Software Engineering Project Report

Documentation for Software system development on Training Simulator for Soccer Players

Prepared by : Dhaval Patel, Kruneet Patel,

Charvi Virani, and Michael Gallagher

for use in CS 440

at the University of Illinois Chicago

September 2018

Table of Contents

List of Figures 7
List of Tables 8

I 6

1 7

2 7

2a 7
2b 8
2c 8

3 9

3a 9
3b 9
3c **Error! Bookmark not defined.**
3d 11

4 12

4a 12
4b 13
4c 13

5 14

5a 14
5b 14
5c 14
5d 14
5e 14
5f 14
5g 15

6 15

6a 15
6b 15
6c 16
6d 16
6e 16
6f 16
6g 16

7 16

7a 16
7b 17
7c 17

8 17

8a 17
8b 17

II 18

9 18

9a 18
9b 19
9c 19

10 26

11 32

12 34

12a 34
12b 35
12c 36

13 37

13a 37
13b 38
13c 39
13d 39

14 40

14a 40
14b 41
14c 42
14d 42
14e 43

15 43

15a 43
15b 44
15c 44
15d 45
15e 45

16 46

16a 46
16b 46
16c 47
16d 47
16e 48
16f 48
16g 49

17 50

17a 50
17b 50

18 51

18a 51
18b 51
18c 52
18d 52

19 53

19a 53
19b 53

20 54

20a 54
20b 54

21 55

21a 55
21b 57

III 60

22 60

22a 60

23 61

24 61

24a 61
24b 62
24c 63
24d 64
24e 64
24f 65
24g 65
24h 66
24i 66
24j 66

25 67

26 67

27 67

27a 67
27b 68
27c 68
27d 68

IV 68

28 68

29 69

29a 69
29b 69
29c 69

30 69

30a 69
30b 69
30c 69
30d 70
30e 70

31 70

31a 70
31b 70

32 70

33 71

34 71

35 71

36 **Error! Bookmark not defined.**

V 71

VI 72

VII 72

List of Figures

Figure 2 - Sample Use Case Diagram from Bruegge & DuToit (modified) 16

Figure 3 - Sample Use Case Diagram from Robertson and Robertson 17

List of Tables

Table 2 - Requirements - Acceptance Tests Correspondence 31

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.

