The Vision Problem Tester

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***Abstract*—With the advancement of the technology the life of humans has got enormously busy leaving them a very limited time to focus on their health especially related to the five senses. According to the facts of the World Health Organization, there are around 285 million visually impaired people around the world out of which 39 million are blind and 246 with low vision. 80% of those visual impairments have been identified has preventable or cured. Vision Problem Tester is a mobile application which was developed with the intension of helping people to accurately detect their vision problems from anywhere at any time absolutely free with a minimal amount of effort. It also provides interesting games for children below 8 years to identify their vison problems. In addition, it includes a Symptom Checker which identify the eye disorders of the users based on their symptoms. Furthermore, it allows users to find the nearest doctors and opticians based on their location. The proposed application was tested and recommended by several ophthalmologists. At present it has been tested with thirty odd eye patients with an impressive level of accuracy.**

Keywords—Mobile applications; hyperopia; astigmatism

I. INTRODUCTION

The mass usage of technology such as computers, laptops, tablets, mobile phones and televisions in work places and houses will work as a catalyst to invoke eye diseases significantly. Not only adults, even some infants and small children suffer from eye diseases due to various reasons. In both cases, the vision problems should be identified in their early stages in order to medically treat them. Otherwise, it may worsen the vision of the eye and eventually cause total blindness. However, with the busy life style of the modern general public, time has become a limiting factor for them to focus on the health of their eyes. In addition, due to the high cost that is involved with vision tests, some people try to skip periodic vision checkups. Lack of knowledge about vision related issues is another reason for these visual impairments of people. According to the facts of the World Health Organization, there are around 285 million visually impaired people around the world out of which 39 million are blind and 246 with low vision [1]. 80% of those visual impairments have been identified has preventable or cured.

Vision Problem Tester is a mobile application which was developed with the intension of helping people to accurately detect their vision problems from anywhere at any time absolutely free with a minimal amount of effort. It mainly focuses on identifying vision problems at their early stages. Any person can test his or her vision using this application without consulting a doctor. It also provides interesting games for children below 8 years to identify their vison problems. In addition, it includes a Symptom Checker which identify the eye disorders of the users based on their symptoms. Furthermore, it allows users to find the nearest doctors and opticians based on their location.

II. LITERATURE REVIEW

Out of the few applications that are available in the market, many of them incorporate limited useful features and provide inaccurate results. Also they only detect limited vision problems. The following four literature reviews attempt to demonstrate and support this hypothesis.

ICARE Vision Test [5] is one of the main vision applications available in the market. It provides vision tests and information regarding very few limited vision problems. Even though this application provides six vision tests, the user friendliness of ICARE Vision Test is very low. In this application also the main issue is the lack of features such as eye exercises. Also the target audience of this application is limited to adults only.

Another vision application that is available in the market is Healthy Vision [6]. In this application it provides three main features which are eye exercises, eye tests and questions and answers about limited vision problems. One of the main advantages of this application when compared with other existing applications is efficient eye exercises that can be used for both adults and children. But one main downside is that the eye tests provided by this application is largely inconsistent. It only provides images of impaired vision for each vision problem whereas if the user was suffering from a certain vision problem he/she will not be able to identify which vision problem they are suffering from using those images.

B2 Eye Test [7] is another popular vision application available in the market. It provides vision tests, a survey and a quiz. The main downside of this application is the user friendliness of considered vision tests and lack of features.

Another vision application revealed by the literature review is Vision Test [3]. It provides four main features which

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are eye tests, quiz, optician finder and eye advice. The main advantage of this application is that is has considerable amount of features apart from eye tests. But when consider about the availability of the eye tests it only provides tests for four vision problems. In optician finder it doesn't give accurate results. The main downside in this application is the lack of features and the targeted audience being limited to adults only. Therefore the amount of people who can benefit from this application is limited. Table I shows a comparison of the features between the existing applications and Vision Problem Tester.

III. METHODOLOGY

An object oriented methodology was used to develop the proposed system. The implementation was carried out using the Android Studio environment with java as the programming language. SQLite was used to build the local storage and MySql sever was used as the web storage. PHP language was used to connect Android application with the database server. An advantage of using this technology is the ability to develop this application compatible with android devices which are of version 2.2 (Froyo) and above.

