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# Video Analysis of Physical Education Teaching and Design of Intelligent Assistant Teaching System: Based on Motion Recognition and Optimization Algorithm

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***Abstract:* -** Nowadays, science and technology has rapidly increasing due to the specific requirements of education. The main aim of this technique is to enhance the physical education activities and helps sports man to finest teaching facilities of these activities. Moreover, the body changes with sports activities based on Deep Learning (DL) frameworks and classifier technology are examined to promote the practical application. Therefore, this paper Deep Reinforcement Learning based Chimp optimization (DRLbCO) algorithm was developed to improve the teaching efficiency of physical education system through the intelligent computer aided assessment models. Also, this model improving the performance, enhancing coaching effectiveness, and gaining competitive advantages in sports. Consequently, the proposed system is based on DL based image detection model DRL, which can analyse and provides proper actions in teaching students and enhance the ability of motion analysis in sports video training quality. Moreover, the DL model is integrated with optimization algorithm to optimize the performance. This could involve reinforcement learning, and other classifiers such as Support Vector Machine (SVM). Based on this provides feedback to students and teachers during physical education classes. The developed model is significantly enhances the physical education teaching student action in virtual sports instruction. Overall intention of the video assessment system of the sports training performance in analyzed.

***Keywords:*** physical education, Deep Learning, Chimp optimization, Support Vector Machine, video assessment

## 1. Introduction

In the modern era, physical education teaching system has increasing exponentially and several Artificial Intelligence (AI) models were incorporated to improve the effectiveness of the teaching process [1]. Also, sports training is rapidly increased towards the video processing technology. Continuous driven advancement technologies are widely used in physical education system, which makes better cater to the various requirements and traits of students [2]. Many of the sport training strategies are adapted in AI models as the effective sports training models. These models can structured the customized training management for physical activity based students on their training requirements, athletic abilities and physical features [3]. In addition, real time sport monitoring system can provides appropriate advice as well as insights. This monitoring system helped as individualized and scientifically analysing student sport systems [4].

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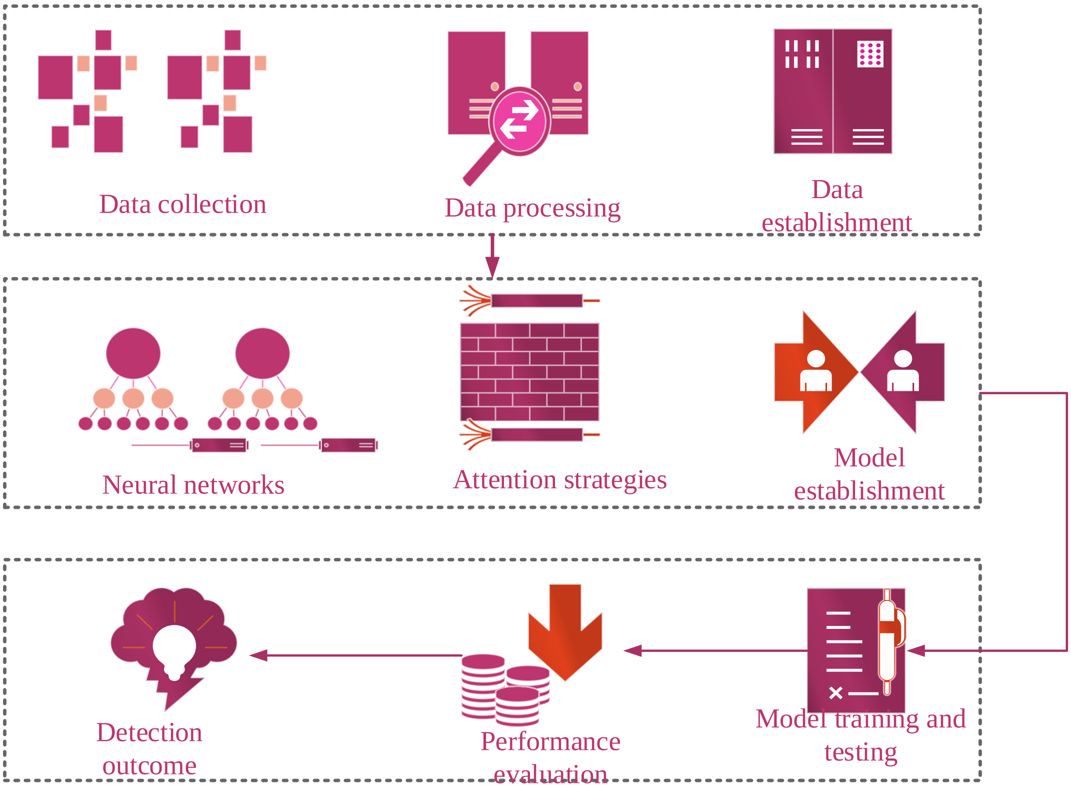


