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ASSESS, TRACK, TRAIN



IMPROVING SOCCER FITNESS EVALUATION PROCESS

THESIS REPORT
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IMPROVING SOCCER FITNESS EVALUATION PROCESS

by

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ABSTRACT

This project aims to solve the problem of the lack of standardization in the football medical examination process through the development of an innovative systemized data tracking process. The current testing process involves the use of 8 different machines and some tests on the field, which is time-consuming and makes it difficult to connect the data points. As a result, trainers and physiotherapists face challenges in accurately assessing players' fitness levels and determining the rehabilitation time for injured players. The proposed solution provides a one-stop solution that assesses, tracks, and trains players through the use of an innovative product that provides rehabilitation, testing, and training facilities. The product is designed to be user-centric, ergonomic, and sustainable while addressing the need for standardization in the football medical examination process. Overall, the solution offers a comprehensive and effective approach to address the challenges associated with the football medical examination process.

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L Other Supportive Raw Data

M Topic Specific Data

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Chapter 1 - INTRODUCTION

1.1 Problem Definition

Football Medical is an unavoidable part of a footballer's life. A transfer player, a loan player & an academy player, they all must do it at any given moment, and it's not just a formality, it's mandatory. Medical examinations are not standardized, they depend on clubs, countries, and players. We can break down the process into two compulsory Areas:

The first is to assess Fitness: Aerobic fitness and anaerobic fitness (running speed and sprint ability) are crucial attributes in football. It focuses on intermediate performance of the player.

The second establishes the player's Health: This section assesses the physical health of the player, including blood samples, urine samples, MRIs, and CT scans. It focuses on long term health of the player.

During this thesis investigation, we will base our analysis on the first aspect of tests, which is fitness. The aim of training and examinations is to determine each player's fitness and competency for physical activity and their performance in the game.

1.2 Rationale & Significance

Evaluation plays a very important role in large sports clubs where major money is spent on purchasing new players, and the buyers are very careful to ensure all players go through a complete fitness evaluation to make sure they are fit enough to play. Performance evaluation consists of two components, fitness and health; Thesis will be focused on the fitness component.

Currently, many different steps are completed on different machines and people take manual notes in addition, which is often not accurate. Moreover, it is necessary to connect the data in some way, which will allow trainers to focus on a player's weak points and coaches to develop a game plan. A need exists that can be met to provide managers/coaches/buyers with accurate information about the players they wish to invest in.

1.3 Background / History /Social Context

Football medical examinations are a necessary and crucial part of a footballer's life. However, there is a significant challenge with the lack of standardization in the examination process across different clubs, countries, and players. This lack of standardization makes it challenging for trainers to accurately assess players' fitness levels and optimize training regime to improve performance. In addition, physiotherapists face difficulties in determining the rehabilitation time for injured players due to the lack of structured data and testing methods. The current testing process is done on 8 different machines and some tests on field making the process time consuming and difficult to connect the data points. This problem can lead to players returning to the field too early or too late, affecting their performance and causing potential long-term injuries. Therefore, there is a need for a systemized data tracking process that can address these challenges and provide accurate information to trainers and physiotherapists to help them make informed decisions about players' fitness levels and rehabilitation time.

There is no doubt that football is the most watched game in the whole world, and that brings big players and clubs fame and money. Every time a player is exchanged, purchased, or retained, a performance evaluation is carried out to predict future performance. This process is very important for players to find out where they are weak, for coaches to know where they should focus when training, and for the clubs that invest a great deal of money in each player to have an understanding of what they need to do.

The problem emerges from mapping the entire cycle of users, benchmarking, and environment of use to demonstrate how diverse the products are for checking the fitness of athletes. There is a need to simplify the procedure, allow physiologists and cardiologists to analyze the data more easily, and provide coaches and trainers with a report on the player's weak points and improve them. There is currently no standardized way to determine a player's fitness level; it varies by club, country, and player.

Through the results of the thesis, players will have a better understanding of their fitness level in terms of soccer, and can use the data to improve their training, coaches and trainers will be able to create better game plans, and clubs will know whether they should invest in players.

CHAPTER 2 –RESEARCH

2.1 User Research

Evaluation plays a very important role in large sports clubs where major money is spent on purchasing new players, and the buyers are very careful to ensure all players go through a complete fitness evaluation to make sure they are fit enough to play.

There is a need that can be solved to help managers/coaches/buyers have accurate data about each of the players they are choosing to invest in. Currently, many different steps are completed on different machines and people take manual notes in addition, which is often not accurate.

2.1.1 User Profile – Persona

Michael
Gayle

Soccer player in Humber studying business management



Michael is a 23 year old student in Humber pursuing business management. He is a player in Humber soccer team and plays as a forward. He lives with his girlfriend in Etobicoke and drives to Humber to his classes and trains in gym afterwards. Fitness is of course the biggest aspect of football so he does a lot of sprinting and jogging and leg workout. There is no collection of his gym data to see if he is improving and where he is lacking. Trainers usually have to see the progress to make the game plan but not in this case. He works hard on his strengths but weakness section is being ignored.

Football fitness testing required before playing for Humber. Results are not implemented into training for development of the player.

- 23 Years old
- In relationship
- Male
- Study 4 days a week
- Travels to school
- Does own a car
- Lives in shared apartment

MOTIVATIONS

- CONVENIENCE
- TO BE SELECTED IN THE HUMBER TEAM
- LOVES TO TRAIN AND PRACTICE SHOTS
- FITNESS FREAK, DOES CARDIO EVERYDAY
- HEALTHY CLEAN EATING

GOALS

- PRACTICE AT HOME AND BE ABLE TO TRACK
- USE THE DATA CREATED TO DEVELOP HIS SKILLS
- TO BE ABLE TO FOCUS ON WEAKNESS TOO
- PASS THE FOOTBAL MEDICAL TEST WITH EASE
- DO WHAT HE DOES EVERY DAY FOR TEST

BARRIERS

- EXPENSIVE MACHINES TO BUY AT HOME
- TAKES A LOT OF SPACE IF BOUGHT
- DOESN'T HAVE CONNECTIVITY FOR TRAINERS TO KNOW THE RESULTS
- LACKS IN WORKING ON HIS WEAKNESSES

LIKES

- LIKES NEW TECH DEVICES FOR PERFORMANCE TRACKING
- PERFORM ON HIGH LEVEL TO BE SELECTED
- TRAINERS USES THOSE DATA TO DVELOP THE GAME PLANS
- LOVES TO PROFESSIONALLY BE ABLE TO DEVELOP HIS FITNESS

PERSONA DESCRIPTORS

Sport enthusiast
Loves soccer

2.1.2 Current User Practice

How is this need being addressed currently?

(Current products and services)

1. There are multiple apps available which can track user movements, measure heart rate and other diagnostics of the player.
2. There are physical machines which are used to check an athlete 's running ability and Strength & weight lifting abilities.
3. There are also data driven performance evaluations which I am not planning to move forward to.

2.1.3 User Observation - Activity Mapping

Soccer player

Soccer player go through the fitness testing for one season and throughout the season to check overall body composition and endurance level.

What are their key goals and needs?

- Track all the tests
- To know their progress and consistency
- To improve their performance on field

What do they struggle with most?

- All require
- WLL require
- Lack of consistency between the performance on field

What tasks do they have?

- Baseline tests
- Dynamic testing
- Training

| Journey Steps Fitness testing phase | Baseline tests | Pressup tests | Agility Testing | Final soccer fitness tests |
|--|---|---|--|--|
| Actions Soccer player follow the testing procedure, agility testing, VO2 max testing, Biop testing | Height and weight Punch tests Body fat percentage | Pushups Situps Squats | 400 yard test 1 mile 2000 yard test | VO2 Max test Biop test |
| Needs and Pains Soccer player wants to pass the test they want to avoid any possibilities of injuries due to their weakness, they want to tackle it after knowing the results. | Flexing sample test | Simple tests instead of 2 different types of tests How to not know the place connected to pass the test Squats only test 100 and 200 kg for girls although they push more | 2-2 seconds test pass 10 seconds pass 1.5 sec, 1.15 sec, 1.2 sec test pass | Measure the hand size and upper body strength Timing of 20 meter with each player |
| Touchpoint players interact with each machine as primary user, they touch points can be hands, feet and knee. | Hand, hand and hand | Hand, hand and hand Hand and hand Hand and hand | Hand and knee Hand and knee Hand and knee | Hand, knee, hand and feet and whole body Whole body |
| Player Feeling how is the player feeling throughout the testing process. | 😊 | 😞 | 😞 | 😞 |
| Backstage | | | | |
| Opportunities What could we improve or introduce? | Currently baseline tests also has 3 different machines, opportunity | these tests have metrics set to pass the test but is not helping | These tests are done on field, opportunity to bring it in machine test | Done on a machine but physio takes the sample by hand by stopping |
| Process ownership Who is in the lead on this? | Physiotherapist or doctor the player | Physiotherapist or doctor the test | Physiotherapist or doctor the test | Physiotherapist or doctor the test |

2.1.4 User Observation – Human Factors of existing products

| | Bowflex velcore bike | Bowflex treadmill 22 | Skillrun live 7000 | Polar Unite Heart Rate Monitors | TATSports Apex Athlete Series GPS Performance Tracker |
|-----------|----------------------|----------------------|--------------------|---------------------------------|---|
| Features | | | | | |
| Interface | | | | | |

When it comes to the human factors of fitness machines, there is significant variability in the usability and ease of use among different products. The Bowflex Velcore bike and treadmill, for example, feature a simple button and screen interface that is easy to navigate. However, there is room for improvement in terms of button placement and ergonomics.

Other machines, such as the Skillrun Live, incorporate touch interfaces that provide users with more dynamic feedback. While these interfaces can enhance the user experience, they may also be more challenging for those with less experience or dexterity.

Emerging technologies are also exploring the use of voice and gesture controls, as seen in products like the Tatsport wearable and Polar Unite watch. While these technologies may offer a more hands-free experience or be beneficial for those with limited mobility, their effectiveness in practice remains to be seen.

Overall, the design of fitness machines must consider various human factors, such as ergonomics, usability, and accessibility. As the fitness industry continues to evolve, incorporating user feedback and design principles will be crucial for creating effective and user-friendly machines.

2.1.5 User Observation – Safety and Health of existing products

When it comes to the safety and health of fitness machines, there are several factors that should be considered. For example, the Bowflex Velcore bike and treadmill have been designed with safety features such as emergency stop buttons and automatic shut-offs to prevent injury.

However, there are also potential health concerns associated with prolonged use of these machines, such as joint stress or repetitive motion injuries. It is important for users to be aware of proper form and technique to minimize the risk of injury.

Touch interface machines, such as the Skillrun Live, have their own unique safety considerations. These machines should be designed with durable and easy-to-clean surfaces to prevent the spread of germs or bacteria, especially in shared gym environments.




When it comes to emerging technologies like voice and gesture controls, there are still unknowns regarding potential health risks or safety concerns. As these technologies continue to be developed and tested, it will be important to ensure they do not pose a threat to user safety or health.



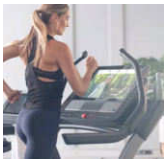


Overall, ensuring the safety and health of fitness machine users requires careful consideration of design, ergonomics, and maintenance protocols. By prioritizing these factors, fitness machine manufacturers can create products that not only enhance physical fitness but also promote safety and well-being.



2.2 Product Research

2.2.1 Benchmarking – Benefits and Features of Existing Products

Product (Benchmarking)

| Products | Image | Features | Challenges |
|--|---|---|--|
| <p>The Catapult PLAYR Smart Coach System</p> |  | <ul style="list-style-type: none"> -Monitors ten core metrics including distance, sprints and speed - Improve performance & Reduce the risk of injury by monitoring your workload. -Manage rehabilitation to support return to play. - Develop coach to player communication with Catapult One. -Unique to Catapult, Movement Profile quantifies the physical load from multi-directional movements. | <ul style="list-style-type: none"> -Product can only be used outside and on field. -Uses GPS to track the runs which constraints the ability to record inside. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric plus has no cardiac metrics too. |
| <p>STATSports Apex Athlete Series GPS Performance Tracker</p> |  | <p>GPS Performance Tracker allows athletes to track game data live using 14 different metrics. Using the tracker app, access stats for heart rate, max speed, total distance, number of sprints, time in red zone and more.</p> <p>Wireless syncing sends information directly to your chosen device. You'll have the ability to compare your stats with other Apex users worldwide.</p> | <ul style="list-style-type: none"> -Product can only be used outside and on field. -Uses GPS to track the runs which constraints the ability to record inside. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric plus has no cardiac metrics too. |
| <p>APEX ATHLETE SERIES GPS PERFORMANCE TRACKER USR EDITION</p> |  | <p>Real-time performance data at your fingertips to help you become fitter, faster and perform at a higher intensity.</p> <p>Increase your max speed and sprint capacity, and test yourself against the pros.</p> | <ul style="list-style-type: none"> -Product can only be used outside and on field. -Uses GPS to track the runs which constraints the ability to record inside. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric |

| | | | |
|---|---|---|---|
| | | | plus has no cardiac metrics too. |
| Polar Unite Heart Rate Monitors |  | Get personalized daily workout guidance to inspire you, 24/7 heart rate and activity tracking to motivate you, and automatic sleep and recovery applications to help you understand your body better. It's time to live life to the fullest: every shape, every size, every step of the way - everybody, unite! | -Product can only be used outside and on field. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric plus has no cardiac metrics too. |
| MRI,CT and ultrasound machines |  | Not the area of focus | Not the area of focus |
| NordicTrack EXP 7i Folding Treadmill - iFit Enabled |  | -NordicTrack EXP 7i Treadmill features a 7" (17.8 cm) full colour smart HD touchscreen -iFIT® enabled for interactive training sessions, streaming global and studio class workouts and connected fitness tracking -30-Day iFit membership included -3.0 CHP smart-response motor -Tread Belt: 20" x 60" (50.8 x 152.4 cm) -FlexSelect™ cushioning & Automatic trainer control | -expensive plus need membership. -it can only work inside -doesn't do metrics for oxygen level and cardiac level. |
| Seimen's Healthineers |  | Not the area of focus | Not the area of focus |
| Skillrun live 7000 |  | Designed to train the pillars of athletic conditioning and performance, Skill Run is a treadmill like no other. Developed side-by-side with academic and research institutes, professional trainers and athletes, it takes performance training to new heights. | expensive plus need membership. it can only work inside doesn't do metrics for oxygen level and cardiac level. |

| | | | |
|-----------------------|---|--|---|
| Bowflex treadmill 22 |  | <p>The Treadmill 22 is our top-of-the-line cardio experience that provides the coaching, motivation, and variety you crave to keep you immersed in your fitness journey.</p> | <p>expensive plus need membership.</p> <p>it can only work inside</p> <p>doesn't do metrics for oxygen level and cardiac level.</p> |
| Bowflex velocore bike |  | <p>Track the metrics you lean on most.</p> <ul style="list-style-type: none"> • Time • Interval* • Distance (km or miles) • Calories • Burn Rate (calories per minute) • Heart Rate • Cadence • Resistance | <p>expensive plus need membership.</p> <p>it can only work inside</p> <p>doesn't do metrics for oxygen level and cardiac level.</p> |

Benefit Table

| Keyword | Frequency |
|------------------|-----------|
| Comfort | 8 |
| Resistance | 7 |
| Activity Tracker | 6 |
| Communication | 5 |

Feature table

| Keyword | Frequency |
|---------|-----------|
|---------|-----------|

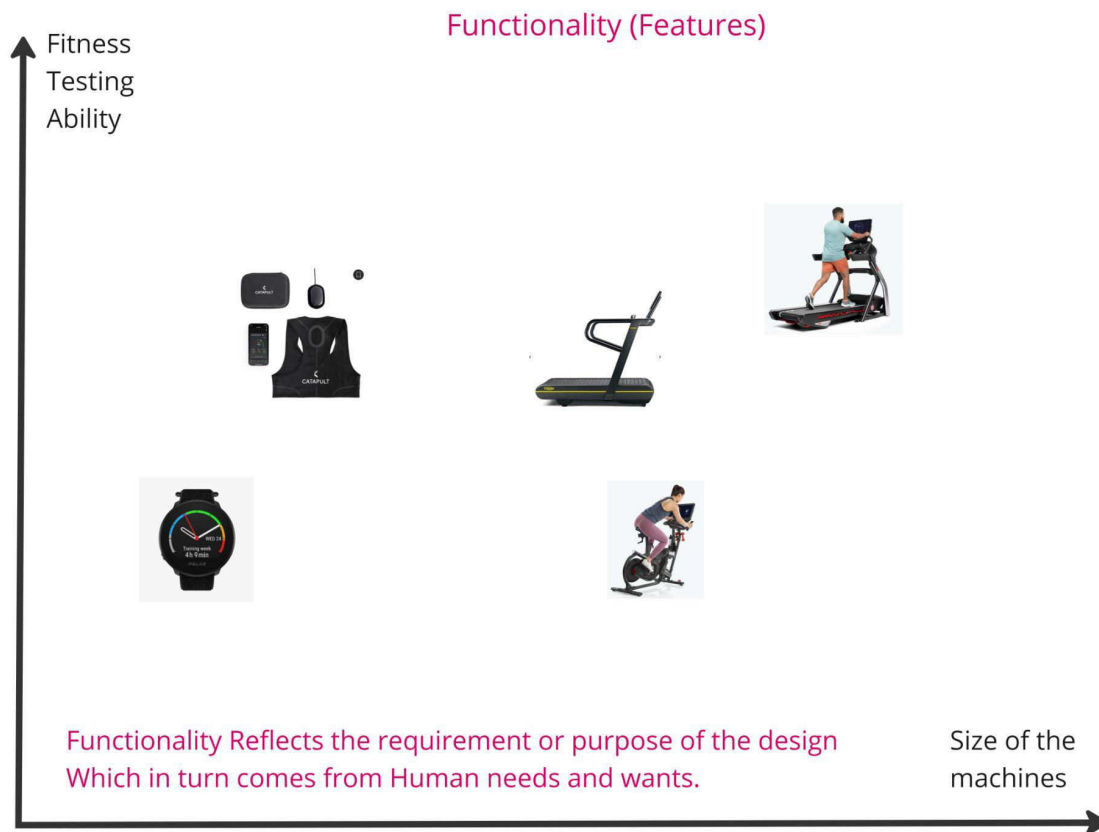
| | |
|------------|---|
| Modularity | 8 |
| Heart Rate | 6 |
| Treadmill | 6 |
| Jump Test | 5 |

2.2.2 Benchmarking – Functionality of Existing Products

Functionality benchmarking was carried out to determine common functionality amongst the product grouping as well as market differentiation.

Characterizing the functionality was carried out using the data set collected for the features, selecting most common features, and comparing two features in an x-y graph.

When it comes to functionality, the existing products in the market offer a range of features and capabilities. The Catapult PLAYR Smart Coach System and the STATSports Apex Athlete Series GPS Performance Tracker are both designed to track an athlete's performance during training and games, providing valuable data for analysis and improvement. The NordicTrack EXP 7i Folding Treadmill - iFit Enabled and Bowflex treadmill 22 offer a variety of workout programs, incline and speed adjustments, and heart rate monitoring. The Skillrun live 7000 takes things a step further with its interactive coaching platform and adjustable running surface. MRI, CT, and ultrasound machines offer advanced diagnostic capabilities for medical professionals. The Polar Unite Heart Rate Monitors track heart rate, sleep, and fitness activity, while the APEX ATHLETE SERIES GPS PERFORMANCE TRACK USR EDITION provides advanced metrics for outdoor and endurance sports. Seimens Healthineers also offer a range of medical imaging equipment and solutions for healthcare professionals. Overall, the functionality of the existing products varies widely based on their intended use and target market.



Takeaways

- There is no connectivity between the machines.
- All the tests are currently done separately. There are hardly 3 tests which can be covered together.
- Half tests are done inside and the other half are done on the ground. Which loses the Data connectivity.

2.2.3 Benchmarking – Aesthetics and Semantic Profile of Existing Products

2.2.4 Aesthetics

The Catapult PLAYR Smart Coach System: The design of this product is sleek and modern, with a focus on functionality rather than aesthetics. The color scheme is primarily black and white, with the occasional use of bright colors to highlight important information.

STATSports Apex Athlete Series GPS Performance Tracker: This product features a simple, minimalist design with a focus on functionality. The color scheme is primarily black and gray, with occasional pops of bright color.

APEX ATHLETE SERIES GPS PERFORMANCE TRACK USR EDITION: This product has a similar design to the STATSports Apex Athlete Series, with a focus on simplicity and functionality. The color scheme is primarily black and gray.

Polar Unite Heart Rate Monitors: This product features a simple and elegant design, with a focus on ease of use. The color scheme is primarily black and white, with occasional pops of color.

MRI, CT and ultrasound machines: These machines typically have a clinical and sterile design, with a focus on functionality rather than aesthetics. The color scheme is often white or gray.

