Article

Evaluation and optimization of basketball tactics training effect in physical education: Application research using Decision Tree (DT) algorithm

Nan Hu[1], Benlong Ma[2,*]

[1] College of Physical Education, Bai Cheng Normal University, Baicheng 137000, Jilin, China
[2] College of Physical Education, Northeast Normal University, Changchun 130024, Jilin, China
* Corresponding author: Benlong Ma, 17304360007@163.com

Abstract: In this study, the decision tree (DT) technique is developed to assess the basketball strategies' training impact on physical education (PE). The recommended DT method effectively guesses the tactics of two teams based on the locations of basketball players with only a small amount of training data. Next, using data concerning ball possession, the interaction of these teams' tactics, and the distinctive features of basketball strategies, the DT approach changes the team's strategies. Therefore, effective findings from prediction could be produced because the suggested DT approach predicts the team strategies that meet these requirements. The suggested DT approach is implemented using the Python platform to analyze efficiency in terms of several metrics. Additionally, the DT method's effectiveness is contrasted with that of other approaches. Based on the results of the experiments, the suggested approach outperforms the current approaches in assessing the impact of basketball strategy instruction in physical education.

Keywords: physical education (PE); basketball; tactics; Decision Tree (DT)

1. Introduction

Basketball is a fast-paced sport that calls for a blend of strength, skill, and cooperation. The effectiveness of basketball tactics training is critical for improving players' abilities and performance in PE [1]. Because basketball methods are always changing and players have a variety of skill sets, it is critical to evaluate the efficacy of various training approaches. Coaches and educators can adapt their methods to the skills and demands of certain players or teams by analyzing different tactics and training programs as shown in **Figure 1**. Basketball tactics training optimization includes figuring out which methods are the most effective and influential in producing measurable gains in players' performance measures, such as shooting accuracy, defensive ability and general game comprehension. Gaining an understanding of the subtleties of basketball tactics training not only helps the players to become more skilled but also cultivates a greater respect for the strategic elements of the game [2].
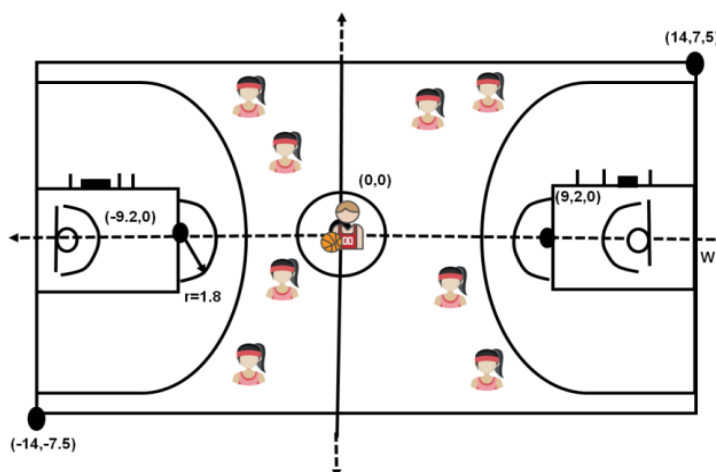
Figure 1. Basketball ground.

1.1. Training and basketball analysis

A basketball team's ability to perform is based on the squad's preparation. Coaches can ensure that players are well prepared. Game analysis is a well-respected method for gaining insights into performance and identifying areas that require further practice emphasis. There aren't many strategies, though, that concentrate on sharing knowledge between the team preparation and game performance [3,4]. Even with historical modifications to sports procedures such as the O'Brian shotput technique and the ski-jump technique, which has been shown that training stimuli are comparably experienced during competition result in the greatest performance gains. Beyond the systematic training of more sophisticated team behaviors for novices, In the meantime they underwent independent development in addition to becoming popular drills to test the tactical, technical and physical skills in team sports, especially basketball. According to the widely accepted ideas of simple to complicated and easy to hard in education [5]. The level of team preparation affects a basketball team performs. Therefore, it is the coach's responsibility to ensure that players are prepared appropriately. Game analysis is a well-respected approach to gaining insights into performances and identifying areas in which practice emphasis is required. There are, few strategies that concentrate on sharing knowledge in team preparation and game performance. Coaches make the everyday intuitive deduction that preparation equals performance [6].

1.2. Performance enhancement through physical fitness training

The fields of sports science and medicine are very interested in sports injuries, and there is a pressing need to find a solution. It has been shown in the past that team ball games frequently result in sports injuries. Since there is a heightened danger of sports injuries in youth groups, the yearly injury rate at basketball competitions has climbed [7]. Muscle strength, power, endurance, and joint flexibility measurements can all be used to operationally describe musculoskeletal fitness. Tests of muscle and bone strength are widely used to assess fitness and health. Basketball players require strength, speed, and agility to pass the ball. They can be able to quickly and steadily accelerate and decelerate whether dribbling, shooting, or collecting rebounds [8]. As a vital part of the body's energy supply systems, the skeletal muscular system's

energy metabolic processes have a substantial impact on athletes' competitive performance when it comes to physical fitness. Enhancing an athlete's unique athletic ability and performance can be achieved primarily through physical fitness training. Physical training is becoming more and more vital as world records in competitive sports are updated regularly [9,10]. Basketball players and coaches should become more aware of how to prevent sports injuries by learning more about basketball sports injuries and rehabilitation training techniques. Coaches and athletes should also understand these techniques. The ability to exercise is limited, which increases the risk of sports injuries [11].