**Fig.1 overall process of Physical education system**

Fig.1 demonstrates that the overall process of physical education system and their detailed functions. Moreover, this process includes three stages such a data preparation, data establishment and prediction process [5]. Data preparation includes data collection, processing and division of datasets. Then, data establishment has integrates neural networks and attention strategies for their improvement. Finally, implementation process are done and prediction outcomes are displayed as student actions [6].

Intelligent teaching systems in educational technology nowadays mostly depend on pre-programmed lesson plans and models; they are not flexible enough to adjust to the unique demands and variations of each student [7]. This issue results from the systems' focus on preset teaching methods, which ignores pupils' unique needs and dynamic advancement. Furthermore, these systems frequently aren't flexible enough to react to the complex dynamics of the learning process, which makes it difficult to make timely modifications based on input and performance from students [8]. This study suggests an intelligent-assisted physical education teaching model based on high-order complex networks to improve current technology in order to address these issues, take into account student individual characteristics, and recognise the special context of physical education [9]. The field of intelligent technology is constantly changing, especially in light of the growing use of AI in sports [10].

The rest of this paper is divided into six sections: In Section II, recent related papers based on the physical education system and its assessment process. Section III, discuss problem statement and section IV, outline the proposed methodology and describe the details of each. In section V, the proposed platform is analysed and the results are discussed. In section V, conclusions are drawn and the scope of future endeavours is discussed.

## 2. Related Works

***Some of recent related studies based on the physical education system and its assessment process are listed below,***

To enhance the simulation of physical education system intelligent image denoising approaches are widely used. However, that are decline the image quality due to their disturbed noise and teaching effect. Therefore, Huang *et al*, [13] have developed the intelligent image denoising based optical principle algorithm to diminish the noise interference as well as improve the characteristics assessment process. Initially, denoising algorithm is enabled in filtering and mathematical operations to remove the noise.

Sport video recognition is the most important concern in the current scenario, but the conventional algorithms are having some drawbacks in managing optical issues. Thus, to increase demand of image optical processing system Qiao *et al,* [14] have introduced a Convolution Neural Network (CNN). Generally, it is the functioned for computed vision application to achieve better understanding as well as video recognition results. Consequently, experimental outcomes show that the CNN model has higher recognition accuracy for all sport video motions. Finally, this model provides efficient training program to trainees and individual athletes.

To address the existing issues like motion blur and illumination change Yong *et al,* [15] have proposed infrared image sensor based DCC-Net network strategy. Moreover, this technique can manage and improve the sports data training performance. Also, CNN model in integrated to extract the motion information from the infrared images. Consequently, proposed network is an important sports data management model, which can offer more accurate raining and comprehensive coaches. Compared to traditional model developed model has better performance as stable motion data.

Traditional and exiting sports training strategies are aimed as sports environment fields and visual inspection of coaches. These are inefficient model and does not extends to raise the level of sports training. Therefore, Zhang et al, [16] have developed the Particle Swarm Optimization (PSO) model to apply the human motion detection in physical training. Initially, update all population size and learning rates according to the sports videos. Then, noise removal, video decoding and video improvement processes are performed to attain the athlete's performance and enhance the training effect.

