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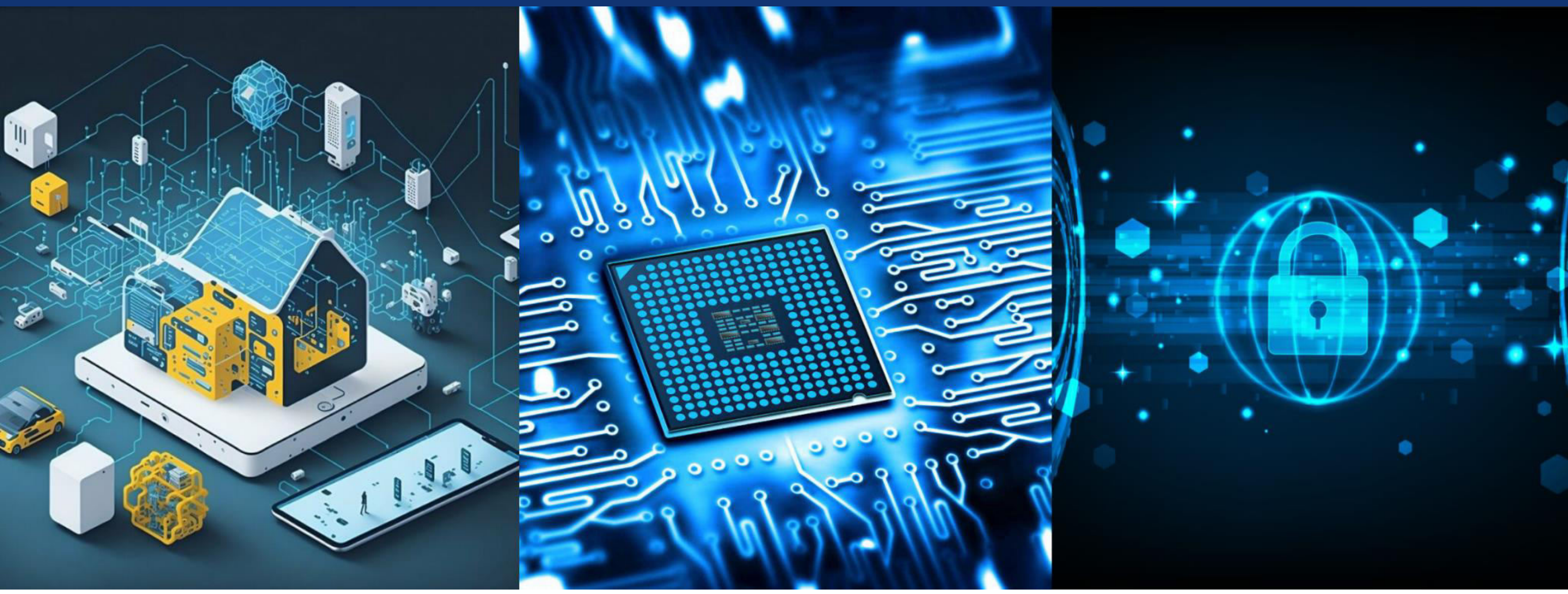

