HANDSCOUT: A NEW SYSTEM TO RECORD FOOTBALL DATA

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ABSTRACT

Background: Since the early 1900s, researchers have been making a great effort to seek more objective ways to analyze sport, especially football matches. **Objectives:** We aimed to describe *HandScout* software development, a quantitative tool projected to record football data based on predefined guidelines. **Methods and Results:** The *HandScout* is designed according to the dynamical self-organizing system and is composed of 99 individual actions, divided into nine categories: Action map, goal map, offensive organization, offensive transition, defensive organization, defensive transition, set-pieces, passes, and goals against and scored goals. This new information-gathering instrument can assist in the assessment of a wide range of characteristics considering the great complexity of the game and thus provide data about the behavior of players on the pitch. **Conclusion:** The *HandScout* is a user-friendly system that provides extensive data information of the team or the opponent. Thus, the *HandScout* software can provide information to coaches to adapt their weekly training sessions and provide relevant information about the football dynamics.

Keywords: Sport; Assessing tool; Performance.

HANDSCOUT: UM NOVO SISTEMA PARA REGISTAR DADOS DO FUTEBOL

RESUMO

Enquadramento: Desde o início dos anos 1900, os pesquisadores têm feito um grande esforço para buscar formas mais objetivas de analisar o desporto, especialmente jogos de futebol. **Objetivos:** Descrever o desenvolvimento do software *HandScout*, uma ferramenta quantitativa projetada para registar dados do futebol com base em ações predefinidas. **Métodos e Resultados:** O *HandScout* foi desenhado de acordo com o sistema de auto-organização dinâmica e é composto por 99 ações individuais, divididas em nove categorias: Mapa de ação, mapa de golos, organização ofensiva, transição ofensiva, organização defensiva, transição defensiva, bolas paradas, passes, e golos contra e golos marcados. Este novo instrumento de recolha de informações auxilia na avaliação de uma ampla gama de características levando em consideração a grande complexidade do jogo e, assim, fornecer dados acerca do comportamento dos jogadores em campo. **Conclusão:** O *HandScout* é um sistema de acessível e detalhado que fornece extensas informações de dados da própria equipa ou da equipa

adversária. Assim, o software *HandScout* fornece informações aos treinadores para adaptarem seus treinos semanais e fornecer informações relevantes acerca da dinâmica do futebol.

Palavras-chave: *Desporto; Ferramenta de avaliação; Desempenho.*

1 INTRODUCTION

Traditionally, information has been collected using rudimentary methods, such as pen and paper (even notepads and simple *Excel*® sheets), limiting the data collection and their interpretation (Barreira et al., 2013; Reep & Benjamin, 1968). These characteristics generate problems to analyze football matches events. In fact, in the last few years, football analysis has been identified as an important tool to improve a wide range of game situations, leading to successful individual and team performances (Carling et al., 2008; Flôres et al., 2019). Many investigations have been developed in recent years, which seek to verify, analyze and compare many variables inherent to the game (Clemente et al., 2020; Clemente & Sarmento, 2020; Sarmentoa et al., 2015).

In the last few decades, also a considerable effort has been devoted to establishing objective forms to analyze football matches (Barreira et al., 2013; Costa et al., 2009a; Reilly & Williams, 2003), especially using notational analysis systems (Barreira et al., 2013; Bekraoui et al., 2010; Hughes & Bartlett, 2002; Mendo et al., 2000). These notational systems' have been simplifying the data processing, by using real-time and post-game analysis, enabling scouts and sports scientists to present the information in numerical and graphical forms, made easy for players to understand (Flôres et al., 2016; Reilly & Williams, 2003).

Although there are instruments capable of collecting the information in football games, the literature has failed to provide a system designed according to the dynamical and self-organizing system of the sport (Davids et al., 2005; McGarry et al., 2002). Record data according to the game model and tactical principles (Costa et al., 2009a, 2011a; Silva et al., 2019) can be important to assess the patterns of play in football. Hughes, Dawkins, David, & Mills (1998) evaluated the presence of perturbative events (events that destabilize the dynamical system during football matches). To the authors, the perturbations such as a penetrating pass or a dribble have the power to create disruptions in the defense, allowing the attacking team a shooting opportunity, for example. Thus, recording and assessing tools should consider these events and need to be able to record what aspects led these events to affect performance. Thus, mapping players' actions concerning their pitch position, and offensive-defensive movements and transitions are extremely important to improve players and team performance. This manuscript aims to describe the development of the *HandScout* software, a quantitative instrument designed to record different football data based on predefined guidelines.