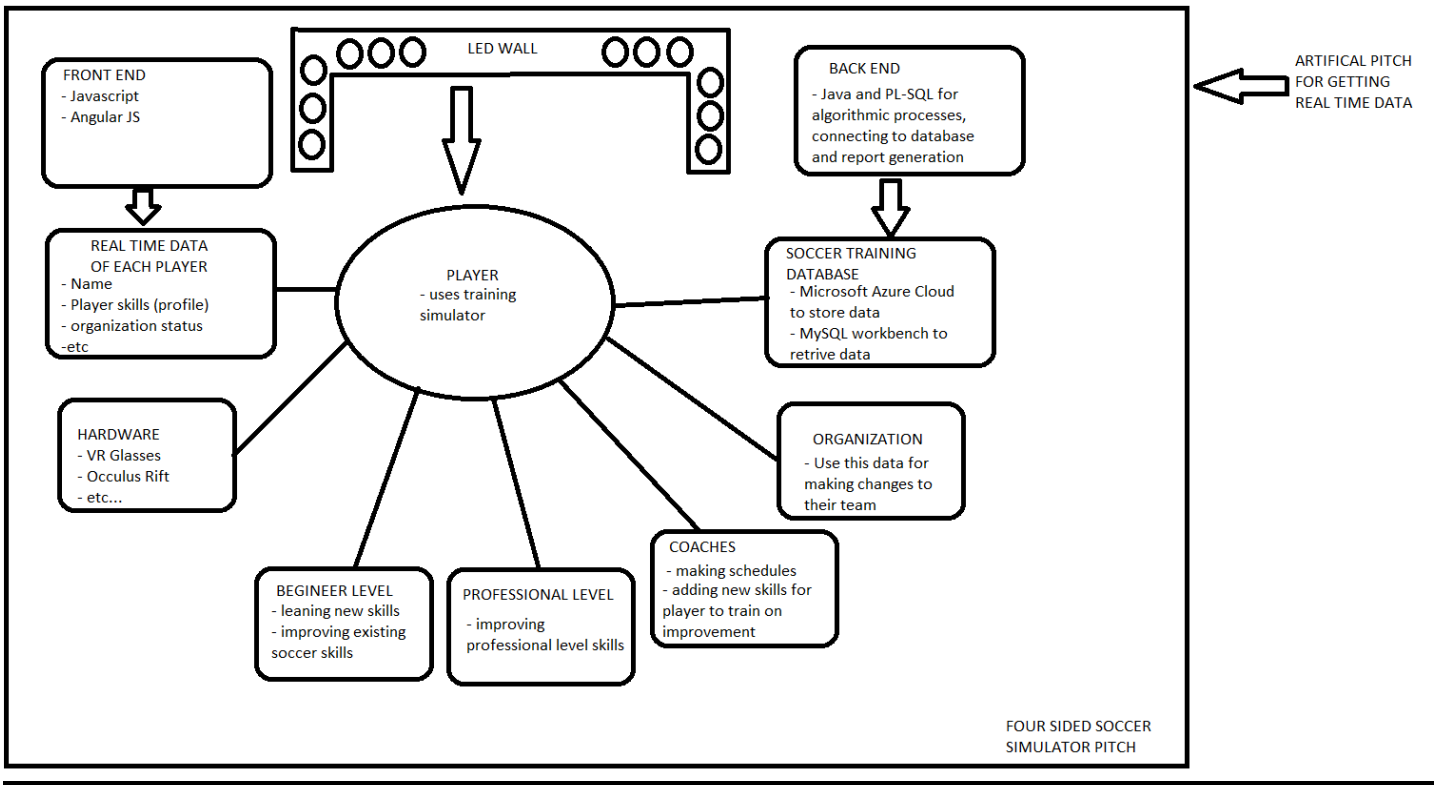
3b The Context of the Work

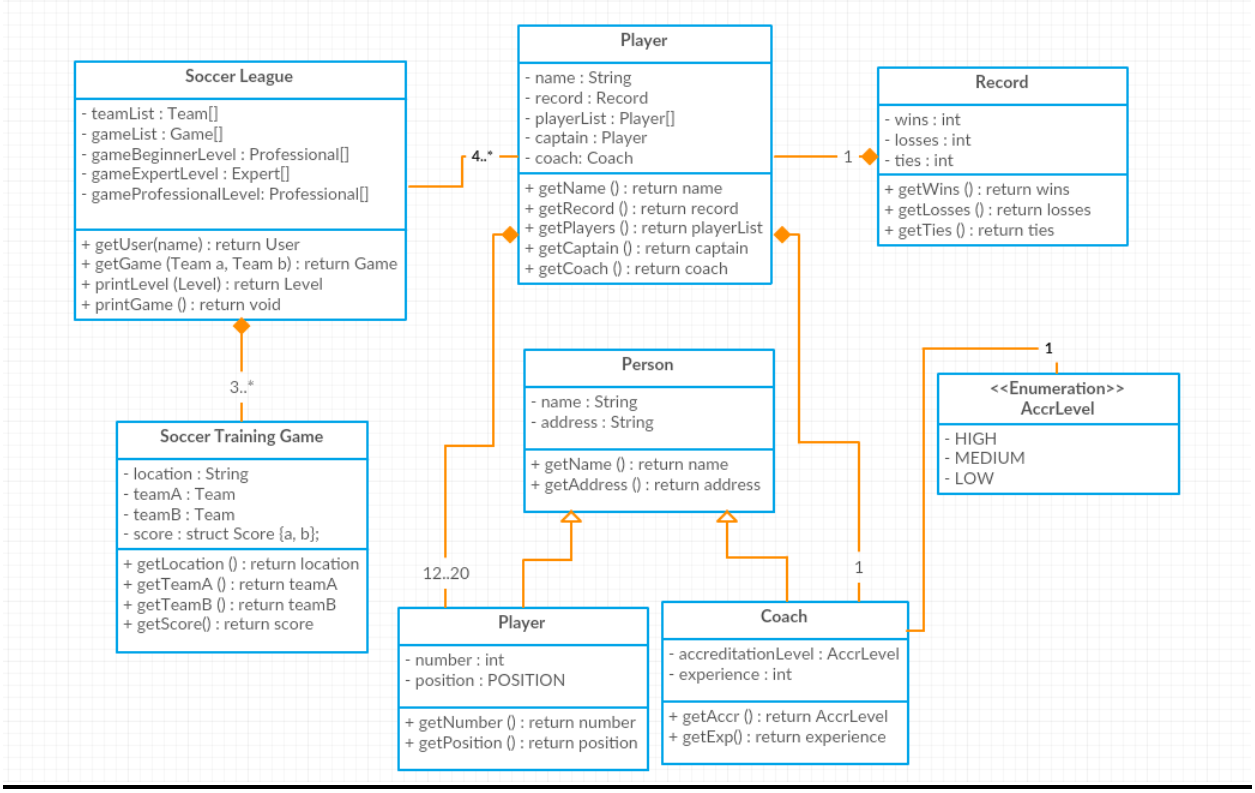
To build the product we need to use both software and hardware components.

Hardware: 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.

Software: The actors for our system are the professional and beginner players, coaches, and teams from different organizations. Each actor is an entity in the soccer training database system. We are collecting real-time data of each player using hardware specified above (mostly sensors) when they are playing in the 4-sided physical box that encloses an artificial soccer pitch. This real time data is useful for tracking current skills and progress in improvement for players and

coaches can make changes in training schedules and methodology based on the effectiveness of a particular method for any skill. VR technology can be incorporated to get view past plays and gain insights about the gameplay of each player 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.





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

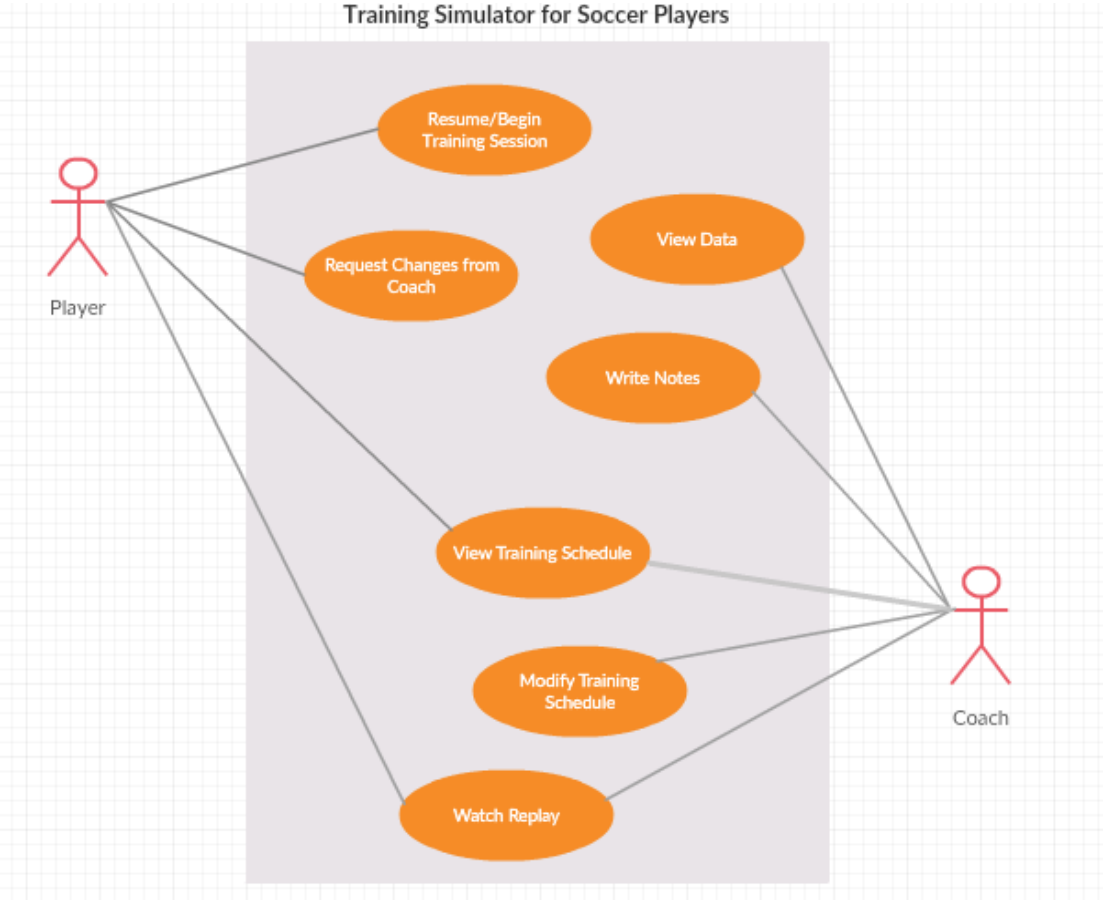
players to work on their skills. The software will have the ability to interact with existing databases and manage training sessions. Each player has their own system profile for training enabling them to track details about their session and generate reports. This is the best product for people who 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)