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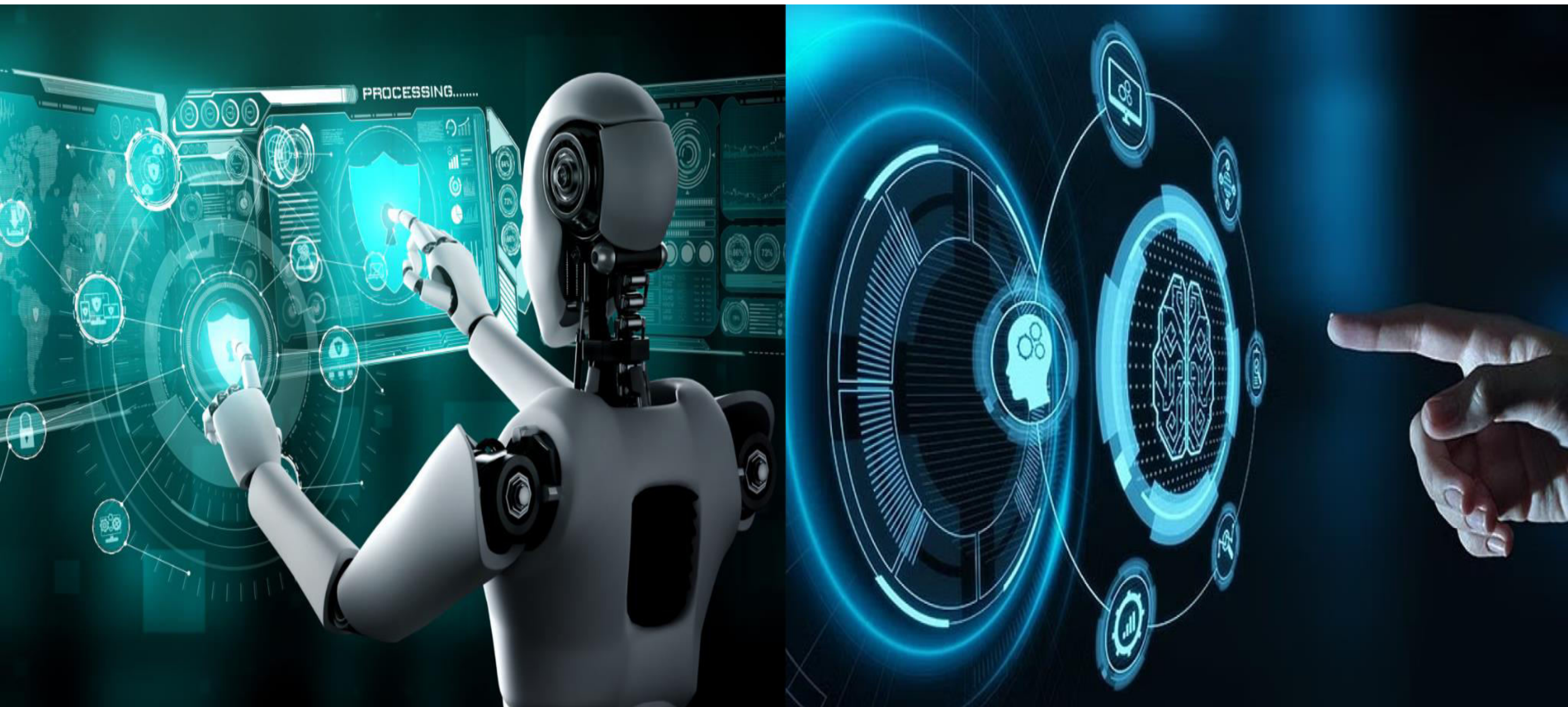


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# Early ADHD Detection in Children using Machine Learning

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**ABSTRACT:** The project on "Children's ADHD Disease Detection Using Machine Learning "with pose estimation technique introduces an innovative approach to detect the ADHD disease. "Attention Deficit Hyperactivity Disorder" (ADHD) is a Neuro development disorder predominantly found in children, and its detection often relies on the analysis of children's pose estimation. This study proposes a novel approach by utilizing Machine Learning algorithms for early Detection of ADHD in children. Currently, there is no automated technique for ADHD detection, and manual monitoring, while being error-prone and challenging, remains the primary method. To address these challenges, we propose the utilization of a machine learning algorithm, specifically the Support Vector Machine (SVM). By leveraging the capability of Support Vector Machine (SVM) algorithm the model integrates multiple features including behavioural, cognitive, and neuroimaging data, to enhance accuracy and reliability. Through rigorous experimentation and validation on a large dataset, the proposed method demonstrates promising results in distinguishing ADHD from typical development with high precision and sensitivity. The SVM will be trained on datasets containing poses from both normal and abnormal instances in children. Subsequently, the algorithm will analyse poses in new test images or videos, providing predictions on whether a child's pose is normal or indicative of ADHD-related abnormalities. The findings suggest the potential of SVM-based approaches as a valuable tool in aiding clinicians for timely and accurate ADHD diagnosis in children, paving the way for personalized interventions and improved outcomes. This approach aims to automate and enhance the accuracy of ADHD detection, contributing to more efficient and reliable diagnostic processes. Moreover, the interpretability of SVM models allows for insights into the underlying patterns and biomarkers associated with ADHD, contributing to our understanding of the disorder's neurobiological basis. This knowledge can inform the development of targeted interventions and personalized therapies tailored to individual children's needs. The potential of SVM-based approaches as a valuable tool in the early detection and management of ADHD in children. By harnessing the power of machine learning and multidimensional data integration, we can advance diagnostic practices, improve treatment outcomes, and ultimately enhance the well-being of children affected by ADHD.

