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AUGMENTED REALITY BASED VISUAL ATTENTION AND WORKING MEMORY ANALYSIS FOR CHILDREN USING COMPUTER VISION

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Abstract:

The mental learning arrangement of children and the impact of visual attention make computer vision researchers extremely inquisitive. Understanding child psychology in the early stage is one of the significant factors for their smooth mental growth which includes thinking patterns, learning styles, and psychological development. Visual inclining is one of the primary drivers of mental advancement in a child where the visual system is constrained by the subject's eye. In this context, the idea of visual attention in children could uncover new learning patterns by means of the visual framework which is addressed by this research. Previous researchers attempted to discover various aspects in this context such as kid improvement, conduct acknowledgment, and field of intrigue where they did not use computer vision and augmented reality technology adequately. This research presents a rigorous investigation to learn about children's psychological development through assigning interactive tasks to children. For this, this research developed a computer vision-based augmented reality system that gets a grouping of videos and identifies data from participating individuals. In this context, this research audited the coordination of eye, head, and hand developments amid the execution of a block copying assignment. Overall experimental investigation performed by this research presents a significant pattern to understand children's phycology. The impacts of the proposed investigation using computer vision-based augmented reality will contribute significantly to design improved education materials for children from an early stage.

Keywords:

Visual Memory Analysis, Augmented Reality, Computer Vision

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Introduction

Interaction always happens through head and eye movements, gestures, sounds, and poses. The visual experience of humans is undauntedly coupled to activity to the viewer's eye, and body enhancement. Technologies and research fields like Computer vision, neural networks, Cognitive science, and Human-computer interaction can be utilized to break down the visual considerations in people-to-people cooperation or interaction. A portion of these progressions are undertaking important, and objective coordinated, while others are unconstrained. From a PC vision perspective, most existing estimations for inquiry affirmation and following social affiliations, activities, and joint ideas are likewise annexed to the activity and the generally influencing and coupled eye, head, and body headways of the people. This examination ponders the bit of the kids or people on considerable engine development and those of the social partner in masterminding the visual counters of the baby. Kids find out about new things from guardians, objects, social creatures, and creatures through regular communication regularly. That is how a child improves learns new things and grows. This is in like manner a fundamental request for hypotheses of human learning. The learning procedure relies upon many things like conditions, the learning system, and the general population around them.

Children learn about new things like objects, actions, other social beings, animals, and language through interaction with parents or other social beings. Mainly interactions happen by expressing bodily actions like head and eye movements, breathing, gestures, vocal sound, body sway, and pose (Shockley et al. 2009; Shockley et al., 2007). A few investigations from formative examinations demonstrate that when associating head, hands, and eye shifts, eye stare is firmly coupled and plays a noteworthy character. One ongoing discovery utilizing a similar arrangement of eye stare discovery. Understanding visual attention in kids or individuals could give new experiences into how the visual framework creates amid developmental years and how visual consideration and decision assume a job being developed and learning. To achieve this, the interaction between children and parents can be observed and recognized to propose efficient estimation of the substance of their visual fields of view and gather gaze information to record where they search inside the visual field. Some ongoing psychophysics think about grown-ups performing regular assignments, for example, playing with toys, demonstrating a nearby coupling between eye, head, and hand developments with eye stare marginally driving the head and after that the hands (Hayhoe and Ballard, 2005). In addition, later proof from formative examinations likewise proposes that when little children are physically following up on items, head movement furthermore, eye shifts and eye gaze are firmly coupled, with most looks to an item likewise including concurrent head turns and hand gestures.

With the open doors for egocentric perspectives come challenges, unmistakably in light of the fact that first-singular video is incredibly amazing stood out from video from a stationary camera. Since a first-individual camera is annexed to the head, each head turns and every modification in body presentation causes overall changes in the in any case singular view. A portion of these progressions are undertaking important, and objective coordinated, while others are unconstrained. From a computer vision point of view, most existing calculations for question acknowledgment and following accept cameras are stationary or have a known, straightforward movement demonstration. Numerous researchers found that eye as well as body development assumes an imperative part in collaboration and learning (Hayhoe and Ballard, 2005). Be that as it may, just utilizing the eye it cannot be stated just in regard to visual consideration. On the off chance that we must find out about the advancement process, eyebrow

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development should be addressed. The visual inclining framework has pivotal distinction while watching, focusing, and showing on account of youngsters and guardians accepting cameras are stationary or have a known, straightforward movement. This requires the coordination of these developments in both realities. Investigations of eye, head, and hand developments have regularly been with single developments, more often than not to flashed upgrades. Be that as it may, the general issue is substantially more troublesome. Eye, head, and hand all need to act regarding a typically arranged framework and remain synchronized in time over various activities (Pelz et al., 2001) which was addressed in this research.

