Optometry Charts Projector

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Abstract:

The goal of this paper is to add a new way of checking visual acuity using a computer based software. OCP (Optometry Charts Projector) is created using the GUI (Graphical User Interface) of MMB (Multimedia Builder) to display basic optometry charts on different screen sizes.

The MMB is used to create this software; it is integrated with many special functions facilitating the display of charts used in the diagnosis of visual acuity. The MMB is inexpensive authoring software with which the user can easily develop auto-run menus, multimedia application and lots more, without even knowing bare basics of programming, With (MMB) the user can create auto-run CD browsers for corporate CD-ROM's.

OCP allows the user to select the screen size and the distance of measurement for a certain chart (i.e. illiterate E's). The control panel provided within the software will allow the user to navigate through different parts of the chart easily.

This software is very effective; because it can be dealt with easily; on the other hand it has a great economical feasibility, where the user doesn't have to buy an expensive device (i.e. Auto Chart Projector). The only thing needed to accomplish the test is the software and a general purpose screen.

Keywords: OCP (Optometry Charts Projector), MMB (Multimedia Builder), VA (Visual Acuity), Optometry Charts.

Introduction

Concept of Visual Acuity:

Although vision is often taken for granted, the assessment of it should not be. The measure of visual acuity is intended to elicit information concerning the integrity of the visual system. Ophthalmologists rely on variety of testing methods and on the technical personnel who perform them to determine a patient's particular acuity problem. The following information is intended to provide an overview of the procedures and techniques that can be used in the consistent and concise assessment of visual acuity.

Visual Acuity(VA): is a clearness of vision, it depend on optical and neural factors, The most common cause of low visual acuity is refractive error or errors in how the light is refracted in the eyeball, Measurement can be done using an (eye chart) by optical instrument or by computerized test**.**

Types of Visual Acuity:

1. **Task of detection or minimum visible**: The presence or absence of an object in their field of vision.

2. **Task of resolution or minimum separable**: The observer should be able to decide if two objects that are very close together are separated or not.

3. **Task of localization**: The observer should be able to discriminate small displacements within the test.

4. **Task of recognition or minimum recognizable (the common type)**

The observer should be able to recognize the details of the object.
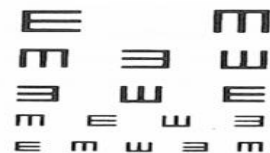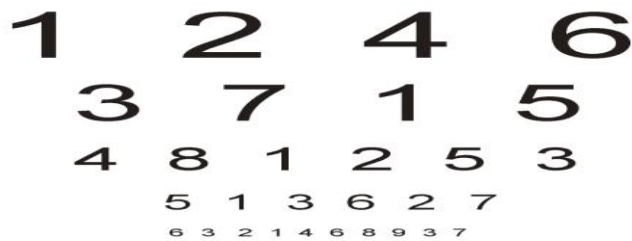
Factors Affecting Visual Acuities:

Visual acuity depends on several factors, including:

1. **Refractive error**: Refractive errors will affect visual acuity by causing defocus at the retina; the result of a mismatch between optics and the growth of the eye, it is due to a combination of genetic and environmental influences.
Treatment includes spectacles, contact lenses, and refractive surgery.

2. **Pupil size**: The size of the pupil is an important factor affecting visual acuity. Large pupils allow more light to stimulate the retina and reduce diffraction, but resolution will be affected by aberrations of the eye. On the other hand, a small pupil will reduce optical aberrations but resolution will be diffraction limited. Therefore, a mid-size pupil of about 3 mm to 5 mm would be optimal, as this is a compromise between the diffraction and aberration limits As noted earlier, pupil area affects the size of the point spread function, and hence resolution.

