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A Survey On Human Action Pattern Recognition For Physical Training Using Machine Learning

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Abstract: Understanding human action patterns is essential for many things, like keeping an eye on your health or figuring out how to get better at sports. This paper presents a novel approach to human action pattern recognition system using physical training for children activities. In this approach, children do exercises. The recognition system is developed by using a varied dataset of physical training attendees performing different exercises. With the use of computer vision and machine learning to implement logistic regression to track and categorize these actions, with consideration given to both spatial and temporal aspects. This real-time recognition system doesn't just accurately identify actions; it also provides physical training for children with personalized feedback and recommendations enhances the fitness experience and promotes proper exercise form to prevent injury. Through this approach, the aim is to broaden the accessibility of action pattern recognition, making it available to a larger group of individuals. The impact is felt in fitness, healthcare, and sports performance analysis, nurturing improved exercise habits and overall well-being

***Key Words*:** Logistic Regression(LR), Machine Learning, Computer Vision, Human action recognition

I. INTRODUCTION

Human action pattern recognition using physical training for children is a cutting-edge field at the intersection of technology and exercise, aiming to transform the way we approach fitness. It involves the development and application of intelligent systems that can see and analyze human movements and actions during workouts in a physical training environment. Picture a physical training where, in addition to human trainers, advanced technology plays a pivotal role in guiding, monitoring, and optimizing your fitness routines. These systems utilize computer vision, sensors, and machine learning algorithms to track your exercises, assess your form, and provide real-time feedback, essentially acting as virtual fitness assistants. This innovative integration of technology into fitness holds the potential to enhance safety, effectiveness, and motivation in our exercise regimens. In this discussion, we will explore the key elements, applications, benefits, challenges, and future prospects of human action pattern recognition using physical training for children technology.

The fusion of human action recognition and fitness technology represents a remarkable advancement in our quest for healthier and more effective workout routines. This technology harnesses the power of computer vision, which allows machines to understand and interpret visual data, much like the human eye. It accomplishes this by deploying cameras and sensors within the physical training environment, enabling the real-time tracking of individuals' movements and actions. These systems, underpinned by sophisticated algorithms and machine learning techniques, can identify various exercises and gauge the correctness of each movement.

The applications of this technology in physical training for children are vast and versatile. Primarily, it offers invaluable guidance on exercise form and technique, ensuring that physical training children perform their workouts correctly, thereby reducing the risk of injuries. It can also tailor workouts to individual goals, monitoring progress and dynamically adjusting routines as users grow stronger. Beyond this, it collects and analyzes data to provide insights into exercise habits, promotes motivation through gamification, and

proactively alerts users to potential injury risks. In group fitness settings, it facilitates the simultaneous monitoring and correction of multiple participants.

The potential benefits of integrating human action pattern recognition into physical training for children are numerous. Safety is significantly enhanced as users receive real-time guidance on proper exercise form. Improved results are another advantage, as users benefit from tailored, data-driven workouts that can optimize their progress. Motivation and consistency are fostered through gamification and rewards, promoting long-term engagement. Furthermore, the data collected provides users with the means to make informed decisions about their fitness journeys, making their physical training experiences more efficient and effective.

However, the implementation of this technology is not without its challenges. Privacy concerns arise due to the use of cameras in physical training settings, necessitating clear policies and consent mechanisms for data collection. The cost of implementing such systems can be a barrier for some physical trainings. It is also vital to ensure that the technology augments the user experience without feeling intrusive or overwhelming. The accuracy of the recognition algorithms is paramount, as misinterpretations could lead to incorrect feedback or advice, potentially causing harm. Data security and user education on how to interact with the technology effectively are also crucial considerations.

As the field of human action pattern recognition using physical training for children technology continues to evolve, it holds the promise of even more exciting developments. The integration of health monitoring features is a possibility, further enhancing the user's fitness journey. With the rise of home workouts, this technology may find applications in remote fitness training and monitoring.

II. LITERATURE SURVEY

Table 1 : literature survey

Ref.no	Paper Title and Paper publication	Year	Methodology Used	Accuracy	Research gap Identified / Future Scope
[1] P. William, Govinda Rajulu Lanke, Dibyhash Bordoloi, Anurag Shrivastava, Arun Pratap Srivastavaa, Sheetal Vishal Deshmukh	Title: Assessment of Human Activity Recognition based on Impact of Feature Extraction Prediction Accuracy Journal: IEEE	2023	It introduces accelerometers and gyroscopic sensors which are used in human activity recognition	94%	Feature extraction techniques should be improved
[2] Shamsa Waheed, Dr. Rashid Amin, Dr. Javed Iqbal, Dr. Mudassar Hussain, Muhammad Adeel Bashir	Title: An Automated Human Action Recognition and Classification Framework Using Deep Learning Journal: IEEE	2023	It provides human activity recognition by using different types of sensors	89%	Real time applications and performance must be increased.