Background Study

To understand the visual world, feeling and subjective systems ought to explicitly deal with a subset of this information. Thought can be viewed as a spatial spotlight (Posner, 1980) that can be realized. Visual consideration understanding in children could open up new expansion into visual system progression in years and how visual thought and assurance are basic in perceiving premium, enhancement, and learning. Late investigations demonstrate that we as of now have imagined numerous things in the field of Computer vision, Cognitive science, and Human PC association utilizing diverse gadgets and calculations. Those can be utilized to investigate the visual consideration in youngster parent or individual-to-individual connection. The examination is to see how the visual consideration in kid-parent cooperation mostly works. The visually inclining framework has earth-shattering distinctions while watching, focusing, and showing on account of youngsters and guardians. Right when the adults are involved with complex errands from influencing sandwiches to reproducing square guides to suggests that the flashing typical for the human body in space fills in as a pointing reference for limiting material things to inside figuring (Spivey et al., 2000). Numerous examines believe that eye as well as body development assumes an imperative job in collaboration and learning. In any case, just utilizing the eye it can not be said just regarding visual consideration. On the off chance that we have to find out about the advancement process, eyebrow development should be checked too. It will bring more precision. On the off chance that just eye development is watched, just the consideration will be eyewitness not the response to the issue (Ekman, 1992).

In the field of visual attention analysis, numerous criteria of the progression and learning condition and the prerequisite for goals on taking in framework to pick up from that normal condition are assembled not as for the certifiable plan of the baby's experiences. Actually, it depends on grown-up feelings about the arrangement of experience and moreover, a few investigations from formative examinations demonstrate that when connecting head, hands, and eye shifts, eye stares are firmly coupled and play a noteworthy character. The modification to parenthood is incomprehensibly perceived to be a period of dynamic change in the family system, and since it is assumed that what shows up in one family subsystem ought to be identified with what turns up in youngster-parent connections. One recent finding used the same system of eye gaze detection. Both children and parents where are playing with a toy and visually take care of the articles held without anyone else's input as well as the items held by another accomplice in doing as such, they pay visual attention and keep up facilitated by taking a gander at the toy in the meantime. In addition, if they are paying attention is the object then the child is noticing and learning. Nevertheless, in this research, the problem is it is only about the attention of the child, but there is no correct explanation of development. Just because a child is looking at something that does not satisfy that child is interest is that facial expression and eyebrow movement can extract that data (Hayhoe and Ballard, 2005).

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Tatler et al. (2009) showed the breaking points of visually striking nature in anticipating eye stare, finding that while base-up saliency measures are significantly perceptive of look in inert pictures, they do whatever it takes not to whole up well to naturalistic customary settings with self-assured overview lead. Their proposed models require to consider of other larger amount factors. Without a doubt, using head-mounted eye trackers transformed into a present example in think visual thought of adults concerning ordinary practices, which has quite recently incited basic disclosures. Because of particular hindrances like camera weight, picture quality, and head shacking, there have been a few considerations on following and recording first-singular view video and eye advancements. To manage boisterous information, best-in-class AI approaches first gather information (with or without showing names) and after that depend on imagining progressed numerical computations that can be associated with the pre-accumulated data. The learning system itself is dormant in this methodology, getting information in a confined stream (Land and Hayhoe, 2001). Interestingly, youthful youngsters learn through their own particular activities that straightforwardly figure out what they see, how they see it, and when they see it. Through body development, youthful students effectively make the visual contribution on which protest learning depends. On the off chance that we are to construct fake gadgets that can all alone learn and also little children, we may benefit from seeing exactly how youthful human students select data through their own behaviour (Metta and Fitzpatrick, 2002). Adding to these Matthew et al. (2010) showed that playing video games improves the development of visual attention by playing video games in school-age children.

