

AN ANDROID SOLUTION FOR GATHERING STATISTICAL DATA IN BASKETBALL AND ITS COMPARISON WITH EXISTING SOLUTIONS

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Abstract- Basketball, one of the world's most famous sports, has become more than a game – it has become a business. Player analysis, player transfers and sporting bets rely on statistical data collected in real time during the game. Thus, the precision of this data is crucial. New technologies allow us to reduce human mistakes to a minimum, therefore decreasing errors during the collection process. This paper offers a new Android application solution, with better characteristics than the existing ones in Serbia, as well as their comparisons with the new application. It offers an improved input method, flexibility and better precision. Moreover, it is user-friendly.

Keywords- Statistics, basketball, Android application, real time.

I. INTRODUCTION

Traditionally, basketball coaches used to intervene during games based on their own observations and subjective thinking. Yet, quite a few studies have proven that those observations and their subjective nature can be imprecise and unreliable [1, 2]. Thus, statistical data started being used widely, especially among coaches, so that they can analyze the game more objectively and based on more reliable data [3]. Statistical data represents the quantitative analysis of sports [4, 5]. It represents a means of making evaluations of the progress of players and teams, as well as for the comparison between players and teams [5].

Previously gathered basketball statistical data was used in many science papers [3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16] to distinguish different pertinent parameters and make conclusions from them. These papers contributed to the development of applications for gathering statistical data throughout history. Most of their influence is seen in the variety of statistical reports, as well as the game actions that are observed and gathered for statistical analysis.

Most of the statistical data is gathered by following the game actions defined in the International Basketball Federation's (FIBA's) manual for statisticians [17]. Yet, there are several other parameters and actions that are not included in the manual, but have been presented in many science papers and practice. In Republic of Serbia, three different applications are used for collecting statistical data:

- "Basket SuperVisor" – used in most of the competitions and leagues organized by Basketball Federation of Serbia (KSS), as well as the Basketball Club Association of Serbia (UKLS). These competitions are comprised of most of the male and

female leagues and tournaments, and the younger selections tournaments and leagues. It is also used in regional leagues, such as the ABA league and Women's Regional Basketball League (MŽRKL) [18, 19, 20]

- "FIBA Europe Stats Suite" – used in most of the competitions organized by the FIBA [21]. These competitions include national selection tournaments and qualifiers, as well as the highest ranked female senior basketball competitions, and less ranked male senior basketball competitions

- "K-Stats" – used for the highest ranked male senior basketball competitions, which are the Euroleague and Eurocup [22, 23]. The Euroleague Basketball Club and League Association organize these competitions. The 21st century brought technological advancements, whereby computers became smaller and portable. On the other hand, the mobile industry developed. Nowadays, mobile phones exhibit the hardware characteristics of a computer. That is why their other name is "little computers". Due to the fact that almost everyone has a smart phone today, and they always have it on themselves, it offers a great tool for statistical work. Developing an Android app eliminates the need of taking a computer to a basketball game, enabling the statistical work to be carried out on a mobile device, or a tablet.

Since "Basket SuperVisor" represents the most used application for these purposes in Serbia, the new solution has preserved some of the user interactions. This offers an easy transition for experienced statisticians to the new application solution, and requires minimal learning time.

II. METHODOLOGY

This paper has been scientifically substantiated by a variety of methods. Theoretical research and analyses

were backed by data from local and international scientific and professional literature. Additionally, findings from authors who had explored basketball statistics in their publications were utilized. The inductive-deductive method explained the proven relationships between different applications used for gathering statistical data in Serbia. The analysis and synthesis methods (also applied for comparisons with the existing solutions in Serbia) evaluated complex concepts, judgments and conclusions in their simpler components, with each element being studied separately. A synthesis method was then employed to connect the individual parts into a single part. Merging the collected materials into one derived conclusions. Empirical methods were used to gather original data or attributive characters.

All these methods led to significant conclusions, showing the importance of the newly created application, following the remarkable results obtained in its comparison with the current solutions.

