International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 11, pp 267-274, November-2023

https://doi.org/10.47001/IRJIET/2023.711037

Novel Approach to Detect Cortical Visual Impairment Using Mobile Application

[1]Ms. Anjalie Gamage, [2]Mr. Sathira Hettiarachchi, [3]S.K. Wimalasiri, [4]A.I. Millewa, [5]W.O.M. Perera [6]M.A.T.M. Nanayakkara

[1,2,3,4,5,6]Department of Information Technology - Sri Lanka Institute of Information Technology (SLIIT), Malabe, Sri Lanka

Authors E-mail: [1]anjalie@my.sliit.lk, [2]sathira.h@my.sliit.lk, [3]sanduniwimalasiri@gmail.com, [4]ashanmillewa@gmail.com, [5]oshanimps@gmail.com, [6]thakshila.maduwanthi78@gmail.com

***Abstract* - Cortical Visual Impairment (CVI) is a disorder which is most common among children, and it happens due to the damage to the visual pathways of the brain. It has become the leading cause of childhood blindness. Latest research and available diagnosis methods are clinical approaches, and the absence of an early effective screening method is identified. A mobile application is introduced from this research to detect the CVI conditions of the children between the ages of 4 to 6 early. The detection is done under the 4 main characteristics of CVI which are color preference, visual field preference, difficulties with visual complexity and need for movement. Each characteristic has an activity that consists of several steps. Under each activity a quiz is given to the parents to get a better understanding of the visual behavior of the child. Based on the results of the activities and the quizzes it determines whether the user has a specific characteristic. Based on the 4 outcomes it determines whether the user has a probability of CVI and if it exists the application provides the guidelines to the parents regarding the necessary steps to follow.**

Keywords: cortical visual impairment screening, color preference, difficulties with visual complexity, visual field preference, need for movement.

I. INTRODUCTION

Cortical Visual Impairment (CVI) is a disorder caused due to damage to the visual pathways of the brain. It is a neurological disorder which impairs the visual processing ability of humans and currently it is the leading cause for childhood blindness. A child with CVI has vision problems which are not caused by the eyes but with their brain. The brain fails to accurately understand and process the signals sent by the eyes. Although the brains of ordinary people transform the signals sent through the eyes, the brains of the CVI affected people are unable to absorb and grasp the signals. [1]

CVI affects approximately 30% - 40% of children with visual impairments and has become the primary cause of visual impairment in children. [2]According to research done by the university of Bristol, one in every 30 children have CVI related visual difficulties. [3]

Damage to the brain is considered as the major cause for CVI and most of them occur before or during birth. In addition to this, several other factors such as lack of oxygen supply to the brain and brain infections can affect the occurrence of CVI. Premature babies also have a high risk of getting CVI conditions. [1]

CVI is distinguished using 10 characteristics which are color preference, need for movement, need for light, visual latency, visual field preference, difficulty with visual complexity, difficulty with distance viewing, difficulty with visual novelty, absence of visually guided reach and atypical visual reflex responses. [4]

Children with CVI require early intervention and therapy. Usually when parents observe unusual visual behavior of their child, they take the child to an eye doctor and get their child examined through an eye exam. Although the eye exam gives normal results the child might have the CVI conditions since they cannot identify through an eye exam. CVI conditions are identified through various tests, manual activities, and brain scans. [1] If the child has the CVI conditions and the parents are satisfied with the results of the eye exam, the delay in identifying the CVI conditions will cause them to lose significant number of opportunities for the development and the education of those children. Hence the objective of this research is to introduce a mobile application to identify the CVI conditions of the children between the age of 4 to 6 in an early stage.

According to professionals it has become a challenge to identify isolated CVI children. Hence this application can be used as a screening application without any specialized knowledge. Parents can use this application at home and get an idea of whether the child is having CVI conditions. It consists of sets of small activities for the children and quizzes for the parents and based on the points gained by the user, it will detect whether the child is having a probability of CVI.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 11, pp 267-274, November-2023

https://doi.org/10.47001/IRJIET/2023.711037

To confirm whether the child is having CVI, it is necessary to go through clinical tests. If it is detected the child has a probability of CVI through the application, it will provide all the guidance including necessary steps to taken by the parents. It will help the parents to refer the child to the relevant doctors and get an early intervention.

