

AI-Based Autism Risk Prediction and Monthly Behavioral Tracking System using Machine Learning

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ABSTRACT

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that affects communication, social interaction, behaviour, and learning abilities in children. Early identification of autism symptoms is essential because timely medical intervention and behavioural therapy can significantly improve a child's developmental progress and quality of life. However, traditional autism screening methods are often time-consuming, expensive, and dependent on specialist availability, making early assessment difficult for many parents and caregivers. Manual behavioural observation methods may also fail to identify subtle developmental patterns accurately during the early stages.

The proposed system, “AI-Based ASD Risk Prediction and Monthly Behavioural Tracking System,” introduces an Artificial Intelligence and Machine Learning based approach for early autism screening and behavioural monitoring. The system collects behavioural responses through age-based questionnaires designed for children across different developmental stages. After collecting assessment data, Machine Learning algorithms such as Random Forest and Logistic Regression are used to analyze behavioural patterns and predict autism risk levels categorized as Low Risk, Medium Risk, and High Risk.

Keywords: Autism Spectrum Disorder, Machine Learning, Random Forest, Logistic Regression, Behavioural Tracking, Early Autism Detection, FastAPI, ReactJS, Artificial Intelligence, Risk Prediction.

I. INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that affects a child's communication skills, social interaction, learning behavior, and emotional understanding. Early identification of autism symptoms is extremely important because timely intervention and therapy can significantly improve a child's developmental progress and quality of life. However, in many cases, parents and caregivers fail to identify early behavioural symptoms due to lack of awareness, limited access to specialists, and the absence of affordable screening systems.

Traditional autism assessment methods mainly depend on manual observation, paper-based questionnaires, and clinical evaluation by healthcare professionals. These methods are time-consuming, expensive, and often inaccessible in rural or underdeveloped areas. In addition, continuous behavioural monitoring and progress tracking are difficult using conventional systems. As the number of children requiring developmental assessment continues to increase.

To overcome these limitations, the project “ASD Early Detection & Behavioural Tracking System” was developed as an AI-powered web application designed to assist parents, caregivers, and healthcare professionals in identifying autism risk at an early stage. The system integrates age-based behavioural questionnaires, Machine Learning prediction models, behavioural tracking, and real-time dashboard analytics into a single platform. Logistic Regression and Random Forest algorithms are used to analyze behavioural patterns and classify autism risk levels into Low, Medium, or High categories.

II. RELATED WORK

Autism Spectrum Disorder (ASD) early screening and behavioural analysis have gained significant attention in recent years due to the increasing need for early diagnosis and intervention support. Researchers and healthcare organizations have developed several systems and methodologies to identify autism-related behavioural patterns in children using questionnaires, observational techniques, and Artificial Intelligence technologies.

Traditional autism assessment systems mainly relied on manual clinical evaluation methods conducted by psychologists and healthcare professionals. These assessments were based on behavioural observation, interviews with parents, and paper-based screening questionnaires. Although clinically reliable, these methods are time-consuming, expensive, and highly dependent on specialist availability. In many rural and underdeveloped regions, access to trained autism specialists remains limited, making early diagnosis difficult for many families.

With the advancement of Machine Learning technologies, intelligent autism prediction systems have been introduced to improve screening efficiency and accuracy. Algorithms such as Logistic Regression, Decision Trees, Support Vector Machines (SVM), and Random Forest classifiers have been widely used to analyze behavioural datasets and predict autism risk levels. These AI-based systems improved prediction speed and reduced manual analysis efforts compared to traditional screening approaches.

Recent studies have also focused on web-based and mobile-based autism screening platforms that provide digital questionnaires and automated prediction results. Some systems include age-specific behavioural assessments to improve screening accuracy for different developmental stages. Machine Learning models trained on behavioural datasets have demonstrated promising results in identifying autism-related symptoms at earlier stages.

III. SYSTEM OVERVIEW

This project, titled “ASD Early Detection & Behavioural Tracking System,” aims to design and develop an intelligent, user-friendly, and AI-powered web application for early autism screening and behavioural monitoring in children. The system is developed using modern web technologies such as ReactJS, FastAPI, PostgreSQL, and Machine Learning algorithms including Logistic Regression and Random Forest for autism risk prediction. The main objective of the project is to support parents, caregivers, and healthcare professionals in identifying early signs of Autism Spectrum Disorder (ASD) and monitoring behavioural development efficiently.

