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ISFA Digital System: An Integrated Platform for Early Detection and Differential Diagnosis of Autism Spectrum Disorder Using Neural Biomarkers and Remote Behavioral Observation

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Abstract

Early diagnosis of Autism Spectrum Disorder (ASD) remains challenging due to fragmented clinical evaluations and the lack of integrated diagnostic frameworks. This study introduces the ISFA Digital System, a multidisciplinary digital platform designed to support the early differential diagnosis of ASD in preschool-aged children. The system integrates clinical assessments from six medical specialties—pediatrics, otolaryngology, ophthalmology, speech and language therapy, neurology (including electroencephalography, EEG), and child psychiatry—within a unified digital workflow. The platform allows caregivers to upload behavioral video recordings, enabling remote behavioral observation and analysis. Clinical reports and neurophysiological data, including EEG findings, are incorporated into a centralized digital patient record. The system then integrates and analyzes behavioral, neurological, and clinical data to generate a structured diagnostic support report for clinicians. By combining neural biomarkers with behavioral observation and multidisciplinary medical evaluation, the ISFA system aims to reduce diagnostic delays, improve diagnostic accuracy, and streamline collaboration among healthcare providers. This integrated approach may provide a scalable digital solution for improving early ASD detection and facilitating coordinated clinical decision-making.

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by impairments in social communication and restricted or repetitive patterns of behavior. Early identification of ASD is critical because early intervention significantly improves developmental outcomes. However, achieving an early and accurate diagnosis remains challenging due to the complexity of ASD presentation and the need for multidisciplinary evaluation.

Current diagnostic pathways often require consultations across multiple medical specialties, including pediatrics, neurology, psychiatry, speech and language therapy, and sensory evaluations such as hearing and vision assessments. These fragmented processes can result in delayed diagnosis, logistical difficulties for families, and inconsistent integration of clinical data.

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Recent advances in digital health technologies provide opportunities to improve diagnostic workflows through integrated data platforms, remote behavioral observation, and the incorporation of objective neurophysiological biomarkers such as Electroencephalography (EEG). Digital tools may facilitate earlier screening, improved data sharing among clinicians, and more standardized diagnostic pathways.

To address these challenges, we propose the ISFA Digital System, a digital diagnostic framework designed to integrate multidisciplinary clinical assessments, behavioral observation via remote video recordings, and neural biomarkers into a unified diagnostic support platform for early ASD detection.

Methods (System Design)

The ISFA system was designed as a digital diagnostic support platform consisting of a mobile application for caregivers and a web-based clinical interface for healthcare professionals.

Data collection

Initial patient data are entered through the mobile application or web portal. Caregivers may upload behavioral video recordings demonstrating the child's communication, interaction, and play behaviors.

Multidisciplinary clinical assessment

The system incorporates sequential clinical evaluations from six specialized disciplines:

1/Pediatrics

2/ Otolaryngology (ENT)

3/Ophthalmology

4/Speech and Language Therapy

5/Neurology (including EEG assessment)

6/Child Psychiatry and Autism Specialist Consultation

Each specialist uploads structured clinical reports to the centralized patient record.