While gaining from communications from adolescent-parent multimodal identifying structure was commonly used in various request and generally depended upon all around adjusted first-singular video and eye advancement. In any case, as displayed by past examinations (Hayhoe and Ballard, 2005), all-around adjusted first-singular video and eye improvement data are so far reliable approximations of people's visual fields and what they deal with in the view. Consequently, it was a decent methodology. For focal points, the Multimodal detecting framework (Bambach et al.,2013; Yu et al., 2009; Xu et al., 2011; Bambach et al., 2014) makes a controlled domain, less jumbled than the genuine world. Item position, relative sizes, holding exercises, and articles in consideration can be resolved. With 6 movements following the system(240Hz) set in both head and hand. This likewise decided the connection between head(eye) and hand developments. Despite the fact that it has a few weaknesses the flat edge of the first individual camera was 900 where, all things considered, a grown-up. The Reward-based models of gaze allocation (Tatler et al., 2011) put learning at the focal point of theoretical records of eye direction, it is imperative to think about how it may be executed in the mind. It likewise takes care of the issues of the multimodal framework where the visual field is an issue. Nicola et al. [2002] tested an infant’s intellectual abilities through a very different method where on each of the four errands every youngster was tested: move screen concealing assignments and the move-article and the looking-where and point-course picture undertakings. The concealing errands were constantly regulated first; generally, the request for the organization of the assignments was completely counteracted. Chen et al. (2009) demonstrated promising outcomes and it likewise unraveled an equivocalness of the multimodal show where the creators did not know whether eye and head development was trailed by one another. It additionally demonstrated a few mistakes of impediments, for example, from the tyke's gaining from condition as and furthermore its hand and eye cooperation however the entire thing was generally one-sided as the tyke was in a controlled domain and he was just permitted to play with the articles before him, where in genuine circumstances the visuals may get a great deal jumbled. Ann et al. (2002) performed through

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propensity and nipple occasions the technique where he took both 8 months and a year and through look and articulation towards an article they endeavored to foresee if by one-year babies could create a comprehension of look and articulation of grown-ups through these preliminaries. The strategy was genuinely straightforward and did not expect anybody to have any learned capacities subsequently no development test was required likewise they really attempted on if the guinea pigs were qualified thus, it was especially viable for the kids. Yet, for handicaps, it was for the most part a one-sided methodology as the babies had just 2 articles to browse and there is a high shot that newborn children just indicated enthusiasm for an item simply because they were egocentric. Dorit and Iris's (Aram and Levin, 2002) scholarly capacities were tried as two mother–kid joint-composing exercises were recorded. Here the mother kept in touch with a few letters and afterward, the youngster was advised to copy in two distinct situations where one mother replicated from a page and another mother just composed a couple of words, and for the perusing test, the mother read an entry or section and made a few inquiries identifying with it. Kay and Robert (Saif and Mahayuddin, 2023) adopted an uncalled-for strategy where an organized profundity talk comprising of 10 questions gave the meeting work process system. With the revelation-arranged nature of this examination, eight of the 10 questions were not set explicitly. Every source was met secretly, by the principal creator with the goal that no other relative knew about them. Vincent and Tricia (2005) additionally examined kid cooperation by means of eye stare developments and checked on the off chance of which activities were affected by their grown-up's eye developments. Here they needed to take a gander at a picture of a face as the face looked towards an article again on another test the face was not taking a gander at any of the two items like this, they took both one-sided, and fair-minded tests where in fair-minded they were not given any grown-ups/developments to follow up on rather they were allowed to do everything. The procedure required no substantial wearable gear thus newborn children were quiet however no such data of what the babies did in the wake of being pulled into an item were given just that they were pulled in.

