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Visual Eye Acuity Test Using Virtual Reality

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ABSTRACT

Visual acuity, the measure of an individual's ability to discern fine details, plays a crucial role in diagnosing various eye conditions and monitoring their progression. Traditional eye acuity tests rely on physical charts, but this research explores the potential of VR to enhance the testing process. Admitting the real- world challenges on a scale of affordance to shiftlessness, a simplified result for vision tests can ease understanding the situations of vision issues. Considering this use case, we essay to make a virtual reality (VR) grounded vision testing medium for studying vision issues for individualities across all age groups. Color Blind is fairly common condition frequently goes undiagnosed, because you don't realize you aren't seeing colors as other people do. Yet testing for color blindness is simple — doesn't indeed bear a trip to the doctor. A mobile VR system has implicit as a tone- individual tool for rapid-fire, low- cost visual perceptivity measures in a completely controlled terrain as well as for furnishing literal vision data and tracing for the early discovery of visual impairments or conditions. The findings suggest that VR-based visual eye acuity testing has the potential to revolutionize clinical assessments and research in the field of ophthalmology. The technology offers a more engaging and immersive testing environment, potentially increasing patient compliance and accuracy of results. Moreover, the adaptability and scalability of VR-based systems pave the way for future advancements and integration with telemedicine, enabling remote eye acuity assessments and expanding access to care.

I. INTRODUCTION

Visual acuity, the ability to discern fine details, is a fundamental measure of visual function and plays a critical role in diagnosing and monitoring various eye conditions. Traditional visual acuity tests utilize physical charts, requiring patients to identify optotypes at different distances. However, advancements in virtual reality (VR) technology offer new possibilities for enhancing the visual acuity testing process. By creating realistic virtual environments and simulating visual stimuli, VR can provide a more immersive and interactive experience for patients while maintaining accuracy and standardization. The Indian subcontinent has quite 20 % of the world's blind population. Majority of surveys have shown that in India Myopia and Cataract because the most common causes of blindness. Initiatives that cater to prevention of blindness are mainly oriented towards the traditional methods. Visual acuity test is the basis of visual function tests and it is the most important part to evaluate the visual function. Vision tests serve us to work out the levels of vision degradation. Existing Vision Acuity are costly and that we need to go to optometrist. Visual acuity affects people's ability to work and quality of life directly, and acuity test is one of necessary check items in almost every health assessment. Virtual Reality is present between us from decades now, VR is that the new kingpin for all the upcoming cutting-edge technological platforms and devices. People can check their Vision Acuity Test reception itself so they don't need to visit doctor if there Vision is Correct. Candidate who want to use for Armed Force can also check if they have Color Blindness or their Stereopsis vision is Correct or not.

II. RELATED WORK

A study by Varsamidis et al. (2019) investigated the feasibility of using VR for visual acuity assessment in children. The results showed that VR-based testing was well-tolerated by the participants and offered a more engaging and interactive experience compared to conventional charts. The researchers concluded that VR has the potential to improve children's compliance with visual acuity testing, leading to more accurate assessments.

There are two further prominent visual acuity testing tools, however they either cost a lot of money or require a controller. There is only one Snellen chart test needed. The lack of a gaze pointer makes it difficult to click the focus UI buttons when they are positioned on the UI. They've done a good job at implementing distance calculations in virtual reality. Several techniques for simulating visual impairments and evaluating their impact have been developed. One technique used to assess the efficacy of signs was the visibility catchment area (VCA), or the amount of space from which a sign can be viewed. Participants were told to approach a sign and go down a corridor until they could read at least half of the letters on that sign during a user research study that the authors conducted. The sign was tilted at varying degrees over the different runs rather than allowing people to approach it from different directions. The study's results showed that as the angle between the observer and the sign increases, the MRD is affected by viewing angle and drops nonlinearly.