Neurophysiological biomarker integration

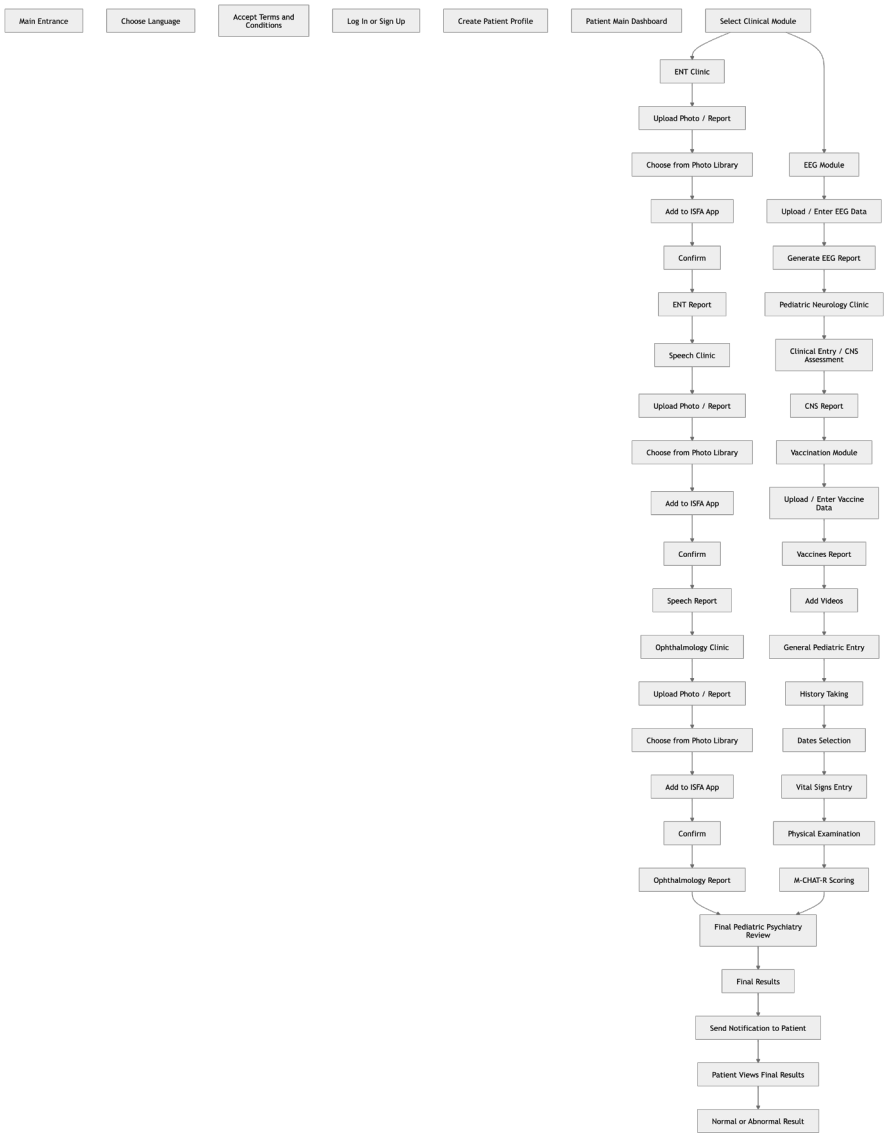
Electroencephalography (EEG) findings are included as neurophysiological indicators to support neurological assessment.

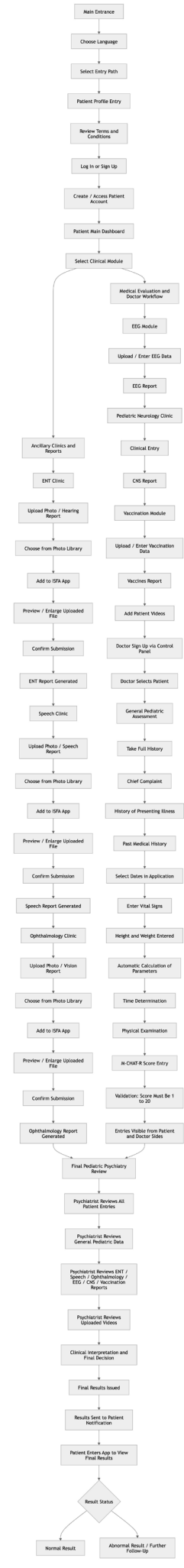
Data integration and analysis

The platform integrates behavioral observations, clinical reports, and EEG results into a unified dataset. This integrated dataset supports clinicians in evaluating the likelihood of ASD and differentiating it from other developmental or sensory disorders.

Diagnostic output

The system generates a structured diagnostic support report summarizing multidisciplinary findings to assist clinicians in making the final diagnostic decision.