## 3. Motivation

Data quality and quantity is the challenging task because wide range of dataset and different datasets training process makes harder particularly for physical activities in physical education teaching system [16]. Moreover, video data has applied to manual labelling for DL models so the training process can take more time and subjectively it is generates the potential errors. Interaction among the multiple individuals such as class room, team based activity can be computationally demanding and difficult. Consequently, offering the immediate feedback is complex specially managing the difficult neural networks [17]. Sometimes it may be requires larger computation time software implementation performance gets degraded. In the deep neural networks has black box models so the model interpretability was difficult for achieving low latency. Furthermore transfer learning model also makes the difficulties such as data privacy, lower training time, etc. [18].

## 4 Proposed methodology

With efficient and proper physical education teaching system is designed to found a coherent and balanced learning strategy was emerged and directly changes the durability. Moreover, these teaching system can resolve the learners and educators gap towards the computer based evaluation process. In this paper, an intelligent Deep Reinforcement Learning based Chimp optimization (DRLbCO) algorithm was introduced to improve the physical education teaching system. Here, video datasets are taken and converted into the frame format for further processing performance. Then, data cleaning ore pre-processing was enabled to eliminate the irrelevant data from the video frames. After that, extract the motion vectors and denotes the movement direction among the two consecutive video frames. Here, also motion video key frame extraction takes place to predict the temporal and spatial significance all fame from the video.

