Software Requirements Specification for Chess Connect: Online tools combined with on-board vision to improve and share your game

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Table of Revisions

Table 1: Revision History

Date	Developer(s)	Change
2022-10-04	Jonathan Cels	Template creation and document formatting
2022-10-04	Jonathan Cels	Non-functional requirements
2022-10-05	Alexander Van Kralingen	Added Context Diagram
2022-10-05	Jonathan Cels	Scope, Intended Reader, Stakeholders
2022-10-05	Arshdeep Aujla	Constraints
2022-10-05	Alexander Van Kralingen	Added Use Cases/Scenarios. Fixed system context diagram position. Added likely change.
date	name	change

1 Units, Terms, Acronyms, and Abbreviations

1.1 Table of Units

Throughout this document SI (Système International d'Unités) is employed as the unit system. In addition to the basic units, several derived units are used as described below. For each unit, the symbol is given followed by a description of the unit and the SI name.

symbol	unit	SI
V	electric potential	volt
A	current	ampere
Ω	resistance	ohm
s	time	second
°C	temperature	centigrade
J	energy	joule
W	power	watt ($W = J\,s^{-1}$)

1.2 Abbreviations and Acronyms

symbol	description
A	Assumption
CSA	Canadian Standards Association
DD	Data Definition
FIDE	International Chess Federation or Fédération Internationale des Échecs
GD	General Definition
GS	Goal Statement
IM	Instance Model
LC	Likely Change
LCD	Liquid Crystal Display
LED	Light-Emmitting Diode
MCU	Micro Controller Unit
PS	Physical System Description
R	Requirement
SRS	Software Requirements Specification
T	Theoretical Model
VnV	Verification and Validation
WCAG	Web Content Accessibility Guidelines

1.3 Mathematical Notation

1.4 Terminology and Definitions

2 Introduction

2.1 Document Purpose

2.2 Characteristics of Intended Reader

The document is written with the purpose of guiding development for the Chess Connect team. The intended readers of this document are the developers of Chess Connect, Dr. Spencer Smith, and Nicholas Annable, the teaching assistant assigned to this project. The document is thus written for an audience that is well-versed in formal specification at a university level. This includes models, diagrams, and mathematical notation. Readers should also have a university-level understanding of electrical circuit knowledge.

2.3 Characteristics of Intended User

2.4 Stakeholders

This project will assist chess players of any level that are looking for a tool to help them learn and study the game. For beginners, the board serves as a learning tutorial and a general introduction to the game, while intermediate and advanced players can use the engine move recommendations to study new lines, puzzles, and specific positions. In addition to chess enthusiasts, this project will also be relevant to chess tournament organizers looking for a method to easily broadcast and share their games online in real-time.

3 Problem Description

Online chess has functionality for both beginners and experienced players to learn and practice the game. However, these forms of learning emphasize a visual style of learning using a standard keyboard and mouse, while physical boards place emphasis on tactile learning when learning or studying the game. The highest-rated chess players often use a combination of the two styles to optimize their play. However, no option exists for players of any skill level to integrate their over-the-board and online play with one solution.
Chess Connect plans to centralize these two mediums of studying the game in order to provide flexibility and remove constraints for new players in learning how to play chess.

4 Assumptions

5 Constraints

C1	The cost should not exceed CAD $750
Rationale	This is the maximum budget alloted to this project as per the course requirements.

C2	The project must be completed by the winter semester of 2023
Rationale	This is the allocated time for this project as per the course requirements.

6 Scope

The system is called Chess Connect, and will include a software application and physical hardware device. The hardware will take the form of a chess set, and will collect and relay move and piece data. The device will convey the best moves for the specific board position,

and will convey legal moves for specific pieces.The device will be connected to the software application, relaying and receiving relevant data. The software application will model and track the physical device, and will broadcast the data in an accessible format. The application will be constrained to a 2-dimensional model of the hardware device, showing a top-down view of the game.

In-scope items for the system include the following:

1. Modeling and tracking a chess game played using the Chess Connect hardware

2. Displaying and broadcasting the game state on the Chess Connect software application

3. Giving users an option to choose between beginner mode, engine mode, and normal mode

   - Beginner mode will display legal moves for individual pieces when a chess piece is picked up, and will warn the players when an illegal move is made
   - Engine mode will display the best moves as determined by a chess engine for the position
   - Normal mode will disable the engine and beginner mode features. This is intended for regular play between experienced players

The following items are deemed to be **out of scope**:

1. FIDE (International Chess Federation) standards for tournament appropriate chess equipment

2. Tracking and support for alternate chess variants such as Chess960, Atomic Chess, King of the Hill. More information found here: List of Chess Variants.

