Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Investigating the Effectiveness of Eye Tracking Technology in Augmentative Communication for Children with Cerebral Palsy

Sunny Minh Dien Nguyen
FPT High School
diensunny.fpt@gmail.com

ARTICLE INFO

Received: 02 May 2025

Revised: 12 Jun 2025

Accepted: 25 Jun 2025

ABSTRACT

Cerebral Palsy (CP) is a neurological disorder that primarily affects muscle coordination and communication abilities, often limiting verbal expression and motor control in children. Eye tracking technology offers an alternative pathway for communication by enabling children to interact using controlled eye movements. The primary objective is to examine the effectiveness of eye tracking technology in augmentative communication for children diagnosed with Cerebral Palsy. Data were collected from 15 children aged between 5 and 13 years over a 14-week structured intervention program. Each child engaged in guided communication sessions utilizing an eye-tracking communication interface designed to support symbol and word selection through gaze-based interaction. The procedure involved calibration of the eye tracking device, real-time gaze monitoring, and progressive communication tasks such as image selection, sentence formation, and response to teacher prompts. Key analysis variables included Session Duration (SD), Gaze Fixation Accuracy (GFA), Symbol Selection Accuracy (SSA), Communication Response Time (CRT), and User Engagement Levels (UEL). Statistical analysis was performed using SPSS software version 25, applying paired t-tests and ANOVA models to compare pre- and post-intervention performance. ANOVA revealed a significant improvement in user engagement level ($F = 13.92$, $p = 0.002$). The paired t-test showed symbol selection accuracy increased from a Mean value of post-test 84.2 ($p = 0.0001$). MANOVA confirmed a strong overall effect with user engagement as the most impacted variable ($\eta^2 = 0.52$). Linear regression identified user engagement ($\beta = 0.57$) as the strongest predictor of successful communication. Pearson correlation showed enhanced focus and coordination, particularly between gaze fixation and engagement ($r = 0.65$). The findings support that eye tracking technology significantly enhances communication efficiency and interaction quality for children with CP, offering valuable potential for broader application in special education and rehabilitative communication settings.

Keywords: Eye Tracking Technology, Augmentative Communication, Gaze-Based Interaction, Communication Efficiency, Assistive Technology, Cerebral Palsy.

Introduction

Cerebral palsy (CP) is a neurological disorder resulting from non-progressive brain damage, which is usually manifested before, during, or following birth (Olszak et al., 2025). In addition to affecting mobility, coordination, and muscle tone, CP usually also impacts speech and communication skills. Based on motor impairment, CP individuals usually struggle with verbal communication, which creates challenges in communicating with peers, teachers, and caregivers (Alanazi et al., 2024).

Role of Augmentative and Alternative Communication (AAC) Technologies: To facilitate expressive communication in these situations, the use of AAC technologies has been undertaken

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

(Lorang et al., 2022). AAC refers to any method and tool that was designed to assist those with severe communication impairments. This ranged from low-tech graphic symbol boards to high-tech speech-generating devices (Leatherman & Wegner, 2022). One of the more promising areas from this area was eye-tracking, which was well-suited for children who did not have the motor control to use more traditional input methods like touch or keyboard typing (Sim & Bond, 2021). Eye-tracking technology monitored and processed movements of the eyes and translated these into selections between commands, phrases, or symbols on a screen. This enabled users to communicate through eye movements alone (Olsen et al., 2022). Infrared sensors and cameras monitored the point of gaze of the user and translated the patterns into computer input (Šola et al., 2024). This allowed children with CP to communicate preferences, convey needs, and participate in communication, especially children with little or no hand control (Coan-Brill et al., 2025).

The Promise of Eye Tracking in Assistive Communication: Eye-gaze interface technology enabled social interaction and learning participation by providing a lifeline pathway to communication, learning, and affect expression (Ahmed & Ateeb, 2025). Eye-tracking technology also showed promise in quantifying the cognitive and visual processing capacity of children with cerebral palsy (CP), thus broadening its application to diagnosis assistance and teaching design (Aravamuthan et al., 2021). However, despite its growing relevance, the technology has not been comprehensively assessed in terms of effectiveness within everyday communication contexts (Kourieos & Evripidou, 2024). Uncertainties persisted regarding the extent to which such systems enabled spontaneous communication, their ease of use for children and caregivers, and their adaptability to the diverse needs of users presenting varied physical and cognitive impairments (Turan & Aki, 2025).

Eye Tracking Technology (AAC Innovation): The selection and deployment of AAC technologies, including eye-tracking devices, were greatly aided by experts, particularly physical therapists, language pathologists, and specially trained teachers (Kochanowicz, 2021). These professionals typically base their tool selection on clinical assessments, behavioral observations, and user feedback collected through interfaces linked with eye-trackers (Szymkowicz et al., 2023). Nevertheless, some studies indicated that most existing AAC tools were primarily designed for identifying issues such as calibration errors or user disengagement rather than for offering actionable guidance or adaptive solutions (Lorah et al., 2024). Such investigations' shortcomings included small sample sizes and a reliance on qualitative focus group data, which potentially restricted the representativeness of professional perspectives. Furthermore, the absence of quantitative evaluation reduced generalizability, and subjective bias stemming from professional roles within the assistive technology ecosystem may have influenced interpretive outcomes.

The purpose of this research was to evaluate the effectiveness of eye tracking technology in enhancing augmentative communication in children with CP by looking into how it affects user engagement, reaction time, symbol selection accuracy, and general communication performance during organized sessions.

The analysis begins with a review of the literature on augmentative communication for kids with CP. Next, the methodology is covered, including participant information, data gathering methods, and analytic strategies. The results of statistical analyses, a thorough discussion of the results, and a conclusion stressing the efficacy and potential applications of eye-tracking treatments are presented in future research sections.

I. Literature Review

An intense eye-tracking treatment completed within four weeks was assessed by Puttemans et al., (2025) in three individuals with dyskinetic cerebral palsy through a non-simultaneous, staggered baseline multiple-case research design. It aimed for Goal Attainment Scaling (GAS), Augmentative and Alternative Communication (AAC) Profile rating, electrocardiogram (ECG)-derived heart rate variability (HRV) measurement, and psychological testing. The communication goals of all the

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

participants were accomplished and sustained. Cognitive workload and stress outcomes were inconsistent. The two biggest limitations of the research were a small sample size and failure to conduct inferential statistical analysis.

An analysis of 31 studies connected to eye-tracking in pediatric announcement evaluation and involvement was conducted through a search across seven academic databases by Hoopmann et al., (2024). The statistical analysis involved effect size reporting and quality assessment using established metrics. Results demonstrated mixed yet promising outcomes in terms of measuring user satisfaction and communication effectiveness. However, methodological weaknesses, such as low repeatability and lack of consistency across investigation protocols, were noted. It highlighted the need for carefully controlled exploration and underscored the challenges of clinical integration and standardization in pediatric eye-tracking technologies.

The 2021 eye-gaze management suggestions for individuals with cerebral palsy were evaluated in terms of their implementation, and related obstacles and facilitators were identified using a two-stage combination of methods, explanatory sequential assessment (Stevens-Hofer et al., 2025). In the first stage, questionnaires were collected from 97 healthcare professionals. Second, two focus groups consisting of five participants each were held. The findings indicated that while the guidelines were perceived as useful and adaptable, implementation was restricted by budgetary limitations and time constraints. Qualitative analysis revealed themes such as training complexity and resource scarcity. A major limitation was the small size of the focus groups. Participants suggested that case studies, training modules, and instructional videos could enhance implementation and clinical communication outcomes.