3. **Contrast Sensitivity**: Contrast is an important parameter in assessing vision. Visual acuity measurement in the clinic uses high contrast, that is, black letters on a white background.
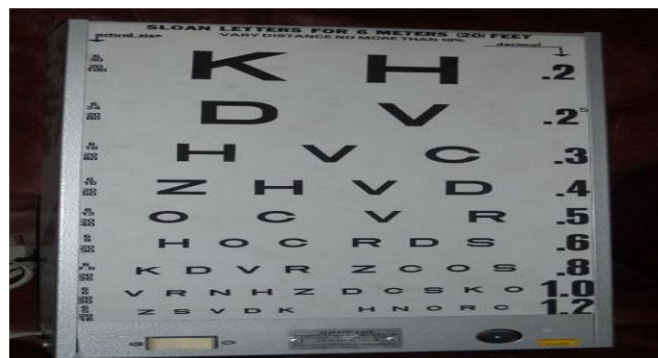
Methodology:

Comparing OCP with the Other Devices
Three main devices:
1. Conventional Chart Projector
2. Autochart projector
3. LCD Chart Projector

❖ **Conventional Chart Projector**

Limitations:

1. It is not practical

2. Light sources maintenance

3. The invention of autochart projectors and LCD chart projectors.

Autochart projector

Limitations:

1. Daily maintenance

2. Replacing the projection bulb

3. Cleaning or replacing the air-filter

LCD Chart Projector

Limitations:
1. These screens are specialized just for visual acuity test
2. They are prone to hardware failure

Costs of Visual Acuity Test Devices:

Device	Cost $
Conventional chart projector	150–250$
Autochart projector	400–700$ Some up to 2000$
LCD chart projector	500–1000$ Some up to 2500$

 OCP is supposed to be very competitive when it comes to the price, the efficiency and reliability for initial eye inspection, especially when it comes with a full set of libraries, however some of these tests remains very basic, so the end user will need further professional medical equipments such as refractometer when examining astigmatism to fully examine the eye. Thus, the target of this software will be optics shops and normal people who are seeking personal eye

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inspection at home. The price of the software will be determined later depending on the number of tests available and the number of screens it serves.

Optometry Charts:

Main charts: Snellen chart, E-Chart, Landolt-C chart, Log MAR chart, Astigmatism.

❖ **Snellen chart**

**Visual Acuity (VA) = Testing distance / smallest line read**

Letter's Height at 6 meters	Snellen notation in feet	Snellen notation in meter	Visual Acuity (VA)
4.4 mm	20/10/10	6/6	200%
8.7 mm	20/20	6/6	100%
13.1 mm	20/30	6/7.5	67%
17.5 mm	20/40	6/12	50%
21.8 mm	20/50	6/15	40%
43.5 mm	20/100	6/30	20%
87.3 mm	20/200	6/60	10%