4 main characteristics have been identified out of the 10 characteristics and they are tested through the application. Color preference, need for movement, visual field preference and difficulties with visual complexity are the four characteristics tested by the application and interactive activities have been designed for children. Moreover, a simple quiz is given to the parents to identify the visual behavior of the children, which helps to increase the accuracy of the result. The user gets a score for each set of activities and the quizzes. Based on the scores it displays whether the child is having a probability of the specific characteristics. Finally based on all the 4 outcomes it detects and displays whether the child is having a probability of CVI or not.

The goal of this research is to enhance the early identification and intervention process for CVI to have a significant impact. This user-friendly application encourages the involvement in spotting CVI related visual abnormalities in children and the collaborative approach between the parents and the professionals has the potential to offer prompt help to children with CVI.

II. LITERATURE REVIEW

Research has been done regarding the methods of visual assessments in children with CVI by Chang Melinda and Borchert Mark in the Roski Eye Institute, University of Southern California in February 2021. It has analyzed the recent research related to the assessment of CVI in children and identified that they are more focused on quantifying the deficits of visual functions more than the visual keenness. According to the research, functional vision assessment, neuropsychological tests and eye tracking have been identified as current research and eye tracking reveals more successful [5]

Another research has been done regarding identification, evaluation, and diagnosis of CVI by Lehman Sharon S in the Wills eye institute at Pennsylvania, USA in September 2012. He has identified methodologies to diagnosis CVI early, the therapies and prevention techniques. Furthermore, he has identified the deficits of vision-guided motor planning and using neuroimaging techniques and electrophysiologic testing, he has further identified the deficits in functions. [6]

Research has also been conducted regarding the development of a quantitative method to quantify the vision of CVI children. It has done by Smith Kettlewell in Eye Research Institute at San Francisco, California, USA. He has done several experiments to confirm the use of sweep visual evoked potential (VEP) as a quantitative measuring tool for CVI. Successful experiments have confirmed that it is a valid and reliable measuring tool to measure grating acuity and decide the best visual environment for CVI children. [7]

Researchers Maria van Genderen, Marjoke Dekker, Florine Pilon, and Irmgard Bals did a study titled "Diagnosing Cerebral Visual Impairment in Children with Good Visual Acuity" to identify the factors that can make it easier to find CVI in children with good visual acuity. 30 kids with good visual frequency and CVI were included in the study. Their clinical traits were examined, and those traits were compared to those of 23 kids who were thought to have CVI. Medical history, visual field evaluations, and MRI reports were taken into consideration as clinical factors in this study. According to the research, children with unusual medical histories are at a higher risk of developing CVI. [8]

The research ‘Behavioral characteristics of children with permanent Cortical Visual Impairment’ was conducted by J.E. Jan, M. Groenveld, A.M. Sykanda and C.S Hoyt. In this research they have described the common behavior of the children with permanent CVI using 50 children. They have identified that most of those children have residual vision and all of them have inconsistent and variable visual behaviors. It has been mentioned that they can see better when they are in a familiar background and most of the time, they touch and identify the things around them. Further they have recognized that most of them turn their heads for a side when they are touching objects and children with the least vision do not tempt to lift their heads. [9]

A group of researchers of the department of Neurology and Radiology of the temple university, Pennsylvania has conducted research ‘SPECT (Single-photon emission computed tomography) in patients with cortical visual lose’. They have used SPECT scans of 7 seven patients and compared them with Magnetic Resonance Image (MRI) scans to decide the relationship between anatomical and functional findings. They proposed that SPECT scan is the most successful method to identify the issues in the visual pathways when compared to MRI scans. [10]

Research ‘Early visual-evoked potential acuity and future behavioral acuity in Cortical Visual Impairment’ is conducted by Tonya Watson, Deborah Orel-Bixler and Gunilla Hagerstown. They have conducted this study to determine whether the visual-evoked potential (VEP) measure related with the future behavioral acuity of young patients. Through research they have identified that VEP test can use as a

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 7, Issue 11, pp 267-274, November-2023
https://doi.org/10.47001/IRJIET/2023.711037

predictive tool to find the future acuity of the young CVI patients. [11]