III. METHODOLOGY

Our Approach

Vision Acuity Test

In this section we will discuss how we will perform the visual acuity test

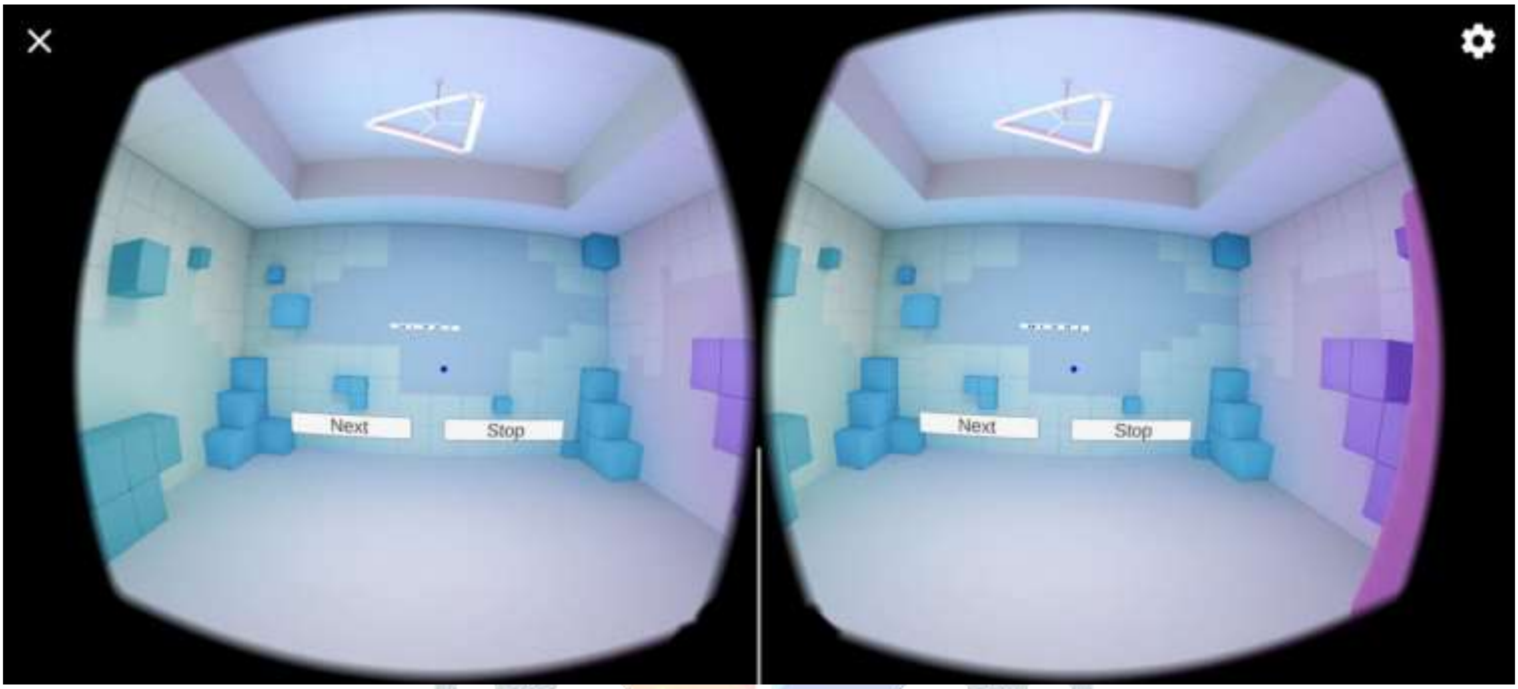

fig 1

The implementation of the eye acuity test involves a visual display of letters to the user, with each subsequent letter becoming progressively smaller as the user clicks on the "next" button. This gradual reduction in letter size allows for a thorough examination of the user's visual acuity. The test consists of a total of nine plates, each displaying a set of letters. By presenting the letters in a decreasing size sequence, starting with larger and more easily recognizable letters and progressing to smaller, more challenging ones, the test aims to assess the user's ability to discern fine details and distinguish smaller characters.

The output of the acuity test, as depicted in Figure 8, provides valuable information about the user's visual acuity. The figure likely shows the nine plates, with the corresponding letters, as they appeared during the test. This output allows healthcare professionals or individuals administering the test to evaluate the user's performance and determine the clarity of their vision. By analyzing the smallest letter that the user was able to identify accurately, professionals can assess the user's visual acuity and make informed decisions regarding potential corrective measures or further examination if necessary.

Color Blindness Test

In this section we will discuss how we perform the color blindness test.

