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# Alsaif Dataset Creation and Evaluation for Gymnastics Movement

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## Abstract

Computer vision systems play a major role in many areas of life, as reliance has clearly begun on these systems in the medical field, where they help doctors diagnose diseases correctly. In addition, they are relied upon in the sports field, where they can help referees in giving correct arbitration decisions. The accuracy of computer vision systems has increased with the emergence of deep learning techniques, which require a large amount of data on which a deep learning model can be trained. Therefore, if any deep learning model is relied upon to detect and distinguish any movement or any entity within images or video clips, it must first Training this model on a set of images of these movements or objects to be discovered and distinguished. From this standpoint, this article presents the construction of a database for one of the important games, the gymnastics game, which is popular in many countries. A database has been built for the gymnastics game, which can be used in the application. Deep learning models were developed in order to help coaches and referees in this game, and for these movements there is no database available on the Internet. A group of video clips

spread on the Internet was relied upon to build this base, where ten basic movements in the game of gymnastics were distinguished, and one of the models was evaluated. Deep learning on these images (yolo7).

**Keywords:** Gymnastics Sports, Creation Dataset, Computer vision, Deep Learing.

## Introduction

The player must possess a variety of skills in order to participate in the gymnastics game. These skills include the ability to maintain balance, flexibility, and strength. The reason for this is that the majority of the actions in this game are dependent on these characteristics. These characteristics include those that depend on strength, such as stability movements, as well as certain movements that require a high amount of flexibility, particularly in certain postures. In this game, the arbitration procedure and point distribution for backward somersaults are very dependent on the player's ability to execute these movements in the exact sequence that is specified [1].

The analysis of the gymnast's motions is a highly significant topic. Analyzing these motions can be advantageous as it can elucidate the player's shortcomings and prevent possibly injurious movements. The reason for this is that conventional approaches depend on the deployment of sensors positioned at different areas on the player's body. These sensors collect data, which is then used to calculate values and quantify the player's performance [2].

Among the subfields of computer science is the field of computer vision. In the present moment, it has been utilized in a wide range of applications and fields, including engineering, industry, and medicine. Complex mechanisms were utilized by the factories in the past in order to monitor the products. When monitoring the product, the worker must exercise extreme caution. Some of the products that have been passed over might not be good if the worker is ignored or if their expertise is insufficient. if

this occurs, the process will be accurate, but at the same time it will exhaust the workers, which will result in an increased demand for additional workers [3].

When it comes to any field, whether it be medicine, sports, or any other field, the primary objective of constructing a computer vision system is to acquire an image. When that is done, the component of his image can be analyzed, which means studying its content. an example of this would be the identification of the movement of an object or a particular color in an image through tracking it within that image, particularly in the context of medical diagnosis [2,3]. to be more specific, the process of constructing a computer vision system is a simulation of the human vision system. The difference between them lies in the fact that the human eye is used in the human vision system, whereas digital cameras are used in the computer vision system [2-4].

As can be seen in figure (1), the algorithms that are utilized in the process of examining the relationship between the components are analogous to the method in which the human mind operates. Human eyesight versus computer vision is depicted in Figure 1. The use of computer vision systems and deep learning has become increasingly prevalent in a variety of sectors, including sports, in order to achieve the most favorable outcomes. Computer vision and deep learning techniques are utilized in the field of sports to assess the movement of players inside stadiums. This analysis is performed in the context of the sports industry. Through the use of these tactics, coaches are able to select the playing strategy as well as the best players who are capable of putting this strategy into action by studying the findings gained from analyzing the performance of the player.2[4].

The Application of Computer Vision in Olympic Sports Among the numerous fields that make use of computer vision is the sporting world. There are a number of computer vision systems that can be deployed in this respect for the purpose of determining the location of players or the ball, as well as tracking their journey inside

the field. In addition, coaches can reap the benefits of such methods when it comes to the process of studying the strategy employed by their opponent. Due to the fact that these systems could be of assistance to the referee in order to rectify a decision that might be made as a result of insufficient view, this decision will be erroneous. A scenario like this demonstrates the need of utilizing computer vision technology [5].