Another group of researchers have conducted research to identify the value of a CVI questionnaire in screening CVI. 91 children were taken to the study and the questionnaire consists of 46 items to identify the different characteristics of CVI. The questionnaire was filled in by the parents and a diagnostic evaluation has been done with the children. It was found that 12 items are common with 45 children, and they proposed that tested CVI questionnaire is suitable to use as a part of the CVI screening process. [12]

III. PROBLEM DEFINITION

Cortical Visual Impairment (CVI) is the leading cause of childhood blindness and a critical condition, especially in children. It arises from damage to the visual pathways of the brain. As of right now, the only diagnostic techniques that are available are clinical, frequently requiring specialized knowledge, and lacking an early detection mechanism has become a major difficulty. By introducing a mobile application for the screening of CVI in kids between the ages of 4 to 6, this study aims to address the above problem. The program is designed to evaluate the four main aspects of CVI: visual field preference, color preference, movement need, and visual complexity challenges.

3.1 Approach

The suggested solution to the issue is to create a mobile application that makes it easier to identify CVI in children at an early age. Using a multifaceted strategy that incorporates quizzes and exercises, the methodology makes the program easy to use and accessible for parents to utilize at home. The following is a summary of the process:

Through activities that focus on each of the four primary CVI characteristics, the application starts the assessment process with the kids. First, it evaluates color preference since children with CVI frequently show preferences for particular colors. Using a series of color-related activities with audio instructions, the application learns the child's preferred colors. Subsequently, it assesses visual complexity issues by showcasing an assortment of tasks with diverse visual complexity levels. The application uses these activities to measure a characteristic that children with CVI often struggle with object identification in complex backgrounds.

The application also investigates the child's preferred visual field. Prefers for visual fields (e.g., upper, lower, right, or left) may be displayed by children with CVI. The application provides activities to help identify the child's preferred visual field to assess this. Finally, since children with CVI are frequently drawn to moving objects, the need for movement is evaluated. The application aids in assessing this quality by presenting tasks that require the user to identify moving objects.

In addition to the activities, the application includes quizzes that correspond with every attribute, enabling parents to offer more insight and perspectives. After these evaluations are finished, the application uses machine learning models that have been trained using data from a sample of kids who have participated in the activities. These models examine the data and offer perceptions into the probability of each CVI feature.

The outcomes of the four characteristics are used to make the final decision. If the app determines there is a possibility that a child has CVI, it advises parents of the steps they should take to confirm the diagnosis and look for early intervention and treatment. This approach makes sure that parents can easily use and access the application, enabling them to identify possible CVI conditions in their kids early on. Through early identification and intervention, the application may be able to provide children with CVI with timely assistance. This is supported by the data gathered during the testing phase. Although the application acknowledges certain limitations, including the need for additional research on other characteristics of CVI and the difficulties in gathering data from a larger sample size, it still marks a significant advancement towards early detection and intervention for CVI, which will ultimately improve children's development and education.

IV. METHODOLOGY

Considering all the conducted research and available techniques to detect CVI conditions, it has identified the absence of an effective screening method which can be used by the parents to detect the CVI conditions of their children at home. This mobile application is developed as a solution to this problem, and it detects whether the user has a probability of CVI and if such condition is detected, it provides further actions to be taken to confirm the disorder and start the treatments.

The detection process is developed under the four main characteristics of CVI. A set of activities and a quiz is available for every characteristic. Initial instructions which need to be followed by the parents are displayed on the screen and all the other instructions for the users are given as audio instructions. At the beginning it is advised to take the child to a dark place to complete the activities. Since manual detection is also done in a dark room, it is considered better to use the application in a dark environment without the distraction of the other lights.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 11, pp 267-274, November-2023

