VISUAL ACUITY CHECK

Ritika Barve
Department of Electronics Engineering *Datta Meghe College of Engineering Airoli, India.*

Poorva Bhide
Department of Electronics Engineering *Datta Meghe College of Engineering Airoli, India.*

Diksha Darekar
Department of Electronics Engineering *Datta Meghe College of Engineering Airoli, India.*

Prof. Shraddha Mithbavkar
Department of Electronics Engineering, *Datta Meghe College of Engineering Airoli, Thane, India*

Abstract – Visual Acuity check is the test initiated to examine patients' potential eyesight problems. After detection, it is then rectified under the guidance of a professional (ophthalmologist) with appropriate solutions. This test usually includes expensive instruments which make the setup bulky and immobile.

Due to the limited resources and high cost, people residing in remote areas do not prefer to undergo this test which makes them ignorant concerning their visual health. So, to turn their attention towards visual health and help them avail this test, we are trying to propose a set-up namely Visual Acuity Check with minimum instruments. The key components of this setup are a standard Snellen Chart, a system that uses a Speech-to-text converter, and a node MCU for remote automation. This system includes pre-defined standard formulae and conversions for diopter calculations. This test does not necessarily require any professional handling. Thus, this movable setup will offer high efficiency at a very low cost.

***Key Words*: Snellen chart, Node MCU Module, speech to text converter system.**

1. INTRODUCTION

Visual acuity measures the ability of a human to recognize the shapes and other particular details of objects. A visual acuity test is considered to be one part of a comprehensive eye examination. Different vision impairments are briefly determined. Two commonly used charts for testing are Snellen and random E charts. Results are determined depending upon the probability of correctness.

The project aims to develop an immobile, unexpensive system that monitors the parameters such as nearsightedness or far-sightedness of the patient precisely and resultant will define the current condition of the eyes. The leading causes of the eye could be age-related, or due to heavy diabetes, blood pressure, glaucoma, cataract, etc. These can be detected accurately using a visual acuity test.

The traditional methods used for correcting vision-based impairments tend to have many constraints, because of which it becomes a tedious task to carry out this test.

The traditional method’s constraints are as follows: Firstly, it needs favorable conditions such as sunlight or a particular level of brightness in a room to carry out the test specifically. Secondly the Necessity of a trained optometrist and specialized equipment. This makes it costly for a small rural area to have access to these. Also, there are Slight possibilities of Human errors and hence, there is a need for a semi-automatic system to reduce errors and increase precision.

2. RELATED STUDY

In "Design and Implementation of an Automatic Acuity Test Software". Hong-Qiang YU, Ting JIANG, and Chun-hui WANG have designed a test software and tried to implement it based on the characteristics of the tablet computer. In the software, distance detection i.e., the distance between the user and the tablet was calculated by using the front camera of the computer, and the optotypes of the Snellen chart were measured using the number of pixels and also considering the distance detected earlier and the tablet resolution which was being detected automatically by the test software.

The test software could represent optotypes i.e., the alphabets of the Snellen chart precisely and manage the appearance of the order effectively. The measurement span and correctness complied with the national standards and it was suitable to gain popularity.

In "Visual Acuity Test for Isolated Words using Speech Recognition" Saud Khan, and Khalil Ullah has designed an interactive method wherein the user utters a word from the listed- selected words and makes a guess according to his/her vision capabilities. The user's speech gets recorded and further undergoes two steps: extraction of salient attributes, speech vectors from the user's speech signal adequate to represent the application to compare the speech vectors.

The correct and wrong guesses made by the user are noted down parallelly based on each isolated optotype spoken by the user and then exhibit in the vision test results on the screen. Hence, the complete process is digitalized, the human errors are notably reduced and hence results are produced more faultless.

In "Design and Implementation of Text to Speech Conversion Using Raspberry Pi" Prof. K. LAKSHMI and Mr. T. CHANDRA SEKHAR RAO have proposed a creative, efficient, and real-time cost-efficient technique. It incorporates the theory of Optical Character Recognition (OCR) and Text to Speech Synthesizer (TSS) using Raspberry pi v2. This kind of technique was specially built for visually impaired people to be able to interact with computers constructively through a speech interface.