Evaluating and modifying basketball programming and coaching effects in physical activity faces several limitations in previous studies. In this study first, relying on limited training data can provide insufficient prediction accuracy, affecting the robustness of the decision tree (DT) model. Furthermore, differences in player skill and physical condition can be underestimated, leading to biased results. The scope of the study can also be constrained by the specific strategies examined, limiting generalizability to other game strategies. Finally, external factors such as team dynamics and coaching effectiveness can influence the results but are difficult to quantify in the model. The goal of this study is to examine the training impact of basketball tactics while also predicting team strategies using a suggested Decision Tree (DT) technique.

1.2.1. Contribution of the study

- This research provides a novel Decision Tree (DT) for basketball training tactics and for enhancing basketball video data by removing noisy data, video preprocessing is used.
- Determining the set of features through the use of the Mel-Frequency Cepstrum Coefficient (MFCC).
- The DT technique allows the team to dynamically modify their plans based on information about ball possession, team dynamics, and the particular characteristics of basketball strategies.
- When compared to other existing methods, our proposed DT method achieves a better outcome.

1.2.2. Organization of the paper

The rest of the paper is as follows: Related works are included in part 2. Part 3 included a thorough methodology. Part 4 presents an analysis of the findings, and Part 5 provides a conclusion.

2. Related work

A comprehensive analysis of the impact of basketball player training and particle swarm optimization categorization is provided in [12]. Additionally, it provides an unbiased evaluation of the training impact of physical fitness and makes recommendations for suitable optimization techniques, all aimed at maximizing basketball players' physical training in an informed manner. The physiological markers like hemoglobin and heart rate are used as the input vectors used by the support vector machine (SVM) described in [13]. They proposed an evaluation

method for the instructional impact on basketball players that relies on wearable technology and machine learning (ML) techniques which could help coaches create more realistic training programs and decrease inaccuracies in the estimation of the players' preparation impact. The methods, to best optimize the basketball teaching scene's parameters to assess the current status and enhance the teaching efficacy are examined in [14]. Improved the basketball instruction scenario using Back Propagation Neural Network (BPNN) technology and then made a genetic algorithm recommendation based on the BPNN. Before examining the experiment's findings, a genetic algorithm was used to enhance basketball teaching scenario. Study [15] aimed to measure and contrast the three intervention programs the Tactical Games Approach (TGA), Direct Instruction (DI), and Service Teacher's Basketball Unit (STBU)that apply different teaching philosophies to teach basketball in schools and the resulting external (eTL) and internal (iTL) loads were described. Based on the student's past experiences and the teaching technique, a comparison was made. The teaching methodology employed in PE classes has an impact on students' PE since the tasks' design establishes the physical and physiological requirements that students can meet. The issue of diverse grouping teaching and learning in different teaching organizations can be examined by examining the business flow of basketball instruction. A process evaluation of basketball instruction is carried out using the modified factor algorithm. Sports have grown in importance in people's everyday lives as a result of the social economy's ongoing growth, particularly ball sports, which are gaining popularity. On the other hand, uniformity and reasoned instruction are crucial in PE [16]. A thorough investigation, including computer swarm intelligence techniques for the basketball tactical system was described in [17]. The basketball tactical system's content and categorization model provide scientific guidance for the advancement of basketball training theory and practice while enhancing understanding of the game's competitive regulations. First, let's discuss the useful aspects of basketball. The juvenile basketball training performance assessment index's weight was determined by the use of an analytical hierarchy procedure, and the system was constructed in compliance with the construction concept determined in [18]. The effectiveness of child basketball training is assessed using a training performance assessment model that was based on the Particle Swarm Optimization (PSO) algorithm. The importance of using multimedia technology in college basketball instruction, the ease with which multimedia PE can be implemented in colleges and universities, and the three views of the multimedia learning surroundings, instructional capacity, and multimedia growth trend [19]. To achieve this, it examines the elements influencing the effectiveness of multimedia-assisted training and outlines the advantages of utilizing multimedia technology in PE instruction. The case for multimedia-based instruction in college basketball and the viability of multimedia-based PE in higher education from three dimensions: multimodal classroom and the instructor's ability to teach into the variables influencing the effects of multimedia-assisted instruction are presented in [20]. Traditional teaching methods were used to instruct students at a Taiwanese institution, making up the control and experimental groups used [21]. Developing a multimedia learning environment for use in PE classes and comparing the impact of traditional and multimedia learning environments on students' learning habits and

knowledge were the goals of this project. To improve students' physical health, the research initiative attempted to optimize the PE program. Students were divided into CG and EG groups at random. PE lessons lasted ninety minutes each, twice a week. A comparison between EG and CG boys revealed that the former had far higher motor tests and more enthusiasm for physical exercise. Based on the findings, additional educational institutions can benefit from implementing basketball-focused PE programs to improve students' motivation and physical condition [22].

Problem statement

Current methods often rely on traditional training practices and lack the scientific rigor necessary to accurately assess physical fitness effects and optimize training interventions [14,15]. In addition, existing instructional approaches, such as the Strategic Game Approach (TGA) and Direct Instruction (DI) exhibit varying advantages in terms of impact on students' physical load, and these approaches need to be objectively evaluated. Integrating multimedia technologies into basketball instruction has shown promise but further research is needed to determine its impact on instructional effectiveness and student engagement [19,20]. Moreover, the use of particle swarm optimization (PSO) and analytical hierarchy methods to evaluate training performance is not yet widely adopted, limiting the potential of customized training algorithms [18]. Thus, there is a critical need to develop a robust program that integrates these new approaches to maximize basketball coaching outcomes and enhance overall player development in educational settings. We proposed DT to assess the basketball strategies' training impact on physical education (PE) with several tactics.