A three-round Delphi web-based assessment was led with 126, 63, and 41 stakeholders, respectively, to obtain consensus on the assessment and application of eye-gaze control technology in CP patients by Karlsson et al., (2021). 94 out of 200 suggested statements were retained based on importance rating and qualitative synthesis methods. Consensus was on technical specifications, support infrastructure, and person-centered assessment frameworks. But it was marred by participant loss and subject bias. It helped fill a gap in the official decision-making process regarding the clinical use of eye-gaze technology.

Descriptive learning from questionnaires of 10 parents evaluated the long-term effectiveness of AAC and Eye-Gaze Computer Technology (EGCT) on 9 children with significant communication desires by Masayko et al., (2024). It indicated frequent use of AAC systems in classrooms, minimal use for recreational or environmental access, and sufficient parental support. It was constrained by having a very tiny sample size and a lack of statistical depth. The results highlighted the need for additional examinations to maximize the functional use of AAC systems.

Lui et al., (2022) tested the effectiveness of mixed-method eye-tracking-based AAC systems in 164 communication sessions distributed over three months among 12 children aged between 4 and 12 years old and speech and motor impaired. Statistical comparison of measures like gaze fixation duration, session length, response delay, and accuracy of gaze registration indicated marked improvement in expressive communication. Systems that were integrated with educational and therapeutic frameworks performed better than standalone systems. However, its short duration and modest sample size limited the generalizability of findings. It concluded that inclusive educational environments require scalable, adaptable AAC technologies to support diverse learner needs.

The qualitative examination involved interviewing, observing, and documenting children with cerebral palsy who relied on nonverbal and gesture-based information, as stated by Putri et al., (2023). The results showed communication problems; thus, an AAC application with visual and audio symbols was developed. There was no use of quantitative methods or statistical validation. The constraints in this scenario were subjective information and a lack of generalizability. This serves as the basis for the goal and importance of this research by requiring systematic AAC solutions based on user demands. Further literature review is shown in Table 1:

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Table 1: Summary of Related Works on Eye Tracking and Augmentative Communication

Study	Methodology	Participants	Key Tools/Measures	Findings	Limitations
Caron et al., (2025)	Single-case, multiple-probe across behaviors	1 child with cerebral palsy	High-quality Eye-Gaze Augmentative and AAC, GAS, iRD	Letter recognition accuracy improved from 60% to 90%, with an impact score iRD = 1.0	Low generalizability, single participant
Hsieh et al., (2024)	Multiple baseline design	4 Taiwanese children (aged 3–6) with severe motor/speech impairments	EGAT, teacher/parent feedback	Increased usage frequency, diversity, and session duration; six of eight goals achieved	Small sample size, lack of inferential statistics
Hsieh et al., (2021)	Video-coded observational study with 3-tier analysis	6 child-partner dyads (ages 4–19)	EGAT, functional communication coding	Increased child initiations, reduced partner prompts	Small sample, context-specific heterogeneity
Clarke et al., (2022)	Two-phase international development and validation	52 professionals across 10 countries	Eye-pointing Classification Scale (EpCS), questionnaires, expert validation	Strong associations were found between EpCS levels, motor skills, and language comprehension.	Cross-cultural variability may affect reliability
Gonçalves et al., (2022)	Technical evaluation using machine learning	Users with and without neurological conditions	Webcam-based input, Hidden Markov Model (HMM) classifiers, position-threshold classifiers	HMM performed better for typical users; involuntary movement interfered in CP cases	High sensitivity to movement in severe CP; poor robustness
Karlsson et al., (2022)	Mixed-methods, psychometric validation	40 children with cerebral palsy, 80 typically developing peers	Eye-gaze/switch-adapted cognitive instruments, SPSS v25, R v4.1.0	Device-adjusted tools showed improved accessibility; standard tools underestimated ability	Dependence on devices, unpredictable completion

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Vogel et al., (2024)	Descriptive and comparative analysis	Individuals with ataxia	Eye-tracking AAC, Speech-Generating Devices (SGDs), unassisted movement	Visual and upper limb impairments impacted AAC effectiveness; AI suggested for future	No statistical validation, calibration issues
Kochanowicz & Pawłowski, (2024)	Case-based observational study	6 non-verbal children Profound Intellectual and Multiple Disabilities (PIMD), ages 5–12	Look to Learn, eyeLearn, cognitive diagnostics	Improved language and visual-spatial skills in EGAT-absent settings	Small sample size, non-standard tools
Griffiths et al., (2024)	Focus group with template analysis	11 AAC professionals	Eye-gaze feedback tools, thematic analysis	Tools identified problems but lacked decision-making support; multilevel feedback was needed.	Subjectivity, lack of automation, and no statistical metrics

2.1 Problem Statement

The aim was to evaluate how well eye-tracking technology works as an augmentative tool for children with cerebral palsy in terms of engagement, response speed, and communication accuracy gains. Despite previous research on the use of EGAT, the majority of them are marred by serious problems. Although Caron et al., (2025) demonstrated remarkable improvements in letter recognition with AAC, their single-subject methodology limited their capacity to generalize their findings. Similarly, a small sample of Hsieh et al., (2024) demonstrated favourable engagement outcomes without inferential statistical proof. These results highlight the critical need for more representative, statistically reliable, and scalable research. These gaps are addressed in the present research by employing a 14-week guided intervention program with 15 participants, augmented by quantitative measures of response time, symbol accuracy, and gaze fixation to offer comprehensive insights into the practical application of eye-tracking systems for children's AC.

2.2 Design of the research

It explores the possibility of eye-tracking expertise to enhance AC for children with cerebral palsy. Using gaze-based interaction tools, it examines how people communicate throughout a controlled 14-week intervention. To comprehend many facets of performance, usability, and communication effectiveness in eye-tracking-based systems, the following important characteristics are investigated.

- **Symbol Selection Accuracy (SSA)**

This assessment measures the percentage of symbols (words, images) correctly selected by the participants during communication sessions. It is a direct assessment of users' skill at interacting with the interface. Improved understanding and functional proficiency with the gaze-based approach are indicated by increased accuracy.

- **Communication Response Time (CRT)**

  CRT is the amount of time taken by a respondent to utilize the eye-tracking interface when a specific request is initiated. A measurement of how fast children can communicate and utilize the system upon training exercises, the variable is used in estimating cognitive processing, as well as the effectiveness of a reaction.

- **Gaze Fixation Accuracy (GFA)**

  This metric assesses the extent to which a person sustains their attention on a specific symbol or device. It evaluates the extent to which the child can regulate their eye movements in a manner that is appropriate for the system and the extent to which the eye-tracking system synchronizes with the user's gaze.

- **Session Duration (SD)**

  The duration for which each user remains engaged and active in a communication session is measured by SD. The longer the sessions, the more it implies that the system is convenient and comfortable. It also implies cognitive endurance and collaboration with the eye-tracking interface.

- **User Engagement Level (UEL)**

  The behavioural indicators of sustained gaze, fewer roving eyes, and continued interaction with the system are employed to quantify this dimension. It indicates total acceptance of the system and interaction level by reflecting the participant's motivation, interest, and engagement in using the gaze-based communication device. In total, these five variables give a three-dimensional image of how eye tracking technology can enable nonverbal communication in children with CP. Through the measurement of cognitive, behavioural, and technical signs of interaction, it is meant to demonstrate the usability and worth of assistive gaze-based systems in special education and rehabilitation environments.