Here, in computer vision, the challenging task is to extract texts from colored images. The system which is used for Text-to-Speech scans and also reads everything ranging from alphabets to numeric that is specified in the image using a technique named OCR, it also helps for converting texts to speech. The built-in device works on two modules

1. Image Processing Module.
2. Voice Processing Module.

The various tools used are Google Speech Recognition, Microsoft translator API, Google Text-to-Speech, and Universal translator with the help of the translation technologies the user can convert the text to the desired speech language, and then again by using the Google Speech Recognition tool the user can convert that changed text into speech. By this, visually impaired ones can be independent too. Also, it is less in cost as compared to other techniques.

In "Design and Implementation of Speech to Text Conversion on Raspberry Pi" A. Pardha Saradhi, A. Sai Kiran, A. Dileep Kumar, B. Srinivas, M. V. Nageswara Rao have proposed executing an immobile speech to text converted system design on a controller i.e., raspberry pi using neural networks and export of the predicted text to a remote receiver via an application layer protocol i.e., simple mail transfer protocol. Concepts such as max-pooling and batch normalization are used to further amend the model and boost its perfection. They have imported the trained dataset model to a controller. Here the controller used is raspberry pi. The use of such kinds of neural network models is restricted to the labels specified in the dataset.

They have made use of Mel Frequency Cepstral Co-Efficient. It means that the voice signal to be processed is segmented into various overlapping frames and the power spectral density for each frame is calculated. The steps to carry out the Mel Frequency Cepstral Co-Efficient are pre-processing, DFT and PSD, Mel filter banks, Log [], DCT, and MFCC.

3. PROPOSED METHODOLOGY

The proposed visual acuity check system works in two parts, first to gather speech data from the user. Further, a Python-based program runs to receive, process, compare and calculate the result based on a set of predefined inputs and the new gathered speech. This paper highlights the aim to recognize the vision impairments of patients efficiently without any professional assistance and specialized bulky equipment.

The system presented utilizes various blocks as in component board (Relay Module), Snellen chart, Node-MCU, to successfully fulfill the activities. The proposed scheme depending on speech to text converter model helps in taking the visitor's or user's voice as input and converting it to text using Google speech-to-text converter, giving a hassle-free and faultless result. The visitor is sited at 20 feet distance from the Snellen chart i.e., the display unit. The speech would be taken as an input using a Bluetooth microphone, and the system would do the calculations and give out the expected accurate result. We have some whip hand here, quick and accurate responses, and the professional help is also reduced, reduction in the bulky equipment's making it more cost-efficient.

A. Block Diagram and Working

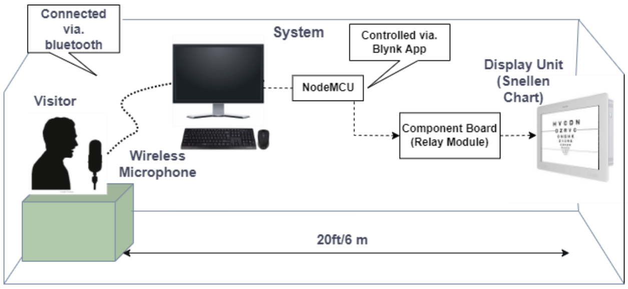

Figure 1. Block

Block diagram of Visual acuity check system using NodeMCU. The working is broadly divided into two steps: Manual and Automatic. Manual steps include:

Setting up the system. Instructing the visitor regarding the whole process. A microphone will be given to the visitor. Connecting the microphone with the system. Remotely controlling the LEDs via NodeMCU.

Automatic steps include: Remotely automated LEDs will indicate the line to be read. The microphone will take the visitor's voice as input and pass it on to the system. Then, using Speech to text conversion algorithm, the voice will be converted to text format. This text will be compared to the standard text stored in the system. Depending on the correctness of the compared text, we will calculate the probability using the formula: -

Log MAR = - Log (Decimal Acuity)

Decimal Acuity = antilog (- Log MAR).

Display the Final Result on the system.

