


Predictive performance analysis of players against training plan

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ABSTRACT

Performance of a player in competitive sports is collective result of skill, physical and mental fitness, diet, training etc. Every human being is different and therefore personalization is required in every aspect. The wide use of computer system in different aspects of training and coaching makes it easy to generate and gather data in digital form. A powerful tool is required for analysis and interpretation of this data. The knowledge extracted from such data could be helpful in decision-making, system learning and automation. The training is requires to be individualized. This individualization helps to achieve maximum performance from each individual player. To ensure personalization it requires individual monitoring and evaluation, which is quite impossible without use of any tool. A system 'Swimming Coach Assistant' developed for predictive performance analysis of a player and assist coaches to extend personalized coaching to the player. The anthropometric measurements as suggested by the Heath-Carter method of Somatotyping of the player are used to describe the present morphological conformation of the player the nearest somatotypes of the players readily available in the system database are identify using distance formula (Somatotype Dispersion Distance). System suggests the best training plan previously identified and recorded by using data clustering approach. Otherwise, coach assign initial training plan based on his knowledge and expertise. The system provides a plot of performance of players in the practice session for the assigned training plan. A time series approach is use for fitting a straight line for the gathered performance data. This result provides a valuable feedback to the coaches to individualize the training activity and can predict the future performance if same training plan continues. **Keywords:** Personalized coaching; Swimming coach assistant; Predictive performance analysis.

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INTRODUCTION

In the era of digital world, the wide use of computer system makes it easy to generate and gather data in digital form. Use of computerized systems in different aspects of sports is generating tons of data every day and dumping in varied media. Amount of data kept in computer files and databases is growing at a phenomenal rate. The data is not only text or numbers but images, video, audio etc. i.e. multimedia data. Databases and data warehouses are the most common data repositories in the sports organizations.

There are many challenges in handling and analysing this data. Some major challenges are:

- Large size data repositories containing multidimensional data in different types and formats.
- Databases are centralized, distributed, web and mobile.
- Multimedia data gathered using varied tools and stored in different formats.
- Changing requirements and expectations of users.
- Retrieval of subset of data or derive inferences from the stored data is very difficult without using tools.
- Enhanced business needs.

To take complete advantage of data; data retrieval is simply not enough. Summarization of data, extraction of the essence of information, generation of useful knowledge are some advanced use of data (Pujari 2001). Due to enormous amount of data in the repositories, it is increasingly important to develop powerful tool for analysis and interpretation of the data. The knowledge extracted from such data could be helpful. In decision-making, system learning and automation (Pei, Han and Kamber 2011) which is the need of time.

Performance of any player in competitive sports is collective result of skill, physical and mental fitness, diet, training etc. (Modak and Debnath 2011). Every human being is different and therefore personalization is required in every aspect (Modak and Debnath 2011).

Traditionally sports knowledge has been believed to be available with experts – the scouts, coaches, and managers. Sports organizations have now begun to realize that there is a wealth of knowledge contained in their data. The coaches who are in-charge of the team on the playing surface, and the general managers, who are in-charge of drafting or signing players, try to retrieve meaning and insight from the wealth of data for the scouts to evaluate future prospects and talent. Most in-house statisticians and analysts are helping the sports organization to gain valuable information from the data available in sports domain.

Hidden knowledge in the data gathered in Sports activity is required to be understood by the coaches and trainers, to apply it correctly to the training process of a particular sport. (Modak and Debnath 2011) The Sports training is based upon many factors like: efficiency, endurance, skills, body types, socio-psychological parameters, nutrition, etc. (Modak and Debnath 2011; Uppal 2018) The training requires to be individualized. This individualization helps to achieve maximum performance from each individual player.

In the competitive sports, players' performance mainly depends upon the physical fitness, skill and training of the player. The skill and training plays vital role in performance and personalization is required in this aspect. To ensure personalization it requires individual monitoring and evaluation, which is quite impossible without use of any tool.

We have developed a system 'Swimming Coach Assistant' for predictive performance analysis of a player and assist coaches to extend personalized coaching to the player.

SYSTEM ARCHITECTURE AND METHODOLOGY

As the personalized coaching and monitoring is required for performance enhancement of players, a computerized system developed which assist coaches to plan personalized training programme, monitor the performance of players during training sessions, assist to select best possible training plan and predict the performance of player for assigned training plan and coaching session. The system developed for swimming and named as 'Swimming Coach Assistant', the system architecture is as given below.