2 METHODS

2.1 *HandScout* initial development

This tool was initially developed after an extensive review of the literature (Costa et al., 2009b, 2011b, 2011a; González-Víllora et al., 2015; Mcgarry & Mcgarry, 2017; Morgans et al., 2014). The *HandScout* was created to be a system to record football data, regarding football game principles (Costa et al., 2011b, 2011a), to provide further information to coaches and players during and after the matches.

After the review of the literature, the first version of the *HandScout* was composed of eight categories and a notepad. The categories were described as follows: (1) Action Map (composed by 12 pitch positions), (2) Goal Map (composed by 9 goal positions), (3) Offensive Organization (composed by 12 actions), (4) Offensive Transition (composed by 8 actions), (5) Defensive Organization (composed by 6 actions), (6) Defensive Transition (composed by 5 actions), (7) Set Pieces (composed by 7 actions), and (8) Passes (composed by 24 actions, 12 for correct passes and 12 for wrong passes). Each action could be recorded according to their occurrence time, providing reliable information regarding all matches. After data collection, an *Excel*® sheet (.xlsx) was created.

The *HandScout* first version was tested by five sports experts (two Brazilian professional football coaches, one Brazilian professional football assistant coach, and one Ph.D. University professor) for content validity and critical review to assess the main components and items. The experts were instructed to express agreement or disagreement with each action and category description and to evaluate it according to football game principles. The experts could also recommend the inclusion or exclusion of actions or categories if necessary. After the sports experts' contributions, 16 actions (i.e., advanced goalkeeper, tackle with ball possession, penalties, etc.) and one category (i.e., score and against goals) were added.

To assess the *HandScout* validity, 10 undergraduate students of Physical Education and Sports collected data of 20 football matches. After data collection, they were asked to point out difficulties and making suggestions for improvements. The instrument was developed in Portuguese, using Brazilian terms and nomenclature.

2.2 *HandScout* Final Version

The *HandScout* final version was written in Microsoft Visual Studio® 2015, using C# programming language. The latest version consists of individual actions, which are part of nine categories: (1) Action Map (composed by 12 pitch positions), (2) Goal Map (composed by 9 goal positions), (3) Offensive Organization (composed of 14 actions), (4) Offensive Transition (composed of 10 actions), (5) Defensive Organization (composed of 9 actions), (6) Defensive Transition (composed of 9 actions), (7) Set Pieces (composed of 10 actions), (8) Passes (composed of 24 actions, 12 for correct passes and 12 for wrong passes), and (9) Goals Against and Scored Goals (composed of 2 actions). In table 1, it is possible to check the final version of the *Handscout* categories, after going through the experts' filter as mentioned above. To further information regarding the *Handscout* design see Figure 1 and Figure 2.

**Table 1** – *Description of the individual actions and HandScout categories.*

Offensive Organization	Defensive Organization	Set Pieces
Assists	Tackle with ball possession	Corner in the first goalpost
Player combinations	Tackle without ball possession	Corner in the second goalpost
Correct Crosses	Aerial duels won	Corner in the small box
Wrong Crosses	Aerial duels lost	Short corner
Correct Dribble (1v1)	Fouls	Free kick to goal
Wrong Dribble (1v1)	Shots against	Short free-kick
Heading on goal	Blocked shots	Free-kick into the box
Heading of goal	Interception with ball possession	Throw-in into the box
Shot on goal	Interception without ball possession	Correct penalty kick
Shot of goal		Wrong penalty kick
Goal scored		
Pass to an open space		
Second assist		
Advanced goalkeeper		

