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Vision Plus Application for Analyzing Vision Defects

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Abstract: - Vision plus is an application that aims to revolutionize eye health and well-being. In an era where the demands on peoples' eyes have never been greater, this application is developed as a tool designed to provide users with the knowledge and resources needed to safeguard and enhance their visual acuity. The application equips users with tools and exercises to identify their own vision defects. While users engage in these tests, the system provides them with clear instructions to ensure the most accurate results. Vision ailments covered by the application include short sightedness, contrast sensitivity, colour blindness and Astigmatism. In addition to these vision ailment tests, the system also offers users a function to test for vision symptoms and receive recommendations or vision exercises. Depending on the user's symptoms, these exercises are recommended for a specific period (1-2 weeks). At the end of that time, the app sends users a notification, inquiring about the success of the exercises. If users respond with, 'The symptoms are still there,' the app prompts them to schedule an appointment with an optometrist through the app itself. The application includes a built-in function to connect users with optometrists, making it easy to schedule visits. Furthermore, there is a system that allows patients to contact optician shops for the manufacture of spectacles. Using this system, administrators can efficiently manage (add, modify, or remove) information regarding tests, optometrists, and shops if needed.

Keywords*: eye symptoms, eye exercises, eye ailments, vision defects.*

1. Introduction

The eye is a very fragile organ which provides humans with the most important sense out of the five senses. one of the most important organs in the human body [1]. Due to society's overreliance on technology and the increase in time spent in front of screens, there is an increase in people suffering from vision ailments. Since people also live in a fast-paced busy environment people are reluctant to spend time on getting eye treatments and to wait in queues. Hoping to remedy this, the Vision plus application will be introduced. Vision plus is a web-based vision care application that helps patients to diagnose their vision ailments from the comfort of their home and easily get in contact with vision professionals to fulfil their vision-based needs.

The user of this system can take tests for eye conditions. These conditions include color blindness, long sightedness, astigmatism etc.

A. Vision Ailments testing

1) For Short sightedness

The test used for short sightedness is the Snellen vision chart test as shown in Fig. 1. Developed by Dutch eye doctor Hermann Snellen developed the in the 1860s. There are typically 11 rows of capital letters on the Snellen chart. One very enormous letter appears on the first line. The number of smaller-sized letters in the subsequent rows increases. The patient read from the Snellen chart while standing 20 feet away and without the patients' glasses or contacts. The patient reads out the tiniest line of letters that the patient can make out while covering one eye. Then repeat the process while covering the other eye [2].

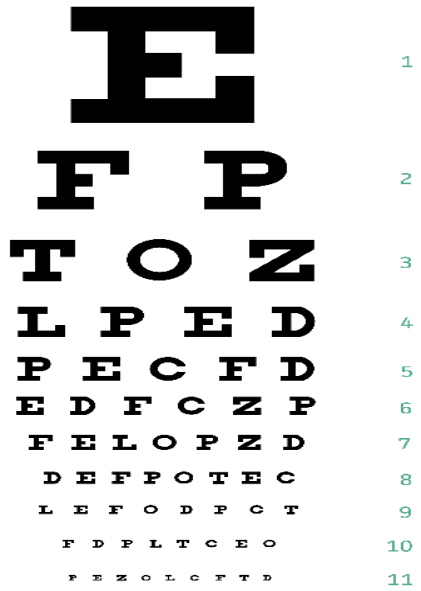

Fig. 1 : Snellen Chart

2) For Contrast sensitivity (CS)

CS is a person's capacity to recognize and clearly distinguish the outlines of very small things. It can also mean the capacity to spot subtle variations in patterns and shadings. CS aids in the detection of ill-defined objects and their separation from their backdrop contrast [3]. Fig.2 represents a CS test.

Fig. 2 : Pelli Robinson contrast sensitivity test

3) For Color blindness

People with color blindness have difficulties telling the difference between certain colors. Color blindness typically runs in families. Despite the lack of a treatment, customized glasses and contact lenses can assist people distinguish between colors. Most people with color vision deficiencies don't have any difficulties going about their daily lives [4].

Color vision deficiency is one of the most common inherited disorders of vision. Its prevalence may be as high as 8% in males and 0.5% in females [5].

The types of colour blindness [6]

1. Red-green color vision deficiency
2. Blue-yellow color vision deficiency
3. Complete color vision deficiency

The test used for color blindness is the Ishihara test as shown in Fig. 3.

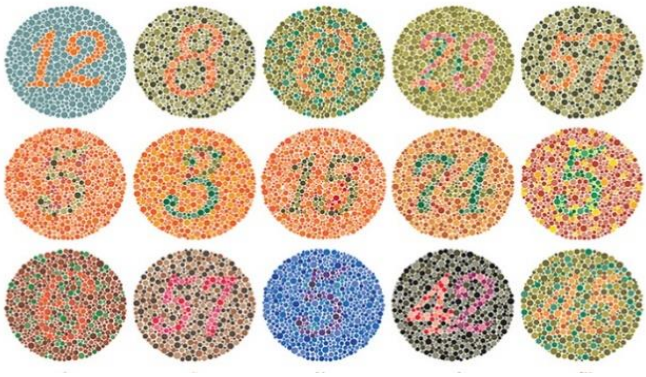

Fig. 3 : Ishihara test

4) For Astigmatism

Astigmatism is a principal refractive error which can lead to amblyopia (lazy eye) and regular examinations should be carried out during childhood to prevent visual impairment [7]. Astigmatism is caused by a cornea or lens that has a different shape than normal. Astigmatism is very common. Scientists don't know the reason why the shape of the cornea or lens varies from person to person. But they do know the risk of getting astigmatism is inherited [8].

