

Development and Analysis of the Boccia Scoring System

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Abstract: The Boccia International Sports Federation has planned all affairs about boccia since 2013. About 120 players attend each international open. It is hard to arrange the time schedule. In this study, we developed a computer competition system and computer scoreboard system. The system developed by Excel VBA (Visual Basic for Applications). The OUR Boccia Competition Program comprises six stages (basic function, schedule manager, score card manager, advance to knockout, tools and scoreboard connection). Therefore The number of even groups and time schedule can be adjusted in the match arrangement in the system. Meanwhile, the schedule would start with the round matches and then knockout ones. It allows flexible and immediate adjustment according the match time and contributes to a more efficient schedule. The system can test the accuracy of the set schedule and completely prevent problems in the arrangement. While the scoreboard can give an immediate display, the main computer can review the scores of all courts. Hence, the boccia scoreboard system, featuring high-level automation and spontaneous input, has significantly improved competitions. In the future, the system can be further developed so that scores will be spontaneously uploaded onto websites and thus more people will be able to see the results of competitions at the same time.

Keywords: boccia, competition system, computer scoreboard system, competition draw, competition schedule, score cards

I. Introduction

Boccia was a match in ancient Greece which requires sharp skills and effective strategies. It is a sport designed for the physical and mental invalids who have great trouble in movement control. The Boccia International Sports Federation has planned all affairs about boccia since 2013. Internationally, over 50 have participated in the sport [4], and each international open is attended by about 120 players. The

events of the competition are as follow: BC1 Single, BC2 Single, BC3 Single, BC4 Single, BC3 Double, BC4 Double and BC1/BC2 Group. Each open consists of about 100 matches, and attention must be paid to the match, time and the number of players in the schedule of the competition [1]. Meanwhile, nearly each boccia contestant would sign up for two events but cannot take part in two consecutive matches, so the schedule of the competition must be well made. Computer is better than human in accuracy, stability and speed [2], so the computer system is used to make competition schedules in all major boccia competitions at home and abroad.

In a boccia competition, all courts are furnished with a computer scoreboard for referees, players and spectators. Traditionally, the referee still needed to write down points on the competition record even after the points were displayed on the computer scoreboard. Since 2015, such a situation has been changed: the scores calculated in the computer are directly uploaded to the main scoring system. This not only saves the time for delivering the competition record but also prevent possible mistakes in the transcription. Moreover, it eliminates the chaos caused by the concurrent submission of several competition records in the competition organization. If the system is installed, there will be no need to repeat scoring or manually calculate ranking in a pool. With the system, the scores input by referees will be automatically uploaded to the main computer after they are displayed on the screen, which will greatly increase the administrative efficiency of the competition.

II. Procedure of the Boccia System

The boccia system can be divided into the OUR Boccia Competition Program and the OUR Boccia Scoreboard, both

of which were developed by Excel VBA (Visual Basic for Applications). The OUR Boccia Competition Program comprises six stages:

Stage I is the stage of basic function, where the diagram of competition in a pool is made according to the players, competition group, and competition list input into the system. After the number of the contestant groups are defined, it is possible to calculate the number of players and matches and make the competition diagram. As shown in Figure 2.

Stage II is the stage of schedule manager. In this stage, all the matches are equipped with the match time and the number of venues; the preset TTset is modified; all the schedules and scoreboards are made. As shown in Figure 6.

Stage III is the stage of score card manager, where scores are input and inquired. As shown in Figure 7.

Stage IV is the stage of advance to knockout, where the scores and rankings in a pool are calculated and the knockout lists are input. As shown in Figure 8.

Stage V is the stage of tools, where all competition lists are made. The contest name and class are alternated or stored.

Stage VI is the stage of scoreboard connection. The scores are automatically input. As shown in Figure 12.

The operating board of the OUR Boccia Competition Program is shown in Figure 1.



Figure 1. OUR Boccia Competition Program

The description of the stages is as follow:

A. Entry of the information about players

First, the players of the same country are gathered. The class of players is defined with (/), and double and group matches are also defined in the same way. If a contestant has a world ranking, the ranking will be recorded in the box. The ranking is taken for a seed arrangement in the pooling. After the software authorization, it is still possible to alternate 2% or Minimum 3 players (family name, given name and position) can be changed after authorization. if it is beyond the scope, the software needs to be reauthorized for the implementation. See Figure 2.

