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CogniTrain: Interactive Cognitive Training for Children with Disabilities

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ABSTRACT: Cognitive development in children with disabilities is often hindered by limited access to specialized training programs. Traditional retraining methods require in-person sessions, which many families find difficult to attend due to geographical, financial, or time constraints. CogniTrain provides web-based solution designed to address these challenges. It provides interactive cognitive training games for children to enhance memory, attention, and problem-solving abilities. Additionally, the system includes a user-friendly interface for doctors to monitor each child's performance and provide timely feedback to caregivers. This ensures personalized care and consistent cognitive improvement.

KEYWORDS: Cognitive training, Interactive games, Disability, Memory, Attention, Problem-solving, Doctor feedback.

I. INTRODUCTION

Children with cognitive disabilities face significant challenges in their mental development. Traditional methods of cognitive retraining are often restricted by physical presence, financial burden, and limited accessibility. Many families struggle to consistently access such programs, which can significantly impact the cognitive progression of these children. This challenge can be addressed by providing a computerised platform for learning[2].

The CogniTrain project seeks to overcome these limitations by offering a web-based platform with games to train the children[1]. This platform features three main games focusing on attention, memory, and number quizzes. These interactive games are tailored to engage children while simultaneously helping them build essential cognitive skills. The system also features a robust feedback loop wherein doctors monitor the child's performance and provide valuable feedback to their caregivers. This feedback allows for personalized interventions to improve the child's performance.

The aim of this platform is to provide children with disabilities a means to engage in consistent cognitive retraining that is accessible, cost-effective, and enjoyable.

II. RESEARCH METHODOLOGY

The methodology focuses on developing a child-friendly and doctor-supervised cognitive training program. The system comprises two user interfaces: one for children and another for doctors. The children's section features interactive games that test various cognitive skills, such as attention span, memory retention, and basic numerical understanding.

The doctor interface allows healthcare professionals to view detailed reports of each child's performance. After reviewing the results, doctors provide feedback, which is sent directly to the child's caregivers. This feedback helps guide caregivers in supporting the child's cognitive development based on the game results.

Data collection involved testing the system with several users. Children played the games, and their performance data was stored in a MySQL database. The structured database helped in managing the interactions, recording scores, and organizing data efficiently for doctors to review. Doctors accessed this data through a dedicated interface to offer

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feedback. This iterative process of testing and feedback allowed for improvements in both the system's design and functionality.

III. THEORY

CogniTrain follows a well-structured process:

Child's Interaction with Games: The child plays three games designed to test memory, attention, and numerical skills. Each game is designed to target specific cognitive skills, ensuring diverse skill development and progression as the child improves.

Data Collection and Analysis: Each game logs the child's responses and time taken to complete tasks. These logs are stored in a database and form the basis for the performance reports accessed by doctors.