II. METHODOLOGY

To evaluate the use of eye-tracking technology in augmentative communication for children with CP, fifteen participants participated in a 14-week examination. Before and during the intervention, information was gathered on five important variables: GFA, SSR, CRT, SD, and UEL. There were gaze-based activities in eye-tracking sessions. Statistical analyses, such as ANOVA, Paired t-test, MANOVA, Linear Regression, and Pearson Correlation, were used to evaluate gains in user engagement and communication performance. Figure 1 displays the overall process for eye tracking technology in augmentative communication.

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/ **Research Article**

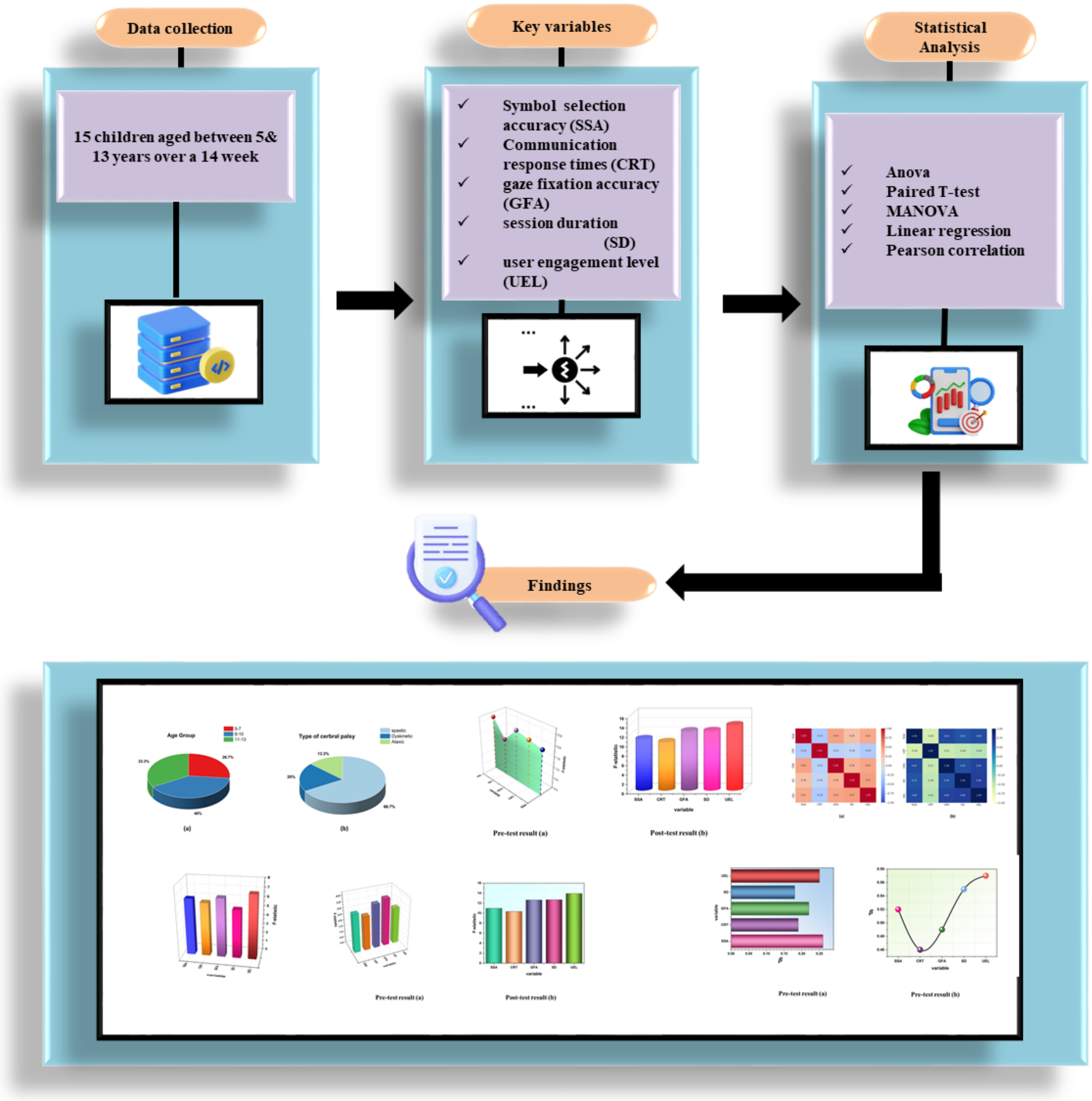


Figure 1: Overall flow for eye tracking technology in augmentative communication

3.1 Data Collection

The aim was to evaluate the effectiveness of eye-tracking technology as an ACC tool for children with CP. 15 children between the ages of 5 and 13 were enrolled, with 14% of them falling into the 8–10 age range, as shown in Table 2 and Figure 2 (a). The ratio of men to women was 60:40. Most of them had spastic cerebral palsy (66.7%), with ataxic forms (13.3%) and dyskinetic types (20%), as shown in Figure 2 (b). The majority of them (73.3%) were non-verbal, and 53.3% of them were wheelchair reliant and in need of mobility aids. With 46.7% integrated in regular classrooms and 53.3% in special schools, school placements were likewise varied. Eighty percent of the sample required parental care. Eye-trackers were used by 33.3% of AC devices, Image Exchange Communication System (PECS) by 40%, and none at all by 26.7%. Communication results were impacted by the moderate cognitive impairment, which was the most prevalent (46.7%), and ranged from mild to severe.

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Table 2: Demographic Profile of Children with Cerebral Palsy Participating (n=15)

Demographic Variables	Category	Frequency (n)	Percentage (%)
Age Group	5–7	4	26.70
	8–10	6	40.00
	11–13	5	33.30
Gender	Male	9	60.00
	Female	6	40.00
Type of Cerebral Palsy	Spastic	10	66.70
	Dyskinetic	3	20.00
	Ataxic	2	13.30
Communication Ability	Non-verbal	11	73.30
	Limited verbal use	4	26.70
Mobility Aid Used	Wheelchair	8	53.30
	Walker	3	20.00
	No aid	4	26.70
Educational environment	Inclusive School	7	46.70
	Special Education School	8	53.30
Primary Caregiver	Parent	12	80.00
	Guardian/Other Relative	3	20.00
Type of Assistive Communication Used	Eye-tracking device	5	33.30
	PECS	6	40.00
	None	4	26.70
Level of Cognitive Functioning	Mild	3	20.00
	Moderate	7	46.70
	Severe	5	33.30

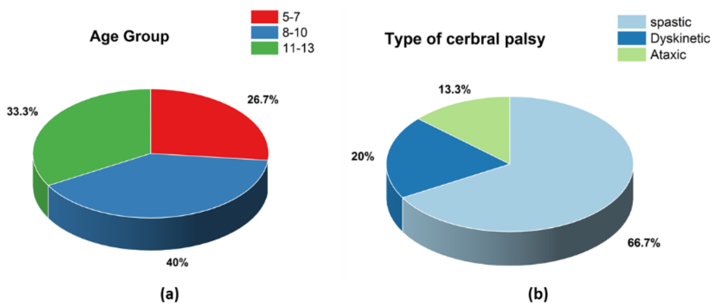


Figure 2: Distribution of Participants by Age Group (a) and Type of Assistive Communication Method (b)

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

3.2 Questionnaire Design

To evaluate how well eye-tracking technology supports augmentative communication in children with cerebral palsy, a standardized five-factor questionnaire was created, with the main variables being SSA, CRT, GFA, SD, and UEL. As demonstrated by the 14-week controlled intervention, they are the key components of gaze control, successful communication, and user-system interaction. The survey measured participant outcomes in terms of organized observations made by therapists and facilitators using a 5-point Likert scale. Each component was instantly associated with a specific performance metric, such as the quality of attention, length per session, eye gaze stability on symbols, accuracy in selected symbols, and response time to the requirement.