We have 2 main actors: (1)Player and (2)Coach.

The use case shows how the actors interact with the system and thus, help us define the requirements and other details of our system.



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 males 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. After a prototype of

the system is ready, we can bring in test users to gain feedback about the look-and-feel as well as their opinion about ease of system usage. Also, they will most importantly be needed during unit testing and integration testing of the system. User feedback about ease-of-usage and the look-and-feel will again be collected during these tests. In the end, test users will also be necessary to demonstrate the functionality of the system during acceptance testing by the client.

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 this 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 hardwares 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 50 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

All skill sets and strategies used during matches and officially recognized as such by FIFA will be recorded by the system. The level for proficiency for these skill sets would range from learning, beginner to expert.

The VR headsets would allow displays upto 1080p HD.

All player profile formats will be according to the international format style as decided by FIFA.

All international player rankings used by teams will be updated periodically and will be those as recognized by FIFA. However, all player rankings of the teams using the system will be according to the skill ranking as recognized by the system.

The quality of all hardware products used as part of the system will be according to international standards as set by the associated committee.

Database will be set-up according to the best model decided by keeping in mind the requirements for Access control, Auditing, Authentication, Encryption, Integrity controls, Backups and Application security.

8 Relevant Facts and Assumptions

8a Facts

There is a ready market for the soccer training simulator based on current market research.

The system will use data from official FIFA databook and officially recognized games only.

The skill sets in the training manual of the system will comply with health and safety regulations for the stress such maneuvers put on the human body. These skills will be officially recognized and recorded skills. The skill available to each player will be based on their current skill and experience level.

8b Assumptions

We assume teams are willing to invest in an expansion to their facility to house our system. We assume our product will be better than any other competing product enough to overlook a disparity in pricing of the system.

We assume all skills recorded officially are properly recorded and no error is in the original data source.