3. Methodology

Basketball is a fast-paced sport that calls for a blend of strength, skill, and cooperation. The effectiveness of basketball tactics training is critical for improving players' abilities and performance in the context of physical education. The suggested methodology's flow is shown in **Figure 2**. The basketball video data was first collected for study and the dataset was pre-processing using the video processed method. Next, we use MFCC for basketball video feature selection. The suggested Decision tree (DT) was utilized in the study to categorize basketball tactics training.
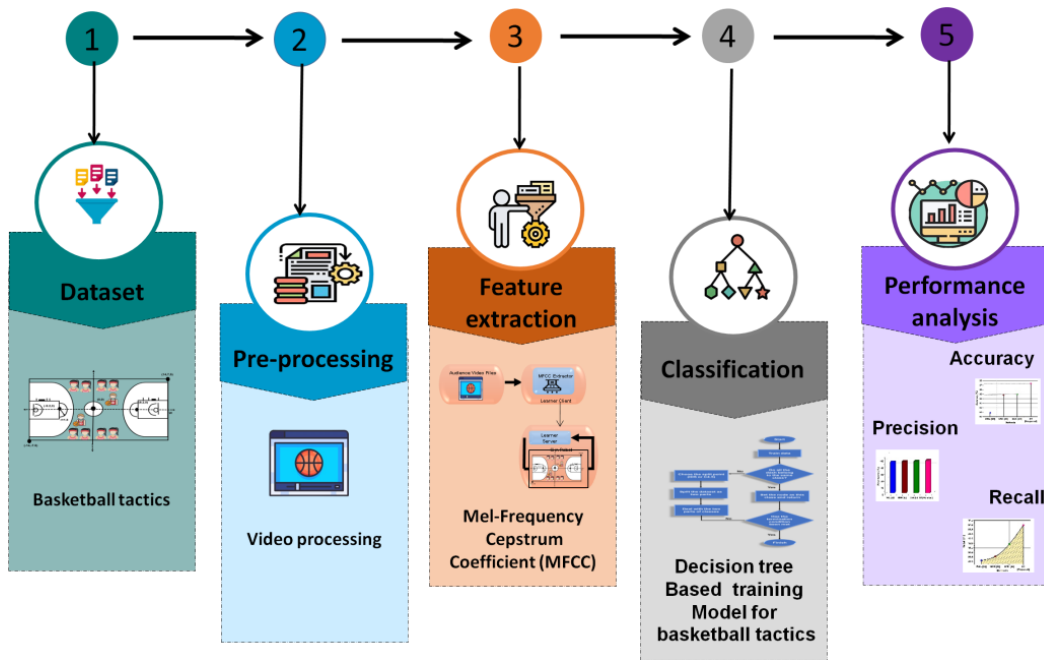
Figure 2. Framework for the proposed model.

3.1. Dataset

This study gathered basketball videos (5637 s, 5 frames per second) from competitions held by final year college students, who have 2 years' experience in basketball. There are two main teams (TEAM 1 and TEAM 2). The basketball videos and monitoring players and ball possession has examined by frames. The details of the dataset are shown in **Table 1**. A target team participated in basketball games using 7 major tactics three-point shooting, pick and roll, slide pick slip and pop, motion offense, pin down, fast break and pack line defense. Compared to other approaches, we employed a significantly higher number of video frames for the experiment. Two years of basketball playing experience were required of the subjects to establish the ground truth of the team procedures. (https://universe.roboflow.com/eagle-eye/basketball-1zhpe).

Table 1. Basketball tactics with time.

Team tactics	Time (seconds)	Frames (5 fbs)
Three-point shooting	1000	5000
Pick and roll	500	2500
Slide pick slip and pop	1200	6000
Motion offense	900	4500
Pin down	800	4000
Fast break	500	2500
Pack line defense	737	3685
Total	5637	28,185

Table 2 illustrates the significant connection between the team strategies of the team 1 and 2 in a match involving basketball. To be more precise, the combination

of the two teams' strategies is determined by a relationship (0 being no relationship and 1 being a significant relationship) between them.

Table 2. Relationship between the two team's tactics.

		Team 1						
	Team tactics	Three-point hooting	Pick and roll	Slide pick slip and Pop	Motion offense	Pin down	Fast break	Pack Line defense
Team 2	Three-point shooting	1	0	0	1	1	1	0
	Pick and roll	0	0	0	1	1	1	0
	Slide pick slip and pop	0	0	0	1	1	1	0
	Motion offense	1	1	1	0	0	0	1
	Pin down	1	1	1	0	0	0	1
	Fast break	1	1	1	0	0	0	0
	Pack line defense	0	0	0	1	1	1	1

3.2. Video pre-processing

After collecting the data, we pre-process the video for improving the quality of the images by removing noisy contents. At the most fundamental level of comprehension, the term "video pre-processing" describes operations on video frames. The input video used in this work is a picture of a video frame. One way to compute this is by using

$$w = \{w_1, w_2, \dots, w_j, \dots, w_m\} \tag{1}$$

where M is the number of frames in the sub-video segment and $w_1 (j = 1,2,..m)$ is its jth frame. The input video clip is divided into equal-length segments and represented as

$$w = \{w_1, w_2, \dots, w_j, \dots, w_N\} \tag{2}$$

where N is the number of sub-video segment segments from which the entire input video is divided.

$$w = \{w_{i1}, w_{i2}, \dots, w_{ij}, \dots, w_{in}\}, \quad i = 1,2,..N \tag{3}$$

here, w_{in} denotes the ith sub video of the segmented input video, and $In = On, i \neq o, i, o = 1,2.., N, r = 1,2, \dots, M$ and W_{ir} are the qth frame images in the ith sub video segment. In the subsequent stage, the video processing output can be utilized for pre-processing using noise reduction.

