

Software Engineering Project Report



Documentation for Software system development on Training Simulator for Soccer Players

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Project Description

1 Project Overview

This development project is about creating a system software that will provide an innovative training system for soccer players. The system reproduces a real situation or a cognitive process designed to boost its users' capabilities. The system consists of a 4-sided physical box that encloses an artificial pitch. Once activated, the simulator fires in balls to a waiting player, who is then directed to settle and pass that ball into a specific quadrant of the box, dribble around physical obstacles, shoot at virtual goalkeepers, etc. The system relies on an LED wall and automated 'ball boy', using fully-customisable system software to analyse performance and allow players to work on their skills. The software will have the ability to interact with existing databases and manage training sessions. Each player has their own system profile for training, enabling them to track details about their session and generate reports. This will allow developing and improving the players' responsiveness, accuracy, speed and 360° vision in a system of individualised training within specific exercises.

Also, in conjunction to control-panel model, the power of virtual reality is incorporated to get insights about the gameplay of each player during the actual games he has played in past via using data from in-stadium cameras and other tracking systems. This will create a VR replay of the entire soccer match which can be seen using hardwares like Oculus, etc. Players (Wearers) can use simple controls to fast-forward to specific points of the game. Also, the player can switch to the perspective as a team-mate and see what he saw at the given moment.

2 The Purpose of the Project

2a The User Business or Background of the Project Effort

The product will be installed in the training facility center of professional soccer academy or soccer clubs. The client wants to get better training simulation for his team players which will enable to practice soccer drills in an indoor replicated physical environment which can be used in all weather conditions.

The virtual reality aspect of system can be used during pre-game or post-game team talks sessions for strategy building and analysing the gameplay of past matches played and learn to do better in upcoming games.

The main motivation behind developing this simulator is to provide almost similar experience to the players while training which they would be facing while playing real soccer games. Also, this training simulation can be used to analyse the overall aspects of past games played by a particular player. This helps them to avoid those mistakes in future to avoid injury or maybe to increase their overall efficiency in actual live games.

The user of the system will be a soccer player or a goalkeeper who is trying to train harder to get better and stronger for his/her future games. Getting better training simulation will help them to learn new techniques and improvise on the existing techniques. The statistical reports generated by the system about their individual profiles will track the performance measures of various aspects of their gameplay. Training the right way before games is a very critical aspect for a sportsperson as it will help reduce injuries and improve the overall efficiency of a player during the actual games.

2b Goals of the Project

We want to develop a realistic as well as an entertaining soccer simulator. The system developed will be more than just a typical Video Game simulation and give the players more thorough training. The system aims to evaluate and improve player's reaction times specifically goalkeepers, and simultaneously collect a variety of performance measures as digitised data that can be utilized in analyzing everything from player positioning to injury recovery.

This product will be used for training both professionals and beginner soccer players. For professional soccer players, their usage is two-fold. The coach can customize the features of software system simulator as required according to the needs of the individual player. During one-on-one sessions, a coach can focus only on certain players for that particular time. Using our system, multiple players can undergo specialized training at the same time. This results in more practice for each player in the same amount of time. Also, practicing risky maneuvers in a controlled in-doors environment is better than practicing them on a field where accidents can occur that can drag in other players and injure both.

A beginner soccer player can also avail the training of a professional coach using the simulator. While the player may not have a coach to teach them personally or have a specialized training regime like a professional would, certain tricks and maneuvers can be taught in a better way. A beginner would have generic in-built training sessions developed by professional coaches that would help them develop faster than individual training or local coaches would. Learning dribbling tricks or overhead passes in a controlled environment would reduce training induced injuries so as to facilitate faster learning.

Both professional players and beginners would be able to see past games. For professional players, this would enable them to analyse strategies of their opponents as well as self-criticize their own games. For beginners, this would enable them to develop a sense of the game-play in soccer and inspire them to achieve greater heights.

2c Measurement

The goal of the system is to improve the overall efficiency of the soccer player or a goalkeeper and that can be best measured by key traits of the player and some performance measures such as

the average velocity of the shots taken during the session, the number of goals scored/saved, the scoring/conceding percentage, controlling ball with varying speeds, reaction time in seconds, accuracy of passes and shots taken, consistency, etc. The goal is said to be fulfilled if it helps to develop the individual performance of the player in terms of the capacity of reaction, the precision and consequently enhancing their decision capacity and technical execution.

3 The Scope of the Work

The product is designed for clients who have well established soccer academies and for the professional soccer clubs. The end users of this system will be soccer coach, team management staff and the players.

3a The Current Situation

Currently, potential clients develop their individual skills by training on the field as a team. Sportspersons need to be careful during practices for team games as there is always a greater chance for injuries. During practice, one or multiple players may get injured and this stalls the development of the team as a whole. For injuries incurred during practicing individual maneuvers, it stalls the growth of the players and decreases the practice time of the player. Also, the weather conditions throughout the year are not benign enough to continue playing outdoors and this might affect the practicing period for players.

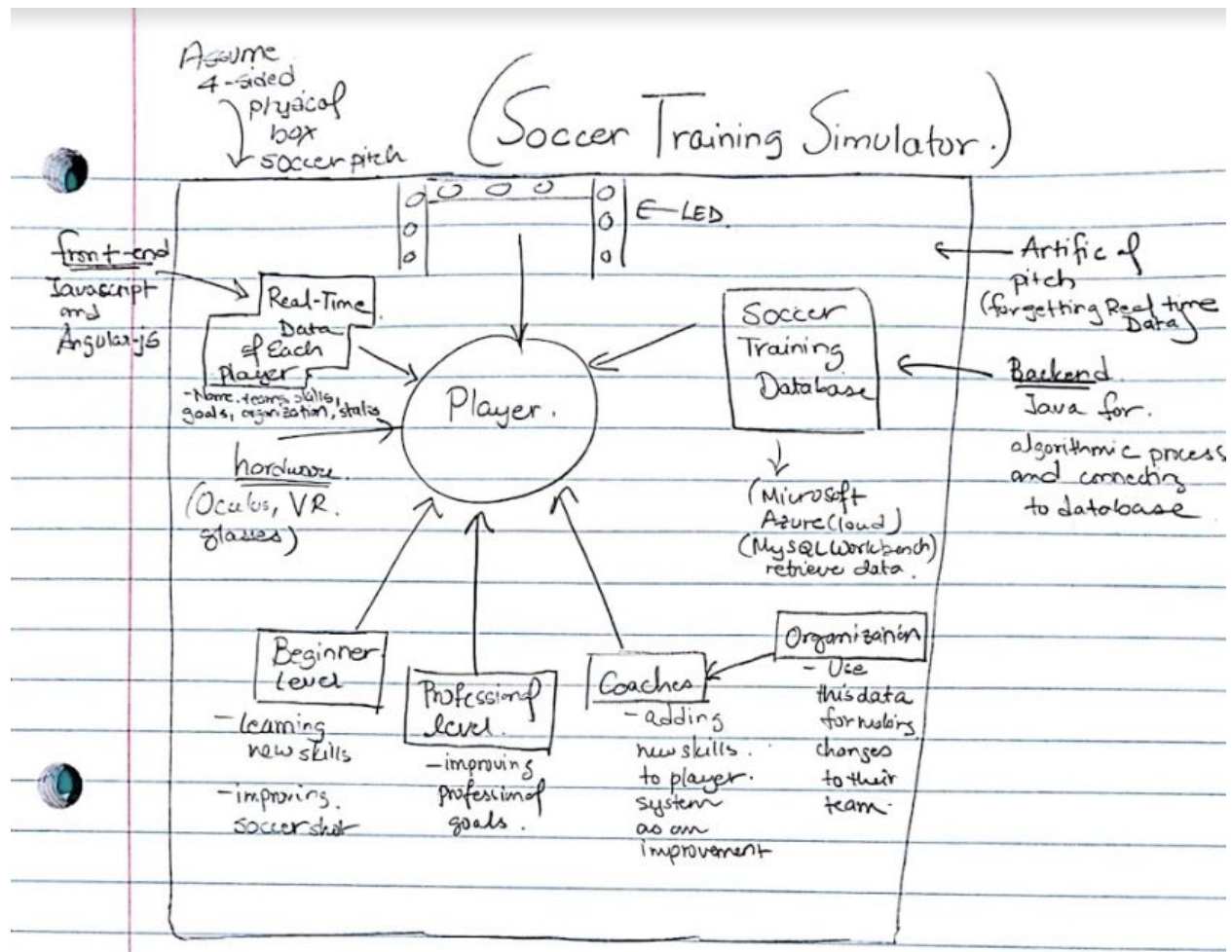
The introduction of this computerized system will allow players to accurately measure their skills and track their growth, much like biometric sensors allow many to track their fitness data in devices like Fitbits. The users will also be able to create scenarios that facilitate the practice of skills in novel ways that can not be achieved conventionally. A safe and secure in-door training environment will decrease practice related injuries and increase skill growth of the player and allow them to practice anytime of the year irrespective of the outdoor weather conditions.