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

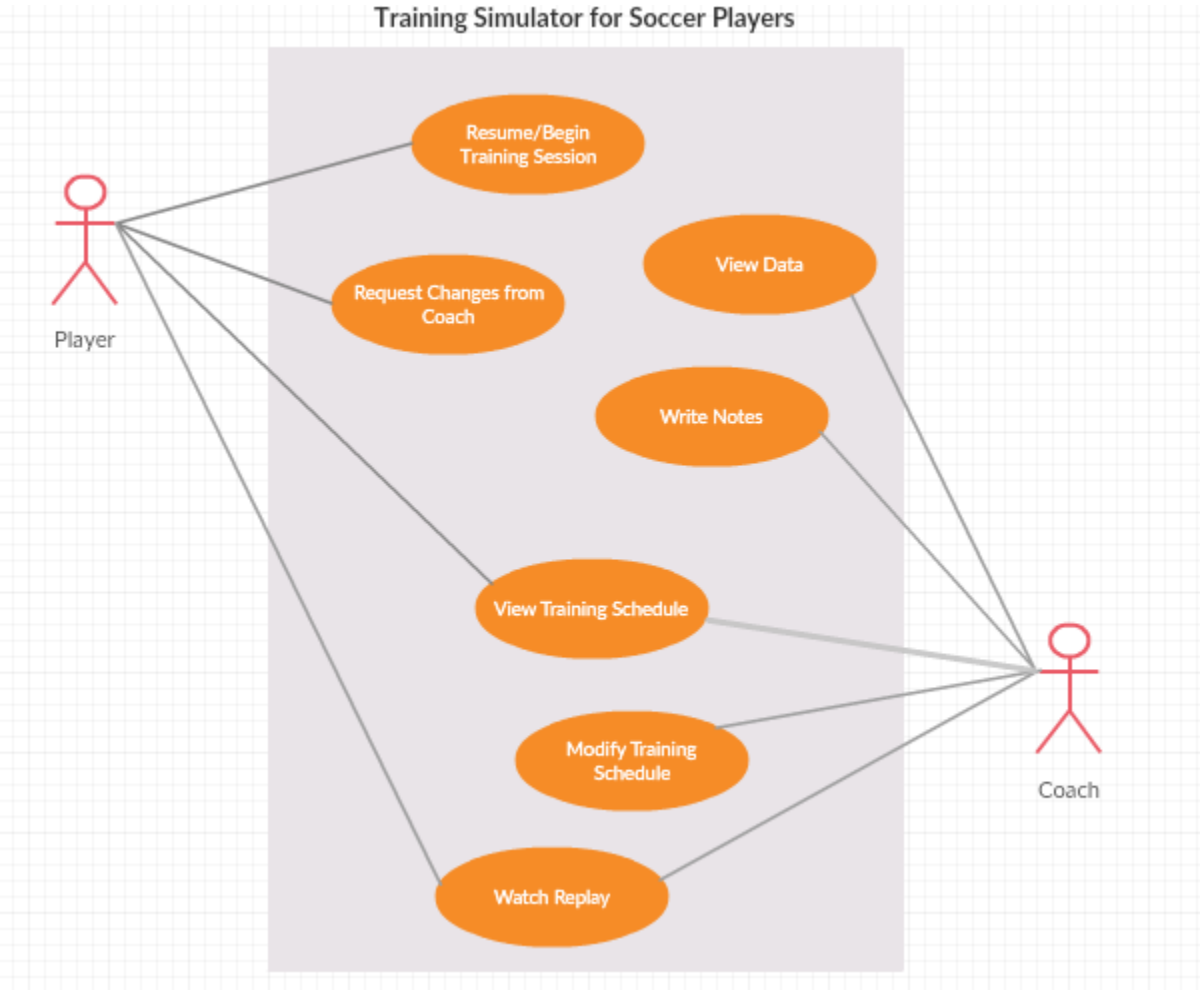


Figure 1. Players and Coaches Use Cases

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

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

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 it's 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

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

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	The call should connect to the help desk in under 5 minutes. The call should re-route in under 5 minutes

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
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 beings tested. The success of the training session will imply the quality of the user documentation manual

8g Training Requirements

ID# - Name	TR1 - Training Session
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)

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
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

13 Requirements Acceptance Tests

13a Requirements – Test Correspondence Summary

Requirements	*Tests*	*Test 1*	*Test 2*	*Test 3*	*Test 4*	*Test 5*	*Test 6*	*Test 7*	*Test 8*	*Test 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*													
	D3	*X*													
	D4	*X*													
	D5	*X*													
	P1	*X*													
	P2	*X*													
	P3	*X*													
	P5	*X*													
	Tests	*Test 1*	*Test 2*	*Test 3*	*Test 4*	*Test 5*	*Test 6*	*Test 7*	*Test 8*	*Test 9*	*Test 10*	*Test 11*	*Test 12*	*Test 13*	*Test 14*
	P6		*X*												
	R1						*X*								
	R2							*X*							
	R3											*X*			
	S1											*X*		*X*	
	LR1												*X*		

	AR1				*X*										
	IR1										*X*				
	PR1				*X*										
	I1													*X*	
	PIR1			*X*											
	LRF1														*X*
	SR1														*X*
	RIAS										*X*				
	CR1														*X*
	PR2														*X*
	MPLC				*X*										

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 Design

1 System Design

1a Design goals

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 sensors should be durable. Sensor readings should be as accurate as possible. The system should be tolerant to some extreme error readings. Database should be designed to it should also be secure, with back-ups and minimize redundancy.

The sensors will be used in a sport-practicing environment, so they should be built durable enough. The sensor readings will be used to analyze player performance. Hence, better accuracy will provide us with better analysis for the clients. Error handling for the sensor reading should be done to the utmost so that random deviations in the readings do not affect the final analysis. As the system will be used by an academy, hence the database should be capable to handling multiple users at the same time without any type of connection lag or miscommunication.

The LED walls, automated ball-boy and ball shooter must be linked to the system so that it can synchronize and keep track of the player progress accurately. All hardware components must be durable and maintained throughout the lifetime of the system.

ACID properties must be adhered to to for the database. As data for each player and coach is important to be kept secure and separate, hence ACID properties are a necessity for any transaction occurring in the system.

2 Current Software Architecture

The design pattern used to create the Soccer simulator software is the MVC (Model View Controller) design pattern. The MVC design pattern clearly separated the web application's behavior, presentation and control. The modularity of this design pattern allows for easier code reuse, more centralized control, bugs easier to track down and code easier to modify. The presentation, or view, of the software makes use of servlets as front controllers and maps incoming request to specific operation and selects views based on the model and session state. Our VR part of the system uses Repository model to run the whole system.

To serve better quality, an appropriate architectural style is critical. Using correct software architectural style not only can make implementation progress more professional, but also easier to update.