NO	FAMILY NAME	GIVEN NAME	Unit	SPOR	SEX	POSITION
401	player02		XXX		M	Athlete
CATEGORY / CLASS						
INDIVIDUAL			World Ranking			
BC 1	BC 2	BC 3	BC 4	BC 3	BC 4	BC 1/2
		/			4	
		/			8	

Figure 2. Entry of the Information about players

B. Setting of competition events

The competition groups are defined according to the class of players, and the computer codes include B1, B2, B3, B4, P3, P4 and T2. B1 refers to BC1 Single; B2, BC2 Single; B3, BC3 Single; B4, BC4 Single; P3, BC3 Double; P4, BC4 Double; T2, BC1/2 Group. Players can choose either “Y” or “N” to decide if one pool uses one court, and the total entry of all groups is automatically calculated in the primitive pooling selected in the computer. The number of pool groups of all classes will be automatically calculated or appropriately adjusted according to the competition needs. The advance number in a pool, the point qualifier and the KO position can also be automatically calculated in the computer and be adjusted according to the competition. The KO position is the multiple of “2”, and the calculation is as follow: the quantity

of pool is multiplied with the advance number in a pool and then aggregated with the point qualifier. The quantity of the pool match and the KO match will be automatically calculated, as is shown in Figure 3.

Event Name Full	Computer Code	One pool use one court (Y or N)	Total Entry (by computer)	Pool number (by computer)
Individual BC1	B1	N	6	1
Individual BC2	B2	N	17	5
Individual BC3	B3	N	15	5
Individual BC4	B4	N	10	3
Pair BC3	P3	N	5	1
Pair BC4	P4	N	3	1
Team BC1/2	T2	N	2	1

advance number in a pool (by computer)	point qualifier (by computer)	KO position (by computer)	Pool match (by computer)	KO match (by computer)
0	0	0	15	-1
1	3	8	21	8
1	3	8	15	8
1	1	4	12	4
0	0	0	10	-1
0	0	0	3	-1
0	0	0	1	-1

Figure 3. Setting of Event Parameters

C. Primitive pooling

After the events are set, the primitive pooling becomes optional. If the expected event of pooling is selected, the screen will show all the players of the event. The number of players of all groups in the pool can be selected, which can also change the total match of the event. Therefore, adjustment can be made according to the competition. The number to be knocked out must be 4, 8, 16 and 32 respectively, with a suggested knockout rate ranging from 30% to 70%, as is shown in Figure 4.

Get Pooling Data for event Individual BC2

Total Entry	KO entry number	Elimination Ratio (%)
<input type="text" value="17"/>	Maximum <input type="text" value="32"/>	Maximum <input type="text" value="70"/>
	Minimum <input type="text" value="4"/>	Minimum <input type="text" value="30"/>

Pool data for elimination ratio between 30.00% to 70.00%

pool number	pool direct KO	total direct KO	point qualifier	total KO entry	eliminate ratio	minimal pool size	pool match number
3	2	6	2	8	52.94%	5	40
4	2	8	0	8	52.94%	4	28
5	1	5	3	8	52.94%	3	21

Figure 4. Menu of Pooling

D. Making of RR, KO, and TT tables

The lists of all classes are arrayed in a descending manner according to the rank and show the classification of pooling of different levels. According to the seed sequence, the players are grouped in a SNAKE-shaped array in a descending manner. Suppose that there are four groups. In the first round of seed array, it starts from Group A to Group D; in the second round, it starts from Group D to Group A, and so forth. According to

the boccia rules, if three players from the same country are in the same group, they will be regrouped; meanwhile, the lists would turn yellow for a reminder. Hence, it is possible to move the boxes to change the events of pooling before the competition diagram is made, as is shown in Figure 5.

level	BISFed rank	No-country-name
1	1	203~xxx~player1
1	2	203~xxx~player2
1	3	203~xxx~player3
2	4	203~xxx~player4
2	5	203~xxx~player5
2	6	203~xxx~player6
3	7	203~xxx~player7
3	8	203~xxx~player8
3	9	203~xxx~player9
4	10	203~xxx~player10
4	11	203~xxx~player11
4	12	203~xxx~player12
5	new(draw)	203~xxx~player13
5	new(draw)	203~xxx~player14
5	new(draw)	203~xxx~player15
6	new(draw)	203~xxx~player16
6	new(draw)	203~xxx~player17
6	bye	

Pool A	Pool B	Pool C
1 203~xxx~player1	2 203~xxx~player2	3 203~xxx~player3
6 203~xxx~player6	5 203~xxx~player5	4 203~xxx~player4
7 203~xxx~player7	8 203~xxx~player8	9 203~xxx~player9
12 203~xxx~player12	11 203~xxx~player11	10 203~xxx~player10
13 203~xxx~player14	14 203~xxx~player15	15 203~xxx~player16
18 bye	17 203~xxx~player18	16 203~xxx~player17