To test astigmatism, the patient is asked to look at the white space in the test image as shown in Fig. 4 and Fig. 5, through both eyes separately and see in which eye they see lines appearing grayer than other eyes.

There are two basic types of astigmatism [8]:

1. Horizontal astigmatism (when the eye is wider than it is tall), and
2. Vertical astigmatism (when the eye is taller than it is wide)

With either type of astigmatism, near and far vision is blurry because of the eye's irregular shape.

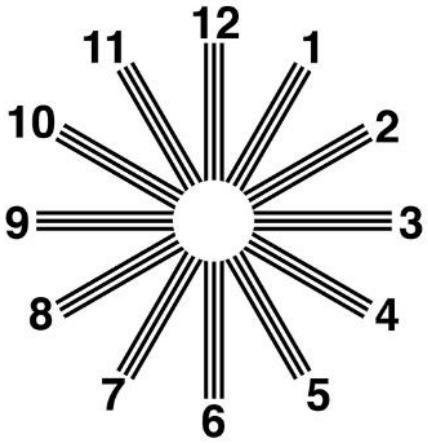

Fig. 4 : Astigmatism test 1

Fig. 5: Astigmatism Test 2

B. Eye exercises

Instead of any major ailments, if the users are currently exhibiting minor vision related symptoms, they can get eye exercise recommendations. This gives the user the option to treat their symptoms themselves without spending money on doctor appointments. When the exercises are assigned, the users are also given a certain amount of time to complete the exercises. At the end of that time period the app sends them a notification asking them if the exercises were successful. If they respond, "The symptoms are still there", then the app asks them to make an appointment with an optometrist through the app itself. These exercises can range from palming, eye roles, 20-20-20 rule etc. Additionally, the team also hopes to include a system to provide the user with a list of possible vision disorders for their symptoms.

C. Optometrist Appointment

Patients can schedule appointments for channeling using this system. It is implemented solely on the patient's side. To begin, when the patient makes an appointment, they may enter their information. They have the option of selecting between an Optometrist, Optician, or an Ophthalmologist. (Technicians who fit eyeglasses, contacts, and other vision-correcting equipment are known as opticians. Patients' eyes are examined, diagnosed, and treated by optometrists. Ophthalmologists are eye doctors who treat problems of the eyes using both medicine and surgery [9]). Also using this system admins can manage (add new, alter, and remove) and generate information regarding the optometrists if the need ever arises.

D. Vision products

The purpose of this section is to provide user-friendly service for the customers. All the vision products are listed under the different categories. Product listing enables customers to discover the products online according to their desirable specifications. This system allows patients to get in contact with optician shops which manufacture spectacles to have their spectacles made. They can send their prescriptions directly to the shop and get them made. After completion they can also have them delivered. Customers also have the option to pick and choose from a wide array of spectacle frames and have the customers' glasses made. If the desired frame isn't available at a nearby location, the customers can have them delivered from its current location to somewhere nearby.

System admin handles the categories of the system. Customers can find the products by searching and browsing the relevant categories. After login to the system, admin can add products. Whenever admin clicks 'add product button' system redirects to the 'add product page'. Then admin needs gather all the information that need to add to the description. Then admin can add those gathered information and relevant photos of the products to the site. After admin add details of the product according to the suitable field. Before clicking the submit button admin re-check all the details of the product that entered to the fields. Finally, the system redirects to the dashboard. Also, admin can update the categories according to the new products and can generate reports about the products.

2. Literature review

Vision problems affect people of all ages globally, with modern technological devices being a primary cause. Early detection is crucial to prevent complications related to vision. The history of vision testing dates back to ancient civilizations, evolving into computer-based testing and innovative telemedicine solutions.

Introduced in 2009, "The Eye Handbook" stands as the industry's pioneer mobile app for eye care, utilized by eye care specialists on a daily basis [12]. Other computer-based systems, such as Optoplus (established in 1991) [13] and Personal Eyes (formed in 2014) [14], contribute to identifying vision problems. However, Personal Eyes primarily focuses on optometrist appointments and information provision rather than online vision tests [14].

Several studies in literature explore vision-based mobile applications. The following three studies attempt to support this hypothesis:

- Vision Guard [1] simplifies the identification of vision issues for users, providing information on causes, remedies, and eye exercises with minimal effort. This app, endorsed by ophthalmologists, demonstrates a high level of accuracy in detecting vision problems.
- Eye Plus [11] facilitates self-administered eye tests, focusing on conditions such as cataracts and conjunctivitis. Achieving an 83.3% success rate, it effectively tackles the scarcity of medical resources in rural areas, underscoring the role of technology in elevating awareness of eye health and providing accessible diagnoses.
- Vision Problem Tester [15] is a mobile application that targets visual impairments through precise detection, symptom assessment, locating professionals, and incorporating activities for children. This app comes highly recommended by ophthalmologists.