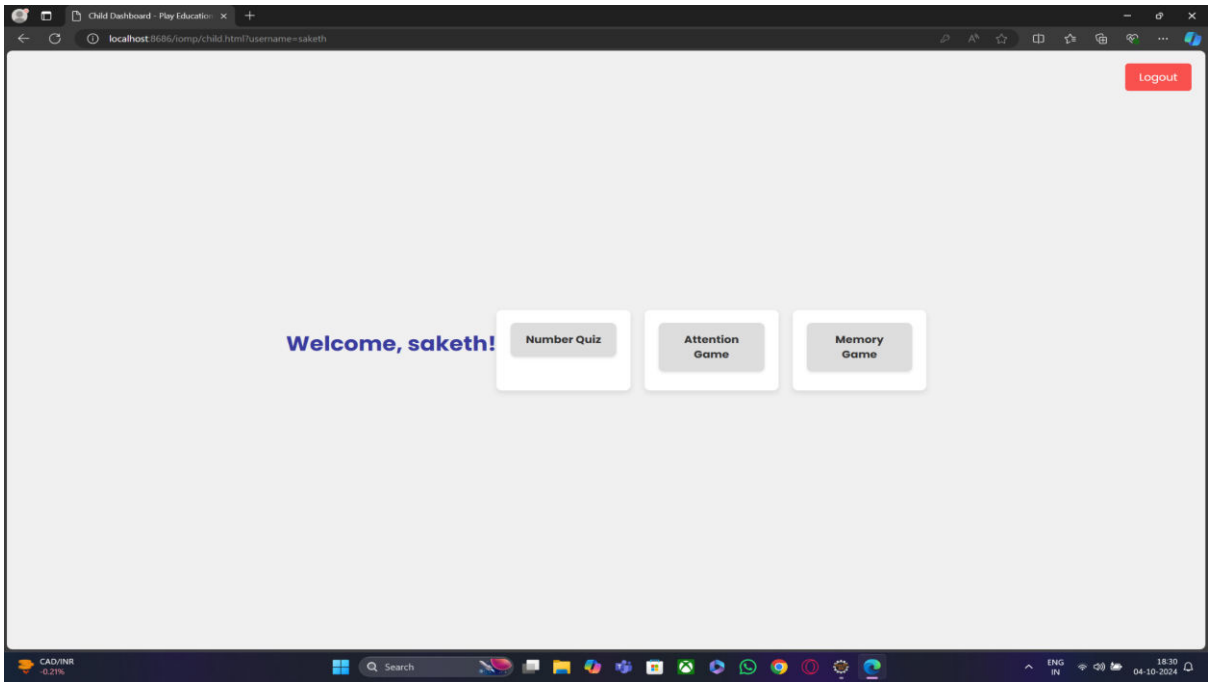
Doctor's Review Process: Doctors can view the game reports, which include statistics on accuracy, speed, and attention span. These reports help doctors assess the child's cognitive abilities and track their progress over time.

Feedback to Caregivers: After analyzing the data, the doctor provides feedback on how the caregivers can help the child improve. This feedback is sent via the system's interface, ensuring real-time communication between doctors and caregivers.

IV. RESULTS AND DISCUSSION

As of now, the *CogniTrain* platform has not been fully deployed for widespread use. However, we have conducted initial testing with a few sample cases to assess its functionality and user experience. During these test runs, the system effectively recorded the children's game performances and allowed doctors to access and provide feedback through the interface. The tests have shown promising results in terms of usability and accuracy of score tracking. Below are some images of the platform in action, showcasing the user interfaces designed for both children and doctors.

Child Home Page:



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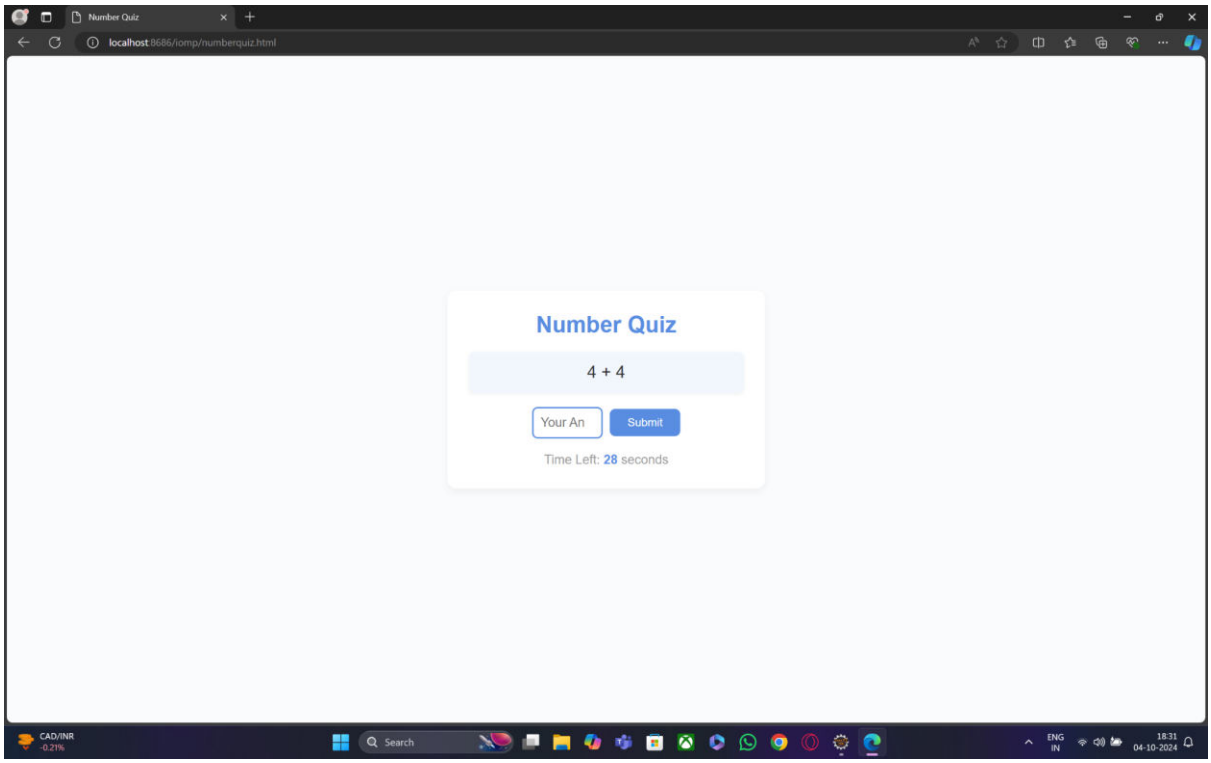
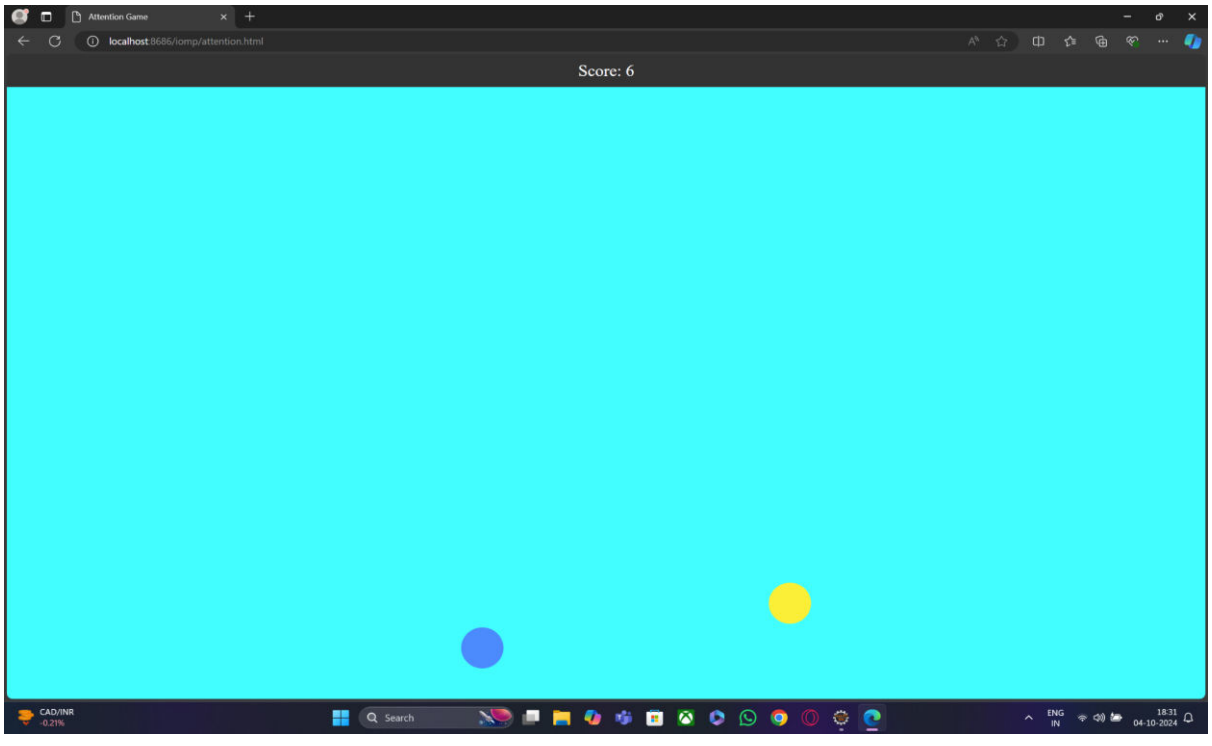
Number Quiz Page:



Attention Game Page:



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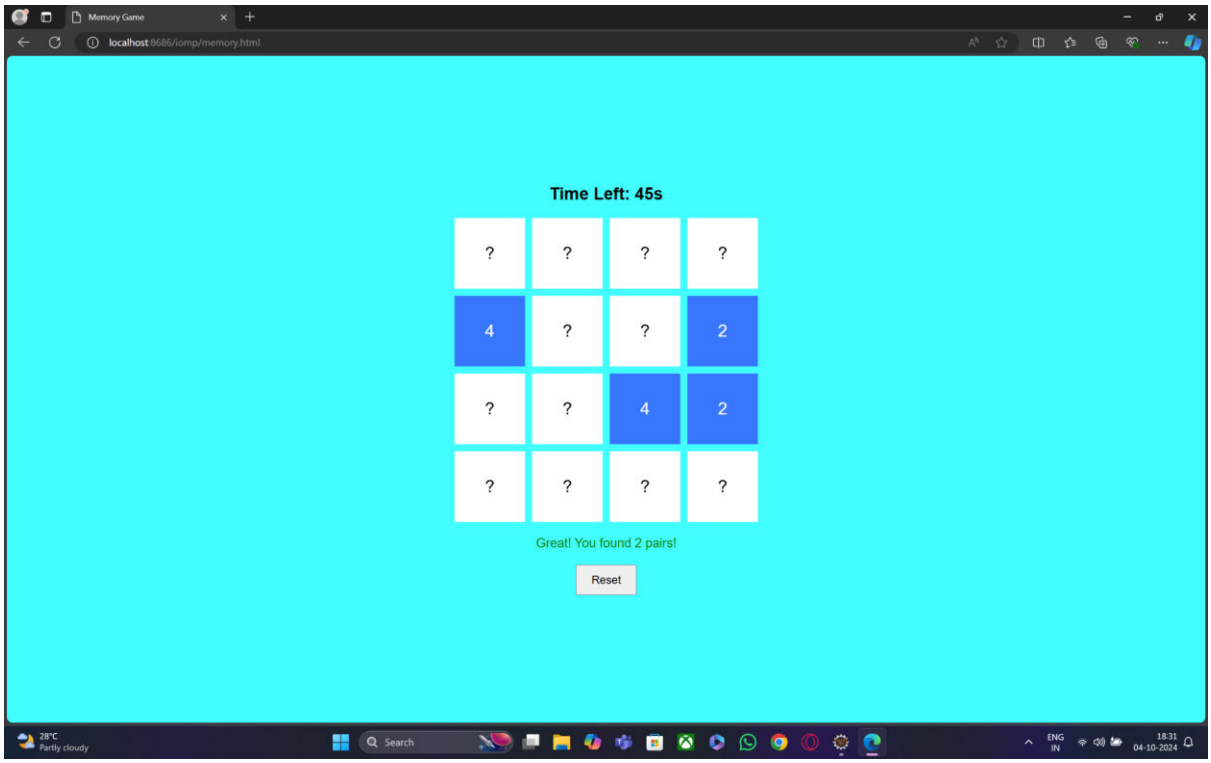
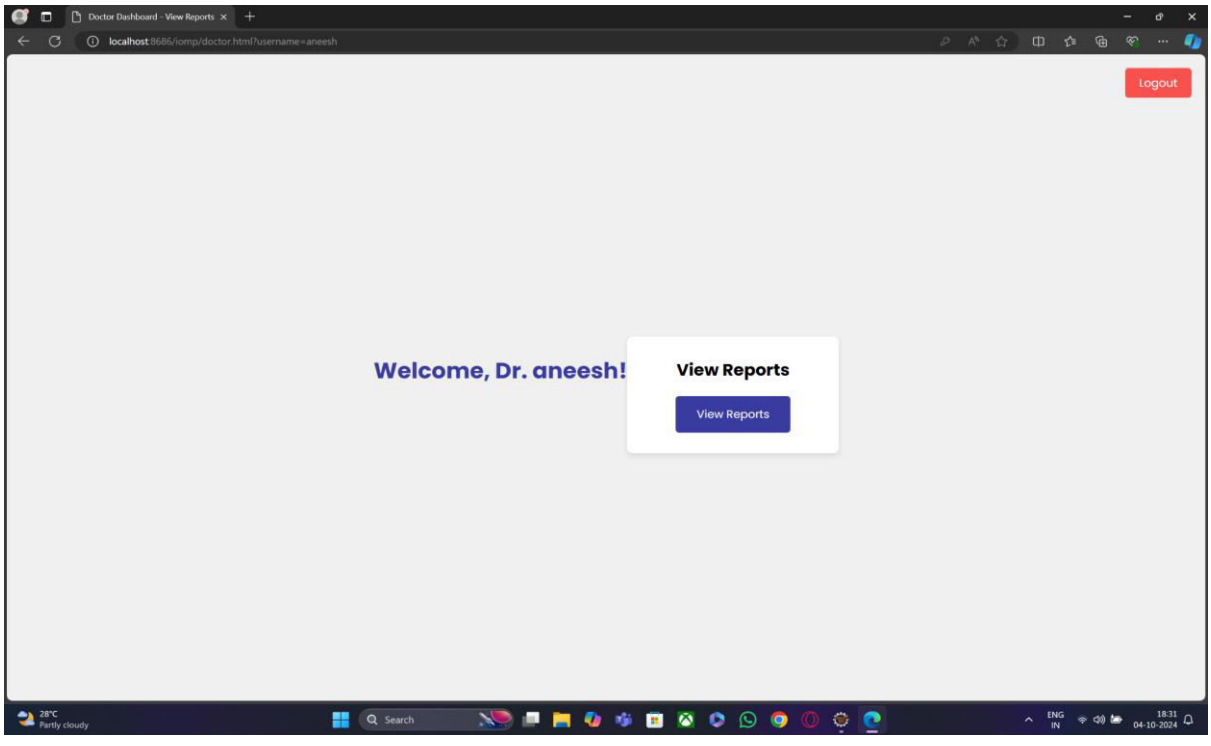
Memory Game Page:



