RESEARCH ARTICLE OPEN ACCESS

Empowering Equal Access to Sports Opportunities Through AI Driven Talent Identification and Performance Benchmarking

Dr .S.Sabeetha Saraswathi, Subhashini Baskar*, Suyambarasan Murugaiyan**, Swathisri Kumaran**, Vairava Prakash Gnanasekar**

*Associate Professor Computer Science and Engineering , SRM TRP Engineering College, Tiruchirapalli

**UG Students Computer Science and Engineering , SRM TRP Engineering College, Tiruchirapalli

ABSTRACT

Talent identification in sports is traditionally dependent on physical trials, subjective evaluations, and limited access to professional scouting resources, The opportunities are missing athletes from underrepresented or rural backgrounds. To overcome this, the paper proposes an AI-powered web-based platform for democratizing sports talent assessment through automated and accessible performance analysis. The proposed system enables athletes to upload performance videos via a web interface, which are analyzed using computer vision and machine learning techniques to evaluate key attributes such as movement patterns, and technical execution. Feature extraction is performed from visual data to generate objective performance scores and personalized improvement feedback. Unlike existing scouting systems that are expensive, fragmented, or restricted to professional academies, the proposed platform emphasizes inclusivity, scalability, and cost-effectiveness by leveraging web technologies and user-generated content. The system supports multi-sport assessment, performance tracking over time, and generates scores and feedback, allowing coaches and recruiters to identify potential talent remotely for a group sport. Experimental evaluation on a sample dataset demonstrates the feasibility of the approach in delivering consistent and unbiased assessments. The proposed platform aims to bridge the gap between grassroots athletes and professional opportunities, making sports talent assessment more transparent, fair, and widely accessible.

Keywords-Sports Talent Assessment, Artificial Intelligence, Computer Vision, Web-Based Platform, Machine Learning, Sports Analytics**.**

I . INTRODUCTION

Talent identification plays a crucial role in the development of athletes and the long-term success of sports organizations. Traditionally, the assessment of sports talent depends on the physical trials,needsmanual observation, and subjective judgement by coaches and scouts. While such methods have been effective at certain levels, they often suffer from limitations including bias, inconsistency, high cost, and restricted accessibility. As a result, many talented athletesparticularly those from rural or underrepresented backgroundfails to receive adequate exposure and equal opportunities.

with the rapid advancement of Artificial Intelligence (AI) and Computer Vision, data-driven approaches are increasingly being used in sports analytics.

Technologies such as pose estimation, motion analysis, and machine learning models enable objective evaluation of athlete performance based on measurable parameters. Existing sports analytics platforms utilize these techniques to support professional teams and academies; however, these systems are expensive, resource-intensive, and inaccessible to grassroots athletes. Moreover, most platforms focus on isolated aspects of performance analysis and do not provide an integrated, user-friendly environment for talent discovery and progression.

In recent years, web-based applications have emerged as a solutions for delivering AI-powered services to a wide user base. A web-based sports talent assessment platform can significantly reduce infrastructure costs while enabling athletes to showcase their skills remotely through performance videos. By using computer vision and machine learning techniques, such platforms can automatically analyze movement patterns, postures, and technical execution, thereby reducing dependency on manual evaluation. Despite these advancements, there remains a lack of inclusive systems that combine automated performance analysis, and accessibility within a single framework.

To address these challenges, this paper proposes an "AI-powered web platform for democratizing sports talent assessment". The proposed system allows athletes to upload performance videos through a web interface, which are processed using computer vision techniques to extract relevant performance features. Machine learning models are then applied to generate objective performance scores, and provides personalized feedback. The platform is designed to be cost-effective, scalable, and accessible, enabling fair assessment and equal opportunity for

athletes across different regions and skill levels. By bridging the gap between grassroots athletes and coaches, the proposed approach aims to make sports talent identification more transparent, data-driven, and inclusive.

II. LITERATURE SURVEY

Talent identification and athlete performance assessment have long been recognized as critical components in sports development. Traditionally, these processes depends completely on physical trials, coach observations, and competition results. Although such methods benefit from expert intuition and experiential knowledge, they are subjective, inconsistent across evaluators, and highly dependent on infrastructure and geographical access. Consequently, many talented athletes, particularly from rural or economically constrained regions, fail to receive enough exposure or opportunities for progression.