**KEYWORDS:** ADHD (attention deficit hyperactivity disorder), Machine Learning, Support Vector Machine (SVM). Pose Estimation Technique.

## I. INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most prevalent neurodevelopmental disorders affecting children worldwide, with an estimated global prevalence of 5-7% among school-aged children (Polansky et al., 2014). Characterized by persistent patterns of inattention, hyperactivity, and impulsivity, ADHD often presents significant challenges in academic, social, and emotional domains, impacting children's overall well-being and functioning (American Psychiatric Association, 2013). Despite its prevalence and profound impact, diagnosing ADHD remains a complex and multifaceted process, often relying on subjective assessments of symptoms and behavioural observations (Willcutt, 2012). Early detection and intervention are critical for mitigating the long-term effects of ADHD and promoting positive outcomes for affected children. However, the heterogeneity of ADHD presentations, coupled with overlapping symptomatology with other developmental disorders, complicates the diagnostic process (Faraone et al., 2015). As a result, there is a growing need for objective, reliable, and scalable methods for identifying ADHD in children, facilitating

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timely access to appropriate interventions and support services. In recent years, advancements in machine learning techniques have shown promise in augmenting traditional diagnostic approaches for ADHD. Support Vector Machines (SVM), a powerful class of supervised learning algorithms, offer an effective framework for classification tasks, particularly in scenarios with high-dimensional data and complex decision boundaries (Cortes & Vatnik, 1995). By learning discriminative patterns from diverse sets of features, including behavioural, cognitive, and neuroimaging measures, SVM models hold potential for improving the accuracy and objectivity of ADHD diagnosis. This paper presents a novel approach to ADHD detection in children using Support Vector Machines, aiming to enhance diagnostic precision, scalability, and interpretability. Leveraging multimodal data integration and advanced machine learning techniques, our proposed method seeks to address the limitations of current diagnostic practices and contribute to more informed and personalized management of ADHD in children.

## II. LITERATURE REVIEW

[1] Early Detection of ADHD in Juveniles using recurrent neural networks, Anish Chintamaneni; Sarvesh Agrawal; Chandana Sowmya. Yelamancheli; G.R Archana; Sainandan Reddy; Ajin Joy, ADHD, or attention deficit and hyperactivity disorder, is a common problem among youngsters that falls under mental diseases. It is one of the most studied disorders, as many industrialized countries with advanced technology cannot diagnose it. In the land of Ethiopia, a study was carried out. The prevalence rate, which is the proportion of the population affected by diseases at a given period, is expected to be around 7 percent among youngsters. If preschool teachers or child care teachers understand what ADHD is and what research is being done on it, they can help the child and inform their parents about the child's concerns. This would also benefit the research community because the data would be provided after the teachers read about the research. Furthermore, teachers can spot ADHD in its early stages, which can aid in early treatment. However, because not every teacher is aware of the study, various machine learning and deep learning techniques have been utilized to solve the current problem statement. The paper's primary goal is to use a Recurrent Neural Network to detect ADHD at an early stage and increase the correctness of the problem statement.