❖ **E-Chart: The principle of visual acuity test is the same of the Snellen chart.**
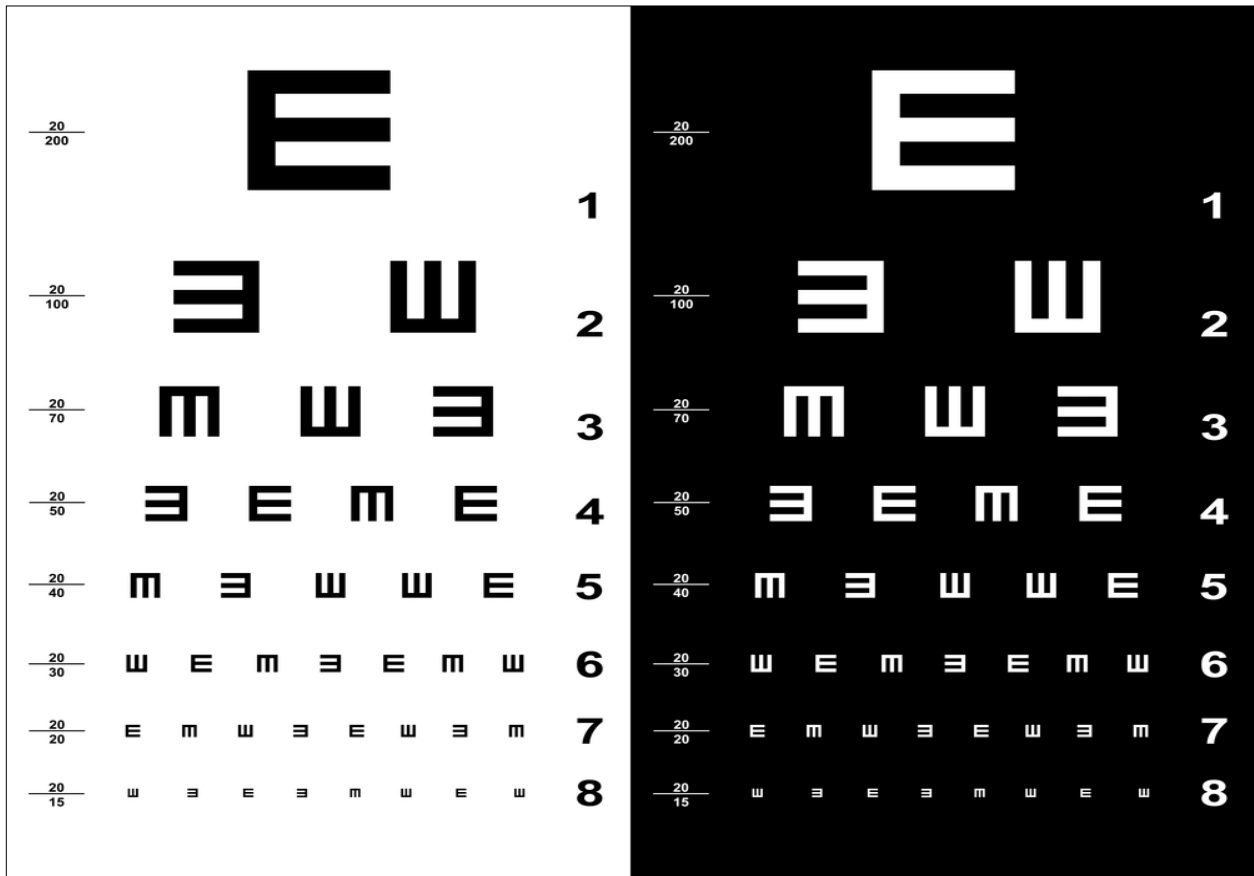

Landolt-C chart:

The Landolt-C consists of a ring that has a gap, thus looking similar to the letter C. The gap can be at various positions (usually left, right, bottom, top and the 45° positions in between) and the task of the tested person is to decide on which side the gap is. The size of the C and its gap are reduced until the subject makes a specified rate of errors. **The minimum perceivable angle of the gap is taken as measure of the visual acuity.**
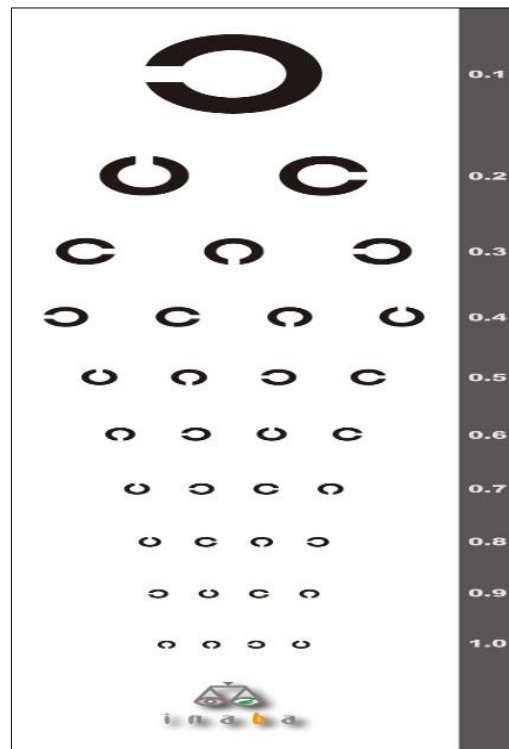
Log MAR chart:

The LogMAR chart consists of 14 lines, each line consist of 5 letters. Each letter has a score value of 0.02 log units. Since there are 5 letters per line, the total score for a line on the Log-MAR chart represents a change of 0.1 log units.