https://doi.org/10.47001/IRJIET/2023.711037

Children with CVI have a definite preference for specific colors, most commonly red and yellow. Additionally, they prefer colors like orange and blue. Since colors like red and yellow have the longest wavelengths and the human eye has many receptors for long wavelengths, it is believed that those colors have a specific preference. Considering these factors, to check whether the color preference characteristic is present in the child, an activity with five steps is included in this mobile application. Even if the attention is diverted, since there are several steps, the result of the activity will not be affected. In the first step the screen is divided into two equal parts and one side is colored with a color with longwave length such as red, yellow, orange, or blue. The other side is filled by a color with a shortwave length. The user gets audio instructions to touch a particular color and if the user is having CVI conditions it is difficult for him to identify the shortwave length colors accurately. But they can easily identify the long wave length colors and most of the time they identify them correctly. The same process continues with different color pairs and the responses along with the reacted times are recorded separately. Based on the results and the reaction time, it generates a score. According to expert's opinion the scores are assigned to the colors. For the color's red, yellow, orange, blue, green, pink, purple, and brown the assigned scores are 1, 0.8, 0.75, 0.5, 0.2, 0.2, 0.2 and 0.2 respectively. If the user reacts within the first five seconds, the score is 1 and if the user reacts within the next five seconds the score is 2. According to the same manner user get the scores up to 5.

The quiz consists of six questions and each question has four options which are never, occasionally, frequently, and always. Based on the selected answers, users get scores 1, 2, 3 and 4 respectively. By considering the activity score, time score and the quiz score, a model trained using the random forest algorithm decides whether the user is having the probability of the characteristic 'color preference' or not. In the last screen of this set of activities, the obtained scores and identified condition are displayed.

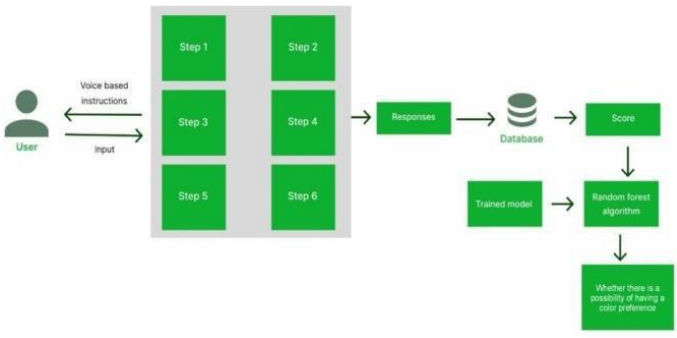

Figure 1: Process of testing color preference

Children with CVI find it difficult to identify objects when they are placed in a complex background, which is known as 'difficulties with visual complexity'. They can easily identify a single-color object placed in a black background and when the number of colors in the object or the background is increased, they could not identify it correctly. The set of activities contains 9 steps and in the first three steps a single- color object, 2 different color objects and a multicolored object placed in a black background respectively. In the next three steps the same objects have been used but the background consists with different colors. In the last three steps a complex background is used with the same objects. The user gets audio instructions to touch a particular object and the responses are recorded separately. The reaction time is divided into four equal ranges, each range consists of five seconds. According to the reaction time the user gets the score between 1 to 5.

The quiz of this component consists of eight questions and each question has four options which are never, occasionally, frequently, and always. Based on the selected answers, users get scores 1 ,2, 3 and 4 respectively. After the set of activities and the quiz are completed, the scores go through the model trained using the naïve bayes algorithm and gets the output whether the user is having a probability of difficulties with visual complexity or not. Along with the obtained scores the identified condition displays at the end.

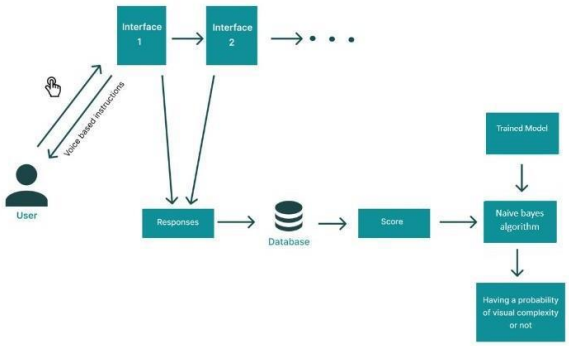

Figure 2: Process of testing difficulties with visual complexity

Most of the children with CVI conditions have a preferred visual field. When they look forward, they cannot get information from a certain area. They might have difficulties with their lower, upper, right or left visual fields and without turning their heads they cannot see the objects in those visual fields. This characteristic is known as 'difficulties with visual complexity' and the application uses a set of activities to detect this condition. This activity contains 9 steps and in the first four steps the user gets a black screen with a wide red stripe on the top, bottom, right and left respectively. In the next five steps the red squares are placed in the 4 corners and the middle of the screen. Then the voice instructions will be given to the user to touch the red areas. The responses and the reaction times are recorded, and the score is calculated according to the correct responses and the