In addition, there are notable mobile applications in the market, such as:

- EyeXam [10] is a well-known and free mobile application within the eye care sector. It assists users in preserving eye health and achieving optimal vision through engaging, user-friendly, and patented self-guided eye tests. Furthermore, it facilitates seamless connections with users' eye doctors, boasting a database of nearly 30,000 eye doctors' offices, including those of renowned Vision Source optometrists. The app enables users to locate a nearby eye doctor using the GPS-based doctor finder, schedule eye exams, and exchange messages with their doctor's office effortlessly.
- Seeing AI [16] is an application specifically crafted for individuals with visual impairments. It employs computer vision to narrate the surrounding environment for users, encompassing tasks such as reading text, identifying individuals, and recognizing different currencies.
- EyeQ [17] is a vision-based application that empowers users to assess their eye health at their convenience. It enables users to furnish their eye doctors with statistics and updates on their eye health progress when they decide to schedule their next visit.
- MaculaTester [18] is an application that guarantees users remain vigilant about their vision care. It enables users to establish daily or weekly reminders for their eye tests, ensuring they never overlook the importance of maintaining their visual health.
- Peek Acuity [19] is a vision check application designed by eye experts, enabling individuals to assess visual acuity using solely an Android smartphone. This app serves as a screening tool to identify individuals who may require additional examination. It's important to note that Peek Acuity is not designed to substitute comprehensive examinations conducted by qualified eye health professionals.

3. Methodology

A. Technology

This application has been developed with the use of MERN technology.

1) Nodejs with Express JS

Inside this application, Nodejs has used to communicate with the database and query the database and to do the CRUD operations. Nodejs was utilized in this application due to its fast delivery, scalability, cross-platform support, community support, and ease of adoption.

2) MongoDB

MongoDB was used because of its cloud-based developer data platform, flexible document schemas, change-friendly design.

3) ReactJS

React was chosen as it has a Simplified Scripting, a Component-based architecture.

B. Proposed system

1) Home pages

Main user home page is shown in Fig. 6 and vision test home page is shown in Fig.7,

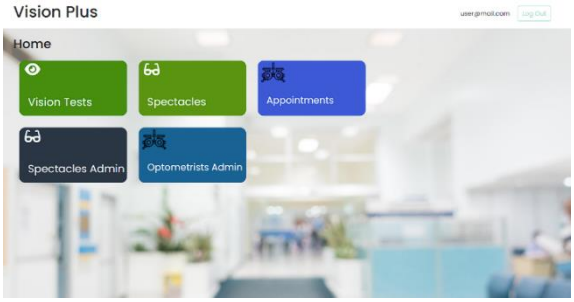

Fig. 6 : Main Home Page

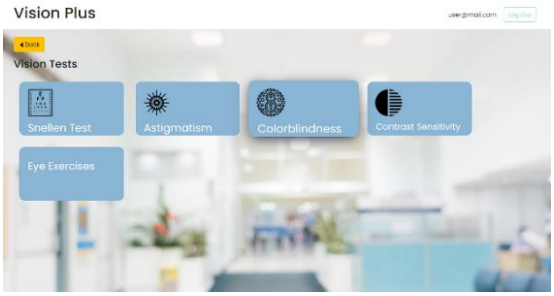

Fig. 7 : Vision Test Home Page

2) Vision tests

a) Distance vision test

The system for the distance vision test is shown below. When a user begins the test, a set of instructions, as shown in Fig. 8, can be seen, and to get their results (refer Fig. 10) they must select the last line they were able to read (refer Fig. 9).

Fig. 8 : Distance vision test instructions

Fig. 9 : Distance vision test results 1

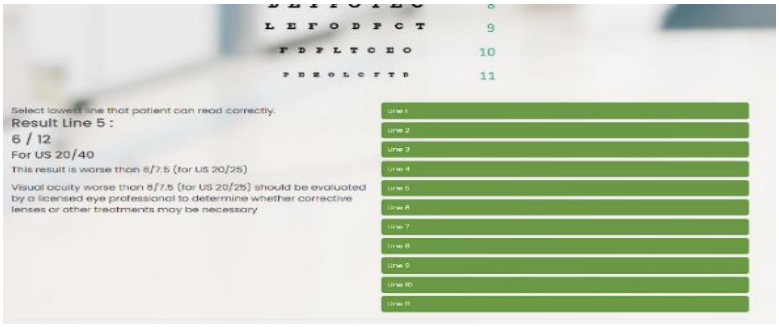

Fig. 10 : Distance Vision test result 2

b) Astigmatism test

The system for the astigmatism test is shown below. When a user begins the test, a set of instructions, as shown in Fig. 11, can be seen. To get their results, as shown in Fig. 12, Fig. 13, Fig. 14, they must select with which eyes they see lines appearing more grey.

