzy set A.

Algo-1

If the .5-cut of A (i.e. the set $A_{.5}$) is a null set
then CS(F1) = 2, Stop. ***else***
If the .8-cut of A (i.e. the set $A_{.8}$) is a null set
then CS(F1) = 3, Stop. ***else***
CS(F1) = 4.

Case-2 : If the Foul is a Yellow Card Foul

Consider a foul of the category F2. The CS value of a foul F2 denoted by CS(F2) will be always one of the numbers 4, 5 and 6. Let A be the fuzzy set awarded by the Referee corresponding to this foul committed by a team. Then the following algorithm called by Algo-2 will be applicable on the basis of α-cut of the fuzzy set A.

Algo-2

If the .5-cut of A (i.e. the set $A_{.5}$) is a null set
then CS(F2) = 4, Stop. ***else***
If the .8-cut of A (i.e. the set $A_{.8}$) is a null set
then CS(F2) = 5, Stop. ***else***
CS(F2) = 6.

Case-3 : If the Foul is a Red Card Foul

Consider a foul of the category F3. The CS value of a foul F3 denoted by CS(F3) will be always one of the numbers 6, 7 and 8. Let A be the fuzzy set awarded by the Referee corresponding to this foul committed by a team. Then the following algorithm called by Algo-3 will be applicable on the basis of α-cut of the fuzzy set A.

Algo-3

If the .5-cut of A (i.e. the set $A_{.5}$) is a null set
then CS(F3) = 6, Stop. ***else***
If the .8-cut of A (i.e. the set $A_{.8}$) is a null set
then CS(F3) = 7, Stop. ***else***
CS(F3) = 8.

3.5. CS values of other Parameters of CESFM

Out of sixteen parameters in the theory of CESFM, there are seven number of negative parameters and nine number of positive parameters. The CS values of three negative parameters are discussed in the preceding subsection. In this subsection we discuss the CS values of other parameters.

3.5.1. CS Value of Negative Parameters

It is discussed in the preceding subsection that for a Simple Foul F1, the CS(F1)∈{2,3,4}. For a Yellow Card Foul F2, the CS(F2)∈{4,5,6}. For a Red Card Foul F3, the CS(F3)∈{6,7,8}.

For the other negative parameters, we propose the following CS values in the theory of CESFM.

(i) For each Offside, CS(O) = 1;
(ii) For each handball, CS(H) = 1;
(iii) For every Bad Penalty Kick, CS(BPK) = 1;
(iv) For Replacement of players (who are not injured during play), the CF value is given by the following norm :

$$CF(R) = \begin{cases} 1, & \text{if 1 or 2 players are Replaced during 90 minutes} \\ 2, & \text{if 3 or more players Replaced during 90 minutes.} \end{cases}$$

3.5.2. CS Value of Positive Parameters

For the positive parameters, we propose the following CS values in the theory of CESFM.

(i) For each Goal G scored during **CPS**, CS value CS(G) = 10.

(It is mentioned in subsection 3.2.1 that CPS is mandatory in CESFM method. The goals of the first 90 minutes of play are not to be considered in CESFM. They are ignored as the situation is a draw/tied case after 90 minutes of play).

(ii) If the Ball Possession of a team across the complete ground the during 90 minutes of play is = x%, then CS(BPC) = x/20.

(iii) If the Ball Possession of a team across the half-ground of the opponent during 90 minutes of play is = y%, then CS(BPH) = y/10.

(iv) For each Shot which Collides at Barpost without scoring Goal during 90 minutes of play, the CS value is CS(SCB) = 5. For each Shot which Collides at Barpost without scoring Goal during CPS play, the CS value is CS(SCB) = 1.

(However, if a Shot Collides at Barpost with a Goal during 90 minutes of play or during CPS, then there is no CS(SCB) value for this shot).

(v) For each corner kick during 90 minutes of play the CF value is given as below :-

CF(CK) = 1, if the corner-kick is a "Bad Corner Kick" (BCK) i.e. the ball of that corner-kick goes directly outside the play-ground without touching any player or inside-ground or barpost. Otherwise, for all other cases CF(CK) = 2. It is to be noted that in case the corner kick hits the barpost, the CS(SCB) value will also be considered as usual.

(vi) If a team gets a Throw, then for each such throw the CF value is given by CF(Throw) = 1

(vii) If a team scores two consecutive goals (without any goal scored by the opponent in-between) during 90 minutes of play, then for each such case the CF value is given by CF(2G) = 1.

This rule is not applicable during CPS play.