[3] Isha Chaudhary, Nongmeikapam Thoiba Singh, Mahak Chaudhary	Title : Real-Time Yoga Pose Detection Using OpenCV and MediaPipe Journal- International Conference for Emerging Technology (INCET)	2023	It proposes a model which includes human posture detection by using deep learning and computer vision.	96%	Human-computer interaction must be improved.
[4] R. Gera, K. R. Ambati, P. Chakole, N. Cheggoju, V. Kamble and V. R. Satpute	Title: Classifying Human Activities using CNN and ConvLSTM in Video Sequences Journal: International Conference on Paradigm Shifts in Communications Embedded Systems, Machine Learning and Signal Processing (PCEMS)	2023	It is based on computer vision and deep learning technologies. The cameras are required for the capturing the video. It uses CNN and ConvLSTM	85%	Security and privacy must be improved.
[5] S. B. Prakash, V. Amudha,M. N	Title: Title: Efficient Human Action Recognition using Novel Logistic Regression Compared over Linear Regression with Improved Accuracy Journal: International Conference on Science Technology Engineering and Mathematics (ICONSTEM)	2023	It describes about novel logistic regression algorithm. It takes samples among that it divides in 2 groups. Accuracy of novel logistic regression algorithm is more than linear regression algorithm	90.42%	The paper does not explain about optimization

[6] Vachirapon Ketsoi, Muhammad Raza, Haopeng Chen, Xubo Yang	Title: A secure approach for human computer interaction using human hand action Journal: IEEE International Conference on Systems, Man, and Cybernetics (SMC)	2022	It uses temporal relation network (TRN) for action recognition and a face recognition-based security network (FRB-SN) for user identification	91%	Security and intuitive interaction should be there
[7] Bardia Esmaeili, Alireza AkhavanPour, Alireza Bosaghzadeh	Title: Surya Namaskar: Real-time advanced pose recognition and correction for smart healthcare Journal: International Conference on Machine Vision and Image Processing (MVIP)	2022	It proposes a model for human body posture recognition. This model is used to recognize human posture correctly. It uses deep convnets which are used to classify postures of RGB images	93%	Performance should be improved
[8] Minjung Lee, Seoung Bum Kim	Title: Sensor-Based Open-Set Human Activity Recognition Using Representation Learning With Mixup Triplets Journal: IEEE Access	2022	Concept of human activity recognition which is based on sensors. Mahalanobis distance (MTMD) which is mixup of triplets is used	75%	Accuracy and performace must be improved
[9] Yaqian Zhang, Jizhuang Hui, Tao Zhou, Kaiyang Zhang, Kai Ding, Weiwei Wang	Title: Efficient skeleton-based Human Assembly Action Journal: IEEE	2022	It uses the concept of data augmentation. To extract 3D features of the skeleton of human, graph convolution network is used.	93%	Virtuals training environment must be improved

[10] Jaeyeong Ryu , Ashok Kumar Patil , Bharatesh Chakravarthi , Adithya Balasubramanyam , Soungsill Park , Youngho Chai	Title: Angular Features-Based Human Action Recognition System for a Real Application With Subtle Unit Actions Journal – IEEE Access	2022	It tried three experiments. This paper has trained the system which recognizes each pose of human. It is also helpful in the transformation of variations of different actions into consistent patterns	82%	Gap between training the data
[11] J. Ji	Title:Action Recognition based on Human Pose Estimation Journal- International Conference on Computing and Data Science (CDS)	2021	Deep learning in human pose recognition is improved	80%	3D pose should be estimated
[12] Ming-Fong Tsai , Chiung-Hung Chen	Title: Spatial Temporal Variation Graph Convolutional Networks (STV-GCN) for Skeleton-Based Emotional Action Recognition Journal- IEEE Access	2021	It uses emotional features and Graph Convolutional Network	80%	Emotional recognition accuracy must be enhanced
[13] Ajay Chaudhari , Omkar Dalvi , Onkar Ramade , Prof. Dayanand Ambawade	Title: Yog-guru: real-time yoga pose correction system using deep learning methods Journal- IEEE	2021	This system uses convolutional neural networks (CNN)	95%	Gap between accessible yoga practice
[14] H. R. Patel , J. Tejaskumar Doshi	Title: Human Action Recognition in Dark Videos Journal- International Conference on Artificial Intelligence and	2021	It describes about action recognition and image processing. It takes one dataset and examine the performance and accuracy. The dark videos are divided into images[	84%	Security must be improved

	Machine Vision (AIMV)				
[15] H. Bai	Title: A Training Method For VideoPose3D with Ideology of Action Recognition Journal- International Conference on Signal Processing and Machine Learning (CONF-SPML)	2021	It gives training for videopose3D. It requires less amount of data for human activity. Action based and post estimation problems can be worked	80%	Real time action recognition and accuracy must be improved.