NordicTrack EXP 7i Folding Treadmill - iFit Enabled: This product features a sleek and modern design, with a focus on functionality and ease of use. The color scheme is primarily black and gray, with occasional pops of color.






Siemens Healthineers: This company offers a range of medical equipment, including diagnostic imaging and laboratory diagnostics. The design of their products is typically clinical and functional, with a focus on ease of use.

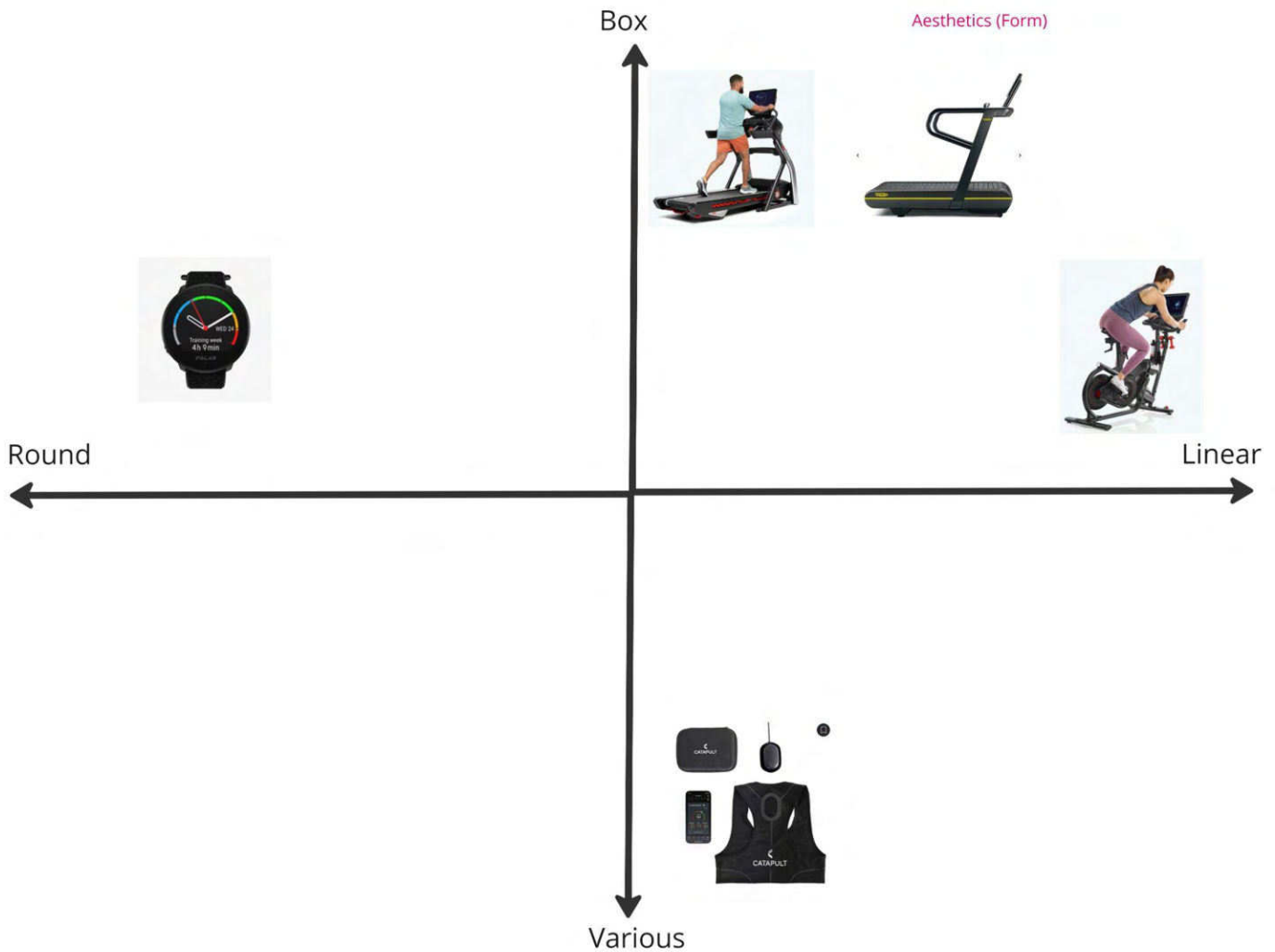
Skillrun live 7000: This product has a modern and sleek design, with a focus on functionality and user experience. The color scheme is primarily black and white, with occasional pops of color.

Bowflex treadmill 22: This product features a modern and sleek design, with a focus on user experience and functionality. The color scheme is primarily black and white.

Bowflex velcore bike: This product has a modern and minimalist design, with a focus on functionality and ease of use. The color scheme is primarily black and white, with occasional pops of color.

Overall, the aesthetic and semantic profile of these existing products varies depending on the specific product and industry. However, many of them share a focus on functionality and ease of use, with simple and modern designs that prioritize user experience.

| | Bowflex velocore bike | Bowflex treadmill 22 | Skillrun live 7000 | Polar Unite Heart Rate Monitors | TATSports Apex Athlete Series GPS Performance Tracker |
|--------------|---|---|---|---|---|
| Overall Form |  |  |  |  |  |
| | Styling and Aesthetics | | | | |
| Shape | Linear | Box | Box | Round | Various |
| Style | General Bike | Modern | Minimalistic | Modern | Body wear |
| Balance | Straight | Top balance | Top balance | Hand balance | Symmetric |
| Pattern | Bars | Treads | Treads | Rubber | Fabric |



Design Takeaways

- a) Product mostly is in the form of Linear and box.
- b) Style is modern yet minimalist.
- c) The balance is symmetrical in most cases.
- d) Sustainability must be mixed with construction.

2.2.4 Benchmarking – Materials and Manufacturing of Existing Products

The Catapult PLAYR Smart Coach System and the STATSports Apex Athlete Series GPS Performance Tracker are both made of durable plastic and silicone materials that are designed to withstand the rigors of athletic training. The Polar Unite Heart Rate Monitors are made of lightweight plastic and rubber materials that are comfortable to wear during workouts.

The MRI, CT, and ultrasound machines are made of high-quality materials such as stainless steel and medical-grade plastics that are easy to clean and maintain. Siemens Healthineers also uses advanced materials in their medical equipment to ensure accuracy and precision.

The NordicTrack EXP 7i Folding Treadmill - iFit Enabled and the Bowflex treadmill 22 are both made of sturdy metal frames and high-quality rubber belts that provide a comfortable and safe workout experience. The Bowflex Velocore bike also uses high-quality metal and plastic materials in its construction.

Skillrun Live 7000 features a sleek and modern design that incorporates high-quality materials such as carbon fiber and aluminum. This not only makes the machine durable and long-lasting, but also aesthetically pleasing.

Overall, these companies prioritize the use of high-quality and durable materials in their products to ensure the safety and satisfaction of their customers. They also employ advanced manufacturing techniques to ensure precision and accuracy in their products.

2.2.5 Benchmarking – Sustainability of Existing Products

The Catapult PLAYR Smart Coach System: The company claims that the PLAYR system has a low environmental impact, as it is made from sustainable and recyclable materials. They also have a program for recycling the devices at the end of their lifecycle.

STATSports Apex Athlete Series GPS Performance Tracker: The company claims that their product is designed to last for years, reducing waste and carbon footprint. They also use eco-friendly materials and manufacturing methods.

Polar Unite Heart Rate Monitors: The company uses sustainable and recyclable materials in the manufacturing of their products. They also have a take-back program for recycling their devices.

NordicTrack EXP 7i Folding Treadmill - iFit Enabled: The company has made efforts to reduce their carbon footprint by using sustainable materials and energy-efficient manufacturing processes. They also have a program for recycling their products.

Skillrun live 7000: The company claims that their product is made from sustainable and eco-friendly materials, and they use energy-efficient manufacturing processes.

Bowflex Treadmill 22: The company has made efforts to reduce their carbon footprint by using sustainable materials and manufacturing methods. They also have a program for recycling their products.

Bowflex Velocore Bike: The company claims that their product is made from sustainable materials and uses energy-efficient manufacturing processes. They also have a program for recycling their products.

Siemens Healthineers: The company has implemented several sustainability initiatives, including reducing their carbon emissions, using renewable energy sources, and promoting sustainable product design and recycling programs.

MRI, CT, and Ultrasound Machines: Many manufacturers of medical imaging equipment have made efforts to reduce their carbon footprint by using energy-efficient manufacturing processes, reducing waste, and promoting sustainable product design.

Overall, it appears that many of the companies producing fitness and medical equipment have made efforts to reduce their environmental impact through the use of sustainable materials, energy-efficient manufacturing processes, and recycling programs.

2.3 Summary of Chapter 2

Existing products in the market offer a wide range of features and capabilities, with a focus on functionality and ease of use. Products such as the Catapult PLAYR Smart Coach System and the STATSports Apex Athlete Series GPS Performance Tracker track an athlete's performance during training and games, while NordicTrack EXP 7i Folding Treadmill - iFit Enabled and Bowflex treadmill 22 offer a variety of workout programs and heart rate monitoring. Medical equipment such as MRI, CT, and ultrasound machines provide advanced diagnostic capabilities. The aesthetic and semantic profile of these products vary based on their intended use and target market. Many companies have made efforts to reduce their environmental impact through the use of sustainable materials, energy-efficient manufacturing processes, and recycling programs. Overall, functionality remains a top priority for these products, but sustainability is also becoming increasingly important.

CHAPTER 3 –ANALYSIS

3.1.1 Needs/Benefits Not Met by Current Products

Some of the machines used in testing athletes, such as MRI and CT machines, are large and expensive, taking up a significant amount of floor space. These machines are designed for

specific types of tests and cannot perform multiple tests. This means that a facility may require multiple machines to accommodate all the necessary tests, further increasing the space required and the cost of the equipment.

In addition to the physical limitations, each machine may have a different way of tracking data, which can make it challenging to analyze and compare results across tests. For example, one machine may provide information on muscle mass, while another may provide information on bone density. Without a way to easily compare and analyze this data, it can be difficult to provide useful insights to athletes, trainers, and physiotherapists.

The process of switching between machines can also be time-consuming, as athletes may need to be moved between different rooms or facilities. This can be particularly challenging when testing is required during a busy training or game schedule. Overall, the current machines used for testing athletes can be inefficient and may not provide the necessary data needed for optimal training and recovery.

3.1.2 Latent Needs



3.1.3 Categorization of Needs

Efficiency: There is a need for a more efficient testing process that can accommodate multiple tests on one machine, reducing the amount of floor space required and eliminating the need to switch between different machines.

Data management: There is a need for a standardized data tracking system that can be used across all tests and machines. This will enable easy analysis and comparison of data, providing useful insights for players, physiotherapists, and trainers.

Portability: There is a need for machines that are portable and easy to move around, allowing for testing to take place at various locations, such as on the field, in the gym, or at a training facility.

User-friendliness: There is a need for machines that are easy to use and understand, so that players, physiotherapists, and trainers can perform the tests without requiring extensive training.

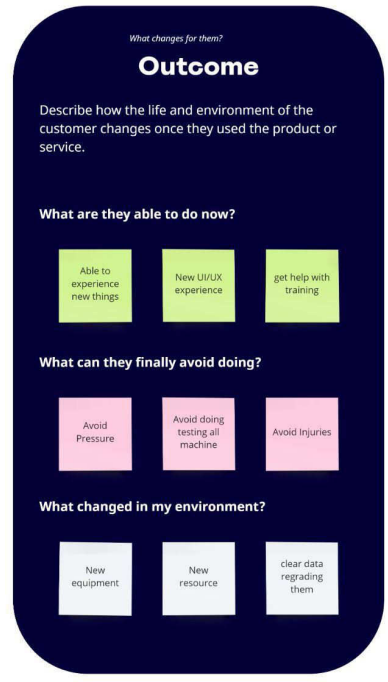
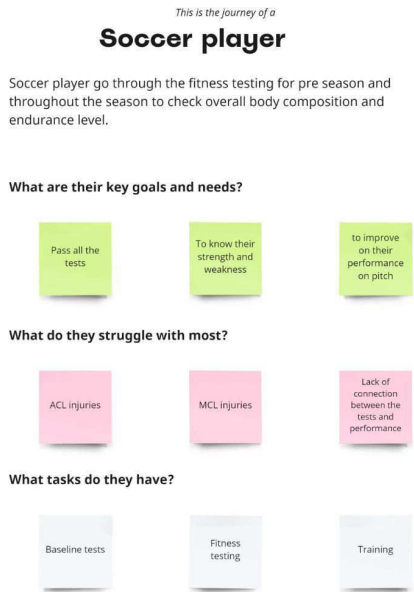
Cost-effectiveness: There is a need for a cost-effective solution that does not require a significant investment in new equipment or technology. This will ensure that the solution is accessible to a wide range of organizations, from amateur sports teams to professional clubs.

3.2 Analysis – Usability

Method

Method used in the usability testing was the 1 to 1 scale model and interview with 90th percentile male and 45th percentile male. The test was conducted using ground as a reference point for the player which is supposed to be 12” high from the ground. The result generated was to emphasize on the pain points and feelings of the player while performing exercises.

Analysis



3.2.1 Journey Mapping






A User Journey Map / User Experience Map was generated from the first user observation (big picture)

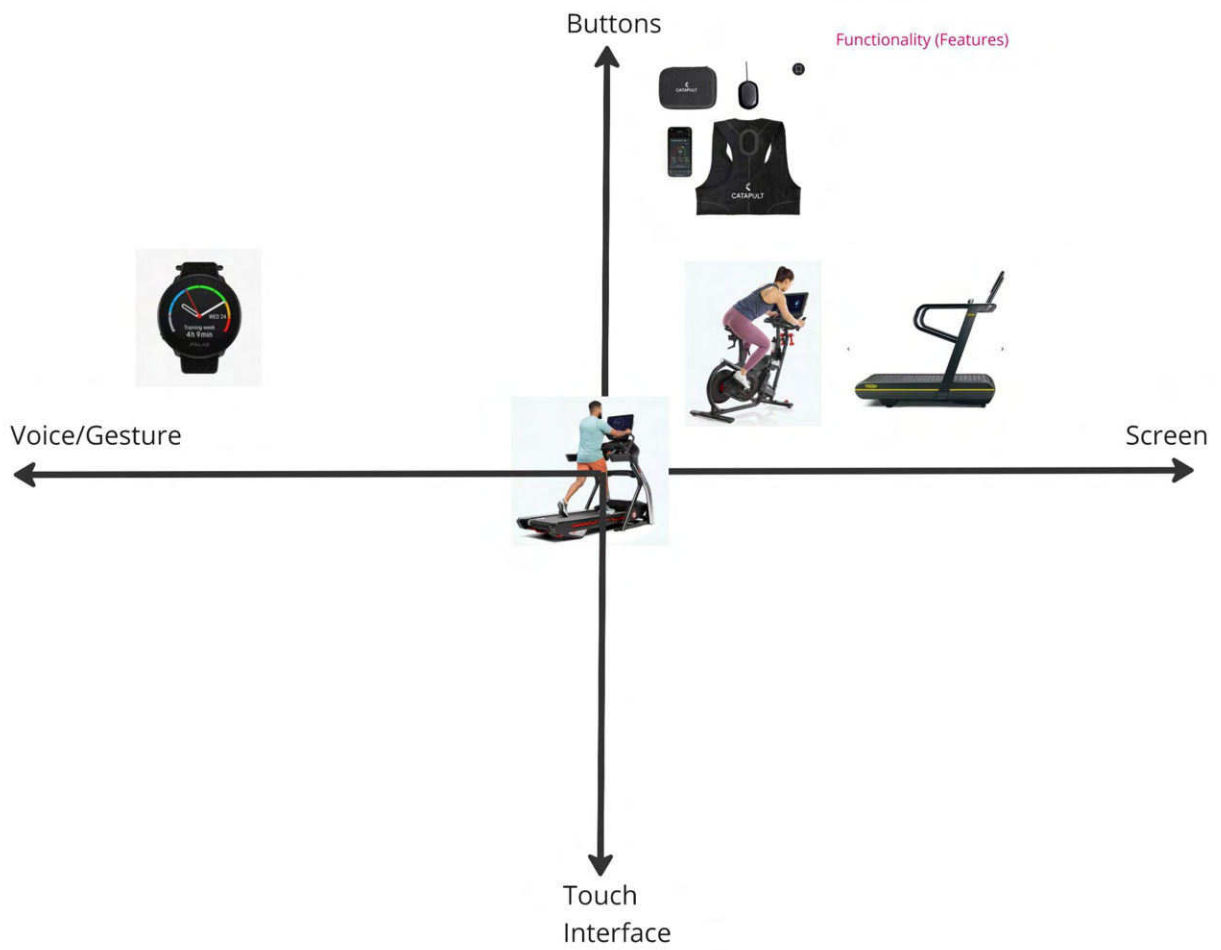
The main pain points related to usability can be seen in figure 2.

| Journey Steps Fitness testing phase | Baseline tests | Pressup tests | Agility Testing | Final soccer fitness tests |
|--|---|---|--|---|
| Actions Soccer player follow the testing procedure, agility testing, VO2 max testing, Bleep testing | Weight and height Heart rate calculator Body fat percentage | Jump test Push up Plank | 505 agility test T test Speed test 10-20-30 meter test | VO2 Max test Bleep Test |
| Needs and Pains Soccer players wants to pass the test, they want to avoid any possibilities of injuries due to their weakness, they want to tackle it after knowing the results. | Pretty simple test. | Simple test, consist of 2 different types of them this is not easy, 47 plus required to pass the test. Seems easy but 120 sec rest is quite difficult after push ups. | 2.2 seconds Fun bees 9.5 seconds pass 1.8 sec, 3.13 sec, 4.12 sec run pass | Measure the heart rate and oxygen/body use during exercise. Running in both direction for 20 meters with each bleep. |
| Touchpoint players interact with each machine as primary user, they touch points can be hands, feet and knee. | Feet, hand and head | feet, hand on waist feet and hand feet and hand | Feet and knee feet, hand and knee feet and knee | Feet, knee, hand and facemask- whole body whole body |
| Player Feeling How is the player feeling throughout the testing process. | 😊 | 😬 | 😞 | 😫 |
| Backstage | | | | |
| Opportunities What could we improve or introduce? | Currently baseline tests also has 3 | these tests have metrics set to pass | These tests are done on field, opportunity to | Done on a machine but physio takes the sample by hand |
| Process ownership Who is in the lead on this? | physiotherapist checks the players | Physiotherapist or trainer does the test. | Physiotherapist or trainer does the test. | Physiotherapist or trainer does the test. |

3.2.2 User Experience

User interaction was carried out to determine common interface practices in the product category. Characterizing the functionality was assessed by benchmarking using the data set collected for the features, selecting most common features, and comparing two features in an x-y graph.

| | Bowflex velcore bike | Bowflex treadmill 22 | Skilrun live 7000 | Polar Unite Heart Rate Monitors | TATSports Apex Athlete Series GPS Performance Tracker |
|-----------------|---|---|---|---|---|
| Features |  |  |  |  |  |
| | Interface | | | | |
| Buttons | * | * | * | * | * |
| Screen | * | * | * | | |
| Touch Interface | | * | | * | |
| Voice/Gesture | | * | | | |



Design Takeaways

- a) Button
- b) Screen
- c) Touch Interface
- d) Gestures, voice activated

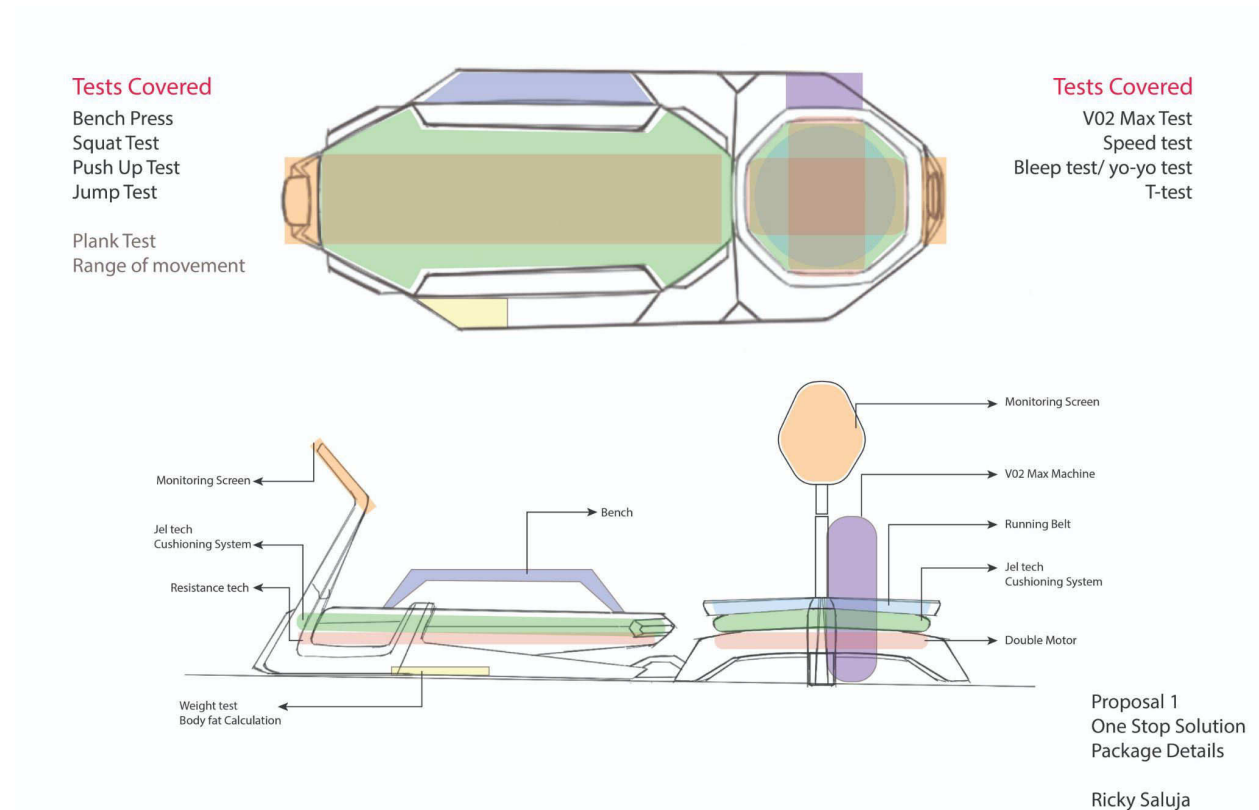
3.3 Analysis – Human Factors

The human factor is an important consideration in the analysis of any system or process. In the case of the current testing process, it is likely that human factors play a role in the inefficiencies and limitations of the system. For example, the need for multiple machines may be due to the fact that each machine is designed for a specific test, which could be attributed to a lack of collaboration between designers and end-users.