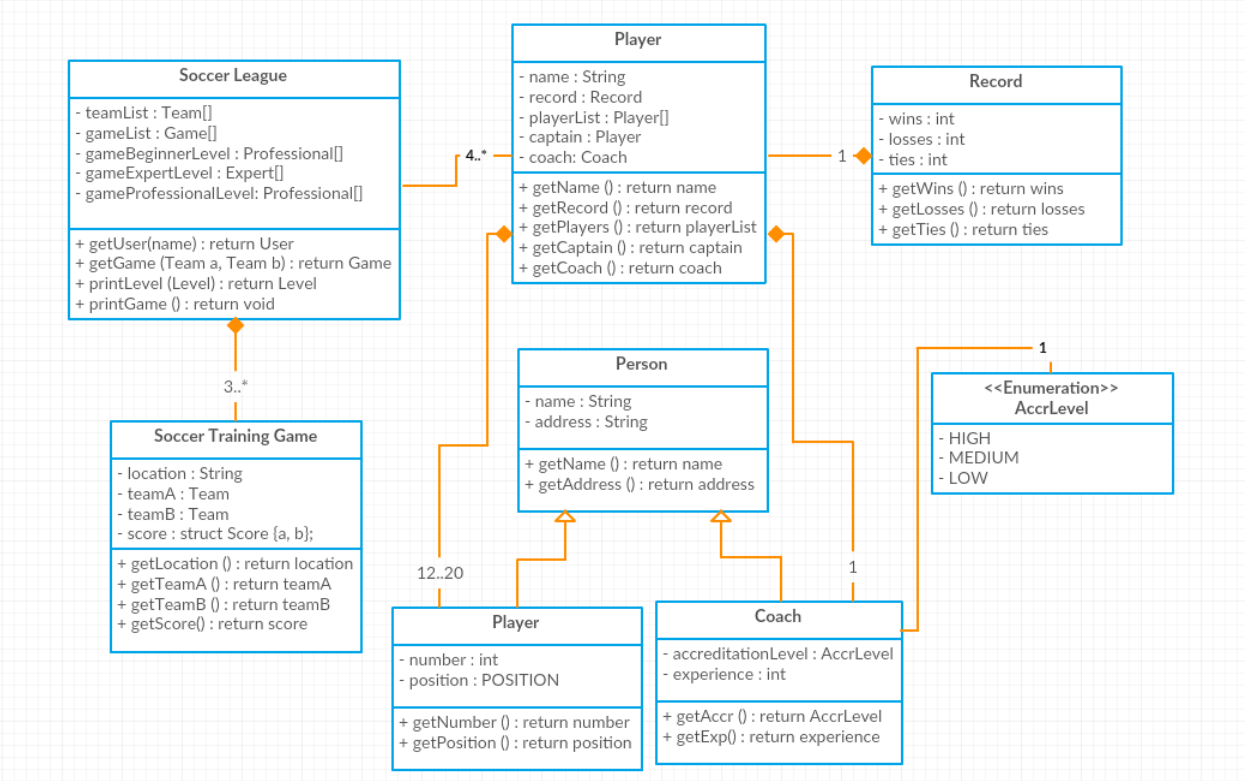
In the VR functionality, since the soccer academy does not have to propagate data further to customers, so the repository model is the best fit. The subsystems such as sensors and in-stadium cameras are writing to and reading from one central database-like repository. However, the software side which interacts with components present in the physical turf requires to have functionality that can propagate analyzed data to coaches and players. Therefore, besides to the repository model that can gather and analyze data within the system, the software needs to have viewer from outside.