3. Proper tracking of alternate starting positions like puzzles

4. Proper tracking of illegal moves and rule violations when warnings are ignored

7 Project Overview

7.1 System Context Diagram

The context of the system invloves two integrated but separate system components, as well as two distinct end users.
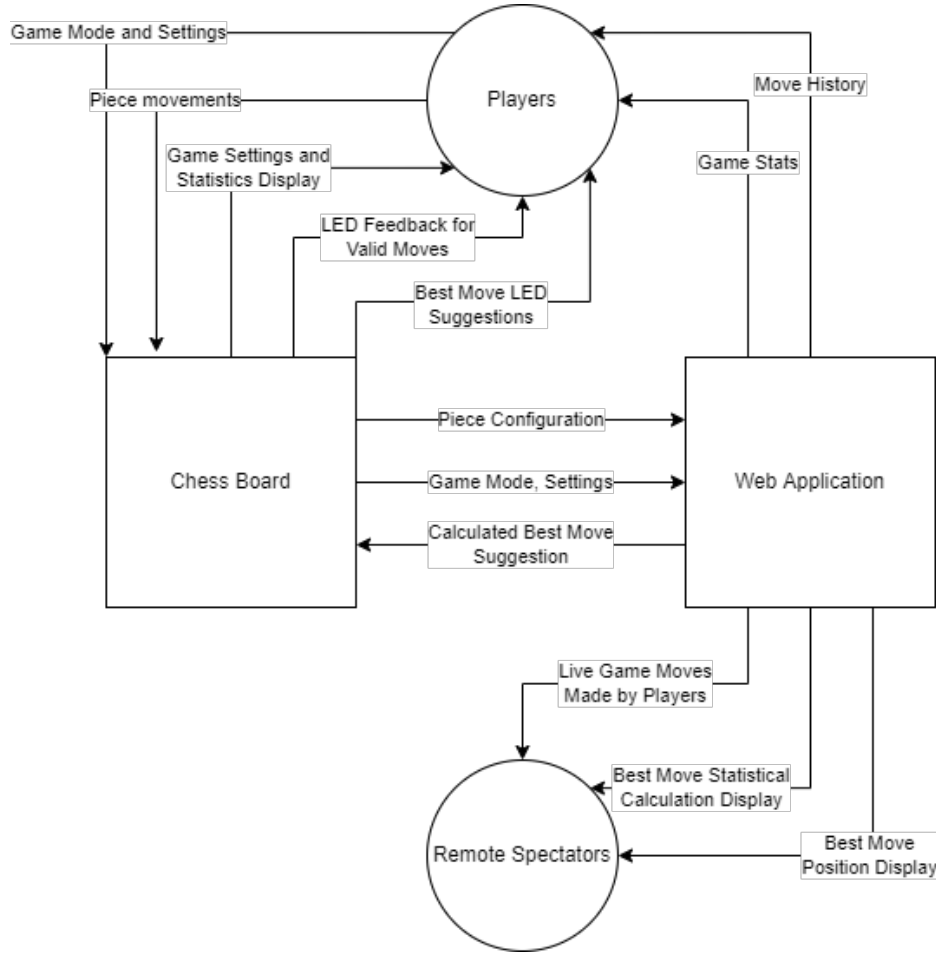
Figure 1: System Context

7.2 Behaviour Overview

7.3 Normal Operation

7.3.1 Description

The normal operation of the chess board involves configuring game mode and settings, reading the physical positions and identifiers (magnetic strength) of the pieces, lighting up corresponding LEDs and determining valid moves on the microcontroller. There will be three game modes: Normal Mode (no LED feedback), Engine Mode (best moves calculated by a chess engine and displayed by LEDs on the board) and Beginner Mode (valid moves displayed by LED when a piece is picked up). The microcontroller will also be simultaneously transmitting data to the server via Bluetooth and receiving responses in the form of "best" moves from the server. The server will be calculating these best moves in real time depending on the configuration of the pieces on the board sent from the chess board, and sending it back over Bluetooth every time it is queried while the game is in "Engine Mode". The

server will also be communicating all of this information to a Web Application where users can tune in and watch the pieces and see game stats in real time.