The **formula** used in calculating the score is**:**
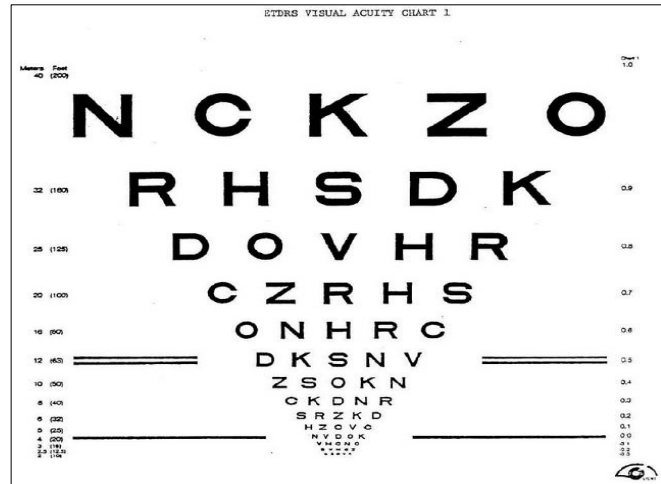
Log-MAR VA= 0.1+ (Log-MAR value of the best line read) -0.02*(number of letters read).

Astigmatism:

Astigmatism is an optical defect in which vision is blurred due to the inability of the optics of the eye to focus a point object into a sharp focused image on the retina.

The common test for astigmatism is called "astigmatism wheel". This consists of radial lines and is viewed with one eye at a time. If some lines look black while others look grey, it is an indication that the person has astigmatism.
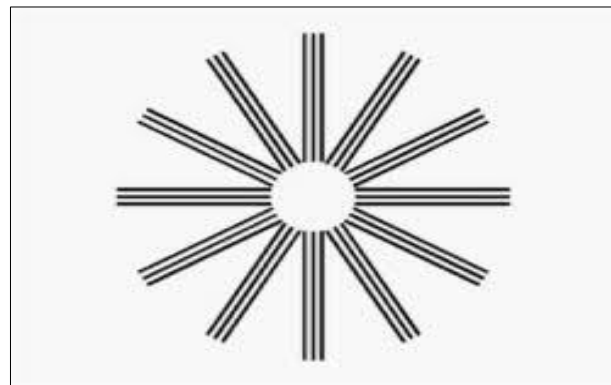
Creating Optometery Charts Projecter:

MMB (Multimedia Builder):

The MMB shown in figure is inexpensive authoring software with which the user can easily develop auto-run menus, multimedia applications and lots more, without even knowing bare basics of programming. It comes with many impressive features facilitating the user to create small size stand alone apps, such as games, installation programs and similar things without spending lot of time.
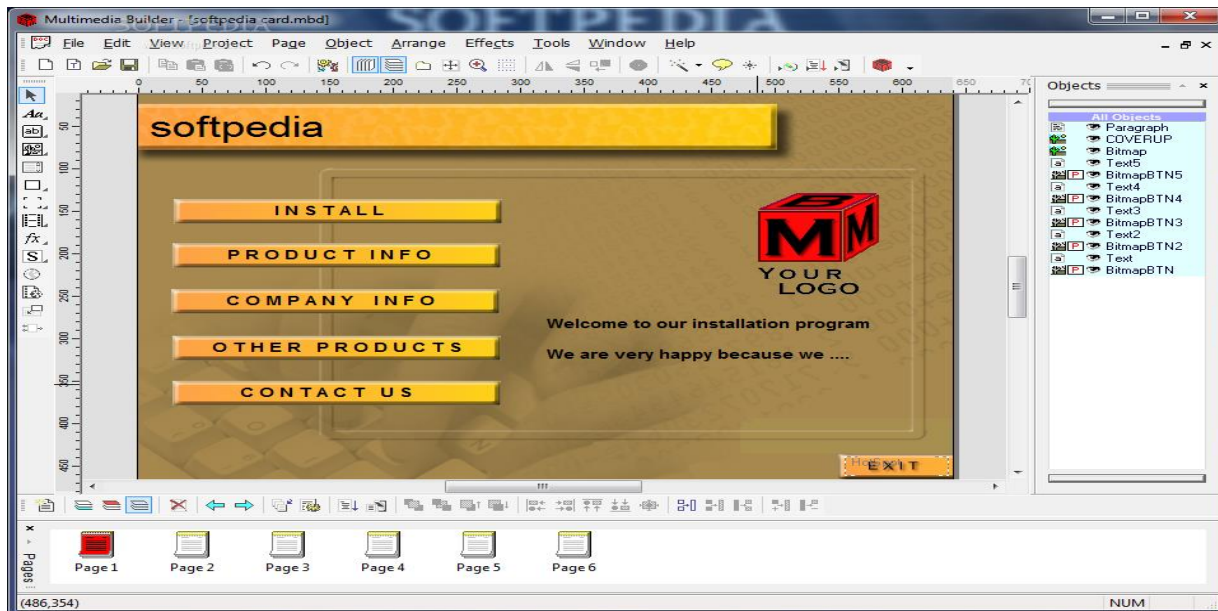
It has many merits such as:

1. It is easy to use.
2. No need to use any kind of programming languages.
3. Extract the code in case the user wants to compile it into another programming language. It is a graphical user interface GUI.

Creating Charts Using MMB:

Three charts are used Snellen chart, E-Chart and the astigmatic wheel. All measurements were taken to match 6 meters distance except the E-Chart that matches 6 meters and 3 meters.

Work Procedure:

The optometry charts were chosen from the internet with high resolution.

Work Steps:

1. Adjusting the size of the whole chart page to match the required size of the biggest optotype, Where **H** is the height of the optotype in mm:
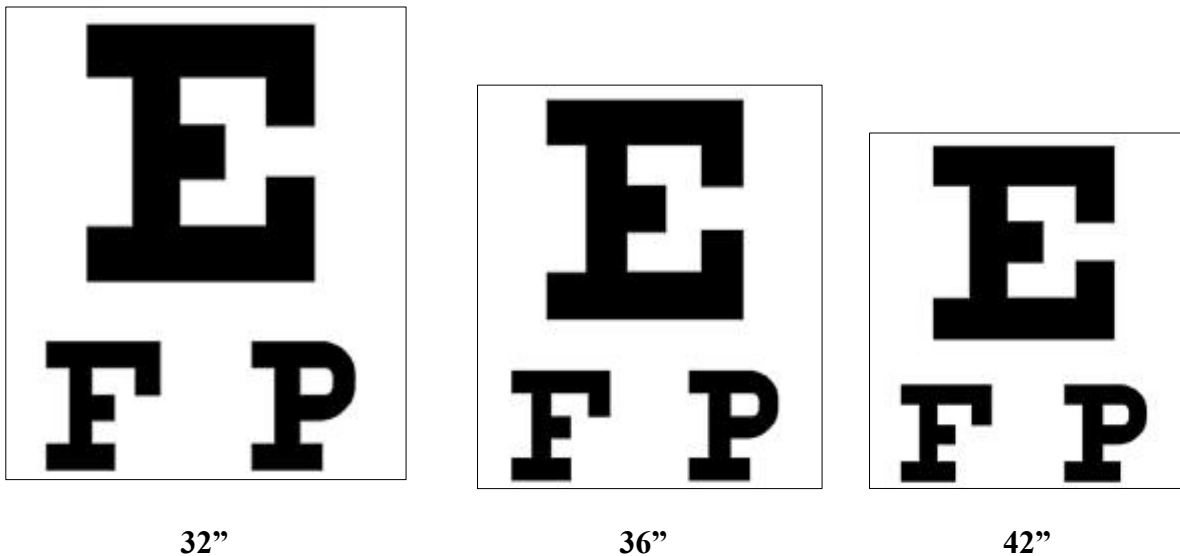
   For E-Chart: Test distance = (H/88)*6