3.3. Feature extraction using Mel-Frequency cepstrum coefficient (MFCC)

Following preprocessing, MFCC was used to select the data. The visual properties corresponding to the chosen sports movements are extracted from the audio segments using the MFCCs. With these coefficients, the MFC amplitudes correspond. Specifically, these steps are used to generate these coefficients. **Figure 3**

illustrates the system architecture, which includes a keyboard that can be used to create crowd noise, the learner's client and server and a video file feature extractor.

- Execute the signal's Fourier transformation.
- Transfer the acquired spectrum powers to the mel scale.
- Take note of the power records for each mel frequency;
- For each mel log power in the list, compute the distinct cosine transformation;
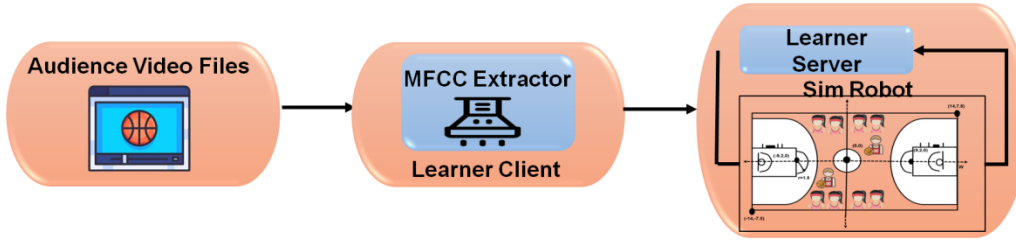- Extract the MFCCs as the amplitudes of the resulting spectrum.

Figure 3. Architecture of MFCC.

The resulting MFCC, which is based on the linear cosine transform of a log power spectrum on a nonlinear MFCC, clearly illustrates the short-term power spectrum of a sound wave. This scale creates a link between the perceived and measured tonal frequencies. Lower-frequency sounds can be distinguished by humans more accurately than higher-frequency sounds, where it is far more difficult to distinguish between distinct sounds. Humans hear sounds as having the same distance when they convert them into the same Mel Scale distance. The conversion of the Hertz scale to the Mel scale looks like this:

$$m = 1127 \times in(1 + \frac{f}{700}) \tag{4}$$

This change in size allows one to measure the separation between two sets of sounds that each individual hears, and then use audio analysis to mimic our unique auditory experiences. MFCC software to extract features using three MFCC components. To differentiate the three groups, we developed criteria based on these three factors. Permission was granted to MFCC to identify patterns in the noises coming from the audience with greater accuracy.

3.4. Proposed method: Decision Tree (DT)

The suggested approach uses the formation elements in basketball films to predict each side's team strategies based on a DT. By taking into account the attributes of tactics, team tactics are updated. Real-time change is made possible by this method, which helps researchers and educators better navigate the intricate field of performance evaluation and training. Sports facilities and research labs can all benefit from the faster translation of training observations into useful insights made possible by the DT algorithm. **Figure 4** shows the Structural design of Decision Tree.
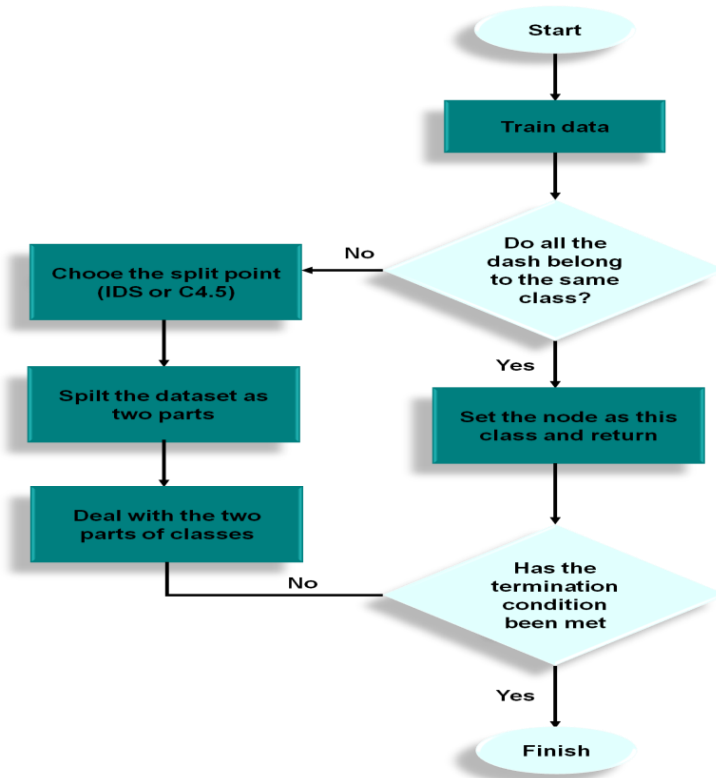
Figure 4. Architecture of DT.

