

Analysis of Women Computer users affected by a Computer Vision Syndrome (CVS) using CETD Matrix

A. Victor Devadoss, M. Clement Joe Anand

Abstract— The objective of this paper is to find out the peak age of women computer users affected by a computer vision syndrome (CVS). For this analysis we studied the most common symptoms associated with Computer Vision Syndrome. It has been classified into five factors as Eyestrain, Headaches, Blurred Vision, Dry Eyes, Neck and Shoulder pain. These symptoms are caused by the following factors such as poor lighting, glare on the computer screen, improper viewing distances, poor seating posture, uncorrected vision problems and a combination of all these factors. For the first time, in the year 1998 matrix theory was developed by W.B.Vasantha and V.Indira to study the passenger transportation problem. To study this problem, they divided and defined four types of matrices which are called Initial Raw Data Matrix, Average Time Dependent Data matrix (ATD Matrix), Refined Time Dependent Data matrix (RTD Matrix) and Combined Effect Time Dependent Data Matrix (CETD Matrix). In the year 2003 the same technique was used by W.B. Vasantha to study the migrant labourers who were affected by HIV/AIDS. In 2004 W.B. Vasantha and A. Victor Devadoss used it to study about agriculture labourers. In the year 2012, A. Victor Devadoss and M. Clement Joe Anand used it to study the dimensions of personality of women in Chennai. Now we use this model to study Computer Vision Syndrome (CVS) of women computer users in Chennai.

Index Terms—Average Time Dependent Matrix, Refined Time Dependent Matrix, Combined Effective Time Dependent Data Matrix, Computer Vision Syndrome, Women,.

1 INTRODUCTION

This paper has four sections. In the first section we just recall the methods of applications of CETD matrix. In section two we describe about the computer vision syndrome. In section three we apply the factors of computer vision symptoms (CVS) using CETD model and find out the peak age of group of women computer users affected by CVS. In final section we derive conclusions and give suggestions based on our study

1.1 The method of application of CETD Matrix

We give a very simple but very effective technique on the collected data. From that data we recognized the computer vision syndrome affected to women, based on the words five attributes are chosen and the entries are recorded in a form of matrix by taking ages along the columns and the disease along the rows.

1.1.1 Average Time Dependent (ATD) Matrix

Raw data transformed into a raw time dependent data matrix by taking the age group along the rows and most common symptoms along the columns using the raw data matrix we make it into the Average Time Dependent Data (ATD) matrix (a_{ij}) by dividing each entry of the raw data matrix by the number of years i.e., the time period. This matrix represents a data, which is totally uniform. At the third stage we find the

average and Standard Deviation (S.D) of every column in the ATD matrix.

1.1.2 Refined Time Dependent (RTD) Matrix

Using the average μ_j of each j^{th} column and σ_j the S.D of the each j^{th} column we chose a parameter α from the interval $[0,1]$ and the Refined time dependent Matrix (RTD matrix),

Using the formula

$$a_{ij} \leq (\mu_j - \alpha^* \sigma_j) \text{ then } e_{ij} = -1 \text{ else} \\ \text{if } a_{ij} \in (\mu_j - \alpha^* \sigma_j, \mu_j + \alpha^* \sigma_j) \text{ then } e_{ij} = 0 \text{ else} \\ \text{if } a_{ij} \geq (\mu_j + \alpha^* \sigma_j) \text{ then } e_{ij} = 1$$

We redefine the ATD matrix into the Refined time dependent fuzzy matrix for here the entries are -1, 0 or 1. Now the row sum of this matrix gives the maximum age group.

1.1.3 Combined Effective Time Dependent Data (CETD) Matrix

We also combined the above RTD matrices by varying the $\alpha \in [0, 1]$, so that we get the Combined Effective Time Dependent Data (CETD) matrix. The row sum is obtained for CETD matrix and conclusions are derived based on the row sums. All these are represented by graphs and graphs play a vital role in exhibiting the data by the simplest means, which can be even understood by a layman.

2 COMPUTER VISION SYNDROME (CVS)

Computer Vision Syndrome (CVS) is the number one occupational hazard of the 21st century. CVS symptoms may affect as many as 70 percent of all computer users. Visual effort is greater when looking at the computer screen as compared to that when looking at a paper.