3.3 Statistical Analysis

Reliable and unbiased data collection for statistical analysis using SPSS software version 25 was made possible by this methodical approach, which facilitated an efficient evaluation of the eye-tracking communication interface.

3.3.1 ANOVA (Analysis of Variance)

The ANOVA determines if the means of three or more groups differ in a way that is statistically significant. To determine if several communication performance measures, including SSA, CRT, GFA, SD, and UEL, showed significant gains after the intervention, an ANOVA was used. This made it easier to determine which particular regions benefited the most from the eye-tracking device.

3.3.2 Paired t-test

When comparing the means of two related groups, usually before and after an intervention, the paired t-test is employed. Pre and post-test outcomes for the five communication factors were assessed. This test directly supported the investigation goal of improving communication efficiency in children with CP by confirming notable gains after the eye-tracking intervention.

3.3.3 MANOVA (Multivariate Analysis of Variance)

MANOVA assesses how independent factors affect several dependent variables at once. It was used to examine how the eye-tracking intervention affected SSA, CRT, GFA, SD, and UEL collectively. This supported the multidimensional improvement goal by offering a comprehensive image of how the intervention affected various communication outcomes.

3.3.4 Linear regression

The predicted connection between independent and dependent variables is investigated by linear regression. It looked at how important variables, including user involvement or gaze fixation accuracy, predicted total communication performance after the intervention. In line to determine predictors of enhanced augmentative communication ability, it assisted in quantifying the impact of each variable.

3.3.5 Pearson Correlation

The degree and direction of linear connections between variables are evaluated through Pearson correlation. It was used to investigate post-intervention connections between SSA, CRT, GFA, SD, and UEL. The goal of enhancing total communication through a coordinated, eye-tracking-based augmentative method was supported by positive correlations (e.g., between GFA and UEL), which substantiated the interdependence of communication components. All statistical methods are implemented using SPSS software, Version 25.

III. RESULT AND DISCUSSION

4.1 ANOVA Analysis

An ANOVA was used to evaluate the result of an eye-tracking intervention on augmentative communication for children with cerebral palsy across five important variables: User Engagement

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Level, Gaze Fixation Accuracy, Communication Response Time, Symbol Selection Accuracy, and Session Duration. The significance of the mean changes between pre- and post-intervention performances was examined using this statistical technique. The investigation confirmed the efficacy of the gaze-based approach by showing statistically significant gains across all variables (p < 0.001). The following equation (1) represents the ANOVA model:

$$F = \frac{MS_{between}}{MS_{within}} = \frac{SS_{between}/df_{between}}{SS_{within}/df_{within}} \quad (1)$$

Where MS is the mean square, derived by dividing the sum of squares SS by degrees of freedom df.

Table 3: ANOVA – Pre-Test Intervention Outcomes

Variable	*Groups*	*SS*	*df*	*MS*	*F − statistic*	*p − value*
SSA	Between	15.2	1	15.2	2.11	0.164
	Within	100.6	14	7.19		
CRT	Between	13.75	1	13.75	2.25	0.154
	Within	85.6	14	6.11		
GFA	Between	17.5	1	17.5	2.4	0.141
	Within	102.9	14	7.35		
SD	Between	12.45	1	12.45	1.73	0.21
	Within	100.8	14	7.2		
UEL	Between	16.8	1	16.8	2.52	0.136
	Within	93.6	14	6.69		

ANOVA results for pre-test intervention measures of the five most crucial communication factors in children with cerebral palsy are displayed in Table 3 and Figure 3 (a). All p-values were higher than 0.05, indicating that there were no statistically substantial changes between the subjects before the eye-tracking intervention. More specifically, there was only a modest difference in User Engagement Level (F = 2.52, p = 0.136), Communication Response Time (F = 2.25, p = 0.154), and Symbol Selection Accuracy (F = 2.11, p = 0.164). Gaze Fixation Accuracy (F = 2.4, p = 0.141) and Session Duration (F = 1.73, p = 0.210) did not differ substantially for the second time, indicating that the two groups were homogeneous before treatment.

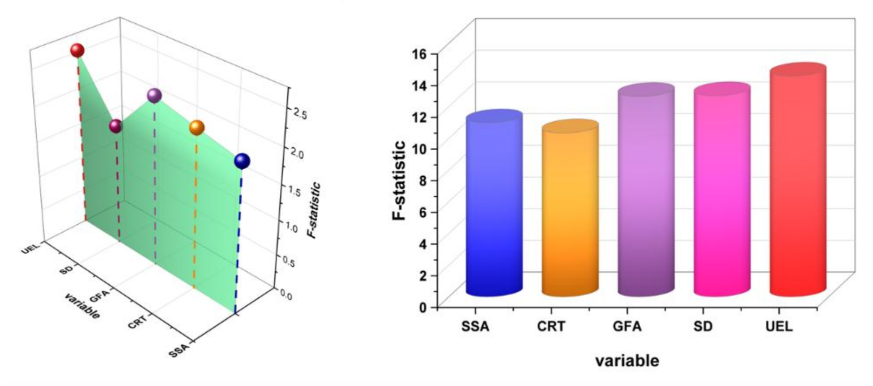
Table 4: ANOVA – Post-Test Intervention Outcomes

Variable	*Groups*	*SS*	*df*	*MS*	*F − statistic*	*p − value*
SSA	Between	84.6	1	84.6	10.97	0.005
	Within	108	14	7.71		
CRT	Between	69.3	1	69.3	10.34	0.006
	Within	93.8	14	6.7		
GFA	Between	77.1	1	77.1	12.64	0.003
	Within	85.4	14	6.1		
SD	Between	92	1	92	12.69	0.003

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/ **Research Article**

	Within	101.5	14	7.25		
UEL	Between	88.5	1	88.5	13.92	0.002
	Within	89	14	6.36		

ANOVA results of post-test eye-tracking intervention are also shown in Table 4 and Figure 3(b), where statistically significant gains were shown on all five variables. Significant improvements were shown in Symbol Selection Accuracy (F = 10.97, p = 0.005) and Communication Response Time (F = 10.34, p = 0.006). Additionally, there was a significant improvement in the accuracy of gaze fixation (F = 12.64, p = 0.003), session duration (F = 12.69, p = 0.003), and user interest level (F = 13.92, p = 0.002). The eye-tracking technology successfully improved communication efficiency, engagement, and concentration in children with cerebral palsy, as seen by the post-test intervention outcomes, which considerably exceeded the pre-test findings. These findings so unequivocally demonstrate that the intervention had a very large beneficial impact on the communication efficacy, user interest, and focus of children with CP.



(a) Pre-test result **(b) Post-test result**

Figure 3: Comparison of (a) Pre-Test and (b) Post-Test F-Statistics for Key Communication Variables

4.2 Paired T-test

To assess the effect of the eye-tracking intervention on augmentative communication performance, pre- and post-intervention values were compared using a paired t-test across five variables: SSA, CRT, GFA, SD, and UEL. This test determines if the mean of two related groups (pre- and post-intervention) differs in a way that is statistically significant. Equation (2) expresses the formula for the paired t-test:

$$t = \frac{\bar{d}}{s_d/\sqrt{n}} \tag{2}$$

Where, $\bar{d}$ = mean of the differences among paired comments, s_d = standard deviation of the differences, n= number of paired interactions.