(viii) If a team scores three consecutive goals (without any goal scored by the opponent in-between) during 90 minutes of play, then for each such case the CF value is given by CF(3G) = 5 (in such case the CF value of 2G will not be considered).

This rule is not applicable during CPS play.

(viii) If a team scores n (n>3) consecutive goals (without any goal scored by the opponent in-between) during 90 minutes of play, then for each such case the CF value is given by CF(3G) = 10 (in such case the CF value of 2G or 3G will not be considered).

This rule is not applicable during CPS play.

3.6. CS Score of a Team

In a football match, suppose that two teams X and Y arrives at a Draw/Tied case after 90 minutes of play. Therefore this is a situation where the fuzzy method CESFM is applicable. To compute the CS Score of a Team X, the CESFM-software computes the following first of all :

(i) Total amount of CS values of all the negative parameters for the team X which is denoted by NCS(X).

(ii) Total amount of CS values of all the positive parameters for the team X which is denoted by PCS(X).

CS Score of the team X is then computed using the formula:

$$CS(X) = 1000 + PCS(X) - NCS(X).$$

Note: *In the above formula for CS(X), there is no significance of the amount 1000. It is added just to ensure that the value of CS(X) does not become a negative real number under any circumstances, for no other purpose. It is obvious that even if we do not added 1000 here, the final result of CESFM-software will not be changed.*

3.7. Who is the Winner by CESFM Method?

Suppose that after 90 minutes of play, situation is 'draw' case between the two teams X and Y. Then the CESFM-software will be executed in the FIFA-Server to compute the CS score of both the teams X and Y.

If CS(X) > CS(Y) then X is the Winner. Otherwise, if CS(X) < CS(Y) then Y is the Winner.

A very rare case is if CS(A) = CS(B). In that case the CPS (as introduced in subsection-3.2.1) will be repeated once more to run the CESFM-software. If the result yet comes 'draw' then CPS will be repeated once again and so on, untill the CESFM-software computes the Winner.

4. A Hypothetical Example

We explain here, with hypothetical data, an application of this fuzzy CESFM method in a football match between two teams X and Y which has become draw (2-2) after 90 minutes of play. Suppose that after CPS play, the following is the statistics for the two teams as recorded in the FIFA-server corresponding to the 16 parameters of CESFM, shown in Table 1:

Table 1. The statistics of 16 parameters for team X and Y

Serial No.	Parameters	Frequency (X) : Number of Occurrences for Team X	Frequency (Y) : Number of Occurrences for Team Y
1	F1	3	1
2	F2	2	1
3	F3	0	0
4	O	3	4
5	H	3	2
6	BPK	1	0
7	R	3	1
8	**G (CPS only)**	**4**	**3**
9	BPC	40%	60%
10	BPH	26%	50%
11	SCB	0	0
12	CK	3 (with one BCK)	5
13	T	6	9
14	2G	0	0
15	3G	0	0
16	nG(n>3)	0	0

Fouls committed by team X

In total there are five fouls committed by the team X, out of which there are three F1 fouls, two F2 fouls and nil number of F3 fouls.

The fuzzy sets corresponding to the three F1 fouls committed by the team X are given by the Referee via his fuzzy pocket machine M which are as below :

X(i) : the fuzzy set {(f_1, .85), (f_2, .8), (f_3, .95), (f_4, .85), (f_5, .9)}, and

X(ii) : the fuzzy set {(f_1, .95), (f_2, .85), (f_3, .9), (f_4, .95), (f_5, 1)}, and

X(iii) : the fuzzy set {(f_1, .85), (f_2, .6), (f_3, .95), (f_4, .85), (f_5, .8)}.

The fuzzy sets corresponding to the two F2 fouls committed by the team X are given by the Referee via his fuzzy pocket machine M which are as below :

X(iv) : the fuzzy set {(f_1, .95), (f_2, .9), (f_3, .95), (f_4, 1), (f_5, .95)}, and

X(v) : the fuzzy set {(f_1, .85), (f_2, .8), (f_3, .95), (f_4, .9), (f_5, 1)}.

While CESM-software executes its Algo-1 and Algo-2, it will get the following de-fuzzified CS values for the team X (see subsection 3.4):

$$CS(X(i)) = 4,\ CS(X(ii)) = 4, CS(X(iii)) = 4,$$

$$CS(X(iv)) = 6,\ CS(X(v)) = 6.$$

Fouls committed by team Y

In total there are two fouls committed by the team Y, out of which there is one F1 foul, one F2 foul and nil number of F3 fouls.