3 Proposed Software Architecture

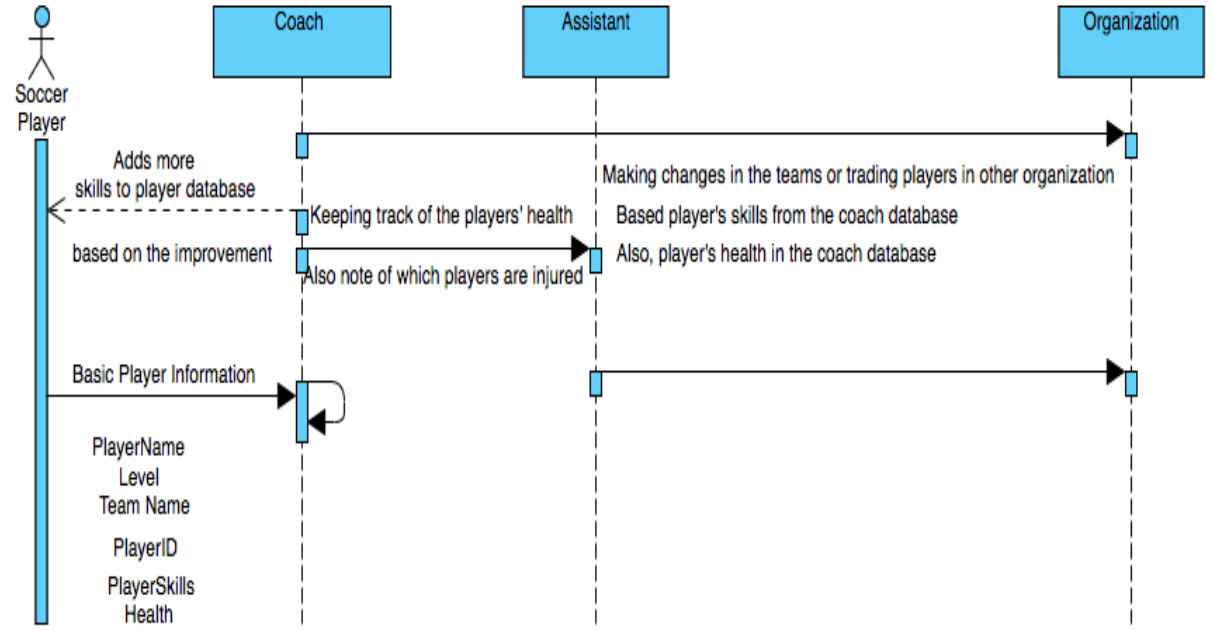
3a Overview

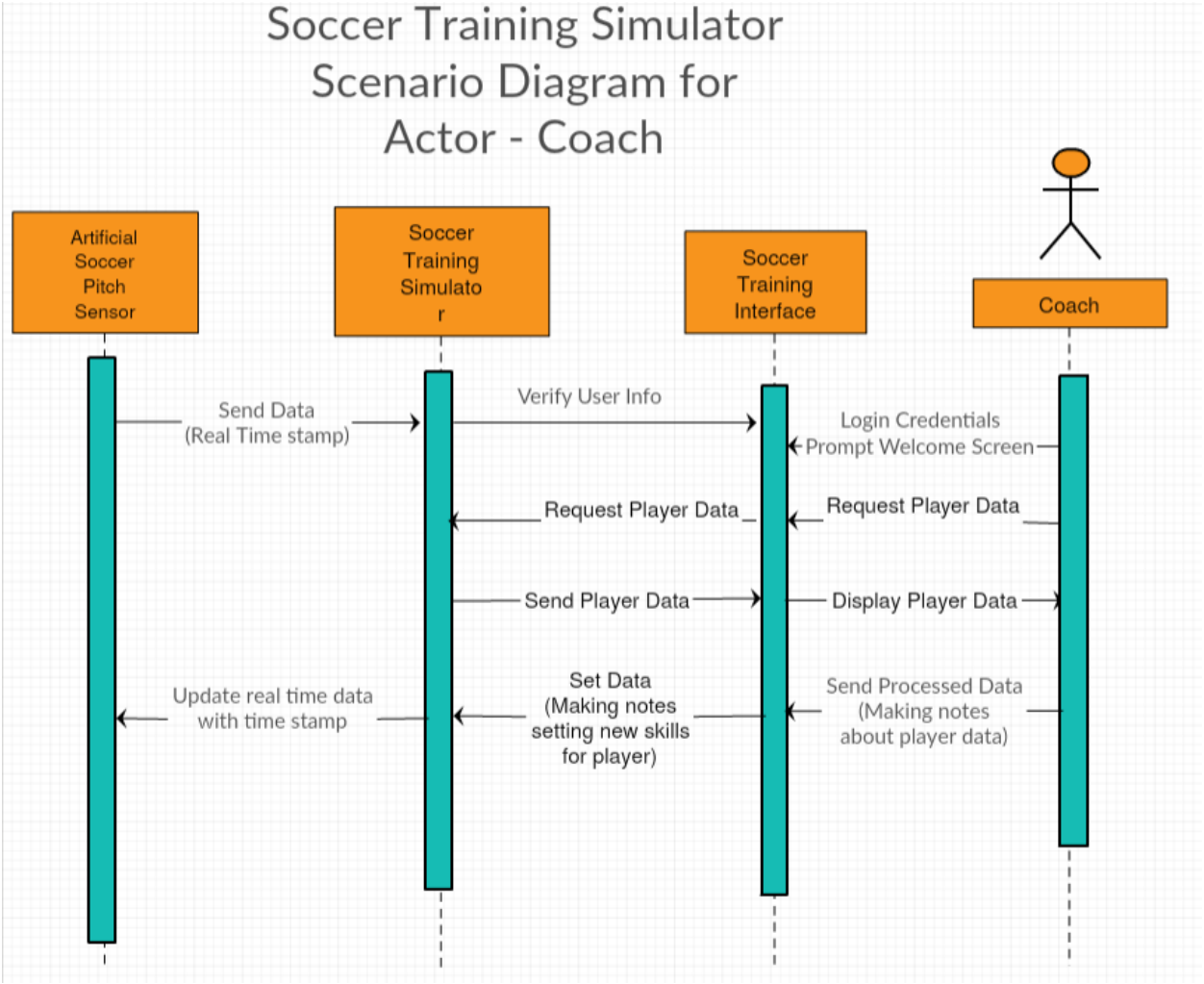
The actors for our system are the professional and beginner players, coaches, and teams from different organizations. Each actor is an entity in the soccer training database system. We are collecting real-time data of each player using hardware specified above (mostly sensors) when they are playing in the 4-sided physical box that encloses an artificial soccer pitch. This real time data is useful for tracking current skills and progress in improvement for players and coaches can make changes in training schedules and methodology based on the effectiveness of a particular method for any skill. VR technology can be incorporated to get view past plays and gain insights about the gameplay of each player 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.

3b Class Diagrams



3c


Coach
Assistant
Organization
Soccer Player
Adds more skills to player database
based on the improvement
Keeping track of the players' health
Also note of which players are injured
Making changes in the teams or trading players in other organization
Based player's skills from the coach database
Also, player's health in the coach database
Basic Player Information
PlayerName
Level
Team Name
PlayerID
PlayerSkills
Health

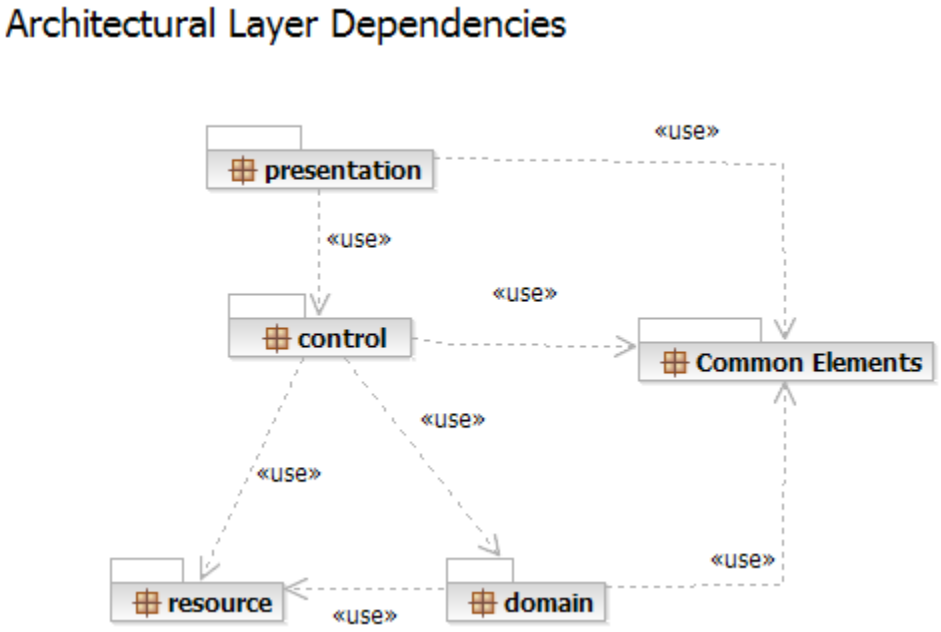

Soccer Training Simulator
Scenario Diagram for
Actor - Coach
Artificial Soccer Pitch Sensor
Soccer Training Simulato r
Soccer Training Interface
Coach
Send Data (Real Time stamp)
Verify User Info
Login Credentials
Prompt Welcome Screen
Request Player Data
Request Player Data
Send Player Data
Display Player Data
Update real time data with time stamp
Set Data (Making notes setting new skills for player)
Send Processed Data (Making notes about player data)

3d Subsystem Decomposition

Logical view of the system can be seen as divided into layers based on the N-tier architecture.The layering model of the soccer simulator software is based on a responsibility layering strategy that associates each layer with a particular responsibility. This strategy has been chosen because it isolates various system responsibilities from one another, so that it improves both system development and maintenance.

Each layer has specific responsibilities.