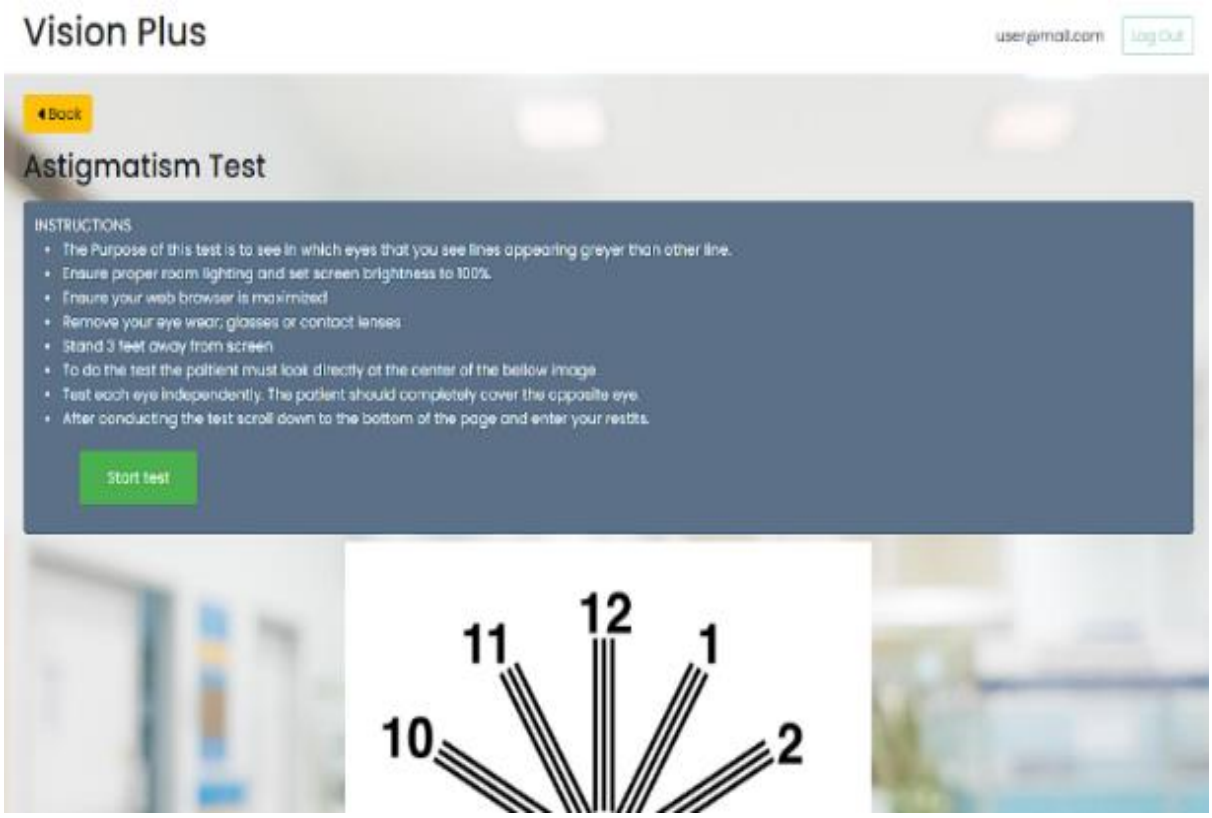

Fig. 11 : Astigmatism test instruction

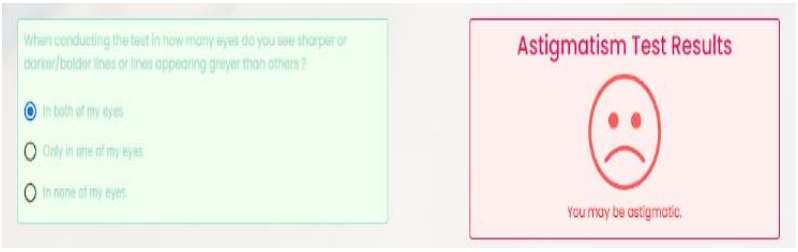

Fig. 12 : Astigmatism test results 1

Fig. 13 : Astigmatism test results 2

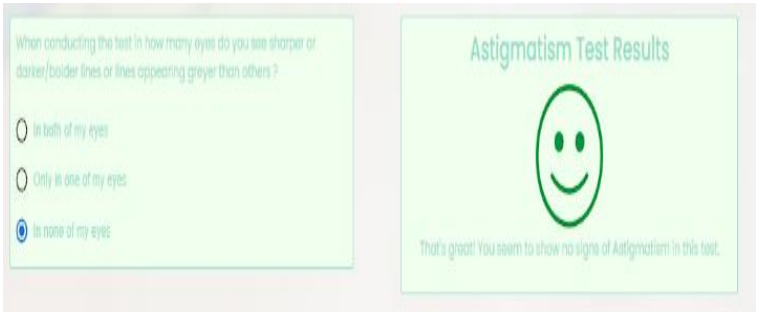

Fig. 14 : Astigmatism test results 3

c) Color blindness test

The system for the colour blindness test is shown below. When a user begins the test a set of instructions (refer Fig. 15) are shown. The user must enter the number they see and when they enter in their answers their result will be shown similar to Fig. 15, Fig. 16 and Fig. 17.