Additionally, the requirement for switching between machines may be due to a lack of user-centered design, as the process of switching machines is likely to be time-consuming and interruptive to the workflow of trainers and physiotherapists. The data tracking system may also be difficult to use or unintuitive, leading to errors and inefficiencies in data collection and analysis.

Overall, improving the human factor in the testing process would require a focus on user-centered design principles, collaboration between designers and end-users, and an emphasis on usability and ease-of-use in machine design and data tracking systems.

3.3.1 Product Schematic –Configuration Diagram



3.3.2 Ergonomic –1:1 Human Scale Study

Literature review:

A study of ergonomics must be conducted to understand the positions of the players when performing all eight major testings on two machines at once. V02 max testing, T-tests, speed tests, and bleep tests were conducted on one side of the machine, while bench pressing, weighted squats, pushups, and jump tests were performed on the other side. Additionally, there were four minor tests conducted with the surface plan of the machines, which include plank

tests, weight and body fat calculations, and range of motion. To perform the tests, one-to-one scale scratch models must be constructed to gain an understanding of how a product will interact with the players.

Methodology:

The study consisted of two parts: one composed of 4 agility tests on a running machine and the other of 4 muscle and strength tests on a resistance machine.

An ergonomic study of the fitness testing station can provide insight into how to size the product to be able to accommodate both male and female soccer players in the 100th percentile and 50th percentile. Moreover, the purpose of the study was to learn how to position the monitoring screens for the players and the coaches/trainers/physiotherapists. In order to understand how the major touching points are distributed, the running station was represented with cardboard to understand the over diameter for the 360 degree run and the height study was done in the gym with preexisting fitness equipment. Again, resistance machine tests were conducted on the cardboard piece laid on top of the bench, which was viewed as a ground unit to determine the length and height measurement was conducted on preexisting machines in the gym.

| Tests conducted on the running machine | |
|---|-------------------------|
| Test 1 | V02 Max test |
| Test 2 | T-test |
| Test 3 | Speed test |
| Test 4 | Bleep test / yo yo test |

| Tests conducted on the resistance machine | |
|--|-----------------|
| Test 1 | Bench Press |
| Test 2 | Weighted Squats |
| Test 3 | Static Jump |
| Test 4 | Pushup test |

Results:

Running Machine:

Study subjects , in this case 6 feet male (90th percentile) and 5 feet 6” Male (40th percentile) were chosen to represent the average height of male and soccer players respectively. The required overall diameter of the circle came out to be 62” As seen in (fig1,2) . The diameter for the running platform accommodates a running surface of 45”x 42” which is wider than the width of the traditional treadmills that can be seen in gyms. It was to ensure that the player is feeling comfortable and secure running in all directions. This extra width supports the monitoring screen outside of the diameter which also takes visual space so it was important to have that extra width inside the circle. The stepper outside of the tread diameter extends by 8.5” as the player has to step both feet to suddenly stop against only one step on each side in a traditional treadmill. The posture remains the same in all tests on running as the activity being done by the user is running either in 1 direction or 3 different directions.

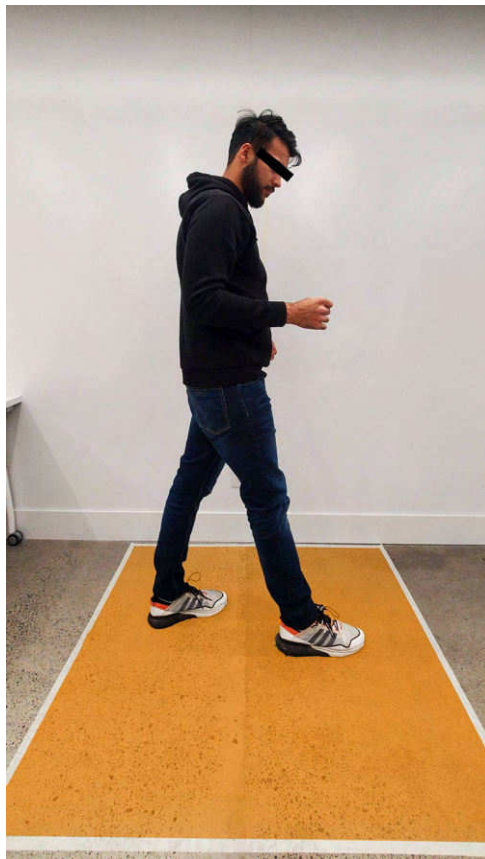
The parts were divided in 2 color schemes to represent the 2 different sets of machine coming together.

Orange was used for running machine

Green was used for resistance machine



(Fig-1)



(Fig-2)

Both users are accommodated in the same square space with different height measurements and weight as seen in (Fig-3). Users remain centered when running which makes sure the player does not step outside of the running area with the sensor on the body.



(Fig-3)

Height of the running machine is based on the traditional treadmill which is tested in the gym. The height includes the machinery and jel tech and the rotation machine for the screen holder. Screen Height is also an important factor as it follows the player when running around in different directions. The dimension taken while facing the screen with 45 degree angle for both 40th and 90th percentile male was 72" top.

Resistance machine:

Study subjects again, 6 feet male (90th percentile) and 5 feet 6" Male (40th percentile) were chosen to represent the average height of male and soccer players respectively doing all the 4 major tests for muscle and strength. The minimum length required to accommodate 90th percentile male was 95", considering the player height will be bigger too in some cases the set length of the resistance training was set to 98" platform as seen in figure-4. The length was able to accommodate 45th percentile male and 90th percentile male performing bench press, squats test, push up test and static jump test comfortably on top of gel tech bed as seen in figures-5,6,7,8,9.



(Fig- 4) showcasing 90th percentile male doing bench press from top view



(Fig-5) showcasing 90th percentile male doing bench press from side view



(Fig-5) showcasing 40th percentile male doing bench press from Top view



(Fig-6) showcasing 90th percentile male doing squat test from side view



(Fig-7) showcasing 90th percentile male doing pushups from side view



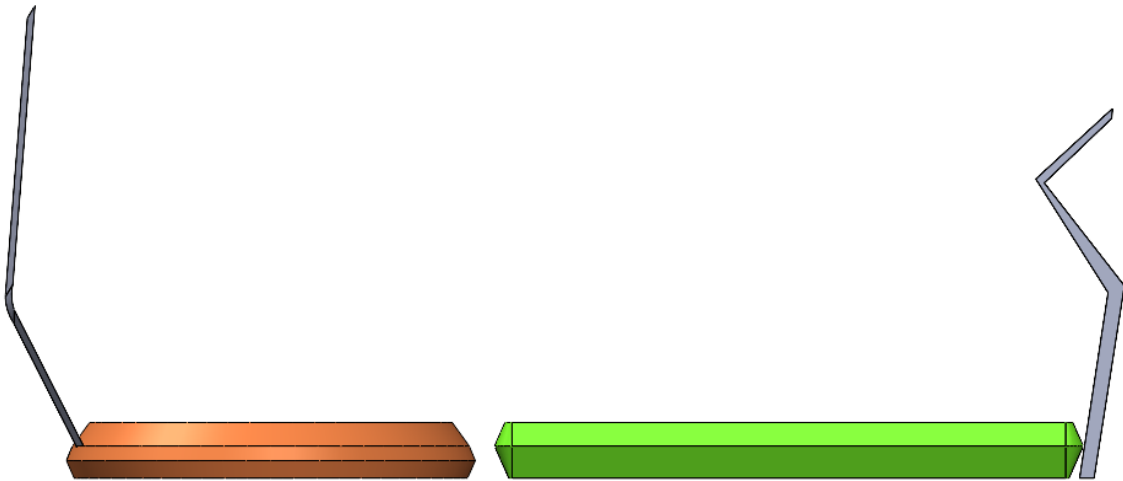
(Fig-8) showcasing 40th percentile male doing pushups from side view



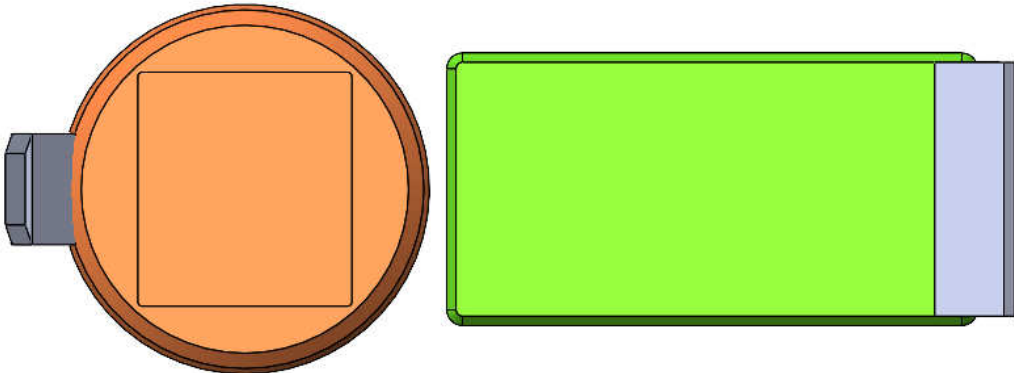
(Fig-9) showcasing 90th percentile male doing squat test from side view

The platform needs to rise when doing bench presses to accommodate the elbow going down from the body and for the rest of the tests, the platform sits flat. The platform width needs to be 24" to lift the body from the center and leave the arms hanging. The length of the rising platform is 50" which is 2" longer than the usual workout bench to accommodate the 100th percentile male comfortably.

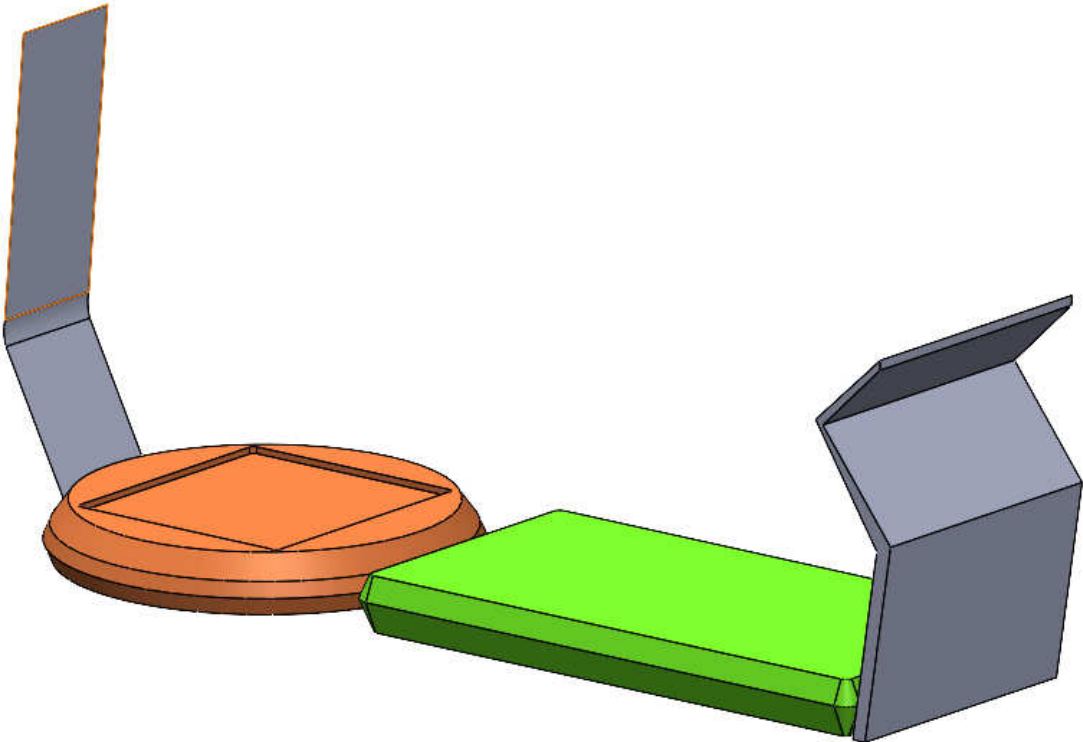
Based on the dimensions collected above, the rough cad model was generated to study accurate schematic and ergonomics of the player doing all the tests. Cad model was important to understand the screen size and the height of the model based on traditional gym equipment as seen in fig 10,11,12.



(Fig-10) showcasing the treadmill and the resistance machine side view

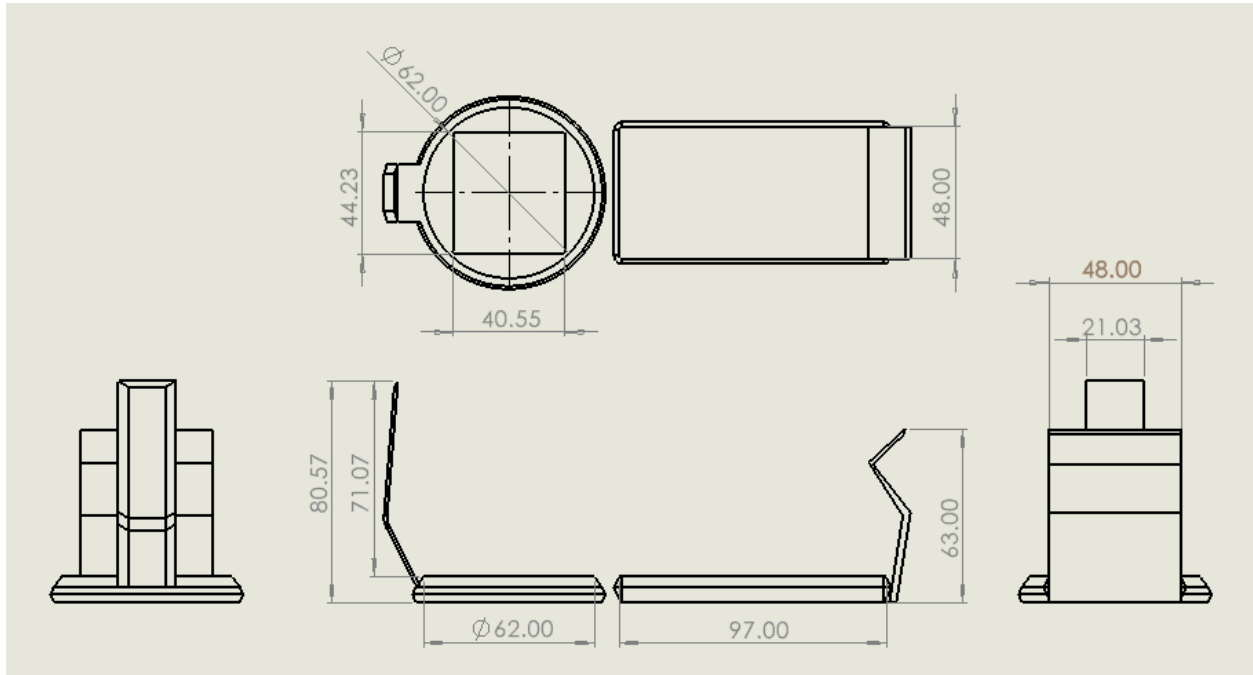


(Fig-11) showcasing the treadmill and the resistance machine top view



(Fig-11) showcasing the treadmill and the resistance machine 3/4 view

Based on the ergonomic study, the dimensions calculated to accommodate 40th percentile male and 90th percentile male were proven very helpful. The dimensions were recorded as seen in fig 12.

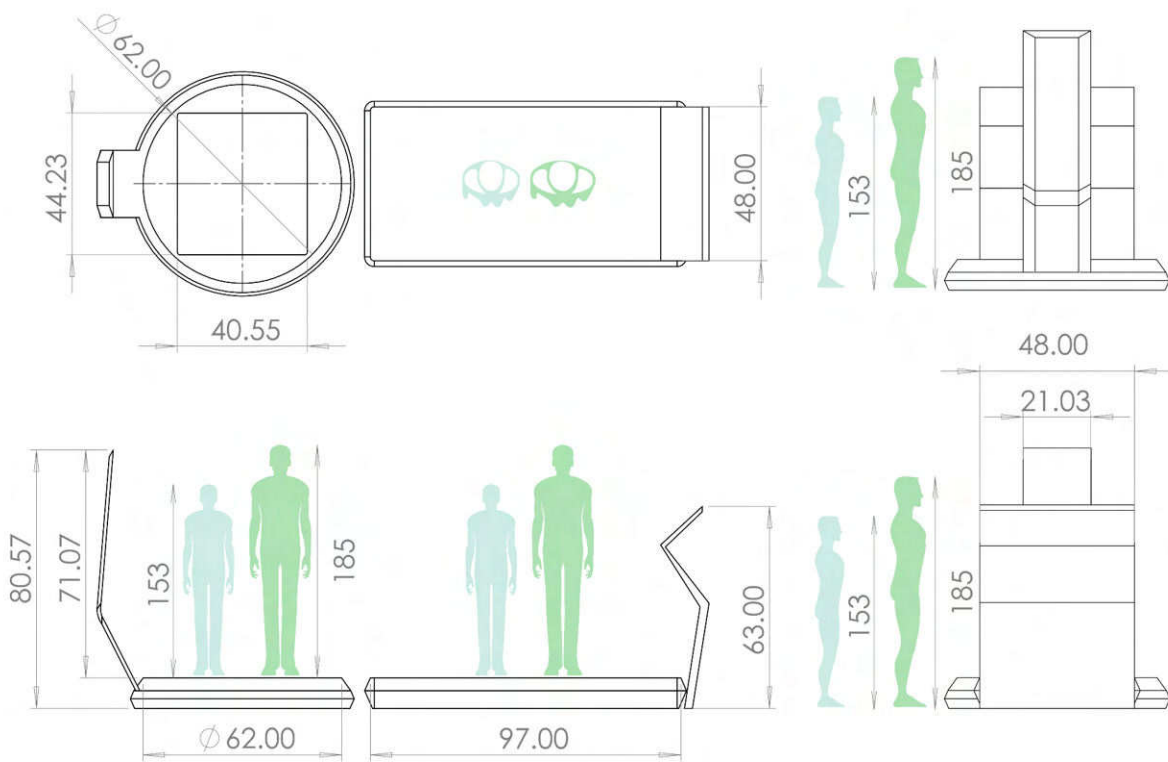


(Fig-12) Showcasing the treadmill and the resistance machine dimensions based on ergonomic study

Analysis of the Running Machine and Resistance machine

Overall, the dimensions for the running machine and resistance machine worked quite well from the starting. There were changes made to the running machine as initially it started as a square platform but the result concluded it as circular platform with square cut out where the player runs. The screen size initially from bottom was 64" which had to be changed to 72" to accommodate 99th percentile male eye sight.

The resistance machine width was changed to meet the aesthetic of the running machine. The required width was 40” initially but as the diameter of the running machine increased, the resistance machine width was increased to 48” to provide more comfort and achieve the aesthetic of the design as seen in fig 11. The ergonomic diagram was created using the 1:1 scale study as seen in Fig 13.