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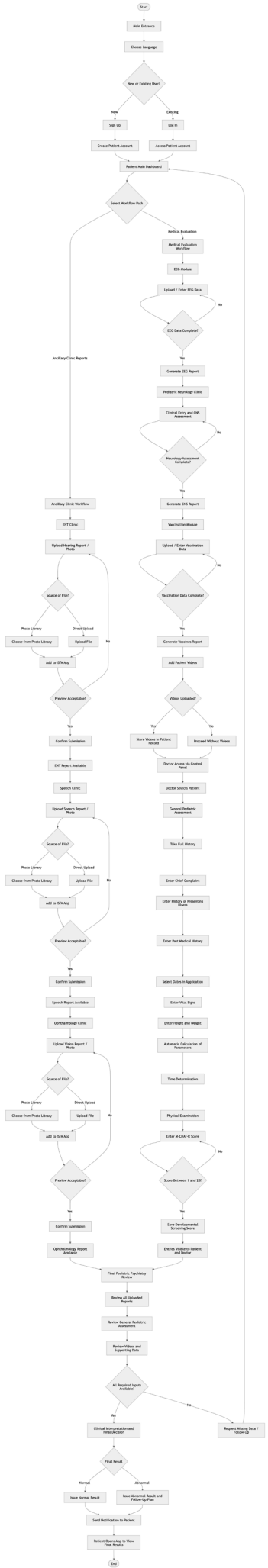
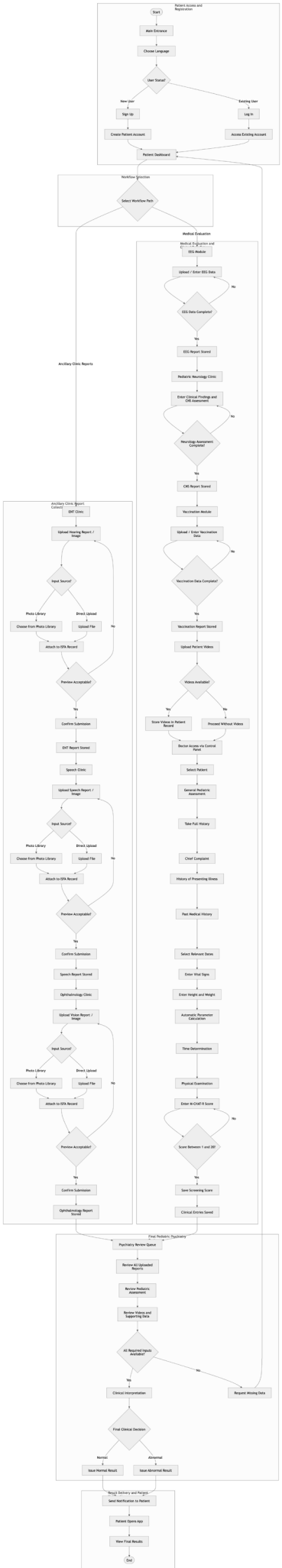
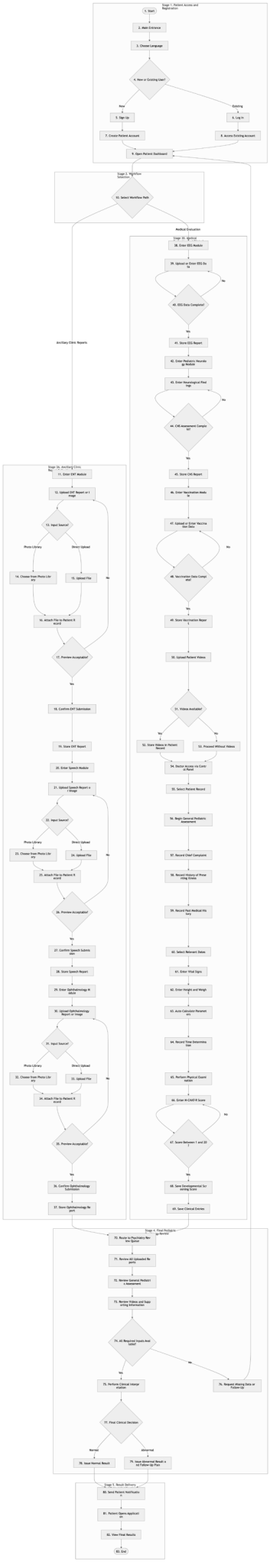
Choose Language
Select Entry Path
Patient Profile Entry
Review Terms and Conditions
Log In or Sign Up
Create / Access Patient Account
Patient Main Dashboard
Select Clinical Module
Ancillary Clinics and Reports
ENT Clinic
Upload Photo / Hearing Report
Choose from Photo Library
Add to ISFA App
Preview / Enlarge Uploaded File
Confirm Submission
ENT Report Generated
Speech Clinic
Upload Photo / Speech Report
Choose from Photo Library
Add to ISFA App
Preview / Enlarge Uploaded File
Confirm Submission
Speech Report Generated
Ophthalmology Clinic
Upload Photo / Vision Report
Choose from Photo Library
Add to ISFA App
Preview / Enlarge Uploaded File
Confirm Submission
Ophthalmology Report Generated
Medical Evaluation and Doctor Workflow
EEG Module
Upload / Enter EEG Data
EEG Report
Pediatric Neurology Clinic
Clinical Entry
CNS Report
Vaccination Module
Upload / Enter Vaccination Data
Vaccines Report
Add Patient Videos
Doctor Sign Up via Control Panel
Doctor Selects Patient
General Pediatric Assessment
Take Full History
Chief Complaint
History of Presenting Illness
Past Medical History
Select Dates in Application
Enter Vital Signs
Height and Weight Entered
Automatic Calculation of Parameters
Time Determination
Physical Examination
M-CHAT-R Score Entry
Validation: Score Must Be 1 to 20
Entries Visible from Patient and Doctor Sides
Final Pediatric Psychiatry Review
Psychiatrist Reviews All Patient Entries
Psychiatrist Reviews General Pediatric Data
Psychiatrist Reviews ENT / Speech / Ophthalmology / EEG / CNS / Vaccination Reports
Psychiatrist Reviews Uploaded Videos
Clinical Interpretation and Final Decision
Final Results Issued
Results Sent to Patient Notification
Patient Enters App to View Final Results
Result Status
Normal Result
Abnormal Result / Further Follow-Up