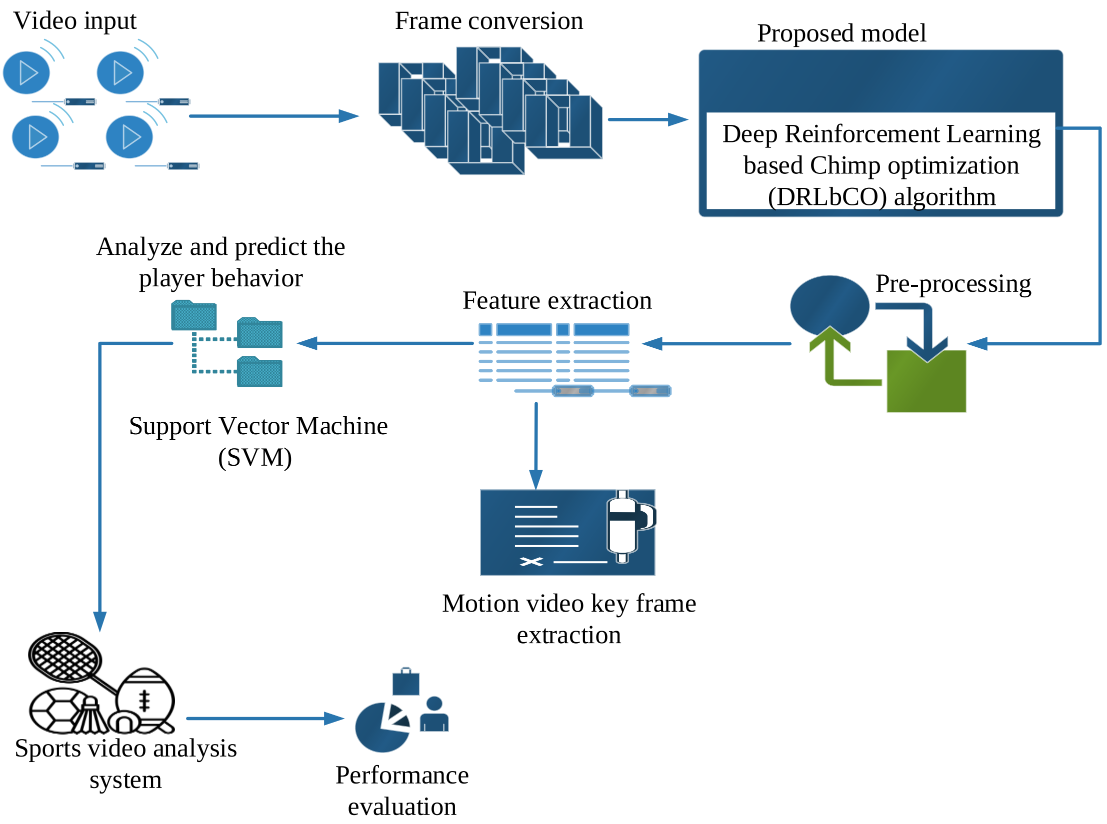


**Fig.2 Proposed sports video analysis system using DRLbCO**

After the key frame extraction, analyze and predict the player behaviour using SVM classifier and finally the prediction results were verified in terms of chimp optimization fitness function. Furthermore, Contextual vector information is a crucial component for addressing the fluctuation in video length is to take the average of all video features and feed that averaged vector into the model each time duration. The overall design of sports video analysis system is illustrated in fig.2.

### 4.1 Dataset description

EduNet dataset were taken for this work it includes unconstrained video which is downloaded from the YouTube and captured from the classroom, etc. This videos has poor lightning effect and cluttered background. 70% data can be utilized in training purpose and remain 30% of data performed in testing process.

### 4.2 Sports video analysis system

Use strategically placed cameras to record training sessions or athletic events in high-quality video from pertinent angles and viewpoints. To present a variety of perspectives, including wide-angle, close-up, and overhead views, use numerous cameras. For convenience and organisation, save video content in a cloud-based platform or centralised repository. Use metadata indexing and tagging to group movies according to participants, date, location, and sport kind. Mark significant plays, goals, assists, fouls, and turnovers in the film with the use of annotation tools. Annotate the video using text or graphics to draw attention to particular scenes, actors, or areas of interest. Moreover, sports video analysis system is shown in fig.3.