B. Flow Chart

Figure 2 illustrates the flow chart of the proposed system, which focus on three main points:

- Visitor's position concerning the Snellen chart
- Correctness of the Speech Detection
- Result in terms of probability

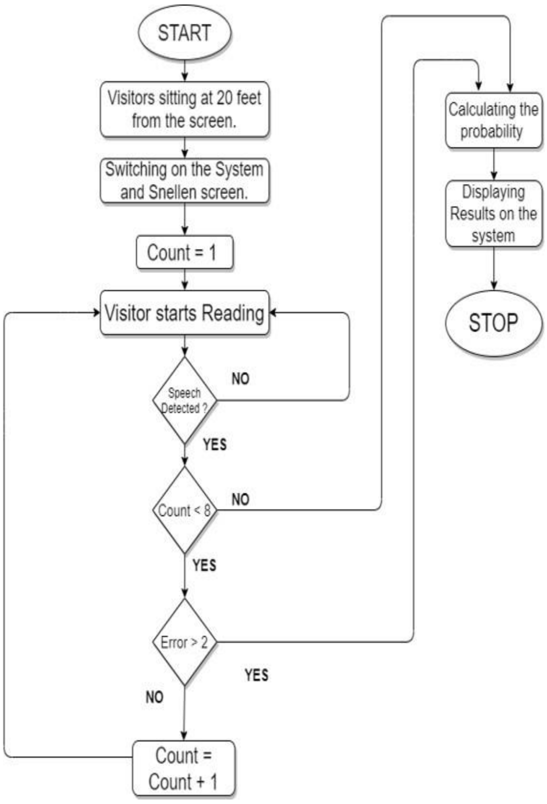

Figure 2. Flow Chart

1) Initially the visitor will be instructed to sit at a distance of 20 feet from the Snellen chart.

2) Then the visitor will be asked to read the Snellen chart.

3) Once he/she starts reading, the system will convert their speech to text format. If the speech is correctly detected, it will check which line the visitor has correctly read.

4) If the speech is not detected correctly, the visitor will be asked to read the chart again.

5) Maximum 2 errors are allowed in each line (Rule implies from line number 3).

6) If the visitor exceeds this limit, the system will come out of the loop and calculate the probability.

7) The result will be displayed on the screen.

C. Node MCU:

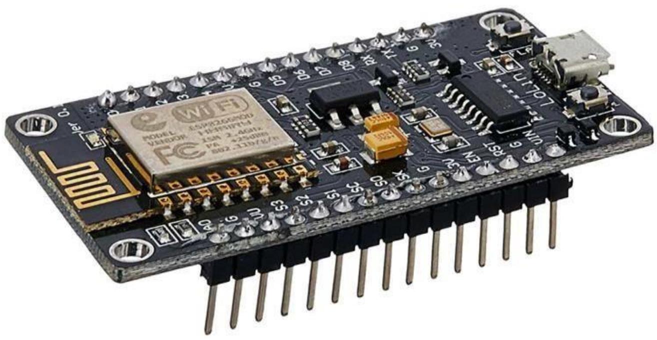

Figure 3. ESP8266(Node MCU)

The NodeMCU ESP8266 development board comes with the ESP 12E module containing the ESP8266chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor.

This microprocessor supports RTOS and operates at80MJz an adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built WI-FI/Bluetooth and Deep Sleep Operating features make it better for IoT projects.

D. Blynk IoT platform

Blynk IoT platform is an IoT framework designed for Android smartphones or iOS that helps in controlling different microprocessors and microcontrollers like Arduino, NodeMCU, and Raspberrypi via the internet. This application is designed for supporting the Internet of Things. It is used for creating a graphical interface or human-machine interface by compiling and providing the appropriate address of the available system. This platform consists of three major components namely Blynk App, Blynk server, and Blynk Libraries.

1) *<u>Blynk App:</u>* This feature provides various widgets using which the user can create amazing interfaces for their projects.

2) *<u>Blynk server</u>:* This feature provides the communication required between the hardware device and the smartphone. Blynk server is open-source and supports Blynk cloud as well as Blynk local server using which the publisher can publish their data on the cloud as well as on the local server.

3)*<u>Blynk Libraries</u>*: This feature enables the communication between hardware platforms and the server and helps in processing incoming and outcoming commands. With a single click on the Blynk Interface, the data is uploaded to the server and the application is automated.

E. Python

Python is an object-oriented, easy-to-learn, and high-level programming language with dynamic semantics. This language uses an easy syntax which makes it an interpreted language. Python has many different libraries which help the user to gain productive results. Python is a user-friendly language, that helps in debugging the code quickly with few commands. It plays a very important role in Artificial Intelligence and Machine learning.