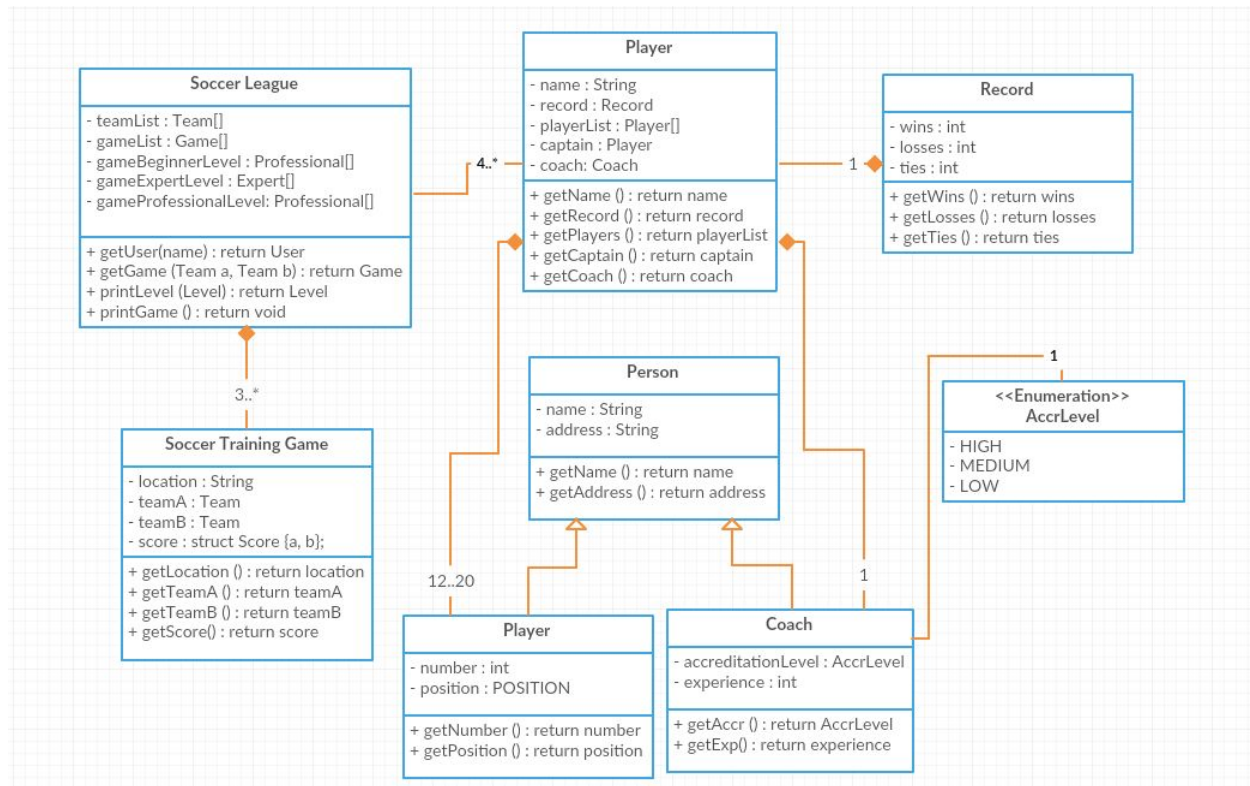
3b The Context of the Work

To build the product we need both software and hardware components for example whenever we retrieve data of a specific player and keeping track of their personal skills we will be using MySQL Workbench, Microsoft Azure for collecting the data and Java is the backend programming language in terms of the algorithmic process and connecting to the database. For front-end we will be using Javascript and Angular.js for rendering the data of each player with their name, skills, team, goals, and achievements from the system.

The subjects that matters for the soccer training simulator are the professional and beginner players, coaches, and teams from different organizations. Each subject is an entity in the soccer training database system. We are collecting real-time data of each player based on the sensors

when they are playing in the 4-sided physical box that encloses an artificial soccer pitch. Since we are collecting real time data it is useful for coaches for making changes in team, beginner and professional players can set their goals higher based on their data.





In terms of the future considerations for soccer simulator we need to research on the sensor that are used on the artificial soccer pitch to collect the real time data of each personal player. If there are multiple group of people playing on that artificial soccer pitch is there collision in terms of retrieve data of each player playing on the soccer pitch. This is something to consider will working on the soccer training simulator.

3c Competing Products

The soccer simulator game such as FIFA and Pro Evolution soccer. Let's take FIFA soccer game as the explanation of the product. FIFA soccer video game can help players pick up the intricacies of the sport at a young aged. By the time they are six years old, a lot of children are already aware of wingers, defensive midfielders and the key attributes that make the best players the best.

Even though FIFA is the best simulated game on mobile or PC it still a video game where the person is not physically playing the game. Basically, FIFA and PES (Pro Evolution Soccer) games are not compatible using Augmented or Virtual Reality device. The person does not have real-world experience playing these game.