Proposed Method

To attain the goals of investigating children’s mental growth of different ages, this research developed an augmented reality-based mobile application by which this research conducted experiment in a less cluttered real-life play environment where a child and a parent sat facing each other and a table or something to place 4 objects/balls was placed between them. Parents were instructed beforehand on how this experiment will take place and they were thoroughly instructed on how to carry out their tasks. Before the experiments began children were sat on a stool or a higher place to align the eye level of both parent and toddler. There were four tasks to perform, and each took about 10 minutes, taking about 30 minutes in total for each dyad. Both the parents and the toddlers wore worn white clothes and were sitting on white sheets, the experiment was conducted in a less cluttered real-life environment so that the proposed research attained better results with less bias. In this context, children were free to do whatever they pleased.

Participants

The participants consisted of 15 children and their parents. This research considered children of three age groups 1.5 to 2 years, 2.5 to 3 years, and 3.5 to 4 years respectively. Each age group consisted of 5 parent-child dyads. There were an additional four infants, but we were not considered in the results as they were distracted did not pay any heed to the instructions given

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or were not comfortable with the head-mounted cameras. All participants were healthy and of proper mental growth, hence ensuring proper results.

Interaction Between Hand and Gaze direction

The experimental set up to evaluate the proposed research was real-life-like and was done in places familiar to the children such as home and playground. This research set up a head mount camera synchronized with the AR mobile application in the infant's head to investigate head movement and considered it eye movement as head and eye movements of children are very much aligned, which this research learned from Chen et al. (2013). This research also set up a camera from the side to record the whole experiment and to keep checking if the experiment was going properly.

Hand Detection Classifier

This research developed a hand detection classifier by training and testing from hand datasets which had about 16k egocentric hand images later on the classifier showed over 94% accuracy. This research used TensorFlow using AR toolkit (Saif and Mahayuddin, 2023; Mahayuddin and Saif, 2021; Saif and Mahayuddin, 2021) to develop hand classifier shown in Figure 1. There are several existing approaches to tracking hands in the computer vision domain (Saif et al., 2021; Saif and Mahayuddin, 2023). Incidentally, many of these approaches are rule-based, i.e., extracting background based on texture and boundary features, distinguishing between hands and background using color histograms and HOG classifiers, etc and most of these methods are not very robust (Mahayuddin and Saif, 2020). For example, these existing methods might get confused if the background is unusual or where sharp changes in lighting conditions cause sharp changes in skin colour or the tracked object becomes occluded. Hence, this research trained and tested its own classifier using both cluttered and clear hand images making it a very efficient classifier.

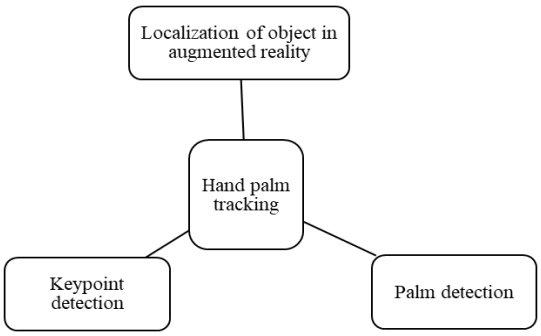

Figure 1: Hand Classifier

Pointing at Object Task

Four balls each having a different colour were presented in front of the children. Parents were instructed to take the ball using the choice of words the toddler would be familiar with while pointing at a random ball for a few seconds and then stopping and not giving any hints. Afterward, this research judged if the child was able to take the correct ball or not. We took about 10 trials for each dyad using this method.

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Same Object and Same Order Task

Like before four balls were given a name to the parent. The given names were familiar to the infant, so it was easy for the infant to memorize. The parent was instructed to speak out each object's name while pointing at the object and right after that parent told the toddler to pick an object by referring to the object by its name. If the toddler picks the wrong object or fails to pick up the correct object, then the parent again speaks out the names while pointing and asks to toddler to pick out that object by referring to its given name keeping the same arrangements keeping them in the same place and order to check how many times a child for a child to be reminded the names to pick out the right object. This process continued for about 5 times or if the toddler picked the right object for each trial. There were 10 trials and took about 10 minutes for each dyad.

Same Object but Different Order Task

This is identical to the "Same Object and Same Order Task" but this time each time on each trial whenever a child needed instructions, the arrangement was randomized keeping but keeping each object's associated same name.

Pick an Object Task

The toddler was told to pick any object out of the four presented to him. This took five trials for each child.