Offensive Transition	Defensive Transition	Goals Against and Scored Goals
Correct Crosses	Tackle with ball possession	Goal against
Wrong Crosses	Tackle without ball possession	Goalkeeper defense
Correct Dribble (1v1)	Aerial duels won	
Wrong Dribble (1v1)	Aerial duels lost	
Shot on goal	Fouls	
Shot of goal	Shots against	
Goal scored	Blocked shots	
Passing to a different position	Interception with ball possession	
Passing into the same position	Interception without ball possession	
Pass to an open space		

Action and Passing Map				Goal Map		
Position 1	**Position 4**	**Position 7**	**Position 10**	**Position 1**	**Position 2**	**Position 3**
Left defense	Pre-defensive left	Pre-offensive left	Left wing	Upper-left side	Upper-middle side	Upper-right side
Position 2	**Position 5**	**Position 8**	**Position 11**	**Position 4**	**Position 5**	**Position 6**
Middle defense	Pre-defensive middle	Pre-offensive middle	Middle attack	Left side	Middle side	Right side
Position 3	**Position 6**	**Position 9**	**Position 12**	**Position 7**	**Position 8**	**Position 9**
Right defense	Pre-defensive right	Pre-offensive right	Right-wing	Bottom-left side	Bottom-middle side	Bottom-right side

Figure 1 shows the *HandScout* system's final version, in the Brazilian Portuguese edition. Additionally, to main functions (as presented in English in table 1) the scout can, account for the game time, add the teams' names, and the goals scored to each team.
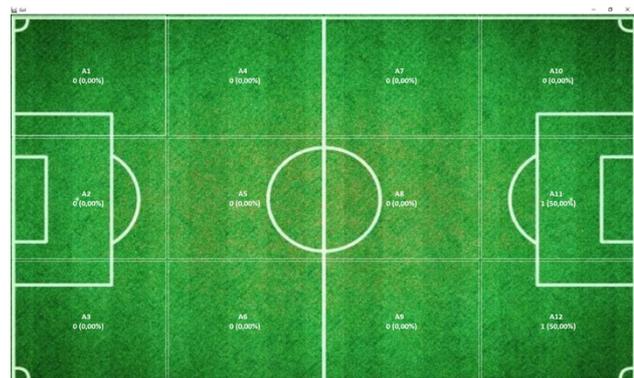
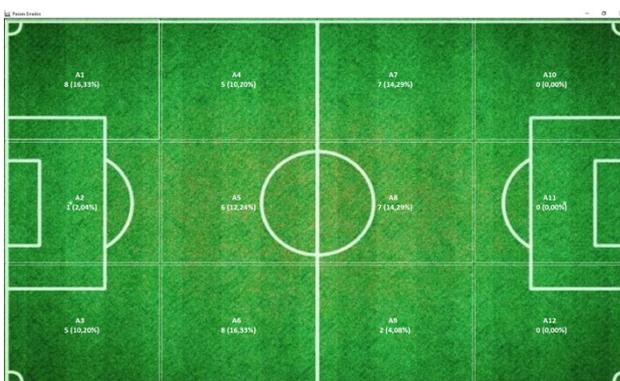***Figure 1** – HandScout software in the Portuguese version*.

Figure 2 shows some of the main outputs that *HandScout* can generate.
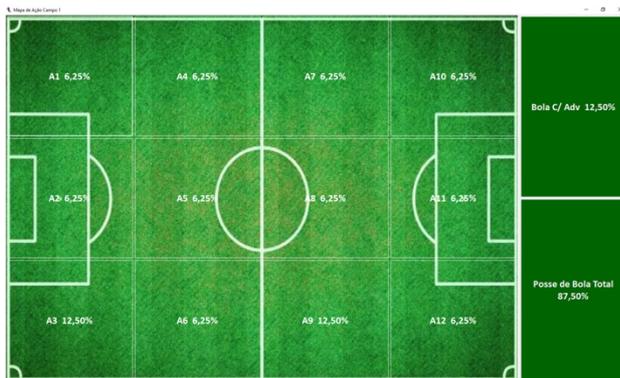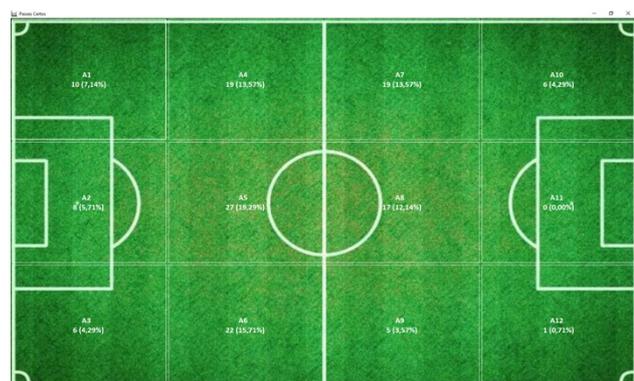