In today’s digital healthcare environment, early identification of developmental disorders has become increasingly important. Many families struggle to access affordable autism screening facilities due to limited medical resources, lack of specialist availability, and delayed diagnosis processes. Traditional assessment methods mainly depend on manual behavioural observation and clinical analysis, which are often time-consuming and difficult to access in rural areas. This project addresses these challenges by providing an intelligent and automated autism screening platform that simplifies behavioural assessment and developmental tracking.

Once the questionnaire responses are submitted, the system processes the behavioural data using Machine Learning algorithms to predict autism risk accurately. The generated results are displayed through interactive dashboards, charts, graphs, and progress analytics, allowing parents and healthcare professionals to easily understand behavioural patterns and developmental changes over time.

The system also includes real-time data management, secure authentication, historical assessment storage, and responsive web interfaces for both desktop and mobile devices. The application is designed to be simple, accessible, and easy to use for non-technical users while still providing meaningful analytical insights for medical

support purposes.



IV. MODULE DESCRIPTION

1. User Authentication & Profile Management Module

This module manages user registration, login, and child profile creation within the ASD Early Detection & Behavioural Tracking System. Parents or caregivers can securely create accounts and store child-related information such as name, age in months, gender, city, and developmental details. Secure authentication mechanisms including encrypted passwords and role-based access are implemented to protect user data and maintain privacy.

The module also supports profile management features that allow users to update child information whenever required. Proper validation techniques are applied to ensure accurate data entry before assessment. This module acts as the foundation of the entire system because all questionnaire assessments, prediction results, tracking records, and reports are connected to the child profile database.

2. Age-Based Questionnaire Module

The Age-Based Questionnaire Module is responsible for collecting behavioural and developmental responses from parents based on the child's age category. Different sets of scientifically designed screening questions are displayed dynamically for children belonging to different age groups such as 12 months, 18 months, and 24+ months.

The questionnaire mainly focuses on behavioural indicators related to communication skills, social interaction, eye contact, emotional response, repetitive behaviour, and learning patterns. User responses are collected in structured format and validated before processing. This module

simplifies the autism screening process and provides a user-friendly way for parents to participate in early behavioural assessment.

3. Machine Learning Prediction Module In this module, Artificial Intelligence and Machine Learning techniques are used to analyze questionnaire responses and predict autism risk levels. The collected behavioural dataset is processed using classification algorithms such as Logistic Regression and Random Forest.

The Machine Learning models analyze behavioural patterns and generate prediction results categorized into Low Risk, Medium Risk, or High Risk. Probability scores and prediction percentages are also calculated to improve result interpretation and decision-making. This module improves the efficiency and reliability of early autism screening by automating behavioural analysis and reducing dependency on manual evaluation methods.

4. Behavioural Tracking Module

The Behavioural Tracking Module helps parents and caregivers monitor the child's developmental progress over time. Every completed assessment is stored in the tracking database, allowing comparison between previous and current behavioural records.

The system maintains month-wise assessment history and generates progress tracking information using graphs and visual analytics. Parents can identify behavioural improvements, stability, or increasing risk conditions through continuous monitoring. This module plays an important role in supporting long-term developmental observation and early intervention planning.

5. Dashboard & Visualization Module

The Dashboard & Visualization Module provides an interactive and easy-to-understand interface for displaying autism assessment results and behavioural analytics. The module converts complex assessment data into graphical visualizations such as pie charts, score trend graphs, progress indicators, and analytics dashboards.

The dashboard displays risk levels, monthly progress summaries, historical assessment comparisons, and behavioural tracking insights in a visually clear format. These visual outputs help parents and healthcare professionals quickly understand the child's developmental condition and monitor changes effectively. The module improves user experience and simplifies data interpretation.

6. Doctor Recommendation Module

This module helps users identify nearby autism specialists and healthcare professionals based on the child's city or location. The system stores doctor and specialist information within a structured database and retrieves relevant recommendations whenever required.

Parents can view specialist details, consultation information, and location-based recommendations directly from the application dashboard. This module bridges the gap between autism screening and professional medical consultation, helping parents take immediate action after risk identification.

8. Report Generation Module

The Report Generation Module creates downloadable assessment reports containing complete autism screening details and behavioural tracking summaries. The reports include child profile information, questionnaire responses, prediction results, monthly tracking history, and doctor recommendations.