Data Analysis

This research took the videos and used a hand detection classifier to detect hands from the videos in a frame-by-frame manner. The center of the video was considered the center of attraction. The videos were in 20 frames per second having a resolution of 600 x 500.

Experimental Results and Discussion

Pointing at Object Task

From Table 1, each age group's mean score can be seen, and it is to be pointed out that the eldest group which ranges from 3.5 to 4 years old did exceedingly well compared to other groups. For the 1.5 to 2 age group, parents had to point at the objects in a very playful manner to grab his/her attention because in most cases the children in that age group got distracted by other things. So, to perform these tasks, parents needed to make sure to have the child's attention towards them, also in most cases, children were more interested in choosing the object they were more interested in or their favourite object/colour. And to some extent, these characteristics were similar for the 2.5- to 3-year-olds but this age group was found to be more attentive. But compared to all these age groups' children, the 3.5 to 4-year-old age group almost reached the peak by showing correct responses in about 10 to 11 cases on average. Then, 3.5 to 4-year-olds were more attentive to tasks compared to other age groups as well.

Table 1: Point At Object Task Correct Responses

Age group / Task Name	1.5 to 2 (Years)	2.5 to 3 (Years)	3.5 to 4 (Years)
Pointing task	3/10	4/10	7/10
Percentage	30%	50%	70%

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Same Object and Same Order Task

This task turned out to be challenging for the 1.5 to 2-year-old age group and the 2.5 to 3-year-old age group shown in Table 2. The results are not very in favour of the 3.5 to 4-year-old group either, in terms of correct response percentages. But when it comes to the number of instructions needed the 3.5 to 4 age group almost never needed instructions more than once and at max, twice. Where the other age groups especially the 1.5 to 2 years old groups in most cases needed more than 5 instructions hence, they were taken as incorrect responses also it becomes easier for them if the object instructed to pic by the parent is the 3rd or 4th object in the order when saying the names to the toddler.

Table 2: Same Object and Same Order Task Correct Responses and Number of Instructions Needed (Mean)

Age group / Task Name	1.5 to 2 (Years)	2.5 to 3 (Years)	3.5 to 4 (Years)
Same Object and Same Order Task	2/10	3/10	7/10
Correct Response Percentage	20%	30%	70%
Number of times instructions needed	4.5 out of 5	2.5 out of 5	1 out of 5

Same Object but Different Order Task

This task turned out to be quite impossible for the 1.5 to 2 years old and the 2.5 to 3 years old age group, but the results given in Table 3 show a 50/50 success rate for the 3.5 to 4 years old age group.

Table 3: Same Object but Different Order Task Correct Responses and Number of Instructions Needed (Mean)

Age group / Task Name	1.5 to 2 (Years)	2.5 to 3 (Years)	3.5 to 4 (Years)
Same Object and Same Order Task	2/10	2/10	4/10
Correct Response Percentage	20%	20%	40%
Number of times instructions needed	4 out of 5	4 out of 5	3 out of 5

Pick an Object Task

After all the tasks, the children were told to pick out a random object from the 4 balls. This task gave some interesting insights. This research found that for the 1.2 to 2-year-old age group, there is no bias of which object to pick out and in fact, each time they would pick out a different object. Arrangement or the order the objects were placed did not really matter to them. In most cases, they would pick out the object that was closest to them regardless of how it looked or felt. But in a few trials (11-12 trials) they start to show interest in one or two objects out of the 4 and hence end up picking them. The 2.5 to 3 years old tend to pick the object that they find most attractive and tries to stick to that in each of the 3 out of 5 trials whereas the 3.5 to 4 years age group in most cases would choose the object of their interest at first and/or 2nd trials but after that, they tend to avoid that by choosing any object just next to that object they find interesting. They grow this sense that they cannot or should not pick the same object each time

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and try to pick a different object but still tend to pick an object close to that object they are attracted to subconsciously.

