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The SmartSight Project: Use of Electronic Glasses to Improve Impaired Fields of Vision

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Abstract. Electronic glasses use advanced assistive technology that can improve function for persons with visual impairments. This paper presents work in progress in the SmartSight project, where existing versions of electronic glasses are adapted and tested for persons with the visual impairments; macular degeneration and retinitis pigmentosa. The project aims are to adapt and innovate electronic glasses for persons with impaired fields of vision and study the impact on the daily function and quality of life. In a pilot test of the electronic glasses, promising results were found that imply a big difference for persons with impaired vision. The outcome of the SmartSight project might change the clinical practise on treatment and rehabilitation of persons with impaired fields of vision, and on how the support services are organised.

Keywords. E-accessibility, Visual impairment, Augmented reality, E-glasses, Usability evaluation

1. Introduction

Two large patient groups have eye diseases that impair their fields of vision, inducing problems in everyday living and thus reduced function. Macular degeneration (MD) causes the central vison to deteriorate while the peripheral vision remains intact [1], see Figure 1 middle. One in ten older than 70 years of age have functional impairments due to MD [2]. In retinitis pigmentosa (RD) central and peripheral fields of vision are impaired, giving a "tunnel vision" for persons affected [3], see Figure 1 right. This is problematic for orientation and implies more impaired vision in dark surroundings [4]. The total prevalence of all different forms of retinitis pigmentosa is variably reported (one case for each 2500 - 7000 persons), but represents one of the most common causes of blindness or severe low-vision in people 20 to 60 years old [5].

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Figure 1. The field of vision for normal vision (left), macular degeneration (middle) and retinitis pigmentosa (right).

In this context, the SmartSight project (*Electronic glasses to improve function for persons with impaired fields of vision*) addresses research gaps connected to clinical studies of eHealth assistive technology aiming to improve function and quality of life for persons with impaired fields of vision. The software in existing technology of electronic glasses (eGlasses) will be adapted to improve function and coping for persons with impaired fields of vision. The effects of using eGlasses will be measured and tested for persons with macular degeneration and retinitis pigmentosa.

The main hypotheses are that use of electronic glasses will have beneficial effects on individual, organisational and societal levels. The research questions (RQs) stated for the SmartSight project:

RQ1: How can the functionality of existing eGlasses products be adapted to improve function and coping for persons with impaired fields of vision?

RQ2: What benefits and effects of using such customised products can be measured for individuals and for the society?

RQ3: What are the user experiences with such customised products?

2. Methodology

To address the user experiences, a mixed-methods research approach will be applied to evaluate the usefulness and user satisfaction with the eGlasses [6][7]. Initially, pilot tests will be made. User evaluations led by a cross-disciplinary research team, will be performed in a usability laboratory together with persons affected by macular degeneration and retinitis pigmentosa, followed by user satisfaction questionnaires and qualitative interviews [8]. By this systematic approach, real end-users get the opportunity to share their user experiences regarding the eGlasses and the results will be used for iterative refinements of the eGlasses. For each iteration in the technical development, 4- 6 test participants evaluate the functionality and usability of the eGlasses. All laboratory tests will be video-recorded for analysis purposes [9][10].

To evaluate the long-term experiences; a 6-12 months long field study will be made with 10-12 participants using a high-fidelity prototype of eGlasses. During the study, there will be regular contacts between the research team and the test participants for evaluating impacts on fields of vision and daily life. Recruitment of test participants is made in close collaboration with The Norwegian Association of the Blind and Partially Sighted [11], the Eye Clinic at Sørlandet Hospital Trust [12] and The National Centre for Optics, Vision and Eye Care, University of South-Eastern Norway [13].

3. Results

The SmartSight project is in an early study phase. A workshop was organised together with The Norwegian Association of the Blind and Partially Sighted, where pilot tests of eGlasses were made. The eGlasses had mounted cameras, and modified pictures from the cameras were projected in the glasses.

Figure 2. The pilot test of different types of eGlasses. Photo: Mona Hauglid.

The tests showed promising results using unmodified eGlasses that may imply great differences for persons with retinitis pigmentosa [14][15], see Figure 3. Unmodified eGlasses did not give any benefit for persons with macular degeneration, but the modified versions are promising, see Figure 4.

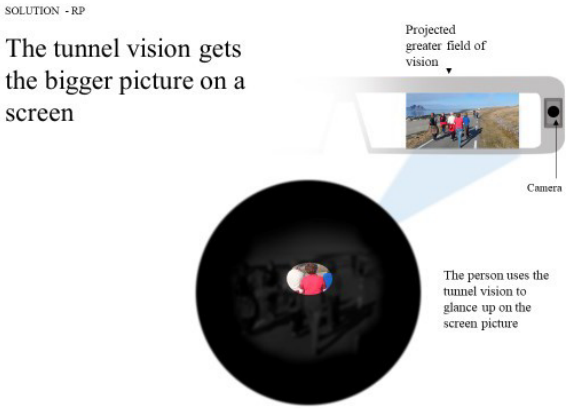

Figure 3. A model of principle function of the eGlasses for retinitis pigmentosa.

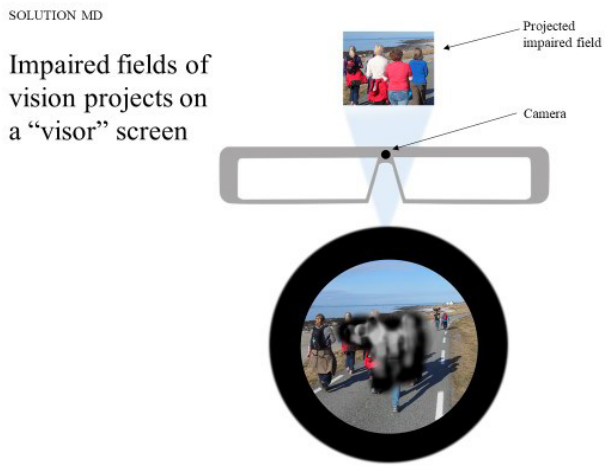

Figure 4. A model of principle function of the eGlasses for macular degeneration.

4. Conclusion

The main contributions of the SmartSight study lie in the adaption and innovation of existing eGlasses technology, a detailed analysis of their usefulness, and user experiences from persons with visual impairments caused by macular degeneration and retinitis pigmentosa. These outcomes might change the clinical practise on examination and rehabilitation for persons with impaired field of vision, and improve quality of life by increasing employability and participation in social life. The outcomes might also have impact on the organisation of support services connected to this area of concern.

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