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This can be attributed to the fact that blinking of eyes is 22 times per minute when looking at a paper which reduced to 7 blinks per minute while looking at a computer screen. This leads to dry eyes. Thus when using a computer, the eyes strain as they attempt to maintain focus, or may be incapable of obtaining focus at all. CVS is marked by eyestrain, tired and burning eyes, headaches, blurred vision, neck and back pain and muscle spasms. Computer work has not yet proven to cause permanent damage to eyes, but temporary discomfort that may occur can reduce productivity. It can cause lost work time and reduce job satisfaction. The performance on a specific task can be significantly decreased due to CVS, as much as 40 percent. This includes a reduction in work accuracy and a decrease in task volume. Working at a computer is more visually demanding than doing other standard office work such as reading printed documents. Aspects of the design of the computer video display such as screen resolution and contrast, image refresh rates and flicker and screen glare, as well as working distances and angles all may contribute to worker symptoms [8]. Employees using VDUs large part of their working days frequently report their eyesight is quite badly affected at work and for some time afterwards. Daum stringly suggests that improving the visual status of workers using computers results in greater productivity in the workplace, as well as improved visual comfort [13]. The visual symptoms can largely be resolved with proper management of the environment and providing proper visual care for the employees [12]. The symptoms of CVS-headaches and eyestrain- can force employees to shut down. Even the symptoms are negligible; they can affect performance and productivity in a big way. Companies can choose to understand and address the hazards of computer use. The gain can be extremely significant, both for employer and the employees (Torrey 2004). Operating a VDT may lead to visual, muscular or mental fatigue. Some people need corrective lenses to avoid eyestrain and headaches. Studies show that 50% - 90% of computer users experience the symptoms of CVS. Still now no one can find out the peak age of women getting diseases CVS using CETD Matrix. For that we interviewed 120 women in Chennai, those who are girls students studing computer course in schools and centres and womens working in Software development companies, IT sectors, Data entry operators, Computer labs. Moreover the data in an unsupervised one and also there is uncertainty in the concepts. Here fuzzy tool alone has the capacity to analyze these concepts. Here it is chosen here.

3 ESTIMATION OF MAXIMUM AGE GROUP OF WOMEN COMPUTER USERS AFFECTED BY COMPUTER VISION SYNDROME (CVS)

3.1 Estimation of maximum age group of women computer users affected by computer Vision Syndrome (CVS) by using 5 x 6 Matrix

In this section we apply the most common 5 factors of CVS.

i.e., C₁-Eye Strain, C₂-Headache, C₃-Blurred Vision, C₄-Dry Eyes, C₅-Neck and Shoulder Pain to the CETD model.

Table 1: Initial raw data matrix of women computer users affected by CVS of order 7 x 6

Age	C ₁	C ₂	C ₃	C ₄	C ₅
10-18	6	4	2	4	3
19-32	14	18	14	16	16
33-46	15	17	18	15	19
47-52	8	6	9	5	9
53-58	5	4	10	7	6

Table 2: The ATD Matrix of women computer users affected by CVS of order 7 x 6

Age	C ₁	C ₂	C ₃	C ₄	C ₅
10-18	0.67	0.44	0.22	0.44	0.33
19-32	1	1.29	1	1.14	1.14
33-46	1.07	1.21	1.29	1.07	1.36
47-52	1.33	1	1.5	0.83	1.5
53-58	0.83	0.67	1.67	1.17	1

Table 3: Average and S.D of the above given ATD Matrix

Average	0.98	0.92	1.14	0.93	1.07
S.D	0.25	0.36	0.57	0.30	0.45

We have taken the value $\alpha = 0.15, 0.35, 0.55$ and 0.75 to find the CETD matrix

The RTD matrix for $\alpha=0.15$

1	-1	-1	-1	-1	1
0	1	-1	1	1	1
1	1	1	1	1	1
1	1	1	-1	1	1
1	-1	1	1	-1	1

row sum matrix

6
2
5
3
1

The RTD matrix for $\alpha=0.35$

1	-1	-1	-1	-1	1
0	1	0	1	0	1
1	1	0	1	1	1
1	0	1	0	1	1
1	-1	1	1	0	1

row sum matrix

6
2
4
3
0

The RTD matrix for $\alpha=0.55$

row sum matrix

$$\begin{matrix} 1 & -1 & -1 & -1 & -1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & -1 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & -1 & 1 & 1 & 0 \end{matrix}$$

$$\begin{matrix} 6 \\ 2 \\ 2 \\ 3 \\ 0 \end{matrix}$$

The RTD matrix for $\alpha=0.75$

row sum matrix

$$\begin{matrix} 1 & -1 & -1 & -1 & -1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & -1 & 1 & 1 & 0 \end{matrix}$$

$$\begin{matrix} 6 \\ 2 \\ 4 \\ 3 \\ 0 \end{matrix}$$

The CETD Matrix is given in the following, which is formulated using the four RTD matrices or fuzzy matrices for the values of $\alpha = 0.15, 0.35, 0.55$ and 0.75 .