[2] Comparative Study of Detection of ADHD using EEG Signals,Anchana V.; Biju K. S.,Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental irregularity which is complex, universal and heterogeneous. Inattention, hyperactivity and impulsiveness are some of the symptoms of ADHD. The disease is developing at preschool years and can even extend to adulthood when proper diagnosis is not provided. Hence detection of ADHD is very essential. ADHD detection can be done using EEG signal. In this review, we analysed the available research on deep and machine learning studies on diagnosing ADHD and found the various diagnostic setups that have been employed. The paper discusses the existing techniques present using different classifiers. It briefly explains the different methods when using Artificial Neural Network (ANN), Support Vector Machine (SVM) and Convolutional Neural Networks (CNN) as classifier. Comparative study on these methods were done and performance measures was increased over time.

## III. PROPOSED SYSTEAM

The proposed system involves the implementation of a machine learning algorithm, specifically the Support Vector Machine (SVM). This algorithm will undergo training using datasets comprising both normal and abnormal children's poses. Once trained, the SVM algorithm will be capable of analyzing new test images or videos to predict whether a child's pose is normal or indicative of ADHD-related abnormalities. By integrating machine learning into the detection process, the proposed system aims to offer a more efficient, consistent, and automated solution for ADHD detection, contributing to early intervention and improved accuracy in diagnoses The system encompasses the following components:

**1. *Data Collection and Preprocessing*:** The system gathers diverse data sources, including behavioral assessments, cognitive tests, and neuroimaging data, from participants diagnosed with ADHD and typically developing peers. Data preprocessing techniques are applied to standardize and clean the collected data, ensuring compatibility for subsequent analysis.

**2. *Feature Extraction and Selection*:** Feature extraction methods are employed to extract relevant features from the collected data, capturing key behavioral, cognitive, and neuroimaging characteristics associated with ADHD. Feature selection techniques are then utilized to identify the most discriminative features, reducing dimensionality and enhancing

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model efficiency.

3. ***Support Vector Machine Model*:** An SVM model is trained using the preprocessed and selected features to classify individuals into ADHD and non-ADHD groups. The SVM algorithm learns to identify patterns in the multidimensional feature space, maximizing the margin between different classes while minimizing classification errors.

4. ***Model Optimization and Evaluation*:** The SVM model is optimized using cross-validation techniques to fine-tune hyperparameters and improve generalization performance. Evaluation metrics such as accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve (AUC-ROC) are used to assess the model's performance on both training and validation datasets.

5. ***Interpretability and Visualization*:** The system provides tools for interpreting SVM model decisions, enabling clinicians to gain insights into the discriminative features and underlying patterns associated with ADHD. Visualization techniques such as feature importance plots and decision boundaries aid in understanding the diagnostic process and enhancing model transparency. 6. *Integration with Clinical Practice*: The proposed system is designed to integrate seamlessly with existing clinical workflows, providing clinicians with user-friendly interfaces for inputting patient data, running the diagnostic algorithm, and interpreting the results. Decision support functionalities assist clinicians in making informed diagnostic decisions and formulating personalized intervention plans.

## IV. METHODOLOGY

The proposed methodology for the AI-powered chatbot system involves a structured process for depression assessment and support. It begins with **data collection** of multimodal inputs, including facial expressions, voice recordings, and text conversations. The data undergoes **pre-processing** to remove noise and ensure quality for further analysis. Using a **hybrid deep learning approach**, the chatbot is trained with advanced models like Convolutional Neural Networks (CNNs) for facial analysis, Long Short-Term Memory (LSTM) networks for voice sentiment evaluation, and Natural Language Processing (NLP) for text-based emotion detection. Once the chatbot is integrated, users initiate conversations seeking emotional support.