The process of categorization entails examining certain characteristics and iteratively identifying classes that set the intended application apart in several ways. In this example, let X stand for a data point's attributes and Y for the class. Calculating the ratio between X and Y is necessary to determine the category to assign the data point to, as indicated by the equation shown below.

$$\text{Ratio}(X|Y) = H(X) - H(X|Y)H(X) \tag{5}$$

When variable X is given variable Y, the conditional entropy $H(X|Y)$ calculates the uncertainty of the variable. In contrast, the marginal entropy $H(X)$ evaluates the uncertainty of variables without considering any other variables. The term $H(X)$ is used for Equation (6):

$$D = \{(X_1, Y_1), (X_1, X_2), \ldots, (X_N, Y_N)\} \tag{6}$$

Let $C_i = \{X_1, X_2, \ldots, X_m\}$ represent the features facatotr of sample ii inthe regression tree, where X_{ji} represents the feature j of sample i. The input space is divided into K regions $(R_1, R_2, \ldots, R_K)$ by the regression tree, each associated with a distinct set of outcomes $(C_1, C_2, \ldots, C_K)$. Consequently, we can express the regression model as follows in the equation

$$Y = F(X) = \sum C_k \times I(X \epsilon R_K) \tag{7}$$

where C_k denotes the specific result associated with area R_K, The regression function is represented by $F(X)$, the expected output variables are represented by Y, and the indicator function $X \epsilon R_K$ evaluates to 1 when the input variables X falls inside R_K and 0 otherwise, as shown in Equation (8):

$$f(x) \sum_{k=1}^{K} C_J \times I(X \epsilon R_K) \tag{8}$$

To determine the values of $jands$, it is essential to solve the following optimization problems: Each variable acts as a dividing line, splitting the input space into two distinct sections (j, s) using equations (9) and (13).

$$min_{j,s} \left(min_{C_1} \sum_{x_j \varepsilon R_1(j,s)} (W_j - C_1)^2 + min_{C_2} \sum_{x_j \varepsilon R_2(j,s)} (W_j - C_1)^2 \right) \tag{9}$$

$$C_1 = ave(y_i | W_i \epsilon R_i(j,s)) C_2 = ave(y_i | W_i \epsilon R_i(j,s)) \tag{10}$$

To process involves selecting the optimal split variables j after calculating the output values for each of the input variables.

Updated team strategy in response to modifications in the game environment depending on ball possession and using the ball and player location data, we first compute the ball possession $Ball_k$ of target frame k where $Ball_k$ denotes the level of ball possession for a single team.

The frame k is subsequently taken into account, regardless of the point that occurred when the ball retention percentage increases or decreases below zero. Ultimately, the proposed DT approach derives the estimation findings by using the point in the team strategy that has been modified to address the surrounding frames' team strategy. Below is a detailed description of how to calculate $Ball_k$. Each target frame's ball possession is utilized to calculate $Ball_k$. When a player possesses the ball, they meet all four of the following requirements.

Rule 1: The player closest to the ball overall is the one holding it.

Rule 2: There is a predetermined distance $Q[n]$ between the closest player and the ball.

Rule 3:

$$||C_k| - |C_{k-1}| < sg_{min} \, or \, |||C_k| - |C_{k-1}|| > sg_{max} \tag{11}$$

Rule 4:

$$\frac{C_k - C_{k-1}}{|C_k| - |C_{k-1}|} < sg_b \tag{12}$$

C_k is a vector that shows how the ball's location changed between the lth frame and $(k + 1)^{th}$ rame. sg_{min}, sg_{max} and sg_b are thresholds.

$Ball_k$ is calculated using the ball retention estimation findings in the manner described below:

$$Ball_k = \frac{1}{S} \sum_{k'=k-s}^{k} e(k) \tag{13}$$

$$E(k') = \begin{cases} 1 \, if \, C_{k'=teamA} \\ -1 \, otherwise \end{cases} \tag{14}$$

where, $C_{k'}$ is the ball retention in the frame k'. Thus, the suggested technique makes

it possible to estimate strategies based on the DT by the distinctive qualities of team tactics in basketball games.

Algorithm 1 Decision Tree Algorithm (DT)
1: Input: training set T, Classes W, attribute b, Value U
2: Output: S, a decision tree predictor
3:          Determine the entropy by using equation (2)
4:          Utilizing equation (2.2), determine the information gained
5: Operational building (T, aplit)
6:          Calculate the information gain (T, j)
7:          Addendum details Acquire(T, j) to IGLIST
8:          Amax=attribute max (IGLIST)
9: If information gain(T, Bmax) $>$ $information gain$ $(T, Aplit)$
10: Then
11:          For all u ϵ to val(Bmax)
12:          Subset= (wϵT|Wmax = u)
13: Build (Subset, Bmax)
14: End

The suggested DT technique updates and effectively estimates the team tactics (**Table 2**), which overcomes the problems. The DT method can accurately forecast and adjust team strategies in real time by utilizing player location data from videos, ball possession statistics, and the dynamic interactions between various tactics. In addition to offering insightful information for improving basketball training programs in PE settings, this technique improves the prediction powers for evaluating team strategies.

4. Results

We used Python 3.10 to implement our proposed methodology, and Windows 10's system setup contains Python 3.10 is compatible with Pytorch 2.0. The proposed DT approach outcomes of accuracy, precision, recall, and F1-score performance indicators for basketball team strategies are displayed in **Table 3** and **Figure 5**. The accuracy scores of various team tactics in basketball. Three-point shooting has the highest accuracy at 0.948, indicating its effectiveness. Pick and roll follows closely behind at 0.873, while slide pick slip and pop and fast break also exhibit high accuracy scores of 0.927 and 0.821 respectively. Motion offense, pack line defense, and pin down show slightly lower accuracies, with motion offense being the least accurate at 0.792.

Table 3. Team tactics outcome.