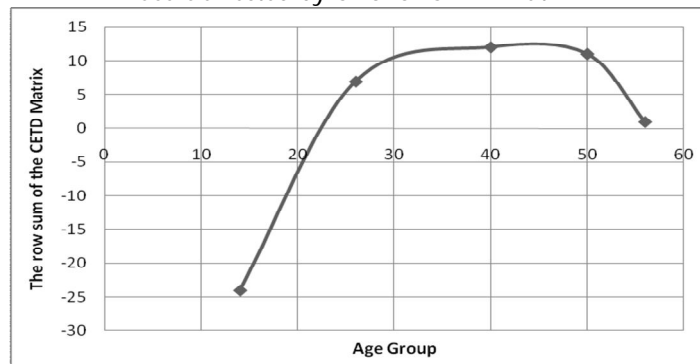
The CETD matrix

row sum matrix

$$\begin{matrix} 6 & -6 & -6 & -6 \\ 2 & 2 & 2 & 1 \\ 5 & 4 & 2 & 1 \\ 3 & 3 & 3 & 2 \\ 1 & 0 & 0 & 2 \end{matrix}$$

$$\begin{matrix} 24 \\ 7 \\ 12 \\ 11 \\ 1 \end{matrix}$$

Graph 1: Depicting maximum age group of women computer users affected by CVS for CETD Matrix



We observe from the above graph that

1. The Computer Vision Syndrome (CVS) Problem starts at the age of 23.
2. The Maximum age of getting CVS problem is 30-51.
3. The peak period of a CVS problem is 40.
4. The above three results also confirmed from the CETD Matrix.

3.2 Estimation of maximum age group of women computer users affected by computer Vision Syndrome (CVS) by using 7 x 6 Matrix

Now we make the study more sensitive we increase the number of row by 7 and see whether the decision arrived is more sensitive to the earlier one.

Table 4: Initial raw data matrix of women computer users affected by CVS of order 7 x 6

Age	C ₁	C ₂	C ₃	C ₄	C ₅
10 - 18	6	4	2	4	3
19 - 24	5	8	6	7	8
25 - 32	9	10	8	9	8
33 - 40	9	10	10	9	10
41 - 46	6	7	8	6	9
47 - 52	8	6	9	5	9
53 - 58	5	4	10	7	6

Table 5: ATD Matrix of women computer users affected by CVS of order 7 x 6

Age	C ₁	C ₂	C ₃	C ₄	C ₅
10 - 18	0.67	0.44	0.22	0.44	0.33
19 - 24	0.83	1.33	1	1.17	1.33
25 - 32	1.29	1.43	1.14	1.29	1.14
33 - 40	1.29	1.43	1.43	1.29	1.43
41 - 46	1	1.17	1.33	1	1.5
47 - 52	1.33	1	1.5	0.83	1.5
53 - 58	0.83	0.67	1.67	1.17	1

Table 6: Average and S.D of the above given ATD Matrix

Average	0.13	1.07	1.18	1.03	1.18
S.D	0.24	0.46	0.48	0.31	0.42

We have taken the value $\alpha = 0.15, 0.35, 0.55$ and 0.75 to find the CETD matrix

The RTD matrix for $\alpha=0.15$

row sum matrix

$$\begin{matrix} 1 & -1 & -1 & -1 & -1 \\ 1 & 1 & -1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 & 1 \\ 1 & -1 & 1 & -1 & 1 \\ 1 & -1 & 1 & 1 & -1 \end{matrix}$$

$$\begin{matrix} 6 \\ 1 \\ 3 \\ 5 \\ 3 \\ 1 \\ 1 \end{matrix}$$

The RTD matrix for $\alpha=0.35$

row sum matrix

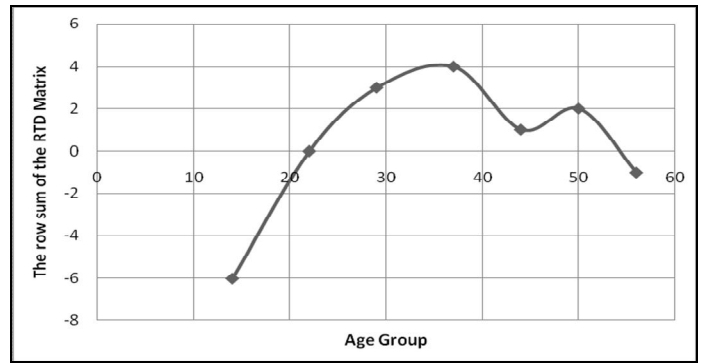
$$\begin{matrix} 1 & -1 & -1 & -1 & -1 \\ 1 & 1 & -1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & -1 & 1 \\ 1 & -1 & 1 & 1 & -1 \end{matrix}$$