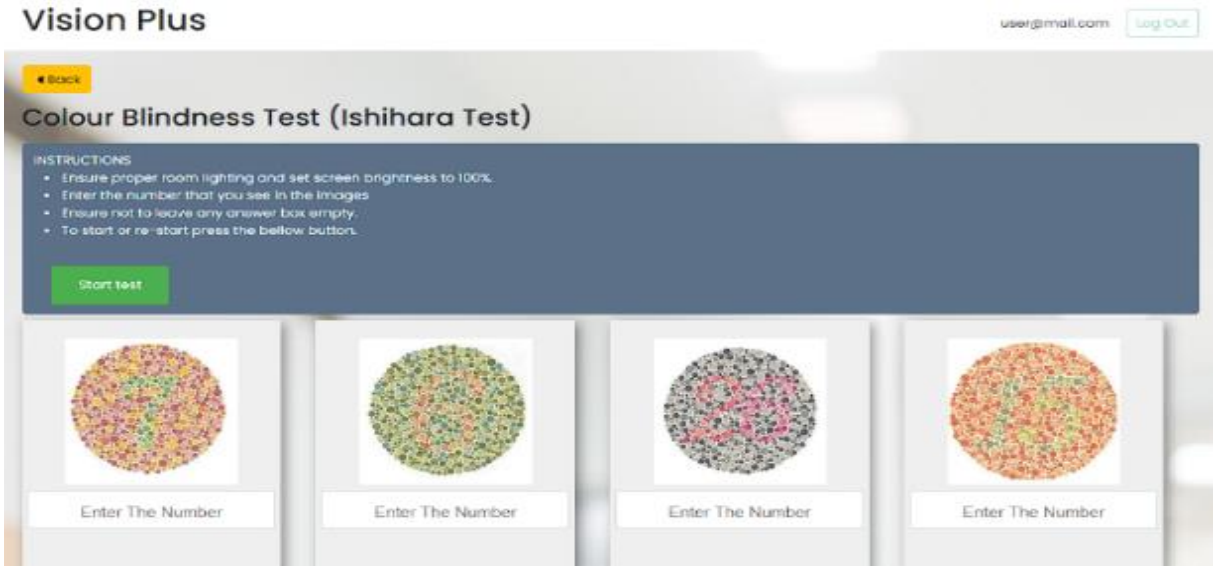

Fig. 15 : Colour blindness test

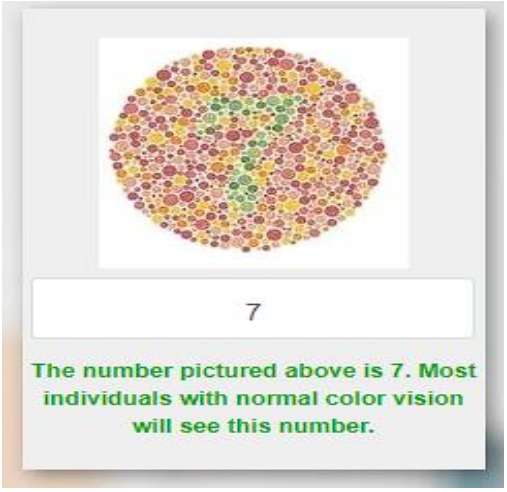

Fig. 16 : Colour blindness positive result

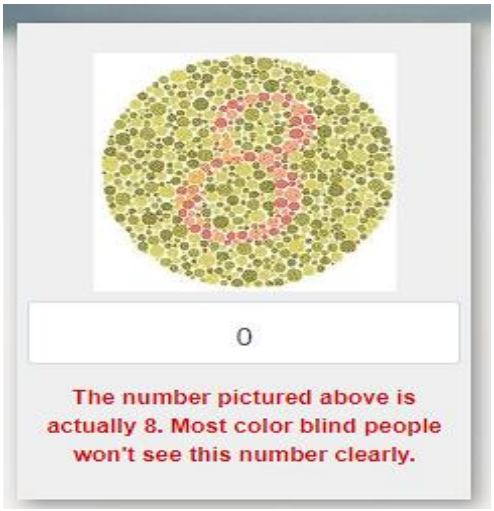

Fig. 17 : Colour blindness negative result

3) Eye exercices

The system for the eye exercises test is shown below. When a user enters their eye symptoms to the form shown in Fig. 18, Fig 19, they will get a list of eye exercises to perform similar to Fig. 20.