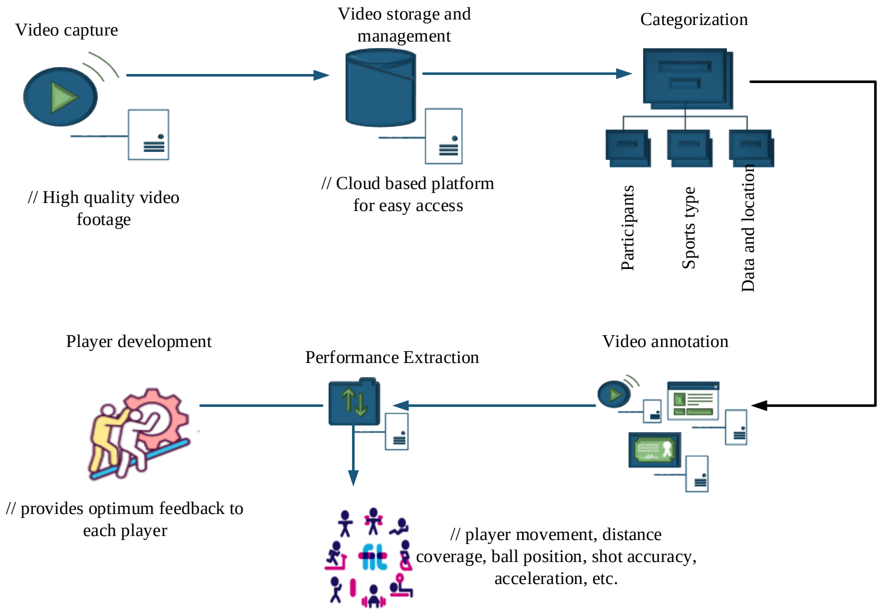


**Fig.3 Sports video analysis system**

To assess the performance of the team and the individual, extract performance indicators from the video, which is demonstrated in fig.4. Examine elements including player mobility, acceleration, distance travelled, ball possession, shot quality, and tactical placement. To automate the process of extracting performance measures from video footage, use specialised software or algorithms. Examine the team's plans, tactics, and formations used in the match or practice. Determine opposing tendencies, set-piece tactics, attack and defence transitions, and playing patterns. To help players and coaches understand tactical principles and methods, use video teleseminar techniques. Based on each player's performance in the video, provide them individual feedback. Determine where technique, judgement, placement, and teamwork need to be improved.  Using video analysis, create customised training regimens and activities to target particular areas of weakness or emphasis. Examine video recordings of rival teams to learn about their advantages, disadvantages, and methods of play. To help with game planning and strategy, identify important players, tactical formations, set-piece routines, and defensive weaknesses. As a coaching tool, use video analysis to teach players tactics, strategy, and game principles. During video review sessions, give participants visual feedback to help them learn and to reinforce coaching ideas. Work together with the coaching team to create training programmes and methods that take into account the knowledge gleaned from video analysis. In sports at all levels, from amateur to professional, sport video analysis is essential for improving performance and helping coaches make decisions. It also gives athletes a competitive advantage. Sports teams and individuals can maximise training, enhance performance, and accomplish their objectives on the field of play by utilising video footage as a rich source of data and insights.

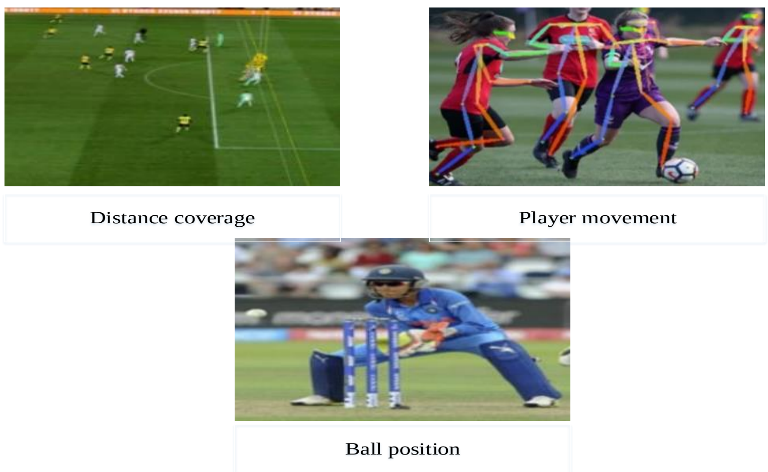


**Fig.4  Performance extraction**

**4.3 Design process**

Initially, collect the data for physical education video analysis of video recordings of physical activities in an educational setting. It includes, student movements, teacher interactions, and multiple actions like player movement, ball position, distance coverage, acceleration etc. Also, exercises, sports drills, or any other relevant activities conducted during physical education classes and sport activities. Here, the collected video datasets are converted into frames then is this fed into the action layer of the DRL network using eqn, (1),

$$A_l(i) = V\,(f_1, f_2, f_3, \ldots\ldots\ldots\ldots\ldots f_n) \tag{1}$$

Where, $A_l(i)$ is denoted as action layer (input layer) of DRL network, $V$ is represents video and $f_1, f_2$ is video frames. Then, pre-processing is enabled to normalize and resize the video frames by adjacent the frames. This will helps to decrease the consistence as well as computational requirements. Here, the frames are resize into the $64 \times 48$ pixel format and picture signal algorithm was applied to remove the artifacts and background clutters using eqn. (2),

$$f\,(c) = sign\ \{D_{ct}[\,f\,(c)]\} \tag{2}$$

Where, $f\,(c)$ is denoted as colour channel for each video frames and $D_{ct}$ is denoted as function of discrete cosine transform. Then, this converted signal is again transformed by the inverse operation and mapped into image reconstruction fields with spatial domain using eqn .(3),

$$f'(c) = ID_{ct}[\,f'(c)] \tag{3}$$

Where, reconstructed image is denoted as $f'(c)$ and $ID_{ct}$ is represents function of inverse discrete cosine transform. Consequently, temporal smoothening is performed to reduce the noise and temporal variations. Also, it can identify the changes among the consecutive frames to differ from the motion information. Then, static saliency map ( $s'(f)$ ) is calculated with normalization interval at [0, 1], which is mentioned in eqn .(4),