(Fig-13) Showcasing the ergonomics of the player alongside the machine

95th percentile - Man

5th percentile - Female

Limitations and Conclusion

Testing the 1:1 scale model provided a great deal of insight, but it also revealed some drawbacks

In this study, there were some limitations that may have affected the findings. It was not possible to test women during the test, which limits the use of the products by men; however, the height study found that testing any male below the 50th percentile provided some data about female anatomy. In addition, the original VO2 max machine, which was not available at the time of study, may present some additional unforeseen limitations.

Overall, the 1:1 ergonomic test was a success, with all eight major tests having been completed. Consequently, The final dimensions with which the design main schematic works were finalized.. As well as finalizing the size, shape, and mechanism, the monitor screen design was also completed.

3.4 Analysis – Aesthetics & Semantic Profile

The aesthetic and semantic profile of the design appears to be modern, innovative, and futuristic. The use of newly developed technology such as the 360-degree runner and jel tech soft bed suggests that the design is cutting-edge and advanced. The inspiration drawn from waves and power, as well as the moon profile, gives the design a unique and distinctive look.

The modular design of the machines also adds to the aesthetic and semantic profile, as it allows for flexibility and customization in terms of which tests can be performed. The use of modular components also suggests a focus on efficiency and ease of use, which would be beneficial in a sports setting where time is of the essence.

Overall, the aesthetic and semantic profile of the design appears to be well thought out and aligned with the needs of the users. It combines modern technology and unique design elements to create a futuristic and innovative product.

3.5 Analysis –Sustainability: Safety, Health and Environment

The design seems to be environmentally sustainable as it saves floor space, which could potentially reduce the environmental impact associated with the construction and maintenance of the building. Additionally, it aligns with the United Nations Sustainable Development Goals (SDGs) 3 (Good Health and Well-Being), 7 (Affordable and Clean Energy), 11 (Sustainable Cities and Communities), and 13 (Climate Action), which suggests that it could contribute to a sustainable future.

The use of lean manufacturing methods can also promote sustainability by reducing waste and optimizing the use of resources. Furthermore, the design's emphasis on safety and health indicates that it was developed with user well-being in mind. Overall, the design seems to be environmentally responsible, promoting user health and safety, and may contribute to sustainable development.

3.6 Analysis – Innovation Opportunity

The modular attached machines that combine multiple functions in one innovative solution offer a unique opportunity for the fitness industry. By providing a one-stop solution for fitness assessment, tracking, and training, it reduces the need for multiple machines, saving both space and time. The live feedback feature engages players and enables them to track their progress and adjust their training programs accordingly. This opens up new avenues for personalized and adaptive training programs that are tailored to individual needs. The innovative design and incorporation of advanced technology can set a new standard for the fitness industry and create opportunities for further research and development in the field of fitness equipment design.

3.6.1 Needs Analysis Diagram

The newly designed product addresses several needs:

Space efficiency: The product solves the problem of taking up too much floor space by combining multiple machines into two modular attached machines.

Data tracking: The product addresses the need for consistent data tracking by having the same tracking system across both machines, making it easier to analyze and provide useful data to players, physiotherapists, and trainers.

Time efficiency: The product reduces the time needed to switch between machines by having both endurance and muscle/strength tests available in the same location.

Sustainability: The product aligns with UN Sustainable Development Goals 3, 7, 11, and 13, and follows lean manufacturing methods, making it a more sustainable option.

Innovation: The product provides a one-stop solution for assessing, tracking, and training, which is a more innovative approach than using multiple machines for the same purposes.

Overall, the newly designed product meets a variety of needs related to space, data tracking, time efficiency, sustainability, and innovation.

3.6.2 Desirability, Feasibility & Viability

Desirability:

- Offers a one-stop solution for testing, training, and rehab facilities, which is convenient for athletes and trainers.
- Provides live feedback during testing and training, making it engaging and interactive for athletes.
- Has a futuristic and innovative design that incorporates new technologies, which adds to its appeal.
- Saves floor space, which is a valuable resource in gym and training facilities.

Feasibility:

- The modular design allows for easy customization and maintenance.

- The use of lean manufacturing methods and sustainable materials makes the product cost-effective to produce.
- Incorporating multiple testing machines into one design reduces the need for multiple machines and reduces overall costs.
- The product is designed to fit into a standard gym or training facility, which makes it easy to implement.

Viability:

- The product is aligned with several UN Sustainable Development Goals, which adds to its viability.
- The product offers a unique and innovative solution to the needs of athletes and trainers, which sets it apart from other products on the market.
- The design incorporates new technologies, which adds to its potential marketability.
- The product's ability to save floor space and reduce the need for multiple machines can lead to cost savings for gym and training facilities.

3.7 Summary of Chapter 3– Defining Design Brief

Needs Analysis Diagram: This is a visual representation of the needs that the newly designed product aims to fulfill. It includes categories such as space requirements, data tracking, time efficiency, and user feedback.

Needs Analysis on the Newly Designed Product: Based on the information provided, the newly designed product meets the needs identified in the Needs Analysis Diagram. It addresses space constraints, data tracking, time efficiency, and user engagement through a modular design that combines multiple testing and training functions into two machines.

Desirability, Feasibility & Viability Factors: These are important factors to consider when evaluating a product design. Desirability refers to whether or not the product is desirable to potential users, feasibility refers to whether or not it is technically feasible to produce and implement, and viability refers to whether or not it is economically viable. The newly designed product is highly desirable to athletes, trainers, and physiotherapists, it is technically feasible to produce with existing technology, and it is economically viable due to its potential to save space and streamline testing and training processes.

CHAPTER 4 –DESIGN DEVELOPMENT

4.1 Initial Idea Generation

4.1.1 Aesthetics Approach & Semantic Profile

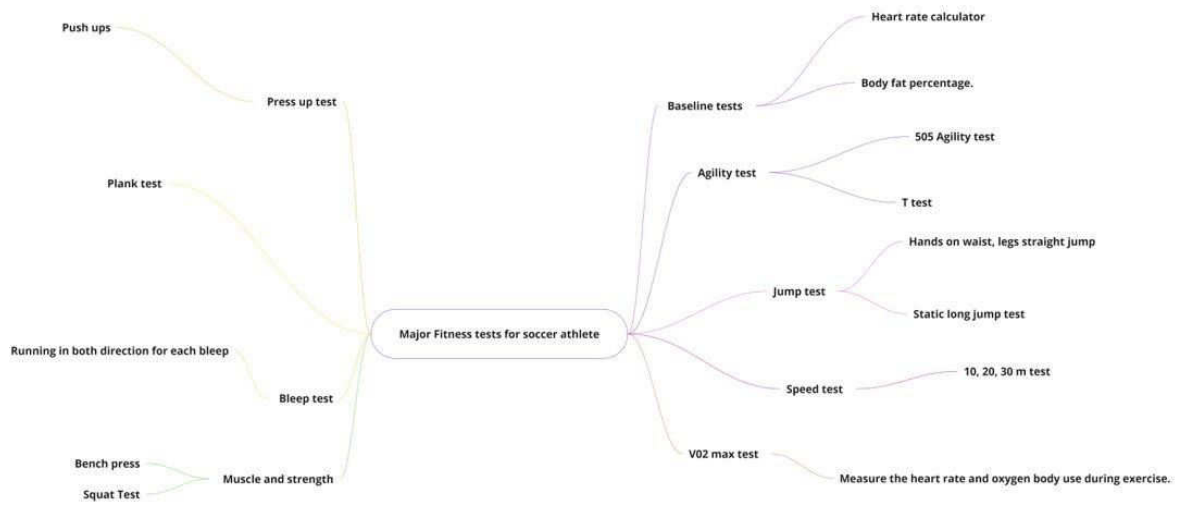
Figure 18 represents aesthetics and semantics of concept designs of fitness machines which inclines my design language.



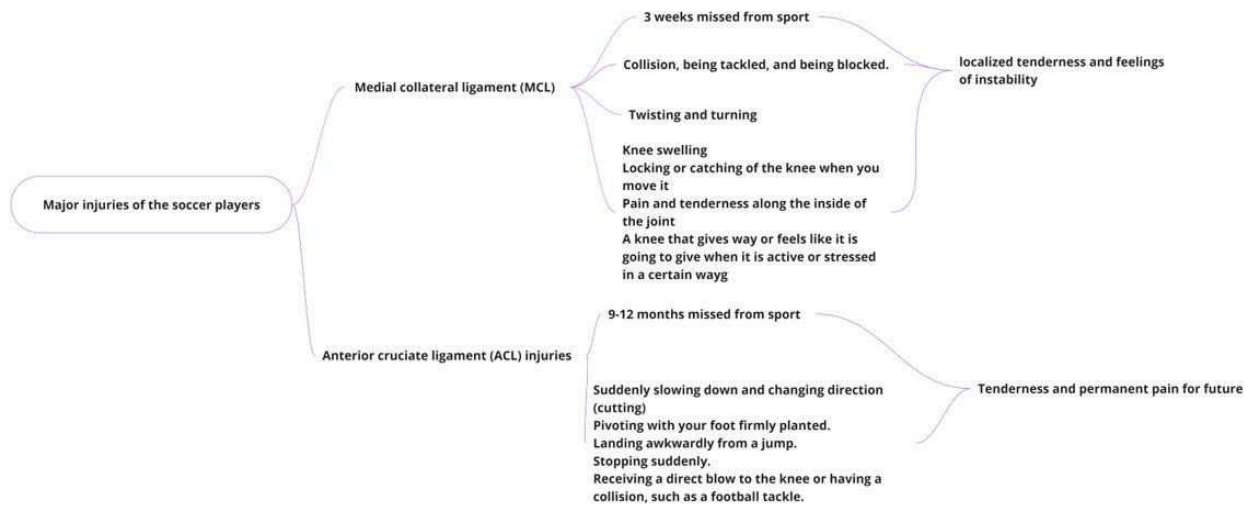
(Fig.-18)

4.1.2 Mind Mapping

Figure 19 and 20 represents the mind mapping for the soccer tests performed overall and also to understand the athlete injuries pattern to have better insight of the player.



(Fig.-19)

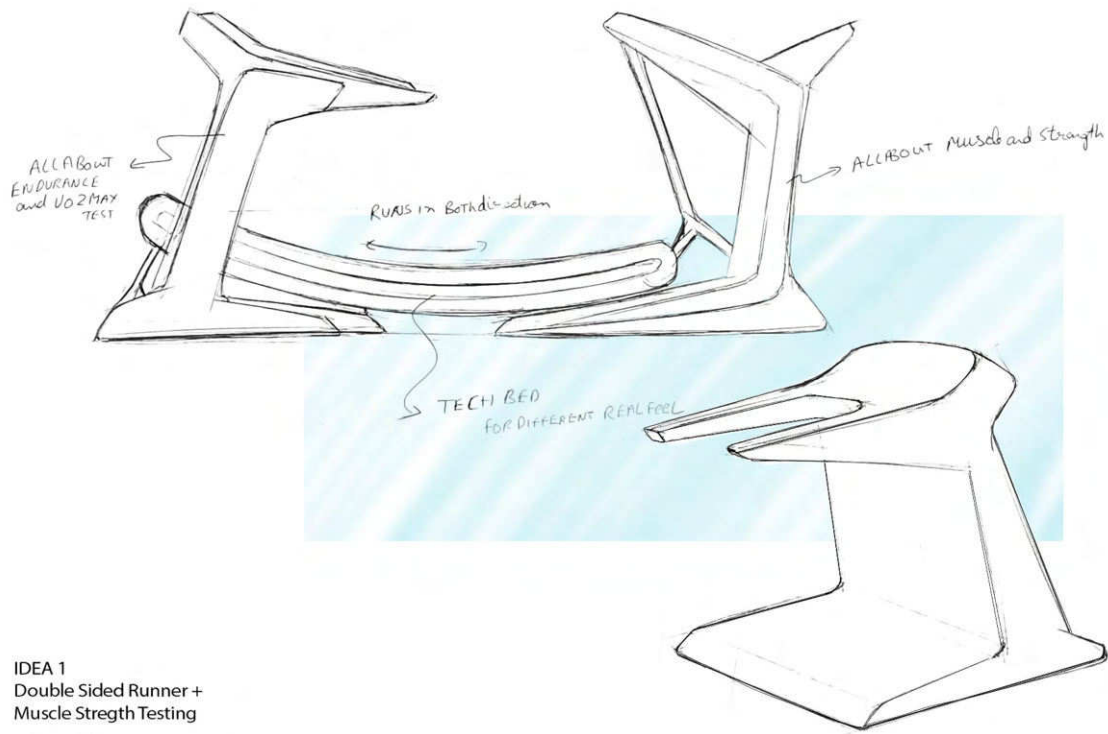


(Fig.-20)

4.1.3 Ideation Sketches

The first idea chosen for further development was building a one stop shop for all the tests.

The concepts can be seen in the following pictures attached.

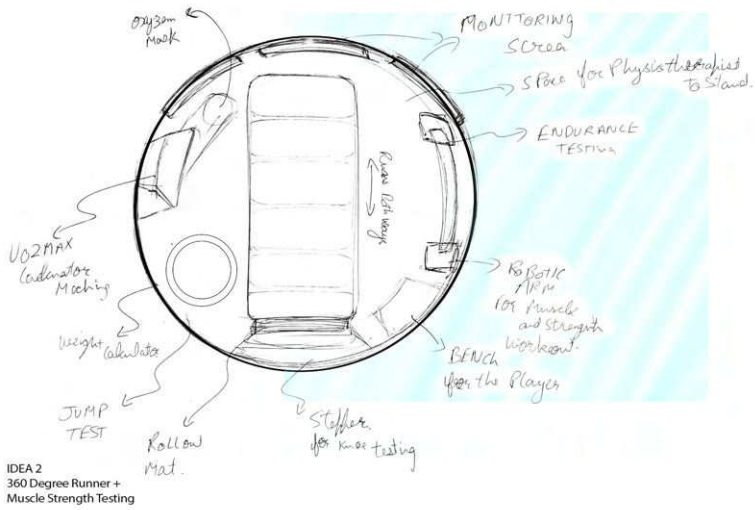


IDEA 1
Double Sided Runner +
Muscle Strength Testing

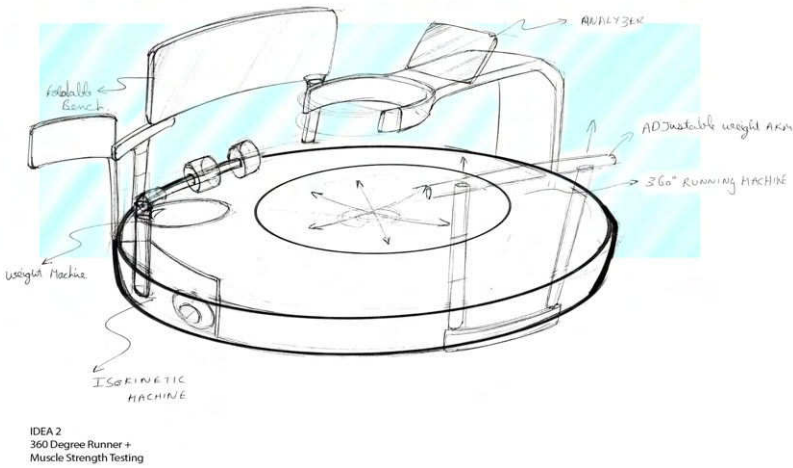
(Fig.-14)

Figure 14 represents a double sided runner.

Figure 15 and 15.1 represent one stop solution for all the major fitness tests.

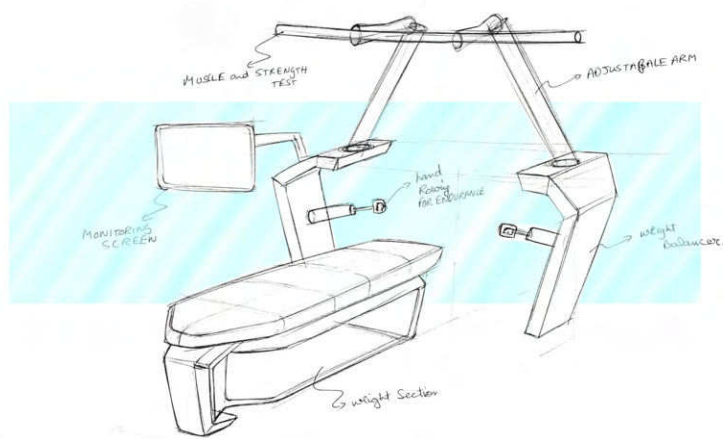


(Fig.-15)



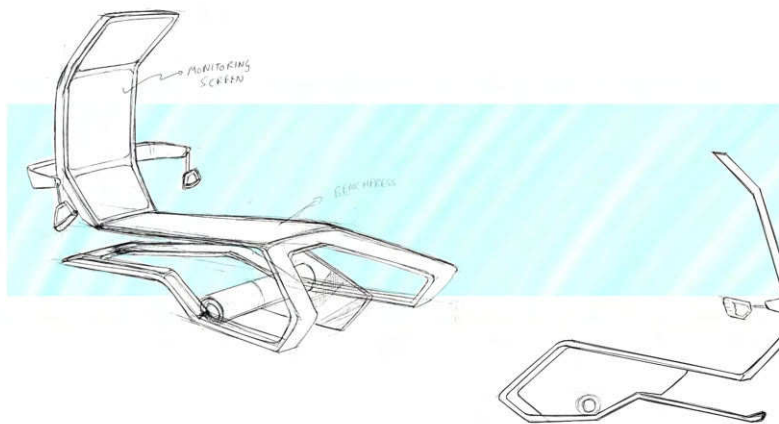
(Fig-15.1)

Figure 16 and 16.1 represent muscle and strength exercise machine.



(Fig.-16)

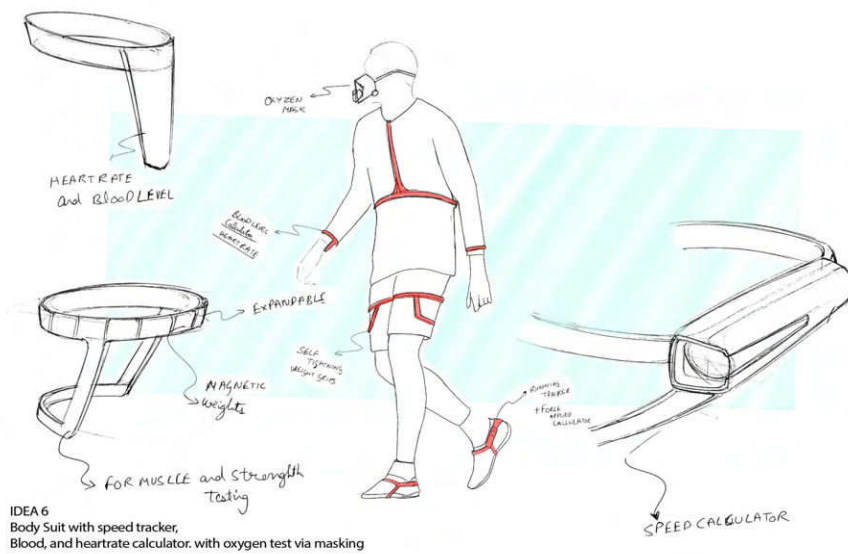
IDEA 4
Endurance and agility tester



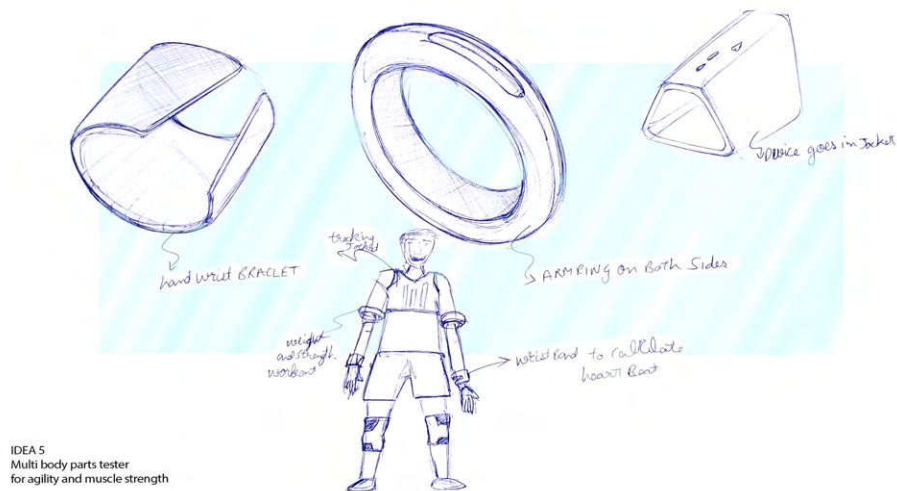
(Fig.-16.1)

IDEA 4
Endurance and agility tester

Figure 17 and 17.1 represent body wear technology to record all the main measures for soccer tests.