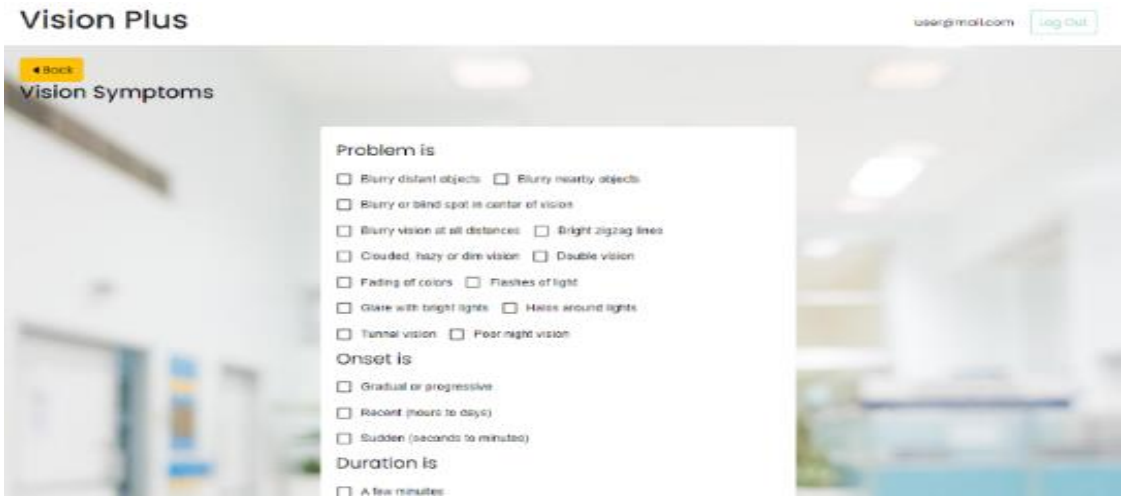

Fig. 18 : Eye symptoms test form part 1

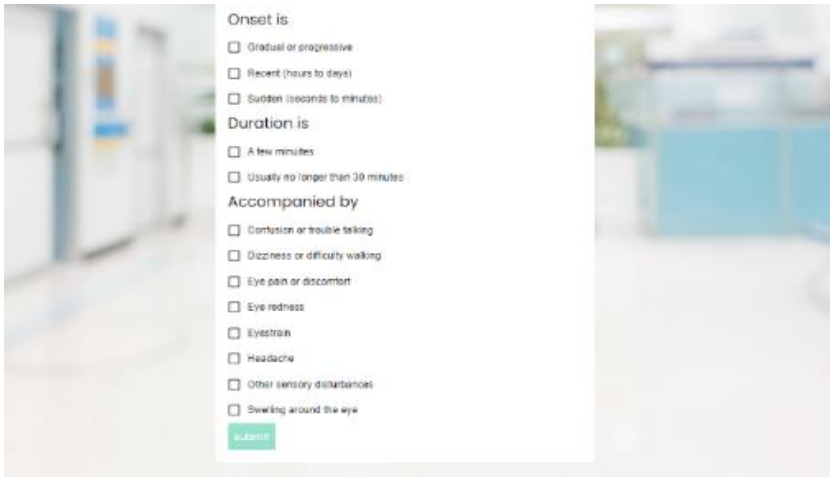

Fig. 19 : Eye symptoms test form part 2

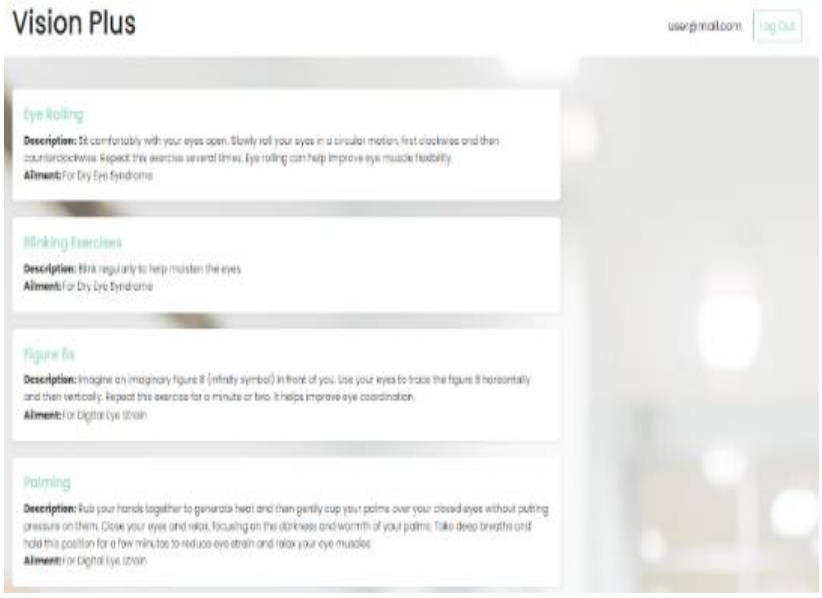

Fig. 20 : Eye symptoms test results

4) Vision products

The system for the vision products is shown below. With this system admin can manage information about vision products as shown in Fig. 21 and Fig.22.