$$s'(f) = G^* \times \sum_c f'(c)\,\Theta\, f'(c) \tag{4}$$

Where, $G^*$ is represented as Gaussian kernel function, convolution operation is represents $\times$, and $\Theta$ is denoted as Hadamard operation. In the feature extraction phase randomly set the cropping and zooming the frames. Several attention values in many algorithms using a linear fusion approach to create a fused attention value. The general form of the linear fusion strategy is as follows if there are $n$ attention values to be fused in eqn (5) and (6),

$$A(l) = \sum_{n=1}^{i} W_n a_n \tag{5}$$

$$\sum_{n=1}^{i} W_n = 1 \tag{6}$$

Where, $W_n$ is denoted as weighting factor of the attention score $a_n$ and attention value is represents $a_n$. After finishing this phase the multiple attention values are integrated using linear fusion strategy. Then, DRL action phase information is essentially related to the static space information. So the dynamic attention of each frame weights are considered as $W_t$. Therefore, dynamic saliency map of each video frames are analysed using following eqn. (7), (8) and (9),

$$W_t = \delta \cdot a_{1-}\delta \tag{7}$$

$$\delta = \max[ds'(f)] - \min[ds'(f)] \tag{8}$$

$$W_s = 1 - W_t \tag{9}$$

Where, $W_s$ represents weighting factor of spatial significance, difference among the maximum and minimum dynamic saliency map function ($ds'(f)$) is denoted as $\delta$. The delta value is greater in the dynamic saliency map ($ds'(f)$) with strong motion information, and vice versa. This leads to a higher weight of the dynamic attention weight $W_t$ of the frame $f$ . SVM model is integrated with COA to analyse and predict the player behaviour. According to that physical education system is designed with proper parameters. The chimp colony is a society based on fission and fusion. This type of society is one in which colony size or composition varies over time as members disperse over the surrounding area. Group composition is an ever-changing characteristic for chimpanzees living in fission fusion colonies. This video motion analysis stage consist two model such as SVM and COA. The proposed framework uses SVM to extract the video frame features with dynamic information. Output layer of the DRM network SVM and optimization algorithm is integrated to enhance the action recognition performance. The integrated SVM with optimization function is mentioned in following eqn. (10), (11),

$$\vec{d} = \left| c.y_p(t') - p.y_c(t') \right| \tag{10}$$

$$y_c(t'+1) = y_p(t') - \vec{a}.\vec{d} \tag{11}$$

$$\vec{a} = 2.f'(c).\vec{r} - f'(c) \tag{12}$$

Where, $t'$ represents total number current iteration, $\vec{a}$, $p$ and c denoted as coefficient vectors in terms of context vectors. $y_p$ is denoted as prey position with hyper plane, $y_c$ is represented as chimp position with perpendicular hyper plane and $\vec{r}$ is random vector or normal vector. Based on that above equation an effective sports analysis system is designed then we have verify whether the designed system is active proper using eqn. (13),

$$y_c(t'+1) = \begin{cases} y_p(t') - \vec{a}.\vec{d} & if\ \delta < o.5 \\ chatic\ \_core & if\ \delta > 0.5 \end{cases} \tag{13}$$

Where, the coefficient vectors are tuned in chaotic maps to determine the random behaviour of the teaching system. The suggested approach collects physical education data, resizes the module, and imitates the sporting tea protocol. A true athletic training systems control mechanism is presented in this work. The fundamental stages of the early data processor and athletics calculation of the real athletic training programme are innovated by the algorithms. This method can improve the teaching atmosphere, raise the correctness of training instances, and ultimately raise the system's overall efficiency and scientific quality. The three stages of the real motion control approach are: starting streaming video speed, partially polynomial fitted energy, and dynamically mounting incline data.

| **Algorithm:1 Proposed DRLbCO algorithm** | | |
|---|---|---|
| | ***Input:*** *sports video dataset* | |
| | ***Output:*** *effective Physical education teaching system* | |
| **Start** | | |
| | *Initialize the video dataset* | *// input layer of DRL* |
| | **Frame conversion** | |
| | int $V \Rightarrow f_1, f_2$ | *// video is converted into frame format* |
| | **Pre-processing** | |
| | Image resize $64 \times 48$ pixel | |