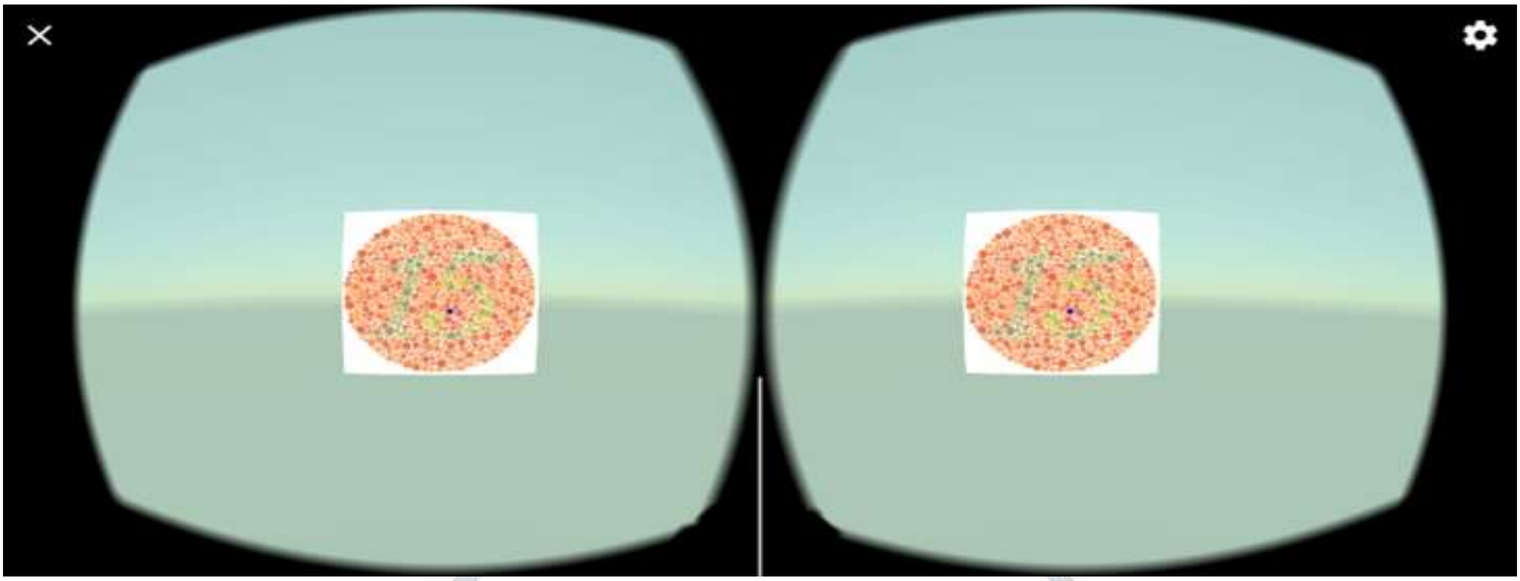

fig 2

The participant will be shown a board . The participant will then have to choose which number they saw. The plate may or may not be diverse. The participant will be selected from 10 plates. Since a participant can give it multiple times, we have 15 random ones, and from those 10 random plates will appear with different random order. After supporting the test, users will answer, the result will show whether they are color blind or not.

Stereopsis Test

The participant is shown 2 dice. The participant must choose the cube that is closer. This process will be repeated 10 times each time both dice appear in a random location. The participant must choose the cube that is closer. Based on the input of the participant, the result will be displayed. The participant can take this test more than once.