III. RESULTS AND DISCUSSION

3.1. Application solution

3.1.1. Input modes

The Android application for collecting basketball statistics has several modes, depending on the statistician's preference. It offers three different input modes that can alternate at any moment:

- Graphical input – graphical user interface (GUI) navigation with numbers, colors and signs, as shown in Fig.1., that navigate the user through each game action;
- Coded input – graphical user interface with numbers, where all the game actions have their one number codes. The statistician has to be familiarized with these codes before working with the application;
- Voice input – the statistician's voice is recognized and the game actions are directly entered in a hands-free manner.

Graphical input represents the easiest mode for first-time use, and requires the least amount of instruction for the statistician.

In order to properly use coded input, the statistician has to learn the numeric code of each of the game actions. Thus, it requires more preparation before the statistician can use it for the first time. This input mode allows faster enter data entry, because the user does not have to give their full attention to the Android device throughout the game. "Blind typing" gives an opportunity to the statistician to concentrate more on what is happening on the court. Although touch screens are normally blamed for the lack of "button feeling" that old mobile phones used to have, a solution for this problem can be found. Since smart phones have Bluetooth and Wi-Fi connectivity, it is possible to hook them up to a wireless numeric keyboard. This gives the user a better feeling for blind typing, because of the "button feeling", which results in better input precision.

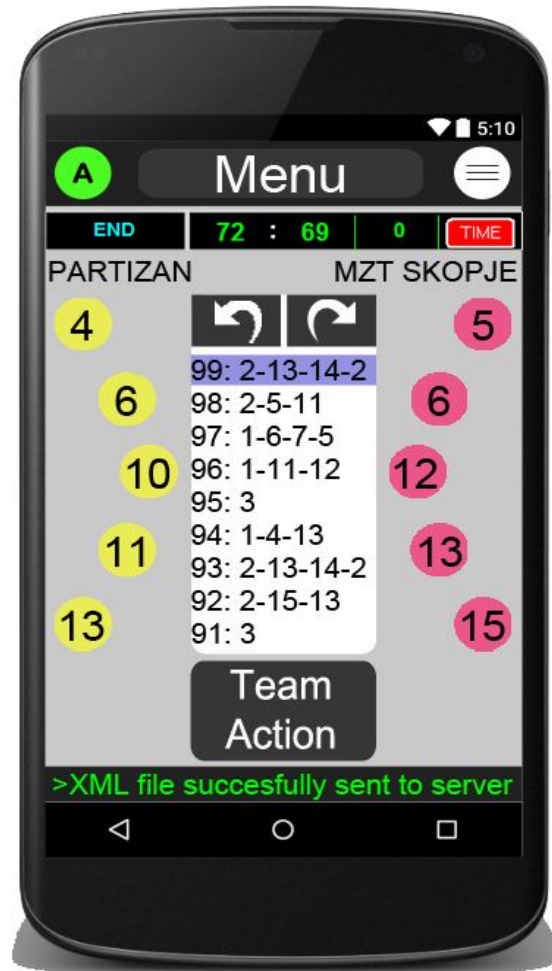


Fig.1. Graphical input mode

Voice input represents the hands-free input, and it has never been utilized before in applications that collect statistical data in basketball. This new input mode allows the statistician to concentrate on the game and use the tool that is easiest and most natural to him – speech. Voice input offers the most flexibility to the user, and it eliminates the need for extra statisticians assisting the main one by telling them what is taking place on the court (i.e. which game action to enter). In order to recognize the voice input, neural network technology was used. Since neural network technology needs a learning phase, it offers the best results if it is learned on each user's voice. This is why there is an option in the application to teach the neural network again with a different voice. This teaching can be stored, such that if there are several different users using the same Android device, it can be adjusted for each of them for better voice recognition. The application also offers recordings of the voice input during the game, and stores them as mp3 files on Android devices. This offers good support for game revision, in case there was a mistake during data collection. The only problem that can occur while operating in this mode is background noise. If the background noise level is too high, the statistician has to wear a mask, inside which a

microphone is placed. The mask, which is a regular medical facemask, isolates the user's sound and reduces the background noise level. Another solution for this problem is to simply change the input mode.