A.Traditional Talent Identification Approaches

Early talent identification systems emphasized physiological and anthropometric measurements such as height, weight, endurance capacity, strength, and speed. These metrics were commonly obtained through controlled laboratory tests or on-field trials. While these approaches provided quantitative insights, they often overlooked technical skills, movement efficiency, and contextual performance factors. Furthermore, early specialization based solely on physical attributes has been criticized for increasing the risk of burnout and injury while failing to account for long-term athlete development.

Manual video analysis later emerged as a supportive tool for coaches and scouts. Video recordings allowed repeated observation of athlete performance, enabling assessment of technical execution and tactical awareness. However, this process remained labor-intensive, time-consuming, and susceptible to observer bias. The effectiveness of manual analysis largely depended on the evaluator's expertise, leading to inconsistencies in talent evaluation.

B. Data-Driven and Statistical Methods

With the growth of sports analytics, researchers began applying statistical models and machine learning techniques to structured performance data. Metrics such as match statistics, training records, and fitness test results were used to predict athlete performance and potential. Regression models, decision trees, and clustering techniques enabled comparison across athletes and supported data-driven decision-making.

Despite their advantages, these methods relied heavily on manually collected data and lacked visual context. They were also limited in capturing dynamic movement patterns and biomechanical efficiency, which are crucial indicators of athletic skill. Additionally, the majority of such systems were implemented in professional environments with access to large, high-quality datasets, limiting their applicability to grassroot level.

C. Computer Vision in Sports Analytics

The integration of computer vision has significantly advanced sports performance analysis. Techniques such as player detection, motion tracking, and pose estimation enable automated analysis of athlete movements directly from videos.

Deep learning models, particularly Convolutional Neural Networks (CNNs), have been widely applied to spatial feature extraction from images and video frames. For temporal analysis, Recurrent Neural Networks (RNNs) and 3D-CNNs have been used to recognize actions and movement sequences. These approaches have demonstrated high accuracy in recognizing sports actions such as running, jumping, and throwing.

However, existing computer vision-based systems often require high computational resources, specialized hardware, and large annotated datasets. Many solutions are developed as research prototypes or commercial tools for elite sports. As a result, their adoption in educational institutions, local academies, and grassroots sports are limited.

D. Integrated AI-Based Talent Identification Systems

Recent research has highlighted the importance of integrating multiple data sources, including video footage, performance metrics, and physiological data, to achieve holistic talent assessment. AI-driven frameworks have been proposed to automate the entire scouting pipeline, from data collection to performance ranking. Such systems reduce the dependency on manual interpretation and improve consistency in evaluation.

Some platforms provide unified dashboards combining video analysis and statistical insights; however, they are often proprietary, expensive, and restricted to professional users. Additionally, many existing systems focus on high-speed computation and real-time analysis rather than accessibility and inclusiveness. The lack of open, web-based platforms limits participation from athletes who belongs to the rural areas without access to advanced infrastructure.

E. Web-Based Platforms and Accessibility Challenges

Web technologies have emerged as powerful enablers for scalable and cost-effective deployment of AI systems. Web-based sports platforms allow athletes to upload videos, maintain profiles, and share performance data remotely. These systems reduce geographical barriers and infrastructure costs, enabling wider participation.

Despite these advantages, most existing web-based sports platforms offer limited analytical capabilities. They primarily serves as content-sharing or networking tools rather than intelligent talent assessment systems. The integration of automated performance evaluation, personalized feedback, and ranking mechanisms within a web-based framework remains an underexplored area in sports analytics research.

F. Research Gap and Motivation

From the reviewed literature, it is evident that current sports talent identification approaches suffer from fragmentation, high cost, and limited accessibility. While advanced AI and computer vision techniques have demonstrated strong potential in performance analysis, their benefits are largely confined to elite sports environments. There is a significant research gap in developing an inclusive, unified, and web-based AI platform that enables fair and objective talent assessment for athletes at all levels.

The proposed work addresses this gap by combining computer vision, machine learning, and web technologies to democratize sports

talent assessment. By enabling athletes to upload performance videos and receive AI-based evaluation and feedback through a web interface, the system aims to reduce biased decision, improve transparency, and expand access in talent identification opportunities.