$$\begin{matrix} 6 \\ 1 \\ 3 \\ 5 \\ 1 \\ 2 \\ 1 \end{matrix}$$

The RTD matrix for $\alpha=0.55$

row sum matrix

$$\begin{matrix}
 \begin{matrix} 1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & -1 & 1 \\ 1 & -1 & 1 & 0 & 0 \end{matrix} \\
 \end{matrix}$$

$$\begin{matrix}
 \begin{matrix} 6 \\ 0 \\ 3 \\ 4 \\ 1 \\ 2 \\ 1 \end{matrix} \\
 \end{matrix}$$


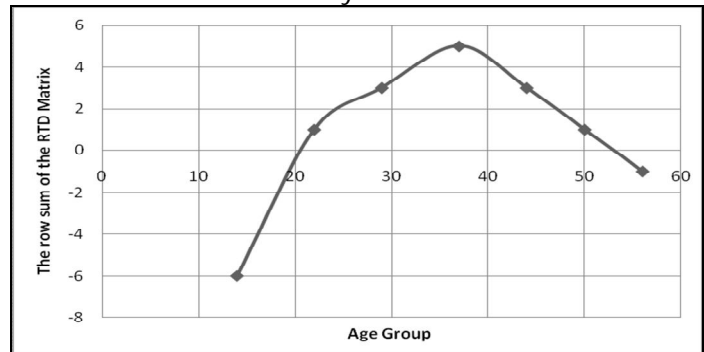
The RTD matrix for $\alpha=0.75$

row sum matrix

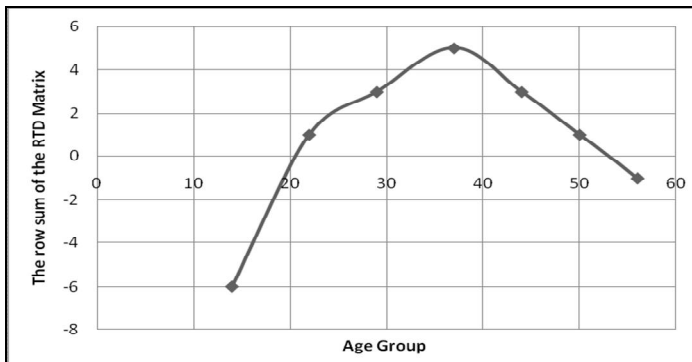
$$\begin{matrix}
 \begin{matrix} 1 & -1 & -1 & -1 & -1 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 1 \\ 1 & -1 & 1 & 0 & 0 \end{matrix} \\
 \end{matrix}$$

$$\begin{matrix}
 \begin{matrix} 6 \\ 1 \\ 3 \\ 4 \\ 1 \\ 2 \\ 1 \end{matrix} \\
 \end{matrix}$$

Graph 5: Depicting maximum age group of women computer users affected by CVS for $\alpha = 0.75$



Graph 2: Depicting maximum age group of women computer users affected by CVS for $\alpha = 0.15$



The CETD Matrix is given in the following, which is formulated using the four RTD matrices or fuzzy matrices for the values of $\alpha = 0.15, 0.35, 0.55$ and 0.75 .