III.PROPOSED WORK

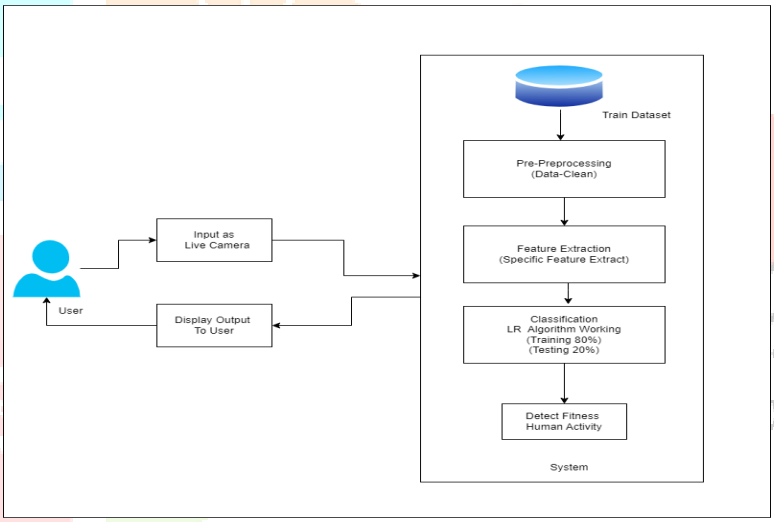

figure 1. System Architecture

3.1 Data Collection:

Prepare a dataset of physical training for children activities, recorded using cameras. Annotate the data with labels for different actions.

3.2 Data Pre-processing:

The process of collecting fitness-related data, including motion data, biometric measurements, and environmental variables. Emphasize the significance of data quality and its role in accurate action recognition.

3.3 Feature Engineering:

Feature engineering involves selecting and transforming raw data into meaningful and informative features that machine learning models can use for accurate recognition of human actions. Engineer features that capture the relevant information for action recognition. Normalize or standardize the features to ensure they have similar scales.

3.4 Model Selection:

Logistic regression has been selected as the baseline model for its innate simplicity and interpretability, making it an ideal starting point for action recognition within a physical training setting. It is important to acknowledge that while logistic regression offers a straightforward approach, it may have inherent limitations in effectively capturing intricate and nuanced actions.

3.5 Model Training:

Train the logistic regression model on the training dataset, with a particular focus on optimizing hyperparameters, including the regularization strength, through the use of cross-validation techniques.

3.6 Model Evaluation:

Assess the logistic regression model's performance on the testing dataset, employing pertinent metrics such as accuracy, precision, recall and the construction of a confusion matrix.

Our proposed study introduces an innovative amalgamation of human action pattern recognition and the gamification of physical training for children. In contrast to conventional fitness regimens, our approach is designed to captivate users in a dynamic and interactive manner, thereby transmuting their workout sessions into captivating and engaging experiences. The fundamental constituents of our proposed work encompass:

Interactive Fitness System: We are in the process of developing an interactive fitness system that utilizes computer vision technology to identify and analyze users' movements during their physical training exercise routines. This intricately designed system is intended to provide real-time feedback and comprehensive guidance, incorporating a range of gamified elements with meticulous attention to detail. These elements are thoughtfully integrated to enhance user motivation and elevate the overall enjoyment of their workout sessions.

Information about training: System provides the basic information of training acticity which includes name of exercise, benefits of training.

Alert Message: If any training exercise goes wrong, it displays the alert message with sound.

This innovative approach serves fitness thereby rendering exercise more engaging and ultimately more efficacious. Children are expected to anticipate their workout sessions with enthusiasm, leading to enhanced adherence and overarching health advantages. Our proposed initiative exhibits substantial potential to transform the prevailing paradigm of how individuals perceive and engage with fitness, offering a solution to the challenge of exercise adherence while concurrently promoting sustained well-being.

IV. MATHEMATICAL MODELLING

Logistic regression is a statistical method used for binary classification problems . It takes the outcome variables in terms of 0 and 1. It uses the logistic function to produce probabilities in terms of 0 and 1.

The logistic regression hypothesis function is given by

$$h_\theta(x)=\frac{1}{1+e^{\theta^T x}} \quad (1)$$

$h_\theta(x)$ is the predicted probability, θ is a vector of parameters (weights) associated with each feature.
x is the feature vector.
e is the base of the natural logarithm.
By finding the values of θ, the logistic regression model is trained.
The cost function for logistic regression is the log-likelihood cost function:

$$J(\theta) = -\frac{1}{m}\sum_{i=1}^{m}\left[-y^{(i)}\, log(h_\theta\,(x^{(i)})) + (1-y^{(i)})\, log(1-h_\theta\,(x^{(i)}))\right] \quad (2)$$

V.CONCLUSION

We have surveyed the papers which includes linear regression algorithm. We will implement system for single user at a time by using logistic regression with MediaPipe Framework. We will also use the concept of computer vision. This system will become a fusion of technology-guided human movement, enhance its appeal and make it more enjoyable. By using logistic regression algorithm in machine learning, we will not only accurately recognize and monitor different physical actions but also provide tailored feedback. We will also work on unseen action. The system will be designed which will more precise, helpful and easy to use.This will help to encourage safer and more efficient workout routines for individuals

VI. REFERENCES

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