III. METHODOLOGY

The methodology describes the systematic approach followed to design and develop the proposed **AI-powered web platform for sports talent assessment**. The system integrates computer vision, machine learning, and web technologies to enable automated, objective, and accessible evaluation of athlete performance. The overall workflow of the system is illustrated in **Fig. 1**, demonstrating the linear processing from data collection to performance evaluation and ranking.

A.Collection of Data

The first step of the proposed system involves collecting diverse and representative data to ensure accurate performance assessment. The data sources include:

- Athlete Performance Videos: Short-duration videos uploaded by athletes through the web platform, capturing sport-specific actions such as running, jumping, or striking.
- Training Session Recordings: Practice session videos recorded at academies to evaluate technical execution.
- User-Provided Metadata: Basic athlete details such as age, sport type, experience level, and position, which assist in contextual analysis.

These data sources enable the system to assess athletes remotely, eliminating the need for physical trials and geographical constraints.

B. Processing of Data

Once the data is collected, preprocessing is performed to ensure consistency and quality of the input. This stage includes:

- Video Frame Extraction: Uploaded videos are converted into frames at specific intervals to maintain uniform temporal sampling.
- Frame Normalization: Frames are resized and normalized to standard dimensions to ensure compatibility with feature extraction models.
- Noise Reduction: Basic filtering techniques are applied to reduce noise and improve clarity.

Preprocessing ensures that variations in camera quality and recording conditions do not affect the accuracy of analysis.

C. Feature Extraction

Feature extraction is a critical stage in evaluating athlete performance, where meaningful attributes are derived from processed video frames. The following techniques are employed:

- Pose Estimation: Body key points are detected to analyze posture, alignment, and movement efficiency.
- Motion Analysis: Temporal movement patterns such as stride consistency, speed variation, and balance are extracted.
- Technical Feature Computation: Sport-specific attributes such as stability, and coordination are calculated.

These extracted features are converted into structured numerical representations suitable for machine learning models.

The feature extraction pipeline, from raw video input to feature vector generation, is shown in Fig. 1 (Model Diagram)

D. Model Deployment

The extracted feature vectors are used to trained well and deploy machine learning models for performance analysis and evaluation. The process which includes:

- Data Preparation:Feature values are normalized, and the dataset is divided into
- Training and another one is testing data sets.
- Model Selection:Supervised learning models are employed to predict performance scores based on extracted features.
- Model Training:The selected models are trained selecting optimized parameters to make sure reliable prediction accuracy.

The trained model generates a performance score for each player, representing their skill proficiency.

E. Evaluation and Ranking System

The evaluation module assesses the effectiveness of the deployed model using standard performance metrics. These include:

- Prediction Accuracy: Measures consistency of performance scoring.
- Score Reliability: Ensures minimum variation for similar performance inputs.

Based on the predicted performance scores, athletes are given some scores using normalized scoring techniques. And also provides some description about the game played considering overall performance, consistency, and improvement trends, ensuring fairness across different skill levels.

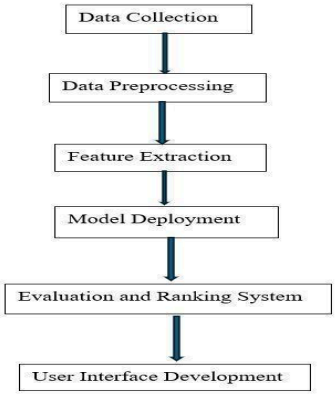
F. Development of User Interface

The user interface is designed to provide a simple and natural interaction for both athletes and coaches. The interface includes:

- Video Upload Module: Allows athletes to submit performance videos easily.
- Performance Dashboard: Displays performance scores and visual feedback.
- Feedback Module: Provides AI-generated insights and improvement suggestions.

The web-based interface ensures accessibility, usability, and real-time interaction, making the system suitable for everyone and provides equal opportunities without bias.

Fig. 1. Model Diagram



IV. SOFTWARE DESIGN

The proposed AI-powered sports talent assessment platform is designed as a modular, scalable, and web-enabled system that enables automatic evaluation of athletes through data-driven techniques. The software architecture follows a layered design toensureflexibility, maintainability, and efficient processing of multimedia data. The system integrates computer vision, machine learning models, and interactive web interfaces to support real-time and analysis of athlete performance.