(Fig.17)



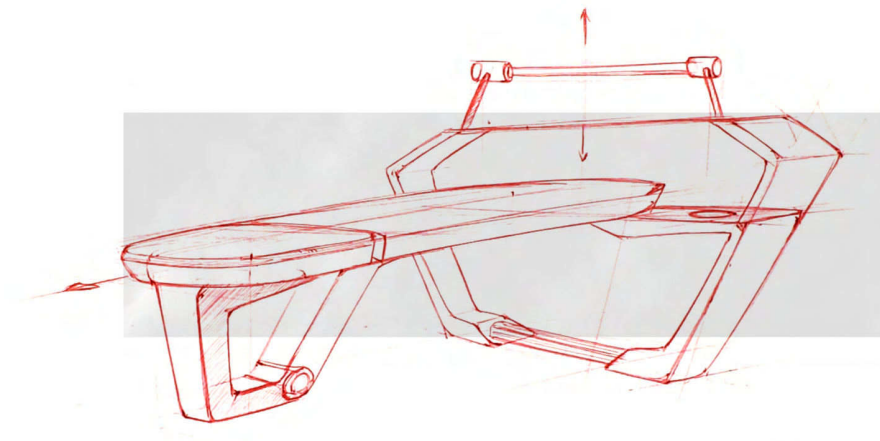
(Fig.-17.1)

4.2 Concepts Exploration

4.2.1 Concept One

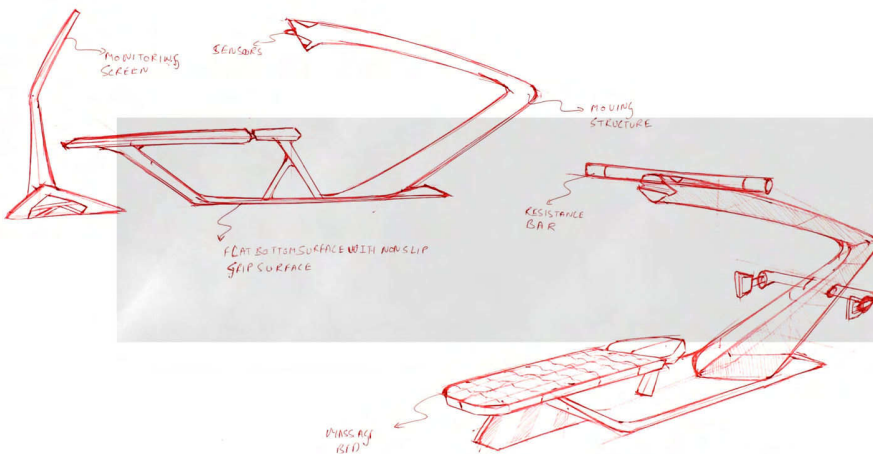
Figure 21 and 21.1 represents the development of the endurance testing machine which covers

all muscle and strength testing of the soccer player.



Idea-I
RICKY SALUJA
Endurance testing

(Fig.-21)

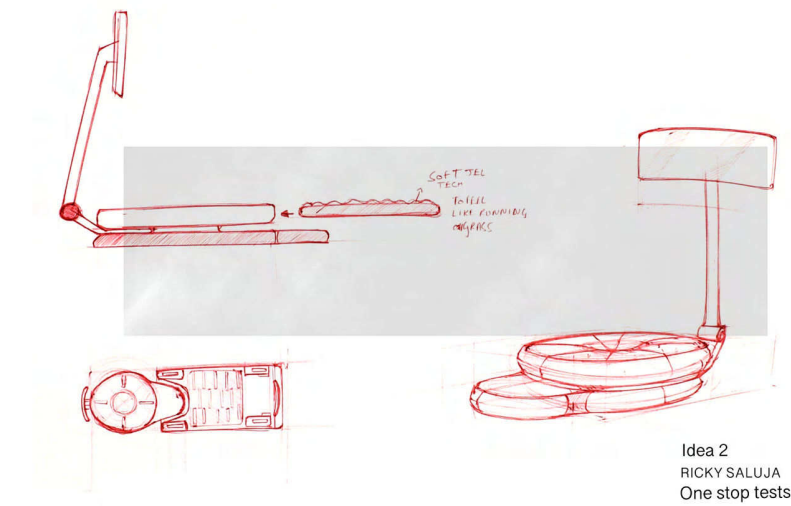
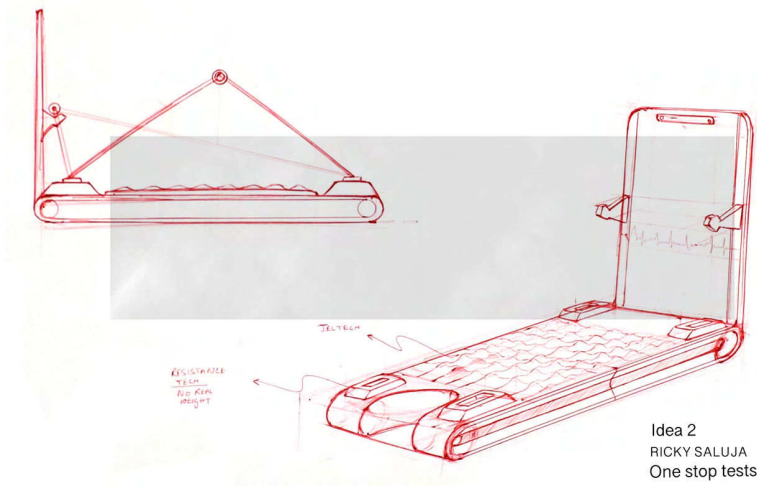


Idea-I
RICKY SALUJA
Endurance testing

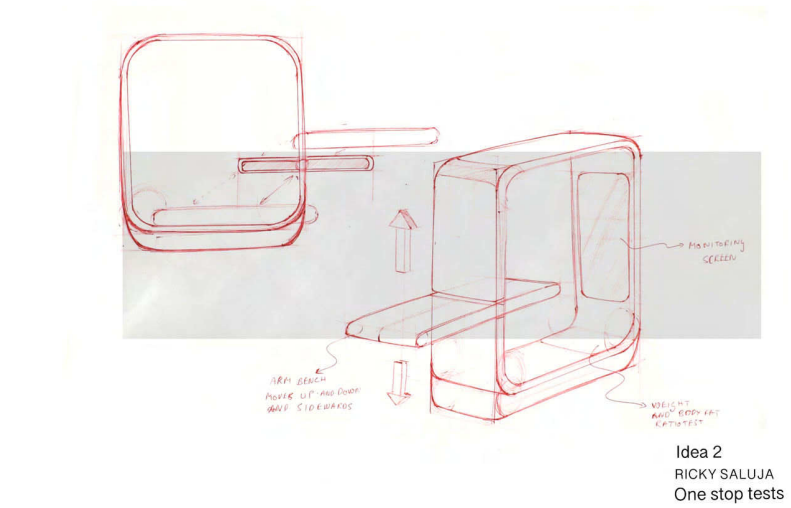
(Fig.-21.1)

4.2.2 Concept Two

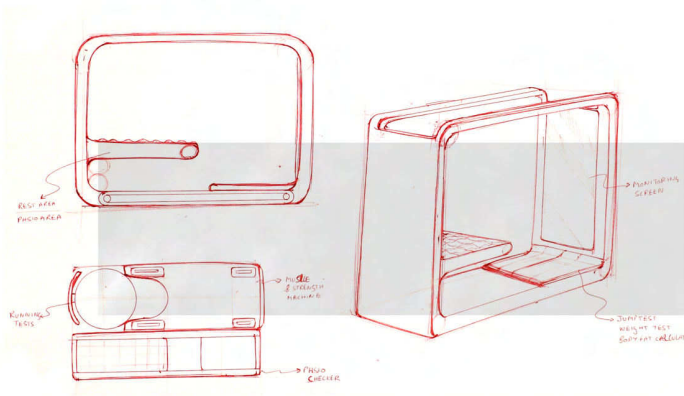
(Fig.-22)



(Fig.-22.1)



(Fig.-22.2)

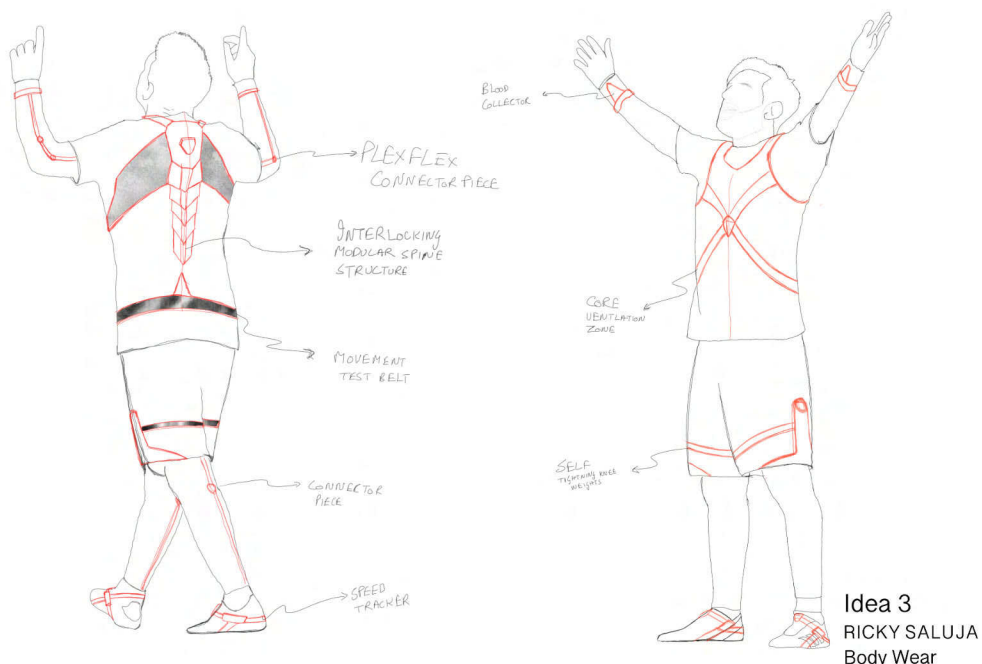


Idea 2
RICKY SALUJA
One stop tests

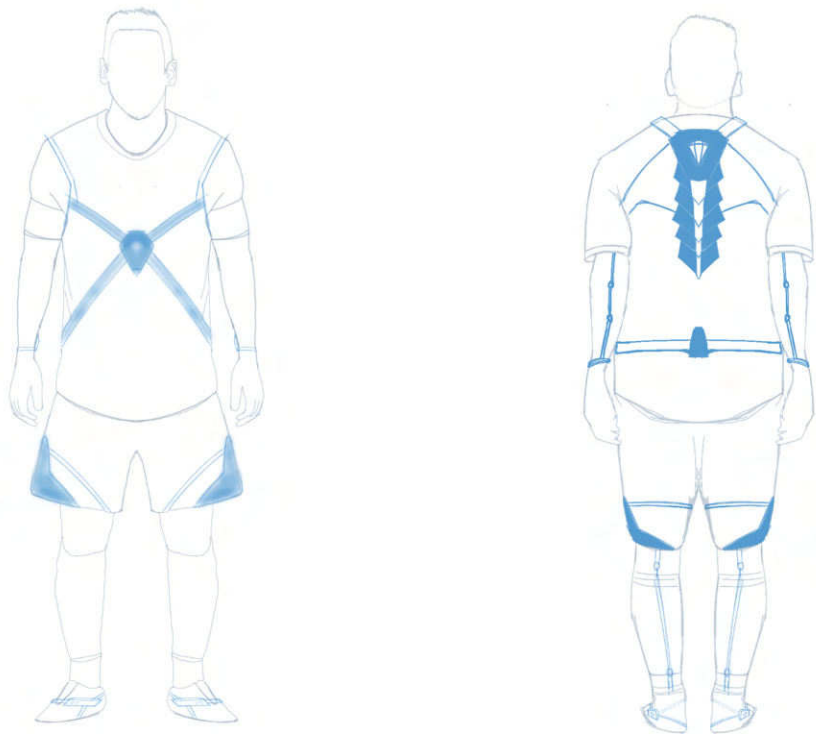
(Fig.-22.3)

Figure 22, 22.1, 22.2, 22.3 represents the concept 2 which details out the one stop modularity system to perform all major soccer fitness tests at one spot and modularity brings out the factor of changing spots for different players if required.

4.2.3 Concept Three



(Fig.-23)

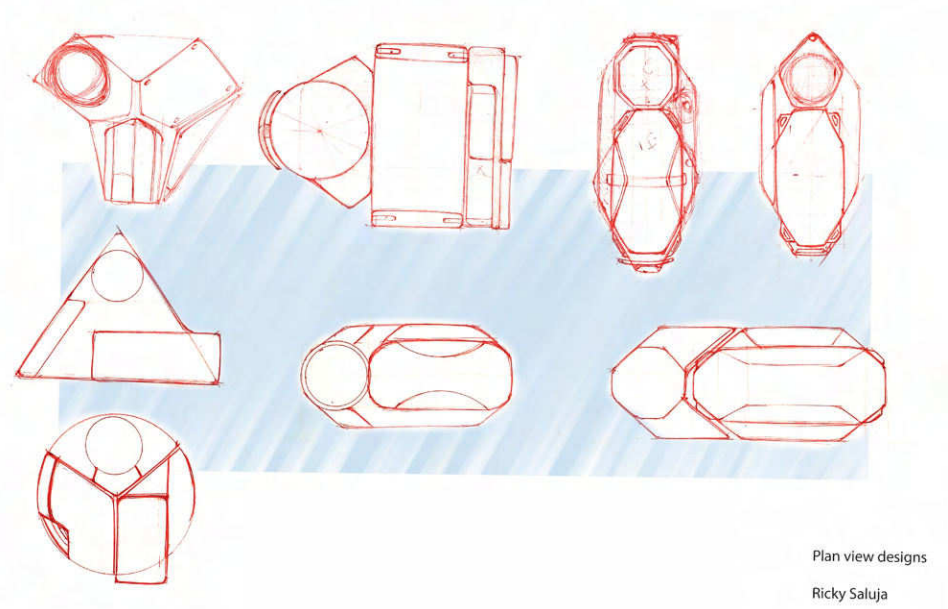


(Fig.-23.1)

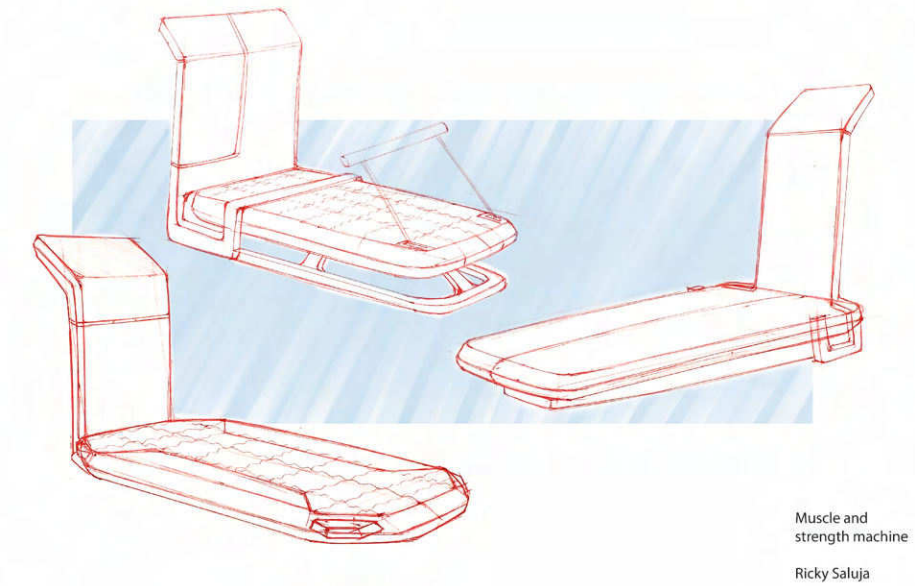
Figure 23 and 23.1 represents the body wear design with interlocking spine system and many body specific calculators.

4.3 Concept Strategy

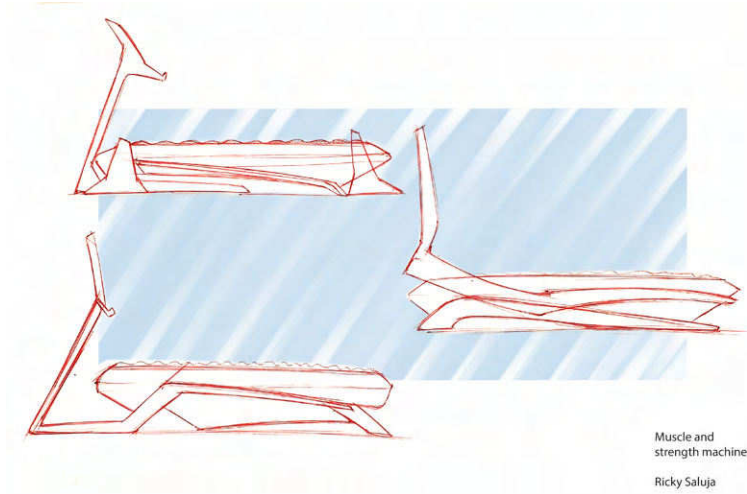
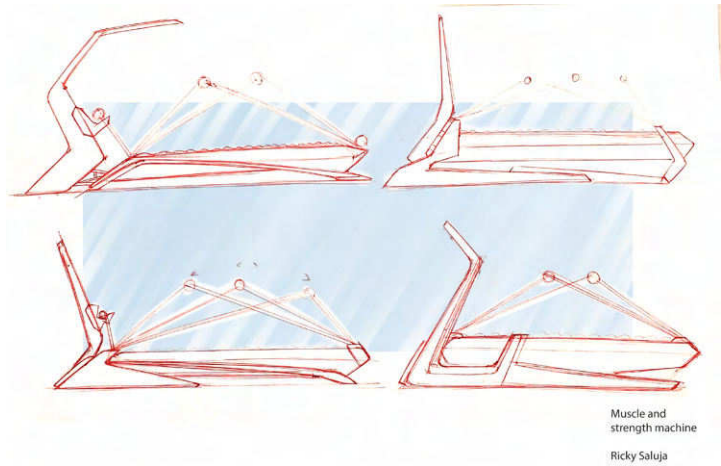
4.3.1 Concept Direction & Product Schematic One



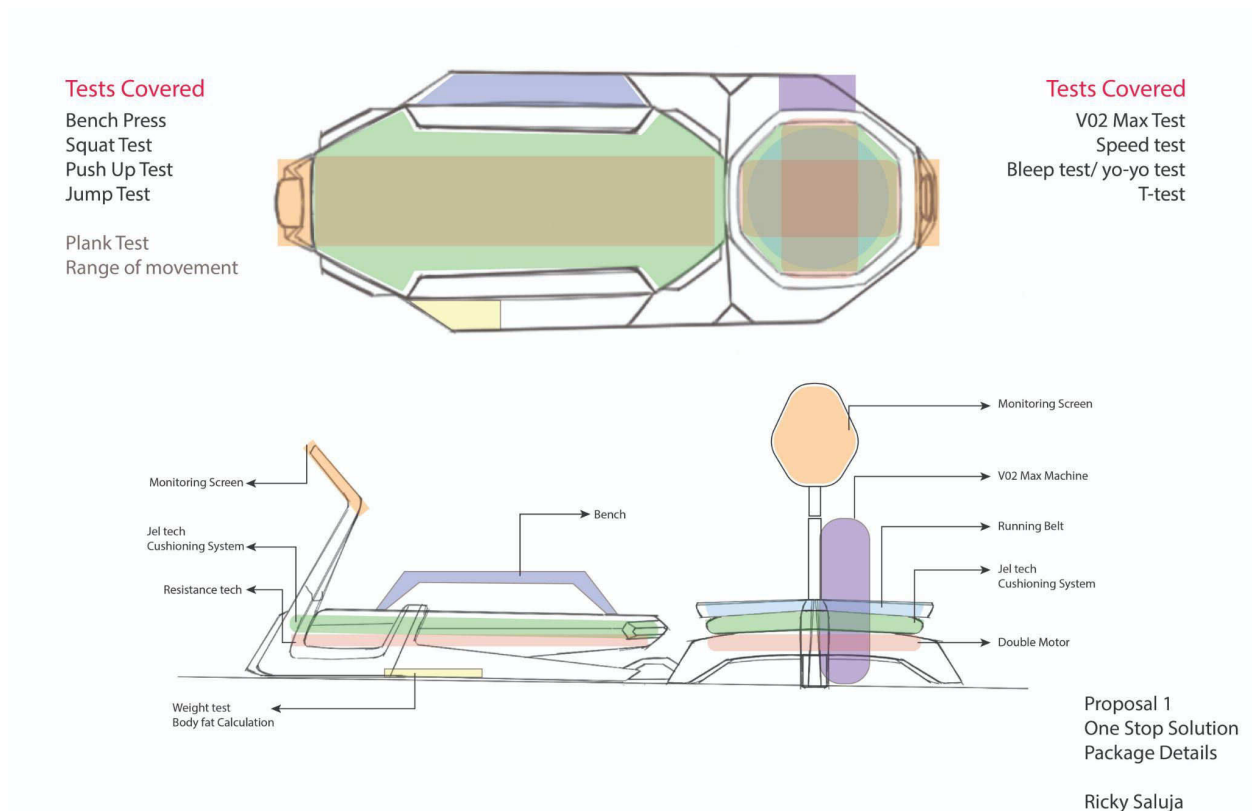
Plan view designs
Ricky Saluja



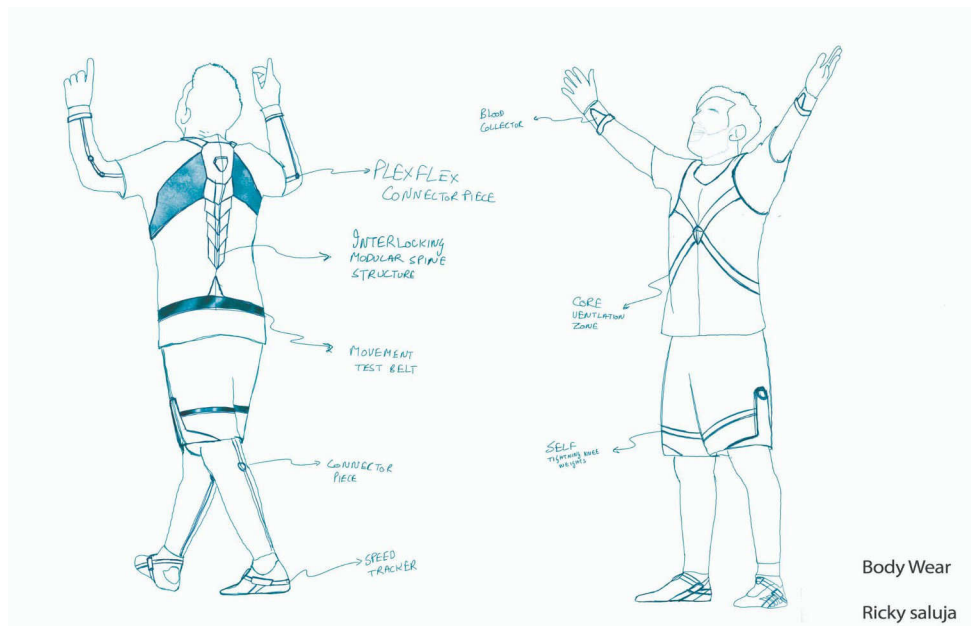
Muscle and
strength machine
Ricky Saluja