Doctor Home Page:



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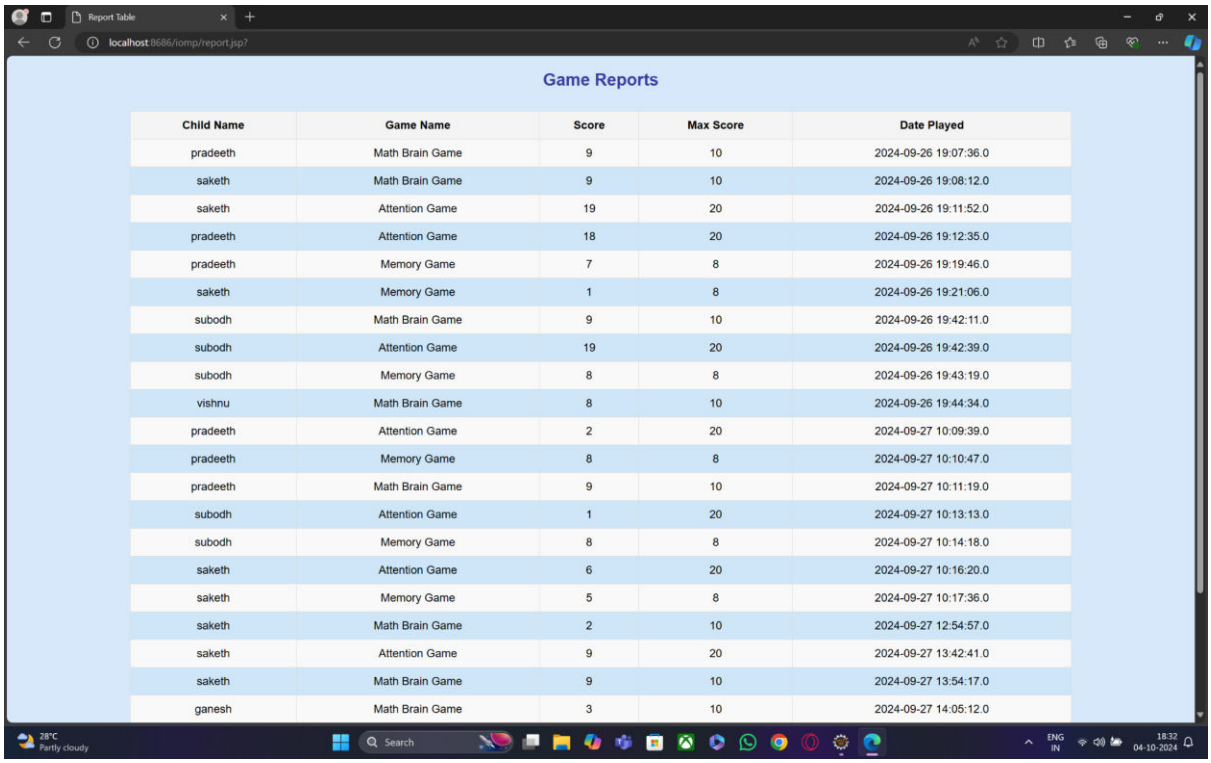
Reports Page:



4.1 Preparation of Figures

The figures below represent the operation and the embedding of the various components of the working system of the CogniTrain platform.

4.1.1 Formatting Figures

Deployment Diagram: The *CogniTrain* deployment diagram illustrates how the system manages interactions between the child's device, the doctor's interface, the web server, and the MySQL database. On the child's side, the device runs a browser-based interface where the child plays various cognitive training games, including a number quiz, attention game, and memory game. Each game records the child's name, the game name, the score achieved, and the maximum possible score. This data is then transmitted to the web server, which handles the backend logic developed using Java Servlets and JSP. The server processes the game data and sends it to the MySQL database for storage. Doctors, on their side, access the system through a separate browser-based interface. They can view detailed reports on the child's performance, including the name of the child, the games they played, their scores, and comparisons with the maximum scores. This helps the doctor assess the child's cognitive development over time. The doctor can then send personalized feedback to caregivers, based on the stored data, which is updated and managed by the backend through read and write operations with the database.

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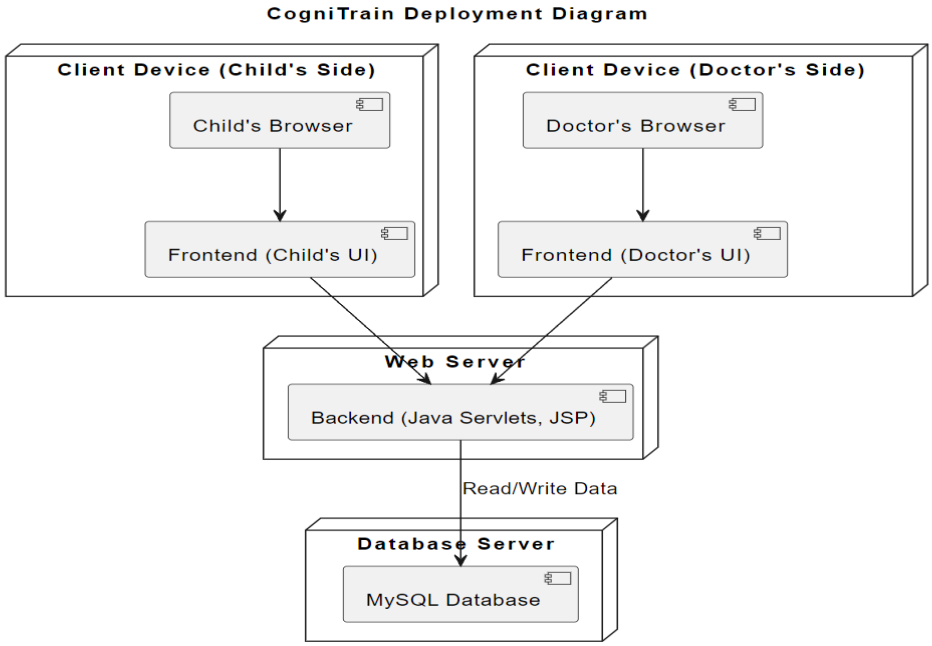

Figure 1: Deployment Diagram of CogniTrain

Component Diagram: The *CogniTrain* system consists of three main layers: the Child's Device , the Doctor's Device, and the Server-side components. On the child's side, the *Child UI* allows the child to interact with cognitive games such as the *Attention Game* , *Number Quiz*, and *Memory Game*, sending data to the backend. On the doctor's side, the *Doctor UI* enables access to a *Report Viewer* for reviewing the child's performance and a *Feedback System* to provide insights to the caregivers. The *Backend Controller* on the Web Server manages communication between the client interfaces and the server-side logic, including the *Game Controller* (for game-related data) and the *Report Controller* (for report management). The system stores and retrieves game scores and reports in the Database Server using a *MySQL Database*, ensuring that both gameplay and feedback data are efficiently processed and stored.