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 11, pp 267-274, November-2023

https://doi.org/10.47001/IRJIET/2023.711037

reaction times. The reaction time is divided into four equal ranges, each range consists of five seconds. According to the reaction time the user gets the score between 1 to 5.

The quiz of this component consists of six questions and each question has four options which are never, occasionally, frequently, and always. Based on the selected answers, users get scores 1 ,2, 3 and 4 respectively. After the set of activities and the quiz are completed, the scores go through the model trained using the logistic regression algorithm and gets the output whether the user is having a probability of difficulties with visual field preference or not. Along with the obtained scores the identified condition displays at the end.

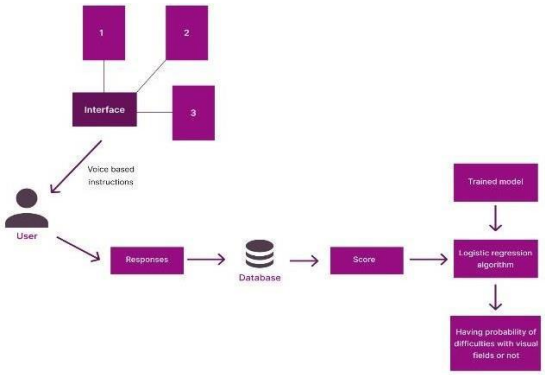

Figure 3: Process of testing difficulties with visual fields

'Need for movement' is the next important characteristic of CVI. Children who are undergoing CVI cannot identify the stable objects and they are attracted to the objects with a movement. Considering this condition an activity has been designed with two steps. In the first interface it displays an object in an environment and gives audio instructions to the child to touch the specific object within a certain period. In this interface only that specific object performs a movement. If the user fails to do that task within the given period it moves to the second interface, where all the conditions are equal and in this interface all the objects are stable. The correct proportion will be compared to the analyses to determine whether the child is likely to experience the need for movement.

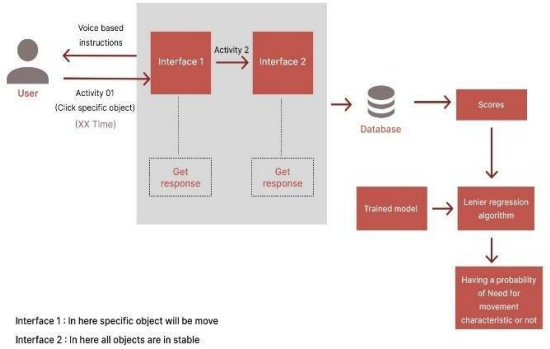

Figure 4: Process of testing need for movement

After the completion of all the 4 activities based on the obtained results it decides whether the user is having a probability of CVI or not. If the user does not acquire 'high probability' for any characteristic, he will get the output as 'no probability of having CVI'. If the acquired results of all the characteristics are 'high probability', the user is identified as 'high probability of CVI'. Similarly, if the user gets 'high probability' for 2 characteristics and 'low probability' for 2 characteristics the results is 'risk of having CVI'. If only 1 characteristic is identified as 'high probability' and all the remaining are 'low probability' the user is identified as 'low probability of having CVI'. If high probability is identified, the application will provide the necessary steps to be taken by the parents and guide to confirm the condition of the child and for early intervention.