$f(c) \Rightarrow$ colour channel (each frames) *// picture signal algorithm*

$D_{ct} \Rightarrow$ discrete cosine transform

*Image reconstruction*

$ID_{ct} \Rightarrow$ inverse discrete cosine transform

*static saliency map*

$G^{*}$ with $\Theta$

**Feature extraction**

*linear fusion approach*

$W_n \Rightarrow a_n$ (attention score)

**Keyframe extraction**

$ds'(f) \Rightarrow W_s$ *// dynamic saliency map function*

*Function of COA and SVM* *// output layer of DRL*

$t' \Rightarrow \vec{a}$, $p$ and c *// coefficient vectors*

**Verification**

effective sports analysis system is designed

**Stop**

**Finest outcomes**

## 5 Result and discussion

The suggested DRLbCO strategy were implemented utilising 4GB of RAM and an Intel (R) Core (TM) i5 processor in the mathematical and constrained programming language environment of MATLAB/Simulink R2018b.

### 5.1 Case study

Children who engage in teacher exercise are more able and more motivated to engage in a variety of physical activities both within and outside of schools. A robust curriculum for athletic education strongly encourages children to engage in a high volume of physical activity. They develop a wide range of abilities and effectively use methods, strategies, and idea composition. The pupils consider their actions, evaluate the situation, and decide when necessary.

Let us consider, 100 students and 5 physical education teaching facilities. Initially, analyse the average participation ratio of varying datasets from minimum 50 and maximum 600 with 50 step size. Moreover, analyse done separately both male and female student participants. Here, dataset size increase at ha same time user performance decrease with respect to their teaching system. Moreover, fig.5, Shows that the Average participation ratio of proposed DRLbCO model. Here the implemention is done with maximum and minimum level of dataset variations. From the outcome participants rate is decrease when changing the dataset.

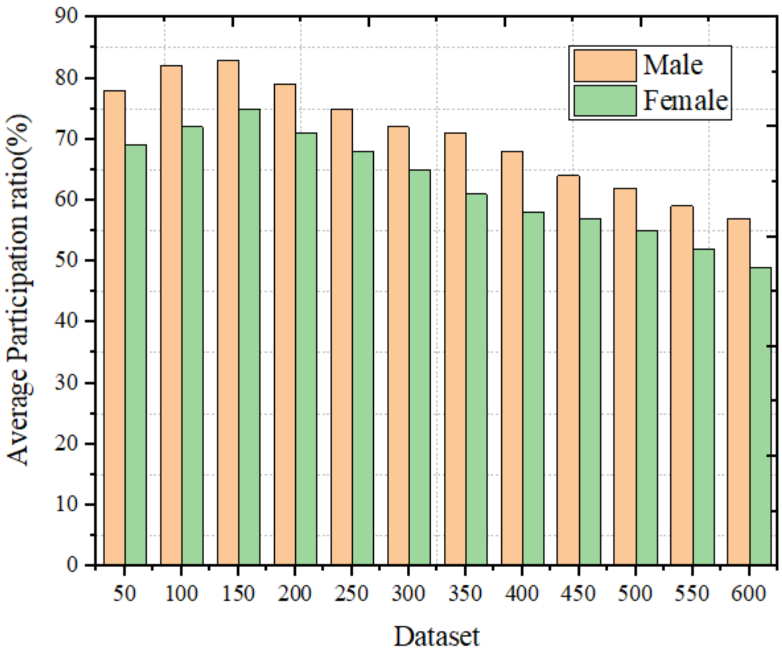


**Fig.5 Average participation ratio**

In the evaluation score is also analysed seprately both female and male participants. The corresponding evaluation scores also change as the dataset gets larger.

Compared to other models, the suggested DRLbCO model evaluation-based educational system yields better outcomes since it accurately assesses the participants' efficiency. In terms of performance, the male candidates outperform the female ones. Moreover, fig,6 demonstrates that he evaluation score of proposed DRLbCO model.