3.1.2. Revision mode

The revision mode represents changing any selected game action from the list of game actions with one of the input modes. This option is configurable, and it offers the statistician the option to personalize the input mode he wants to change, with regard to the game action. This offers more flexibility and better correction. For example, if the user is using voice input, it is advisable to have a coded input in the correction mode, because most of the voice input mistakes come from faulty voice recognition. In this way, the user can make corrections really fast.

It is important for the correction mode to be one click away from the input mode, as this allows for the entered game actions to be easily filtered and modified. If the voice input mode is selected for entering the data, then there is a special voice command that activates the revision mode. Furthermore, there is a special voice command for returning to the input mode. In case the voice input mode is also selected for managing the revision mode, there are more dedicated voice commands for rapid filtering and modification of game actions.

The application also saves each of the changes made in the revision mode in a special log file, in case it is needed for amendment after the game.

3.1.3. Rules-checker algorithm

Another important component of this solution is the rules-checker algorithm. This algorithm is programmed based on the official FIBA rules. Its main purpose is to control the user's input; confirm that the input is logical; and notify the user if the game action entered is unacceptable. For example, only the defensive team's rebound, or the other team's player defensive rebound can follow another player's missed shot for 2 or 3 points [17]. Since it is crucial for the revision mode to be one click away from the input mode, it is also vital for the rules-checker algorithm to be easily enabled or disabled. This common question appears - why is there a need for disabling the rules-checker algorithm? Basketball is a game with its own rules. The referees arbitrate those rules. These referees are prone to human error. In lower leagues, where less experienced referees are adjudicating games, these mistakes are more common. The statistician has to be able to enter these game actions, although they may not follow the rules. Thus, the rules-checker has to be disabled, so that atypical game actions can be entered.

It is important to note that in the revision mode, the rules-checker algorithm is automatically disabled. In case it was enabled in the input mode, before going to the revision mode, the algorithm will be enabled

again on return to input mode. In case it was disabled, it will return to the input mode accordingly.

3.1.4. Printing reports

Modern smart phones have the ability to print any document wirelessly, using Wi-Fi or Bluetooth. It is therefore beneficial to have a modern printer that has a built-in wireless receiver (as most of them do nowadays). If that is not the case, the smart phone has the ability to save the document in pdf file format. That is why the application offers the capacity to predefine email addresses through which, with just one touch, it sends the generated pdf file to the client. Then, the connected computer can receive the pdf and print it on a connected printer. This option is less popular, but it offers more flexibility and works in weak working conditions.

The application offers a variety of different statistical data reports. These reports contain a lot of statistical data and graphs, shown through many aspects of the basketball game, some for each player, and some for the whole team.

Since all the statistical data is stored in a database, it is possible to make new reports in the future and generate them for any game that took place in the past.

3.1.5. Live game statistics

Ordinarily, there is a need for sending collected statistical game data in real time to specific servers. The application solution offers the predefinition of the connection parameters to which, with just one touch, it sends the XML file with all the game details and game actions for the current game. This touch activates the live mode, and it sends the XML file to the desired server automatically. The XML file is constantly being altered and sent so long as it is predefined in the application settings. The default interval is 15 seconds, which means that in every 15 seconds, an altered XML file is being sent to the server. The server then reads the received XML file and shows game details and data on a public website. This option is really vital for basketball competitions and major leagues.

3.2. Comparison with existing solutions

Vasiljević [24] offers a detailed comparison between existing solutions in Serbia. In this section, our Android solution will be compared against previously mentioned ones.

The following comparison will be based on precision, affordability and user-friendliness.

3.2.1. Precision

Basketball is a complex game, with numerous rules. The statistician has to be an expert in this game, understand the rules, and be able to store observed game actions in electronic form. Nowadays, people that bet have the ability to bet on any aspect of any game. That is why it is crucial to gather precise

statistical data. A major factor that ensures better precision than the rest of the solutions is the rules-checker algorithm. Without it, this application would be at a similar precision level as the rest of the applications. It eliminates illogical actions as well as atypical game action sequences. Other applications only disallow the entering the number of a player who is not on the court, but that is all the protection they offer.