7.3.2 Use Cases/Scenarios

7.3.2.1 Normal Mode

Users play the game without any LED feedback. This would typically be a formal match involving players that are familiar with the game. Moves would still be broadcast to the Web-App, and move history will still be recorded for future reference.

7.3.2.2 Engine Mode

Users play the game with LED feedback indicating which pieces to move to which positions that would be statistically the most probable move to win the game. This game mode would be most likely played as a way to improve one's skill level and to gain a deeper understanding of the game.

7.3.2.3 Beginner Mode

Users play the game with LED feedback on lifting a piece. The piece lifted will be determiend by the hardware and corresponding valid moves will be lit up on the board. This game mode is designed to help beginners learn the game of chess. Valid moves will involve more complex strategies such as "en passant" and "castling."

7.3.2.4 Studying Past Games

The Web-App will have a record of the moves made in past games. This can be used to study the game moves and understand scenarios which could have been handled differently to produce a more favourable outcome.

7.3.2.5 Tournament Play

Since the moves made in the game will be broadcasted live to the internet via the Web-App, tournaments can be held with spectators watching the game in real time.

7.4 Undesired Scenario Handling

8 System Level Variables

8.1 Constants

Constant	Unit	Value
Chess board width	inches	12
Chess board length	inches	12
Chess board tile width	inches	1.5
Chess board tile length	inches	1.5
Supply Power to Board	Volts	110 VAC

8.2 Monitored Variables

Variable	Units	Description
s_a{1-8}	Volts	States of tiles a1 - a8 on the board. They are analog signals converted to digital and the state of the tile is determined. The possible states of each tile is empty, black/white pawn, black/white rook, black/white knight, black/white bishop, black/white queen, black/white king.
s_b{1-8}	Volts	States of tiles b1 - b8 on the board. " "
s_c{1-8}	Volts	States of tiles c1 - c8 on the board. " "
s_d{1-8}	Volts	States of tiles d1 - d8 on the board. " "
s_e{1-8}	Volts	States of tiles e1 - e8 on the board. " "
s_f{1-8}	Volts	States of tiles f1 - f8 on the board. " "
s_g{1-8}	Volts	States of tiles g1 - g8 on the board. " "
sw_3pos_p1-2	Volts	The three-position switch for both players is located on top of the board on their respective sides. It toggles between the beginner advice, engine advice and no advice modes for each player.
tieB_p{1-2}	Volts	The "draw" push-button for each player is located on the top of the board on their respective sides. When both players press their button the game is a draw.
engine_move	chess notation	The chess engine API provides best moves into the system.

8.3 Controlled Variables

Variable	Units	Description
LED_row{1-9}	Volts	A total of 81 LEDS will be located under the board. They are on the corner of each tile and illuminate based on conditions of the inputs.
LCD_Display	Volts	An LCD Display is located on the chess board to indicate best moves delivered by the engine.

9 Requirements

9.1 Functional Requirements

9.2 Nonfunctional Requirements

9.2.1 Look and Feel Requirements

9.2.1.1 Appearance Requirements

LF1. The product shall use white, black, grey, and brown as its primary colours.

LF2. The product shall use green, red, and blue as its secondary colours.

9.2.1.2 Style Requirements

LF3. The product shall look and feel similar enough to traditional chess boards and chess pieces that the target audience will recognize the product as a chess set when encountering it for the first time. The level and speed of audience recognition achieved by the design shall be described following the procedure given in Section 5.2.1 of the VnV (Verification and Validation) Plan.

9.2.2 Usability and Humanity Requirements

9.2.2.1 Ease of Use Requirements

UH1. The system shall require the user to place chess pieces fully on their intended squares.

UH2. Physical hardware components of the system will not impede the user during play.

9.2.2.2 Personalization and Internationalization Requirements

UH3. The system will only display information in English.

UH4. The system will only use the Arabic numerals.

9.2.2.3 Learning Requirements

UH5. The product shall be able to be used by members of the public over with no previous training. Details on the learnability of the system shall be described following the procedure given in Section 5.2.2 of the VnV Plan.

9.2.2.4 Understandability and Politeness Requirements

UH6. All symbols and words shall be similar to historically used Chess symbols. Wall (2003)

9.2.2.5 Accessibility Requirements

UH7. The system shall follow guidelines for correct size and colour contrast ratio for text to the background as stated in the WCAG.