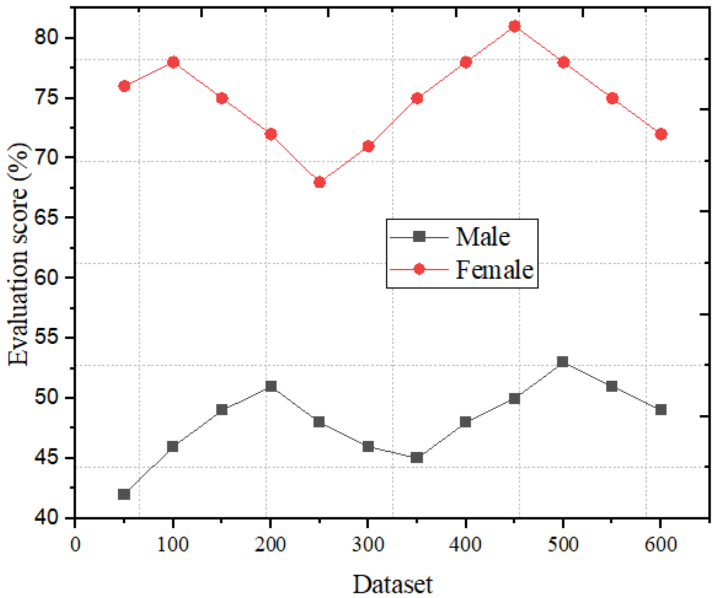


**Fig.6 Evaluation score**

**5.2 Performance evaluation and comparison**

The efficiency of the developed DRLbCO model is analysed in terms of recognition accuracy, precision, computaion time. Moreover, the achieved outcomes ae compared with various traditional strategies such as long short term memory (LSTM) [19], CNN [20], ResNet model [21], Fuzzy Logic (FL) [22] and Neural Netwok [23] which is mentioned in table.1.

**Table.1 overall perfomance**

| **Parameters**<br>Techniques | **Recognition Accuracy (%)** | **Precision ratio (%)** | **Computation time (s)** |
|---|---|---|---|
| LSTM | 87 | 87.5 | 23 |
| CNN | 91.4 | 91 | 12 |
| ResNet | 78 | 80 | 34 |
| FL | 82.6 | 82.3 | 5.78 |
| NN | 93.55 | 92 | 21 |
| Proposed | 99.3 | 99 | 0.2 |

The proposed DRLbCO model was utilized physical education teaching assessment obtained from kaggle database for physical activity recognition. It demonstrates finest values are reported for an entity. Moreover, accuracy is one of the metrics used to evaluate the performance of a recognition system. The accuracy is defined as the ratio of correctly identified instances to the total number of instances in the dataset. It is expressed as a percentage. The implementation outcomes of data recognition accuracy has better performance while comparing other models. Moreover, fig, shows that the comparison of data recognition accuracy. Precision is the ratio of true positive predictions to the total predicted positive instances. It measures the accuracy of positive predictions. The time complexity of the algorithm itself is a crucial factor. Algorithms with lower time complexity generally require less computation time. Efficient implementation and optimization of algorithms can significantly reduce computation time. The size of the dataset being processed affects computation time. Larger datasets generally require more time to process. Data reduction techniques, such as feature selection or dimensionality reduction, can helps to mitigate this problems.

## 6 Conclusion

Using video recordings to evaluate and improve instruction strategies, student participation, and the general efficacy of physical education classes is known as video analysis of physical education teaching systems. Teachers and administrators can enhance teaching quality, provide important insights into instructional methods, and give students a more engaging and productive learning environment by methodically using video analysis into physical education curriculum. Here, this paper a novel DRLbCO model is developed to analyse the physical education teaching system. Moreover, the model is implemented in MATLAB platform and performance are calculated in terms of accuracy, precision, and computation time. In, future the work will further extended by integrating neural network and applied to the various education domain applications.

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