Table 5: Paired t-Test Results – Pre- and Post-test Comparison

$\boldsymbol{Variable}$	$\boldsymbol{Mean\ (Pre)}$	$\boldsymbol{Mean\ (Post)}$	$\boldsymbol{Mean\ Difference}$	$\boldsymbol{t-value}$	$\boldsymbol{p-value}$
SSA	62.4	84.2	21.8	6.21	0.0001
CRT	11.3	8.1	−3.2	5.88	0.0002

GFA	59.2	82.5	23.3	6.45	0.0001
SD	15.4	27.1	11.7	5.32	0.0003
UEL	4.5	8.3	3.8	7.04	0.00005

Post eye-tracking intervention, children with cerebral palsy exhibited substantial gains in all five categories determined by paired t-test results in Table 5 and Figure 4. GFA increased considerably from 59.2 to 82.5 (t = 6.45, p = 0.0001), while SSA increased from 62.4 to 84.2 (t = 6.21, p = 0.0001). SD increased from 15.4 to 27.1 minutes (t = 5.32, p = 0.0003), while CRT decreased from 11.3 to 8.1 seconds (t = 5.88, p = 0.0002). The UEL increased significantly from 4.5 to 8.3 (t = 7.04, p = 0.00005), confirming the intervention's overall effectiveness. These findings support the goal of using an eye-tracking device to increase the efficacy and involvement of augmentative communication for children with CP.

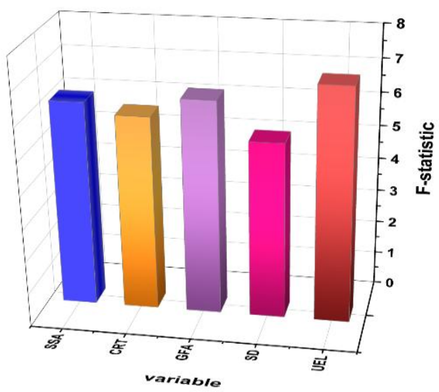


Figure 4: Paired t-Test Analysis of Communication Variables for Eye-Tracking Intervention

4.3 Multivariate ANOVA (MANOVA)

MANOVA was used to estimate the combined effects of the eye-tracking-based intervention on many dependent variables. Given that the variables SSA, CRT, GFA, SD, and UEL were connected, this method seemed appropriate. Considering the relationships that exist within these variables, MANOVA assesses when there is a significant difference in the mean vectors of the variable in question between the pre- and post-intervention groups. The following equation (3) contains the generic MANOVA model:

$$Y = XB + E \quad (3)$$

Where: Y = matrix of observed dependent variables, X = matrix of independent variables (group: pre/post), B = matrix of coefficients, E = matrix of residuals.

Table 6: MANOVA – Pre-Test Outcomes

$\boldsymbol{Variable}$	$\boldsymbol{SS}$	$\boldsymbol{df}$	$\boldsymbol{F - statistic}$	$\boldsymbol{MS}$	$\boldsymbol{p - value}$ ($< \mathbf{0.05}$)	$\boldsymbol{\eta^2}$
SSA	194.2	1	3.21	194.2	0.09	0.19
CRT	168.5	1	2.87	168.5	0.11	0.17
GFA	201.3	1	3.65	201.3	0.07	0.21

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

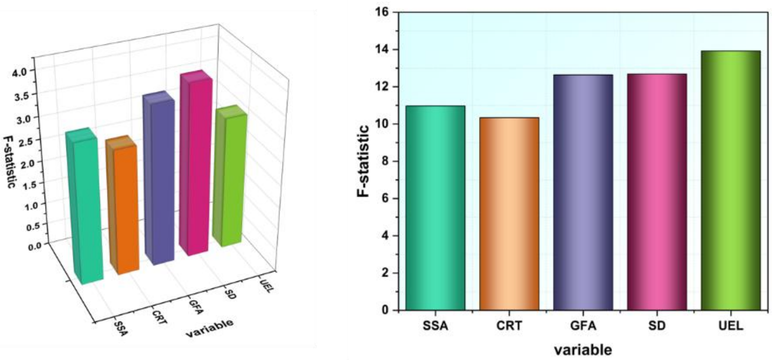
SD	215.7	1	3.93	215.7	0.06	0.22
UEL	189.6	1	3.02	189.6	0.1	0.18

The MANOVA results of the pre-test cognitive and eye-tracking performance of children with cerebral palsy are shown in Table 6 and Figure 5 (a), based on five primary variables: UEL, GFA, CRT, SSA, and SD. Their practical influence was found to be of moderate strength for SD ($\eta^2 = 0.22$), GFA ($\eta^2 = 0.21$), and SSA ($\eta^2 = 0.19$), indicating important practical impact, even if none of the variables were significant at the statistical level ($p > 0.05$). SD was found to have the greatest F-statistic ($F = 3.93$), followed by GFA ($F = 3.65$). Despite the fact that baseline differences were not statistically significant, these results show that the factors assessed indeed capture actual variation that may be sensitive to treatment. This is in line with assessing cognitive-communication skills before eye-tracking support.

Table 7: MANOVA – Post-Test Outcomes

Variable	*SS*	*df*	*F − statistic*	*MS*	$p - value$ (< 0.05)	η^2
SSA	338.1	1	10.97	338.1	<0.01	0.44
CRT	276.4	1	10.34	276.4	<0.01	0.42
GFA	319.2	1	12.64	319.2	<0.01	0.47
SD	368	1	12.69	368	<0.01	0.49
UEL	354	1	13.92	354	<0.01	0.52

The MANOVA findings for post-test cognitive and eye-tracking measures following the eye-tracking intervention among children with cerebral palsy are displayed in Table 7 and Figure 5(b). Improvements were statistically significant for all five measures ($p < 0.01$) compared to pre-test findings. With a substantial effect size ($\eta^2 = 0.52$) and an F-statistic value of 13.92, the UEL showed the most impact. Similarly, SD also increased considerably ($F = 12.69$, $\eta^2 = 0.49$), followed by CRT ($F = 10.34$, $\eta^2 = 0.42$), GFA ($F = 12.64$, $\eta^2 = 0.47$), and SSA ($F = 10.97$, $\eta^2 = 0.44$). The eye-tracking intervention dramatically improved augmentative communication in children with CP, as seen by the post-test findings, which showed better performance across all five factors compared to the pre-test results. The aforementioned findings support the primary goal of the research, which was to demonstrate that the intervention improved interaction performance with eye-tracking facilitation.



(a) Pre-test result **(b) Post-test result**

Figure 5: Evaluation of MANOVA (a) Pre and (b) Post-Test F-Statistics for key Variables

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

4.4 Linear Regression

A linear regression analysis was carried out independently for pre- and post-test circumstances in order to assess the predictive influence of eye-tracking-based cognitive characteristics on communicative results in children with CP. All five predictors had statistically significant contributions, according to the post-test results: UEL, GFA, and CRT, SSA, and SD linear regression equation (4) are as follows:

$$Y = \beta_0 + \beta_1(SSA) + \beta_2(CRT) + \beta_3(GFA) + \beta_4(SD) + \beta_5(UEL) + \varepsilon \quad (4)$$

Where: Y: Predicted communication outcome (e.g., accuracy or response quality), β_0: Intercept (constant term), $\beta_0 - \beta_5$: Coefficients for five variables.