Relations Between The Tasks

All the given tasks are dependent on age, the number of attention toddlers give, and also the ability to understand the tasks were also a factor in this. Then any other task the pointing at object task was more dependent on the amount of attention a toddler could give in their task. But both "Same Object and Same Order Task" and "Same Object but Different Order Task" were related to each other and the task required mainly understanding and the ability to recall and reminisce. Despite all, task 3 was the most challenging one out of them. But if we partial-out age and performance, the correlation between tasks 2 and 3 remained significant especially among the groups of 1.5 to 2 and 2.5- to 3-year-olds.

The "Pointing at object task" showed superior results compared to any other task in any of the age groups. The pick an Object task gave us a lot of observational results than any other and from our observation that 2.5 to 3-year-old children tend to think more than the other groups. Even though 3.5 to 4-year-olds seem to have a more developed sense of understanding the task assigned to them, the 2.5 to 3-year-olds tend to be more alert of their action and hence take a considerable amount of time in trying to think things through.

The order of the object arrangements really did not have any significance other than the "Same Object but Different Order" and "Same Object and Same Order" tasks, for these two tasks if the child was told to pick an object from the referred 3rd or 4thobject, in majority of the cases children picked out the right object. But in the other two cases, the order was not an issue. From these two tasks, this research observed that people 2.5 to 3 years old put much more effort into thinking things through than any of the other age groups, and as a result, they tend to take more time performing the tasks. Also, in cases where the toddlers have or grow no interest in a specific object, the observations seemed similar in all three age groups.

From investigation, this research observed that about 80-90% of the time whenever a toddler is told to pick a specific object and if he/she gets confused about which object to pick he or keeps staring at their parents while pointing or putting their hands over the object for cues or some sort of assurance that if they are right show in Figure 2. Also, in 50-55% of cases at first, the toddler would pick the wring object, and right after he/she would realize it and pick the right one on the second try.

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Figure 2. Children Confused About Which Object to Pick

Conclusion

This research investigated the coordination of eye, head, and hand developments amid the execution of a block copying assignment towards children's mental growth for learning styles. The undertaking included obtaining of visual data from the square example, exchanging with outwardly guided hand developments for square pickup and situation. Spectators exploited the repetitive idea of the assignment to produce stable however setting explicit coordination designs. The data sets that were used were mostly the type of videos of the other references. This research builds a similar environment so that results comparison becomes possible with others. This research developed an augmented reality-based mobile application using computer vision to collect grouping of video and identifying data from participating individuals. There are a few techniques to inquire about, among those this research utilized trial research and assessment-based research. Tests inquire about straightforward tests, including free factors, measurable information, and controlling factors. This research followed trial strategies because our exploration is connected to writing, and we accumulated information on visual consideration of children and dissected them which resulted likewise being utilized for theories and the outcomes which is created by the model this research wrinkled that provided a reasonable idea of the aftereffects of the investigation. The items and the individuals the individuals who are taking an interest are factors and the conduct is start controlled in each factor. A feeling, inclination, and conduct are incorporated into the examinations, so this research likewise requires a conclusion-based research technique. By evaluating the conduct, this research utilized a numerical scale to the sort of conduct to change the conduct into esteem.

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References

Aram, D., & Levin, I. (2002). Mother—Child joint writing and storybook reading: Relations with literacy among low SES kindergartners. Merrill-Palmer Quarterly (1982-), 202-224.

Asada, M., Hosoda, K., Kuniyoshi, Y., Ishiguro, H., Inui, T., Yoshikawa, Y., . . . Yoshida, C. (2009). Cognitive developmental robotics: A survey. IEEE transactions on autonomous mental development, 1(1), 12-34.

Bambach, S., Crandall, D. J., & Yu, C. (2013). Understanding embodied visual attention in child-parent interaction. Paper presented at the 2013 IEEE third joint international conference on development and learning and epigenetic robotics (ICDL).

Bambach, S., Franchak, J., Crandall, D., & Yu, C. (2014). Detecting hands in children's egocentric views to understand embodied attention during social interaction. Paper presented at the Proceedings of the Annual Meeting of the Cognitive Science Society.

Dye, M. W., & Bavelier, D. (2010). Differential development of visual attention skills in school-age children. Vision research, 50(4), 452-459.

Ekman, P. (1992). Facial expressions of emotion: New findings, new questions: SAGE Publications Sage CA: Los Angeles, CA.