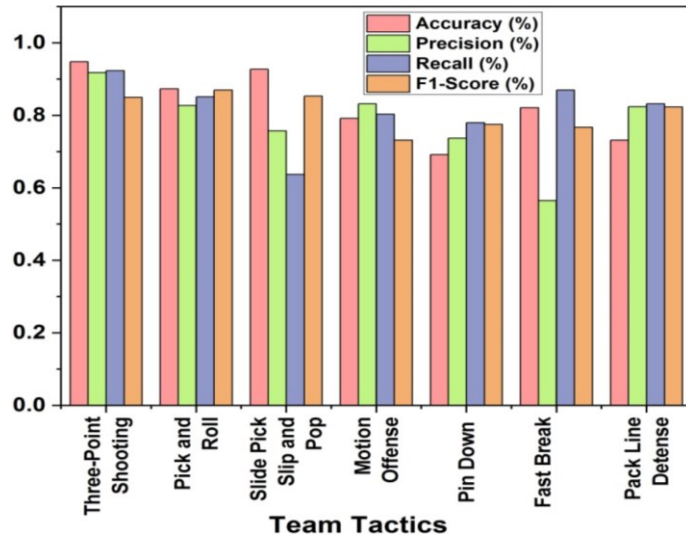| Team tactics	Accuracy	Precision	Recall	F1-score
Three-point shooting	0.948	0.918	0.923	0.85
Pick and roll	0.873	0.827	0.851	0.87
Slide pick slip and pop	0.927	0.757	0.637	0.853
Motion offense	0.792	0.832	0.803	0.732
Pin down	0.692	0.737	0.78	0.775
Fast break	0.821	0.565	0.87	0.767
Pack line detense	0.732	0.824	0.832	0.823

Figure 5. Accuracy, precision, recall, and F1-score outcome of team tactics.

4.1. Tactics estimation obtained by the proposed method

Figure 6 displays a few of the estimation outcomes for the suggested approach and the comparison techniques. We can affirm from the findings that the suggested technique yields the most accurate estimation, with the results closest to the actual data. Precise estimations of "Three point-shooting" and "Pick and Roll Possession" are made feasible. Ball possession is used by the DT method to accurately update the estimation findings of various team strategies. The proposed approach addresses issues in this manner. Thus, a key factor in the effective estimate of team tactics is the novelty of the suggested approach.
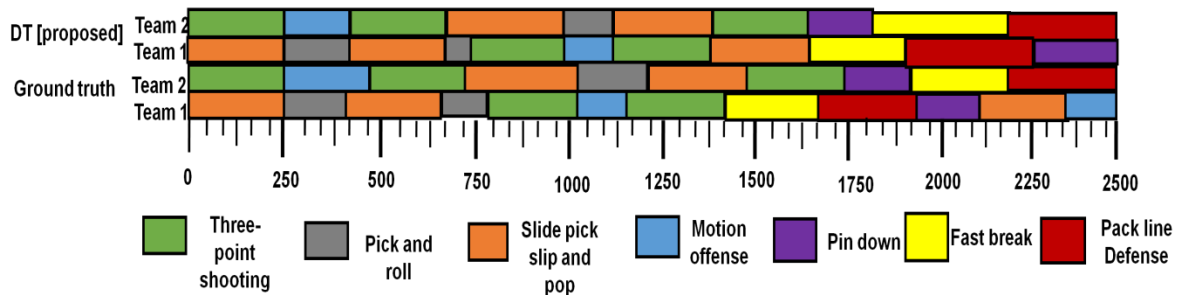

Figure 6. Tactics estimation.

4.2. Confusion matrix

Based on the aforementioned, the relationship between the two teams' team strategies can be used to increase the estimation performance. Additionally, **Figure 7** displays confusion matrices for the estimation results of the suggested strategy. A confusion matrix was produced from the estimation outcomes following the computation of the best possible set of team strategies using the suggested approach. These outcomes line up with those of our approach.
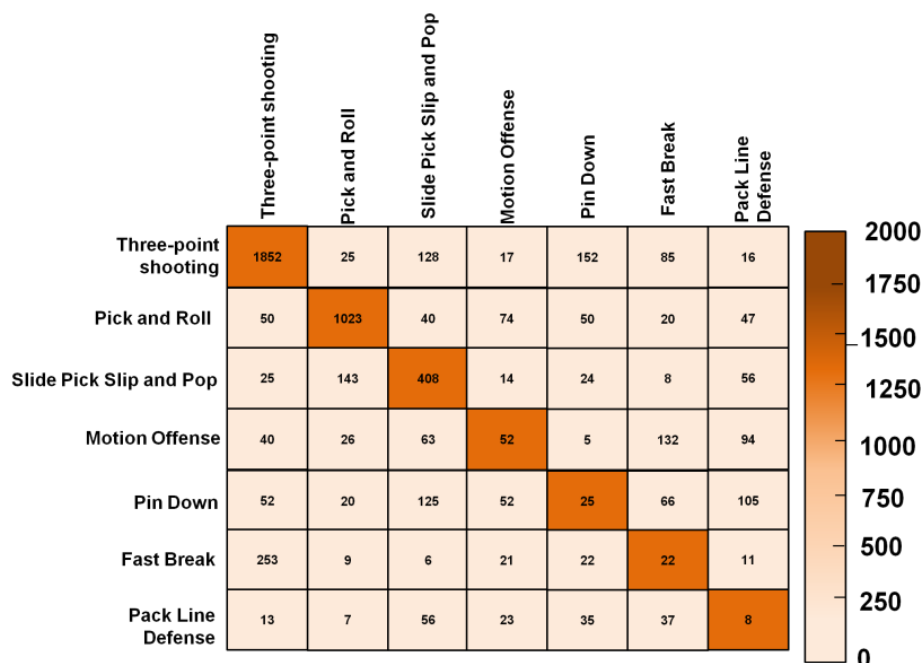
Figure 7. Confusion matrix.