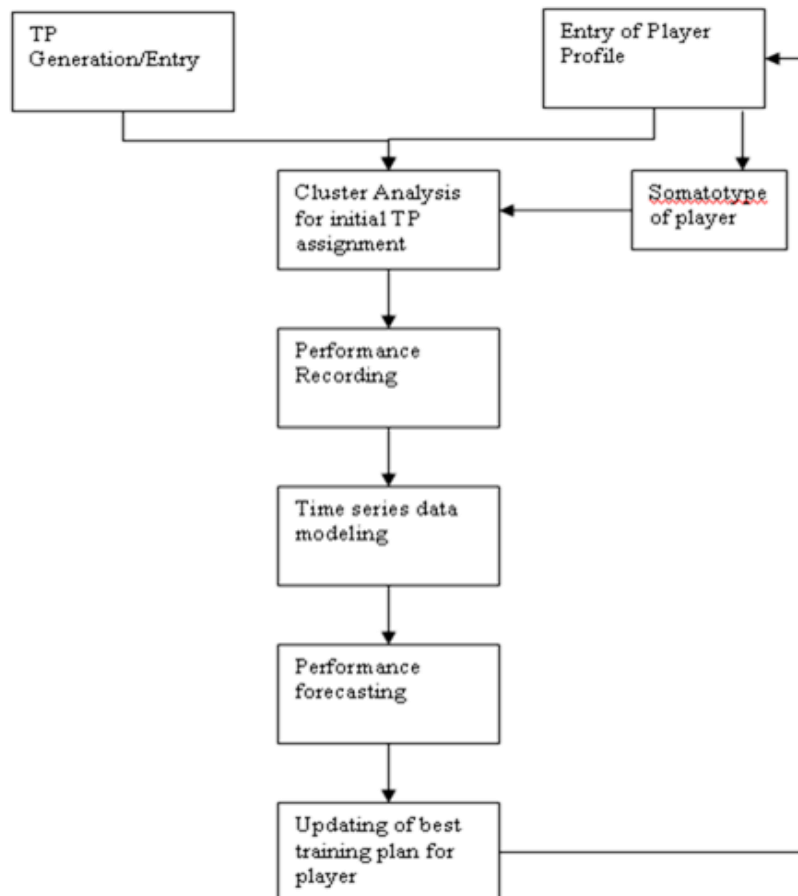


Figure 1. Flowchart of the system.

This system has four main processes, Entry of Players' Profile and Training Plans, Assigning the training plan to player, Performance entry and analysis, updating best training plan for player. System is developed in .Net framework and available an interface to connect touch panel for accurate auto capturing of swimmers' performance.

Coaches enter anthropometric measurements as suggested by the Heath-Carter method of Somatotyping of the player (Singh and Mehta 2009; Norton and Olds 2002). Somatotypes describe the present morphological conformation and have three numeral ratings representing Endomorph (fatness in physiques), Mesomorph (musculo-skeletal development) and Ectomorph (individual physique based on height-weight ratio). System generates a triplet representing somatotype of the player and compares it with somatotype of existing players the nearest somatotypes are identify using distance formula (Somatotype Dispersion Distance) (Singh and

Mehta 2009). If near similar somatotype available in the database, system suggest the best training plan previously identified and recorded. Otherwise, coach assign initial training plan based on his knowledge and expertise. Data clustering using 'Nearest Neighbour' for near similarity for assignment of training plan executed.

Training Plan

List of Training Plans

Plan Name	Prepared Date	For Days	Remarks
Advanced Swimmers Plan	18/08/2010	20	
check	25/05/2012	20	high

Events

Select All Events

- Freestyle- 100 mtr-under 17-Male
- Backstroke- 50 mtr-under 19-Male
- Breaststroke- 50 mtr-under 19-Male
- Butterfly- 50 mtr-under 19-Male
- Freestyle- 50 mtr-under 17-Male
- BreastStroke- 100 mtr-under 17-Male

Training Plan Details

Training	Repetition	Intensity	Recovery	Duration
Warm up in I.M. sequence	800 mts			
Freestyle & back stoke	10*100 mts	85 to 90%	Active rest 25 mts	
Own stroke kick	10*50 mts		Passive Rest 1.00 min	1 to 3.00 hour
Freestyle & breast strokes	10*75 mts	70 to 80 %		
Own stroke arm action	10*50 mts			
Freestyle set	8*50 mts	75 to 80 %	Active rest 25 mts	
Relax swimming	200 mt			