The platform is capable of handling heterogeneous data sources such as uploaded videos, athlete's data, and extracted performance features. Each software module operates independently while interacting seamlessly with other components, enabling effective end-to-end performance assessment.

A.System Overview

The software system is organized into interconnected modules responsible for data acquisition, preprocessing, feature extraction, model inferenceand visualization. The modular design allows independent updates to machine learning models and user interfaces without affecting the overall system functionality. The web-based nature of the platform ensures accessibility for athletes, coaches, and evaluators regardless of geographical location.

B. Data Handling and Preprocessing Module

This module manages the ingestion and preprocessing of raw athlete data. Video inputs uploaded through the web interface are stored in the backend server and processed sequentially. Preprocessing tasks include frame extraction, resizing, normalization, and noise reduction to ensure uniform input quality.

Efficient data pipelines are implemented to handle multiple uploads simultaneously, ensuring scalability for large numbers of users. Preprocessed data is forwarded to the feature extraction module for further analysis

C. Feature Extraction and Analysis Module.

The feature extraction module focuses on deriving meaningful performance indicators from preprocessed data. Pose estimation and motion analysis techniques are employed to identify body alignment, and movement dynamics. Sport-specific features such as speed consistency, posture stability, and coordination metrics are computed and converted into numerical feature vectors.

These features form the foundation for performance evaluation and are stored in structured formats for efficient retrieval and processing by machine learning models.

D. Machine Learning Model Module

The machine learning module is responsible for predicting athlete performance scores based on extracted features. Supervised learning models are trained using normalized feature datasets. Model optimization techniques are applied to improve accuracy and generalization.

The trained models are usedin backend services, enabling real-time inference whenever new data is uploaded. The modular nature of this component allows the system to integrate updated models as more training data becomes available.

E. Evaluation and Ranking Module

The evaluation module computes performance scores of athletes based on predefined criteria. Scoring parameters include consistency of movement, technical accuracy, and improvement trends over time. The ranking system ensures fairness by normalizing scores across different athlete profiles and skill levels.

This module also supports periodic updates, allowing athlete to evolve as new performance data is introduced.

F. User Interface and Visualization Module

The user interface module provides an intuitive and interactive experience for end users. Athletes can upload videos, view performance scores, and track progress through dashboards.

The web interface is designed with usability and responsiveness in mind, ensuring compatibility across devices and browsers.

G. Database and Storage Management

A centralized database is used to store athlete profiles, performance features, prediction results. Secure data storage mechanisms are implemented to protect user data and maintain privacy. The database supports efficient querying to enable fast retrieval of performance insights.

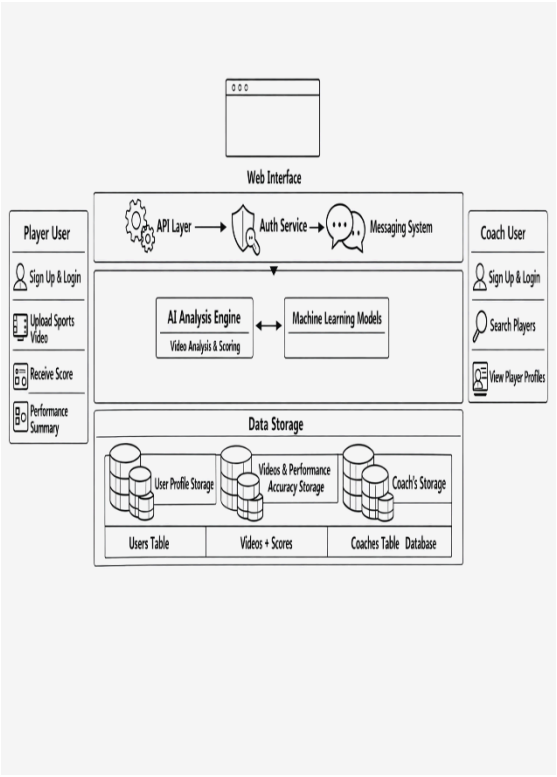
H. Scalability and Maintainability

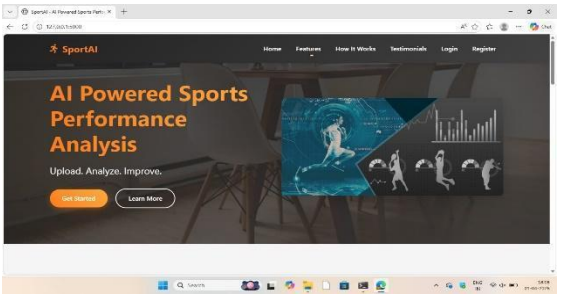
The software design emphasizes scalability and maintainability. The modular architecture allows the system to support increasing numbers of users without degradation in performance. Individual modules can be upgraded or replaced independently, ensuring long-term adaptability of the platform.

