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Neo Tandem Technologies

Eye Tracking
Design Documentation

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Functional requirements

Eye Tracking

Github Link: https://github.com/MichaelNunes/Neo-Tandem-Tech-Eye-Tracking

Version: 0.2 Basic requirements
Version: 0.5 Added content
Version: 0.9 Added in-depth content
Version: 1.0 Stable release (version 1) requirements

Contents

1 Introduction

1.1 Description of Document

This document aims to show the design processes used to create the NTT Eye-Tracking application. The document is divided into three sections. Each section describes a certain aspect about the design of the software and how the underlying structure and interfaces are combined to create the final product. The purpose of this eye-tracking software is to allow the user to track eye movements on different kinds of media types and models. This is something that has not been done on models such as three dimensional and video models as yet and will be a great contribution to the eye-tracking community.

1.2 Section Overview

The three sections that are as follows:

- Data Design.
- Interface Design.
- Procedural Design.

These three sections each cover a very important part this software application. Data design will explain the structures used with in the software and how each one works with the other. Interface design will describe the choices made for the look of the software while still incorporating user experience goals to make the program as user friendly as possible. Procedural Design will focus on the procedures and functionality used through out the application.

Take special note that Architectural Design is not included with in this document. This is not necessary as the topics that would be covered by the already existing architectural requirements document. Please refer to it for further information about design structures and such.

2 Data Design

The data structures used through out the application take the form of C# (C-Sharp) classes and external references such as aForge.Net and OpenTK that will be used to process data and return relevant results. The data structures all interact with each other and there is no solitary class that is stand alone but each feature is modularized so that we can easily add or remove features as we see fit. Information is passed through to the desired functionality where further processing can take place.

2.1 Models class

The models classes store all the information about the media that is being used and analysed. The models classes allows developers to add new types of models which can then be used to collect information as recordings and thus apply this information to the relevant models. Currently four different types of models are available to the user.

- 3D Model
- 3D Model Fly Through
- 2D Model
- Video Model

2.2 Heat map class

The heat-map object allows the creation of a heat-map for a specific media model type. The heat-map uses the raw information collected from the eye tracking recording and then generates a heat-map that can be applied. The heat-map can appear in two forms: a heat-map overlay and a heat-map that can be directly applied to the desired model. A heat-map overlay shows the raw information on a blank base image unlike if it were applied to the relevant model base image.

2.3 Gaze Plot class

The gaze-plot object allows the creation of a gaze-plot for a specific media model type. The gaze-plot uses the raw information collected from the eye tracking recording and then generates a gaze-plot that can be applied. The gaze-plot can appear in two forms: a gaze-plot overlay and a gaze-plot that can be directly applied to the desired model. A gaze-plot overlay shows the raw information on a blank base image unlike if it were applied to the relevant model base image.

2.4 Statistics class

The statistics class uses the the raw recording data to create a statistical analysis on the model and gives the user statistics that can aid them in further analysis and forming decisions. The transfer of data from raw to summarized changes the data structure so that it is easier to view by the user.

2.5 Record class

This class initiates the recording process which begins to track the users eye movements. When a record is used it begins to pull coordinates from the existing Eye-Tribe server which are then saved into a file for later processing.

3 Interface Design

The interface design for this project is meant to be kept as simple as possible so that users could easily familiarize themselves with the program. The design should minimize any mistakes the user could make while using the system. We have taken multiple user aspects into account to try and ensure this such as limiting what actions can be made at different times, ensuring no important steps are missed along the way.

3.1 Evolution of the design design

The previous design for the interface was a very primitive windows design .It was a basic and boring design which was only used as a proof of concept. The forms would constantly open and close to new sections and was not very user-friendly. The colours of the form were bland and lacking any appealing factors. The placement of elements were also not ideal for efficiency and clarity when using the program.

The new design improves greatly with a simple interface design that minimizes user error and allows for an easy flow from one task to the next to the next. The placements of elements also uncluttered the interface to make it easier for the users to use the system. The application styles such as colours and texts have also been improved increase appeal.

3.2 Flow of design

An important factor in the design of the interface design is the flow of the interfaces. The flow of interfaces can make a program easy to navigate or harder. We have tried to make it as easy as possible by flowing one form straight into the other in a logical order. The user will also be able to go back to previous forms without any detrimental effects. The main goal behind the new designs was to create a work space for the user that would never be cluttered with options or additional forms.

3.3 Form element placement

The placements of all the elements are carefully placed so that the user would be able to view what options are available. This is vital as this makes it easier to perform tasks and understand what tasks must be preformed before another can take place. when opening or creating a project elements are centred to the form so that it would be the main focus. The recording forms have the buttons listed vertically on the right and a open space to the left that will be used to display a preview of the model that is chosen by the user.

3.4 Interaction with functionality

The interfaces serve as a front end to the user and functionality is added to the various form elements which allow relevant application functionality to be called.

4 Procedural Design

The program has a main procedure which outlines the entire process involved in using the program which can be subdivided into multiple sub-procedures that are used in completing functionality.

4.1 Main Procedure: NTT Eye-tracking application

This will start from the moment the program is initiated. The first subsection is the selection of the method to start the entire process. The user will be greeted with a screen requesting if they would like to open a new or existing project. This then starts the relevant project start process.

