HCI KOREA 2022 DIGITAL EXPERIENCE
TRANSFORMATION
: 전화위복(轉禍爲福)

# AmslerTouch: Self-testing Amsler Grid Application for Supporting a Quantitative Report of AMD Symptoms

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# BACKGROUND

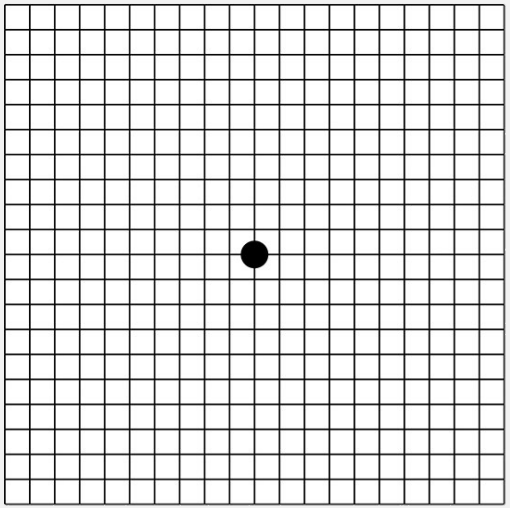
Age-related Macular Degeneration & Amsler Grid testing

# Age-related Macular Degeneration (AMD)

- Age-related macular degeneration (AMD) is a prevalent chronic disease led by damage of macula
- According to Jeon et al., AMD is a highly prevalent disease in society, where 6.62% of the South Korean population are suffering from the symptoms of AMD
- It is widely known that the symptom often accompanies disastrous symptoms, such as blurred vision or vision loss, as well as psychological vulnerability
- Since little or no effective treatment for treating AMD exists, the most feasible and cost-effective management of AMD is to prevent further development of symptoms, necessitating importance of diagnosis

# Amsler grid testing

- Amsler grid testing is the most prevalent AMD testing since the 1940s, widely used by medical practitioners to diagnose AMD
- Consisting of dozens of squares as a grid, Amsler grid helps users report distorted areas or blurred regions in sight verbally to the medical practitioners



Amsler grid

# Limitation of Amsler grid & Computational approach

- However, paper-based AMD testing had been shown inaccessible and unsuccessful in terms of precise diagnosis
- Thus, previous studies have applied novel input methods that enable remote, accurate testing
- Yet, these approaches are limited in their efficiency and generalizability, since such techniques required costly devices that are not easily available

| Name | Description |
|---|---|
| NGRID (Mohaghegh et al., 2016) | Head-mounted Amsler-grid app |
| 3D TEST (Kim et al., 2020) | Implemented with 3D screen and polarized glasses |

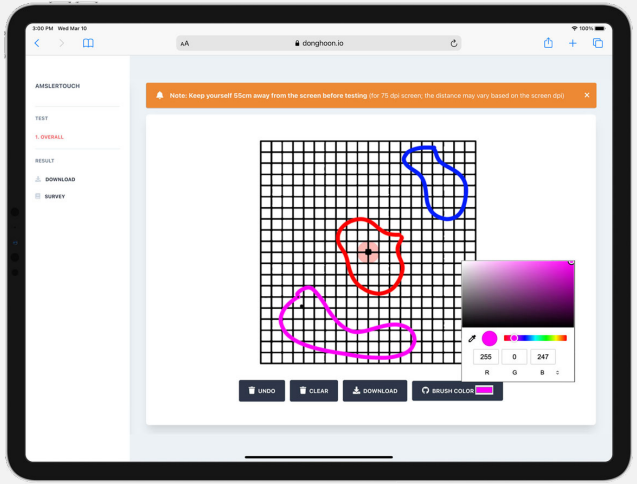
**Examples of computational approach for Amsler grid testing**

# SYSTEM DESIGN

AmslerTouch: Self-testing Amsler Grid Application for Supporting a Quantitative Report of AMD Symptoms

