The UMIST Eye System

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Abstract—The UMIST Eye System provides computer implementations, on a standard IBM-PC compatible, of most sight test routines used by the optometrist in practice.

1. INTRODUCTION

For assessing deficiencies of visual function, the optometrist in practice uses a large arsenal of vision tests, most of which are well suited for computer implementation. The UMIST Eye System (UES) provides a collection of these on a readily available computer platform. The emphasis is on visual acuity testing, testing of colour vision, and screening for visual field defects and ocular pathology such as glaucoma. Monitor calibration procedures are included so that the system represents a robust tool both on a stationary platform or a notebook. A comprehensive and carefully assembled manual will aid the user in the interpretation of findings. The increased reliability of a computer system is of particular value for the practitioner. The system has been used in research from 1985, routinely in ophthalmic practice since 1990, and has been available commercially from 1993.

2. ACUITY TESTING

The system builds on software written by the author in the early 1970s that produced offline computer-generated eye test charts, and its primary aim remains to test visual acuity. Further references can be found in French-Teeling and French (1994). A wide range of online generated conventional letters and symbols are used: the Bailey-Lovie ‘DEFHNPRUVZ’ set, the Sloan ‘CDHKNORSVZ’, the Stycar ‘HOTVXALCU==+’, lower case letters ‘aceimnoprstu’; digits ‘0123456789’; pictograms for children; the Ffooks symbols (circle, triangle and square); tumbling E s; Landolt C s; vernier figures; and square- and sine-wave gratings.

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Conventional multi-line optometric charts are mimicked within the confines given by the size of the computer monitor being used. Letters and symbols may also be presented in single character (with and without variable-distance crowding bars), single line, variable contrast, duochrome (red/green) and stereogram modes. Testing can be passive—carried out by the PC operator using the monitor simply as a display—or interactive and automatic, with the operator or subject entering responses at the keyboard. Symbol presentation may be pseudo- (sequences repeat themselves) or quasi-random.

Eye-to-screen distance can be varied from 33 cm to 8 m including the conventional 6 m distance, and the screen display can be reversed to accommodate the use of a mirror, typically at 3 m distance. Acuity can be measured by identifying symbols, with sizes from 6/117 down to 6/4 (0.66 arcmin) in terms of Snellen fraction, minimum angle of resolution (MAR), cycles per degree or point size, using conventional and logMAR scales. For any size of symbol, contrast can be measured down to 2.5%, owing to the 64 grey-level limit of the VGA graphical standard. Polarity may be positive or negative. Contrast-sensitivity testing can be carried out within the restricted range.

As character presentation can be entirely random, measurement reliability can be controlled over a considerable range by adjusting the number of components in each testing procedure, enabling examinations to range from ‘quick and dirty’ to ‘slow and meticulous’, an option which is not available with conventional testing equipment.

3. SPECIALISED OPTOMETRIC DISPLAYS

A number of specialised static and dynamic displays used by optometrists are also included: astigmatic fan, cross-cylinder circles, cross-cylinder disks, duochrome test, OXO-style displays, phoria test, random UK-vehicle number plate, ‘Sm-eye-ly’ face fixation/reward target, Amsler-style grids and Worth-style figure (Emsley, 1973).

4. COLOUR VISION TEST

A test of colour vision in the style of the City University Colour Vision Test (Fletcher, 1980; available from Keeler) is incorporated. The City test is based upon the colours used in Farnsworth’s D15 test, itself a successor to the Farnsworth-Munsell 100-Hue Test; all use colour ‘chips’ drawn from the Munsell Book of Colour (Travis, 1991). The UES implementation is limited to 18-bit colour and the system allows for a limited amount of user-configuring as well as comprehensive calibration (also important for contrast-sensitivity measurements). Chromaticity confusion charts are included in the manual to help interpret the results’ indication of protanomaly, deuteranomaly, or tritanomaly. Although clinical experience supports the effectiveness of the UES version, it has not been formally validated.