   For Snellen: Applying the tables

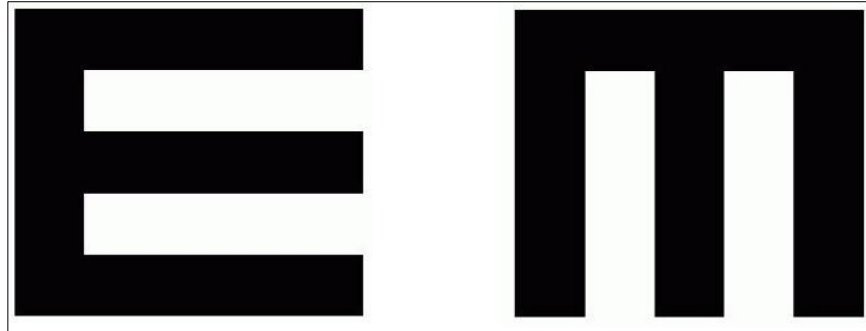**Divide the chart page into sections:**
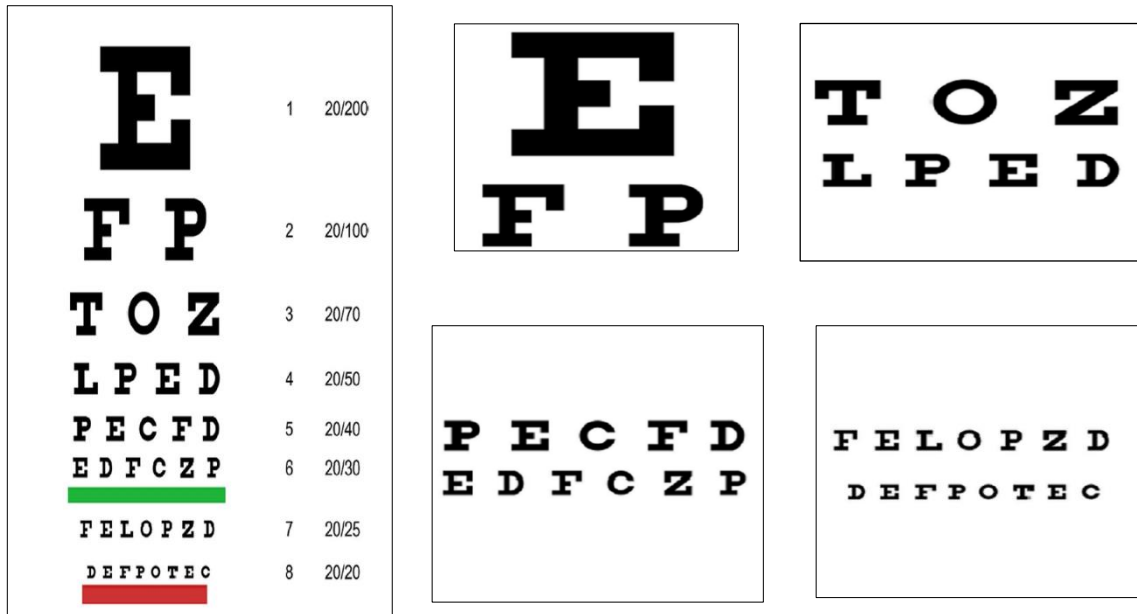
2. a) Resizing the charts to match the following screen sizes (15", 32", 36", 42", and 46") considering the distance of 6 meters using **Paint** software as shown in figure :