Figure 5. List of Pooling

E. Adjustment to schedule sheets

After the time schedules of all classes are made, all the matches are combined to form a competition schedule. After the arrangement is made based on the appointed time and the time of competitions of all levels, it is stored as a preset TTset. Then, the preset TTset will be stored in the data book, and the time schedule will generate the competition schedule according to the preset TTset. If there is a new pooling, the competition schedule will be still based on the preset TTset; if the number of matches increases because of the rearrangement, the system will place the extra matches on the bottom of the list and incorporate the matches to be arranged into the competition list according to the schedule, as is shown in Figure 6.

date	time	Court 1	Court 2	Court 3	Court 4	Court 5
4-30	09:30	B3 A-1-1	B3 B-1-1	B3 C-1-1	B3 D-1-1	B3 E-1-1
4-30	10:00	B2 A-1-1	B2 B-1-1	B2 C-1-1	B2 D-1-1	B2 D-1-2
4-30	10:30	B3 A-2-1	B3 B-2-1	B3 C-2-1	B3 D-2-1	B3 E-2-1
4-30	11:00	B2 A-2-1	B2 B-2-1	B2 C-2-1	B2 D-2-1	B2 D-2-2
4-30	11:30	B3 A-3-1	B3 B-3-1	B3 C-3-1	B3 D-3-1	B3 E-3-1
4-30	12:00	B2 A-3-1	B2 B-3-1	B2 C-3-1	B2 D-3-1	B2 D-3-2
4-30	13:00	B3 ko8-1	B3 ko8-2	B3 ko8-3	B3 ko8-4	
4-30	14:00	B2 ko8-1	B2 ko8-2	B2 ko8-3	B2 ko8-4	
4-30	15:00	B3 ko4-1	B3 ko4-2			
4-30	16:00			B2 ko4-1	B2 ko4-2	
4-30	17:00	B3 ko2-1	B3 ko2-2			

Figure 6. Competition Schedule

F. Checking of TT sheet

Focuses in the check on the competition schedule. A contestant should not be in different matches held at the same time. There is not rest time in the interval between two consecutive matches. Players do not have time for rest before the knockout matches. The knockout matches are held before the group matches. There is no time for rest after the pooling matches and before the knockout matches.

G. Score input of the OUR Boccia Competition Program

If a computer is used, then the points of all matches are input into the computer, as is shown in Figure 7. After the points are input, they will be spontaneously displayed in the score calculation lists of all classes (Figure 8), the competition draw of all levels (Figure 9), and the match lists. The score input board automatically aggregate the scores of all games. Any retirement can also be ticked on the board which shows the matches of each class to be held and automatically generates the list of the next match after the advancement.

Figure 7. Score Input of the OUR Boccia Competition Program

Match	Day	Time	Court	B4 Group A	advance:0
1*4	9-28	09:00	1	401~QUEBEC~Dispaltro,Marco	1
2*3	9-28	09:00	2		
1-5	9-28	12:00	5	405~BC~Vietniek,Caroline	2
2-4	9-28	13:00	5		
1-3	9-28	17:00	1	403~BC~Van Strepen,Mark	3
4-5	9-28	17:00	2		
3-4	9-29	10:00	1	402~QUEBEC~Levine,Alison	4
2-5	9-29	10:00	2		
3-5	9-29	12:00	3	404~MIXED PAIR 1~Brown,Charlie	5
1-2	9-29	12:00	4		

1	2	3	4	5	rank
	10:0	14:0	3:2	8:4	1
0:10		1:3	8:1	6:1	3
0:14	3:1		3:6	7:1	2
2:3	1:8	6:3		9:2	4
4:8	1:6	1:7	2:9		5

Figure 8. Work List of Score Calculation of All Classes

Individual BC1 : KO for 4 Teams			
1	Mawji, Hanif 2		
	<1>9-29-12*00-T1	Smith-worthylake	
2	Smith-worthylake		
		<3>9-29-14:00-T1	Halpen, Chris
3	Richardson		1st
	<2>9-29-12*00-T2	Halpen, Chris 3	
4	Halpen, Chris 3		
	<1>loser	Mawji, Hanif 8	
		<4>9-29-14:00-T2	Mawji, Hanif
	<2>loser	Richardson	3rd

Figure 9. Competition Draw

H. Score cards

The system can print the score cards of all matches in set, as is shown in Figure 10. The score card manager can show and print scores.