Figure (1): Human vision vs. Computer Vision

**Deep learning:**

This field has brought about fundamental changes in a number of different areas, including the deep learning field, which was created by the neural network (NN) sub-field on it. Deep learning is a specialized branch of the machine learning field that was inspired in the 1950s by models of computation and human cognition. Deep learning

represents a small branch in the artificial intelligence field. Since it was first introduced, deep learning has been responsible for even more significant disruptions, demonstrating resounding success in every field of application [6-8]

Deep learning can be either a hierarchical learning model or a deep construction method. Learning refers to a method that is used to estimate the parameters of the model in order to design an algorithm that is designed to perform a specific task as well as possible. On the other hand, deep learning has numerous layers between input-output layers that allow for many non-linear processing units for information in several stages of a hierarchical structure. This structure is used for the purpose of feature learning. Learning approaches that are based on data representation are referred to as representation the learning, and some recent work has described deep learning (DL) as a learning model that is comprehensive and capable of delivering solutions to a wide variety of issues in a variety of scientific domains [9].

There is a collection of techniques known as representational learning, which involves providing a machine with unprocessed data in order to discover the representations that are required for the categorization and discovery process. Deep learning techniques are representational learning modes that consist of several levels of representations produced from simple non-linear units. These representations are transformed from lower to higher levels in a hierarchical fashion, and with sufficient transformation, they are able to learn extremely complex functions. This is the point of strength when compared to the traditional approaches that are used in machine learning (Deep learning is based on data-driven learning algorithms, which are used to generate feature layers. These feature layers are represented by various levels in a hierarchy [10-12].

## The Popular Concept of Deep Learning

The intelligent system (AI) can learn and improve experiences based on the experience

gained through data known as machine learning (ML), where machine learning algorithms require that the input data be represented appropriately for the purpose of giving correct predictions. Each representation for the project characteristics which enables a system to make decisions is known as a feature, as learning by representation (RL) helps machine learning algorithms not only learn the feature map but can also help the representation itself. But the problem of learning by representations is that it does not help in solving feature extraction, which represents essential abstract properties that bring the system to critical decisions in prediction in realism applications. Deep learning (DL) works on studying these difficulties and building complex representations based on simple representations and having multi-layered abstractions [13-15]. The algorithm allows models consisting of several processing layers to work on and learn to represent that data using abstractions from several layers. Figure 2. shows the relationship between the field of deep learning, teaching representations, the discipline of machine learning, and artificial intelligence's last field [16].

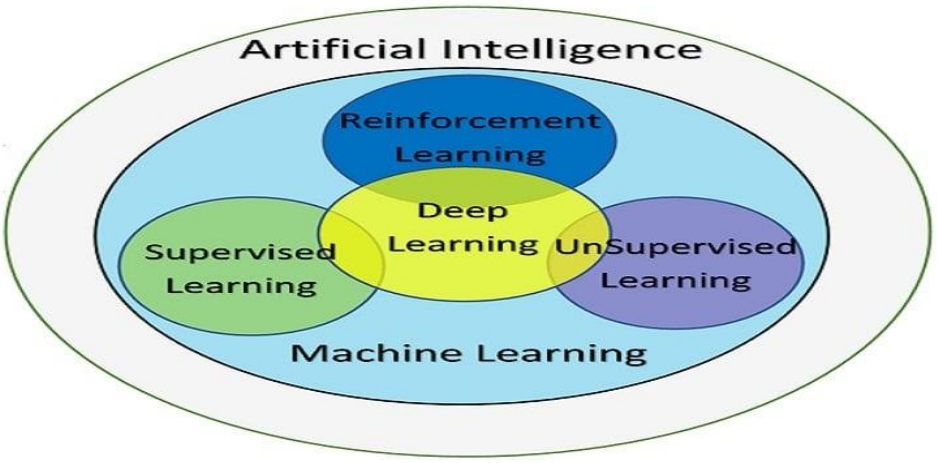


Figure 2: The relationship between fields, AI, ML, RL, and DL

**Gymnastics Sprot**

Gymnastics is a sport that requires strength, flexibility, balance, coordination, and physical fitness. It is a comprehensive sport that includes performing complex and varied movements on different tools or directly on the ground. Here is an explanation of the most important types of gymnastics [17-19]:

**Artistic Gymnastics:** This category includes performing exercises on equipment such as vault, uneven bars, balance beam, and floor exercises. This category relies on strength, flexibility, balance and coordination to execute artistic movements with the utmost precision and mastery.

**Rhythmic Gymnastics:** This category relies on performing exercises coordinated with music using hand tools such as rope, ring, ball, plates, and ribbons. Players combine power, precise control and elegance in executing movements.

**Trampoline Gymnastics:** This category includes performing acrobatic movements and high jumps on a trampoline. Skills in this category require strength, air control, and coordination to execute movements accurately and at the highest possible height.