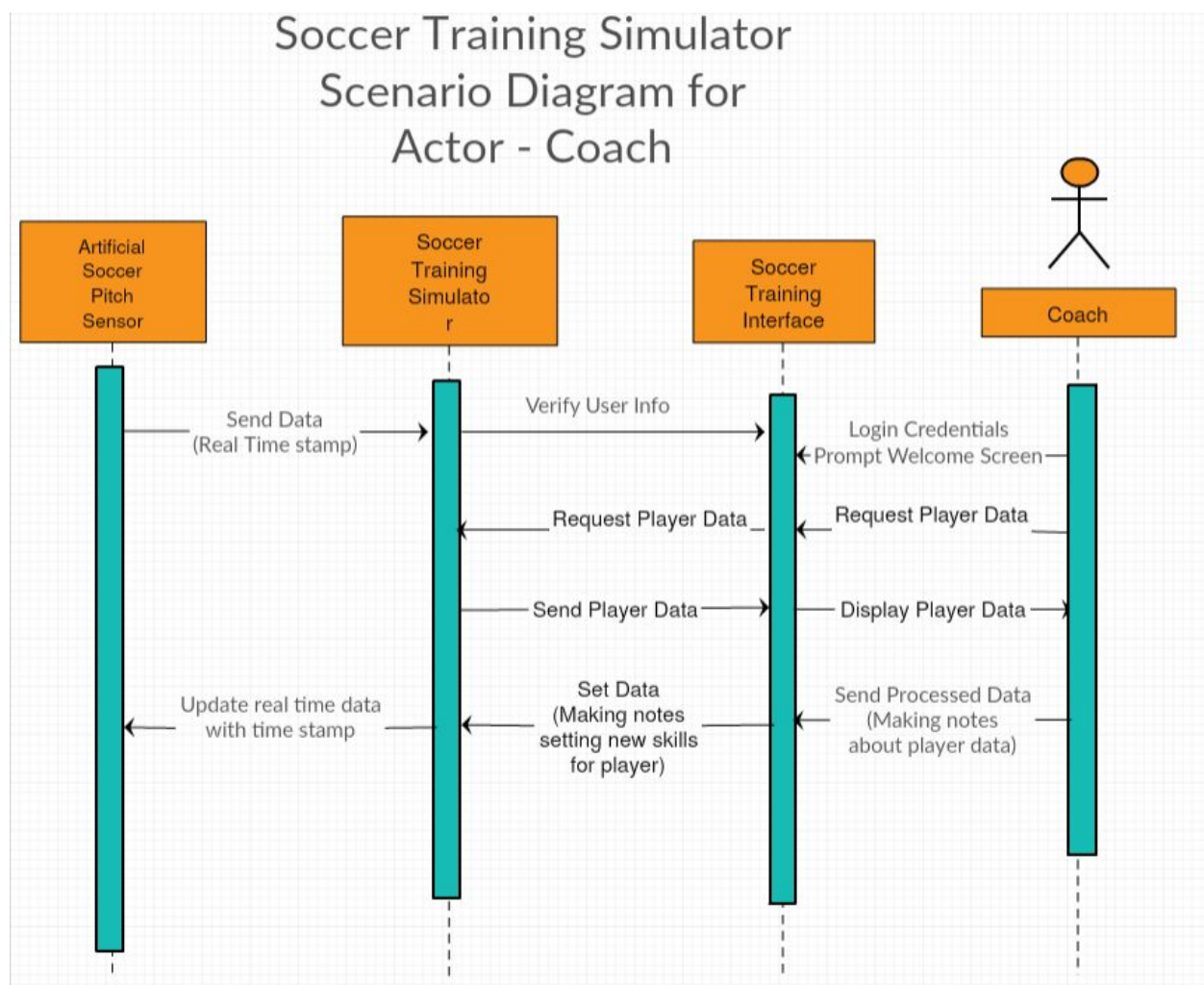
This is where are our product Soccer Training Simulator comes in which covers all the flaws or deficiencies existing products have for instance our product's system relies on an LED wall and

automated 'ball boy', uses fully-customisable system software to analyse performance and allow players to work on their skills. The software will have the ability to interact with existing databases and manage training sessions. Each player has their own system profile for training enabling them to track details about their session and generate reports. This is the best product for people who are new to soccer, want to practice on their soccer skills, and have some physical activity going on during the weekend rather playing the FIFA games remotely on their PC or laptops.

4 The Scope of the Product

4a Scenario Diagram(s)

Scenario diagram for user 'Coach'



4b Product Scenario List

There are 2 main scenario for our system based on the types of users and the system function they avail.

First scenario, called 'coach', is for user coach. The main function of a coach is to develop training schedules specifically designed for the improvement of each individual player. A coach also analyzes past game play and makes notes for its strength and weaknesses.

The second scenario, called 'player', is for user player. It has 3 sub-scenarios based on the system function they avail. A player can choose to (a) either look at past practice sessions or gameplays, (b) continue a past training session or (c) begin a new training session.

4c Individual Product Scenarios

The two users of our system would be the coach and the player. Scenarios for both are as given below:

Coach:

The coach will login to the system using his credentials.

After the welcome screen, the system will show him the list of players under his purview. For each player, the current statistics, training schedule and desired improvement after the training schedule are given. A progress bar showing distance between current statistics and desired statistics is also given.

The coach can modify the training schedule for each player according to various stages of improvement and rate of improvement.

The coach can also view various past games and make note of game play strategies and their success and failure rates.

After all modifications are completed and notes are stored in the database, the coach will log out.

Player:

The player will login to the system using his credentials.

After the welcome screen, the current statistics, training schedule and desired improvement after the training schedule are given. A progress bar showing distance between current statistics and desired statistics is also given.

A player can send a notice to the coach for any desired changes in the training schedule or any additions/updates in maneuvers he wants to learn.

A player can then chose to either look at past practice sessions or gameplays, continue a past training session or begin a new training session.

If the player chooses to look at past practice sessions or gameplays, then he can utilize the LED display as a screen or use VR head gear for a full 3D experience to analyze past performances.

If the player chooses to continue a past training session, then the previous progress bar is shown and the player can resume the paused training session or reset it and start that particular session from the beginning.

If the player chooses to begin a new training session, then a list of all available training sessions will be displayed to him. He will choose one of those and start the training. He can either finish the session in one go or pause the session and continue it later on if he has to take a break for any reason.

After the session is over, the player will be shown the progress made during this session by displaying his worst and best scores achieved during the session and those scores will be compared to his past worst and best scores in all sessions.

The progress bar showing distance between current statistics and desired statistics is updated according to the worst and best scores achieved in the latest sessions.

After the session is completed, the player will log out.

5 Stakeholders

5a The Client

The client is a professional soccer team and beginner players who are trying to improve their soccer skills.

5b The Customer

The customers are professional soccer teams, and beginner soccer player who are trying to learn soccer as the new sports and improve their skills.

5c Hands-On Users of the Product

The actually users will be coaches and players. Coaches will be able to design their own training scenarios, and players will be able to play out the scenarios on the field and with the VR headset.

5d Maintenance Users and Service Technicians

Maintenance will be the responsibility of the maintenance department of the given soccer team. New specialized technicians may be necessary to upkeep the components.

5e Other Stakeholders

Other potential stakeholders are universities with soccer teams.

5f User Participation

It may be necessary to bring users in to test the functionality of the features. They could give valuable feedback on the details.

5g Priorities Assigned to Users

Key Users: Players, the system must be optimized for their use so that they will see the results in their playing. A team will not want to pay for this product if it has no effect on their players and does not lead to more wins.

Secondary Users: Coaches, they are also important to the team's success, but ultimately the players will be using most of the product's features and they are the ones that need to improve.

Unimportant Users: Any other users would be considered unauthorized: the intended use is for professional teams.

6 Mandated Constraints

6a Solution Constraints

Description: The product must allow teams to practice in all weather conditions.

Rationale: Allowing teams to practice year round is a primary marketing point.

Fit criterion: The environment must be completely enclosed and unaffected by the outside.

Description: The product must replace FIFA games during training.

Rationale: One of the main goals of the project is to create a better tool for strategic training.

Fit criterion: 70% of coaches testing the system must say they would like to use it as a replacement.