COUNTRY		OTTAWA	
No.	Name	Sub	
304	Shaw, Kevin		

			COLOR
Score	End	Time	Time out
Tie-Break			
Tie-Break			

Violation

Figure 10. Score Card

I. Filling of points and ranks

Select the filling of the points and ranks of all classes. If there is a need to enter the event of knockout matches, the pooling of knockout matches will be automatically ranked by the computer or set by the system according to pooling done by the chief referee, as is shown in Figure 11.

Second stage KO ✕

Event

BC1
 BC2
 BC3
 BC4
 PAIRS BC3
 PAIRS BC4
 TEAMS

Fill Points and Rank

Exit

Figure 11. Select the Filling of Points and Ranks

J. Score cards

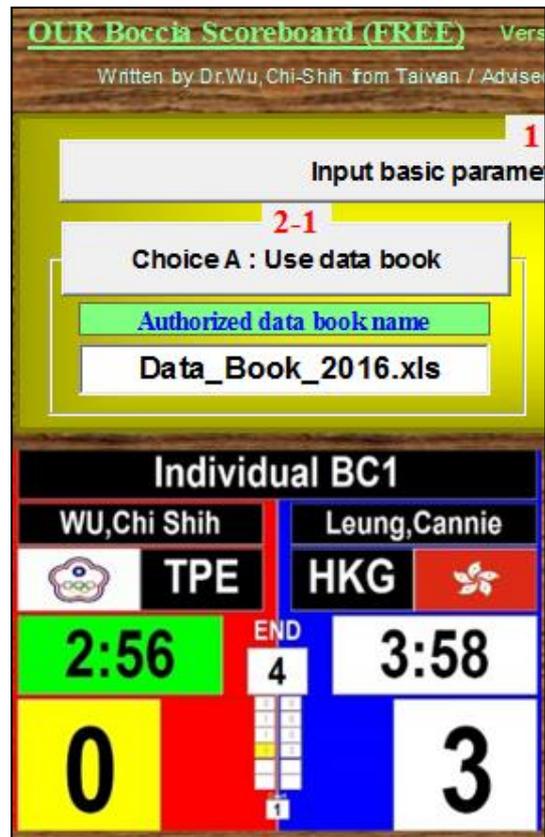
The system can print the score cards of all matches in set, as is shown in Figure 10. The score card manager can show and print scores.

K. Auto input score in the system

After the “auto input score” is selected in OUR_VI_20160225, the OUR Boccia Scoreboard establishes the network-sharing folders through home group. All computers share the same folder for the spontaneous connection of archives. Either the wireless network sharing or the regional connection sharing can be adopted. The time (seconds) for automatic uploading can be set. The uploaded scores are spontaneously displayed in the group lists, KO lists, and match scores in the Data_Book_2016.

L. OUR Boccia Scoreboard

OUR Boccia Scoreboard is designed to show players, scores, time and the number of games on the screen in the competition, as is shown in Figure 12. The setting involves the number of games, the time for each game, the suspension time, and medical (seconds). The Data_Book_2016.xls after the pooling can be adopted, or the data of scoreboard can be automatically input.



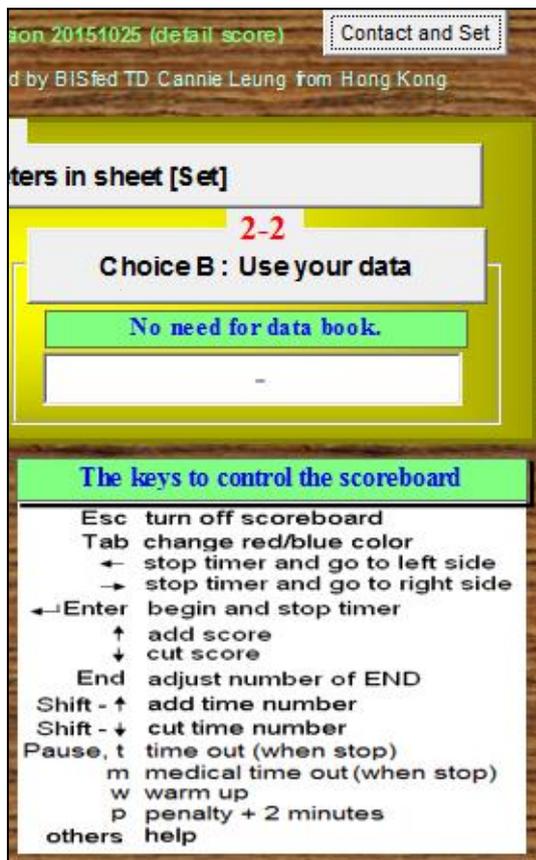


Figure 12. OUR Boccia Scoreboard

M. Competition report tool

The system can generate the Rank-Point Report and the Office Result Book and upload the scores to the official boccia website (<http://www.bisfed.com/>).

