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**Team Union Pacific**

**Michigan State University**

Switch Alignment Mobile Game

Project Plan

Spring 2023

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# **Executive Summary**

Union Pacific operates and maintains one of the largest railroad systems in the United States. The freight-hauling railroad transports thousands of goods and materials each day, including food, automobiles, coal, and chemicals. The company was originally founded under the Pacific Railroad Act of 1862, and now operates 8,300 locomotives and over 32,000 miles of railroads nationwide. Headquartered in Omaha, Nebraska, Union Pacific serves as a blueprint for efficient, reliable, and sustainable transportation.

Safety is a top priority for Union Pacific. In the rail industry, misaligned railroad switches can be a major safety threat. For this reason, employees must be well-trained to recognize proper switch alignment. Identifying switch alignment both quickly and accurately is crucial for Union Pacific employees in the event of a misaligned switch. This is achieved by diligent training and frequent practice. Our goal is to create an entertaining mobile game to help train employees in proper switch identification. The game will be a realistic looking simulation with various weather conditions and scenarios. The game will also have leaderboard features to help motivate employees to keep improving their score and, in turn, keep practicing and learning.

# **Functional Specifications**

With a company as large as Union Pacific, operating in such a vast area, there are many possible switch alignment scenarios that any employee might encounter. Employees are often moved around, so training for only the location an employee begins in is not practical and will slow performance if they are moved to a place covering a vastly different environment because they will need to be trained again. From rain and snow to a plethora of different switches and indicators, it can be difficult to effectively train a new hire, or continue preparing established workers, for all the environments they might need to operate in. Not being properly trained for all conditions can cause mistakes to arise, which is costly since the frequent outcome for a misaligned switch is train derailment.

Getting hands-on experience for all scenarios would involve a long process of moving workers from place to place and going through many hours of training at each new location. This process is taxing on the workers and costly to the company. However, technology has evolved to the point where it is possible to simulate different scenarios and present them to better prepare an employee, without having to move them across the country just for training.

This project aims to solve these problems by presenting a mobile game that is both informative and fun. It will present the player with a scene to challenge them to properly identify a railroad switch’s alignment in a variety of environments and conditions to better prepare them for real world scenarios. With a competitive leaderboard and captivating gameplay, new and established employees will have the opportunity to be entertained during downtime, while simultaneously furthering their switch alignment identification skills.

# **Design Specifications**

## **Overview**

Switch Alignment Mobile Game allows new field employees of Union Pacific to learn and practice aligning switches in different conditions in a new, fun, and interactive way. All users have accounts. These are used for logging in to the game, as well as adding other players as friends. The scores of users are displayed on a leaderboard with corresponding usernames. This leaderboard can be checked at any time with a button and will be shown at the end of every run. The game scenarios are repeatable and randomized to ensure a fun and engaging learning environment. The game also provides immediate feedback to the users according to their performance in the game through sound and visual feedback. The game view is a train cab with three buttons; left, right, and emergency stop. The cab window provides the visual of rails ahead as would be seen by a conductor.

## **Screen Mockups**

**Graphical user interface, diagram

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Figure 1: Web-interface of Switch Alignment Mobile Game

**A picture containing text, monitor, electronics, screenshot

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Figure 2: Main Menu of Switch Alignment Mobile Game

A picture containing text, electronics, cellphone

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Figure 3: Cloudy Midday Gameplay of Switch Alignment Mobile Game

**Graphical user interface, application

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Figure 4: Game Over Menu of Switch Alignment Mobile Game

**A picture containing text, electronics, cellphone

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Figure 5: Snowy Weather Gameplay of Switch Alignment Mobile Game

# **Technical Specifications**

## **System Architecture**

**Graphical user interface, application, Teams

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## **Overview**

The Switch Alignment Mobile Game will have all front-end and game architecture components created in Unity 3D, and all back-end components handled by Oracle Database services. Unity 3D will communicate with the database through a RESTful API which will be developed using Spring framework.

The front-end components in Unity will be split across five distinct scenes: User Authentication, Main Menu, Settings, Game Instance, and Game End Menu. Users will begin at User Authentication, where they will login to the database using their Union Pacific employee credentials. Once authenticated, users will load into the Main Menu scene, where they can either begin a game, navigate to settings, or display a leaderboard. The leaderboard will have two tabs, one to display the scores of all the employees and one to display scores of the user’s service unit. Both tabs will have data sorted in ascending order. Once a user loads into the Game Instance scene they will be presented with various switch alignment scenarios and will earn points as they correctly identify them. If a switch is misidentified the Game End Menu scene will be loaded, displaying the users high score, along with an option to display a leaderboard, return to Game Instance, or return to Main Menu.

The back-end component of the project will include an independently hosted Oracle Database along with a REST API developed using Spring. The Oracle Database will feature fake data formatted similarly to what is used in Union Pacific’s own database. This data will include each employee's name, identification number, high score, and service unit members by employee ID. The front-end component in Unity will access this data to provide user authentication, leaderboards, and to track each user's high score. This data will be accessed through the REST API. Once the project is completed, Union Pacific’s own backend database team will migrate the project to their own backend services along with including their own user authentication.