Description: The LED display necessary for the enclosed training area has to have a display of at least 1080p.

Rationale: The high level of resolution will be needed for players to fully engage with the system.

Fit criterion: Self-described

6b Implementation Environment of the Current System

This system is its own environment, so all of these considerations are included in the design.

6c Partner or Collaborative Applications

The systems strategic learning capacity must take the role of FIFA in training and must be similar and intuitive to use for the coaches and players. The team's use of FIFA should be studied and used as a model for development of the strategy system. Partnership is also an option to explore. FIFA will not be part of the system, but the strategy training element may incorporate FIFA features such as the in-game AI.

6d Off-the-Shelf Software

We will need a VR gear like hardware like Oculus, etc. Players (Wearers) to view replay of the entire soccer match. We can use simple controls to fast-forward to specific points of the game.

The power of virtual reality is incorporated to get insights about the gameplay of each player during the actual games he has played in past via using data from in-stadium cameras and other tracking systems. Also, the player can switch to the perspective as a team-mate and see what he saw at the given moment.

6e Anticipated Workplace Environment

The finished product is its own working in-door environment, so these concerns are completely encapsulated in the design work.

6f Schedule Constraints

This product should be completed before a soccer season, to give teams time to adjust their training regiment and make full use of it. Completion during the soccer season makes it less likely that teams will buy it at that time. The facility will take 10 years to complete, including testing, and should be deployed for a team before the 2028 soccer season.

6g Budget Constraints

We have estimated a budget of 20 million USD is needed for development of this project.

7 Naming Conventions and Definitions

7a Definitions of Key Terms

FIFA- International Federation of Association Football (Fédération Internationale de Football

Association)

Teams- professional soccer teams such as those in FIFA or similar.

7b UML and Other Notation Used in This Document

No UML diagrams have been used in this document. Only various diagrams that show desired design and working of the finished product have been used.

7c Data Dictionary for Any Included Models

No data dictionary needed.

8 Relevant Facts and Assumptions

8a Facts

8b Assumptions

We assume teams are willing to invest in an expansion to their facility to house our system.

II Requirements

1 Product Use Cases

This section begins to describe in more specific and precise detail exactly what steps the system takes in the course of its performance. Use cases serve not only to more specifically define the system (and its boundaries), but also to identify functional requirements, to identify initial objects / classes, and to organize the work.

1a Use Case Diagrams

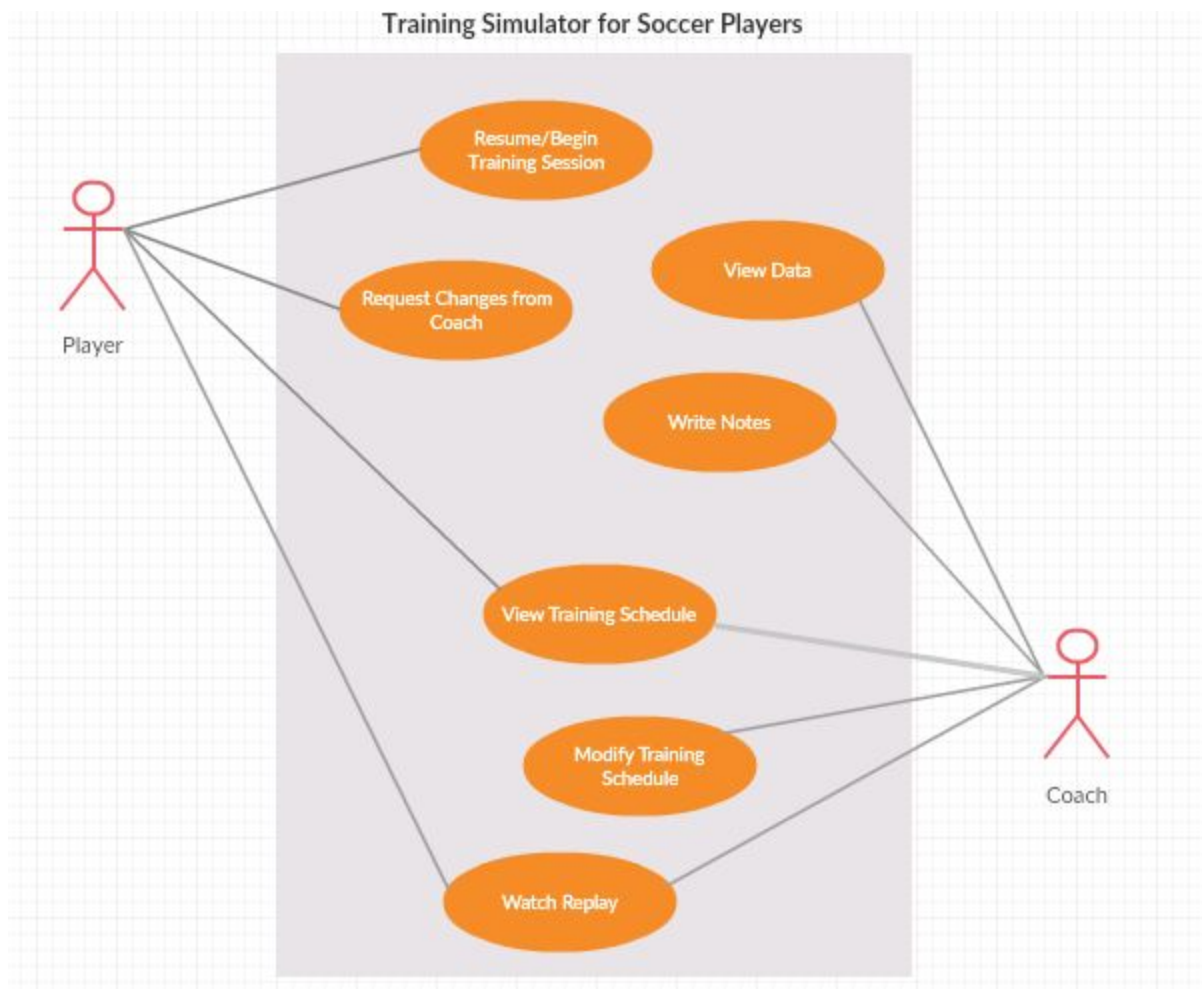


Figure 1. Players and Coaches Use Cases

1b Product Use Case List

The use case diagram is a graphical way of summarizing the product use cases relevant to the product. If you have a large number of product use cases (we find 15–20 is a good limit), then it is better to make a list of the product use cases and model or describe each one individually.

1c Individual Product Use Cases

Use cases are similar to scenarios, in that both tell the story of how the system interacts with the user(s) in response to some business event or while conducting some business task. The difference is that use-cases are much more formal, with certain predetermined sections for each use-case, and that use-cases indicate clearly what action the system takes in response to what actions taken by the user.

Use case ID/Name: Write Notes

pre-conditions: Data exists in the system; User logs in; User has access privileges to queried data

post-conditions: Data remains in system modified by the Assistant

Initiated by: Coach or Player

Triggering Event: User requests data through GUI

Additional Actors: N/A

Sequence of Events:

1. User logs into system
2. User requests the data they want to see
3. The data is copied and displayed to the user
4. Additional actor assistant is added to the application to keep track of the notes taken from the user after the processed data is displayed as a result.

Alternatives: Notes Accessible Data

Exceptions: Player and Coaches have the access to the Assistant database since it will be to look at the data and retrieve specific information from it which will be useful for the player to improve on their scoring goals.