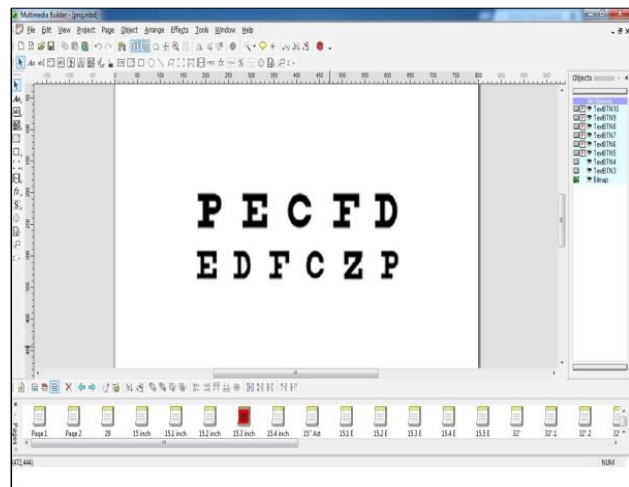|		
32"	**36"**	**42"**

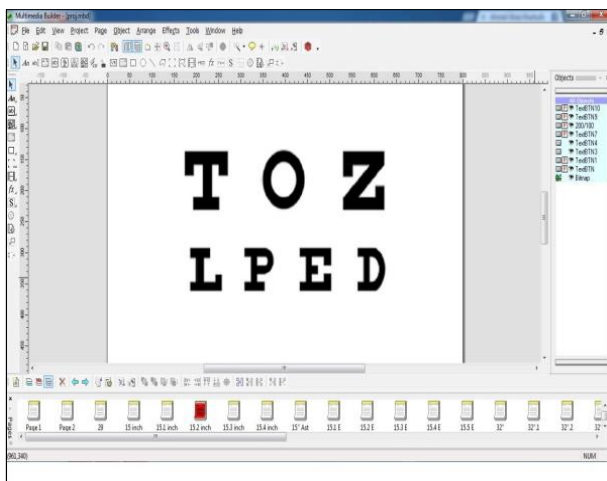☒ . b) Resizing E-Chart to fit 3 meters distance
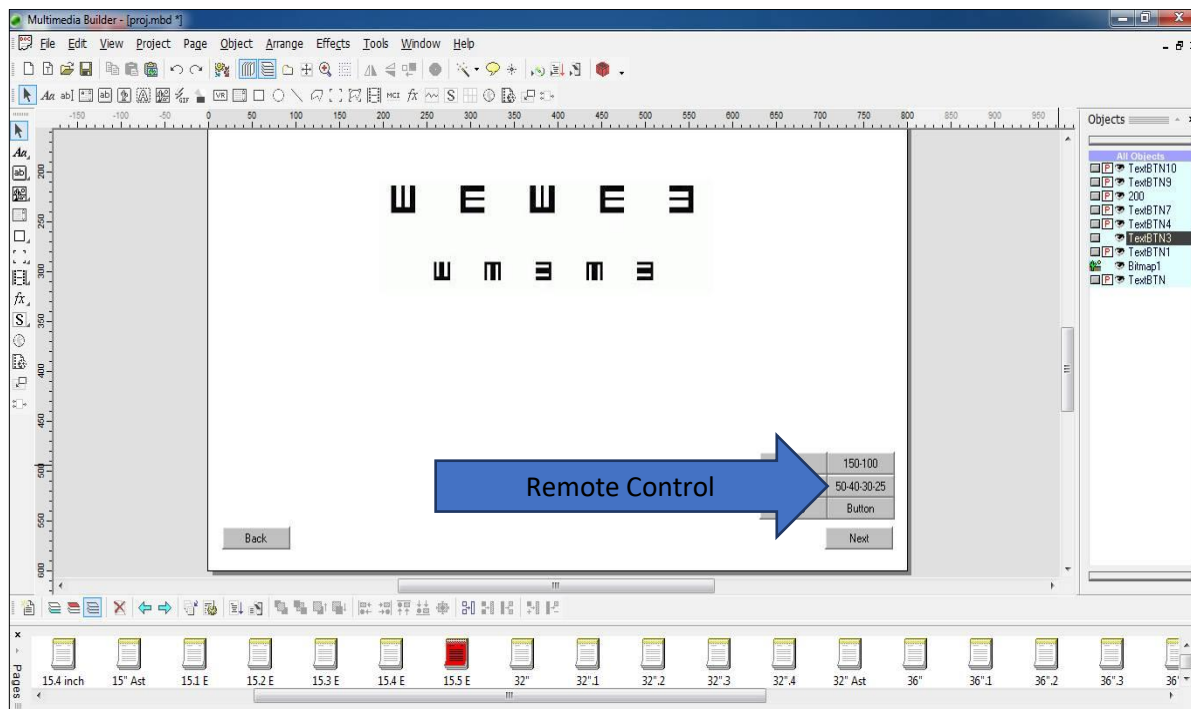
Test distance = 6 meters