Vision problem tester is able to detect eye problems such as Contrast Sensitivity, Strabismus, Visual Acuity, and, Depth Perception, at an early stage before they become critical. In addition to detecting eye problems, it also includes several other features as well. Following is a brief description about the methodologies of all the features of the proposed application.

A. *Contrast Sensitivity*

Contrast Sensitivity is a visual function which is used to identify objects separated from its background. For a person with poor contrast sensitivity it is difficult to identify objects clearly in situations like low light, fog or glare. When driving at night a driver should have contrast sensitivity for safety driving [9].

To test Contrast Sensitivity this application uses images with different contrast levels. Users has to provide feedback based on the images provided by the application.

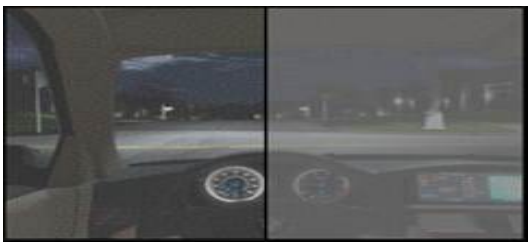

Fig. 1. Normal vision and poor contrast sensitivity vision

B. *Color Blindness*

Color Vision Deficiency is a genetic condition which makes it difficult for a person to identify a range of colors certain in the color spectrum [2]. This ailment is genetically inherited among people in the society.

The proposed application uses Ishihara test plates to detect whether the user suffer from Color Vision Deficiency. Based on whether the user has identified the number on each plate accurately, the application determines the color vision deficiency status of the user. Color Vision Deficiency of children is detected using a game with color images of animals provided in the application. Based on how the child plays the game, the application provides the color vision deficiency status of the child.

Fig. 2. How people with different color deficiencies see certain colors

C. *Visual Acuity*

Visual acuity is a condition which specify how clear a person sees objects. It measures how well a person sees. The word "acuity" comes from the Latin acuitas, which means sharpness [8].

When testing for Visual Acuity in Vision Problem Tester it uses images of small letters. This test is similar to "Snellen chart" which is used as a standardized test in medical practice. Based on the feedback provided by the user after completing the test, the application determines whether the user is having a Visual Acuity condition.

Fig. 3. Visual Acuity

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TABLE 1. COMPARISON OF THE FEATURES BETWEEN THE EXISTING APPLICATIONS AND VISION PROBLEM TESTER

Features \ Apps	Vision Problem Tester	Healthy Vision	Central Vision	ICare	Vision Test	Vision Check Up	B2 Eye Test
Tests for Hyperopia	✓			✓	✓	✓	✓
Tests for Astigmatism	✓			✓	✓		
Tests for Color Blindness	✓			✓	✓	✓	✓
Tests for Depth Perception	✓						
Tests for Macular Degeneration	✓	✓	✓	✓			✓
Tests for Contrast Sensitivity	✓	✓		✓			
Tests for Strabismus	✓						
Kids games for Contrast Sensitivity	✓						
Kids training game for Strabismus	✓						
Symptom Checker	✓						
Nearest doctor and optician finder	✓				✓		
Quiz related to the health of the eye	✓						✓

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D. *Poor Depth Perception*

Poor Depth Perception is the inability to determine distances between objects and see the world in three dimensions[4]. Lack of stereopsis is the cause of poor depth perception. At present poor depth perception is recognized as a frequent vision problem among people, which is highly disturbing a person's life.

To detect poor depth perception of a person, the application provides a simple yet an accurate test. First the user has provided with a set of activities to perform and answer the questions prompt by the application. Secondly, the application displays a set of three dimensional images which has to be observed using red-green or red-cyan stereo glasses. Then the user has to provide a feedback on observations to the application. Finally, based on the feedback provided by the user, the application determines whether the user has poor depth perception condition.