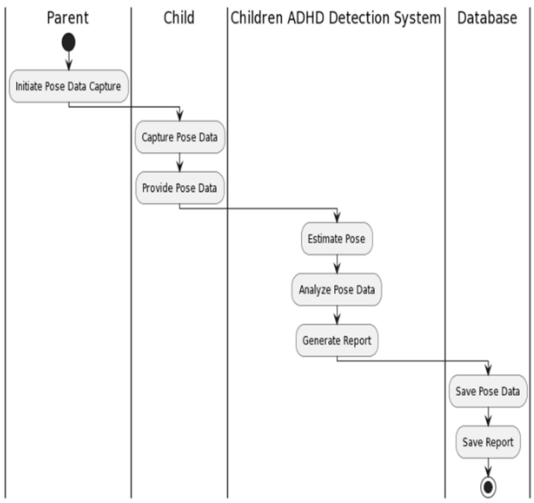


Fig 1: Methodology

Designing a system to detect ADHD (attention deficit hyperactivity disorder) in children using a Support Vector Machine (SVM) involves several steps, from data collection and preprocessing to model training and validation. Below, I will outline a basic approach to create such a system, focusing on the usage of SVM as a classification tool. SVMs are effective in handling high-dimensional data and binary classification tasks, making them suitable for medical diagnosis problems

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like ADHD detection.

**Step 1: Define the Problem**
ADHD detection involves distinguishing between children with ADHD and those without based on various features. These features can include behavioral data, cognitive tests, potentially genetic information, or brain imaging data.

**Step 2: Data Collection**
***Clinical Data*:** Gather data from clinical sources, which might include symptoms, doctor's notes, and diagnostic scores from standardized ADHD tests.
***Behavioral Assessments*:** Data from behavioral assessments that might include parent or teacher questionnaires.
***Cognitive Tests*:** Performance on tasks that measure attention, impulse control, and memory.
***Neuroimaging Data*:** If available, MRI or Fmri data could be used.
***Demographic Information*:** Age, gender, and educational background.

**Step 3: Data Preprocessing**
***Cleaning*:** Remove or impute missing values. ***Feature Extraction*:** From complex data like MRI images, feature extraction might be necessary, such as using PCA (Principal Component Analysis) to reduce dimensions.
***Feature Construction*:** Creating new features that might better capture the distinctions between ADHD and non-ADHD instances, based on expert knowledge.
***Feature Selection*:** Identify the most relevant features that contribute to ADHD. This might involve statistical techniques and domain expert consultations.
***Normalization/Standardization*:** Scale the data so that it is suitable for SVM, which is sensitive to the scale of input features.
***Label Encoding*:** Convert categorical labels into numerical values.
The chatbot provides **personalized support** using Cognitive Behavioral Therapy (CBT) techniques, offering coping strategies and therapeutic guidance. A validation step evaluates the chatbot's responses, ensuring appropriate support is provided. Additionally, the system **monitors user progress** over time, tracking emotional patterns and suggesting interventions if necessary. This end-to-end methodology enhances depression assessment accuracy and offers continuous mental health support.

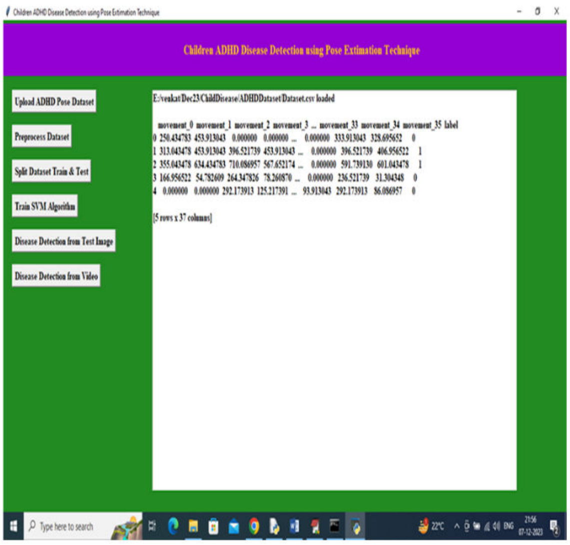


Fig 2: Data processing and Training

**Step 4: Model Selection**
- Choose an SVM model:
- ***Linear SVM*:** When the data is linearly separable.

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- ***Kernel SVM*:** For non-linearly separable data, using kernels such as RBF (Radial Basis Function), polynomial, or sigmoid.