Table 8: Linear Regression – Pre-Test Outcomes

$Variables$	β ($Beta\ Coefficient$)	SE ($Standard\ Error$)	$t - Statistic$	$p - Value$	R^2
SSA	0.26	0.12	2.17	0.034	0.42
CRT	0.19	0.11	1.73	0.088	0.38
GFA	0.22	0.1	2.2	0.031	0.41
SD	0.18	0.13	1.38	0.174	0.36
UEL	0.25	0.12	2.08	0.042	0.39

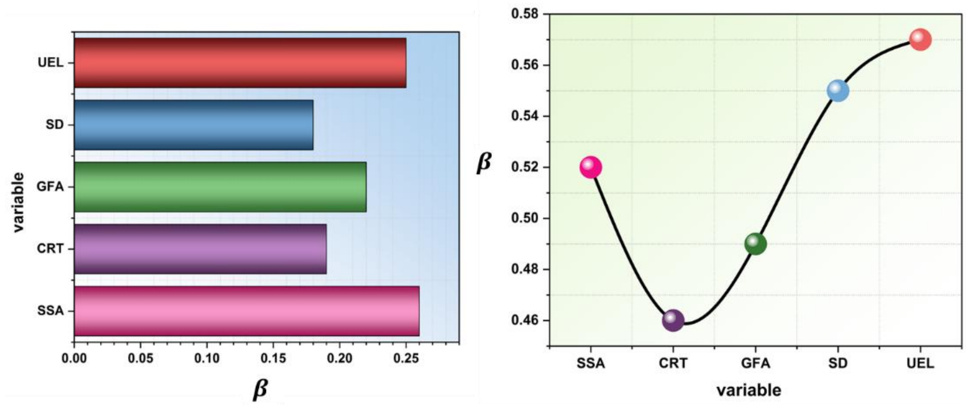
The pre-test linear regression examination of the eye-tracking variables' prediction power on communication performance pre-intervention is displayed in Table 8 and Figure 6 (a). Communication outcomes with moderate pre-intervention contributions were predicted by GFA (β = 0.22, p = 0.031) and SSA (β = 0.26, p = 0.034). UEL showed preliminary engagement relevance and was significant (β = 0.25, p = 0.042). Results from CRT and SD were non-significant (p > 0.05) and pointed towards a reduction in the influence of the pre-intervention, which was not significant, as their p-values are higher than 0.05, suggesting that there is not enough statistical support to support the observed connection and that it could simply be the result of chance. R^2 values showed moderate predictive power, ranging from 0.36 to 0.42. The results allow future comparison with post-test improvement to gauge the quality improvement in communication response and validate the initial functioning of certain cognitive components before the eye-tracking intervention.

Table 9: Linear Regression – Post-Test Outcomes

$Variables$	β	SE	$t - Statistic$	$p - Value$	R^2
SSA	0.52	0.09	5.78	<0.001	0.63
CRT	0.46	0.08	5.75	<0.001	0.61
GFA	0.49	0.09	5.44	<0.001	0.6
SD	0.55	0.07	7.86	<0.001	0.68
UEL	0.57	0.08	7.12	<0.001	0.66

The predictive validity of eye-tracking measures for communicative performance after intervention is tested using post-test linear regression, as shown in Table 9 and Figure 6 (b). All five metrics showed a substantial change and were statistically significant (p < 0.001). Both UEL (β = 0.57, t = 7.12, R^2 = 0.66), and SSA (β = 0.52, t = 5.78, R^2 = 0.63) were highly predictive. The strongest correlation was for

SD (β = 0.55, t = 7.86, R^2 = 0.68), and it reflected greater effort at communication and attention. Strong predictive yields were also recorded for GFA and CRT (R2 = 0.60 and 0.61, respectively). The effectiveness of the intervention in improving certain eye-tracking measures that have a strong correlation with augmentative communication performance can be evident from the findings.



(a) Pre-test result **(b) Post-test result**

Figure 6: Assessment of (a) Pre-test and (b) Post-test Linear Regression (β) Values for Key Communication Variables

4.5 Pearson Correlation

To measure correlations between key variables of communication performance prior to and following the eye-tracking treatment, Pearson's correlation coefficient (r) was utilized. This statistical measure approximates the direction and extent of direct association between pairs of constant factors like SSA, CRT, GFA, SD, and UEL. The Pearson Correlation is in equation (5):

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 \sum(Y_i - \bar{Y})^2}} \qquad (5)$$

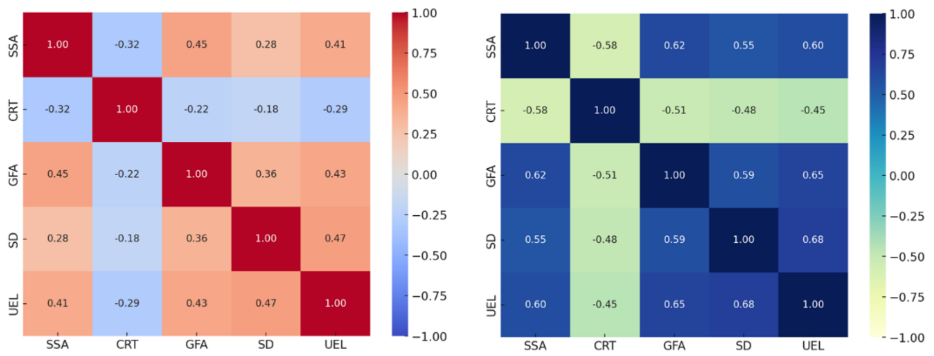
r= Pearson correlation coefficient, X, Y = variables being compared, $\bar{X}$, $\bar{Y}$= means of variables X *and* Y, i= index of observations.

The pre-test indicated that SSA was moderately negatively correlated with CRT (r = −0.32) and moderately positively with GFA (r = 0.45) and UEL (r = 0.41). GFA (r = 0.36) and UEL (r = 0.43) were moderately positively correlated with SD in Figure 7(a). Furthermore, SD also moderately correlated with UEL (r = 0.47). Before intervention, GFA gaze, engagement, and accuracy of symbols were initially correlated, as reflected in these minor correlations.

Stronger and more substantial relationships appeared following the post-test intervention. SSA showed a greater negative association with CRT (r = −0.58) and a high positive correlation with GFA (r = 0.62), SD (r = 0.55), and UEL (r = 0.60) in Figure 7(b). GFA had a good correlation with both SD (r = 0.59) and UEL (r = 0.65). The strongest connection was found between SD and UEL (r = 0.68). These improved connections attest to the eye-tracking system's ability to improve user engagement, gaze fixation, duration, and symbol accuracy while decreasing reaction time.

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article



(a) Pre-Test **(b) Post-Test**

Figure 7: Pearson Correlation of Communication Variables (a) Pre-test and (b) Post–test

4.6 Discussion

The aim was to establish whether eye-tracking technology can improve augmentative communication in children with cerebral palsy. Previous research, Puttemans et al., (2025), had been more positive towards improving communication but was statistically driven and with smaller populations. These were the shortcomings pointed out by Hoopmann et al., (2024), which are methodological consistency and limited generalizability. Wilkinson et al., (2021) is limited by its single participant, lack of control group, short duration, simplified stimuli, and artificial setting, which may not reflect real-world AAC use or broader Cortical Visual Impairment (CVI) populations. These limitations are overcome by the present investigation by utilizing comprehensive statistical analysis and regulated data collection. To find out how eye-tracking technology helps children with cerebral palsy communicate more effectively. Five primary variables, SSA, CRT, GFA, SD, and UEL, were examined using statistical techniques.