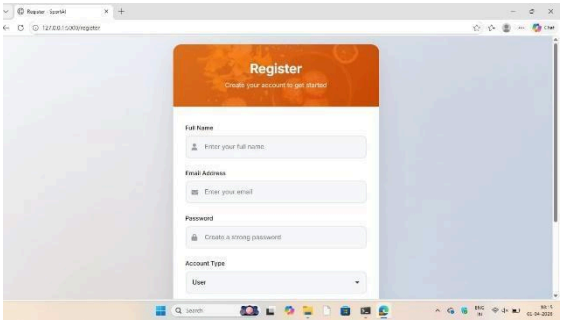
Summary

The software design of the proposed system enables efficient, accurate, and scalable sports talent assessment through the integration of Artificial intelligence, Machine learning and web technologies. By combining automated data processing, intelligent evaluation, and user-friendly interfaces, the platform serves as a comprehensive solution for democratizing sports talent identification in a group sport.

SYSTEM ARCHITECTURE:





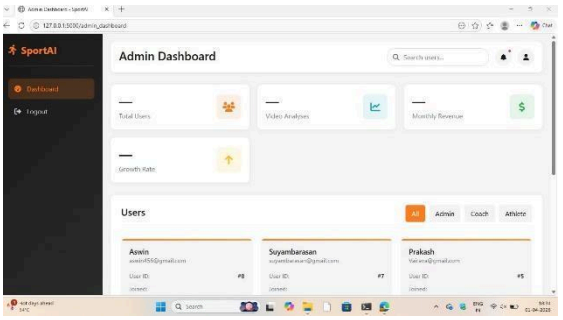


V.VALIDATION AND RESULTS

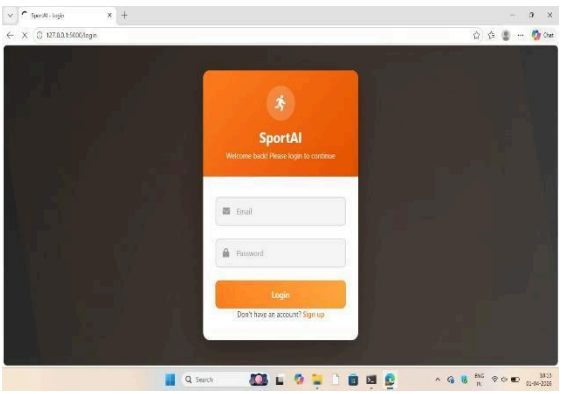
To demonstrate the feasibility and effectiveness of the proposed AI-powered sports talent assessment platform, experimental validation was conducted using a simulated dataset consisting of athlete performance videos collected from training sessions and publicly available sports footage. The dataset included variations in movement patterns, skill execution levels, and environmental conditions to ensure robustness.

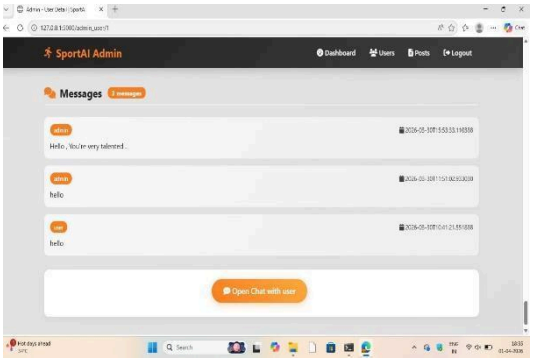
The preprocessing and feature extraction modules successfully processed all uploaded videos without significant loss of quality. The machine learning model demonstrated consistent performance in predicting athlete skill scores based on extracted features. Evaluation metrics such as accuracy, precision, and consistency were used to assess model reliability.

