

# Hazard Analysis Chess Connect

Team #4,  
Alexander Van Kralingen  
Arshdeep Aujla  
Jonathan Cels  
Joshua Chapman  
Rupinder Nagra

Table 1: Revision History

| <b>Date</b> | <b>Developer(s)</b>     | <b>Change</b>   |
|-------------|-------------------------|---|
| 2022-10-09  | Arshdeep Aujla          | Added table for FMEA  |
| 2022-10-09  | Alexander Van Kralingen | Updated Introduction, Scope, System Boundaries and Critical Assumptions |
| 2022-10-09  | Alexander Van Kralingen | Fixed FMEA table placement  |
| 2022-10-19  | Jonathan Cels           | Added requirements  |
| 2022-10-19  | Joshua Chapman          | FMEA table edits and description changed                                |
| ...         | ...                     | ...   |

# Contents

|          |   |          |
|----------|---|----------|
| <b>1</b> | <b>Introduction</b>                         | <b>1</b> |
| <b>2</b> | <b>Scope and Purpose of Hazard Analysis</b> | <b>1</b> |
| <b>3</b> | <b>System Boundaries and Components</b>     | <b>1</b> |
| <b>4</b> | <b>Critical Assumptions</b>                 | <b>1</b> |
| <b>5</b> | <b>Failure Modes and Effects Analysis</b>   | <b>2</b> |
| <b>6</b> | <b>Safety and Security Requirements</b>     | <b>4</b> |
| 6.1      | Access Requirements . . . . .               | 4        |
| 6.2      | Integrity Requirements . . . . .            | 4        |
| 6.3      | Privacy Requirements . . . . .              | 4        |
| 6.4      | Audit Requirements . . . . .                | 4        |
| 6.5      | Immunity Requirements . . . . .             | 4        |
| <b>7</b> | <b>Roadmap</b>                              | <b>4</b> |

## 1 Introduction

Creating a product designed for consumer use requires a robust hazard identification and mitigation strategy before the product is released to the public. A hazard can be defined as any source of potential damage, harm or adverse health effects on something or someone [for Occupational Health and Safety \(2022\)](#). A hazard for the Chess Connect system is anything that could either harm the user or cause system failure.

## 2 Scope and Purpose of Hazard Analysis

In this document, the potential cause for hazards will be explored in detail, as well as methods for preemptive detection, and recommended actions should the hazard still present itself. Its purpose is to identify potential sources for harm or failure and address them before they are presented in the finished product.

## 3 System Boundaries and Components

The Chess Connect system is comprised of three main components:

1. The hardware including the chess pieces, board, microcontroller and all electronic components:
  - LEDs
  - Hall-Effect sensors
  - LCD screen
  - Connecting wires
  - Power adapter
2. The nearby server to receive data through a Bluetooth connection.
3. The hosted Web Application used to connect to the game remotely.

The boundary of this system begins at the chess board and ends at the Web Application (Web-App). The distance between the chess board and the server is spanned by a Bluetooth connection, and the server to the Web-App by Wi-Fi. The user will cross the system boundary by interacting with the hardware and the Web-App, however everything in between will be isolated within the system.

## 4 Critical Assumptions

The assumptions made in this document are meant to constrain the hazards to those present within typical operation. These assumptions are as follows:

1. The chess board is operated in a dry environment.

2. The server present will be capable of both Bluetooth and Wi-Fi connections.
3. The user is not intentionally trying to disconnect the electronics within the board.
4. The Web-App hosting platform will remain up and running without interruption.

## **5 Failure Modes and Effects Analysis**

The failure modes and effects analysis is used to identify and analyze potential hazards to the system. Causes of failure discuss existing hazards that will have negative effects on the system. Hazard detection details the methods used to distinguish failures. Recommended actions explain the behavior of the system when the failures occur. Likelihood is a scale to detail the frequency and probability-of-occurrence in the event of a failure. All of these methods are used to enhance requirement implementation and hazard prevention.

| Component       | Failure                                   | Causes  | Detection  | Recommended Action  | Likelihood | Requirements |
|-----------------|---|---|--|---|------------|--------------|
| Web Application | Loss of internet connection               | (a) Internet outage<br>(b) Internet time-out<br>(c) Board is taken out of connection range  | Ping the Internet and wait for the response                    | Alert the user to check Internet connection   | 0.4        | SR3, SR4     |
| Web Application | Connection lost between server and client | (a) Deployment hosting platform fails<br>(b) Platform is taken down for maintenance   | Loss of connection to the platform                             | Alert the user of the issue and wait accordingly  | 0.1        | SR3, SR4     |
| Microcontroller | Unable to detect starting game state      | (a) A player begins with the pieces in the incorrect location<br>(b) Player does not follow the correct starting protocol   | Strict guidelines programmed in the microcontroller to prevent | Prompt user to make appropriate changes to pieces or board state  | 0.2        | SR5          |
| Microcontroller | Unable to follow game state               | (a) A player makes two moves in a row<br>(b) A player makes an illegal move<br>(c) Loss of power to system  | Edge cases programmed on the controller                        | Prompt user to make appropriate action to the board   | 0.3        | SR5          |
| Microcontroller | Loss of Bluetooth connection              | (a) Distance between microcontroller and host is too large<br>(b) Physical barriers between microcontroller and host<br>(c) Failed to initialise connection<br>(d) Packet loss from board to server | Continuously monitor Bluetooth connection                      | Prompt the user to re-establish connection before continuing  | 0.1        | SR3, SR4     |
| Microcontroller | Loss of Power                             | (a) Board is unplugged<br>(b) Cable connection failure<br>(c) Power surge   | N/A  | Store game state in local flash memory  | 0.1        | SR3          |
| Hall Sensor     | Bad inputs                                | (a) Sensitivity loss over a period of time<br>(b) Interference from external magnetic objects<br>(c) Distance between sensor and object too large   | Monitoring Hall sensor inputs                                  | (a) Prompt the user to clear area of obstacles from the board<br>(b) The sensor should be replaced after the recommended use time | 0.1        | SR5          |

## 6 Safety and Security Requirements

### 6.1 Access Requirements

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

### 6.2 Integrity Requirements

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

SR3. The system shall locally maintain the current game state, making no changes until a connection is reestablished.

SR4. The system shall alert the user that a connection has been lost.

SR5. The system shall prompt the user to take an appropriate hazard-specific action.

### 6.3 Privacy Requirements

SR6. The product will not store or collect user data.

### 6.4 Audit Requirements

SR7. Requirements shall be easy to follow and verify against both the system and the VnV (Verification and Validation) plan in order to facilitate regular inspections.

### 6.5 Immunity Requirements

N/A

## 7 Roadmap

[Which safety requirements will be implemented as part of the capstone timeline? Which requirements will be implemented in the future? —SS]

## References

Canadian Centre for Occupational Health and Safety. Hazard and risk: Osh answers. [https://www.ccohs.ca/oshanswers/hsprograms/hazard\\_risk.html](https://www.ccohs.ca/oshanswers/hsprograms/hazard_risk.html), 2022. Accessed: 2022-10-05.