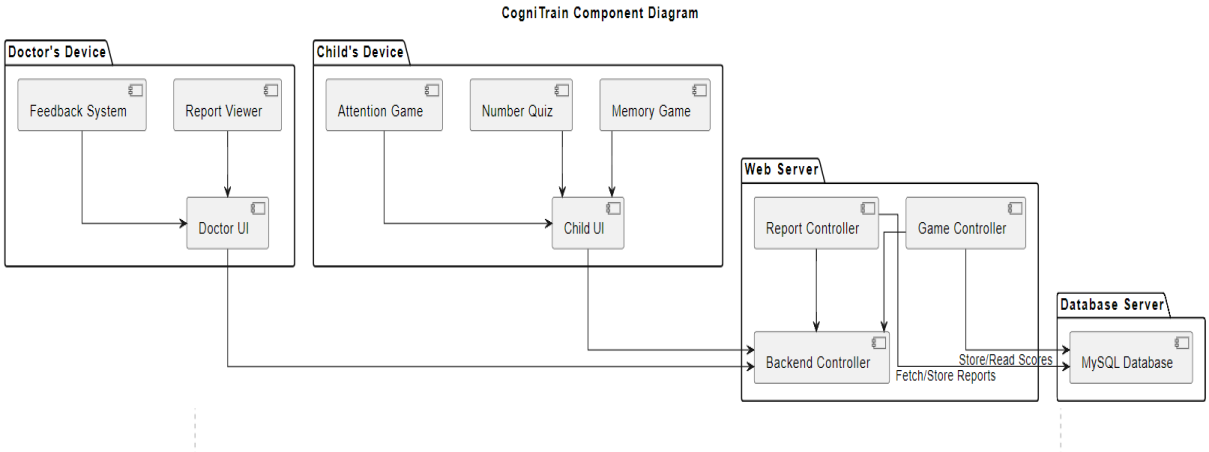

Figure 2: Component Diagram of CogniTrain.