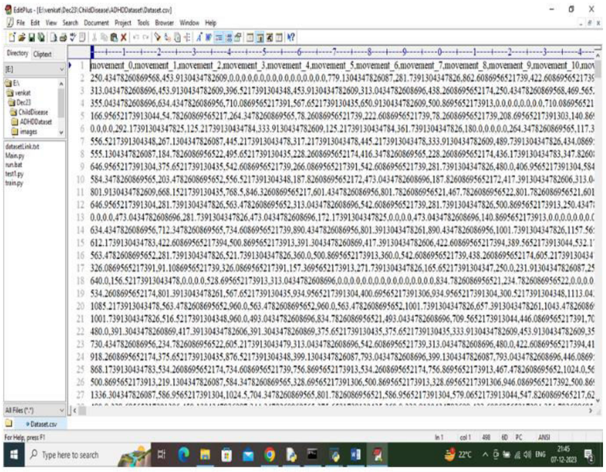

Fig 3: Dataset contains children's motion

**Step 5: Model Training**
***Split the Data*:** Use a training set and a validation set (commonly 80/20 split).
***Cross-validation*:** Implement cross-validation to ensure the model generalizes well to unseen data.
***Parameter Tuning*:** Utilize grid search or similar methods to find the optimal parameters for the kernel type, the penalty parameter C, kernel coefficients, etc. Step 7: Model Evaluation ***Performance Metrics*:** Evaluate the model using accuracy, precision, recall, F1-score, and ROC curves. Consider the specific needs of medical diagnostics, such as high recall to minimize false negatives.
***Confusion Matrix*:** Analyze the types of errors the model is making.

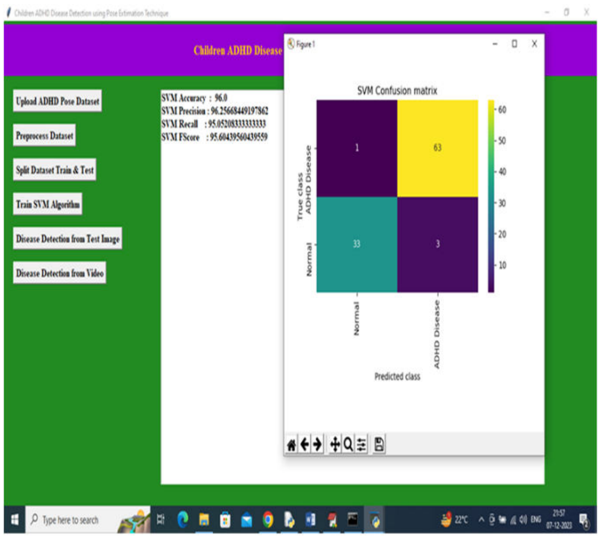


Fig 4: Train SVM Algorithm

**Step 6: Model Deployment**
**-** Integrate the model into a clinical decision support system where it can be used by healthcare providers to support their diagnostic process. – Ensure compliance with medical data regulations and patient privacy considerations.

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**Step 7: Monitoring and Maintenance**
- Regularly update the model with new data.
- Monitor performance and adjust as necessary to adapt to changes in data patterns or clinical definitions of ADHD.

Designing a system to detect ADHD (Attention Deficit Hyperactivity Disorder) in children using a Support Vector Machine (SVM) involves several steps, from data collection and preprocessing to model training and validation. Below, I will outline a basic approach to create such a system, focusing on the usage of SVM as a classification tool. SVMs are effective in handling high-dimensional data and binary classification tasks, making them suitable for medical diagnosis problems like ADHD detection.