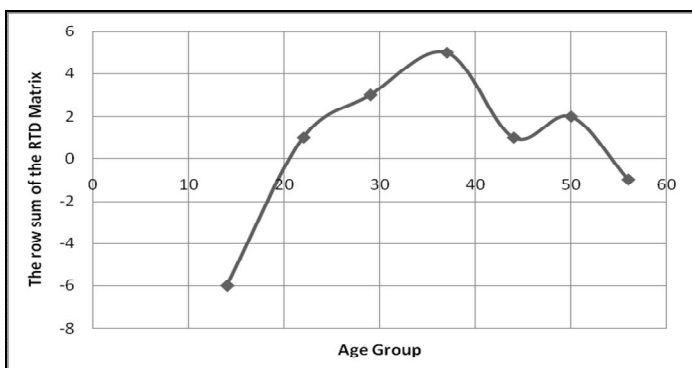
The CETD matrix

row sum matrix

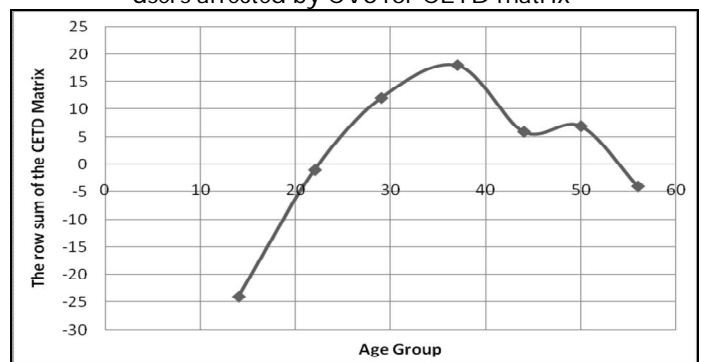
$$\begin{matrix}
 \begin{matrix} 6 & 6 & 6 & 6 \\ 1 & 1 & 0 & 1 \\ 3 & 3 & 3 & 3 \\ 5 & 5 & 4 & 4 \\ 3 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 \\ 1 & 1 & 1 & 1 \end{matrix} \\
 \end{matrix}$$

$$\begin{matrix}
 \begin{matrix} 24 \\ 1 \\ 12 \\ 18 \\ 6 \\ 7 \\ 4 \end{matrix} \\
 \end{matrix}$$

Graph 3: Depicting maximum age group of women computer users affected by CVS for $\alpha = 0.35$



Graph 6: Depicting maximum age group of women computer users affected by CVS for CETD matrix



Graph 4: Depicting maximum age group of women computer users affected by CVS for $\alpha = 0.55$

5 CONCLUSION AND SUGGESTIONS

5.1 Conclusion

First contrary to the natural happening that the women after 30 has more chances of getting the Computer Vision Syndrome (CVS). Nowadays most of the women are working in Software fields, IT sectors, BPO / Call center, and computer lab. Once they are complete their college, most of the women like to work in above fields. Therefore their work is starting at the age above 20. Of the 120 women computer users we have interviewed, 70 of them suffered from the CVS. When we use the system continuously, Eye Strain, Headache, Blurred Vision, Dry Eyes, Neck and Shoulder pains arises automatically. So that Computer Vision Syndrome (CVS) starts at the age 23. From the graph: 6 we can see that the peak period is 29 - 41. From our study the peak age women affected by CVS is 36. The main reason for this is improper usage of computers. This conclusion has been completely supported by our analysis of the 120 women computer users using fuzzy matrix.

5.2 Suggestions

Based on our research we are giving the proper body positioning for computer usage. Some important factors in preventing or reducing the symptoms of CVS have to do with the computer and how it is used. This includes lighting conditions, chair comfort, location of reference materials, position of the monitor, and the use of rest breaks.

Location of computer screen - Most people find it more comfortable to view a computer when the eyes are looking downward. Optimally, the computer screen should be 15 to 20 degrees below eye level (about 4 or 5 inches) as measured from the center of the screen and 20 to 28 inches from the eyes.

Reference materials - These materials should be located above the keyboard and below the monitor. If this is not possible, a document holder can be used beside the monitor. The goal is to position the documents so you do not need to move your head to look from the document to the screen.

Lighting - Position the computer screen to avoid glare, particularly from overhead lighting or windows. Use blinds or drapes on windows and replace the light bulbs in desk lamps with bulbs of lower wattage.

Anti-glare screens - If there is no way to minimize glare from light sources, consider using a screen glare filter. These filters decrease the amount of light reflected from the screen.

Seating position - Chairs should be comfortably padded and conform to the body. Chair height should be adjusted so your feet rest flat on the floor. If your chair has arms, they should be adjusted to provide arm support while you are typing. Your wrists shouldn't rest on the keyboard when typing.

Rest breaks - To prevent eyestrain, try to rest your eyes when using the computer for long periods. Rest your eyes for 15

minutes after two hours of continuous computer use. Also, for every 20 minutes of computer viewing, look into the distance for 20 seconds to allow your eyes a chance to refocus.

Blinking - To minimize your chances of developing dry eye when using a computer, make an effort to blink frequently. Blinking keeps the front surface of your eye moist.

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