Hayhoe, M., & Ballard, D. (2005). Eye movements in natural behavior. Trends in cognitive sciences, 9(4), 188-194.

Land, M. F., & Hayhoe, M. (2001). In what ways do eye movements contribute to everyday activities? Vision research, 41(25-26), 3559-3565.

Mahayuddin, Z. R., & Saif, A. S. (2021). Vision based 3D gesture tracking using augmented reality and virtual reality for improved learning applications. International Journal of Advanced Computer Science and Applications, 12(12), 631-638.

Mahayuddin, Z., & Saif, A. (2020). Efficient hand gesture recognition using modified extrusion method based on augmented reality. TEST Engineering and Management, 83, 4020-4027.

McGuigan, N., & Doherty, M. J. (2002). The relation between hiding skill and judgment of eye direction in preschool children. Developmental psychology, 38(3), 418.

Metta, G., & Fitzpatrick, P. (2002). Better vision through manipulation. Paper presented at the Proceedings of the Second International Workshop on Epigenetic Robotics: Modeling Cognitive Development in Robotic Systems.

Pelz, J., Hayhoe, M., & Loeber, R. (2001). The coordination of eye, head, and hand movements in a natural task. Experimental brain research, 139, 266-277.

Phillips, A. T., Wellman, H. M., & Spelke, E. S. (2002). Infants' ability to connect gaze and emotional expression to intentional action. Cognition, 85(1), 53-78.

Posner, M. I. (1980). Orienting of attention. Quarterly journal of experimental psychology, 32(1), 3-25.

Reid, V. M., & Striano, T. (2005). Adult gaze influences infant attention and object processing: Implications for cognitive neuroscience. European Journal of Neuroscience, 21(6), 1763-1766.

Saif, A. S., & Mahayuddin, Z. R. (2023). Augmented Reality-Based 3D Human Hands Tracking From Monocular True Images Using Convolutional Neural Network Handbook of Research on Artificial Intelligence and Knowledge Management in Asia's Digital Economy (pp. 129-137): IGI Global.

Saif, A. S., & Mahayuddin, Z. R. (2021). An efficient method for hand gesture recognition using robust features vector. Journal Information System and Technology Management (JISTM), 6(22), 25-35.

Journal of Information System and Technology Management
JISTM
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Volume 9 Issue 37 (December 2024) PP. 121-132
DOI: 10.35631/JISTM.937010
Saif, A. S., Mahayuddin, Z. R., & Shapi'i, A. (2021). Augmented reality based adaptive and collaborative learning methods for improved primary education towards fourth industrial revolution (IR 4.0). International Journal of Advanced Computer Science and Applications, 12(6).

Saif, A. S., & Mahayuddin, Z. R. (2023). Robust Analysis of Motor Imagery From Brain Signals for a BCI-Controlled Virtual Reality System to Aid Paralysis Patients Handbook of Research on Artificial Intelligence and Knowledge Management in Asia's Digital Economy (pp. 119-128): IGI Global.

Shockley, K., Richardson, D., & Dale, R. (2009). Conversation and coordinative structures. Topics in Cognitive Science, 1 (2), 305–319.

Shockley, K., Baker, A. A., Richardson, M. J., & Fowler, C. A. (2007). Articulatory constraints on interpersonal postural coordination. Journal of Experimental Psychology: Human Perception and Performance, 33(1), 201.

Spivey, M. J., Tyler, M. J., Richardson, D. C., & Young, E. E. (2000). Eye movements during comprehension of spoken descriptions. Paper presented at the Proceedings of the Annual Meeting of the Cognitive Science Society.

Tatler, B. W., Hayhoe, M. M., Land, M. F., & Ballard, D. H. (2011). Eye guidance in natural vision: Reinterpreting salience. Journal of vision, 11(5), 5-5.

Xu, T., Chen, Y., & Smith, L. (2011). It's the child's body: The role of toddler and parent in selecting toddler's visual experience. Paper presented at the 2011 IEEE International Conference on Development and Learning (ICDL).

Yu, C., Smith, L. B., Shen, H., Pereira, A. F., & Smith, T. (2009). Active information selection: Visual attention through the hands. IEEE transactions on autonomous mental development, 1(2), 141-151.