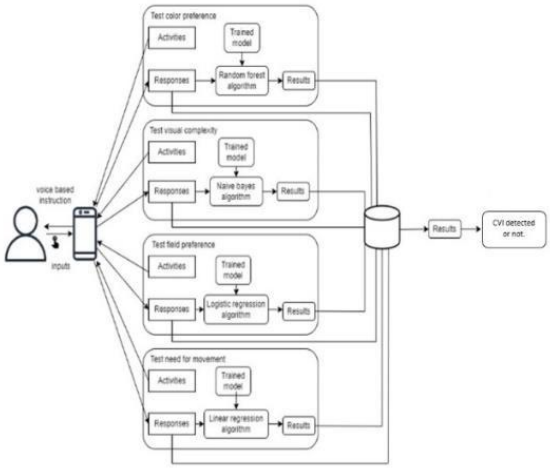

Figure 5: System overview

As the initial step, all the 4 activities were developed and given to the two sets of children who have been diagnosed with CVI and who have not diagnosed with CVI and asked them to use the application under the observation of the authorized adults. The responses were collected, and they have been used to train the separate models that have been used to identify the 4 characteristics. The sample contains 127 children between the ages of 4 to 6. The participants for the study were taken from the hospitals in western province of Sri Lanka and several preschools. None of the confidential data was collected during the data collection process and the authors ensure that the collected data will not create any privacy concerns for the children who have participated in the data collection process.

The mobile application is developed using Flutter and firebase is used for data storing purposes. All the user details are stored in an encrypted manner, and it ensures the privacy of the users.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 11, pp 267-274, November-2023

https://doi.org/10.47001/IRJIET/2023.711037

V. RESULTS

To test the developed application a group of 15 children between the ages of 4 to 6 were considered and 6 of them were diagnosed with CVI and the rest are not. The results were compared with the expected results of the application and checked how successfully the application is working.

The objective of this mobile application is to make it easier for adults to get an idea of whether the children are having CVI. It combines several features and functionalities to simplify the assessment procedure and offer insightful information. The design of the application is centered around particular tasks created to assess various CVI-related traits. To assess the user-friendliness of the application and the ability to use the application it was provided for the parents. The results indicate that the application fulfills its requirements. Parents were able to use the application without requiring assistance from a specialized person. They also indicate how accessible and user-friendly the product is by conducting assessments of their child's CVI condition with ease.

The application's user interfaces (UIs) were meticulously created to meet the special requirements of kids with cortical visual impairment (CVI). It was noticed the kids were at ease while using the application and didn't experience any discomfort at all. This feature highlights how well the UI design worked, guaranteeing that CVI kids can use the application in a stress-free and fluid way. Moreover, providing voice instructions instead of displaying them on the screen was impactful since they were able to follow the instructions easily. The three parameters activity score, time score and quiz score are analyzed to get the best outcomes by avoiding the faults due to distractions of the children. Since the steps of all the activities were carefully planned, distractions will have the least possible effect on the test outcomes.

Among healthy children the application exhibited a remarkable degree of involvement. They actively interacted with the application and the interest of healthy kids implies that it has attributes that appeal to a wider demographic, potentially making it a flexible tool for evaluating and involving kids in varied visual situations.

During the testing phase some significant outcomes were observed which indicate suspicious CVI conditions among the nursery children who have not been diagnosed with CVI before. Suspected children demonstrate a higher preference for red color than the other colors (Figure 6). When they experienced interfaces with low contrast color combinations, they showed more interest in and interaction time with these interfaces compared to others.

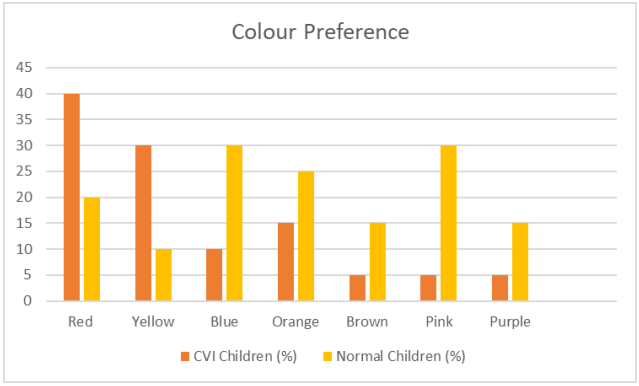

Figure 6: Color preference

These kids seemed to prefer the lower visual field over the upper one, as evidenced by the frequent lowering of their heads, which may indicate a preference or discomfort there. Suspected children had trouble when identifying objects in complex backgrounds while engaging with the complexity assessment. Compared to background screens that were simpler, their reaction times were significantly slower in the complex backgrounds. Furthermore, in evaluating the need for movement, a unique situation with a stationary object showed that these kids frequently misunderstood the directions. For example, varying visual perception and interpretation led to the red-colored car being touched instead of the intended ash-colored car.