4.3. Comparative analysis

The effectiveness of aDT method is contrasted with those of modern techniques including Wide and Deep Learning (WDL), Gated Residual Networks (GRN), and Deep Neural Networks (DNN) as well as measures including f1-score, accuracy, precision, and recall. As shown in **Table 4**.

Table 4. Overall comparison of outcomes.

Methods	Accuracy (%)	Precision (%)	Recall (%)
WDL	90.87	91.81	90.15
GRN	94.84	93.51	90.58
DNN	94.97	93.85	91.92
DT [Proposed]	97.37	96.37	93.99

4.3.1. Accuracy

The accuracy of basketball tactics training effects evaluated and optimized in PE is contingent upon the extent of data collection, the methods of analysis and the degree of alignment with learning objectives. Improving teaching strategies and accomplishing the intended results in basketball training in PE programs, entails evaluating player performance, strategic comprehension, and skill development. Accuracy comparison and outcomes are shown in **Figure 8**. When compared to other techniques such as WDL achieved at 90.87, GRN achieved at 94.84, DNN achieved at 94.97, and the suggested method's DT value is at 97.37. Compared to other existing methods, the proposed approach DT has greater accuracy.
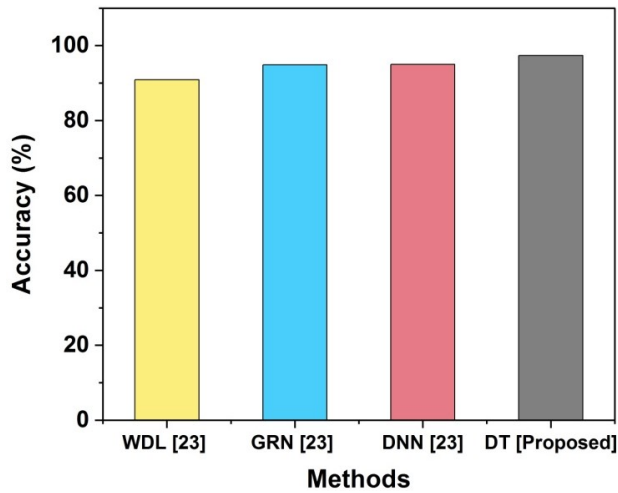
Figure 8. Comparison of accuracy.

4.3.2. Precision

Precision in sports training is the degree of tactical proficiency and skill development attained via deliberate practice and coaching interventions. It is expressed as the ratio of successful tactical executions to all attempted techniques quantified in basketball training regimens by accounting for decision-making, execution, and adaptability. Precision comparison and outcomes are shown in **Figure 9**. When compared to other techniques such as WDL achieved 91.81, GRN achieved at 93.51, DNN achieved at 93.85, and the suggested method's DT value is 96.37. Compared to other existing methods, the proposed approach DT has greater Precision.
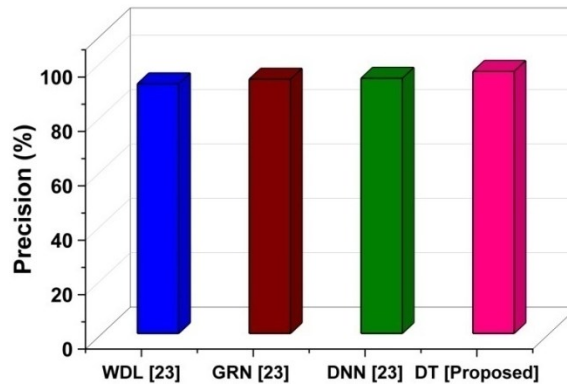

Figure 9. Comparison of precision.

4.3.3. Recall

Recall is the capacity of basketball players to recover and implement strategic maneuvers and talents taught during practice or training sessions. It is related to the effect of basketball tactics training on PE. A basketball game's fast-paced atmosphere puts players' individual abilities and tactical maneuvers to the test in addition to their memory and ability to execute a variety of offensive and defensive schemes. Recall comparison and outcomes are shown in **Figure 10**. When compared to other techniques such as WDL is achieved at 90.15, GRN is achieved at 90.58, DNN is achieved at 91.92, and so on, and the suggested method's DT value is at

93.99. Compared to other existing methods, the proposed approach DT has greater Recall.
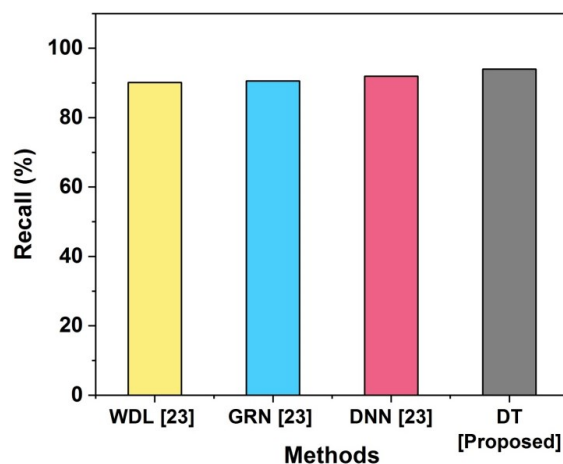

Figure 10. Comparison of recall.