PDF generation techniques are used to create structured and professional reports that can be shared with healthcare professionals for further evaluation. This module improves documentation, simplifies medical communication, and provides a permanent record of developmental assessment history.

V. METHODOLOGY

The methodology of the ASD Early Detection & Behavioural Tracking System consists of multiple stages including user registration, behavioural data collection, questionnaire analysis, Machine Learning-based autism risk prediction, behavioural tracking,

visualization, and report generation. These stages work together to provide accurate early autism screening, continuous developmental monitoring, and intelligent support for parents and healthcare professionals.

Initially, parents or caregivers register into the system and create a child profile by entering details such as name, age, gender, and city. Based on the child's age group, the system dynamically generates behavioural questionnaires designed to identify early developmental symptoms and autism-related behavioural patterns. The collected responses are validated to ensure completeness and consistency before further processing.

After data collection, the questionnaire responses are preprocessed and converted into a structured dataset suitable for Machine Learning analysis. Important behavioural indicators such as communication skills, eye contact, social interaction, repetitive behaviour, and emotional response patterns are analyzed. The processed data is then passed into Machine Learning models including Logistic Regression and Random Forest algorithms. These models evaluate the behavioural responses and classify autism risk levels into Low, Medium, or High categories with prediction probability scores. Once the prediction process is completed, the generated assessment results are stored in the database for future tracking and comparison. The system continuously maintains behavioural history records to help parents monitor developmental progress over time. Monthly assessments and behavioural updates are compared with previous records to identify improvements, stability, or increasing risk patterns in the child's development.

The analysed results are displayed through an interactive dashboard developed using modern web technologies. Various visualization techniques such as pie charts, bar graphs, progress trends, behavioural comparison graphs, and assessment summaries are used to help users easily understand the child's developmental status. These visual reports simplify complex prediction data and provide meaningful insights for parents, caregivers, and healthcare professionals.

VI. REQUIREMENTS SPECIFICATION

Requirement Specification is an important phase in the development of the ASD Early Detection & Behavioural Tracking System. It defines the hardware, software, development tools, frameworks, and technologies required for the successful implementation of the project. Proper requirement specification ensures smooth system execution, reliable performance, secure data handling, and efficient Machine Learning-based autism prediction.

Software Requirements

Software requirements include the programming languages, frameworks, libraries, development environments, and database technologies used for implementing the system. The backend of the application is developed using Python 3.10 with FastAPI for API development and backend processing. The frontend interface is developed using ReactJS, HTML5, CSS3, and JavaScript to provide a responsive and user-friendly dashboard experience.

SOFTWARE COMPONENT	SPECIFICATION
Operating System	Windows 10/11 (64-bit)
Programming Language	Python 3.10+
Frontend Technology	ReactJS, HTML5, CSS3, JavaScript
Backend Framework	FastAPI
Machine Learning Library	Scikit-Learn
Data Processing Libraries	Pandas & NumPy
Authentication & Security	JWT Authentication, bcrypt
Package Manager	Node.js & npm
IDE / Code Editor	Visual Studio Code

Hardware Requirements

Hardware requirements refer to the physical components required for the successful implementation and smooth execution of the ASD Early Detection & Behavioural Tracking System. Proper hardware configuration helps ensure efficient Machine

Learning processing, secure database management, faster response time, and stable application performance. The system requires appropriate computing resources for handling user authentication, questionnaire processing, behavioural tracking, dashboard visualization, and report generation functionalities.

HARDWARE COMPONENTS	SPECIFICATION
Processor	Intel Core i5 or higher
RAM	8 GB or Above
Storage Device	256 GB SSD
Input Devices	Standard Keyboard & Mouse
Graphics Support	Integrated Graphics
System Architecture	64-bit System
Power Supply	Standard UPS / Power Backup

VII. SYSTEM IMPLEMENTATION

IMPLEMENTATION PHASES

System Implementation is the phase where the proposed design of the ASD Early Detection & Behavioural Tracking System is converted into a fully functional web-based application. This phase involves coding, integrating, configuring, testing, and deploying all modules required for autism screening, behavioural tracking, dashboard visualization, and Machine Learning prediction. The implementation process focused on developing a secure, user-friendly, and AI-powered platform that assists parents and healthcare professionals in identifying early autism symptoms and monitoring child development effectively.