Start
Main Entrance
Choose Language
New or Existing User?
New
Existing
Sign Up
Log In
Create Patient Account
Access Patient Account
Patient Main Dashboard
Select Workflow Path
Ancillary Clinic Reports
Medical Evaluation
Ancillary Clinic Workflow
ENT Clinic
Upload Hearing Report / Photo
Source of File?
Photo Library
Direct Upload
Choose from Photo Library
Upload File
Add to ISFA App
Preview Acceptable?
Confirm Submission
ENT Report Available
Speech Clinic
Upload Speech Report / Photo
Speech Report Available
Ophthalmology Clinic
Upload Vision Report / Photo
Ophthalmology Report Available
Medical Evaluation Workflow
EEG Module
Upload / Enter EEG Data
EEG Data Complete?
Generate EEG Report
Pediatric Neurology Clinic
Clinical Entry and CNS Assessment
Neurology Assessment Complete?
Generate CNS Report
Vaccination Module
Upload / Enter Vaccination Data
Vaccination Data Complete?
Generate Vaccines Report
Add Patient Videos
Videos Uploaded?
Store Videos in Patient Record
Proceed Without Videos
Doctor Access via Control Panel
Doctor Selects Patient
General Pediatric Assessment
Take Full History
Enter Chief Complaint
Enter History of Presenting Illness
Enter Past Medical History
Select Dates in Application
Enter Vital Signs
Enter Height and Weight
Automatic Calculation of Parameters
Time Determination
Physical Examination
Enter M-CHAT-R Score
Score Between 1 and 20?
Save Developmental Screening Score
Entries Visible to Patient and Doctor
Request Missing Data / Follow-Up
Final Pediatric Psychiatry Review
Review All Uploaded Reports
Review General Pediatric Assessment
Review Videos and Supporting Data
All Required Inputs Available?
Clinical Interpretation and Final Decision
Final Result
Normal
Abnormal
Issue Normal Result
Issue Abnormal Result and Follow-Up Plan
Send Notification to Patient
Patient Opens App to View Final Results
End