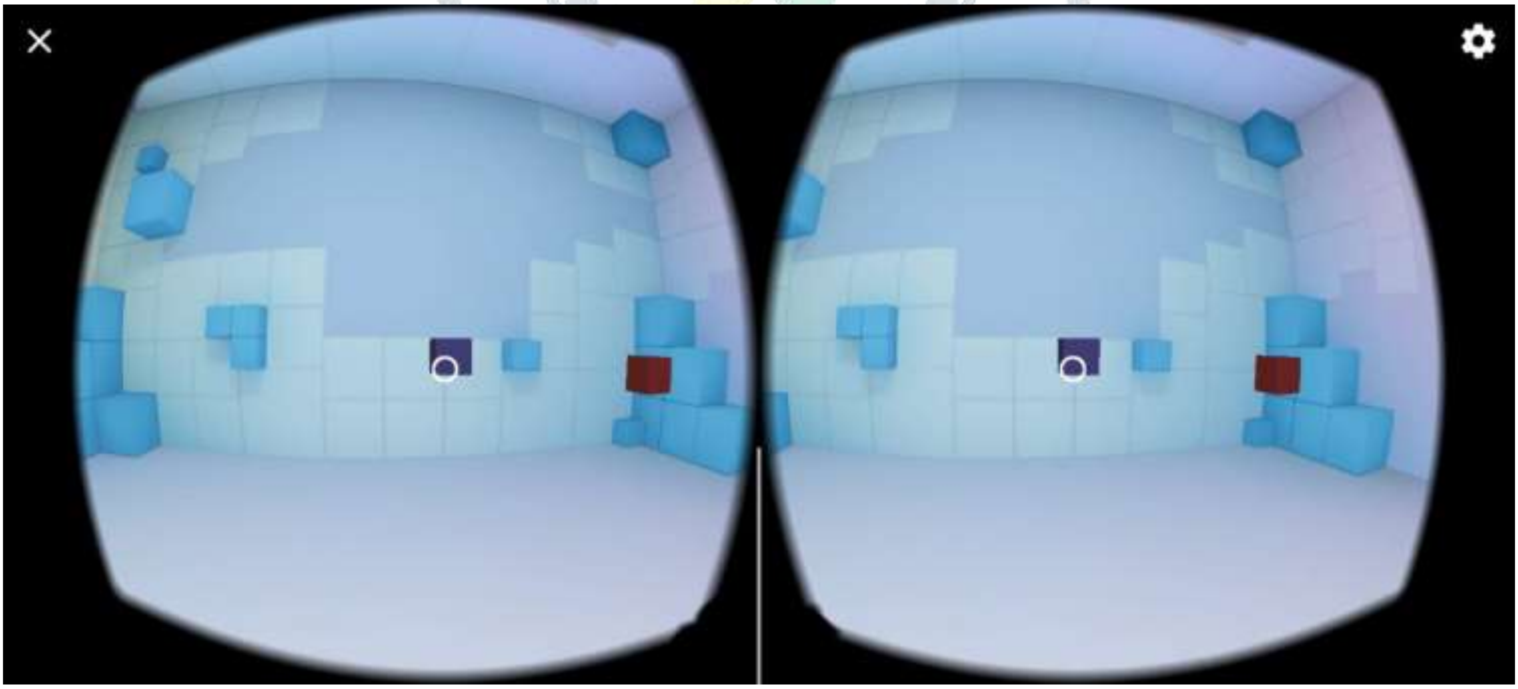

fig 3

IV. RESULTS AND DISCUSSION

A significant achievement in our project was the development of a user-friendly menu, as depicted in Figure 4. This menu serves as a central interface that allows users to navigate through various options and features within our VR-based acuity testing system. By designing an intuitive and visually appealing menu, we aimed to enhance the overall user experience and streamline the testing process.

In addition to the menu, we also implemented a view pointer feature within the VR interface. This view pointer serves as a virtual cursor that responds to the user's gaze, allowing them to interact with the UI elements by hovering over them for a designated period, typically two seconds, before triggering a click. This approach ensures accurate and intentional user inputs, preventing unintentional clicks and ensuring a more seamless interaction with the UI.

The combination of the menu and the view pointer feature creates a cohesive and user-friendly interface for our VR-based acuity testing system. Users can easily navigate through the menu options using the view pointer, accessing different testing modes, adjusting settings, or reviewing test results. This streamlined interface design promotes efficiency and ease of use, enabling users to focus on the testing process itself and obtain accurate results without unnecessary distractions.