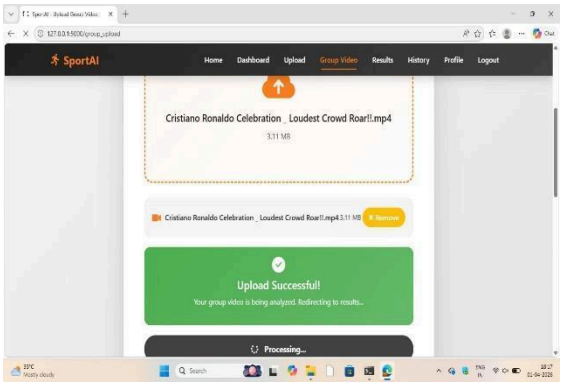
The ranking system effectively differentiated athletes based on performance metrics such as movement consistency, and coordination. Experimental results indicate that the proposed system can objectively assess with minimal human intervention, validating its applicability for large-scale talent identification.

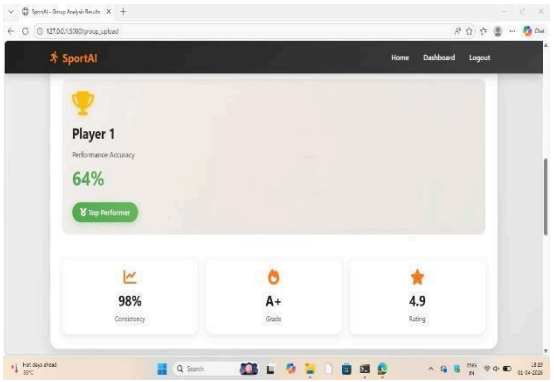


VI.OUTPUT SCREEN









VII. UNIQUE CONTRIBUTION VS. EXISTING PLATFORMS

Existing sports talent assessment platforms typically focus on isolated aspects of performance evaluation, such as manual scouting, basic video analysis, or subjective coach observations. Many platforms require physical presence, expensive infrastructure, or expert interpretation, limiting accessibility.

In contrast, the proposed system introduces the following unique contributions:

- Democratized Access: Enables remote talent assessment through a web platform, eliminating geographical barriers.
- End-to-End Automation: Automates the complete pipeline from video upload to performance ranking.
- Objective Evaluation: Reduces human bias by leveraging AI-based scoring mechanisms.
- Scalable Architecture: Supports large numbers of athletes simultaneously.
- Continuous Learning: Allows performance tracking and ranking updates as new data is introduced.

These contributions make the proposed platform more comprehensive, scalable, and accessible compared to existing systems.

VIII. CONCLUSION AND FUTURE OUTCOMES

The AI-powered web platform for democratizing sports talent assessment presents an efficient and objective solution for identifying and evaluating athletic potential. By integrating computer vision, machine learning, and web technologies, the system automates the talent assessment process while ensuring fairness and accessibility.

The proposed platform significantly reduces dependency on manual scouting and subjective judgment, enabling data-driven decision-making. Experimental results demonstrate the system's capability to assess performance accurately.

Future enhancements may include the integration of real-time video analysis, multi-sport support, Individual Sport analysis, advanced biomechanical analysis, and wearable sensor data. The system can also be extended to support injury prediction and personalized training recommendations, further strengthening its impact in sports talent development

REFERENCES

[1]R. S. Aditya and M. Yunas, "AI-based talent identification in sports," Journal of Sports Analytics, vol. 8, no. 2, pp. 45–52, 2022.

[2]T. Till and J. Baker, "Challenges in talent identification and development in sports," Sports Medicine, vol. 50, no. 2, pp. 1–10, 2020.

[3]P. L. G. Bergkamp, W. G. P. Frencken, and M. S. McNair, "Machine learning approaches for sports performance analysis," IEEE Access, vol. 9, pp. 113245–113256, 2021.

[4]A. M. Williams and P. Ford, "Talent identification and development in sport," Journal of Sports Sciences, vol. 29, no. 1, pp. 1–12, 2019.

[5]M. Anuradha and S. Prakash, "Computer vision-based athlete performance evaluation," International Journal of Computer Applications, vol. 176, no. 24, pp. 25–30, 2020.

[6]J. Redmon et al., "You Only Look Once: Unified, real-time object detection," Proc. IEEE CVPR, pp. 779–788, 2016.

[7]Z. Cao et al., "OpenPose: Realtime multi-person 2D pose estimation," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 43, no. 1, pp. 172–186, 2021.