UNO Flip Remix - Hazard Analysis

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Revision History Log

Date	Developer(s)	Change
10/25/2024	Mingyang Xu, Jiahao Wei, Kevin Ishak	Wrote sections 1–7
10/25/2024	Andy Liang	Wrote Appendix: Reflection for team and self
03/26/2025	Kevin Ishak	Revised document according to feedback. Added proper attribution for Nancy Leveson, fixed roadmap section, added List of Tables, and removed page layout artifacts.

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1 Introduction

This document follows principles from system safety engineering, particularly the work of Nancy Leveson on hazard analysis.[1] This document is the hazard analysis of the UNO Flip Remix game. It analyzes potential hazards within the digital game project. Hazards are identified and assessed to ensure safety, data integrity, and uninterrupted game play, particularly in a multiplayer online setting.

2 Scope and Purpose of Hazard Analysis

The analysis focuses on identifying hazards related to user interaction, server reliability, AI behaviors, and multiplayer synchronization, and offers mitigation strategies to maintain game play integrity and security.

3 System Boundaries and Components

The UNO Flip game project consists of several major software components:

- **User Interface (UI)**: Handles player interaction, input validation, and displays the game state.
- **Game Logic**: Controls game play mechanics, rule enforcement, and game state tracking.
- **Networking Module**: Facilitates communication between players in multiplayer mode.
- **Database or Game State Storage**: Manages saving of game progress, scores, and player data.
- **Card Management System**: Manages cards' actions such as shuffling, drawing, and flipping.
- **Server (if applicable)**: Manages player interactions and game sessions in an online environment.
- **Audio/Visual Effects Module**: Enhances user experience with animations and sound cues.

4 Critical Assumptions

- **User Inputs**: Players are assumed to provide valid inputs; however, validation will prevent illegal moves.

[1] Nancy G. Leveson, *Engineering a Safer World: Systems Thinking Applied to Safety*, MIT Press, 2011.

- **Network Stability**: Assumes stable network connections; error handling will address potential disconnections.
- **System Resources**: Assumes sufficient memory and processing power.
- **Server Reliability**: Server can handle multiple game sessions without performance degradation.
- **Deck Management**: Assumes proper shuffling and flipping mechanisms.
- **Game Logic Accuracy**: Assumes bug-free game logic.
- **Audio/Visual Synchronization**: Assumes correct synchronization of game cues.

5 Failure Mode and Effect Analysis

Failure Mode	**Effect**	**Mitigation Strategy**
Server crash during multiplayer game	Game interruption and loss of data	Implement auto-save and allow for session recovery
Invalid card play due to client-side bug	Game logic inconsistency	Validate all actions server-side and reject illegal plays
AI makes invalid move	Unfair game play or crashes	Add server-side rule enforcement and fallback logic
Network latency causes turn desync	Players see inconsistent game states	Use rollback networking or lock-step turn control

Table 2: Sample Failure Modes and mitigation

6 Safety and Security Requirements

6.1 Access Requirements

- AR1: Only server administrators can modify basic game features.
- AR2: Only server administrators can modify user accounts, with user consent.

6.2 Integrity Requirements

- IR1: The system should not unintentionally modify user information and game data.
- IR2: The system should conduct regular authentication checks.
- IR3: The app should store unsynced data locally and upload it when possible.

6.3 Privacy Requirements

- PR1: The app should encrypt conversations and not save unencrypted chat data.
- PR2: The app should not provide personal information to third parties.

7 Roadmap

This section outlines key implementation activities and alignment of hazard-related mitigation:

- ~~Sept. 11, 2024: Team formation and initial brainstorming.~~
- ~~Sept. 23, 2024: Project approved and scope defined.~~
- ~~Oct. 11, 2024: Drafted SRS document outlining early risks.~~
- ~~Oct. 25, 2024: Initial hazard analysis drafted.~~

- Finalized SRS and requirements document to define scope for hazard analysis and mitigation.
- Hazard mitigation strategies were documented alongside failure modes for integration into the design.
- Security requirements (such as encryption, server validation, and disconnection recovery) will be implemented during the core system development phase.
- Post-implementation testing will validate that all critical safety requirements are functional.
- Reflection and post-mortem review will evaluate effectiveness of implemented mitigation.

Appendix — Reflection

- **1. What went well while writing this deliverable?**
  Team members collaborated effectively and identified hazards systematically, which allowed for a comprehensive hazard analysis.

- **2. What pain points did you experience during this deliverable, and how did you resolve them?**
  Challenges arose in defining system boundaries clearly and categorizing hazards accurately. The team discussed these issues and revised sections collaboratively to reach a clearer understanding.

- **3. Which of your listed risks had your team thought of before this deliverable, and which did you think of while doing this deliverable?**
  Prior risks included server stability and user data integrity. New risks discovered during this process included specific game play interruptions due to network issues and risks associated with card management errors.

- **4. Other than the risk of physical harm, list at least two other types of risks in software products. Why are they important to consider?**

  1. **Data Privacy Risk**: Ensuring user data is secure and only accessible by authorized individuals is crucial for user trust and regulatory compliance.
  2. **System Reliability Risk**: Preventing unexpected crashes and ensuring smooth game play are essential for user satisfaction and retention.