Use case ID/Name: View Data

pre-conditions: Data exists in the system; User logs in; User has access privileges to queried data

post-conditions: Data remains in system unchanged

Initiated by: Coach or Player

Triggering Event: User requests data through GUI

Additional Actors: Assistant

Sequence of Events:

1. User logs into system
2. User requests the data they want to see
3. The data is copied and displayed to the user

Alternatives: N/A

Exceptions: Player may not have access to the queried data and an error message would be displayed.

Use case ID/Name: View Training Schedule

pre-conditions: Data exists in the system; User logs in; User has access privileges to queried data and selects the training schedule column to retrieve information

post-conditions: Data remains in system unchanged

Initiated by: Coach, Player, or Assistant

Triggering Event: User requests data through GUI

Additional Actors: N/A

Sequence of Events:

1. User logs into system
2. User requests the data they want to see
3. The data is copied and displayed to the user
4. Training schedule GUI is shown to the coach, player and assistant to view the soccer practice schedule after selecting the training schedule column in the database.

Alternatives: N/A

Exceptions: Player may not have access to the queried data and an error message would be displayed. Only coaches can modified the training schedule.

Use case ID/Name: Modifying Training Schedule

pre-conditions: Data exists in the system; User logs in; User has access privileges to queried data and selects the training schedule column to retrieve information.

Only the coaches can modify the training schedule

post-conditions: Data remains in system unchanged

Initiated by: Coach, Player, or Assistant

Triggering Event: User requests data through GUI

Additional Actors: N/A

Sequence of Events:

1. User logs into system
2. User requests the data they want to see
3. The data is copied and displayed to the user
4. Training schedule GUI is shown to the coach, player and assistant to view the soccer practice schedule after selecting the training schedule column in the database.

Alternatives: N/A

Exceptions: Only Coach can modified the training schedule.

Use case ID/Name: Watch Replay

pre-conditions: Everyone has access to watch replay feature but no actors can edit/modify the replay feature.

post-conditions: Data for watch replay feature remains in system unchanged

Initiated by: Coach, Player, or Assistant

Triggering Event:

1. User requests recording through GUI
2. User gets access to watching replay feature that uses the 360 Vision
3. Every actors in the application has access to this feature of watching the replay

Additional Actors: N/A

Sequence of Events:

1. User logs into system
2. User requests the data they want to see
3. The data is copied and displayed to the user
4. Watching Replay recording using Vision 360 is show as a GUI is shown to the coach, player and assistant to view the soccer practice schedule after selecting the training schedule column in the database.

Alternatives: N/A

Exceptions: Every actor in the application has access to the watch replay feature but no one can change or modified the watch replay recording feature in the application

Use case ID/Name: Resume / Begin Training Session

pre-conditions: Data exists in the system; User logs in; User has access privileges to queried data and selects the Training Session column to retrieve information

post-conditions: Data remains in system can only be modified by Coach when to resume/ begin the training session

Initiated by: Coach, Player, or Assistant

Triggering Event: User requests data through GUI

Additional Actors: Public beginner Soccer Player to view Training Session

Sequence of Events:

1. User logs into system
2. User requests the data they want to see
3. The data is copied and displayed to the user
4. Training Session GUI is shown to the coach, player and assistant to view the soccer practice schedule after selecting the training schedule column in the database.

Alternatives: N/A

Exceptions: Player may not have access to the queried data and an error message would be displayed. Only coaches can modified the training schedule.

Use case ID/Name: Request Changes From Coach

pre-conditions: Data exists in the system; User logs in; User has access privileges to queried data and selects the Training Session column to retrieve information

post-conditions: Data remains in system the Assistant actor can request changes from coach based on player performance and give suggestion to the coach

Initiated by: Coach, Player, or Assistant

Triggering Event: User requests data through GUI

Additional Actors: n/a

Sequence of Events:

1. User logs into system
2. User requests the data they want to see
3. The data is copied and displayed to the user
4. Training Session GUI is shown to the coach, player and assistant to view the soccer practice schedule after selecting the training schedule column in the database.

Alternatives: N/A

Exceptions: This private request changes from coach is being made from assistant to give them suggestion about the player's performance.

2 Functional Requirements

ID# - Name	F1 - Ball Launchers
Description	The system shall provide controls to fire the balls to awaiting player at a particular pace and trajectory.
Rationale	This functionality provides the player to practice drills with varying pace and trajectories of the incoming ball.
Fit Criterion	F1 - Button should launch the ball to the user based on his skill level from beginning to skill level. The ball should be thrown straight to user if beginner. If professional make it challenging.

Acceptance Tests	Test 5: Ball Launcher
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ID# - Name	F2 - Target detection on LED wall
Description	The system shall provide accurate detection when the player passes/shoots the ball to the physical wall made of LED
Rationale	This functionality is critical to report generation of performance measures like accuracy, consistency, etc.
Fit Criterion	F2 - Button should have LED light up once the user score the goal for example green once the user scores the goal. Also, and red when user misses the goal.
Acceptance Tests	Test 6: LED Wall

ID# - Name	F3 - Ball Recovery
Description	The system shall communicate with the 'automated ball boy' conveyor belt to deliver the ball accordingly with the needs of the system.
Rationale	This functionality is crucial to fetch balls for training sessions.
Fit Criterion	F3 - Button based on the sensors that are placed on the soccer net to recover the all the ball once user is score the ball in the soccer net.

Acceptance Tests	Test 7: Ball Recovery
-------------------------	-----------------------

ID# - Name	F4 - Fetch report from DB
Description	The system must fetch report from the existing databases for a particular player's training session.
Rationale	This functionality is necessary for performance analysis and sports science.
Fit Criterion	The fit criteria for this part is that all the user report should fetch our database into the UI design should that user can retrieve the information using the F4 button.
Acceptance Tests	Test 8: Fetch Report from DB

ID# - Name	F5 - VR footages
Description	The VR hardware of the system must fetch data from the in-stadium cameras
Rationale	This functionality is critical to generate video recordings of past games played.
Fit Criterion	F5 - Button is used for watch replay using software such as 360 Vision and Oculus rift for this feature should not be lagging.

Acceptance Tests	Test 9: VR Footage
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ID# - Name	U1 - Assistant Notes
Description	The system must fetch report from existing Assistant database for a particular player in the training session
Rationale	This usability is critical to for coaches and players to retrieve notes from assistant database to improve player's performance
Fit Criterion	U1 - Assistant notes helps out to both coaches and soccer players to improve their performance basically retrieve Assistant database and interacting with UI design so the soccer player or coaches can retrieve their personal notes
Acceptance Tests	Test 10: Assistant Notes

ID# - Name	U2 - Create drills
Description	The system must allow the coach to create customised drills for players like long balls, trajectory, speed, etc.
Rationale	This usability is crucial for training various aspects of the game like passing, shooting, headers, etc.
Fit Criterion	U2 - Button is used to create drills based on the selected level by the user

	from beginner to professional level. For example speeds, trajectory and ball curving might be different for each level.
Acceptance Tests	Test 11: Create Drills

ID# - Name	U3 - Sports Science and Medicine
Description	The system shall allow the technicians and analysts to fetch reports from the system's database.
Rationale	This usability is important for analysing player's performance and injury prevention.
Fit Criterion	U3 - Sports Science and Medicine notes helps out to both coaches and soccer players to improve their performance basically retrieve Sports Science and Medicine database and interacting with UI design so the soccer player or coaches can retrieve their personal notes see injured player statistics
Acceptance Tests	Test 12: Sports Science and Medicine