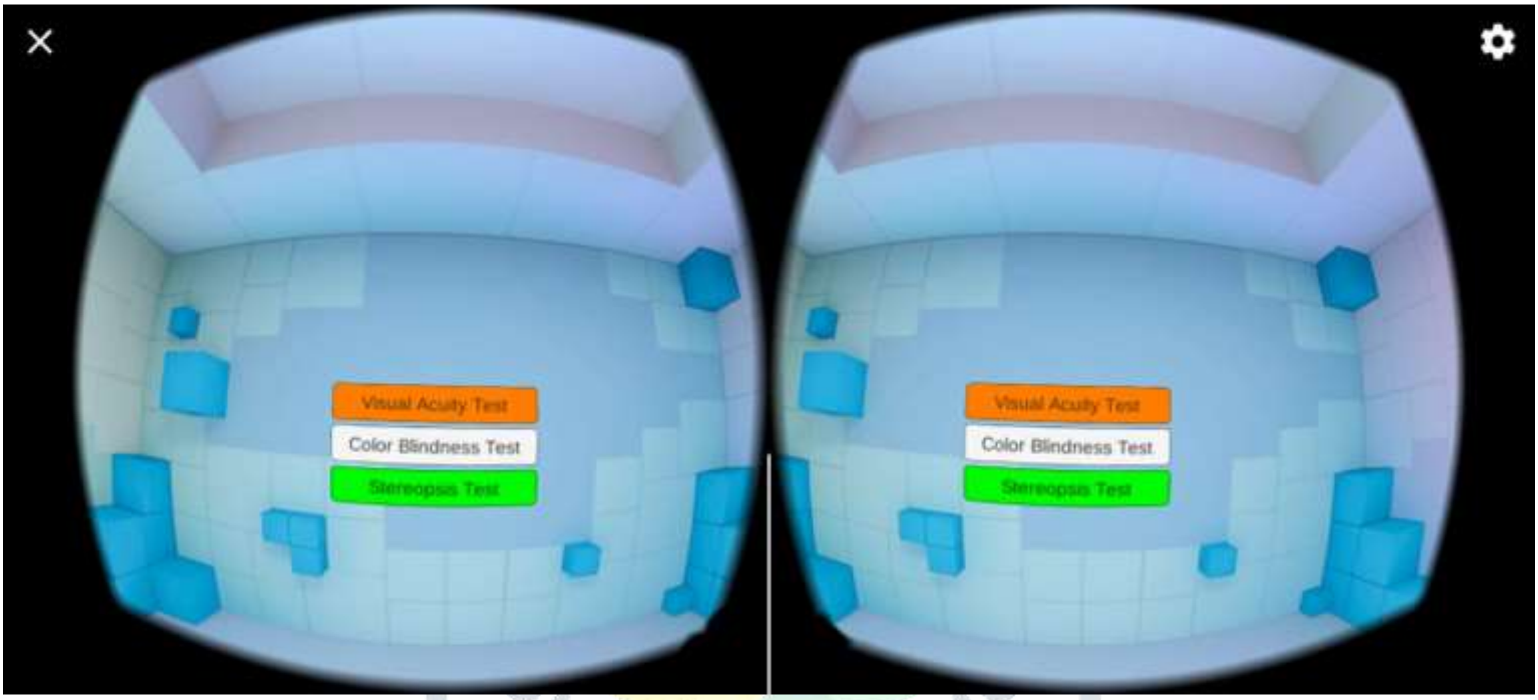

fig 4

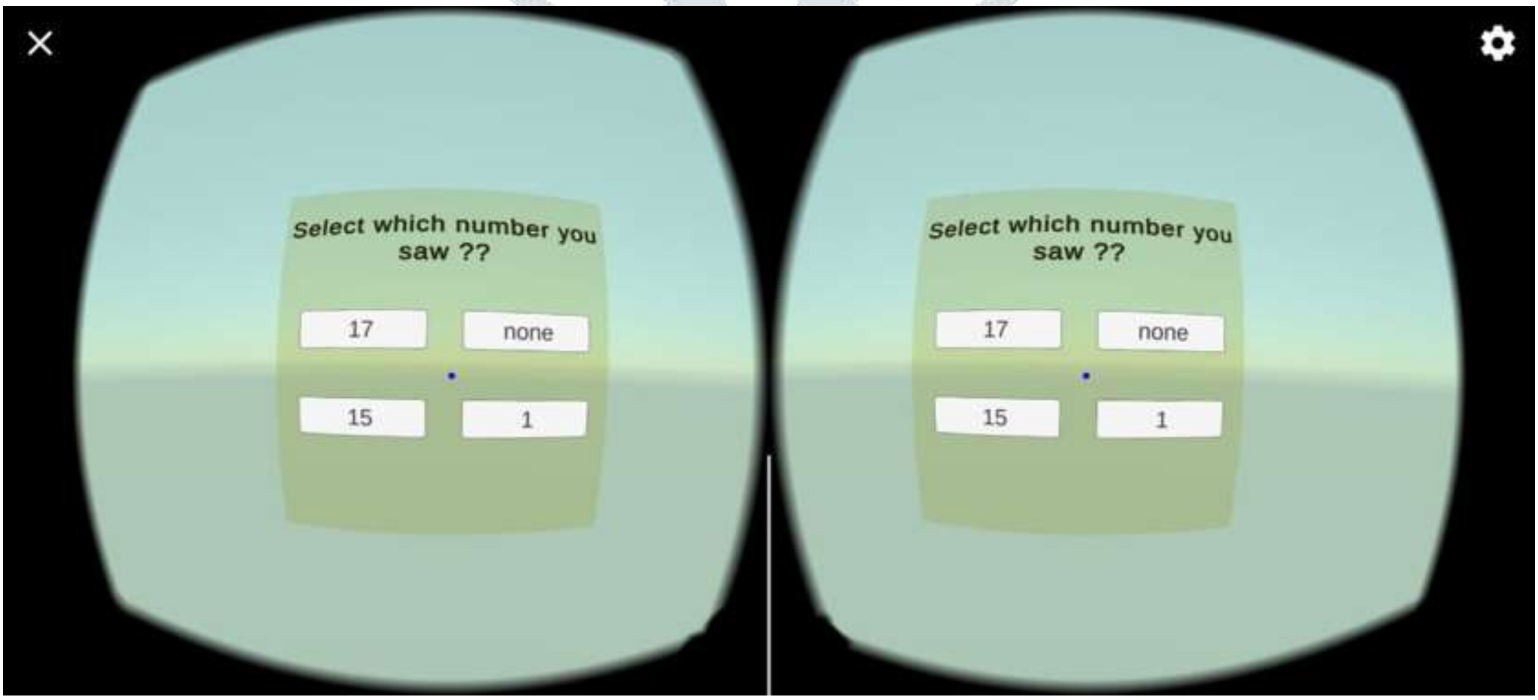

fig 5


Color Blindness Test Result
Out of 10 questions, you got 9 correct!
Your color vision is just about spot on!
What would you like to do now?
Try Again
Main Menu