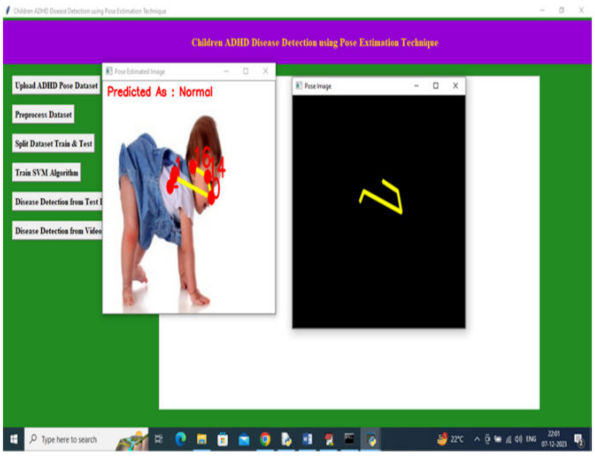


Fig 5: Output predicted as ADHD Disease

## V. RESULTS & DISCUSSION

When employing Support Vector Machines (SVM) for detecting Attention deficit hyperactivity disorder (ADHD) in children, several critical considerations come into play. Firstly, the selection of appropriate features is paramount, encompassing behavioral assessments such as ADHD rating scales (e.g., Conners' Rating Scales), cognitive evaluations (e.g., continuous performance tests), and potentially neuroimaging data if accessible. Secondly, ensuring data quality is imperative, necessitating accurate and standardized assessments, meticulous preprocessing of neuroimaging data (if applicable), and addressing any data anomalies. Thirdly, optimizing the SVM model involves tuning hyperparameters like kernel functions, regularization parameters, and kernel parameters, with techniques like cross-validation aiding in parameter selection. Moreover, a sufficiently large and diverse dataset is indispensable for training a robust SVM model that generalizes well. Additionally, interpreting SVM decision boundaries offers insights into ADHD symptomatology, aiding in targeted intervention development. Ethical considerations surrounding privacy and data security are crucial, especially concerning children's sensitive medical information. Finally, validating the model on independent datasets is essential for assessing generalizability and real-world applicability, ultimately aiming to develop a tool facilitating accurate ADHD diagnosis in children, enabling timely interventions and enhanced outcomes.

## VI. DISCUSSION

**Attention Deficit Hyperactivity Disorder (ADHD)** offers a reliable and objective alternative to traditional methods. Unlike conventional approaches that rely on subjective assessments, SVM models analyze complex patterns in behavioural, cognitive, and neuroimaging data to detect ADHD symptoms accurately. This reduces the chances of misdiagnosis and ensures timely intervention.
A major strength of SVMs is their ability to handle large datasets and identify subtle patterns. They effectively distinguish ADHD from other neurodevelopmental disorders with overlapping symptoms. Additionally, SVM models provide consistent results across different datasets, improving diagnostic reliability.

However, challenges remain. ADHD symptoms can vary widely among individuals, making it difficult for SVMs to generalize across all cases. Variations in data quality and collection methods may also affect model accuracy. Furthermore, SVM models are often viewed as "black boxes" since their decision-making processes are not easily interpretable. Providing clearer explanations of how the model reaches its conclusions is essential for building trust among clinicians.

Despite these challenges, SVMs are a valuable tool for enhancing ADHD diagnosis. They offer faster and more accurate assessments, enabling earlier interventions. Combining SVMs with other machine learning models or using hybrid approaches could further improve their performance. With continued research and development, SVM-based systems have the potential to transform ADHD diagnosis, ensuring better support for affected children.

## VII.CONCLUSION

In conclusion, the project addresses the existing challenges in ADHD detection by introducing a machine learning-based approach. The proposed system, utilizing the SVM algorithm, offers a promising solution to automate and enhance the accuracy of ADHD detection based on children's pose estimation. By transitioning from manual monitoring to a more sophisticated and automated system, this project contributes to the advancement of ADHD diagnostic capabilities. The successful implementation of the proposed system has the potential to positively impact the field of neurodevelopmental disorder diagnosis, fostering earlier identification and intervention for improved patient outcomes.

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