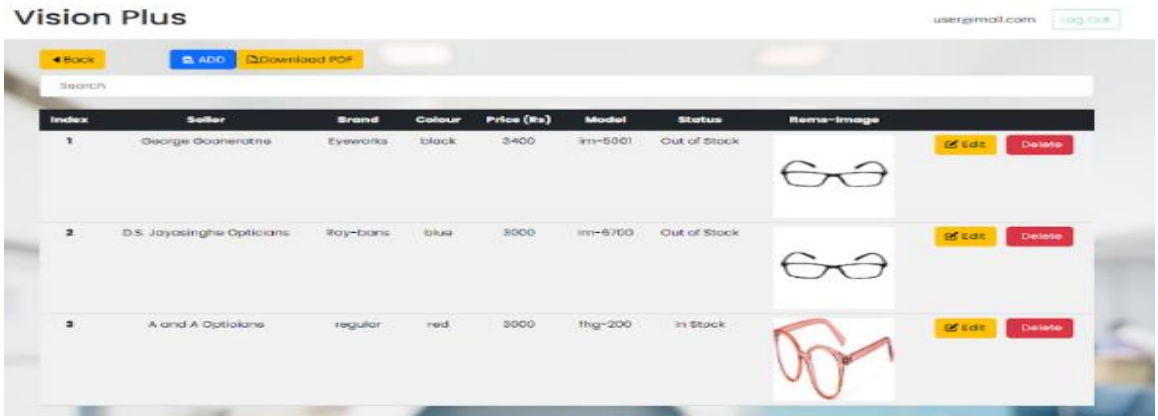

Fig. 21 : Eye frames list

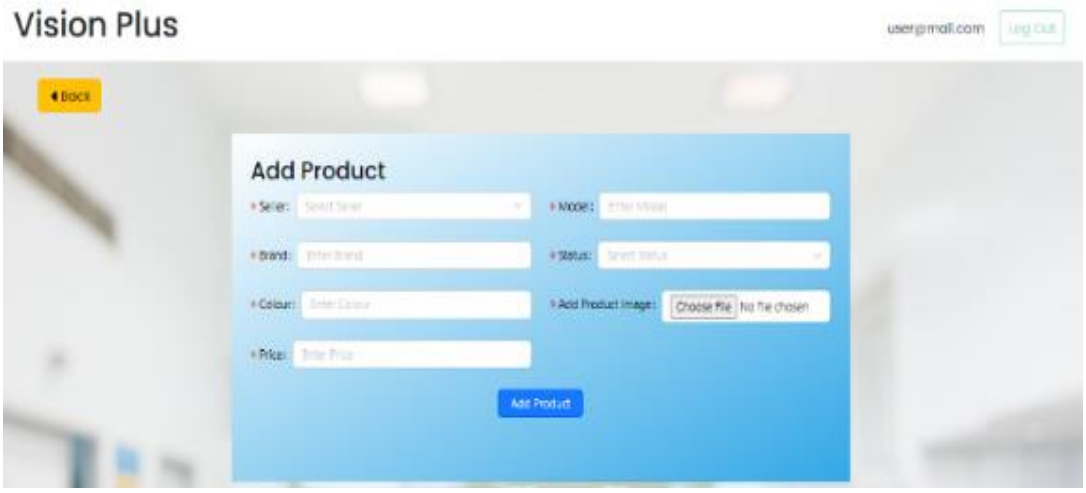

Fig. 22 : Add new frame.

5) Optometrist Appointment

The system facilitates patients' access to eye doctors based on their specific specialties. Patients seeking specialized eye care can effortlessly locate relevant practitioners within the system, improving their overall healthcare experience as shown in Fig. 23.

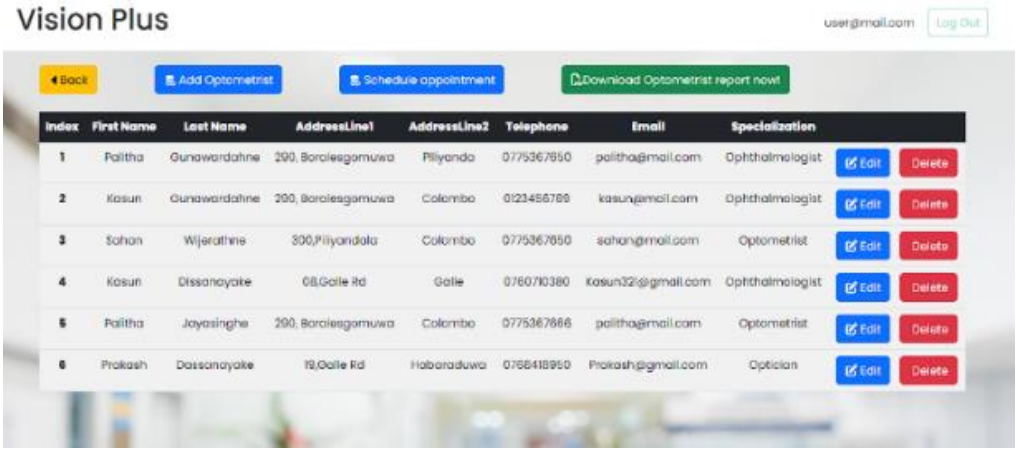

Fig. 23 : Optometrist List

Patients benefit from real-time visibility into their scheduled appointments. Detailed information about appointments, including patient name, age, relevant doctor, and date is readily available. This feature as shown in Fig. 24 promotes patient engagement and ensures appointments are never missed.

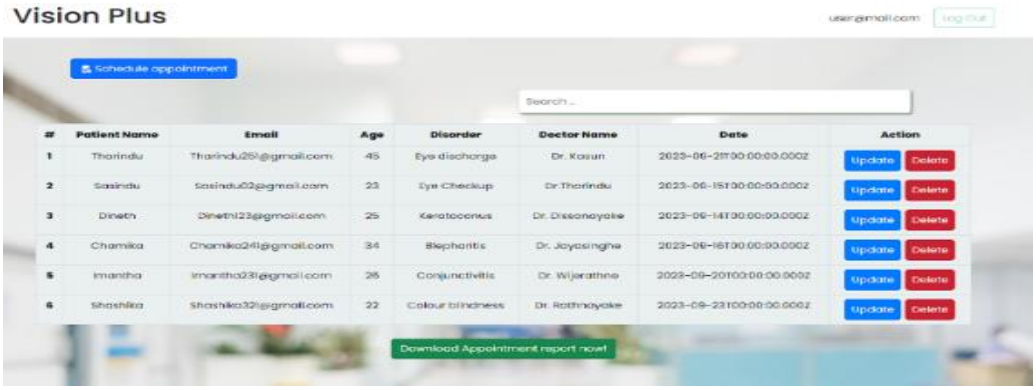

Fig. 24 : Appointment List

Patients can seamlessly schedule appointments with their preferred eye doctors using the system shown in Fig. 25. By selecting a doctor, choosing an available time slot, and specifying the purpose of their visit, patients can efficiently book appointments, fostering a user-friendly and efficient booking process.

