Design of Smart Head-Mounted Display Technology: A Qualitative Study

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BACKGROUND

- Head-mounted displays (HMD) have been used for vision enhancement for more than 25 years (1).
- Microelectronic technology provides feature-rich commercial HMD.
- HMD provides magnification and/or contrast enhancement (2).
- HMD benefits individuals with visual impairment (VI) (2,3,4).
- Our purpose is to explore the role of HMD in adults with chronic eye disease and VI, perceptions of HMD, and preference for commercial HMD devices.

METHODS

- Participants included self-identified VI with a diagnosis of age-related macular degeneration (AMD), diabetic retinopathy (DR), glaucoma (GL), or retinitis pigmentosa (RP).
- Participants completed the Impact of Vision Impairment (IVI) questionnaire.
- Participants were taught to use three HMDs: eSight, NuEyes, and Epson Moverio.
- All HMDs had video, video processing and display.
- Semi-structured usability interviews were recorded and transcribed.
- Interview data was analyzed with inductive thematic approach in MAXQDA 2018.

RESULTS

- Table 1: Demographics

<table>
<thead>
<tr>
<th>Participants</th>
<th>Age (years)</th>
<th>Gender (n %)</th>
<th>Visual Acuitya</th>
<th>Visual Field</th>
<th>Overall HMD Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>(median (range))</td>
<td>61 (50-81)</td>
<td>20/20/20-20/100</td>
<td>11.5 (5.3-7)</td>
<td>eSight (AMD), NuEyes (DR), Epson (RP)</td>
</tr>
<tr>
<td></td>
<td>Gender (n %)</td>
<td>9 (50%)</td>
<td>20/20/20-20/100</td>
<td>11.5 (5.3-7)</td>
<td>eSight (AMD), NuEyes (DR), Epson (RP)</td>
</tr>
</tbody>
</table>

- Table 2: Joint display linking self-reported well-being with participant preference for HMD

<table>
<thead>
<tr>
<th>IVI Well-Being</th>
<th>DX</th>
<th>Age</th>
<th>Sex</th>
<th>BCVA</th>
<th>Type of VI</th>
<th>Preference</th>
<th>Quotes</th>
<th>Meta-Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 GL 36 F 20/80 mixed eSight</td>
<td>2.00 AMD 71 M 20/30 central Epson</td>
<td>0.60 DR 72 M 20/20 peripheral eSight</td>
<td>3.00 DR 30 M 20/50 central eSight</td>
<td>4.00 DR 51 M 20/100 mixed eSight</td>
<td>5.00 RP 61 F 20/40 mixed NuEyes</td>
<td>6.00 AMD 83 M 20/50 central Epson</td>
<td>0.18 GL 57 M 20/40 mixed eSight</td>
<td></td>
</tr>
</tbody>
</table>

- Figure 1: Participants age with ocular diagnoses

- Figure 2: Participants overall HMD preference stratified by diagnosis

CONCLUSION / DISCUSSION

- Individuals with different types of vision loss (e.g., central and peripheral) and levels of vision-related quality of life may have different HMD preferences.
- Participants with low self-reported well-being preferred eSight for the clarity, usability and vision improvement it provided. Those with slightly higher self-reported well-being primarily preferred NuEyes for its appearance, wireless design, and magnification provided.
- Participants who scored highest in well-being were most concerned with usability and didn't have one clear preference for HMD.
- Though the majority of participants noted they had difficulty in certain mobility scenarios, zero participants could imagine using current HMD to walk or navigate.
- Qualitative interviewing was beneficial for identifying features participants found challenging or useful in usability testing.
- Results from this study can inform the design of HMD tailored to the visual needs and usability concerns of individuals with VI.

REFERENCES