fig 6

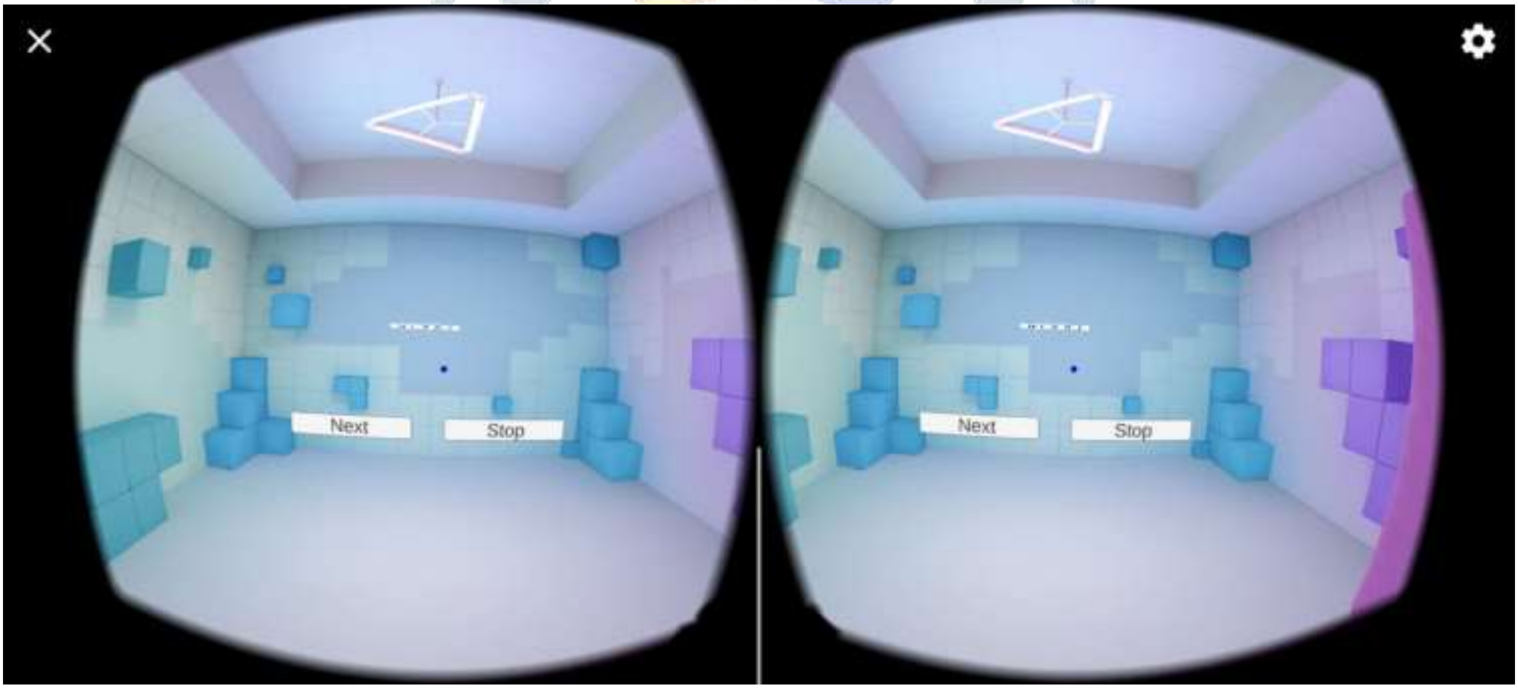
Next
Stop

fig 7

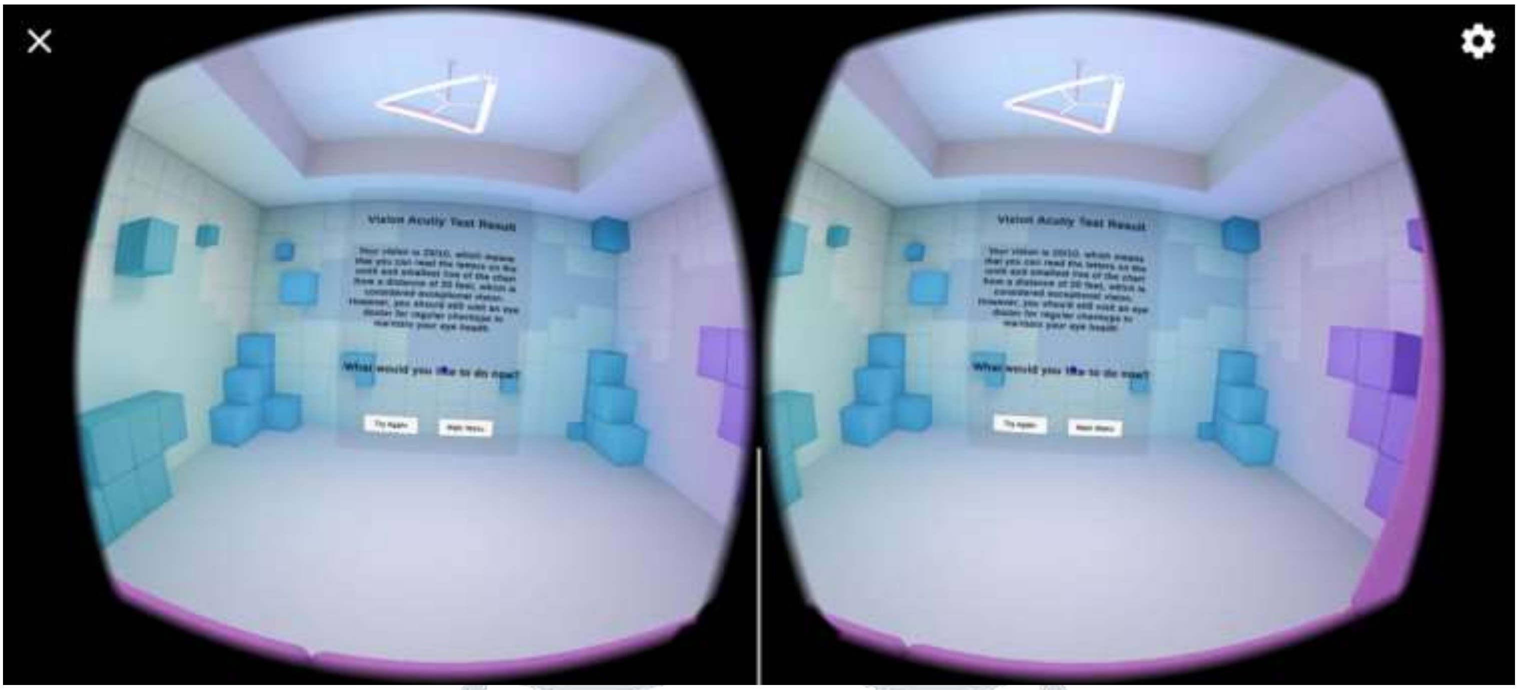

fig 8

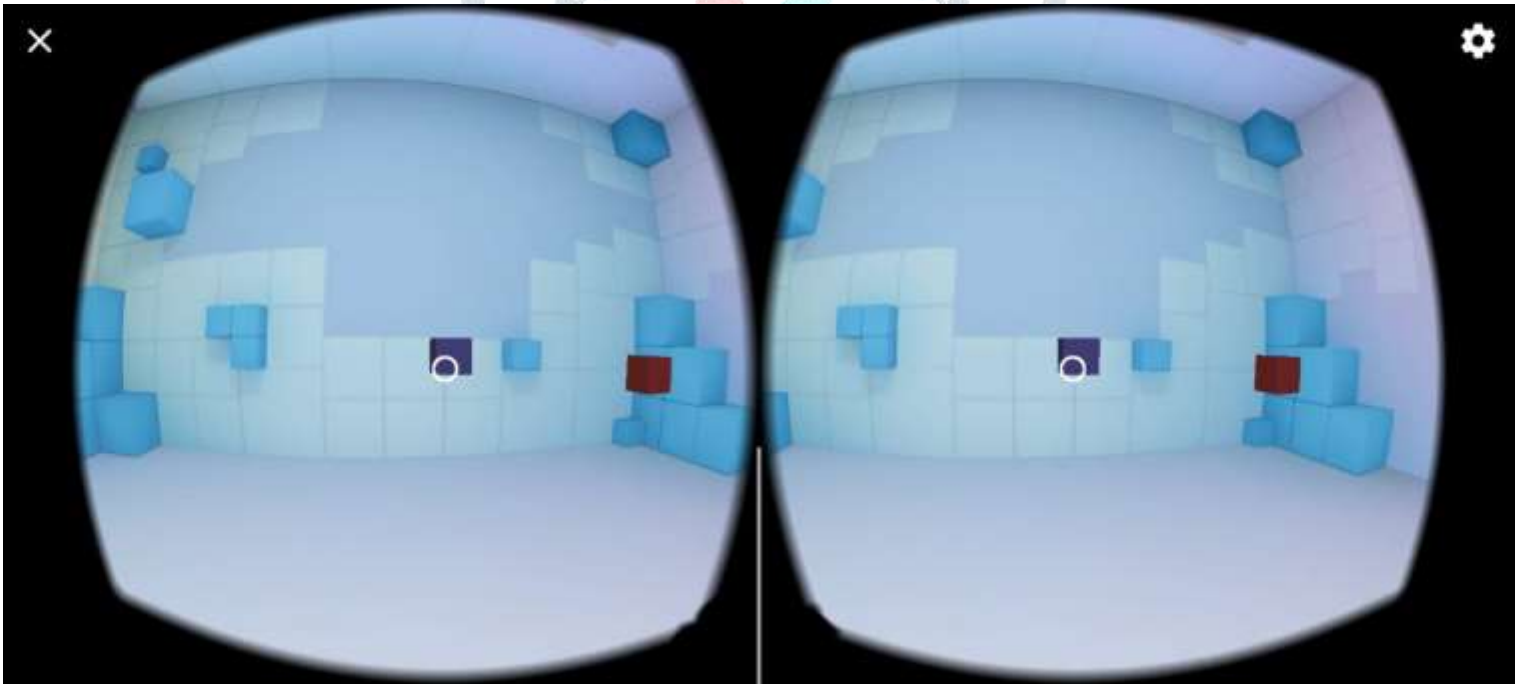

fig 9

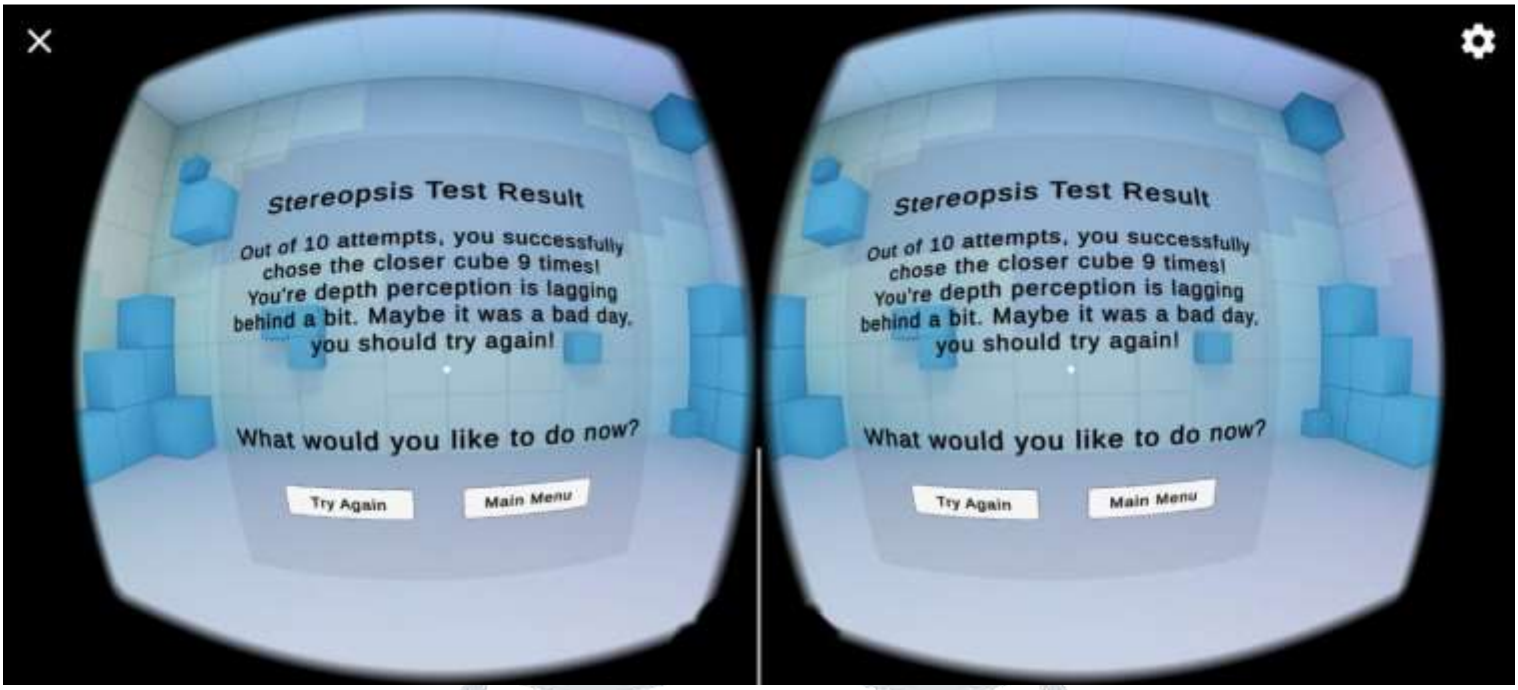

fig 10

We have also successfully created a color blindness test where the user is shown 10 random [fig. 2] Color Label and then it will be given the option [fig. 5] to select which number the user saw. He will like the quiz test.

As we can see, it's just a basic quiz, but we've made sure it's responsive and doesn't require the controller to click on an option. Only the user has to move the pointer to the option he considers to be the right choice. [fig. 6] shows the output after performing the test.

We have implemented eye acuity test by showing letters to user which get small as you click on next and like this you will be shown 9 such plates of letters. [fig. 8] shows the output

of acuity test.