VI. DISCUSSION

Since cortical visual impairment (CVI) is the primary cause of childhood blindness, it is extremely concerning, especially in children. Standard eye examinations cannot resolve visual difficulties caused by the brain's inability to accurately process visual signals. An inventive mobile application created to identify CVI in kids between the ages of 4 to 6 was the study's distinctive methodology. The four primary characteristics of CVI that are highlighted in this application are preference for color, challenges with visual complexity, preference for visual fields, and need for movement. It provides parents with an easy-to-use and accessible tool to determine their child's risk of CVI and take the appropriate early intervention measures.

The application's design considers the distinct needs of children with CVI, ensuring that they can interact with it comfortably and without discomfort. The voice instructions provided for each activity enable these children to follow the tasks easily, which is essential given their unique visual challenges. Moreover, the carefully planned steps of the activities minimize the impact of distractions, resulting in more accurate test outcomes.

ISSN (online): 2581-3048
Volume 7, Issue 11, pp 267-274, November-2023
https://doi.org/10.47001/IRJIET/2023.711037

The application proved to be efficient and effective during the testing stage. It demonstrated its potential as a flexible tool for assessing and involving children in a range of visual situations by engaging healthy children in a successful manner. But the most encouraging finding from the testing was the detection of possible CVI conditions among the nursery children who had not yet received a diagnosis. These findings included a strong preference for red, trouble distinguishing objects against complex backgrounds, trouble with low-contrast color combinations, and a preference for the lower visual field. These results highlight the application's potential for early detection as well as for identifying traits associated with CVI in children who are not yet diagnosed.

The importance of early intervention cannot be overstated, especially for children with CVI. The development and education of a child can be greatly impacted by the timely identification of CVI conditions. The application can be an essential part of the cooperative approach between parents and professionals by giving parents a useful tool to determine their child's risk of having CVI. Parents can use this app to gain insight into their child's visual behaviors at home, which will help them determine if further clinical testing is required.

The application's results indicate that it is possible to simplify the CVI screening procedure such that parents with no prior experience can use it. It is imperative to acknowledge that the application does not serve as a replacement for clinical diagnosis. Rather, it acts as a preliminary screening instrument that can direct parents towards obtaining a professional assessment and, if required, early intervention.

In conclusion, this study provides a practical and efficient method for identifying CVI in young children. A useful tool that enables parents to take proactive measures in the early identification and intervention of CVI has been developed by concentrating on four essential characteristics and creating interactive activities and quizzes. This mobile application can guarantee that children with CVI receive the care and support they require early on, which could have a profound effect on their lives. The accuracy and usability of the application can be further improved through future developments and enhancements, which will ultimately benefit the lives of children with CVI and their families.

VIII. CONCLUTION

The severe issue of cortical visual impairment (CVI), a neurological condition that is the primary cause of blindness in children, has been addressed in this study. Because of the undiagnosed and misunderstood with other visual impairments, CVI frequently remains undiagnosed despite having a substantial impact on a child's development and education. A novel application that can identify CVI in kids between the ages of 4 and 6 has been released to address this disparity. The four main features of CVI that are highlighted in this application are preference for color, challenges with visual complexity, preference for visual fields, and requirement for movement.

The findings of the research indicate how practical and user-friendly the application is. It successfully involved healthy kids in testing and detected possible CVI conditions in kids in preschool who hadn't received a diagnosis yet. These findings included a strong preference for red, trouble distinguishing objects against complex backgrounds, trouble with low-contrast color combinations, and a preference for the lower visual field. This implies that the app helps identify CVI-related traits in children who have not been diagnosed in addition to helping with early detection. For kids with CVI, early intervention is essential since it has a big impact on their growth and education. To help parents seek professional evaluation and early intervention if needed, the application offers parents a useful tool for determining their child's likelihood of having CVI.