Training Plan Details:

* Plan's Competition Level: National Level

* Training Plan Name: Advanced Swimmers Plan

* Plan For: Male Female

* Age Group: 15 to 19

* Prepared On: 18/08/2010

* Total Days: 20

* Remarks:

* Training Plan Contents: Create New Use Existing

If Existing Attach the file: **Browse**

New Update Delete Cancel

Figure 2. Entry form for Training Plan.

Player/Swimmer Master

Swimmer List

Swimmer ID	Swimmer Name	BirthDate
1	Manali Pande	26/03/11
2	Mayuri Dakhane	19/10/11
3	Ashish Kathar	22/04/11
4	Prathamesh Yawale	22/06/11
5	Shashwat Tiwalkar	27/04/11
6	Chaitanya Bhadke	01/06/11
7	Ashutosh Thete	14/09/11
8	Aditi Parbhure	05/04/11
9	Sonali Asolkar	11/06/11
10	Rupal Giridhar	05/07/11
14	Abhijeet Bodhankar	22/12/11
15	Chaitali Gokhale	24/05/11

Add Swimmer

* Swimmer Name: Shashwat Tiwalkar

* Birth Date: 27/04/1994

* Gender: Male Female

Address: Akola

Contact No.:

Qualification:

* Competition Level: National Level

Events

Select All Events

- Freestyle- 100 mtr-under 17-Male
- Backstroke- 50 mtr-under 19-Male
- Breaststroke- 50 mtr-under 19-Male
- Butterfly- 50 mtr-under 19-Male
- Freestyle- 50 mtr-under 17-Male
- BreastStroke- 100 mtr-under 17-Male

Anthropometry Measures

* Weight: 53 (in kgs) Head Circumference: 0 (in cms)

* Standing Height: 167 (in cms) Arm Circumference: 0 (in cms)

Sitting Height: 0 (in cms) Chest Circumference: 0 (in cms)

* Triceps Skinfold: 20 (in mm) Waist Circumference: 0 (in cms)

* Subscapular Skinfold: 15 (in mm) Thigh Circumference: 0 (in cms)

* Suprailiac Skinfold: 6 (in mm)

* Medial Calf Skinfold: 13 (in mm)

Thigh Skinfold: 0 (in mm)

* Humerus Breadth: 6.7 (in cms)

* Femur Breadth: 9.5 (in cms)

* Upper Arm Girth: 22.7 (in cms)

* Calf Girth: 29.6 (in cms)

Hand Length: 0 (in cms)

Hand Breadth: 0 (in cms)

Foot Length: 0 (in cms)

Foot Breadth: 0 (in cms)

Ankle Circumference: 0 (in cms)

Ankle Breadth: 0 (in cms)

New Update Delete Cancel

Figure 3. Entry form for Anthropometric Measurement.

Swimmer's List with Anthropometry Measurements

Swimmer Id	5	Weight	53.00	Hand Length	0.00	Medial Calf Skinfold	13.00
Swimmer Name	Shashwat Tiwalkar	Standing Height	167.00	Hand Breadth	0.00	Humerus Breadth	6.70
		Sitting Height	0.00	Foot Length	0.00	Femur Breadth	9.50
Birth Date	27/04/1994	Head Circumference	0.00	Foot Breadth	0.00	Endomorphy	4.26
M/F	M	Arm Circumference	0.00	Ankle Circumference	0.00	Mesomorphy	2.53
Address	Akola	Chest Circumference	0.00	Ankle Breadth	0.00	Ectomorphy	3.96
		Waist Circumference	0.00	Thigh Skinfold	0.00	Somatotype Rating	4-3-4
		Thigh Circumference	0.00	Triceps Skinfold	20.00		
Qualification		Upper Arm Length	22.70	Subscapular Skinfold	15.00		
		Calf Girth	29.60	Suprailiac Skinfold	6.00		
Practices Events							
Freestyle-100Mtrs -under 17-Male							
Backstroke-50Mtrs -under 19-Male							
Breaststroke-50Mtrs -under 19-Male							
Butterfly-50Mtrs -under 19-Male							
Freestyle-50Mtrs -under 17-Male							
BreastStroke-100Mtrs -under 17-Male							

Figure 4. Evaluation of Somatotype Rating.

