Software Requirements Specification

for

Chemistry Equilibrium Visualization

Version 1.0 approved

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1. Introduction

1.1.Purpose

This document details the design, structure, and client requirements for Chemistry Equilibrium Visualization as requested by Dr. Ray Scott. Dr. Scott is the primary audience of this document, with secondary audiences including the implementation and testing teams that will later take over this project.

1.2.Scope

The client, Ray Scott wants a visual aid to assist his students in the understanding of equilibrium. The students are the main users of the system. The software helps these students by providing a hands-on, visual representation of equilibrium.

1.3.References

Khan Academy (https://www.khanacademy.org/science/chemistry/chemical-equilibrium) serves as a reference to clarify principles of elementary chemical equilibrium and use of the k-constant as it relates to chemical systems. Information is provided about factors that influence chemical equilibrium outside of k-constant, though reaction quotients and the like lie outside the scope of this project as it is currently established.

1.4.Overview of the Remainder of the Document

The rest of this document gives an overview of the project and its purpose with details of its intended users, basic requirements and project descriptions. User stories, non-requirements and diagrams will also be included near the end of the document to further explain the software's ability.

2. Project Description

2.1.System Overview

Chemistry Equilibrium Visualization allows students to view models of chemical equilibrium as represented by the seesaw metaphor and to learn how their changes to aspects of the system affect the balance as a whole. To accomplish this, students are provided with a simple visual representation of chemicals on a seesaw, a field to change the equilibrium constant, and a field to change the percentages of chemicals present. Students may either change the equilibrium constant k (noting change in the fulcrum of the seesaw and chemicals present), the chemical percentages (noting change in k and in the fulcrum and sizes of seesaw loads), or the fulcrum itself (noting change in k and chemical percentages).

2.2.Client Characteristics

Dr. Ray Scott is a Chemistry professor at the University of Mary Washington. In his years of teaching, he has found that many of his students tend to find the topic of equilibrium a bit difficult to understand. He desires to have software that introduces the topic in a manner that is interactive and easy to understand.

2.3.User Characteristics

Dr. Scott and his students are intended to utilize the software with Dr. Scott having the ability to demo the software in front of his students in class on a projector screen and his students having personal access to the software to use for themselves.

2.4.Product Functions

The product will open to a start screen where the user has two options

2.4.1.Manual Button

If selected, user is able to manipulate an aspect of the program. User must then configure other aspects to the new values of the manipulated aspect.

2.4.2.Automatic Button

If selected, user is able to manipulate an aspect of the program. System will calculate new values of the other aspects and configure accordingly, user can watch.

3. Requirements

3.1.Title: Increase the equilibrium constant

Description: Increase the equilibrium constant either by dragging the fulcrum to the right or by directly changing the value in the input box to a higher value. In both cases, the fulcrum and the value will both change accordingly (If the value is changed directly, the fulcrum will also move and vice versa). If in AUTO mode, the percentage of reactants will decrease and its visual will get smaller and the percentage of products will increase and its visual get bigger. If in MANUAL mode, the visuals of the reactants and products and their percentages will retain the same and show the unbalanced lever leaning to left.

Assumption: User's actions only intend to increase (not decrease) the equilibrium constant.

Basic Flow:

1. The user drags the fulcrum to the right.
2. The equilibrium constant in the input box increases.

3. The program validates being in AUTO mode.
4. The percentage of products increases.
5. The percentage of reactants decreases.
6. The visual representation of the products grows in size.
7. The visual representation of the reactants shrinks in size.

Alternate Flow:

1. The user changes the equilibrium constant in the input box to a value greater than the original. The fulcrum moves to the right. Flow continues to (3).
1. The user enters a value greater than the allowed maximum. The equilibrium constant shows the maximum value and the fulcrum moves to its rightmost position. Flow continues to (3).
3. The program validates being in MANUAL mode. The unbalanced lever leans to the left. Flow ends.