- The **presentation layer** deals with the presentation logic and the pages rendering
- The **control layer** manages the access to the domain layer
- The **resource layer** (integration layer) is responsible for the access to the enterprise information system (databases or other sources of information)
- The **domain layer** is related to the business logic and manages the accesses to the resource layer.
- The **Common Elements layer** gathers the common objects reused through all the layers



3e Hardware / software mapping

All simulation software will be mapped to the VR headset and the field subsystems. The databases will be mapped to servers in a part of the facility separate from the pitch.

All sensors will need to be mapped to appropriate receivers and data fields in the system software.

3f Data Dictionary

Each player should have their own id number, to be associated with their FIFA player ID if they have one. It's format should be PlayerName_GeneratedUniqueNumericID_FifaID(if no Fifa ID, set it to FifaID = NULL).

Each training session for each individual player must have it's own unique session ID. The format for the name of the file storing session information should be PlayerID_SessionID_StartTimeDate_EndTimeDate.

Each sensor should record the reading according to its unique session ID. The readings from sensor should be recorded in a separate file with the name format as Session_ID_TimeOfReading.

3g Persistent Data management

User preferences: Most used parameters, most used visualizations, the layout of display, profile of players frequenting that particular system.

Reports/Data Visualization: What parameters were used to generate the reports, what style was chosen by user

Training Session: The progress made in the latest training session in a report form.

Storage Management Strategy: Relational Database

We have decided on using a relational database to store persistent data because of these reasons:

ACID properties - As multiple users may access the database at the same time, our system requires the database transactions to have handle atomicity, concurrency and integrity to the utmost. The system always needs to be durable too.

Handles Report generation well - Our system is constantly analyzing large amounts of information from sensors to generate a performance report for each training session for each individual user. This data has to be displayed in a proper format (like pie charts and graphs) so the player can easily understand their performance evaluations and coaches can interpret them and plan ahead well.

Security - Encryption and data security for relational databases is the most easily applicable and difficult to break. As the player data is to be made available only to the player themselves and the coach, security is paramount for out data.

Supports queries over attributes - Since one of the system's main features is the generation of reports and data visualizations of many different performance evaluation parameters, it should support the quick and complex searching of parameters to pull for the data included within the reports and data visualizations.

3h Access control and security

Our system will have 2 main users: (1)Players and (2)Coaches. Thus, we will have a role-based access control policy. A player's data will only be visible to that player him/her-self and his/her respective coach. No player will have access to another player's data. Similarly, no coach will have access to data of player assigned to another coach.

Only coaches will have access to create, update and delete training schedule and techniques for their assigned player. Player's won't be able to do so themselves. However, a player will be able to add a new skill to be learnt after their assigned training schedule create by the coach is completed and if they have time available without violating any health and safety regulations.

Both the data stored by the system as well as in the central database will be encrypted and secured. The connection itself will have to be secured by firewalls and latest anti-virus software security, to be kept up-to-date. RASP protection for the local system as well as main database is also to be implemented.

3i Global software control

The backend system will be implemented and maintained by our developers and software maintenance team. Thus we need to give Remote Control Access to our developer for the system.

By not depending on going to the physical location of the system to make any updates or for software error handling, Remote Access Control will make easy for our team to resolve any issue from offshore.

Remote Access Control can help handle any kind of software errors and overflowing the system, can be handle any time from anywhere by our developers without wasting time for waiting.

Our client might not have any developer department, therefore it will be upto us to handle software maintenance activities.

3j Boundary conditions

These are the boundary conditions we have identified:

1. The addition of a new hardware component or sensor to the system
2. Start up of the system
3. Shutdown of the system
4. Removal of a hardware component or sensor from the system
5. Corruption of sensor data
6. Loss of connection between sensors and database

4 Subsystem services

The system will contains other subsystems as player profile information, training schedule enabler, available skills for the player at their current skill level, user interface, server services that will create a full system for the client.

The developers will build this subsystems concurrently, to reduce time required for system development, and then it will be included for further implementation.By integrating each subsystem our software system will be a minimum coupling and maximum cohesion system in the end, becoming an overall easily sustainable system. Each sub system will contain their own classes and pattern design. Hereby, it system will be working as one.

The developers should understand each of the sub systems are related with each other. Each sub system needs to work by their own, but they also requires handling when they will communicate with each other.

5 User Interface

The user interface will be a combination of screens to display data, VR displays, and sensors that take input.

Screen Displays:

Will take in data from a keyboard and display requested information. This could take the form of data of an individual team member or the team as a whole, memos that the entire team needs to read, or instructional information.

VR Displays:

Will display training scenarios and loaded replays. Used to immerse individual players during training that does not involve intense physical activity.

Sensors:

Used with the artificial pitch to collect data on the team and each player. Stores the data in the database for later analysis.

6 Object Design

6a Object Design trade-offs

We want to make each of the subsystems work independently, so each part can be maintained and accessed without disturbing the workings of other subsystems. But the negligible communication between different subsystems means that we might sacrifice some communication time and overheads when getting or processing sensor data.

We will be using a large amount of sensors. This is because we want a model analysis that is as

accurate as possible. Getting data from multiple sensors, having a system that recognizes and compares sensor data to the in-built data of optimum statistics of skill sets to generate a report for training purposes requires time overhead and may even introduce some errors that we cannot afford. We must sacrifice time for final data analysis after sensors have already delivered the data to the system database for report generation time to get more accurate and consistent sensor data in the first place.

6b Interface Documentation guidelines

Each of the subsystem will contain their own objects. Each object will be documented with their purpose of the class definition.

Each object class will be maintaining their own works for that specific work scheduling, hence by it will be easy for the developers to create more objects of the same class with better feature changing and more advanced implementations.

Object classes will be defined as individual sub system for modification purpose. The developers need to document each of the object class interfaces, purpose of the object, the relationship of the object within system requirements. Each object interface will be documented properly to facilitate future improvements.