4.2 Sub-procedure: Project Start

This sub-procedure executes based on whether a new or existing projected is selected. For the case of a new project, the application will create a file structure to organize all recordings for the project. If an existing project is chosen then the user would be prompted to select the ".eye" file that created with the project. This then loads all project specific details into the system for initialization. From this point the user would be asked to further set-up a recording for the current project.

4.3 Sub-procedure: Recording Set-up

The recording set-up procedure allows the user to select the type of recording they wish to use (2D, 3D or Video) and allows the user to give it a unique name. This procedure is the last step before the user is given the chance to use the main work-space where recordings can be done and results printed.

4.4 Sub-procedure: Main work-space

The main work-space is where the user will preform all tasks needed when using the system. The user will have access to the task bar located on the top of the screen where they can for example start a new project or recording but when it comes to recording specific tasks the user will be granted with multiple buttons on the left of the form. These buttons are enabled as specific functionality becomes available to the user, thus minimizing mistakes and errors. The first button the user will be prompted to use is the calibration button, which will open up the calibration system. Once this is done the

user can now choose a model relevant to the specific recording type. The selected model will then be displayed in the left portion of the screen as a preview and the user can begin a recording. After the recording has taken place multiple new options will become available that allows users to retrieve results from the system. The above mentioned sub-systems will now be further described below.

4.4.1 Sub-procedure: Camera Calibration

This opens the existing The Eye Tribe calibration software that is provided with the eye-tracking camera. We recommend all users preform a calibration step before progressing further in the system as this will ensure the most accurate results for recordings.

4.4.2 Sub-procedure: Model Selection

Users will have the option to pick a model once the calibration step has been completed. They can then select a new model based on the recording type chosen in the recording set-up.

4.4.3 Sub-procedure: Record

With calibration and model selection complete users can now begin the recording. When pressed the selected model will be made full screen and the camera will begin recording data. The user can press the escape key ("Esc") at any time to stop the recording. When this task is complete the user will be able perform any result based tasks.

4.4.4 Sub-procedure: Printing overlays

This provides the user with two relevant outputs, one that is the heat-map and the other that is the gaze-plot diagrams, both are given on blank base images. The results can be found in the relevant recording folder.

4.4.5 Sub-procedure: Printing Heat-map

This provides the user with a new version of the selected model with the heat-map placed on top of it. This outputted result will be in the format of the original model. The results can be found in the relevant recording folder.

4.4.6 Sub-procedure: Printing Gaze Plot

This provides the user with a new version of the selected model with the gaze-plot placed on top of it. This outputted result will be in the format of the original model. The results can be found in the relevant recording folder.

4.4.7 Sub-procedure: Printing Reports

The printing of reports takes the existing recorded data and uses it to provide relevant feedback to the user. Some of the data that will appear in the reports are the selected models meta-data and a grid point analysis. The results can be found in the relevant recording folder.

4.4.8 Sub-procedure: View Results

This option opens the directory of all results and recorded information so that it can be viewed and used as seen fit.

5 Usability testing

Usability testing was seen as an essential exercise to ensure that all features for our application were easy to use.

5.1 Date of testing

Usability testing of the program took place between the 5th of October and 9th of October 2015. Users were asked to perform multiple tasks with in the system testing the full functionality.

6 The participants

The participants used in the testing were largely students from different departments within the university. Each participant was asked to use the program to perform various types of recordings on all the types of models available. The feedback from each participant included their opinion on the following: accuracy of recordings, guided nature of the process, layout of the forms, preview window, size and style of font, size and style of buttons, loading times and calibration.

7 The feedback

The feedback taken from the users were gathered and then analysed. The results of the usability tests are listed below. The original system consisted of small text and blue colour back grounds.

7.0.1 Calibration

The calibration was considered easy to perform and the window that displays the position of the eyes was helpful in positioning the user for optimal use of the program. No

updates were made to this form.

7.0.2 Accuracy of recordings

The heat-maps and gaze-plots have a high enough accuracy that most participants agreed with the results. There were a couple of inconsistencies between the gaze-plot and the heat-maps.

7.0.3 Layout of the forms

The forms were thought to be very simple and clean. Initially (with the first group of participants) the layouts were considered very cluttered. The text was hardly readable and the blue back colour was not to every ones liking. We updated this by making form text bigger and more readable, as well as allowing users to change themes for the application. The base theme was also updated to a lighter more appealing style.

7.0.4 Guided nature of the process

This helped most of those who were lost at first although advanced users felt a bit held back in terms of being able to do as they wish when they wanted.

7.0.5 Preview window

This window was useful to the user as it showed a preview of their model and they could then decide to continue the recording or choose a new model.

7.0.6 Size and style of font

The text was too small and hard to read at times, this made it hard to use as people couldn't see the buttons labels. This was improved upon but changing the font and size.

7.0.7 Size and style of buttons

The buttons were not easily to distinguish from the form as the colours where the same colour. This made it hard to see and click the buttons.

7.0.8 Loading times

Most of the participants agreed that the loading times were too long with any video processing and the 3D rendering.

7.0.9 The changes made

Changes were made to the interface to make it more usable. The colour of the form was updated to a lighter theme to help with this. This makes the text easier to read and the font has also changed and made bold to make it stand out more. The buttons have borders around them to make them easily distinguishable from the background and this helps you know where the buttons are.