Exceptions:

1. The fulcrum is already at its rightmost position. Nothing occurs. Flow ends.

3.2.Title: Decrease the equilibrium constant

Description: Decrease the equilibrium constant either by dragging the fulcrum to the left or by directly changing the value in the input box to a lower value. In both cases, the fulcrum and the value will both change accordingly (If the value is changed directly, the fulcrum will also move and vice versa). If in AUTO mode, the percentage of reactants will increase and its visual will get bigger and the percentage of products will decrease and its visual get smaller. If in MANUAL mode, the visuals of the reactants and products and their percentages will retain the same and show the unbalanced lever leaning to right.

Assumption: User's actions only intend to decrease (not increase) the equilibrium constant.

Basic Flow:

1. The user drags the fulcrum to the left.
2. The equilibrium constant in the input box decreases.
3. The program validates being in AUTO mode.
4. The percentage of products decreases.
5. The percentage of reactants increases.
6. The visual representation of the products shrinks in size.
7. The visual representation of the reactants grows in size.

Alternate Flow:
1. The user changes the equilibrium constant in the input box to a value less than the original. The fulcrum moves to the left. Flow continues to (3).
1. The user enters a value less than the allowed minimum. The equilibrium constant shows the minimum value and the fulcrum moves to its leftmost position. Flow continues to (3).
3. The program validates being in MANUAL mode. The unbalanced lever leans to the right. Flow ends.

Exceptions:
1. The fulcrum is already at its leftmost position. Nothing occurs. Flow ends.

3.3.Title: Set the system

Description: The user enters the number of reactant and product species desired in the system. The user then clicks either the AUTO mode button or the MANUAL mode button. The screen changes to the simulation screen with the proper number of species in the system set at equilibrium.

Basic Flow:
1. The user enters number of reactant and product species.
2. The user clicks the AUTO mode button.
3. The screen changes to the simulation screen showing a visual and equation with the proper number of species and the system in equilibrium.

Alternate Flow:
2. The user clicks the MANUAL mode button. Flow continues to (3).
3. The user has entered an invalid value/system (a non-integer, a negative number, a number greater than 3, both numbers are 0, or a non-number). Message pops up on screen saying that the values are invalid and should be integers between 0 and 3, inclusive. Flow goes back to (1).

4. Non-requirements

Non-requirements for Chemistry Equilibrium Visualization largely stem from the ability to present it to the class and smoothy use the application across sections. The system functions as an educational tool rather than a test for explicitly personal use, and preserving that aspect of the system mandates the use of non-requirements.

1. **The system should not have a user database or login screen.**
2. **The system should not use values too specific for general student understanding.**
3. **The system should not react too strongly to slight graphical fulcrum change.**

5. Assumptions

5.1 Assuming security is not a concern as software will be used only in classroom setting.
5.2 Assuming students have basic understanding of chemistry as the software will be used only to explain equilibrium and not the fundamentals of chemistry.
5.3 Assuming students have the basic knowledge of how to work a computer and launch an application as the software will be accessible on a computer.
5.4 Assuming students have a basic awareness of equilibrium function to understand the cause-and-effect goal of the software.
5.5 Assuming internet connection is not a concern as software will not need to connect to a network in order to run.

6. Appendices

6.1.Glossary of Terms

6.1.1.Equilibrium: when the concentrations of reactants and products are constant and their ratio does not vary.
6.1.2.Fulcrum: the support about which a lever turns. In the system the fulcrum is what the seesaw rests upon.
6.1.3.Reactant: a substance or substances that are changed into other substances.
6.1.4.Product: a substance that is formed as the result of a chemical reaction.
6.1.5.Equilibrium Constant (k): a number that expresses the relationship between the amounts of products and reactants present at equilibrium in a reversible chemical reaction at a given temperature.

6.2.Author Information

Corey Staier
Introduction, Project Description, Non-Requirements, Assumptions, Glossary
De'Toine Jones
Document Formatting, Client Characteristics, User Characteristics, Requirements, Overview of the Remainder of the Document
Jordan Mambert
Scope, Overview of the Remainder of the Document, Product Function, Assumptions, Glossary of Terms, Additional Documents

6.3.Additional Documents

6.3.1.Start up page when user opens software.

6.3.2.Example of blank template of what the user sees when running the program.