ID# - Name	U4 - Player's training session
Description	The system shall allow player to shoot at the virtual goal post formed by LED wall

Rationale	This usability is very basic for any training session
Fit Criterion	U4 - Button is used to create session based on the selected level by the user from beginner to professional level. For example using Oculus rift is helpful for players to have virtual training session.
Acceptance Tests	Test 13: Player's Training Session

ID# - Name	U5 - Goalkeeper's training session
Description	This usability must allow the goalkeeper to save shots from the incoming ball launchers.
Rationale	This usability is basic for goalkeeper's drill.
Fit Criterion	U5 - Button is used for the goalkeeper training session to save shot from ball launcher this is also based on selected user level from beginning to professional level.
Acceptance Tests	Test 14: Goalkeeper training session

3 Data Requirements

ID# - Name	D1 - Accuracy
Description	The accuracy of the player's training session must be measured in percentage. And its value must fall in range 0 to 100.
Rationale	This validation establishes uniformity in the database.
Fit Criterion	The accuracy of a player must be measured in percentage by a double precision number.
Acceptance Tests	Test 1: Systems Test

ID# - Name	D2 - Speed of pass/shot at the LED wall
Description	The speed of the player's training session must be measured as the average speed of all the shots taken at the virtual goalpost formed by the LED wall.
Rationale	This validation establishes uniformity in the database.
Fit Criterion	The shots of a player must be measured by the virtual goalpost and the data must be computed and stored as an average. Average value must be greater than zero and the units measured in kilometers per hour.

Acceptance Tests	Test 1: Systems Test
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ID# - Name	D3 - Number of goals saved/scored
Description	The system must give the total count of failed shots/passes of the entire training session.
Rationale	This validation establishes uniformity in the database.
Fit Criterion	Failed shots must be recorded and stored as an integer.
Acceptance Tests	Test 1: Systems Test

ID# - Name	D4 - Responsiveness
Description	The reaction time of any player be measured and stored.
Rationale	This validation establishes uniformity in the database.
Fit Criterion	The reaction time of a player must be measured in seconds, must be greater than 0, and must be stored as a double precision number.
Acceptance Tests	Test 1: Systems Test

ID# - Name	D5 - Player and respective coach details
Description	The profile of players and their coaches must be in the valid form format.
Rationale	This validation helps to avoid user input exceptions.
Fit Criterion	The format of all stored data shall conform to the requirements of each individual statistic and shall be displayed as such.
Acceptance Tests	Test 1: Systems Test

4 Performance Requirements

4a Speed and Latency Requirements

ID# - Name	P1 - LED wall
Description	The virtual goal post form by LED lights must be synchronised with the software's input parameters customized by coach to inhibit its display delay by more than a second.
Rationale	This is crucial to maintain the dynamic environment of the game and maintain the accuracy of reports generated after training sessions.

Fit Criterion	The LED display should respond within a second of input.
Acceptance Tests	Test 1: Systems Test

ID# - Name	P2 - Watch Replay Feature
Description	The system should have a display with high minimum resolution for replays without any lag in between frames.
Rationale	The product should be not lag because it is both public and private feature available in this application.
Fit Criterion	The system shall display content at a minimum resolution of 72 PPI.
Acceptance Tests	Test 1: Systems Test

4b Precision or Accuracy Requirements

ID# - Name	P3 - Ball Launchers
Description	The system shall be able to accurately deliver the ball to the awaiting player using cannons according to the precise value of trajectory and pace of the ball fired.
Rationale	This is crucial to get the drills rolling in a precise fashion.

Fit Criterion	The ball launching systems should be able to locate and launch balls to players within 5° of their position.
Acceptance Tests	Test 1: Systems Test

4c Capacity Requirements

ID# - Name	P5 - Automated Ballboy
Description	The system shall be able to deliver the balls to the ball launchers rapidly. using an automated conveyor belt delivering at a count of 50 balls per cycle.
Rationale	This is critical aspect to increase the level of difficulty of drills.
Fit Criterion	The balls shall be delivered to the ball launchers using an automated conveyor belt delivering at a count of 50 balls per cycle.
Acceptance Tests	Test 1: Systems Test

ID# - Name	P6 - Player accomodation
Description	The system shall be able to accomodate a complete soccer team at any one time.

Rationale	This is critical aspect not to compromise the efficiency of players.
Fit Criterion	The system shall be able to accomodate the maximum of 5 players at a time.
Acceptance Tests	Test 2: Team Systems Test

5 Dependability Requirements

5a Reliability Requirements

ID# - Name	R1 - LED wall
Description	The system's LED target wall shall operate correctly independently of other component's operations. Also the quadrants formed by LEDs should be accurately depicted as customized by the software input parameters.
Rationale	This is crucial for getting accurate performance measures like shot accuracy, etc.
Fit Criterion	The LED display should respond within a second of input.
Acceptance Tests	Test 6: LED Wall

ID# - Name	R2 - Ball Boy
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Description	The system's conveyor belt shall operate correctly in case of any kind of interruptions due to power failure, etc. In case of minor interruption, the conveyor belt should resume its operation where it left off.
Rationale	This is crucial to keep the continuous availability of balls rolling in the physical pitch.
Fit Criterion	The ball conveyor systems should be able to keep the ball rolling in the pitch
Acceptance Tests	Test 7: Ball Recovery

ID# - Name	R3 - Important events and Safety
Description	The system shall allow interruptions for change of drills and other important events from coach and also the system shall not interfere for other electronic devices for safety purposes.
Rationale	This is necessary for safety purposes and change in training procedures.
Fit Criterion	Important interruptions should be able to interrupt a player's session
Acceptance Tests	Test 11: Create Drills

5b Availability Requirements

ID# - Name	A1 - System Availability
Description	The system shall be available 24/7 for both players and coaches
Rationale	The players may need to practice at any hour of the day and the coaches need the system available when players aren't practicing to set up their schedule
Fit Criterion	The system should be available always
Acceptance Tests	N/A

5c Robustness or Fault-Tolerance Requirements

ID# - Name	FT1 - Failure Handling
Description	The system shall have basic practice maneuvers available even in case of any 'connectivity' failure
Rationale	Basic training maneuvers can be trained in even if a specific schedule isn't loaded or there is some connectivity failure with the database
Fit Criterion	N/A
Acceptance Tests	N/A

5d Safety-Critical Requirements

ID# - Name	S1 - Maximum training time
Description	The daily training time-period available in the simulator would be regulated based on health conditions
Rationale	It is not healthy for a person to be doing physical training for more than a set amount of time very day. Also, when injured or strained, the training time needs to be less than normal for that player.
Fit Criterion	NA
Acceptance Tests	Test 11, 13 Create Drills and Player's Training Session

6 Maintainability and Supportability Requirements

6a Maintenance Requirements

ID# - Name	M1 - Equipment/Machinery Maintenance
Description	For physical maintenance of the equipment, the client shall be the one responsible
Rationale	In case of displays being broken or connection problems due to broken wires, the client has to be the one to replace or repair the broken piece

Fit Criterion	NA
Acceptance Tests	NA

ID# - Name	M2 - Software Upgrade/Maintenance
Description	For any software or application problems, any possible upgrades or hardware-software compatibility issues, the user will contact the developers through the help desk
Rationale	In case of new versions of the software being available or hardware being replaced or hardware-software compatibility issues, it is the developers who know the most about the application and thus, will be able to fix it
Fit Criterion	NA
Acceptance Tests	NA

6b Supportability Requirements

ID# - Name	SR1 - Contact the relevant people to solve system issues
Description	Through a help desk
Rationale	Whenever there is a problem with the simulator, contact the help desk, who

	would then re-route the issue to the appropriate personnel
Fit Criterion	<p>The call should connect to the help desk in under 5 minutes.</p> <p>The call should re-route in under 5 minutes</p>
Acceptance Tests	N/A

6c Adaptability Requirements

ID# - Name	IS - Independent System
Description	The system will be built completely for its own hardware and will not need to be ported or adapted.
Rationale	The final product is a self-contained facility, special made for its purpose.
Fit Criterion	N/A
Acceptance Tests	N/A

6d Scalability or Extensibility Requirements

ID# - Name	ER1 - Adding multiple Systems
Description	Each system should have a unique ID number, to keep record of the system and users.