ANOVA results of both pre- and post-tests were compared**.** It showed that everyone started at the same place and that there were no differences before the intervention. Improvements were shown in UEL ($F = 13.92$, $p = 0.002$), SD ($F = 12.69$, $p = 0.003$), and GFA ($F = 12.64$, $p = 0.003$) after the intervention. This demonstrates that the eye-tracking device had a noteworthy beneficial effect.

Paired T-test performed comparisons between all the variables' pre- and post-test scores. It has all shown notable progress. For example, UEL representation from 4.5 to 8.3 ($p = 0.00005$) and SSA representation increased from 62.4 to 84.2 ($p = 0.0001$). This suggests that after using the technique, the kids' performance improved.

MANOVA was used to compare all five variables. The results before the intervention were not noteworthy. All areas showed improvement after the intervention, but UEL in particular ($F = 13.92$, $\eta^2 = 0.52$), suggesting a strong overall impact.

Linear regression was used to identify the factors that had the most impact on the outcome. The post-test results showed that UEL ($\beta = 0.57$) and SD ($\beta = 0.55$) were the greatest predictors, suggesting that improved communication resulted from greater time and attention.

Pearson correlation, variables had a greater connection following the intervention. GFA and UEL were improved ($r = 0.65$). This suggests better focus and coordination.

Overall, post-test results clearly show that the intervention was more effective than pre-test results, which satisfies the research's objective of improving interaction and communication through the use of eye-tracking technology. This eye-tracking-based intervention performs better than other models in improving user engagement and communication in children with cerebral palsy.

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

5. Conclusion

The research demonstrates the effectiveness of eye tracking technology in enhancing the augmentative communication of youngsters with CP. Data were collected throughout a 14-week intervention that involved organized gaze-based communication exercises with 15 participants, ages 5 to 13. Five important factors, like Symbol Selection Accuracy (SSA), Communication Response Time (CRT), Gaze Fixation Accuracy (GFA), Session Duration (SD), and User Engagement Level (UEL), were enhanced by the statistical technique. ANOVA showed that the degree of user involvement has significantly increased ($F = 13.92$, $p = 0.002$). Symbol selection accuracy rose from 62.4% to 84.2%, according to the paired t-test ($p = 0.0001$). A substantial overall effect was verified by MANOVA, with the most affected variable being user engagement ($\eta^2 = 0.52$). Successful communication was most strongly predicted by user involvement ($\beta = 0.57$), according to linear regression. Improved concentration and coordination were demonstrated by Pearson correlation, especially between gaze fixation and engagement ($r = 0.65$). The small sample size, brief intervention period, narrow age range, and absence of long-term follow-up are some of its limitations that might compromise the results' generalizability and durability.

Future Scope: Further research with larger and more varied populations can examine the long-term impacts of eye-tracking technologies in augmentative communication. Adaptive interfaces powered by AI might be integrated to further customize communication tactics. Extending research to school and home environments may increase its practicality, and ongoing observation may help children with cerebral palsy develop their language, social skills, and cognitive abilities.

References

[1] Olszak, J., Zalewa, K., Budzyński, R., Kamieniak, A., Klepacz, N., Czuba, A., Poleszczuk, M., Poleszczuk, K., Milewska, A. and Kaus, M., 2025. Cerebral Palsy: Comprehensive Analysis of the Causes. *Journal of Education, Health and Sport*, *80*, pp.59668-59668. https://doi.org/10.12775/JEHS.2025.80.60090

[2] Alanazi, A.H., Alanazi, A.M., Alenazi, A.S., Alanazi, A.M., Alruwaili, A.A.S., Alabdali, S.S., ALanzi, I.E., and Alabdli, A.M., 2024. Improving Quality of Life for Patients with Cerebral Palsy: Evidence-Based Nursing Strategies. *Journal of International Crisis and Risk Communication Research*, *7*(S8), p.2292. https://doi.org/10.10.63278/jicrcr.vi.1226

[3] Lorang, E., Maltman, N., Venker, C., Eith, A. and Sterling, A., 2022. Speech-language pathologists' practices in augmentative and alternative communication during early intervention. *Augmentative and Alternative Communication*, *38*(1), pp.41-52. https://doi.org/10.1080/07434618.2022.2046853

[4] Leatherman, E.M. and Wegner, J.R., 2022. Augmentative and alternative communication in the classroom: Teacher practices and experiences. *Language, Speech, and Hearing Services in Schools*, *53*(3), pp.874-893. https://doi.org/10.1044/2022_LSHSS-21-00125

[5] Sim, G. and Bond, R., 2021. Eye tracking in child computer interaction: challenges and opportunities. *International Journal of Child-Computer Interaction*, *30*, p.100345. https://doi.org/10.1016/j.ijcci.2021.100345

[6] Olsen, J.K., Ozgur, A.G., Sharma, K. and Johal, W., 2022. Leveraging eye tracking to understand children's attention during game-based, tangible robotics activities. *International Journal of Child-Computer Interaction*, *31*, p.100447. https://doi.org/10.1016/j.ijcci.2021.100447

[7] Šola, H.M., Qureshi, F.H. and Khawaja, S., 2024. AI Eye-Tracking Technology: A New Era in Managing Cognitive Loads for Online Learners. *Education Sciences*, *14*(9), p.933. https://doi.org/10.3390/educsci14090933

[8] Coan-Brill, J., Friesen, J., Kay, J., Costigan, F.A., Chau, T., Geytenbeek, J., Stadskleiv, K., Batorowicz, B., McCauley, D., Hopmans, S., and Grahovac, D., 2025. "My child is completely underestimated": Canadian parents' perspectives on implementing an accessible language comprehension assessment for non-speaking children with cerebral palsy. *Disability and Rehabilitation*, pp.1-13. https://doi.org/10.1080/09638288.2025.2468844

[9] Ahmed, I. and Ateeb, M., 2025, January. Enhancing Education Accessibility through Eye Gaze Technology (EGT). In *2025, 19th International Conference on Ubiquitous Information Management and Communication (IMCOM)* (pp. 1-8). IEEE. https://doi.org/10.1109/IMCOM64595.2025.10857579

[10] Aravamuthan, B.R., Fehlings, D., Shetty, S., Fahey, M., Gilbert, L., Tilton, A., and Kruer, M.C., 2021. Variability in cerebral palsy diagnosis. *Pediatrics*, *147*(2). https://doi.org/10.1542/peds.2020-010066

[11] Kourieos, S. and Evripidou, D., 2024. Lack of Eye Gaze and Its Effects on Spoken Interaction in Synchronous Online Communication. *TESL-EJ*, *28*(3), p.n3. https://doi.org/10.55593/ej.28111a4

[12] Turan, Z.C. and Aki, E., 2025. Cognitive Rehabilitation Improves Functional Vision Skills in Children with Cerebral Visual Impairment. *Brain Sciences*, *15*(6), p.590. https://doi.org/10.3390/brainsci15060590

[13] Kochanowicz, A.M., 2021. Using eye-tracking technology as an art medium and a tool of clinical intervention in the art therapy of a child with multiple disabilities. *Studia Paedagogica Ignatiana*, *24*(4), pp.131-149. https://doi.org/10.12775/SPI.2021.4.007

[14] SZYMKOWICZ, E., BODET-CONTENTIN, L., MARECHAL, Y. and EHRMANN, S., 2023. Eye tracking technology to improve communication with intubated critical care patients: a randomized study. https://doi.org/10.21203/rs.3.rs-1644919/v3