Systems Suggestion for assigning Training Plan on Performance Evaluation of previous Swimmer's							
Details of Swimmer under consideration							
Swimmer Id	5	Weight	53.00	Hand Length	0.00	Medial Calf Skinfold	13.00
Swimmer Name	Shashwat Tiwalkar	Standing Height	167.00	Hand Breadth	0.00	Humerus Breadth	6.70
		Sitting Height	0.00	Foot Length	0.00	Femur Breadth	9.50
Birth Date	27/04/1994	Head Circumference	0.00	Foot Breadth	0.00	Endomorphy	4.26
M/F	M	Arm Circumference	0.00	Ankle Circumference	0.00	Mesomorphy	2.53
Address	Akola	Chest Circumference	0.00	Ankle Breadth	0.00	Ectomorphy	3.96
		Waist Circumference	0.00	Thigh Skinfold	0.00	Somatotype Rating	4-3-4
		Thigh Circumference	0.00	Triceps Skinfold	20.00		
Qualification		Upper Arm Length	22.70	Subscapular Skinfold	15.00		
		Calf Girth	29.60	Suprailiac Skinfold	6.00		
List of Swimmers matching the selection criteria :							
Swimmer Id	14	Weight	61.00	Hand Length	0.00	Medial Calf Skinfold	27.00
Swimmer Name	Abhijeet Bodhanekar	Standing Height	173.00	Hand Breadth	0.00	Humerus Breadth	6.20
		Sitting Height	0.00	Foot Length	0.00	Femur Breadth	8.90
Birth Date	22/12/1997	Head Circumference	0.00	Foot Breadth	0.00	Endomorphy	4.21
M/F	M	Arm Circumference	0.00	Ankle Circumference	0.00	Mesomorphy	2.01
Address		Chest Circumference	0.00	Ankle Breadth	0.00	Ectomorphy	3.59
		Waist Circumference	0.00	Thigh Skinfold	0.00	Somatotype Rating	4-2-4
		Thigh Circumference	0.00	Triceps Skinfold	15.00	Best Training Plan	Advanced Swimmers Plan
Qualification		Upper Arm Length	24.40	Subscapular Skinfold	18.00		
		Calf Girth	35.00	Suprailiac Skinfold	9.00		

System Suggest following Training Plan based on previous Performance Evaluation

Training Plan (s)
Advanced Swimmers Plan

Figure 5. System suggest a training plan for player based on anthropometric measurements.

Once the training plan assign to the player, it will be record in the system. The entry of performance of the player during the practice session shall be automatic through an interface available with the system connected to the touch panel. The best performance of every practice day is use for further analysis. Following is the entry form for performance recording.

The screenshot shows a software window titled "Swimmer's Performance". It contains several input fields: "Coach" (Dr. L.M. Khandagale), "Practice Date" (10/08/2011), "Practice Start Time" (5:00:00 PM), "Practice End Time" (7:00:00 PM), and "Gender" (Male selected). Below these are two panes. The left pane, "Select Swimmer", has a table with columns "Swim...", "Swimmer Name", "Gender", and "Plan Name". It lists swimmer "5" (Shashwat Tiwal...) with gender "M" and plan "Advanced S...". The right pane, "Swimmer's Performance", has a table with columns "Plan Name", "Event Name", "Lane No", "Time in (hh:mm:ss)", and "Time(Microsecond)". It shows "Advanced Swimmers Plan", "Freestyle 50 Mtrs.", "4", "12:00:59 AM", and "67". At the bottom are "Save" and "Close" buttons.

Figure 6. Form for recording the performance of the swimmers.