Product schematic



4.3.2 Concept Direction & Product Schematic Two



Product schematic

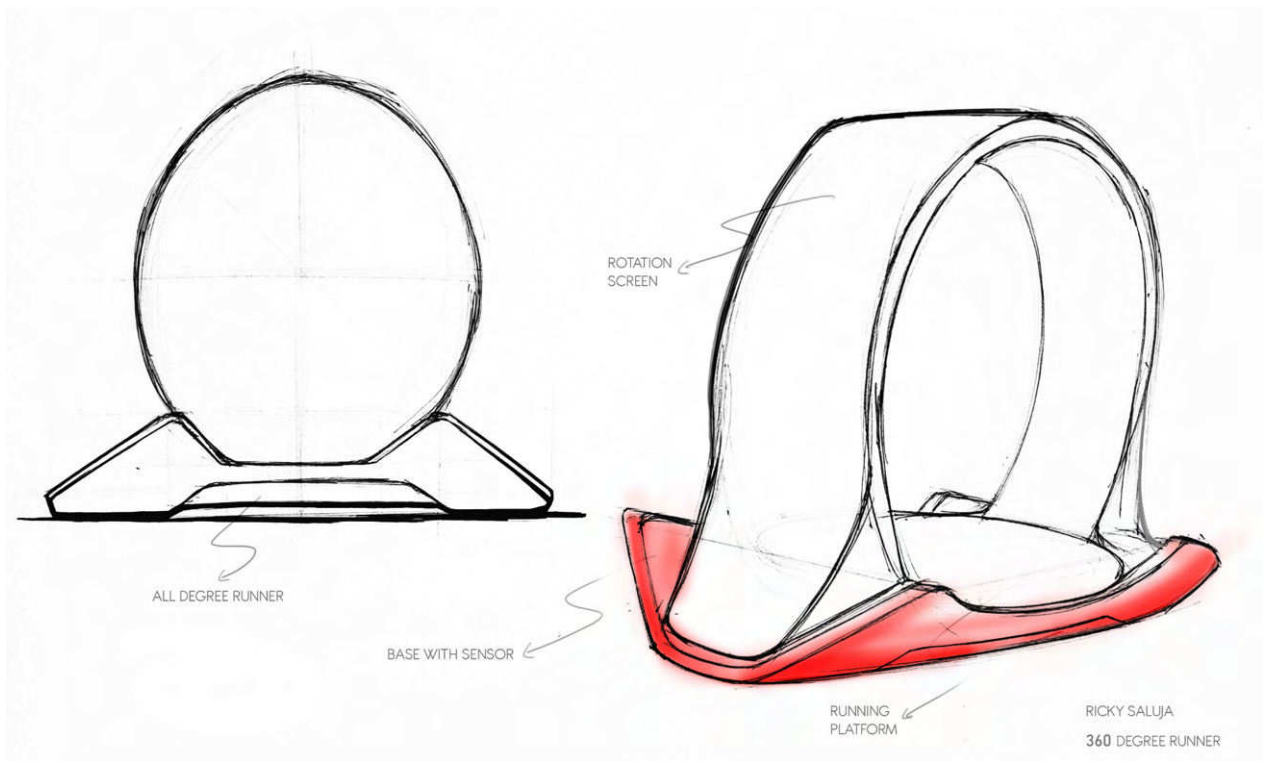
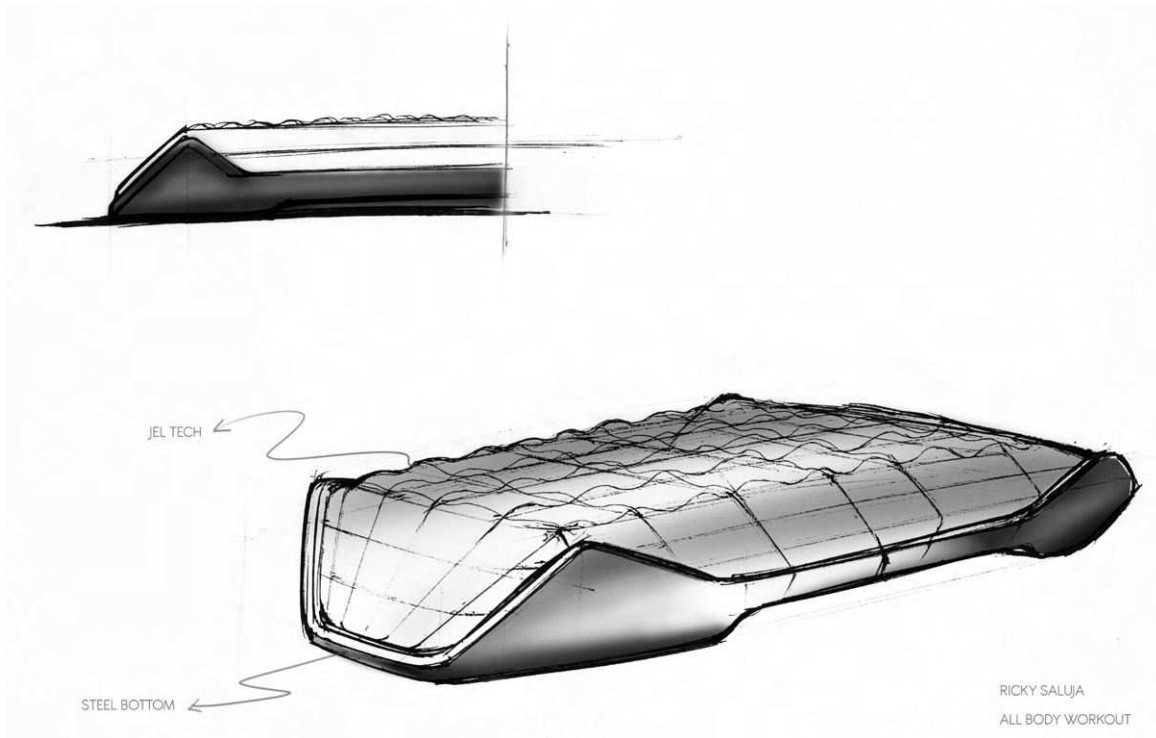
Tests Covered
V02 Max Test
Speed test
Bleep test/ yo-yo test
T-test
Jump Test
Push up test

Proposal 2
Body Wear
Package Details
Ricky Saluja

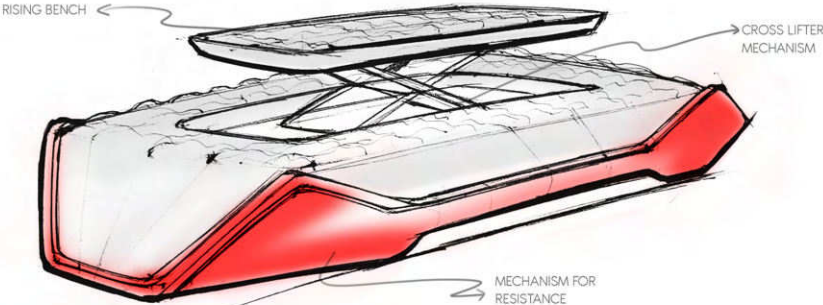
4.4 Concept Refinement And Validation

Proposal 1
One Stop Solution
Ricky Saluja

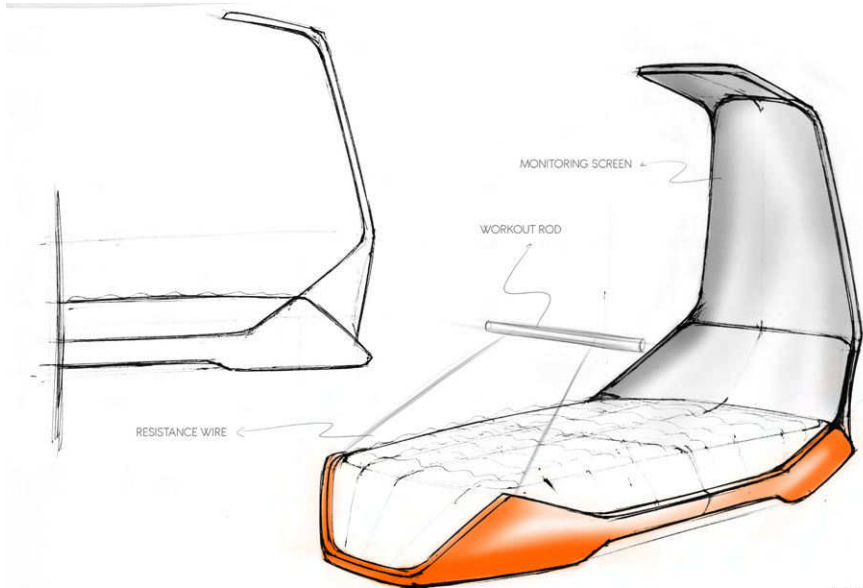
4.4.1 Design Refinement



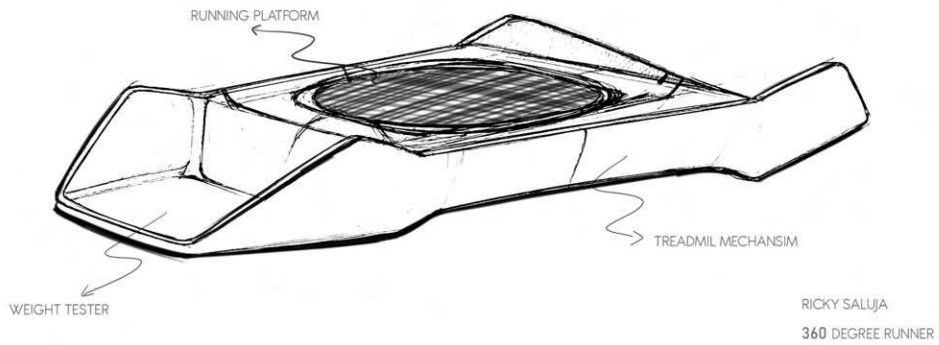
4.4.2 Detail Development



RICKY SALLUJA
ALL BODY WORKOUT



RICKY SALLUJA
ALL BODY WORKOUT



RICKY SALUJA
360 DEGREE RUNNER

4.4.3 Refined Product Schematic & Key Ergonomic

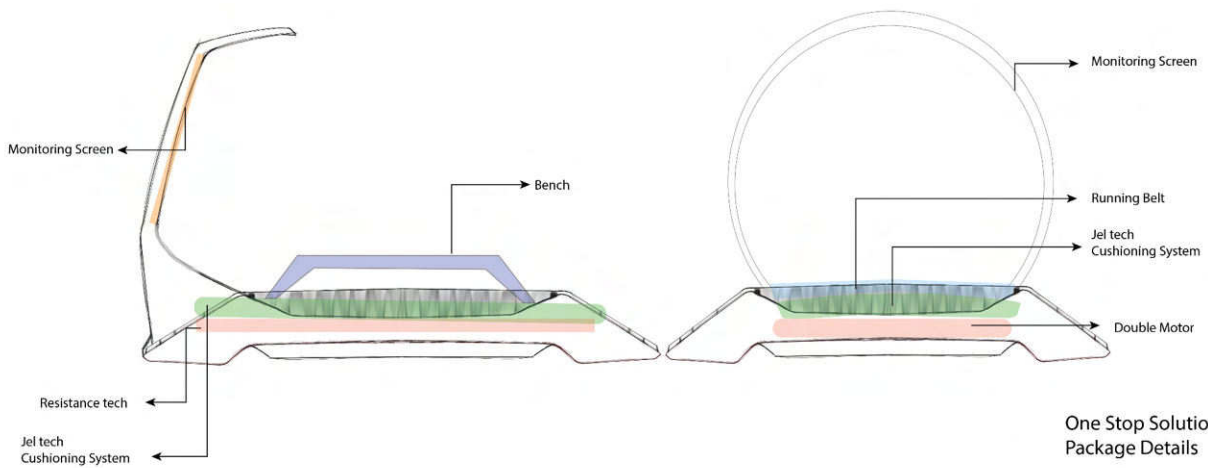
Tests Covered

- Bench Press
- Squat Test
- Push Up Test
- Jump Test

- Plank Test
- Range of movement

Tests Covered

- V02 Max Test
- Speed test
- Bleep test/ yo-yo test
- T-test



One Stop Solution
Package Details

Ricky Saluja

4.5 Concept Realization

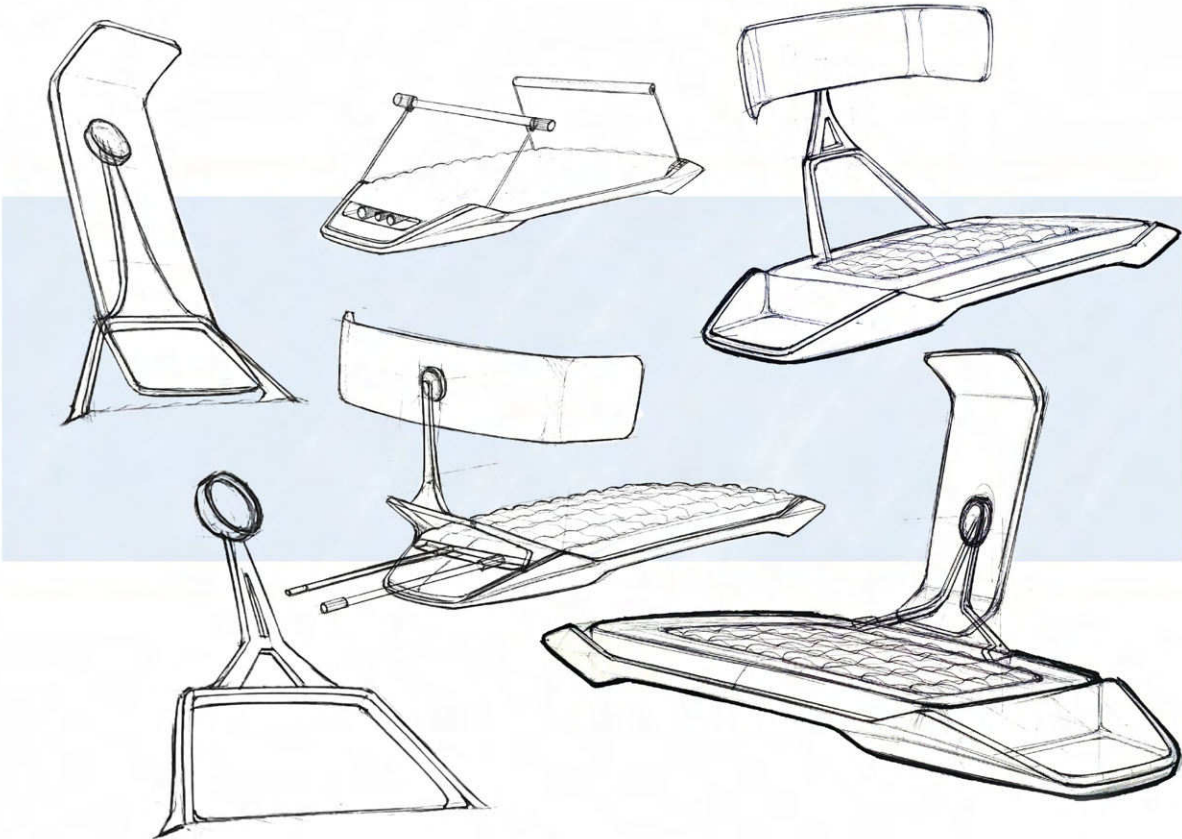
the design aims to provide a comprehensive solution for athletes and trainers by combining multiple testing and training machines into a single, modular system. The design is inspired by futuristic and organic shapes, with an emphasis on sustainability and innovation.

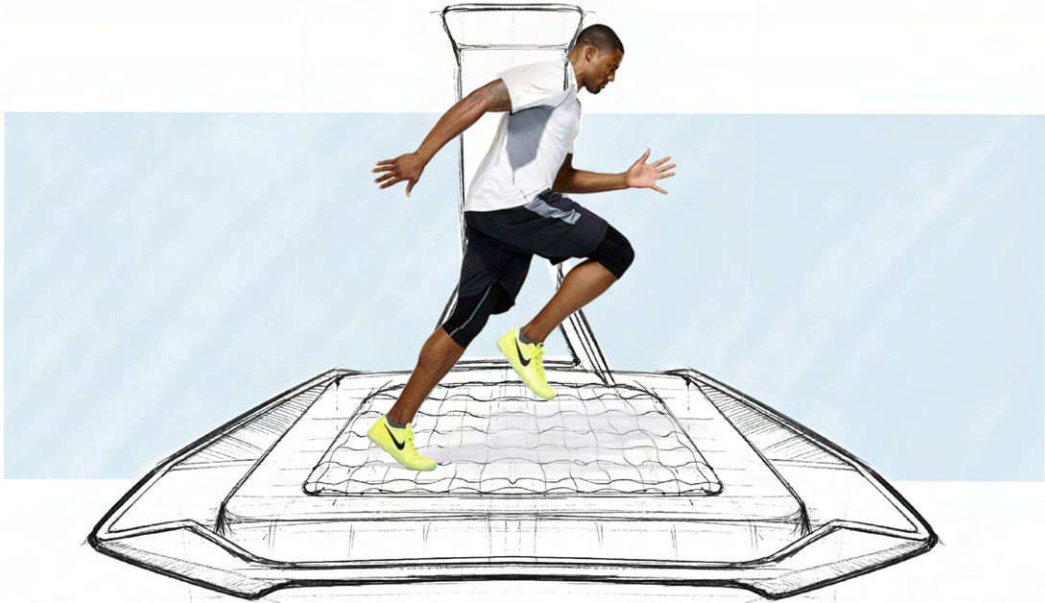
The design includes two modular machines: one for endurance testing and the other for muscle and strength testing. Both machines feature advanced technology such as the 360-degree runner and Jel Tech soft bed, which provide a comfortable and engaging experience for users.

The design also addresses the needs of athletes and trainers by reducing floor space requirements and providing a single platform for testing, tracking, and training. It aligns with UN Sustainable Development Goals 3, 7, 11, and 13 and follows a lean manufacturing method.