The fuzzy set corresponding to the one F1 fouls committed by the team Y is given by the Referee via his fuzzy pocket machine M which is as below :

Y(i) : the fuzzy set {(f_1, .2), (f_2, .1), (f_3, .15), (f_4, 0), (f_5,0)}.

The fuzzy set corresponding to the one F2 foul committed by the team Y is given by the Referee via his fuzzy pocket machine M which is as below :

Y(ii) :the fuzzy set {(f_1, .15), (f_2, .2), (f_3, .1), (f_4, 0), (f5,0)}.

While CESM-software executes its Algo-1 and Algo-2, it will get the following de-fuzzified CS values for the team Y (see subsection 3.4):

$$CS(Y(i)) = 2 \text{ and } CS(Y(ii)) = 2.$$

The CESFM-software will thus compute all the CS values (see subsection 3.4 and 3.5) which are shown in the Table 2.

Table 2. The CS values of 16 parameters for team X and Y

Serial No.	Parameters	Frequency (X)	CS Value (for X)	Frequency (Y)	CS Value (for Y)
1	F1	3	12	1	2
2	F2	2	12	1	4
3	F3	0	0	0	0
4	O	3	3	4	4
5	H	3	3	1	1
6	BPK	1	1	0	0
7	R	3	2	1	1
8	**G (CPS only)**	**4**	**40**	**3**	**30**
9	BPC	40%	2	60%	3
10	BPH	26%	2.6	50%	5
11	SCB	0	0	0	0
12	CK	3	5	5	10
13	T	6	6	9	9
14	2G	0	0	0	0
15	3G	0	0	0	0
16	nG (n>3)	0	0	0	0

The CESM-software then computes the following :

$$NCS(X) = 12+12+0+3+3+1+2 = 33$$

$$\text{and } PCS(X) = 40+2+2.6+0+5+6+0+0 = 55.6.$$

$$NCS(Y) = 2+4+0+4+1+0+1 = 12$$

$$\text{and } PCS(Y) = 30+3+5+0+10+9+0+0 = 57.$$

Then, CS(X) = 1000 + PCS(X) – NCS(X) = 1022.6 and
CS(Y) = 1000 + PCS(Y) – NCS(Y) = 1045.

Final output of the CESM-software :

Since CS(Y) > CS(X), CESM outputs that Y is the Winner, X is the looser.

Declaration : The team Y is the Winner in today"s football match.

Comment:

In the above example, see that if the fuzzy CESFM method is not applied to this football match between two good teams X and Y then by the existing FIFA norms of Penalty-shootout method FIFA will declare the team X as the Winner(4-3) and the team Y as the looser. But any football-fan or expert will get psychologically shocked with this declaration witnessing the 90 minutes continuous play of both the team and also feeling about the real statistical data, visualized data.

It is not any fault of FIFA nor of any of the teams X and Y, nor of the Referee, nor of any football fans, nor of the venue, nor of the host country, nor of the weather-climate or any other reasons. Surely it is due to an obsolete method followed by FIFA on one of the most important issues of football game : "How to select the Winner if the result comes draw after 90 minutes of play?". It is due to non-availability of any new innovative modern mathematical (and philosophical) technique which can provide solution retaining the justice to the football, retaining the interest of the game, retaining the interest of the football fans and experts, retaining the interest of the football world as a whole. The author here claims that the

soft computing method CESFM is a much improved method for this problem of football subject.

5. Conclusion

In this research work we propose a new theory called by Theory of CESFM to FIFA and Football-experts of the world with a claim that if FIFA incorporates this fuzzy method in the World Cup Football, there will be a huge improvement in the justice to the game 'football' if considered as a subject. The proposed method is a continuous evaluation method to compute the WINNER using a software known as CESFM-software to be executed at the FIFA server. The fuzzy pocket machine is a simple wireless machine M by which the inputs of the Referee transmitted to the server directly from the playground at real time. The hardware of this machine M can be manufactured by a good company dealing with electronics and communication engineering. The code of CESFM-software can be easily developed by a programmer. CESFM does not exclude the penalty-shootout results. Rather a modified and improved version of penalty-shootout is introduced called by CPS which is also a mandatory components in the CESFM method. The CPS is a much improved version in the sense of football-interest both meritoriously and philosophically than the existing penalty shootout method of FIFA presently being followed in World Cup Football matches. The proposed method CESFM can do huge justice to the football, can provide huge satisfaction to the football world, for the cases of football matches which have a draw situation after 90 minutes of play. A hypothetical example is presented to explain how the CESFM computes better results than the results applying the existing 'Penalty Shootout only' norms of FIFA. The CESFM is not to be applicable for a decided match in 90 minutes of play.

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