Graphical Representation of Swimmers Performance against Plan and Event

Plan Name : Advanced Swimmers Plan
 Swimmer Id : 5
 Swimmer Name : Shashwat Tiwalkar
 Event Name : Freestyle-50 Mtrs -under 17-Male

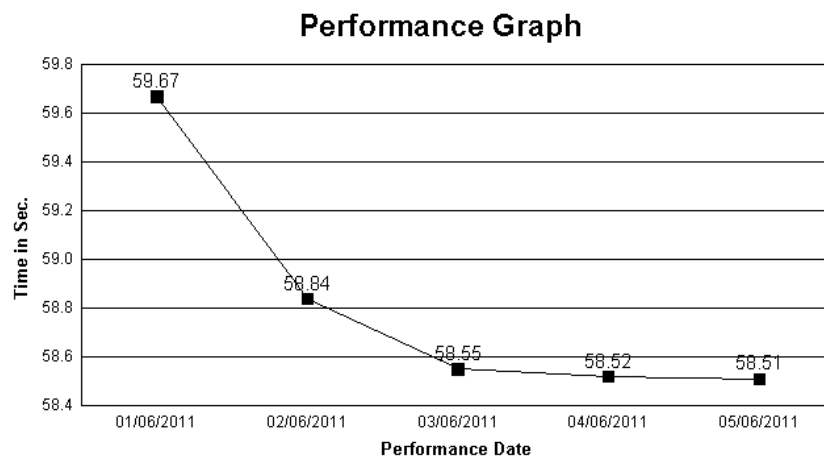


Figure 7. Graphical presentation of player's best performance day wise.

Coaches can plot the graph of player's performance over a specified period. Coaches can analyse the performance and feedback player accordingly. System uses the Time-Series approach Linear Regression for fitting a straight line for the performance data. Using least-square method system fits a straight line, evaluates the values for 'Slope' and for 'Constant'. This is a classification method, which is use for prediction. With the help of values evaluated for 'Slope' and 'Constant' the straight line can be, extend for prediction of the further performance if the same training plan continues. Coaches can use this feedback and make decision, whether to continue the same training plan or assign a new one.

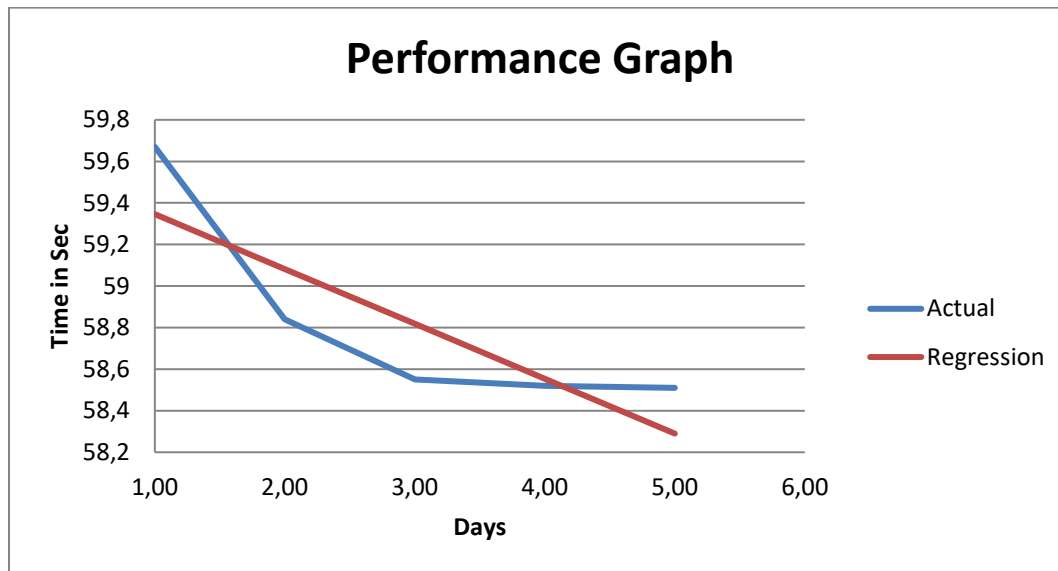


Figure 8. Linear regression of performance data showing actual performance and regression.

RESULTS

For better visualization and understanding, system generates graphical output. The result gives performance analysis of player against the applied training plan. System also suggests the best suitable training plan for the player based on anthropometric parameters. Time series analysis (linear regression) gives prediction of performance on the day of competition if the existing training plan continues.

DISCUSSION AND CONCLUSION

Every player based on his physical, mental, social and economic status need to be treated independently. A common approach during training/coaching badly affects performance of player. Personalized training/coaching/monitoring is difficult without tools for performance analysis. This system assists the coaches in administering and monitoring the training/coaching activity. As a part of future scope one can integrates other aspects like: diet plan, conditioning sessions, medication and counselling sessions etc. which may impact the players' performance in the competitions.

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