**Aerobic Gymnastics:** This category focuses on performing exercises that contain repetitive aerobic elements, such as jumping, spinning, and strong movements, in coordination with music. This class requires strong fitness, flexibility and physical coordination.

Gymnastics requires hard work and regular training to develop the necessary skills. It is considered an exciting sport and is very popular all over the world, whether for participation in sports competitions or as a recreational activity for children and adults alike.

## Dataset Creation

In this paragraph, we will discuss the method by which a dataset was built for the movements of the gymnastics player, which is not available on the Internet. Therefore, this is considered the first database in this field that will be available on the Internet. It was built to study 10 basic movements in the game of gymnastics, which are the movements of strength and stability in the throat apparatus, which It is intended for men because these movements require a lot of strength to perform, and therefore they will be intended for men The next step will explain the process of building it in detail, in addition to its website through which one can access and deal with it.

## Data Collection

Hence, it is apparent that this game lacks popularity in numerous regions. The variation in popularity of these games across different countries is attributed to the differing levels of infrastructure required for this genre of game. Consequently, these rooms are not universally accessible due to a scarcity of certified gyms in various countries. In Iraq, we utilized a compilation of video clips and images that were widely circulated on the internet. Additionally, we incorporated a small assortment of pictures obtained from the Education for Physical Sciences department at Tikrit University. After the event, we depended on high-quality video clips. This compilation of video clips was first converted into a series of individual frames, which were subsequently converted into a series of photographs. Figure 4 displays an example of one of these images.

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Figure (4): ALsaif Dataset

## Data Augmentation

Deep learning models require a substantial quantity of photos during the training process, and the accuracy of the outputs generated by the model is directly influenced by the amount of images utilized in training. Consequently, it is preferable to train the model using a substantial volume of data in order to achieve extremely precise outcomes and so avoid inaccuracies. It is essential for the model to be trained on a large number of images. However, it is preferable for these images to have diversity in terms of lighting conditions and viewing angles of the objects. Therefore, it is ideal to avoid obtaining these effects. It is more advantageous to employ software that can apply a set of effects to these photographs, including modifying the composition and rotating them from multiple perspectives.

## Data Annotations

At this point, annotations will be made on the images of the gymnast player's moves that were captured on the static ring apparatus in the gymnastics game contained in the dataset. In addition, a thorough investigation was conducted on the ten most

significant movements in this game. To enable the deep learning model to distinguish these motions, it is necessary to accurately identify the images of these movements. During the testing phase, we utilized the roboflow application to complete the task of annotating the images with comments. Figure 5 showcases a compilation of photos that have been accompanied by remarks.


Figure (5): ALsaif Dataset Annotation

The annotated technique will result in squares that are enclosed by images of the gymnast's movements and contain a compilation of information. The information will be contained within these squares. The framework of the deep learning model (yolov7) can collect five distinct bits of information. Aside from the image's locations inside the original image, the primary piece of information is the image's classification. Furthermore, the dimensions of the image depicting the gymnast's movements, which will serve as the training data for the deep learning model, are also provided in this information. Figure 6 displays an instance of the format that is stored in text format.

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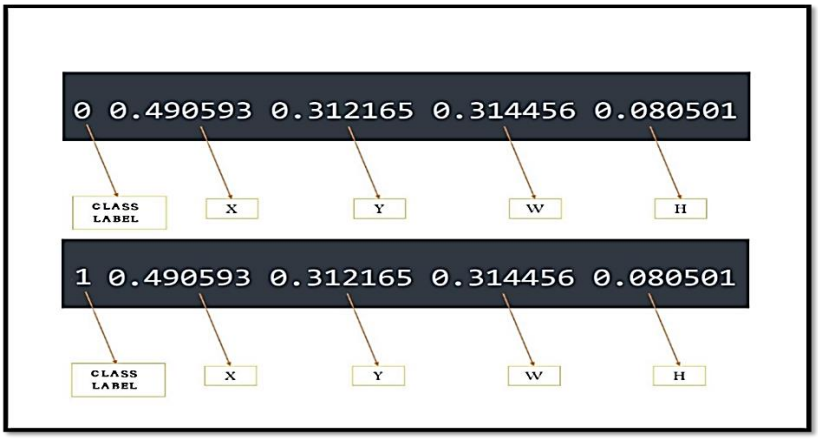


Figure (6): Label Alsaif Dataset

## Dataset Splitting

After the data has been collected and a set of effects have been added to the images, the data is now divided into groups for training and testing. The following algorithm shows the method of dividing the data.