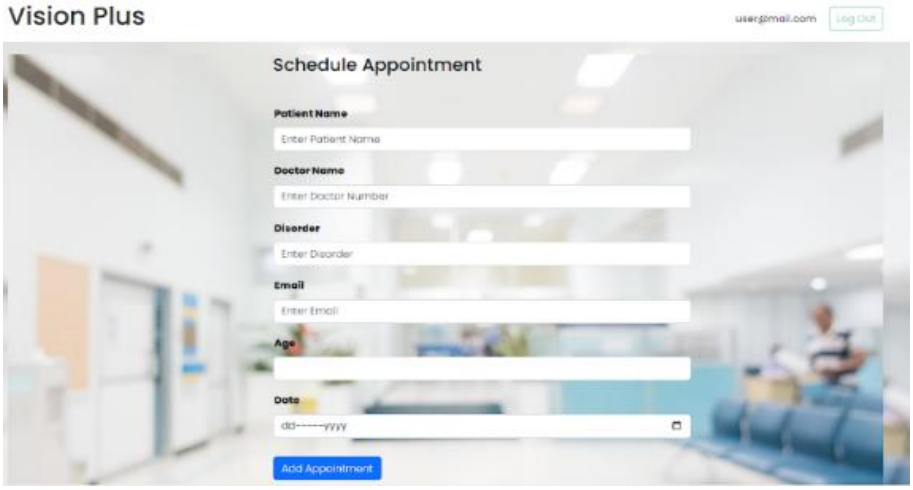

Fig. 25 : Schedule Appointment

Administrators wield the capability to incorporate new eye doctors into the system as shown in Fig. 26. When a new optometrist joins the practice or clinic, administrators can effortlessly input essential details such as the doctor's name, contact information, and specialty. This ensures that the system remains up to date with the latest healthcare providers, simplifying the patient's search for suitable specialists.

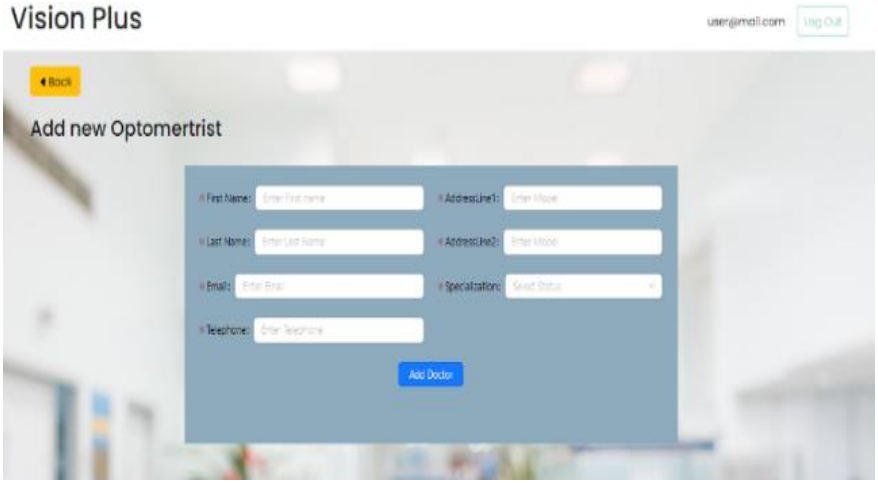

Fig. 26 : Add Optometrist to system.

4. Discussion

This vision care system is very helpful when identifying vision defects early. Identifying vision defects early allows customers to take necessary action to protect their eyes. In today's world vision defects are mainly caused due to the excess use of electronic devices such as mobile phones, laptops etc. The main problem is there is no specific way to understand early vision defects by user who hasn't any medical background. This system identifies the vision defects and has a short-term treatment system that suggests some eye exercises according to the relevant symptoms. With this user can reduce channeling fees that they would have spent on doctor visitations. This system includes complete computerization of all operations and automated maintenance of all records. Patients can get an appointment with a doctor using this app. They can pick out the optometrists who are located near them and book appointments with them from the comfort of the customer's home. This provides ease of access for users. If optometrist suggest glasses for the patient, they can choose the any frame design from all the shops in one

dashboard and they can reserve it using the system. The goal of this project is to provide a system for online database maintenance and truncation to manage a travel system.

5. Conclusion

In conclusion, the development and implementation of a vision care application is a step forward in promoting eye health and well-being among individuals of all ages. This report has outlined the aspects of the application, including its features, functionality, and potential impact.

Vision plus aims to address various needs, from basic eye health assessments to providing valuable information on common vision ailments and symptoms. It offers interactive tools and exercises that can help users maintain and improve their eye health.

The development team has been committed to developing an intuitive and user-friendly interface throughout the entire development process so that people from all backgrounds and levels of technological skill may make use of its features.

The vision care app also urges users to seek the advice of eye care specialists when necessary and acknowledges the value of routine eye exams. The provided tests are a useful addition to conventional eye care procedures but should not be used in place of expert medical advice or diagnosis.

The need for preventive eye care cannot be emphasized in today's digital age, where screen time is abundant and visual demands are high. The vision care application provides users with a practical and approachable platform to take control of their eye health, perfectly aligning with the growing awareness of the value of preserving healthy vision.

The features, content, and overall user experience of the program may all be improved with the help of user feedback. The expectation is that this vision care application will not only help specific users but will also add to the overall situation about eye health and the adoption of eye care techniques.

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