In conclusion, this research has led to the creation of an approachable and reliable method for identifying CVI in young children. A useful tool that enables parents to take proactive measures in the early identification and intervention of CVI has been developed by concentrating on four essential traits and creating interactive activities and quizzes. This mobile application can guarantee that children with CVI receive the care and support they require early on, which could have a profound effect on their lives. The accuracy and usability of the application can be further improved through future developments and enhancements, which will ultimately benefit the lives of children with CVI and their families. The goal of the contributions made in this area is to improve children's lives.

ACKNOWLEDGEMENT

The authors would like to express gratitude to Ms. Anjali Gamage and Mr. Sathira Hettiarachchi for their guidance and support throughout the research process. Gratitude to all the medical students and the active consultant for the insightful information and the knowledge shared with the study. Also extend special thanks to all the preschool teachers, medical staff, parents, and kids who gave their time and support for the study. Gratitude to all the members of the department of Information Technology, Sri Lanka Institute of Information Technology.

REFERENCES

[1] N. E. Institute, "Cerebral Visual Impairment (CVI)," 2020.

ISSN (online): 2581-3048
Volume 7, Issue 11, pp 267-274, November-2023
https://doi.org/10.47001/IRJIET/2023.711037

[2] pcvis, "What is CVI?".
[3] K. B. Rachel Bennett, "What is CVI?".
[4] "What are the 10 Characteristics of Cortical Visual Impairment (CVI)?," March 12, 2023.
[5] M. S. B. Melinda Y Chang, "Methods of visual assessment in children with cortical visual impairment," 2021 Feb 1.
[6] S. S. Lehman, "Cortical visual impairment in children: identification, evaluation and diagnosis," National Library of Medicine, 2021.
[7] "What are the 10 Characteristics of Cortical Visual Impairment (CVI)?," cvijourney.com, 12 March 2021.
[8] L. A. R. B. J. R. K. J. S. C. W. Rachel Fiona Pilling, "Clinical assessment, investigation, diagnosis and initial management of cerebral visual impairment: a consensus practice guide," PubMed Central, 2022.
[9] M. G. A. M. S. C. S. H. J. E. Jan, "Behavioural Characteristics Of Children With Permanent Cortical Visual Impairment," WILEY Online Library, 1987.
[10] S. L. G. L. G. G. M. M. S. W. A. A. H. M. A. A. I E Silverman 1, "SPECT in patients with cortical visual loss," National Library of Medicine, 1993.
[11] D. O.-B. G. H.-P. Tonya Watson, "Early Visual Evoked Potential Acuity and Future Behavioral Acuity in Cortical Visual Impairment," PubMed Central, 2014.
[12] D. G. M. B. C. J. A. G. C. S. G. P. Frouke N. Boonstra, "The Multidisciplinary Guidelines for Diagnosis and Referral in Cerebral Visual Impairment," PubMed Central, 2022.

AUTHORS BIOGRAPHY

Ms. Anjalie Gamage,
Supervisor, Faculty of Computing, Sri Lanka Institute of Information and Technology, Western Province, Sri Lanka.

Mr. Sathira Hettiarachchi,
Co-Supervisor, Faculty of Computing, Sri Lanka Institute of Information and Technology, Western Province, Sri Lanka.

S.K. Wimalasiri,
Undergraduate Student, Faculty of Computing, Sri Lanka Institute of Information and Technology, Western Province, Sri Lanka.

A.I. Millewa,
Undergraduate Student, Faculty of Computing, Sri Lanka Institute of Information and Technology, Western Province, Sri Lanka.

W.O.M. Perera,
Undergraduate Student, Faculty of Computing, Sri Lanka Institute of Information and Technology, Western Province, Sri Lanka.

M.A.T.M. Nanayakkara,
Undergraduate Student, Faculty of Computing, Sri Lanka Institute of Information and Technology, Western Province, Sri Lanka.

Citation of this Article:

Ms. Anjalie Gamage, Mr. Sathira Hettiarachchi, S.K. Wimalasiri, A.I. Millewa, W.O.M. Perera, M.A.T.M. Nanayakkara, "Novel Approach to Detect Cortical Visual Impairment Using Mobile Application" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 11, pp 267-274, November 2023. Article DOI https://doi.org/10.47001/IRJIET/2023.711037

****