**Algorithm 2): split the dataset**

**Input:** images Dataset
**Output:** Training data, Testing data
**Begin**
**Step1:** Get Gymnastics Movements images from the dataset
**Step2:** Define img_num = number of images in the dataset file
Define n=0 // define checker variable
**Step3:** Divide the dataset into the training set and Testing set
**for** i ← 1 **to** end of dataset file size **do**
**Begin**
**if** n< 0.8* img_num
Training data = images (i)
n=n+1
**else**
Testing data = images (i)
**End**

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## Evaluation Alsaif Dataset

The deep learning model employed in this thesis was assessed on different dataset partitions to identify the most accurate split of the data. The dataset was split into two halves, with 70% of it allocated for training and the remaining 30% for testing. Furthermore, it was expected that a quarter of the data would be allocated for testing, whereas three-quarters of the data would be allocated for the testing process. During the training phase, the algorithm showed that the best division happened when 100% of the data was used, which corresponded to eighty percent. Based on the performance of the deep learning model provided in this thesis, Figure 7 illustrates an evaluation of the model's performance on different partitions of the dataset.

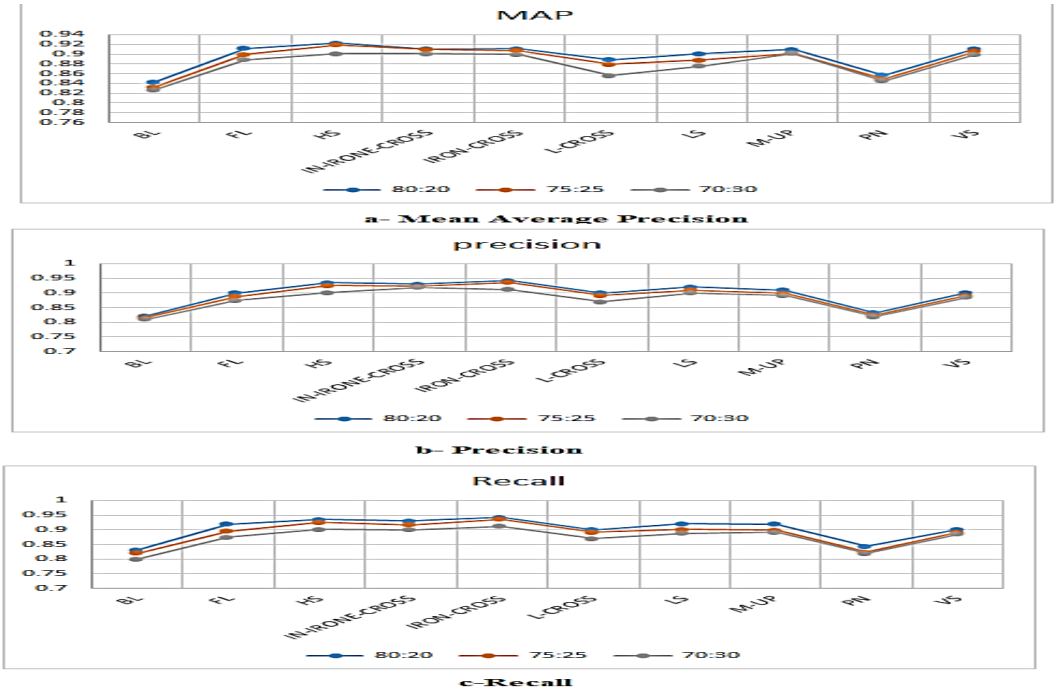


Figure (7): Evaluation Alsaif Dataset



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## Conclusion

Relying on computer vision systems in the sports field is very important, especially in the arbitration process, in order to obtain high accuracy in arbitration decisions instead of relying on the human vision system, which may be subject to error as a result of poor vision for the referees, in addition to the fact that referees sometimes have little experience in Some arbitration cases, or the referee may be sympathetic to one of the teams. Providing databases for games that are not widely spread, such as football or basketball, will open new horizons for researchers to apply models of deep learning to these data. This database contains approximately 2,200 divided images. There are 10 types of movements for the gymnast on the throat apparatus, and the database is available on the Rap Flow website and at the following link: https://app.roboflow.com/alsaifforgymnastic-edhbc/alsaif_for_gymnastic/2

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