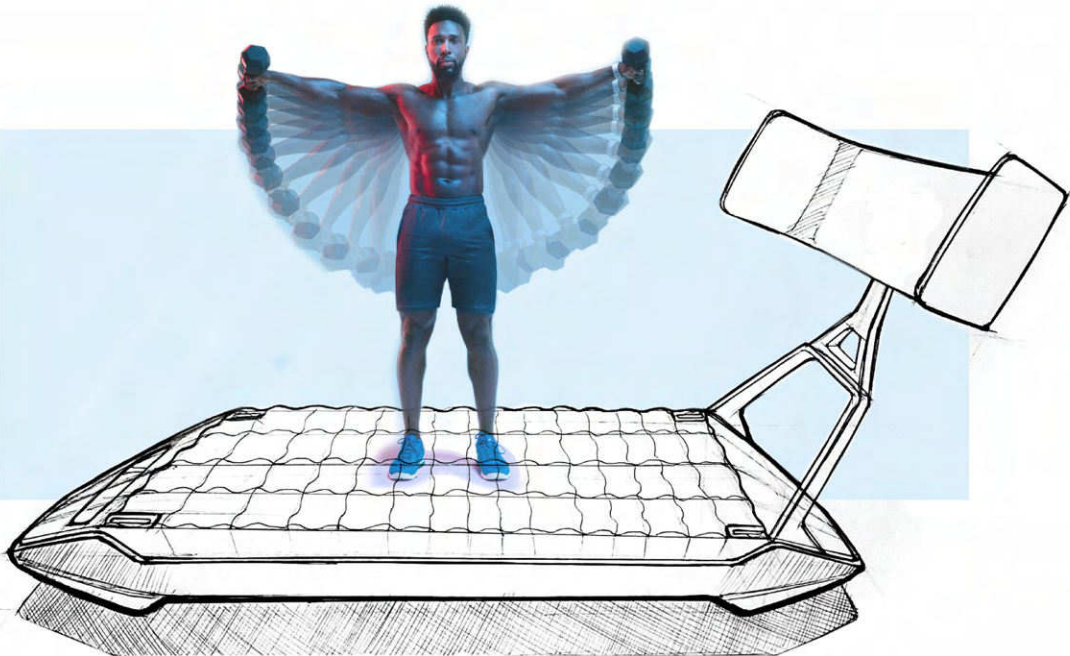
Overall, the design represents a significant innovation opportunity for the sports industry, providing a more efficient and effective solution for athletes and trainers. The concept realization phase will focus on further refining and developing the design to ensure that it meets the needs of users and can be produced at scale.

4.5.1 Design Finalization

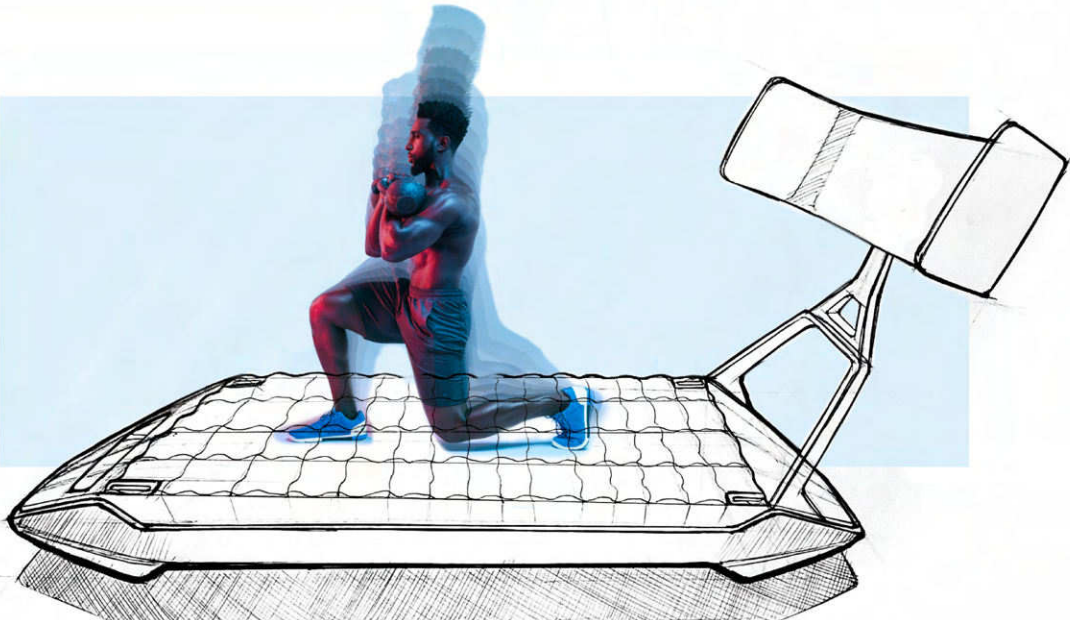




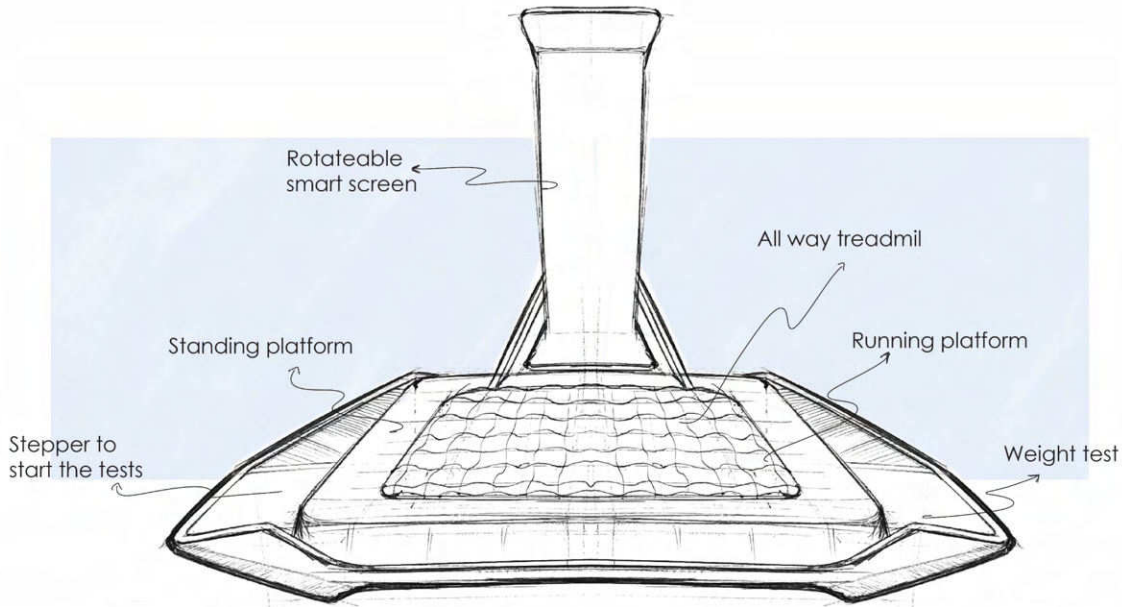
Ricky Saluja
Design Finalization



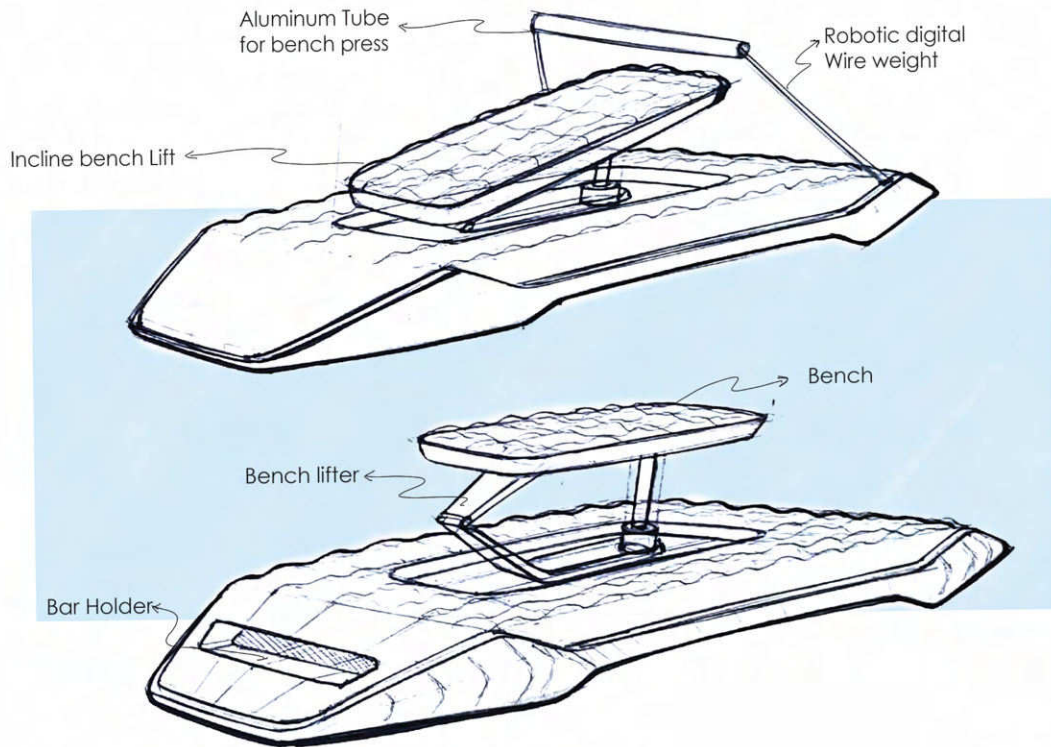
Ricky Saluja
Design Finalization



Ricky Saluja
Design Finalization

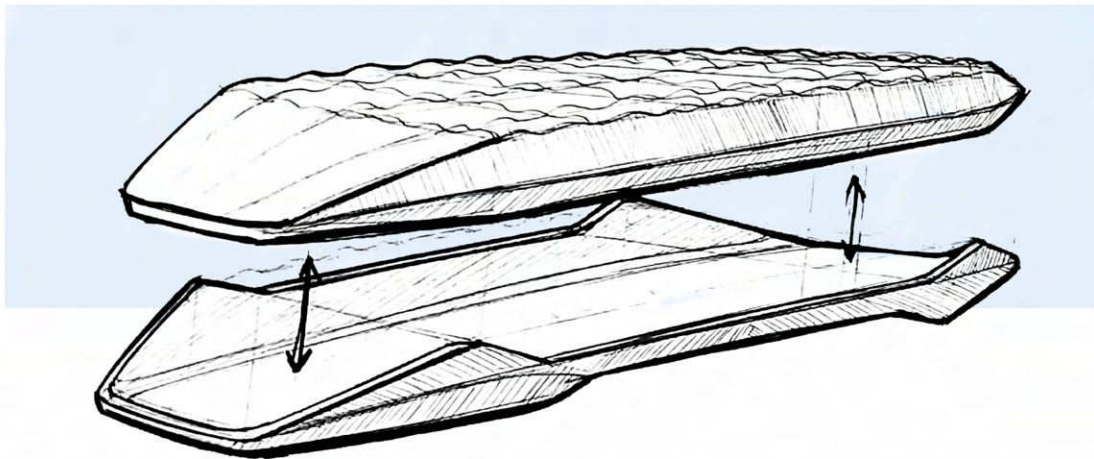


Ricky Saluja
Design Finalization



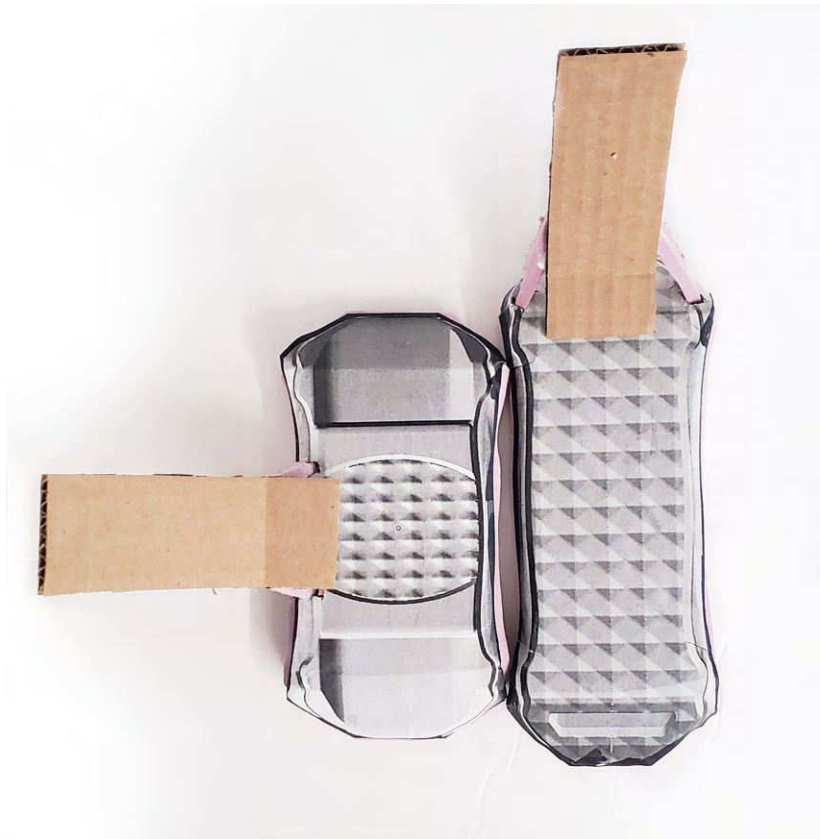
Ricky Saluja
Design Finalization

Showcasing top surface seperated from the the metal base.

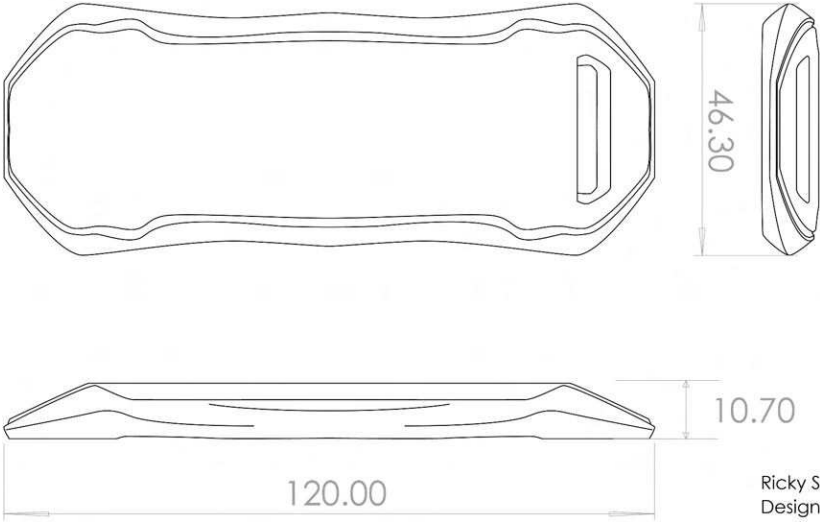


Ricky Saluja
Design Finalization

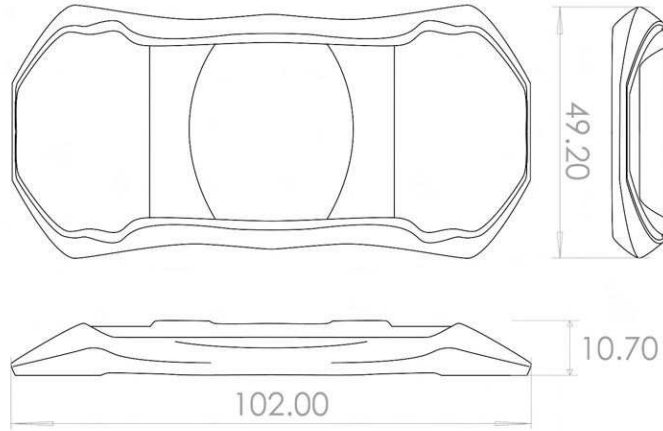
4.5.2 Physical Study Models



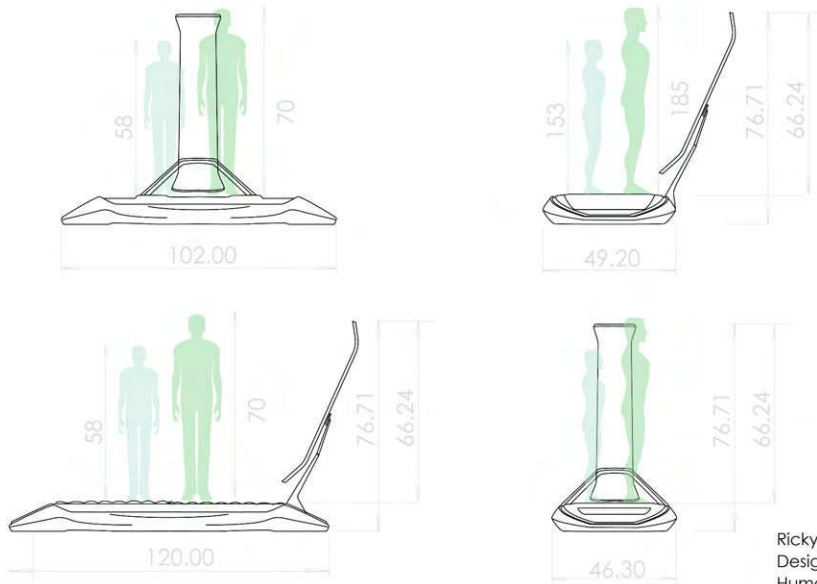




Ricky Saluja
Design Fabrication
Workout station
Scale- 1:12



Ricky Saluja
Design Fabrication
Runner platform
Scale- 1:12



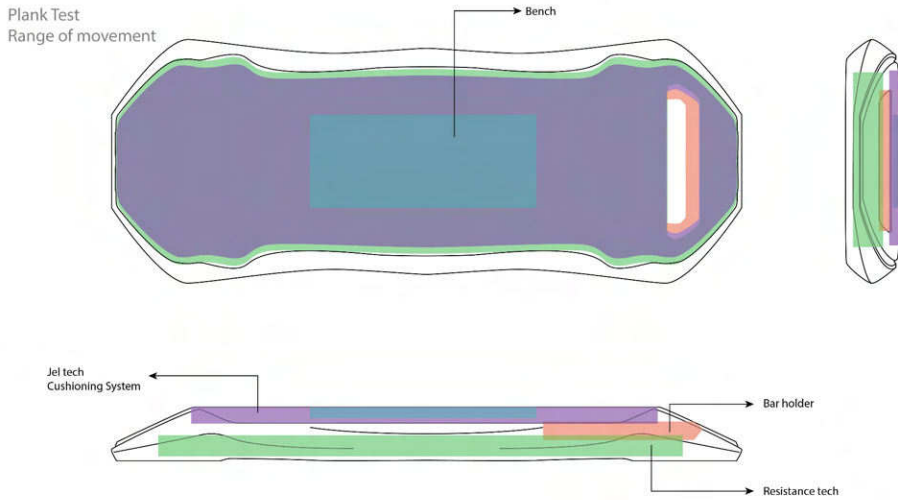
Ricky Saluja
Design Fabrication
Human Reference
Scale- 1:22

