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ADHD Detection in Children Using Pose Estimation Techniques

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ABSTRACT - *The "Children ADHD Disease Detection Using Pose Estimation Techniques" project seeks to transform the early diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) in children using sophisticated pose estimation algorithms. The novel method scrutinizes children's movement patterns and postures to detect possible symptoms of ADHD, providing a non-invasive and objective alternative to conventional assessment methods.*

ADHD, a neurodevelopmental condition that affects school performance and social function, stands to gain enormously from early detection and treatment. The project improves the validity and responsiveness of ADHD diagnoses through the use of PoseNet for pose estimation. The system records and analyzes the movement of the body during particular activities that are designed to trigger typical ADHD patterns of behavior.

The project uses sensors, cameras, or depth sensors to record detailed movement data such as joint locations, angles, and time information. This information is used as input for a trained Support Vector Machine (SVM) model, which makes predictions about movement patterns of ADHD versus normal development. While this technology is promising, it is meant to augment and not replace thorough clinical evaluation, since ADHD is a complex disorder that needs to be approached in a holistic manner. Ethical issues, specifically around data privacy and the possibility of misuse, also need to be considered.

This project is a major step forward in child mental health assessment. By bringing high-tech capabilities to the imperative of early and correct detection of ADHD, it can potentially enhance diagnostic precision, facilitate earlier intervention, and ultimately raise the quality of life in children with ADHD. Extensive testing and verification will be imperative to establish reliability, making this technique an important resource in ADHD assessment and care.

Key Words: *Detection of ADHD, Pose Estimation, PoseNet, Support Vector Machine, Movement Analysis, Early Diagnosis of ADHD, Child Mental Health, Machine Learning*

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I. INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental condition that impairs the academic achievement, social relationships, and general well-being of children. Early diagnosis is necessary to ensure timely intervention and better long-term prognosis. Current methods of ADHD diagnosis are based on non-standardized subjective assessments, including behavioural ratings scales, clinical interviews, and teacher reports, which lack consistency and are subject to personal biases. To overcome these constraints, this research investigates the use of pose estimation methods for objective evaluation of children's movement patterns and the identification of possible ADHD markers.

Computer vision and machine learning advancements have made data-driven behavioural analysis possible. Pose estimation methods such as PoseNet enable precise tracking of body movement, which can be used as an objective measure of ADHD behaviours. The work presents a new system that couples PoseNet with a trained Support Vector Machine (SVM) model for ADHD-related behaviour detection. The system takes advantage of real-time motion tracking via depth sensors or cameras to capture movement timing, angle, and position of joints and temporal movement patterns, which the SVM model distinguishes from regular development patterns to detect ADHD-related behaviour.

The intended system presents a robust ADHD detection technique with essential advantages: automated and objective detection, earlier ADHD behaviour identification, and non-invasive, scalable testing methodology. Through the integration of computational techniques and behavioural science, the research contributes to technology-driven mental health assessment. Further studies will involve the system validation by real-world testing, the treatment of data privacy-related ethical issues, and model optimization for enhanced performance and usability in the diagnosis of ADHD.

II. LITERATURE SURVEY

A standard Machine Learning (ML) system has a data acquisition mechanism, which can be cameras or other sensors. The data acquired is pre-processed in the form of filtering and normalization, and then it is split into training and validation sets. The training dataset, typically larger, is utilized to train machine learning models with particular hyperparameters, and the validation dataset tests the model's performance based on accuracy measures. If the precision is not to the desired levels, the hyperparameters are modified and the training process is again iterated.

2.1 Pose Estimation in ADHD Detection

Pose estimation methods have been extensively investigated for neurological disorder detection. Research has shown that pose estimation can offer an objective and measurable way to examine ADHD-associated behaviors. PoseNet algorithms can be used to monitor and assess children's movement patterns, detecting hyperactivity indicators. Through the use of movement data, researchers hope to improve the accuracy of ADHD diagnosis and minimize reliance on subjective measures.

2.2 Computer Vision-Based Behavioral Analysis

Computer vision techniques have been studied widely for detecting ADHD. Recent studies investigate the way machine learning models label ADHD-related behaviors from movement trajectories. Some of the main methods are monitoring motor irregularities and differentiating ADHD behavioral patterns from normal movement behaviors. These computer vision-based assessments enhance diagnostic accuracy and facilitate early intervention.

2.3 Machine Learning in ADHD Diagnosis

Machine learning models combined with pose estimation have made it possible to advance ADHD diagnosis. Support Vector Machines (SVM), Convolutional Neural Networks (CNNs), and other AI-based models have been used to distinguish ADHD-related movement from normal behavior. These models assist in early detection, enabling timely intervention and better treatment outcomes.