4.3.4. Error rate

Body posture: Proper body position enhances balance, stability and agility, allowing players to move faster and more dexterously. The gravity of bent knees helps protect the spindle and also helps prevent injury. Player Positions: Each position point guard, shooting guard, small forward, power forward, and center holds specific responsibilities that define offensive and defensive strategies Understanding these roles allows coaches to develop targeted training programs so that enhances teamwork and skill development. Player actions: Actions such as dribbling, shooting and passing influence body position and posture. Successful execution requires coordination and situational awareness, as players can adjust their actions based on their teammates and opponents' positions. Overall, the interaction of these factors is critical to improving basketball coaching and performance. Their research helps coaches equip athletes with the skills and strategies they need to succeed in competitive situations. As shown in **Table 5** and **Figure 11** represents the values of error rate has occurred lower of body posture at 1%, player position at 1.2% and player action at 0.80%.

Table 5. Numerical outcomes of error rate.

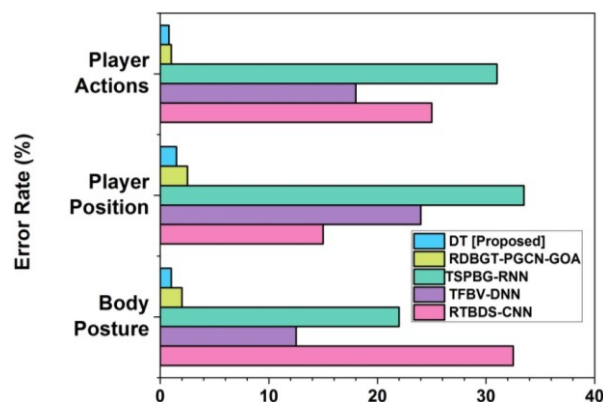| Error rate (%)	Body posture	Player position	Player action
RTBDS-CNN	32.5	15	25
TFBV-DNN	12.5	24	18
TSPBG-RNN	22	33.5	31
RDBGT-PGCN–GOA	2	2.5	1
DT [Proposed]	1	1.5	0.80

Figure 11. Error rate.

4.4. Discussion

Basketball is a fast-moving sport that requires coordination, strength, and ability. The improvement of players' skills and performance in the context of PE is contingent upon the success of basketball tactics training. WDL's intricacy is one of its drawbacks, since it can make implementation and interpretation difficult. Wide linear models and deep neural networks add to the computational burden and need meticulous hyper parameter adjustment, which can limit accessibility and scalability in some applications. The difficulty of GRNs is one of its limitations since it can outcome in superior computing operating expenses for implication and preparation. Since GRN gating systems need additional calculation, learning can be slowed and real-time submission can be disadvantaged in contexts with limited property. Although DNN contains immense probability for investigative basketball strategy in physical instruction, their difficulty is the huge quantity of data and dispensation power they necessitate. Moreover, DNNs can find it complex to appreciate intricate tactical plans, which can decrease their capability to offer thorough preparation insight. The proposed DT approach responds by lowering the computing load, humanizing interpretability, and reorganizing the investigation of intricate basketball strategies. The constraints of WDL, GRNs, and DNNs in PE contexts are overcome by DT's simple arrangement and effectual algorithms, which make it available and scalable and enable additional capable player skill improvement. The findings from the experiment highlight significant advancements in the evaluation and optimization of basketball tactic training. The proposed Decision Tree (DT) method outperforms traditional models, achieving an accuracy of 97.37%, compared to 90.87% for Wide and Deep Learning (WDL), 94.84% for Gated Residual Networks (GRN), and 94.97% for Deep Neural Networks (DNN). This superior accuracy implies that the DT method provides a more reliable prediction of basketball strategies, enabling physical education (PE) instructors to make informed adjustments during training. Moreover, the DT method exhibits a precision score of 96.37%, surpassing WDL's 91.81%, GRN's 93.51%, and DNN's 93.85%. This high precision indicates that the players are executing tactical maneuvers more successfully, reinforcing the effectiveness of the proposed training regimen. In terms of recall, the DT method achieves a score of 93.99%, compared to 90.15% for WDL, 90.58% for GRN, and 91.92% for DNN. This high recall value signifies that players are not only able to execute learned tactics but also recover and implement these strategies effectively

during games.

5. Conclusion

In this study, the DT method is enhanced to evaluate the basketball strategies' preparation effect for PE. The DT technique efficiently anticipates team strategy by analyzing player position and ball control data, which produces greater preparation outcomes. Because of this, the DT algorithm shows promise as a useful tool for improving basketball training programs' efficacy in PE settings, leading to improved player development and performance outcomes. The physical data will be created by utilizing basketball datasets to identify basketball tactics. To enhance the data by removing noisy data, video processing is used in the data pre-processing. Also, effectively determine the set of features through the use of MFCC. The proposed decision tree (DT) method exhibits a strong performance in basketball system training, achieving 97.37% accuracy, which indicates high reliability in prediction group strategies Its 96.37% accuracy score indicates high success in different strategies implementation in, while a recall score of 93.99%, show how effective the players are in recalling and applying the taught techniques These results highlight the potential of the DT method to improve basketball coaching in practice.It is important to carefully evaluate the validity and application of the DT algorithm since, despite its effectiveness; it can have drawbacks related to player skill variances, coaching approaches, and low-quality and generalizable training data. Future research could enhance the decision tree (DT) approach by integrating real-time data analysis for adaptive training strategies in basketball. Extending the dataset to include different skill levels of players would improve the generalizability of the model to different situations. Furthermore, combining DT techniques with advanced machine learning (ML) techniques can increase the prediction accuracy. Exploring the application of the DT algorithm in other sports could expand its usefulness. Longitudinal studies could also assess the long-term effects of DT-based training on player development and performance outcomes, ensuring the effectiveness of training programs.

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