# AmslerTouch

- In this paper, I propose AmslerTouch, an interactive web-based Amsler grid testing app that can easily be used with any existing devices (e.g., tablet, desktop)
- AmslerTouch allows users to use both touch- and mouse-based interactions to ensure its generalizability
- Based on the literature, I applied several design considerations in order to ensure the usability of AmslerTouch



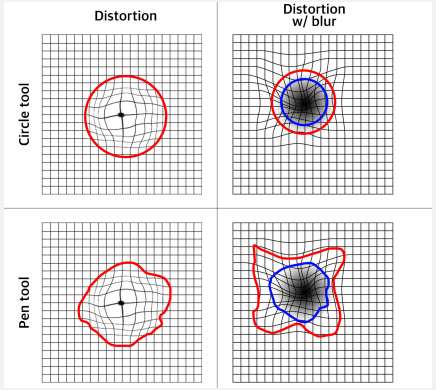

Keyscreen of AmslerTouch

# Literature review & design considerations

| The system should offer both (i) fixed-shape tool and (ii) free-shape tool | The system should let users distinguish between different types of symptoms |
|---|---|
| In most cases, I identified that the region of symptoms is c ircular or ellipse, which implies the need for annotating wit h a circle-shaped tool<br><br>Yet, their symptoms differ a lot across patients, which req uires to offer them a tool for drawing freely | AMD is a heterogeneous disease in terms of symptoms, w here more than one visual symptom often appears<br><br>Thus, it is reasonable to let users note each symptom diffe rently to let them distinguish each symptom |
| **The system should let users computationally pass their diagnosis data to others** | **The system should make the user focus on the center of Amsler grid** |
| My system ultimately aims to facilitate communication bet ween a patient and medical practitioner.<br><br>On such an account, it is important for the system to offer a reportable format of drawings | It is extremely important to have patients center-align thei r vision while taking a test |

# 1. Interaction methods: Circle & pen tool for drawing

- To ensure that users may draw both (i) burden-free and (ii) precisely, I designed two interaction methods: (i) circle tool and (ii) pen tool
- **(i) Circle tool**: Stemming from the idea that most of the reported regions are circle in shape, the circle tool focuses on intuitive use by letting users easily draw. Specifically, once a user keep pressing on a specific region, a circle is created and enlarged until the users stop holding



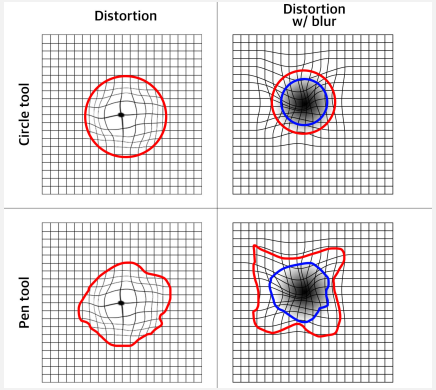

Exemplar usage of circle/pen tool

```
Procedure ISCIRCLE(initialPosition):
    timer ← fire
    while timer.isValid and elapsedTime < 500ms do
        if initialPosition.distanceTo(currentPosition) > 50px
then
            return false
        end if
    end while
    return true
endprocedure
```

Algorithm for automatically detecting and switching tool

# 1. Interaction methods: Circle & pen tool for drawing

- **(ii) Pen tool.** Like a real-world pencil, pen tool lets users freely draw without any constraint. This tool makes users draw every type of shape precisely
- To let users switch between Circle tool and Pen tool easily, I applied an algorithm to change a tool based on the user's initial point of the cursor and point of the cursor after 500ms
- User can also undo/redo their action by clicking the button

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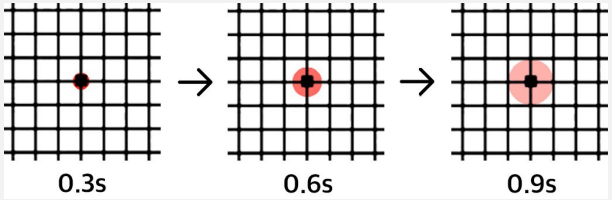
Algorithm for automatically detecting and switching tool