# **System Components**

**Oracle Database:** Oracle Database will be used for all back-end purposes of this project. For testing purposes, a free demo database will be hosted by our team with fake employee data. Once completed, the project will be migrated to a new back-end hosted on Oracle by Union Pacific’s own database team.

**Spring:** Spring will be used to create a REST API to enable communication between our Oracle Database back-end and Unity 3D front-end. This will allow the front-end in Unity to call SQL queries to the Oracle Database.

**Unity 3D:** Unity 3D will be used to create the switch alignment simulation. Everything that involves the actual gameplay will be created in Unity. Unity will be used to create the weather conditions, terrain, and railroads.

**Zebra Phone:** The Zebra phone is the primary device used by Union Pacific employees. For that reason, it is imperative that this application is functional on that device.

# **Risks Analysis**

**Risk 1​: Assure REST API is compatible with both the client’s preferred database and Unity framework.**

**Difficulty:** Medium

**Description:** A REST API is necessary to communicate between the client’s database and the Unity project.

**Mitigation:** Create a REST API capable of communicating with an SQL database and determine how to utilize it in Unity to call queries.

**Risk 2​: Incorporating snow as an environmental obstacle.**

**Difficulty:** Medium

**Description:** No assets on the App Store include snow models and we were not provided any resources to accommodate for this, we will need to figure out a work around to add these environmental elements.

**Mitigation:** Create our own models to show snow on the tracks or acquire models with proper licensing from a free source.

**Risk 3​: Game performance/Battery usage when running on Zebra phone, which is used by Union Pacific employees​​.**

**Difficulty:** Medium

**Description:** The employees of Union Pacific play the Switch Alignment Mobile Game using a Zebra phone, but team members only have Android and IOS devices. So, there will probably be bugs or errors that are not tested until using a Zebra phone.

**Mitigation:** Team Union Pacific will use Unity device simulator to simulate screen dimensions​​, and possibly test on our own Android devices.

**Risk 4​: Scalability of database and queries based on employees active​​.**

**Difficulty:** Medium

**Description:** There may be a cost to use a database if the database is large. Team Union Pacific is not sure about how large the clients want the database to be.

**Mitigation:** Team Union Pacific will consult clients about scale, make sure the cost of queries isn't out of their comfort zone​.

# 

# **Schedule**

**Week 1: 1/9 - 1/14**

* Joined Teams channel for communication.
* Assign main contact person (Jiayue Chai).
* First meeting with team and clients.

**Week 2: 1/15 - 1/21**

* First triage meeting with Team Manager (Luke Sperling).
* First status report of project.
* Second meeting with clients to follow-up unclear details of project.
* Take team photos.
* Start project plan document draft.
* Sign Intellectual Property Agreement and Non-Disclosure Agreement documents.

**Week 3: 1/22 - 1/28**

* Finish first draft of project plan document and share with clients.
* Create mock-up screens for different use cases.
* Finish project plan presentation slides.

**Week 4: 1/29 - 2/4**

* Project plan presentation.
* Review and submit project plan document.
* Work on prototypes.
* Begin working on game development.

**Week 5: 2/5 - 2/11**

* Create main page of the game.
* Connect game to database.
* Add railroad tracks to the game.
* Get Zebra phone from clients/set up device simulator.

**Week 6: 2/12 - 2/18**

* Add weather effects to the game.
* Add train to the game.
* Set switches on railroad.
* Animation of switches and trains.
* Work on alpha presentation slides.

**Week 7: 2/19 - 2/25**

* Finish alpha presentation slides.
* Team Alpha presentation.
* Add tunnel and random weather to the game.
* Prompt direction instructions on screen.

**Week 8: 2/26 - 3/4**

* Set scoring and immediate feedback.
* Test leaderboard.
* Add tutorial to the game.

**Week 9: 3/5 - 3/11**

* Spring break.

**Week 10: 3/12 - 3/18**

* Refine UI.
* Test basic game features and fix bugs.
* Work on the second status report presentation slides.

**Week 11: 3/19 - 3/25**

* Finish the second status report presentation slides.
* Share first version of game with clients and make changes.

**Week 12: 3/26 - 4/1**

* The second status report presentation.
* Work on beta presentation slides.

**Week 13: 4/2 - 4/8**

* Finish beta presentation slides.
* Meet with clients and discuss any final changes to make.

**Week 14: 4/9 - 4/15**

* Work on the third team status report presentation slides.
* Team beta presentation.
* Final test of game and fix bugs.

**Week 15: 4/16 - 4/22**

* Finish team status report presentation slides.
* Work on project video.
* Third team status report presentation.

**Week 16: 4/23 - 4/29**

* Finish project video.
* All project deliverables due.
* Design day setup.
* Design day.

**Week 17: 4/30 - 5/6**

* Project completion.