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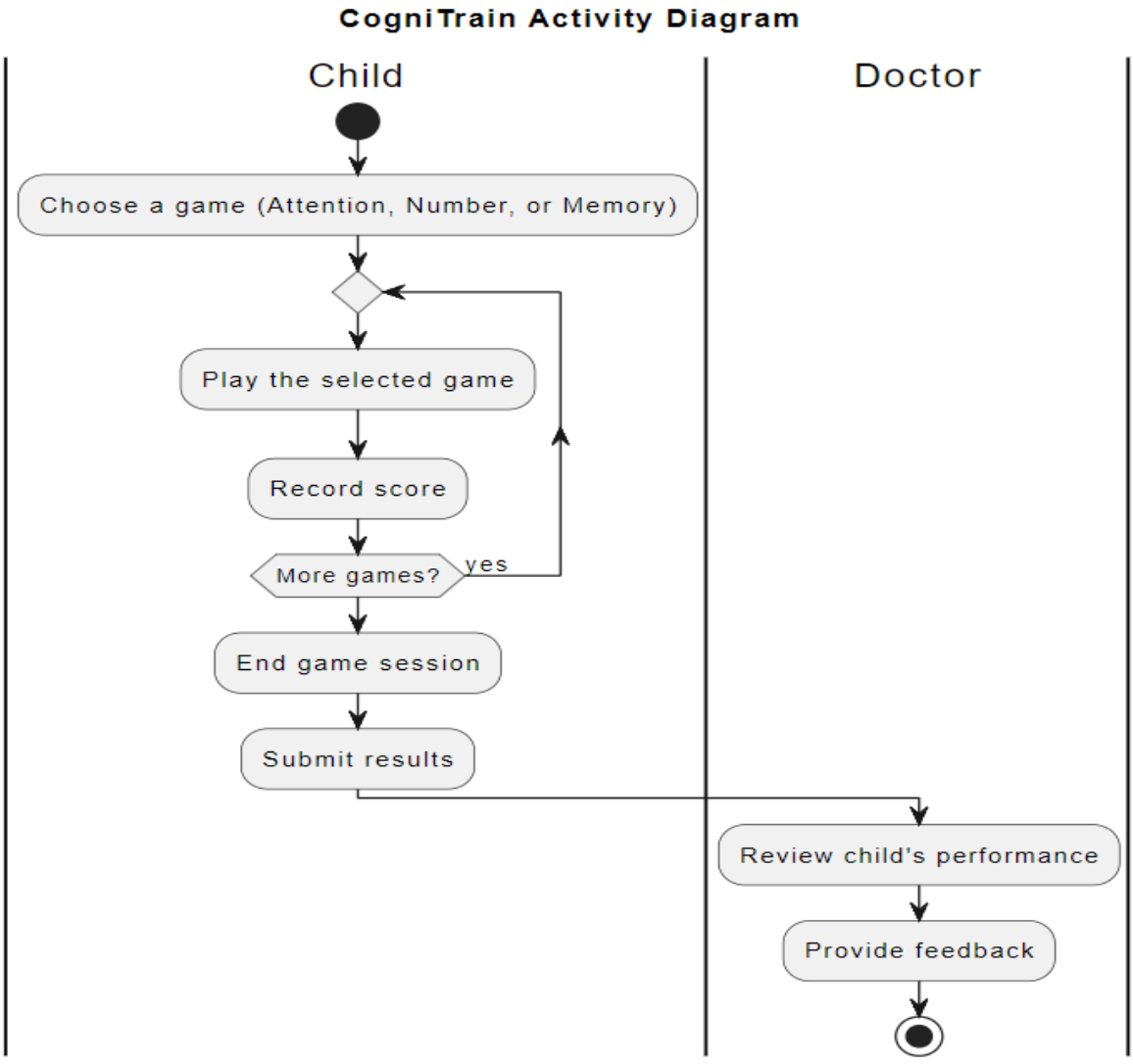
Activity Diagram: The activity diagram for *CogniTrain* system effectively captures the essential interactions between the child and the doctor. The process begins when the child selects a game from three available options: Attention, Number, or Memory. This choice initiates the gameplay, during which the child actively engages with the selected game. As the child plays, their performance is monitored, and scores are recorded in real time.

The diagram includes a repeat loop that allows the child to decide whether to play more games, facilitating an engaging and flexible gaming experience. If the child opts to continue, they can select a different game, further enriching their interaction with the platform. Once the child concludes their game session, they submit their results for evaluation.

This submission is crucial, as it triggers the next step in the workflow. The doctor then reviews the child's performance based on the recorded scores. This review process allows for an informed assessment of the child's cognitive abilities. Finally, the doctor provides feedback, which may include recommendations for further action or adjustments to the treatment plan. Overall, the diagram illustrates a seamless flow of activities that enhances the child's cognitive training experience while enabling the doctor to track progress effectively.



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V. CONCLUSIONS

CogniTrain successfully demonstrates how a web-based platform can provide effective cognitive retraining for children with disabilities. The system's integration of interactive games, real-time progress monitoring, and a feedback loop between doctors and caregivers creates a comprehensive approach to cognitive development. By using MySQL to manage the data, the platform efficiently tracks performance and feedback, ensuring both accuracy and accessibility.

Future iterations of CogniTrain could include additional games targeting other cognitive functions, such as spatial reasoning or verbal memory. There is also potential for incorporating artificial intelligence to provide even more personalized feedback and adaptive game difficulty.

VI. DECLARATIONS

6.1 Study Limitations
None.
6.2 Acknowledgements
None.
6.3 Funding source
None.
6.4 Competing Interests
The authors declare no competing interests..

VII. HUMAN AND ANIMAL RELATED STUDY

This study does not involve physical testing or data collection from humans or animals.
7.1 Informed Consent
All tests were conducted with the consent of participants' legal guardians.

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