Fig. 4. Depth Perception

In addition to detecting vision problems Vision Problem Tester also includes:

A. *Nearest doctor and opticiam finder*

This application provides users with the facility to find nearest opticians and doctors based on user's exact location. The user's current location is tracked and acquired by using GPS. Then, based on the acquired location, the system will display nearest hospitals and opticians to the user. If the user selects a hospital from the generated list it will display the available Ophthalmologists and Orthoptists available in the selected hospital with their consulting dates and times.

B. *Symprom Checker*

Symptom checker provided by Vision Problem Tester is a tool to identify eye disorders from symptoms. In Symptom checker user can provide symptoms of the eye disorder by selecting them. This also provides the facility to update symptoms added by the user. Once the user confirms the symptoms, application will provide a list of possible eye disorders user might have along with symptoms of each eye disorder. From the list provided user can select an eye disorder by observing the symptoms. Once the user selects an eye disorder application will display the in detailed description of the selected eye disorder.

IV. RESULTS AND DISCUSSION

Vision Problem Tester is able to accurately detect four vision problems: Contrast Sensitivity, Strabismus, Visual Acuity, and Depth Perception. Using standard methodologies and technologies. It allows users to diagnose their vision problems at an early stage so that they can be treated quickly before becoming critical. It also provides attractive games for kids for easy detection of their vision problems.

In addition, Vision Problem Tester also provides the facility to find the most suitable doctor or optician nearby. It displays the names of the nearby specialized doctors relevant to a particular vision problem along with the location of the hospital or clinic.

The Symptom Checker provides a list of symptoms to be selected by the user and the application provides the defect or eye disease with details user might be having according to the symptoms.

The proposed application is unable to detect myopia because it is not possible keep the phone in a larger distance in order to take the tests. Also it is unable to detect convergence insufficiency. In order to detect convergence insufficiency both the pupils of the user should be detected within a short distance of 6cm by the phone camera which is practically impossible.

The Vision Problem Tester has been tested and recommended by ophthalmologists. At present the application has been tested with 30 odd eye patients and has been able to detect the vision problems up to an impressive level with a higher accuracy.

V. CONCLUSION

The Mobile based vision testing applications are very useful to test users' vision regularly without having to commit time and money regularly for vision tests. This application provides many beneficial features such as vision tests for adults, vision games for kids, doctor and optician finder. Even though there are existing vision applications most of them fail to provide a beneficial application like the Vision Problem Tester. By using this application the user can stay updated with his/her vision status. For future work this mobile application can be implemented with additional vision tests which are not currently included.

REFERENCES

[1] Jugnoo S Rahi et al, "Visual Function in Working-Age Adults," American Academy of Ophthalmology 2009.

[2] California Department of Education, "A guide for vision testing in California public schools", Sacramento, California , USA (October 1978), 31-35.

[3] Hartman, E. Eugenie and others, "Preschool Vision Screening: Summary of a Task Force Report," Ophthalmology, vol. Vol. 108, no. 3 (March 2001), 479-86.

[4] M. O.D. Garin, " Understanding Your Depth Perception" eyehealthweb, [Online]. Available: http://www.eyehealthweb.com/depth-perception/

[5] R. Leonard, Statistics on Vision Impairment, 5th ed., Arlene R. Gordon Research Institute of Lighthouse International, 2002, pp. 11.

978-1-5090-0082-1

[6] Zeiss.com, 'Why good vision is so important | ZEISS International', 2015.[Online].Available:http://www.zeiss.com/vision-care/en_de/better-vision/understanding-vision/health-and-prevention/why-good-vision-is-so-important.html. [Accessed: 29-Jun- 2015].

[7] Rocktime Ltd, "Vision Test", 2015. [Online]. Available: https://itunes.apple.com/en/app/vision-test/id380288414?mt=8. [Accessed: 29- Jun- 2015].

[8] Wikipedia. 2015. Visual acuity - Wikipedia, the free encyclopedia. [ONLINE] Available at: https://en.wikipedia.org/wiki/Visual_acuity. [Accessed 22 July 15].

[9] AllAboutVision.com. 2014. Contrast Sensitivity Testing - AllAboutVision.com. [ONLINE] Available at: http://www.allaboutvision.com/eye-exam/contrast-sensitivity.htm. [Accessed 22 June 15].

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