# 2. A diffusing animation for inducing users' focus

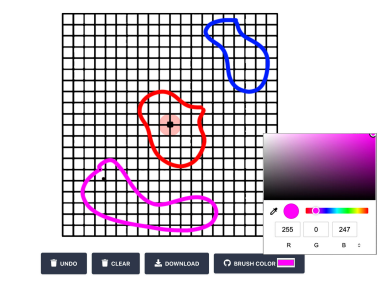
- It is important to keep the user's vision at the center of Amsler grid while testing. Thus, I designed a spreading circular animation to keep users focused on the center
- At the center of the grid, a circle keeps growing every 1 second, with the opacity going down, accordingly making as if it is diffusing and having users focus on it



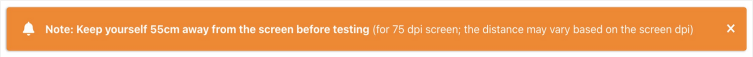

An animation for inducing user's center-aligned focus

# 3. Color picker for distinguishing symptoms
# 4. Tooltip view for keeping them with a fixed distance
# 5. Download function

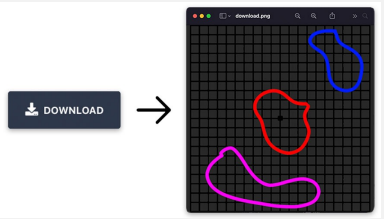
- With using color picker and easily altering colors for each symptom, users can easily draw without any confusion
- In order to make users stay away from the screen, I added a tooltip view on top of Amsler grid
- After completion, user can use download function to electronically report their results to relevant stakeholders (e.g., medical practitioners)




Color picker for drawings. Users can designate a different color for each drawing




Tooltip view for inducing users to keep designated distance away from the screen




Download function

# PRELIMINARY EVALUATION

Heuristic evaluation

# Heuristic evaluation

- Due to the limited resource and difficulty of recruiting participants, I decided to run heuristic evaluation for the preliminary evaluation of my interface
- Even though some specialized heuristics are suggested to be applied to a specific domain, I followed the original checklist suggested by Nielsen, since
  - (i) it has long been proved efficient across various domains of interaction design
  - (ii) little or no specialized checklist exists for our domain
- The process was conducted with one evaluator, which lasted about 2 hour

# Results

- Insufficient description exists for how the user may initiate using the system
- The text on tooltip view is too small to recognize
- There is no perceivable distinction between Clear and Undo button
- No detailed cue exists on how the drawing algorithm works

| Issue | Severity | Ease of Fixing |
|---|---|---|
| Insufficient description exists for how the user may initiate using the system | 3 | 1 |
| The text on tooltip view is too small to recognize | 3 | 1 |
| There is no perceivable distinction between *Clear* and *Undo* button | 2 | 1 |
| No detailed guideline exists on how the drawing algorithm works | 2 | 2 |
| It is difficult to pick a color for markups; lack of scaffolded options | 2 | 3 |
| Tooltip does not induce user to stay away for a designated amount of distance | 3 | 3 |
| User cannot setup directory for downloading the markup | 1 | 3 |

Results of the heuristic evaluation

# DISCUSSION

Discussion & Limitation

# Extensibility to Remote Diagnosis

- The system initially assumed physical settings, such as hospitals, with a patient and a medical practitioner co-located
- Yet, since the system fully runs online and may make use of the internet network, I believe that the system is extensible to remote clinic situations where each stakeholder is connected to collaborate remotely

# Limitation & Future Work

1. Necessity of reflecting real-world users' needs
    1. Even if we elicited key considerations from the literature, it is also important to understand what the end-users (i.e., patients) truly requires toward an interactive Amsler grid app
2. Evaluation
    1. This study adopted a heuristic evaluation method without evaluating the system with real-world users
    2. In order to fully understand how patients perceive the system and gain feedback from them, clinical testing and interview sessions would be required

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# THANK YOU!


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