2.4 Ethical Implications of Automated ADHD Diagnosis

With advancing pose estimation technology, privacy, consent, and bias issues in interpreting the data become the subject of concern. Automated ADHD detection tools should provide secure data and unbiased tests. Research emphasizes the necessity for regulatory frameworks and open algorithms to avoid misuse and ensure ethical usage in clinics and schools.

2.5 Future Directions of Pose Estimation for ADHD Diagnosis

Future directions involve novel technologies including multimodal integration of data and hybrid AI models, which show great potential in ADHD diagnosis. Future studies would focus on increased system reliability using more behavioral markers and optimizing AI-based analysis. The integration of pose estimation with speech and face expression recognition further enhances ADHD screening processes. Recent studies are addressing model optimization so that the application is feasible for real-world cases, allowing widespread use in pediatrics healthcare services.

III. PROPOSED SYSTEM

The proposed ADHD detection system integrates pose estimation with machine learning techniques to enhance the accuracy and objectivity of ADHD diagnosis. The system focuses on real-time movement tracking and classification to provide an efficient, scalable, and non-invasive solution. The following modules are incorporated into the proposed system:

3.1 Pose Estimation-Based Motion Analysis

The system employs PoseNet to track and analyse children's movements, identifying potential ADHD-related motor patterns. This data is pre-processed and used to train a Support Vector Machine (SVM) model for classification. By leveraging PoseNet's accuracy in joint localization, the model ensures an objective assessment of hyperactivity markers.

3.2 Machine Learning-Based Classification

To improve classification accuracy, the extracted movement data undergoes feature selection and hyperparameter tuning. Various machine learning algorithms were tested, and SVM demonstrated high accuracy in distinguishing ADHD-related movements from typical behaviours. The trained model is stored for real-time classification, enabling efficient and automated ADHD detection.

Model	Acc (%)	Prec (%)	Rec (%)
SVM	92.5	91.8	93.0
RF	89.3	88.5	90.0
KNN	85.7	84.9	86.5
DT	83.4	82.7	84.1
XGB	91.2	90.5	91.8
GB	88.9	88.0	89.5
CNN	94.1	93.5	94.8

Fig 3.2.1

3.3 Data Collection and Preprocessing

Movement data is collected using camera-based sensors, ensuring a non-invasive assessment method. The collected data undergoes preprocessing, including noise filtering, normalization, and feature extraction. This step enhances the quality of input data for the machine learning model, improving overall diagnostic accuracy.

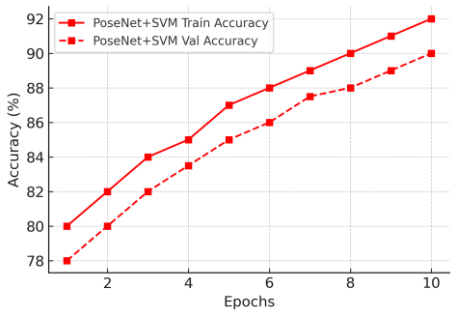

Fig 3.3 .1 Accuracy of PoseNet with SVM

3.4 Real-Time Monitoring and Detection

The system provides real-time monitoring capabilities, allowing parents, educators, and healthcare professionals to assess ADHD-related behaviours efficiently. A mobile application serves as the central hub, offering real-time alerts and comprehensive movement analysis. This feature ensures timely intervention and support for children at risk of ADHD.

3.5 Integration of AI and IoT Technologies

The proposed system integrates AI-driven analytics with IoT-enabled sensors to enhance accuracy and efficiency. Future developments will explore the incorporation of additional behavioural markers, such as facial expression and speech analysis, to further refine ADHD screening capabilities. The goal is to create a holistic and scalable solution for early ADHD detection.

3.6 Ethical Considerations and Future Enhancements

Given the sensitivity of ADHD diagnosis, the system prioritizes ethical considerations such as data privacy, informed consent, and bias mitigation. Future research will focus on validating the model through clinical trials, optimizing performance, and ensuring compliance with healthcare regulations to establish a reliable ADHD assessment tool.

IV. CONCLUSION AND FUTURE WORK

The Children ADHD Disease Detection Using Pose Estimation Techniques project presents a new, non-invasive method of ADHD detection through the use of pose estimation and machine learning. The system improves diagnostic accuracy and efficiency with a real-time, objective evaluation of children's movement patterns, minimizing dependency on subjective assessment approaches. Through the use of AI-based analytics, the system guarantees early intervention and assistance for vulnerable children, making ADHD screening more accessible and accurate.

Future efforts will be directed toward fine-tuning the model through field testing, enhancing accuracy through the addition of more behavioral markers, and resolving ethical issues like data privacy and informed consent. Future developments could involve the integration of speech and facial recognition technologies to create a full ADHD screening system. Through ongoing development, this project hopes to make a significant contribution to pediatric mental health evaluation and early intervention practices.

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