(a) Action Map

(b) Position of goals scored

(c) Wrong Passes

(d) Correct Passes

***Figure 2** – HandScout main outputs*.

2.3 Procedures and data analysis

The notational data were recorded by three blinded and independent scouts. The scouts carried out the observation and evaluation of all *HandScout* variables, using the indirect observation of the matches (Flôres et al., 2019). To collect data, the scout must use the mouse to choose the combination that just occurs in the pitch. After every occurrence, the scout must confirm the data by clicking on the designated button in the bottom-right corner of the system. To record passing, the scout must use the keyboard using the following shortcuts to correct passes (F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12) and to wrong passes (Ctrl + Q, Ctrl + W, Ctrl + E, Ctrl + R, Ctrl + T, Ctrl + Y, Ctrl + U, Ctrl + I, Ctrl + O, Ctrl + P, Ctrl + A, Ctrl + S). After the data collection, the scout must confirm the data by clicking on the designated button in the bottom-right corner of the system.

3. DISCUSSION AND CONCLUSION

The main goal of the present investigation was to describe the development of the *HandScout* software. This instrument is a quantitative assessing tool design to collect football information, thus the items and categories are presented trying to consider the complexity of the game, which can constrain the players' behavior (Araújo et al., 2016; Davids et al., 2013). This tool is a user-friendly system that provides well-designed and hierarchically organized buttons, divided into nine different categories. After a data recording, such as a goal scored, for example, the scout can assess the hard data by looking at the recording table at the bottom of the system, or the excel sheet after ended the data collection. Scouts and coaches can perform the data collection of their team or the opponent. Also, the *HandScout* can be used during the match or game break, providing important information to coaches and players.

Barreira et al. (2013) developed the *SoccerEye* instrument to observe and record football behaviors. Despite all the strengths, this software was not designed to be used during match breaks. Additionally, contrary to the *HandScout*, *SoccerEye* does not provide an action map to assess ball possession and pass accuracy in different pitch positions. A strength presented by *SoccerEye* is that the user can add video and analyze data through hierarchically organized buttons.

Another important point is that the *HandScout* system can record the association of multiple factors. For example, if a goal was scored the scout can identify: the time that the goal was scored, the position of the shooting (among twelve options, see figure 1), they can assess the position of the player that assists the goal (if that's the case), they can assess if the goal were scored during an offensive organization or transition (or during set-pieces) phase, and they also can identify the position where the ball touched the goal net (among nine positions, see figure 1). Thus, understanding and discriminate the association of the variables during a tactical play may help the scouts to improve their reports. Besides, being football an open, dynamic, and complex sport, our instrument can help to search for new ways to seek regularity within a system that consists of multiple degrees of freedom (McGarry et al., 2002).

Despite the strengths of the present investigation, we do not try to validate the *HandScout* system. The present research intends to present the *HandScout* to the scientific community and provide a new assessing tool for football professionals. Future research must give further information regarding the validation of this instrument and provide a real analysis of designated football games. Additionally, compare the results using *HandScout* and other instruments is one of our primary goals.

Finally, after the scout reports, coaches can use all the collected information as a basis to adapt their weekly training and seasonal schedules, seeking to improve performance (Barreira et al., 2013). To sum, the *HandScout* was designed to provide specific observational data on time and sequence interaction, providing relevant information about the football dynamics, and can be used by team staff with a small or limited budget, and to research purposes.

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