- Convert the proposed system design into a working AI-powered autism screening application using FastAPI, ReactJS, and PostgreSQL.
- Ensure smooth integration between behavioural questionnaires, Machine Learning prediction models, dashboard visualization, tracking modules, and report generation functionalities.
- Provide a responsive and user-friendly web

interface accessible for parents, doctors, and administrators through modern web browsers.

1. Environment Setup

- Installed required technologies and libraries such as: FastAPI – for backend API development and server-side processing.
- ReactJS, HTML5, CSS3, JavaScript – for developing the frontend user interface and dashboard components.
- PostgreSQL and SQLAlchemy – for database management and ORM-based database connectivity.
- Scikit-Learn – for implementing Machine Learning models such as Logistic Regression and Random Forest.

2. Module Development

- Each functional module was developed and integrated separately for better scalability and maintainability.
- User Authentication Module: Implemented secure registration, login, JWT token authentication, and role-based access for Parent/User and Admin.
- Child Profile Management: Developed modules to store child details such as name, age, gender, and behavioural history records.
- Age-Based Questionnaire Module: Implemented dynamic autism screening questionnaires based on the child's age group.

3. Frontend Interface Integration

- Developed an interactive and responsive frontend interface using ReactJS components and dashboard layouts.
- Created user-friendly forms for registration, login, child profile creation, and questionnaire submission.
- Implemented dashboard panels displaying prediction results, risk percentages, behavioural trends, graphs, and assessment history.
- Added navigation sidebars, charts, alerts, and report download features for improved user interaction and accessibility.

4. Testing & Debugging

- Unit testing and integration testing were conducted for authentication, questionnaire processing, prediction modules, and dashboard functionalities.

- Verified proper handling of invalid questionnaire inputs, incomplete forms, authentication errors, and database exceptions.
- Tested Machine Learning prediction accuracy using behavioural sample datasets.
- Ensured responsive frontend performance across desktop and mobile devices for better usability.

5. Deployment

- The application can be executed locally using FastAPI backend servers and ReactJS frontend development servers.
- PostgreSQL database connectivity was configured for storing user records, behavioural tracking history, prediction results, and reports securely.

VIII. SAMPLE OUTPUTS



Fig 1. Assessment for child

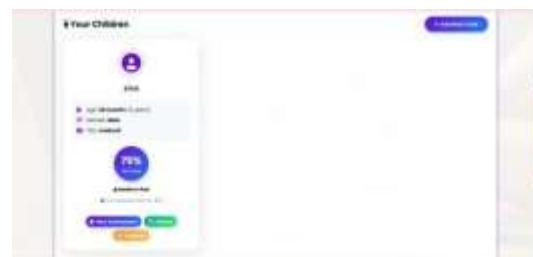


Fig 2. Child Risk Prediction Result

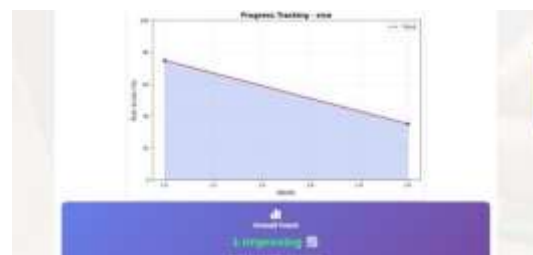


Fig 3. Chart Based Risk Prediction

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Fig 4. Risk Prediction Report

IX. CONCLUSION

The ASD Early Detection & Behavioural Tracking System was developed successfully as an Artificial Intelligence and Machine Learning-based platform to assist in the early screening and monitoring of Autism Spectrum Disorder (ASD). The system provides a structured and accessible solution for parents, caregivers, and healthcare professionals to identify behavioural signs of autism at an early stage through age-based questionnaires and intelligent risk prediction models. By integrating Machine Learning techniques with behavioural assessment, the system helps improve the accuracy and efficiency of autism risk evaluation.

The project successfully implements several essential features, including user authentication, child profile management, age-based autism assessments, ML-powered risk prediction, behavioural tracking, doctor recommendation, dashboard analytics, and PDF report generation. The use of Random Forest and Logistic Regression algorithms enables the system to classify autism risk into categories such as Low, Medium, and High, thereby helping users better understand behavioural concerns and take timely action. Monthly behavioural tracking and dashboard visualizations further support long-term developmental monitoring and progress evaluation.

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