The interface of object classes mostly depends on the developers implementation. Interface will keep changing and improving during the development life-cycle of the project based on test user feedback. Each change should be properly documented, the before and after interface should also be noted in the documentation.

6c Packages

There will be different packages for the data storage objects, the user interface objects, and the sensor objects. Each package can be developed independently with only a few interface objects needed to make the system work together.

6d Class Interfaces

Sensors will interface with the database to store the data. The GUI classes will interface with the database to fetch the data.

IV Project Issues

1 Open Issues

One problem with tracking data while the players are using the artificial field would be making sure the data is associated with the player performing the action. If the ball hits and electronic goal, only the hit will be registered, and not the player that it came from. This will be a problem

with tracking accurate stats for players effectively. This problem has no clear solution in our design yet and is the focus of active research.

2 Off-the-Shelf Solutions.

2a Ready-Made Products

Database systems such as SQL or NoSQL databases can be used for the backend of the system. GUI packages can be used to create the displays. Unity or a similar game engine can be used to create the VR displays.

Many hardware components, which either do not use sensors, like the soccer balls or they need sensors to be manually added to them, like simple LED's for the wall, can be bought and used ready-made for the system.

2b Reusable Components

GUI libraries such as Java Swing can be used for displays.

Many hardware components are also reusable. Soccer balls, ball-boy and LED for the walls are some of the hardware components that are all reusable, easy to find and replace.

2c Products That Can Be Copied

This project suffers from its own uniqueness, and similar products will be hard to find. Currently, most of the similar themed products in the market are all aimed towards games and not professional game play like our product will be.

3 New Problems

3a Effects on the Current Environment

The facility could radically alter the way soccer leagues operate. It would change the kinds of personnel that are necessary to keep the team going. It would also require a larger budget and large swaths of land to go to the soccer team that operates the facility. It could also create disparities in the performance of teams in the league, with teams that have access to a facility out performing other teams.

3b Effects on the Installed Systems

This system aims to replace the use of FIFA and current training fields. The FIFA developers as may not like this loss of revenue.

3c Potential User Problems

If implemented improperly, the players could suffer from injury or have other adverse effects from not training the way that is generally accepted. Players could also have adverse mental

health effects from the pressure of having all their stats recorded and scrutinized constantly. They could also face stress from the digitization of their profession, much like people in other fields when computers are integrated deeply into their work (Doctors, Construction Managers, etc)/

3d Limitations in the Anticipated Implementation Environment That May Inhibit the New Product

The facility will be entirely self contained, so all environmental concerns will be taken care of by the design. The space the team allocates may not be big enough for the facility, but this will be ironed out on a case by case basis.

3e Follow-Up Problems

Since our project has both software and hardware components, many potential follow-up problems can occur.

First and foremost, upon replacing of sensor components, synchronicity between new sensor hardware and software system is a big problem.

As multiple sensors are used, the system must be able to handle a continuous flow of data from a large amount of sensors. The processors must be able to keep up in speed and accuracy to be able to analyze and generate reports based on this sensor data.

The software security must always be kept up to date, as new viruses and hacking techniques are being invented daily.

4 Migration to the New Product

4a Requirements for Migration to the New Product

Migration will be total when the new system is installed. Training and usage manuals for the new system must be distributed to and understood by the players and coaches. Proper software maintenance chain must be set up by the development team while the customers will be responsible to setting up a proper hardware maintenance schedule as well as first-aid facilities in case of any emergency,

4b Data That Has to Be Modified or Translated for the New System

Current player statistics may be recorded by teams and would need to be formatted and integrated into the system's database. Many skill sets, like team formations, team plays, maneuvers and techniques must be added to the system and make it possible for the system to be able to recognize them being executed by the players using sensor data.

5 Risks

Insufficient research into the needs of a training soccer team could result in a product that does not give a team better performance. This will supposedly be taken care of in the research leading

to the design, but thorough research does not guarantee success. Players might not like playing in the new facility.

Also, proper health care and physics required for the various maneuvers and techniques to be trained-in by the player need to be documented and implemented by the system. Insufficient research into these topics could fatally injure a player when they try to learn a skill not suitable for their play-style, body type or above their current skill-level.

6 Costs

The cost of development of the system itself is estimated to take 50 million dollars. Each system facility will be designed based on a contract with the team or academy, so the cost for each individual system and its installation will be determined on a case by case basis.

7 Waiting Room

In the waiting room, I would like to add like to integrate the hardware side simulation tools such as Oculus Rift Virtual Reality headset with the soccer training simulator application. Also, it should be physical soccer pitch with Artificial Intelligence sensor integrating with VR headset so the soccer player real-world experience from beginner to professional level. These are the recorded ideas that could not included in the current release of the product. But it will be definitely added in the later release of the project.

8 Ideas for Solutions

For the Development Project our group suggested the following ideas below:

Programming Languages:

Front-End: Javascript and React since React easier to deploy as well as very popular language in the software industry right now.

Back-end: C#. .NET. for manage database and connecting it with API also the front-end of the training simulator.

IDE Recommended: Android Studio, Visual Studio, MySQL Workbench

Library: Node Package, React and other necessary libraries need to deploy simulator

Project Retrospective

The design went smoothly, but we have no idea how useful it would be. In the future, users should be part of the design process so that the end product will be well tailored to their needs.

V Glossary

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

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

Coach- Individual employed by the soccer team to lead the practice for the players and decide the strategy of the team.

Players- Any individual on the team that who is employed to play game.

VI References / Bibliography

[1] Robertson and Robertson, Mastering the Requirements Process.

[2] A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts, Ninth ed., Wiley, 2013.

[3] J. Bell, "Underwater Archaeological Survey Report Template: A Sample Document for Generating Consistent Professional Reports," Underwater Archaeological Society of Chicago, Chicago, 2012.

[4] M. Fowler, UML Distilled, Third Edition, Boston: Pearson Education, 2004.

VII Index

Design	61, 63	Test	64, 65
Requirements	35, 51, 58		