Test distance = 3 meters

3. Applying the formulas and the tables of Snellen chart and E-Chart to get the optimal optotypes size.

4. Distribute the optotypes into MMB work pages as shown in figure:

5. Adding control panel (remote control) to navigate between different optotypes as shown in figure :

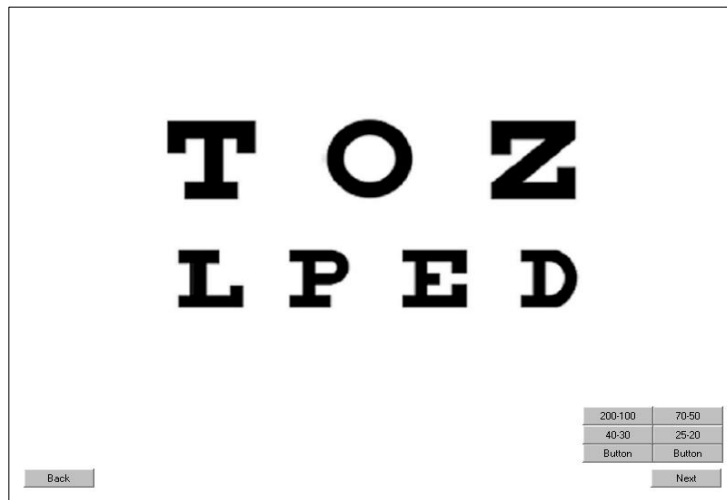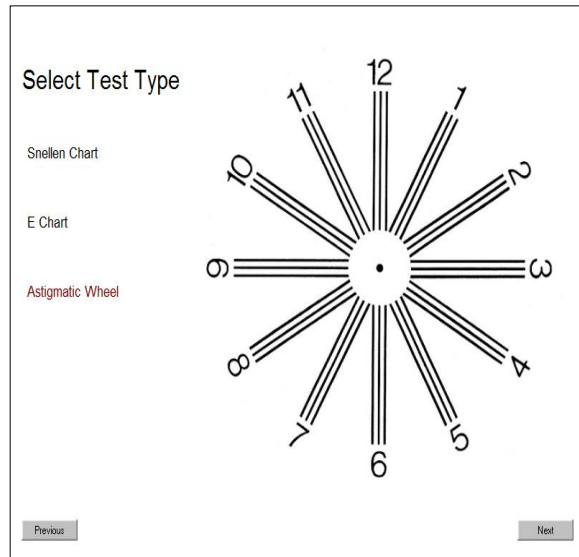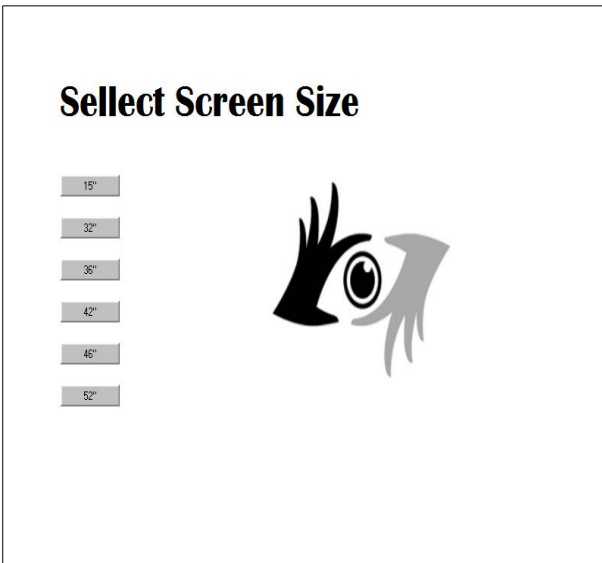6. **Resizing Charts Using Paint Program**
☒ **Resizing by percentage:**

❑ **For 15" screen: 100%**

❑ **For 32" screen: (15"/32")*100% = 46.87% ≈ 47%**

❑ **For 36" screen: (15"/36")*100% = 41.66% ≈ 42%**

❑ **For 42" screen: (15"/42")*100% = 35.71% ≈ 36%**

❑ **For 46" screen: (15"/46")*100% = 32.6% ≈ 33%**

The previous ratios are taken in respect to the smallest screen size which has the largest chart size. For example, 32 inch screen charts are 47% of the reference chart used on the 15 inch screen.

Results and Conclusion:

☒ **OCP is a unique and simple software**

☒ **Display different types of optometry charts on different screen sizes**

☒ **Low cost**

☒ **Has a small size. Currently, the size is around 55 MB which make it easy to share or download.**

☒ **Selecting Screen Size ,Selecting Test Type , Selecting The Suitable Chart**

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