Moreover, one of the better contributors of precision is the voice input mode. This mode wasn't used in earlier applications. "K-Stats" and "FIBA Europe Stats Suite" only offer graphical input, while "Basket SuperVisor" offers graphical and coded input. When using graphical input, work has to be carried out by at least two statisticians. One of them has an obligation to watch the game and tell the other statistician what game data to enter into the computer. This can lead to serious precision problems, especially in noisy surroundings, where miscommunication is likely to occur. When using coded input, a professional and experienced statistician, who is an expert at "blind typing", can do the work. If this person is not an expert in some of these fields, precision suffers. The voice input mode only requires one statistician to do the job. This person does not have to be an expert in as many fields. He only needs to have the knowledge of basketball rules, and be able to talk. Thus, for an average statistician, this input mode offers better precision.

The easy revision of entered game actions and their fast modification are crucial for better precision. Since it is only one touch away, it is easily accessible. Special voice commands offer fast filtering and fast modification. Other benefits are that these modifications are saved as additional actions, so they can be removed (returned to a previous state). This is something that existing solutions do not offer, and that can sometimes be critical for precision. It is possible for the statistician to accidentally change the wrong action, or forget the one they just modified. Since these solutions do not offer an undo option, this can be a serious problem. The new solution adds modifications as a special action. These are stored with the rest of the actions, and can be easily deleted, or even modified by other actions. This offers great flexibility and leads to better precision.

3.2.2. Affordability

This aspect can be analyzed through the money that is needed for paying the statistician for their work, and for the working equipment.

As mentioned earlier, this application offers the possibility for one person to do the work. This decreases the cost of gathering the statistical data by reducing the number of statisticians. In addition, it also offers the opportunity to raise the statistician's salary by a certain percentage. Other applications demand at least two statisticians for their use, or, in

the case of "Basket SuperVisor", at least one that is an experienced professional.

Another contribution of the new application is it lowers the need for equipment. Due to the ubiquity of smart phones or tablets, there is no need to buy computers. All the other solutions require a computer, which results in a big financial investment, and an additional cost for their maintenance.

3.2.3. User-friendliness

GUI of the new solution adjusts to the screen resolution and size, and it uses the space optimally. Other applications would normally have fixed window sizes, and would not adjust to different screen resolutions and aspects. Some of them even have GUI bugs, depending on the screen aspect of the computer.

A critical factor for statisticians is the weight of the equipment. By developing an Android application, the equipment weighs less, in comparison to previous solutions.

This solution offers many options and a high level of flexibility to satisfy the statistician's needs. More advantages offered by the application include: more input methods; the ability to enable/disable the rules-checker algorithm; teaching personalized voice recognition to the neural network for every user; connecting to the printer wirelessly; and the capacity to undo or change mistakes that occur during game action revision. All of the aforementioned methods are unique for this solution, and cannot be found in other applications.

CONCLUSIONS

This Android solution represents a synergy of all the advantages from the existing solutions, and has several new additions that offer enhanced and easier use. This solution is more flexible than any existing ones, which makes it better for the future of this game. Its flexibility also offers easy switching to any similar sport, simply by making several GUI changes and defining different rules for the rules-checker algorithm.

Users of the existing solutions in Serbia faced several limitations. Experienced statisticians, who used those solutions professionally in recent years, discovered these weaknesses. This Android application takes into account their experience, and reduces those weaknesses. Moreover, thanks to these incidents, a lot of user-friendly methods were implemented in this application.

It represents a modern solution that uses the advantages of new technologies, such as wireless connectivity and powerful hardware. Removing the need for a computer and offering a voice input mode reduces the cost of collecting statistical data, and it allows for an increase in the statisticians' salary by decreasing the number of people gathering the data.

Finally, precision has been brought to new heights. This is a crucial element in collecting statistical data today, because it puts a lot of money from betting (on any aspect of the game) at stake. This new application deals with this challenge, and increases precision by creating a new input mode and developing a flexible rules-checker algorithm.

In all these aspects, this Android solution has shown better results and greater user experience, and thus represents the future of gathering statistical data.

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