Rationale	As each system is personalized for each player, adding multiple new systems to a larger capacity as the business grows isn't going to be a problem.
Fit Criterion	The system should be highly personalizable
Acceptance Tests	NA

6e Longevity Requirements

ID# - Name	LR1 - Perpetual Use
Description	The product should last indefinitely with proper maintenance.
Rationale	The finished product will be a facility that will be part of the team's training program for the foreseeable future.
Fit Criterion	No component of the facility should be known to fail with proper maintenance.
Acceptance Tests	Test 12: Longevity Test

7 Security Requirements

7a Access Requirements

ID# - Name	AR1 - Data Privacy
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Description	A players data should not be visible to other players. Data should only be visible to the player that is the subject of the data or the coach.
Rationale	Other players from the team should not be able to see personal data from other members unless that players or the coach shows them.
Fit Criterion	Unauthorized users will be denied when accessing the data.
Acceptance Tests	Test 4: Unauthorized Access Test

7b Integrity Requirements

ID# - Name	IR1 - Data Integrity
Description	Data will regularly be encrypted and stored in a backup memory unit
Rationale	This protects data from being corrupted, lost or stolen
Fit Criterion	Database should be encrypted and backed up weekly
Acceptance Tests	Test X: Database Test

7c Privacy Requirements

ID# - Name	PR1 - Privacy Requirements
Description	A player's medical as well as training data will only be available to himself and the coach
Rationale	To prevent theft or unfair alteration of another player's data
Fit Criterion	Unauthorized users will be denied when accessing the data.
Acceptance Tests	Test 4: Unauthorized Access Test

7d Audit Requirements

ID# - Name	AR2 - Data Access Auditing
Description	Systems must be in place for governing bodies to audit the collected data and the access to collected data.
Rationale	Regulator agencies will want to make sure systems are complying with privacy law.
Fit Criterion	Some system must be agreed upon in the contract for auditing the database.
Acceptance Tests	N/A (based on contract)

7e Immunity Requirements

ID# - Name	I1 - Isolation
Description	Changing the system should not be possible to any person outside the team.
Rationale	In extreme cases, cyber attacks could be used to ruin a teams training season.
Fit Criterion	No user outside an authorized maintenance team should be able to make changes to the system.
Acceptance Tests	Test 13: Isolation

8 Usability and Humanity Requirements

8a Ease of Use Requirements

ID# - Name	EUR 1 - Easy to Use
Description	The product should be easy to use and get used to for the players and the coaches
Rationale	The product should be seen as a tool, not a hindrance to work.
Fit Criterion	N/A
Acceptance Tests	N/A

8b Personalization and Internationalization Requirements

ID# - Name	PIR1 - International Usage requirements
Description	The product should support many languages
Rationale	The product should be easy to use by people who speak different languages
Fit Criterion	The system should support the official language of every country in FIFA
Acceptance Tests	Test 3: Language Test

8c Learning Requirements

ID# - Name	LR1 - Learning to use the system
Description	Both players and coaches should find it easy to learn to use the system
Rationale	The system should have a relatively short learning curve in order to encourage use of it among busy employees
Fit Criterion	NA
Acceptance Tests	A week's worth of training should allow 90% of the testing group to be able to enable players complete a training schedule and coaches to be able to set a comprehensive schedule

8d Understandability and Politeness Requirements

ID# - Name	UPR1 - Understandability
Description	The system should not require users to reason about how their training is quantified and parameters calculated by the system
Rationale	The system should be easy to understand by eliminating the need to reason about hardware
Fit Criterion	Details of simulator hardware should be hidden from users unless they have elevated privileges
Acceptance Tests	NA

8e Accessibility Requirements

ID# - Name	AR3 - Individuals with Disabilities
Description	NA
Rationale	Since this is a soccer training simulator, it requires the player to be in good physical condition without any disabilities. Even the coach is required to have proper eyesight and hearing to be able to properly supervise a player's training.

Fit Criterion	NA
Acceptance Tests	NA

8f User Documentation Requirements

ID# - Name	UDR 1 - Documentation
Description	The product should be accompanied by a detailed user manual
Rationale	A user manual would be helpful to answer quick questions so that users do not have to consult service personnel
Fit Criterion	The documentation should be organized and understandable for even a layman
Acceptance Tests	The user manual should be provided in the testing of the usability of the product and its content should relate to functions being tested. The success of the training session will imply the quality of the user documentation manual

8g Training Requirements

ID# - Name	TR1 - Training Session
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Description	New users of the system will engage in a week long training session
Rationale	A week is a reasonable amount of time for any academy or team to commit to.
Fit Criterion	NA
Acceptance Tests	The week long training session will be designed and held by the system developers

9 Look and Feel Requirements

9a Appearance Requirements

ID# - Name	LFR1 - Looks of the product
Description	The product's design should appeal to both academy as well as team players and coaches
Rationale	In order to encourage or users to engage with the product, its appearance should follow their ideals.
Fit Criterion	NA
Acceptance Tests	Test 14 - Feedback Form

9b Style Requirements

ID# - Name	SR1 - Style
Description	The product's interface design should be clean, simple, and professional.
Rationale	Since our product's user group is working professionals, it makes sense for it to give a usable and professional feel.
Fit Criterion	NA
Acceptance Tests	Test 14 - Feedback Form

10 Operational and Environmental Requirements

10a Expected Physical Environment

ID# - Name	EPE1 - Environment
Description	The product will operate in an enclosed environment
Rationale	Since the system consists of LED displays and sensors, it is important for the system to be enclosed in a room.
Fit Criterion	The system should be placed in an indoor environment
Acceptance Tests	NA

10b Requirements for Interfacing with Adjacent Systems

ID# - Name	RIAS - Oculus Head-sets
Description	The software of the system must be compatible with Oculus Headsets. The simulations must be able to display on them.
Rationale	The headset is an important part of the system and will be integral in immersing and training players.
Fit Criterion	Designated systems, such as the replays and scenarios, must be available for viewing on the Oculus Headsets.
Acceptance Tests	Test X: Oculus Integration

10c Productization Requirements

ID# - Name	PR 3 - Installation of system
Description	The system will be installed by the company for the clients
Rationale	This is to ensure the system is set up properly and to demonstrate set-up and usage of the system to the client for future purposes
Fit Criterion	The company must have the means to install the system based on the contract with the client.