4. RESULT ANALYSIS

The software GUI was created using Python language. Below are steps to perform the Visual Acuity Test on the system:

A. *VISUAL ACUITY TEST –*

1. Read the Snellen's Chart line-wise from the top by clicking on the "Speak!" button each time.

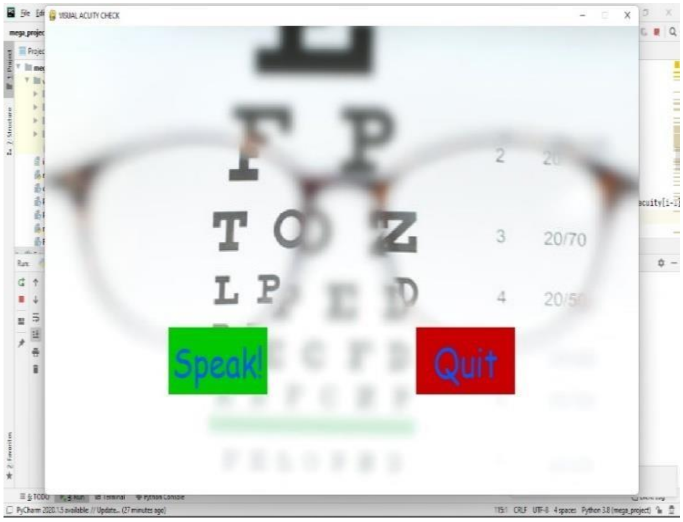

Figure 4. Start screen of visual acuity

2. Output will be displayed on the terminal of the current line read. The methodology behind this output is when the line crosses the value of errors allowed it will come out of the loop and the final result will be calculated. The result will be appended to the concatenated dataset (Fig. 5)

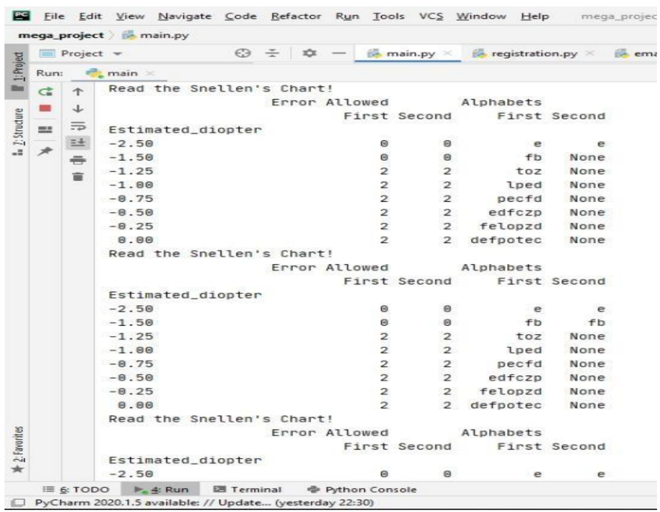

Figure 5. Results of line 1 and line 2

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 04 | April - 2022 Impact Factor: 7.185 ISSN: 2582-3930

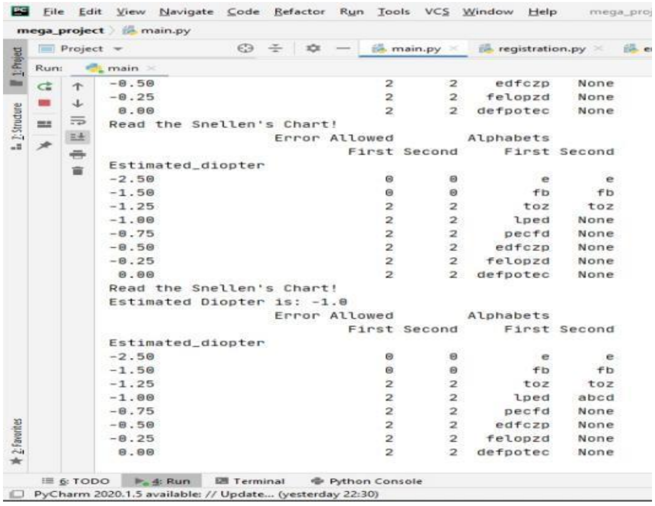

Figure 6. Results of line 3 and line 4

1st,2nd, and 3rd lines are correctly read so the process continues but in the 4th line, the error is greater than allowed errors. The result is been calculated as Estimated Diopter (Fig. 6)