We have also successfully implemented stereopsis test in which user will be shown two boxes and he have to select the one which is nearer and he will be shown 10 instances of these 2 boxes spawning at random location. [fig. 10] shows the output of stereopsis test.

V. CONCLUSION

As part of our research, we dedicated our efforts to exploring the potential of virtual reality (VR) as a platform for conducting acuity testing. Throughout this process, we encountered various challenges, identified shortcomings, and recognized the advantages of utilizing VR technology to detect vision problems in individuals. By leveraging the immersive and interactive nature of VR, we aimed to create a more engaging and accurate testing environment.

One of the key accomplishments in our project was the successful development of a virtual scale within a VR scene for Snellen-based acuity testing. By creating a virtual representation of the Snellen chart, participants were able to navigate through the VR environment and interact with the chart in a way that closely resembled the traditional testing process. This virtual scale provided a realistic and adaptable platform for conducting acuity tests, allowing for precise measurements of visual acuity.

Furthermore, we explored the potential of VR in detecting other vision problems, such as color blindness and stereopsis. Leveraging the capabilities of Unity software and the Google VR (GVR) package, we implemented specialized tests for color blindness and stereopsis within the VR environment. These tests utilized interactive elements and visual stimuli to assess the individual's ability to perceive colors accurately and perceive depth through binocular vision. By incorporating these tests into the VR-based acuity testing framework, we aimed to provide a comprehensive assessment of an individual's visual capabilities.

VI. REFERENCES

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