Acceptance Tests	N/A (Will be based on individual contracts and testing is unlikely beforehand)
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10d Release Requirements

ID# - Name	RR1 - Release and Upgrades
Description	The system must be released after all the tests are successfully passed. Twice in a year the system will be updated with our company's new release.
Rationale	Have to periodically release new versions of the system software application to keep up with new and improved hardware and compatibility issues between them.
Fit Criterion	Teams must be set up to keep creating updates and infrastructure must be set up to update client systems.
Acceptance Tests	N/A

11 Cultural and Political Requirements

11a Cultural Requirements

ID# - Name	CR1 - Cultural Requirements
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Description	The product will not hurt or even address any cultural belief held by the users of the system
Rationale	As a sports training simulator, the system has no use of nor addresses the cultural belief by the user in any way, shape or form.
Fit Criterion	NA
Acceptance Tests	Test 14 - Feedback Form

11b Political Requirements

ID# - Name	PR2 - Political Requirements
Description	The product will not hurt or even address any political belief held by the users of the system
Rationale	As a sports training simulator, the system has no use of nor addresses the political belief by the user in any way, shape or form.
Fit Criterion	NA
Acceptance Tests	Test - 14 Feedback Form

12 Legal Requirements

12a Compliance Requirements

ID# - Name	MPLC - Medical Privacy Law Compliance
Description	Medical data should be available to users based on HIPAA or similar laws based on the country in which the system is deployed. Access of relevant fields should be restricted from users beyond the player in question.
Rationale	The system must follow the law in regards to medical privacy, and keep personal data out of the hands of other players or coaches.
Fit Criterion	Unauthorized users will be denied when accessing the data.
Acceptance Tests	Test 4: Unauthorized Access Test

12b Standards Requirements

ID# - Name	CDS1 - Client Deal Standard
Description	A contract specific to each individual client must be created with a company.
Rationale	Each team will have specific needs based on numerous factors (political, cultural, geographic) that can't be generalized.
Fit Criterion	Each client has a specific contract detailing their exact needs from the product.

Acceptance Tests	N/A
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13 Requirements Acceptance Tests

13a Requirements – Test Correspondence Summary

SV: The following sample table is available from the CS 440 web site as “Sample Requirement Test Correspondence Table.xlsx” It is recommended that you work with the table in Excel, and then drag it into the document when it is completed. Depending on the number of requirements and/or tests included, it may be necessary to use multiple tables, and/or use landscape mode. Every row and every column of the table should include at least one X. Below the table list the ID #, name, and short description of each individual acceptance test.

Re quire me nts	Test s	Tes t 1	Test 2	Tes t 3	Tes t 4	Test 5	Te st 6	Te st 7	Tes t 8	Tes t 9	Test 10	Test 11	Test 12	Test 13	Test 14
	F1					X									
	F2						X								
	F3							X							
	F4								X						
	F5									X					
	U1										X				
	U2											X			
	U3												X		
	U4													X	
	U5														X
	D1	X													
	D2	X													

	<i>D3</i>	<i>X</i>													
	<i>D4</i>	<i>X</i>													
	<i>D5</i>	<i>X</i>													
	<i>P1</i>	<i>X</i>													
	<i>P2</i>	<i>X</i>													
	<i>P3</i>	<i>X</i>													
	<i>P5</i>	<i>X</i>													
	<i>P6</i>		<i>X</i>												
	<i>R1</i>						<i>X</i>								
	<i>R2</i>							<i>X</i>							
	<i>R3</i>											<i>X</i>			
	<i>S1</i>											<i>X</i>		<i>X</i>	
	<i>LR1</i>												<i>X</i>		
	<i>AR1</i>				<i>X</i>										
	<i>IR1</i>										<i>X</i>				
	<i>PR1</i>				<i>X</i>										
	<i>I1</i>													<i>X</i>	
	<i>PIR1</i>			<i>X</i>											
	<i>LRF1</i>														<i>X</i>
	<i>SR1</i>														<i>X</i>
	<i>RIAS</i>										<i>X</i>				
	<i>CR1</i>														<i>X</i>
	<i>PR2</i>														<i>X</i>

	MPLC			X										
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Table 1 - Requirements - Acceptance Tests Correspondence

13b Acceptance Test Descriptions

Test 1: Systems test

Description- Each mechanical system will be tested and evaluated based on its necessary requirements.

Success- All systems pass within reasonable parameters.

Failure- Any system fails to meet up to its specified requirements.

Test 2: Team Systems Test

Description- A team of 5 players will attempt to use the simulations.

Success- They are reasonably able to use the system.

Failure- The system does fails or is a hindrance to advancement of the team.

Test 3: Language Test

Description- The system should be reconfigured into each available language and a person who speaks the language natively should evaluate the system.

Success- The system is understandable and usable.

Failure- The system has errors in that hinder effective use of the system.

Test 4: Unauthorized Access Test

Description- A user will login as a player and try to access another players private data. They will then login as a coach and try to access private medical data.

Success- The user is denied on both tries.

Failure- The data is displayed in either case.

Test 5 : Ball Launcher

Button is successfully test got the ball thrown to the user based on the selected skill level by the user from beginner to expert.

Test 6: LED Wall

F2 - Button is functioning successfully based on the requirements of lighting LED once the user scores the goal.

Test 7: Ball Recovery

F3 - Button works properly based on the functionality and algorithm that is used on the sensor that are placed on soccer net to recover the ball once the user score the goal in the score net.

Test 8: Fetch Report from DB

F4 - Button works perfectly for this using MySQL to all data must be fetch from here into the UI layer so that user can interact with and retrieve the information that user needs to improve performance.

Test 9: VR Footage

F5 - Button is functioning properly helping coaches and soccer player to watch the video recording and help players improve their performance using the Oculus Rift and 360 Vision

Test 10: Assistant Notes

U1 - Assistant notes work properly since we using MySQL Workbench for setting database and using connection code to make sure UI button is working properly with User Interface to retrieve assistant notes information for the user.

Test 11: Create Drills

U2 - Button work as the requirement of creating personal customized training drills from beginning to professional level.

Test 12: Sports Science and Medicine

U3, R3 - Sports Science and Medicine work properly since we using MySQL Workbench for setting database and using connection code to make sure UI button is working properly with User Interface to retrieve injured player statistics also prevent injuries notes information for the user.

Test 13: Player's Training Session:

U4- Button is working perfectly to create session based on the selected level by the user from beginner to professional level. For example using Oculus rift is helpful for players to have virtual training session

Test 14: Goalkeeper Training Session:

U5 - Button functions properly and is used for the goalkeeper training session to save shot from ball launcher this is also based on selected user level from beginning to professional level. Technology used for this virtual oculus rift headset for training sessions also sensors on the ball launcher to see what level user player is beginner or professional level.

Test 12: Longevity Test

A mock-up of the systems must be able to run without major issues that hinder practice for 6 months with regular maintenance.

Success- The system works and allows a team to practice for 90% of 6 months.

Failure- The system is down for more than 10% of the 6 month period.

Test 13: Isolation Test

A team of Cyber-Security professionals must be recruited and instructed to change the system by any means necessary. They are given a month and access to the system that any clandestine entity may reasonably acquire.

Success- They are unable to make any changes to the system within the allotted time.

Failure- Changes are made to the system.

Test 14: Feedback Form

A sample from our potential user group will be given a survey where they will answer questions about the design and whether it matches their preferences. We will be able to know whether the requirement has been fulfilled or not by an analysis of this survey.

III References / Bibliography

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