3. The final result will also be displayed on the system. (Fig. 7)

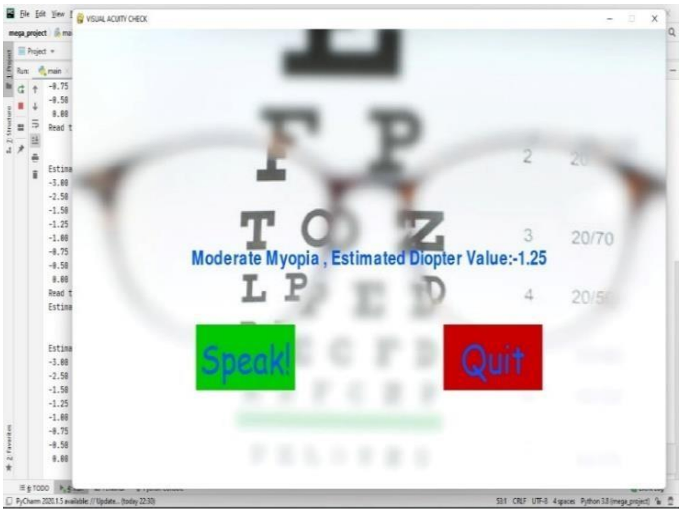

Figure 7. Visual Acuity Screen

B. REGISTRATION AND DATA MANAGEMENT–

Figure 8. Registration Form

1. Once all the filled information is validated and successfully registered. A PDF file is generated which is then sent via E-mail (Fig. 9)

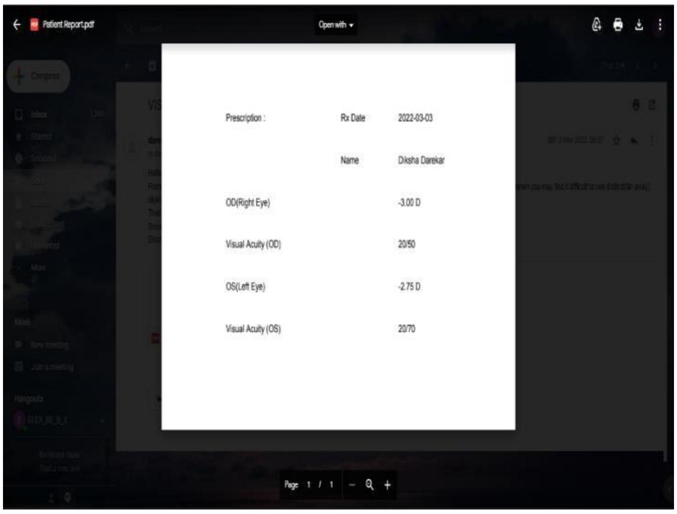

Figure 9. PDF of Visual Acuity Test

2. This result can be further used for reference.

5. CONCLUSION

A system for conveniently and portably testing Visual functionalities even in a constrained environment and remote areas is designed and implemented. The proposed system can compare the user input to standard Snellen's Chart and depending upon the correctness the result is calculated. The system could present the estimated diopter and accordingly predict the behavior of myopia.

6. ACKNOWLEDGMENT

I would like to express my deep gratitude to Professor Shraddha Mithbavkar, my research supervisor, for their valuable intelligence, enthusiastic encouragement, and useful evaluation of this research work.

Finally, I wish to thank my parents for their support and motivation throughout my study.

7. REFERENCES

1. Yeun Lok Lin, Ngai-Fong Law, and Chi-wai Do†," PORTABLE VISION SCREENINGS SYSTEM", Dept of Electronic and Information Engineering, The Hong Kong Polytechnic University (IEEE Publication), December 2017.
2. Prof. Jack T. Holladay, "PROPER METHOD FOR CALCULATING AVERAGE VISUAL ACUITY", Special Article - Holladay Publication, Journal of Refractive Surgery - Volume 13, July/August 1997.
3. Prof. Hong-Qiang YU, Ting JIANG, Chun-hui WANG," DESIGN AND IMPLEMENTATION OF AN AUTOMATIC VISUAL ACUITY TEST SOFTWARE". Institute of Electrical and Electronics Engineers (IEEE Publication),2016.
4. Prof. A. Pardha Saradhi, A. Sai Kiran, A. Dileep Kumar, B. Srinivas, M. V. Nageswara Rao," DESIGN AND IMPLEMENTATION OF SPEECH TO TEXT CONVERSION ON RASPBERRY PI". International Journal of Innovative Technology and Exploring Engineering (IJITEE), April 2019.
5. Prof. Saud Khan, Khalil Ulla," VISUAL ACUITY TEST FOR ISOLATED WORDS USING SPEECH RECOGNITION". 2017 International Conference on Innovations in Electrical Engineering and Computational Technologies (ICIEECT).