III. Discussion on the Application of the Match Arrangement System

A. Discussion on its application in matches

The number of players for each match varies in the boccia competitions of all classes, but the duration and time of the competition are released before the competition; therefore, it is necessary to make an appropriate adjustment in the total matches in the match arrangement. The number of groups and advances in each round can be adjusted in the match arrangement in the system, and the total matches can be immediately displayed after the adjustment; hence, it can make a flexible and immediate adjustment according to the match time and make the match arrangement more efficient.

B. Discussion on its application in match time

After setting the number of groups for the pool, the system can gather the time of all matches on the same list. The chief referee can arrange the match time according to the competition rules, and different colors are used to show matches of different classes, which facilitates the making of a correct match schedule. After the schedule is made, the system would test the appropriateness of the schedule to prevent any problems in match time; therefore, a contestant would not face two matches at the same time. Meanwhile, the schedule would

start with the round matches and then knockout ones. Moreover, the system can check if a contestant has to participate in consecutive matches without rest, so as to ensure the appropriateness of the schedule.

C. Discussion on its application in spontaneous scoring

The spontaneous scoring system can use either the wireless network or the cable network to share the information in the network. With the system, the competition record team does not need to re-input scores after receiving the written score record; instead, the scores can be displayed on the screen after they are input. Moreover, the scores can be spontaneously uploaded to the main computer where the scores of all courts can be obtained. This will greatly increase the efficiency of the competition committee.

IV. Conclusion

A. Application of OUR Boccia Competition Program

To date, the competition system has been applied to various opens and the Boccia World Cup, and its spontaneity proved effective in the test in the 8th ASEN Para Games 2015. The network stability and accessibility vary from one country to another, so it is necessary to make sure that the network is stable in the application of the spontaneity of a wireless network. Also, the cable network can be adopted to achieve spontaneous scoring. In an actual competition, if there is anything wrong with the function of spontaneity, it is possible to adopt the competition record list, without causing any problem to the work of the competition committee. Currently, the boccia competition lists and diagrams have been gradually standardized, and players and coaches have gradually become accustomed to the lists generated by the OUR Boccia Competition Program. If the list and the system need to be modified, the modification can be done only after the referee makes a decision about it, so as to meet the international standard of universal application.

B. Influence of change to the procedure of the boccia competition software

The boccia competition software has been developed for 5 years. Since 2015, the spontaneity of the competition system has been gradually applied by various organization units. In the sharing of folders, the information technicians need to assist the designated home group and ensure the computer network of all courts before the competition. Originally, scoring was done by the competition record team; now, the task is done by the referee because of the application of the automatic and spontaneous score input. For a double check, the competition committee and the chief referee must check the accuracy of scores in the main computer. The automatic and spontaneous scoring has enhanced the efficiency of the competition and reduced the burden on the competition staff. Moreover, scores are reviewed by the staff on site, which can reduce input errors and enhance the level of boccia competitions.

C. Vision on the boccia competition software

Boccia International Sports Federation consists of referees, development, rules, competitions, drug banning, and committees of all levels. Currently, Excel is still adopted for the signing up in the system, and the world ranking is input into the list. It is suggested that the sign-up system can generate the list to facilitate the making of contestant book and combine it with the ranking system to generate ranking, so as to reduce the time for sorting out the information about players and enhance the efficiency of the competition.

With the computer competition system, information will be used in a fast, convenient and correct manner; the input of all match points into the system can fasten the calculation [2][3]; the time prearrangement can contribute to an accurate estimation on match time [1]. To date, the boccia competition has been equipped with computer-based automatic match arrangement and automatic score calculation, and all courts have been furnished with large electronic scoreboards for players, referees and spectators [5]. Since 2015, the automatic and spontaneous score input system has been adopted in major international competitions. This has significantly improved the boccia competitions. In the future, scores are expected to be spontaneously uploaded onto websites for wider inquiry into scores.

Currently there is no officially designated system for Boccia competition. However, the biggest advantage of this system was developed from Microsoft Office Excel. Therefore, most referees can use it. The system also recommended form many technique delegate to guide the development. The competition process or correctness is unquestionable. I hope this system can be more widely used, and the effective promotion of the Boccia competition.

Acknowledgment

We are grateful to the Dr. Wu development System.

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