[15] Lorah, E.R., MacNeil, S., Zimmerman, T., Rackensperger, T., Holyfield, C., Caldwell, N., Dragut, E.C., and Vucetic, S., 2024, October. Spurring Innovation in AAC Technology through Collaborative Dreaming and Needs Finding with Individuals with Developmental Disabilities Who Use AAC. In *Seminars in Speech and Language*. Thieme Medical Publishers, Inc.. https://doi.org/10.1055/s-0044-1791789

[16] Puttemans, F., Copermans, E., Karlsson, P., Ortibus, E., Dan, B., Monbaliu, E. and Bekteshi, S., 2025. An intensive eye-tracking intervention in children with dyskinetic cerebral palsy: a multiple case study. *Disability and Rehabilitation: Assistive Technology*, *20*(4), pp.867-877. https://doi.org/10.1080/17483107.2024.2412073

[17] Hoopmann, L., Bailey, B. and Arciuli, J., 2024. Let the eyes do the talking: A scoping review of eye-tracking in paediatric communication assessment and intervention. *International Journal of Speech-Language Pathology*, pp.1-12. https://doi.org/10.1080/17549507.2024.2425012

[18] Stevens-Hofer, B., Wallen, M., Mcinerney, M. and Karlsson, P., 2025. Eyes on communication: strategies to facilitate uptake of clinical practice guidelines for implementation of eye-gaze control technology by people with cerebral palsy. A mixed methods study. *Disability and Rehabilitation: Assistive Technology*, *20*(4), pp.1128-1139. https://doi.org/10.1080/17483107.2024.2437142

[19] Karlsson, P., Griffiths, T., Clarke, M.T., Monbaliu, E., Himmelmann, K., Bekteshi, S., Allsop, A., Pereksles, R., Galea, C. and Wallen, M., 2021. Stakeholder consensus for decision making in eye-gaze control technology for children, adolescents and adults with cerebral palsy service provision: findings from a Delphi study. *BMC neurology*, *21*, pp.1-24. https://doi.org/10.1186/s12883-021-02077-z

[20] Masayko, S., McGowan, J. and Grampurohit, N., 2024. Parents' Perceptions of Eye-Gaze Technology Use by Children With Complex Communication Needs. *American Journal of Speech-Language Pathology*, *33*(3), pp.1254-1265. https://doi.org/10.1044/2023_AJSLP-23-00100

[21] Lui, M., Maharaj, A., Shimaly, R., Atcha, A., Ali, H., Carroll, S. and McEwen, R., 2022. User experiences of eye gaze classroom technology for children with complex communication needs. *Journal of Special Education Technology*, *37*(3), pp.426-436. DOI: https://doi.org/10.1177/01626434211019399

[22] Putri, L.A., Shanty, D., Homdijah, O.S., Ramadhan, R. and Sakti, R., 2023. Application-based development of alternative and augmentative communication system for children with cerebral palsy. *Edunesia: Jurnal Ilmiah Pendidikan*, *4*(3), pp.1301-1315. https://doi.org/10.51276/edu.v4i3.510

[23] Caron, J.G., Ryan, N., Babb, S., Holyfield, C. and O'Brien, M., 2025. Effect of explicit literacy instruction on letter-sound correspondence acquisition for a child with cerebral palsy who uses AAC eye gaze. *Augmentative and Alternative Communication*, pp.1-12. https://doi.org/10.1080/07434618.2025.2466166
[24] Hsieh, Y.H., Granlund, M., Odom, S.L., Hwang, A.W. and Hemmingsson, H., 2024. Increasing participation in computer activities using eye-gaze assistive technology for children with complex needs. *Disability and Rehabilitation: Assistive Technology*, *19*(2), pp.492-505. https://doi.org/10.1080/17483107.2022.2099988
[25] Hsieh, Y.H., Borgestig, M., Gopalarao, D., McGowan, J., Granlund, M., Hwang, A.W. and Hemmingsson, H., 2021. Communicative interaction with and without eye-gaze technology between children and youths with complex needs and their communication partners. *International journal of environmental research and public health*, *18*(10), p.5134. https://doi.org/10.3390/ijerph18105134
[26] Clarke, M.T., Sargent, J., Cooper, R., Aberbach, G., McLaughlin, L., Panesar, G., Woghiren, A., Griffiths, T., Price, K., Rose, C. and Swettenham, J., 2022. Development and testing of the eye-pointing classification scale for children with cerebral palsy. *Disability and Rehabilitation*, *44*(8), pp.1451-1456. https://doi.org/10.1080/09638288.2020.1800834
[27] Gonçalves, C.W.P., Richa, R.A. and Bo, A.P., 2022. Tracking and classification of head movement for augmentative and alternative communication systems. *Sensors*, *22*(2), p.435. https://doi.org/10.3390/s22020435
[28] Karlsson, P., Honan, I., Warschausky, S., Kaufman, J.N., Henry, G., Stephenson, C., Webb, A., McEwan, A. and Badawi, N., 2022. A validation and acceptability study of cognitive testing using switch and eye-gaze control technologies for children with motor and speech impairments: a protocol paper. *Frontiers in Psychology*, *13*, p.991000. https://doi.org/10.3389/fpsyg.2022.991000
[29] Vogel, A.P., Spencer, C., Burke, K., de Bruyn, D., Gibilisco, P., Blackman, S., Vojtech, J.M. and Kathiresan, T., 2024. Optimizing Communication in Ataxia: A Multifaceted Approach to Alternative and Augmentative Communication (AAC). *The Cerebellum*, *23*(5), pp.2142-2151. https://doi.org/10.1007/s12311-024-01675-0
[30] Kochanowicz, A.M. and Pawłowski, L., 2024. Enhancing Interaction: The Crucial Role of Eye-Tracking Technology in Assessing Children with Profound Intellectual and Multiple Disabilities in Poland. *Multidisciplinary Journal of School Education*, *13*(2 (26)), pp.229-250. https://orcid.org/0000-0003-0425-4502
[31] Griffiths, T., Judge, S. and Souto, D., 2024. Use of eye-gaze technology feedback by assistive technology professionals: findings from a thematic analysis. *Disability and Rehabilitation: Assistive Technology*, *19*(7), pp.2708-2725. https://doi.org/10.1080/17483107.2024.2338125
[32] Wilkinson, K.M. and Wolf, S.J., 2021. An in-depth case description of gaze patterns of an individual with cortical visual impairment to stimuli of varying complexity: Implications for augmentative and alternative communication design. *Perspectives of the ASHA Special Interest Groups*, *6*(6), pp.1591-1602. https://doi.org/10.1044/2021_PERSP-21-00111

APPENDIX

Variables	Question Item	Likert Scale
SSA	1. Does the child consistently select the correct symbols using the eye-tracking system?	1 – Strongly Disagree2 – Disagree3 – Neutral4 – Agree5 – Strongly Agree
	2. Is the symbol selection process accurate and aligned	

Journal of Information Systems Engineering and Management
2025, 10(56s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

	with the intended communication?	
CRT	1. Does the child respond promptly to communication prompts using the device?	
	2. Has the time taken to select a response reduced after repeated sessions?	
GFA	1. Does the child maintain steady eye contact with the selected symbol?	
	2. Does the eye-tracker accurately detect where the child is looking?	
SD	1. Does the child remain engaged throughout the communication session?	
	2. Has the duration of interaction increased with continued use?	
UEL	1. Does the child show interest and enthusiasm while using the device?	
	2. Does the child prefer the eye-tracking system over other communication methods?	