9.2.3 Performance Requirements

9.2.3.1 Speed and Latency Requirements

PR1. The average time between a user placing down a piece and the visual model response shall be small.

PR2. The maximum time between a user placing down a piece and the visual model response shall be small.

PR3. The average time between a user picking up a piece and the visual board indicator response shall be small.

PR4. The maximum time between a user picking up a piece and the visual board indicator response shall be small. The degree of speed for PR1 through PR4 shall be described following the procedure given in Section 5.2.3 of the VnV Plan.

9.2.3.2 Health and Safety-Critical Requirements

PR5. The system shall be properly grounded according to the Canadian Electrical Code. CSA (2021)

PR6. The maximum power on any single wire shall be within the safety limits described in the Canadian Electrical Code.

9.2.3.3 Precision or Accuracy Requirements

PR7. The software application game state will model the game state on the Chess Connect hardware with a high degree of accuracy. The level of accuracy shall be described following the procedure given in Section 5.2.4 of the VnV Plan.

9.2.3.4 Reliability and Availability Requirements

PR8. The product shall be available with a high degree of uptime. The level of availability shall be described following the procedure given in Section 5.2.5 of the VnV Plan.

9.2.3.5 Robustness or Fault-Tolerance Requirements

PR9. The software application shall maintain the game state if the connection between the software and hardware systems is interrupted.

9.2.3.6 Capacity Requirements

PR10. The software shall require computer memory to function effectively. The level of memory capacity required shall be described following the procedure given in Section 5.2.6 of the VnV Plan.

9.2.3.7 Scalability or Extensibility Requirements

PR11. The product must support the addition of new features and components.

9.2.3.8 Longevity Requirements

PR12. The product must be supported while the application remains deployed.

PR13. The product will depend on the continued support of packages and libraries.

9.2.4 Operational and Environmental Requirements

9.2.4.1 Expected Physical Environment

OE1. The hardware and software systems shall be close enough to each other to facilitate communication. The degree of proximity required shall be described following the procedure given in Section 5.2.7 of the VnV Plan.

OE2. The area shall be clear of potentially dangerous or harmful environmental factors.

9.2.4.2 Requirements for Interfacing with Adjacent Systems

OE3. The system shall interface with an external server to make requests to a chess engine.

9.2.4.3 Productization Requirements

OE4. The product shall be deployed to a public website where users may access it.

9.2.4.4   Release Requirements

OE5. The product will be tested for bugs and issues. These issues will be fixed and the application will be redeployed accordingly.

9.2.5   Maintainability and Support Requirements

9.2.5.1   Maintenance Requirements

MS1. The product shall be maintained actively by the developers until the Chess Connect team graduates.

9.2.5.2   Supportability Requirements

N/A

9.2.5.3   Adaptability Requirements

MS2. The software application will be able to be hosted on Apple, Windows, and Linux devices.

MS3. The product shall be accessible from any web browser.

9.2.6   Security Requirements

9.2.6.1   Access Requirements

SR1. Only the Chess Connect team are able to modify the software system.

9.2.6.2   Integrity Requirements

SR2. The product will not store game data after a game has concluded.

9.2.6.3   Privacy Requirements

SR3. The product will not store or collect user data.

9.2.6.4   Audit Requirements

SR4. Requirements shall be easy to follow and verify against both the system and the VnV plan in order to facilitate regular inspections.

9.2.6.5   Immunity Requirements

N/A

9.2.7 Political and Cultural Requirements

9.2.7.1 Cultural Requirements

PC1. The product will not use and terms or symbols that are deemed offensive to any culture.

9.2.7.2 Political Requirements

N/A

9.2.8 Legal Requirements

9.2.8.1 Compliance Requirements

LR1. The system shall comply with the Canadian Electrical Code CSA (2021).

9.2.8.2 Standards Requirements

LR2. The product shall follow WCAG.

10 Likely Changes

10.1 Play Against Computer Opponent

An additional game setting to enable either white or black to be a "computer" opponent will be implemented in Engine Mode. The user will be able to set a skill level for the computer, and moves will be displayed as squares lit up by the on-board LEDs.

11 Unlikely Changes

12 Traceability Matrix

A Values of Auxiliary Constants

A Reflection

A.1 Skills for Success

A.2 Knowledge and Learning Approaches

References

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