Patient Access and Registration
Start
Main Entrance
Choose Language
User Status?
New User
Existing User
Sign Up
Log In
Create Patient Account
Access Existing Account
Patient Dashboard
Workflow Selection
Select Workflow Path
Ancillary Clinic Reports
Medical Evaluation
Medical Evaluation and EEG Module
Upload / Enter EEG Data
EEG Data Complete?
EEG Report Stored
Pediatric Neurology Clinic
Enter Clinical Findings and CNS Assessment
Neurology Assessment Complete?
CNS Report Stored
Vaccination Module
Upload / Enter Vaccination Data
Vaccination Data Complete?
Vaccination Report Stored
Upload Patient Videos
Videos Available?
Store Videos in Patient Record
Proceed Without Videos
Doctor Access via Control Panel
Select Patient
General Pediatric Assessment
Take Full History
Chief Complaint
History of Presenting Illness
Past Medical History
Select Relevant Dates
Enter Vital Signs
Enter Height and Weight
Automatic Parameter Calculation
Time Determination
Physical Examination
Enter M-CHAT-R Score
Score Between 1 and 20?
Save Screening Score
Clinical Entries Saved
Ancillary Clinic Report Collect
ENT Clinic
Upload Hearing Report / Image
Input Source?
Photo Library
Direct Upload
Choose from Photo Library
Upload File
Attach to ISFA Record
Preview Acceptable?
Confirm Submission
ENT Report Stored
Speech Clinic
Upload Speech Report / Image
Speech Report Stored
Ophthalmology Clinic
Upload Vision Report / Image
Ophthalmology Report Stored
Final Pediatric Psychiatry
Psychiatry Review Queue
Review All Uploaded Reports
Review Pediatric Assessment
Review Videos and Supporting Data
All Required Inputs Available?
Clinical Interpretation
Request Missing Data
Final Clinical Decision
Normal
Abnormal
Issue Normal Result
Issue Abnormal Result
Result Delivery and Patient
Send Notification to Patient
Patient Opens App
View Final Results
End


Stage 1. Patient Access and Registration
1. Start
2. Main Entrance
3. Choose Language
4. New or Existing User?
New
Existing
5. Sign Up
6. Log In
7. Create Patient Account
8. Access Existing Account
9. Open Patient Dashboard
Stage 2. Workflow Selection
10. Select Workflow Path
Ancillary Clinic Reports
Medical Evaluation
Stage 3a. Ancillary Clinic
11. Enter ENT Module
12. Upload ENT Report or Image
13. Input Source?
Photo Library
Direct Upload
14. Choose from Photo Library
15. Upload File
16. Attach File to Patient Record
17. Preview Acceptable?
18. Confirm ENT Submission
19. Store ENT Report
20. Enter Speech Module
21. Upload Speech Report or Image
22. Input Source?
23. Choose from Photo Library
24. Upload File
25. Attach File to Patient Record
26. Preview Acceptable?
27. Confirm Speech Submission
28. Store Speech Report
29. Enter Ophthalmology Module
30. Upload Ophthalmology Report or Image
31. Input Source?
32. Choose from Photo Library
33. Upload File
34. Attach File to Patient Record
35. Preview Acceptable?
36. Confirm Ophthalmology Submission
37. Store Ophthalmology Report
Stage 3b. Medical Evaluation
38. Enter EEG Module
39. Upload or Enter EEG Data
40. EEG Data Complete?
41. Store EEG Report
42. Enter Pediatric Neurology Module
43. Enter Neurological Findings
44. CNS Assessment Complete?
45. Store CNS Report
46. Enter Vaccination Module
47. Upload or Enter Vaccination Data
48. Vaccination Data Complete?
49. Store Vaccination Report
50. Upload Patient Videos
51. Videos Available?
52. Store Videos in Patient Record
53. Proceed Without Videos
54. Doctor Access via Control Panel
55. Select Patient Record
56. Begin General Pediatric Assessment
57. Record Chief Complaint
58. Record History of Presenting Illness
59. Record Past Medical History
60. Select Relevant Dates
61. Enter Vital Signs
62. Enter Height and Weight
63. Auto Calculate Parameters
64. Record Time Determination
65. Perform Physical Examination
66. Enter M-CHAT-R Score
67. Score Between 1 and 20
68. Save Developmental Screening Score
69. Save Clinical Entries
Stage 4. Final Pediatric Psychiatric Review
70. Route to Psychiatry Review Queue
71. Review All Uploaded Reports
72. Review General Pediatric Assessment
73. Review Videos and Supporting Information
74. All Required Inputs Available?
75. Perform Clinical Interpretation
76. Request Missing Data or Follow-Up
77. Final Clinical Decision
Normal
Abnormal
78. Issue Normal Result
79. Issue Abnormal Result and Follow-Up Plan
Stage 5. Result Delivery
80. Send Patient Notification
81. Patient Opens Application
82. View Final Results
83. End