4.6 Design Resolution

Tests Covered

- Bench Press
- Squat Test
- Push Up Test
- Jump Test

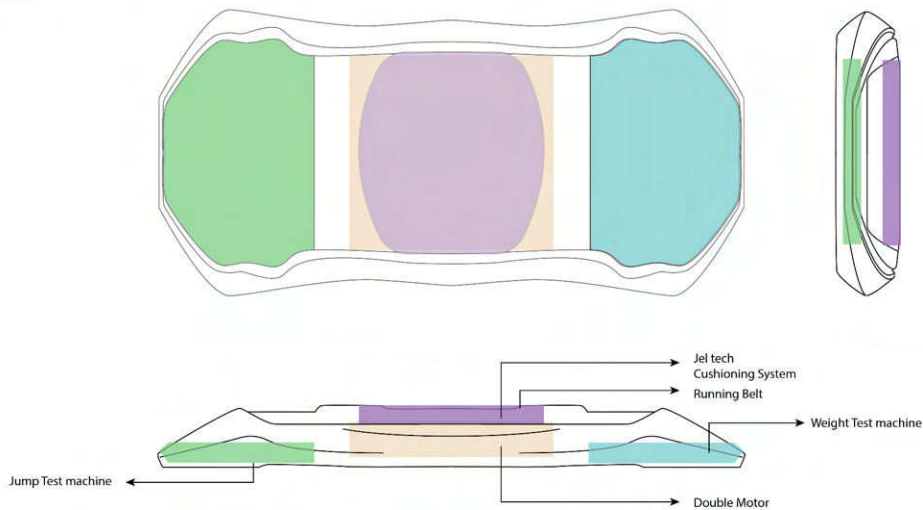
Plank Test
Range of movement



Ricky Saluja
Workout station
Design schematic

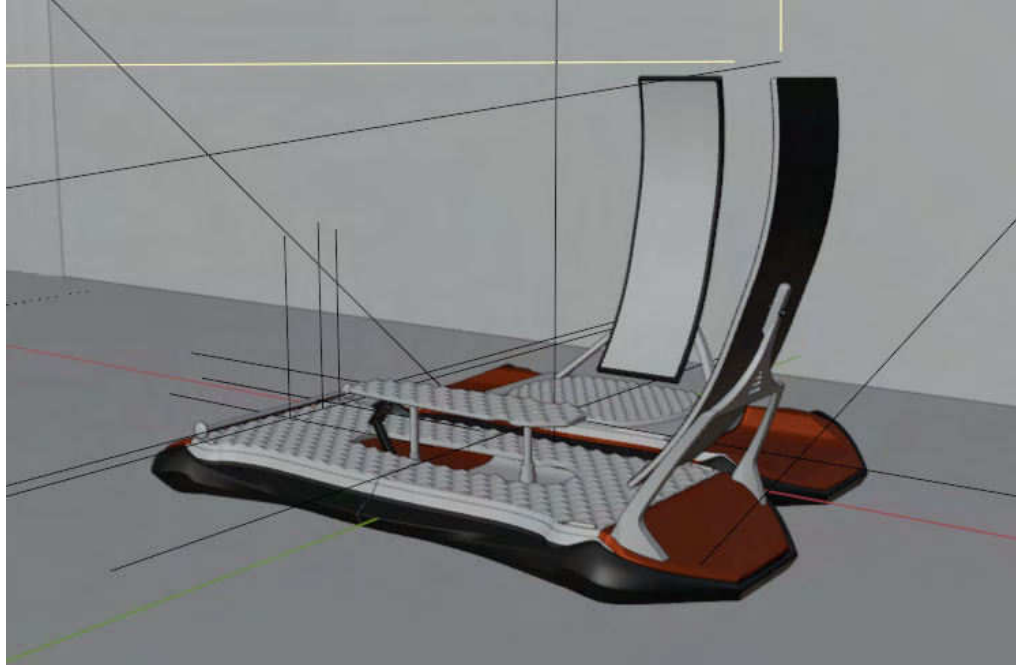
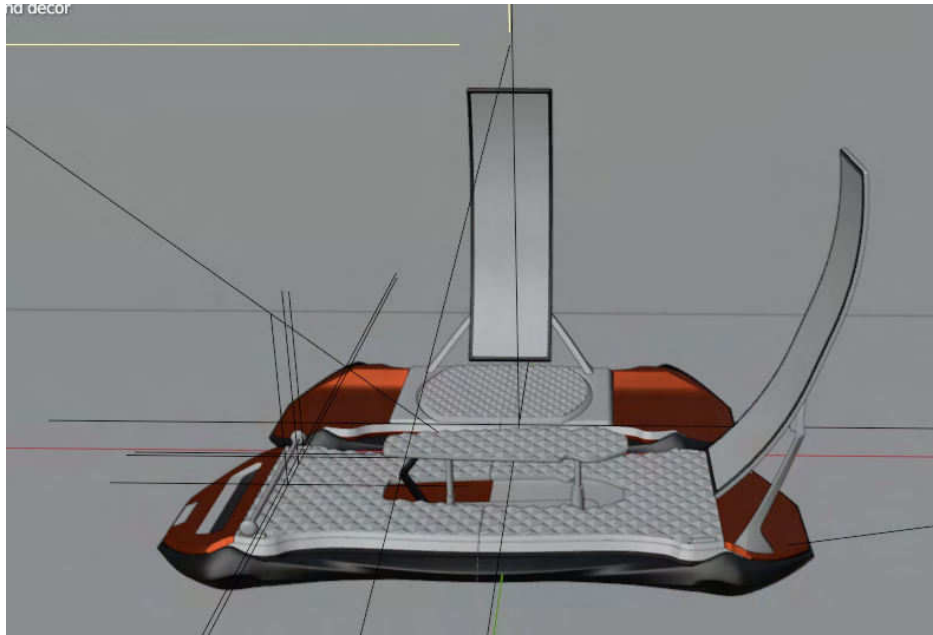
Tests Covered

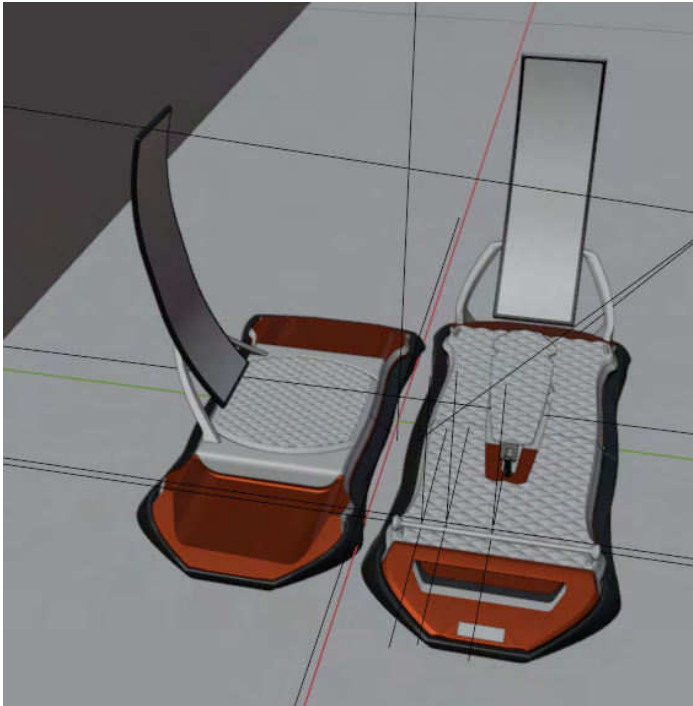
- V02 Max Test
- Speed test
- Bleep test/ yo-yo test
- T-test



Ricky Saluja
Running Platform
Design schematic

4.7 CAD Development





4.8 Physical Model Fabrication





CHAPTER 5 – FINAL DESIGN

5.1 Design Summary

The overall design is a modular attached machine that consists of two parts - the first part performs five endurance tests, and the second part conducts muscle and strength tests. The design is inspired by futuristic concepts and incorporates newly developed technologies such as the 360-degree runner and jel tech soft bed. The overall design aims to solve the problem of using multiple machines, taking up a lot of floor space, and having different data tracking, which makes it difficult to analyze and provide useful data to players, physiotherapists, and trainers.

The design is sustainable and aligns with UN Sustainable Development Goals 3, 7, 11, and 13. It saves floor space of 300 square feet and follows lean manufacturing methods. The product provides an all-in-one solution for assessing, tracking, and training, including rehab, testing, and training facilities, providing live feedback, and engaging the player.

The desirability, feasibility, and viability factors have been considered throughout the design process. The product is desirable as it provides a convenient and comprehensive solution to the problem at hand. It is feasible as it incorporates existing and emerging technologies and follows lean manufacturing methods. It is viable as it aligns with sustainable development goals and provides value to players, physiotherapists, and trainers.

The design brief and concept realization have been considered to ensure the product meets the desired outcome and specifications. Overall, the design is innovative, sustainable, and provides a valuable solution to the problem at hand.

5.2 Design Criteria Met

The design criteria for this project were Enhancement of Human Lifestyle, Human-Interaction & User-Centric Design, Ergonomics & Human Factors Design, and Sustainability & Social Responsibility. The newly designed product has met all of these criteria by providing a one-stop solution for athletes and fitness enthusiasts to assess, track, and train themselves. The product has a user-centric design that provides live feedback to the user, making it engaging and motivating. The ergonomic design of the product ensures that the user is comfortable and safe while performing the tests and training. The sustainability aspect of the product is evident in the lean manufacturing method and the use of sustainable materials. Moreover, the product aligns with UN Sustainable Development Goals 3, 7, 11, and 13, further highlighting its social responsibility aspect. Overall, the design of the product has successfully met all the design criteria, providing an innovative and sustainable solution for enhancing human lifestyle and well-being.

5.2.1 Full Bodied Interaction Design

The modular attached machines offer a full-bodied interaction design as they allow the user to perform a variety of endurance tests, muscle and strength tests, and rehab exercises, all of which require full-body engagement. The 360-degree runner technology and the jel tech soft bed also contribute to the full-bodied interaction design by providing a comfortable and supportive platform for the user to engage with. The live feedback feature further enhances the full-bodied interaction design by providing real-time data on the user's performance and progress, allowing for an immersive and engaging experience. Overall, the full-bodied interaction design of your product offers a unique and effective way to enhance human lifestyle by promoting physical

activity and providing a user-centric design that considers the human factors and ergonomics of the user's experience.

5.2.2. Materials, Processes And Technology

Materials: The design incorporates a range of materials such as metals, plastics, and fabrics.

These materials have been carefully selected for their durability, strength, and flexibility. They have been chosen to ensure the machines are safe and comfortable for users while also being sustainable and environmentally friendly.

Processes: The machines have been designed using a combination of traditional manufacturing processes such as molding, cutting, and welding as well as advanced processes like 3D printing and laser cutting. The design has been optimized for efficiency and sustainability using lean manufacturing principles.

Technology: The machines integrate a range of advanced technologies to enhance user experience and provide accurate and reliable data. The 360-degree runner technology and Jel tech soft bed are some of the notable technologies used. The machines also feature advanced data tracking and analysis systems to provide personalized training plans and live feedback to users. The design incorporates wireless connectivity for seamless integration with mobile devices, making it easy for users to track their progress and stay motivated.

5.3 Final CAD Rendering









5.4 Physical Model

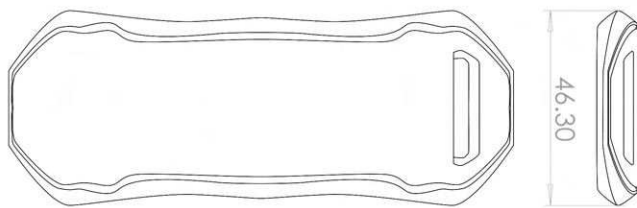
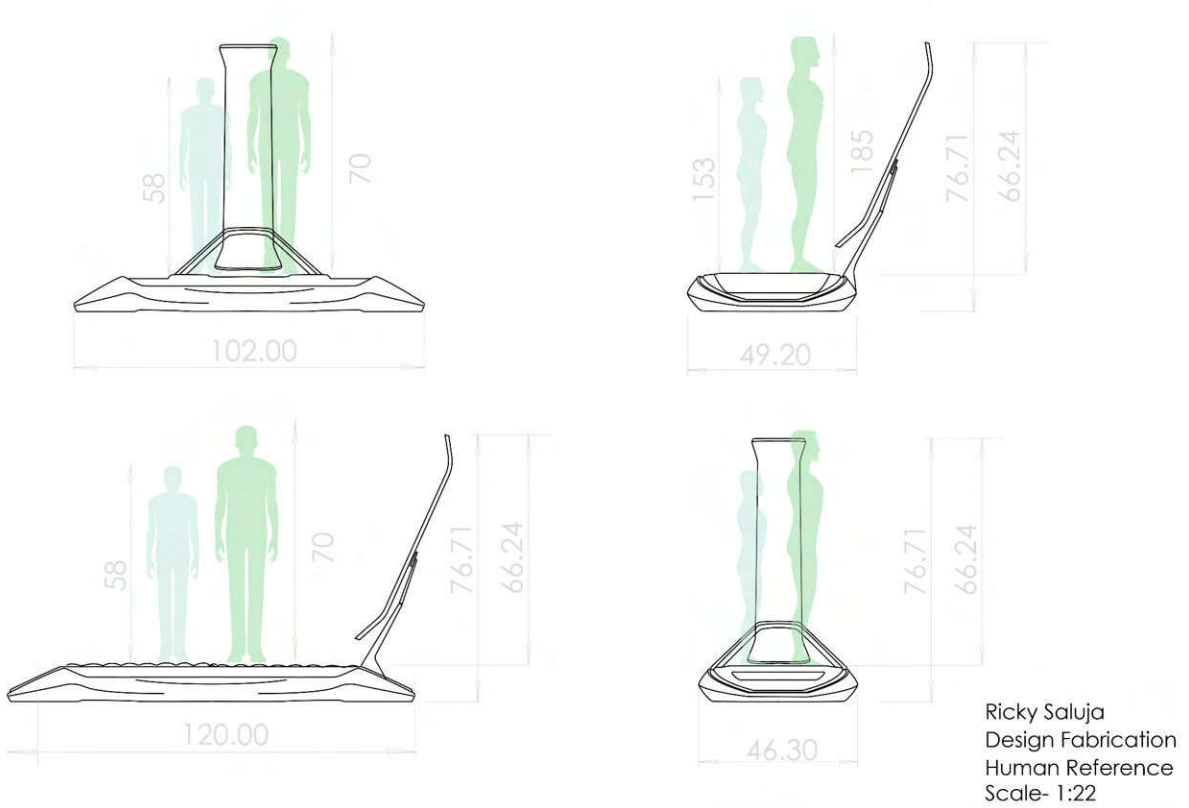




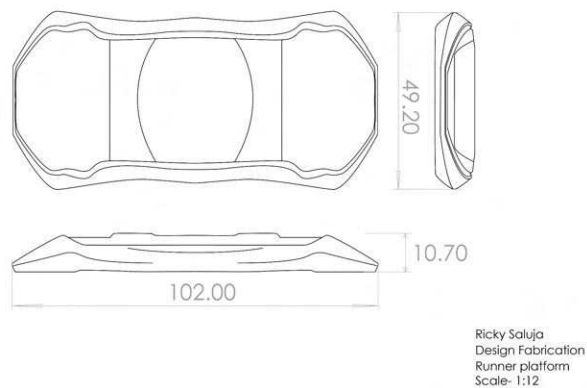




5.5 Technical Drawings



Ricky Saluja
Design Fabrication
Workout station
Scale- 1:12



5.6 Sustainability

Introduction:

The design of the modular attached machines for assessing and training athletes has a strong focus on sustainability. The design brief placed emphasis on creating a sustainable solution that would align with the United Nations Sustainable Development Goals (SDGs) 3, 7, 11, and 13. This report will detail how the design of these machines is sustainable, and how it addresses these SDGs.

Materials:

The materials used in the construction of the machines were carefully selected to ensure they were environmentally friendly and sustainable. The frame of the machines is made from recycled steel, which reduces the carbon footprint of the manufacturing process. The upholstery used on the machines is made from recycled plastic, further reducing the environmental impact. The

electronics used in the machines are energy-efficient, with low standby power consumption, helping to reduce energy use.

Processes:

The manufacturing process of the machines was designed with sustainability in mind. The lean manufacturing method was used to reduce waste and increase efficiency, reducing the impact on the environment. The machines are also designed for easy disassembly, allowing for parts to be recycled or reused at the end of their life cycle.

Technology:

The machines utilize the latest technology in energy-efficient electronics, reducing the energy consumption of the machines. The design also incorporates a data tracking system that collects data on usage, energy consumption, and performance. This data can be used to identify areas for improvement and reduce the environmental impact of the machines further.

Sustainability impact:

The design of these machines has a significant positive impact on sustainability. The use of recycled materials and energy-efficient electronics reduces the carbon footprint of the manufacturing process and the ongoing use of the machines. The lean manufacturing process reduces waste, and the design for easy disassembly ensures that parts can be reused or recycled at the end of their life cycle. The data tracking system can be used to improve the sustainability of the machines further, identifying areas for improvement and reducing energy consumption.

Conclusion:

In conclusion, the design of the modular attached machines for assessing and training athletes has a strong focus on sustainability. The use of recycled materials, energy-efficient electronics, and a lean manufacturing process has reduced the carbon footprint of the machines, while the design for easy disassembly ensures that parts can be reused or recycled. The data tracking system provides an opportunity to improve sustainability further, reducing energy consumption and identifying areas for improvement. This design aligns with the United Nations Sustainable Development Goals (SDGs) 3, 7, 11, and 13, providing a sustainable solution for the assessment and training of athletes.



SUSTAINABLE DESIGN

SPACE SAVING OF MORE THAN 300 SQUARE FEET PER MACHINE.
ALIGNS WITH UN SUSTAINABLE DEVELOPMENT GOALS 3, 7, 12 AND 13.

| | | | |
|--|---|--|---|
| <p>3 GOOD HEALTH AND WELL-BEING</p> | <p>7 AFFORDABLE AND CLEAN ENERGY</p> | <p>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</p> | <p>13 CLIMATE ACTION</p> |
| <p>Design promotes well being of major stakeholders assuring good health to all.</p> | <p>Responsibly designed to use less energy in order to power 2 machines instead of 12 different ones.</p> | <p>Designed to use less material in production of only 2 machines using post-consumer materials.</p> | <p>Responsibly chosen materials and zero waste with the recycling of parts.</p> |

LEAN MANUFACTURING

The design of the product is crafted with lean manufacturing principles that aim to minimize waste and enhance production efficiency, while adhering to the objectives of **value, value stream, flow, pull, and perfection**, and promoting environmental sustainability.



ONE STOP SOLUTION

SUSTAINABLY DESIGNED

Compared to a traditional weight rack and accessories which can take up to 300 square feet of floor space, the Evaluator Workout Station is a compact, all-in-one fitness solution saving space while promoting reduce, reuse and recycleability.




- Robotic digital weight
- 360 degree runner
- Screen rotater/holder
- Jel tech Soft Bed
- Indication finish lights
- Smart all angle bench lift
- Multi bar holder
- Weight/BMI calculator

CHAPTER 6 –CONCLUSION

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APPENDIX

A Discovery

The discovery of the problem was made through a series of interviews conducted with soccer players, coaches, and rehabilitation facilities. The goal was to understand their needs and challenges when it comes to fitness evaluation processes. The interviews were conducted in person and recorded for reference. The visuals of the interviews have been compiled and analyzed to extract insights that led to the creation of a design brief. Through these interviews, it was identified that there is a need for a more efficient, user-friendly, and sustainable fitness evaluation process that can accommodate multiple tests and provide useful data to players, physiotherapists, and trainers. The information gathered from the interviews formed the foundation of the design brief, which guided the development of the final design solution.

| Journey Steps | Baseline tests | Pressup tests | Agility Testing | Final soccer fitness tests |
|--|---|--|---|---|
| Fitness testing phase | | | | |
| Actions Soccer player follow the testing procedure. agility testing, V02 max testing, Bleep testing | Weight and height Heart rate calculator Body fat percentage | Jump test Push up Plank | 505 agility test T test Speed test 10 20 30 meter test | V02 Max test Bleep Test |
| Needs and Pains Soccer players wants to pass the test, they want to avoid any possibilities of injuries due to their weakness, they want to tackle it after knowing the results. | Pretty simple test. | Simple test, consist of a different types of them this is not using 47 block required to pass the test. Swims today feel 1.0 we had to make it more difficult after jump test. | 2.2 seconds run pass 11.5 seconds pass 1.8 sec, 3.15 sec, 4.12 sec run pass | Measure the heart rate and oxygen body use during exercise. Running in both direction for 20 meters with each bleep. |
| Touchpoint players interact with each machine as primary user, they touch points can be hands, feet and knee. | Feet, Hand and head | feet, hand on waist feet and hand feet and hand | Feet and knee feet, hand and knee feet and knee | Feet, knee, hand and forearm whole body whole body |
| Player Feeling how is the player feeling throughout the testing process. | 😊 | 😬 | 😞 | 😬 |
| Backstage | | | | |
| Opportunities What could we improve or introduce? | Currently baseline tests also has 3 different machines, opportunity to make it 1 is super easy. | these tests have metrics set to pass, the test but is not helping the player in any form. | These tests are done on field, opportunity to bring in machine test combining all aspect of agility testing together. | Done on a machine but physio takes the sample by hand by stopping him after each bleep, sensors attached to the body to calculate data. |
| Process ownership Who is in the lead on this? | physiotherapist checks the players. | Physiotherapist or trainer does the test. | Physiotherapist or trainer does the test. | Physiotherapist or trainer does the test. |



Objective:

Planning for an Observation Session

Thesis Topic

How may we improve the performance evaluation process for soccer athletes?

| | |
|---|---|
| <p><i>I Selection of Specific Activity to Observe</i></p> <p><i>(After looking at the overall activity, make a decision on where you are going to focus)</i></p> | |
| <p>Specific Activity #1:</p> | <p>After Looking at the overall tasks soccer players perform, my focus will be on the testing phase of the player's fitness ability.</p> |
| <p>Objective(s): <i>(Needs Statement)</i></p> | <p>This will keep the focus on the activities the thesis topic is concerned with which includes all the muscle and strength testing and agility testing.</p> |
| <p>Decision to be Made <i>(The 'why' of doing your observation)</i></p> | <p>Reason behind doing the observation at testing phase due to lack of connectivity between different machines and also number of tests can only be performed outside for now.</p> |
| <p>Target (individual or group) <i>Selection criteria used: age, sex, income, education, location, specific target, special interest etc.)</i></p> | <p>Target for this study are soccer players, coach or trainer and physiotherapist.</p> <p>Players are the primary users and average age is between 22 to 27 both female and male.</p> |
| <p>Observation Method <i>Notes, Photos, Audio, Video, Scaled Mockup, Other</i></p> | <p>Observation will be done via videos currently available of england premier league training sessions.</p> <p>Observation will also be done live in the humber center watching players go through testing phase.</p> |

| | |
|---|---|
| <p>Specific Activity #2:</p> | <p>Second activity is focused on physiotherapist movements along the machines while performing the tasks and range of movement of the player.</p> |
| <p>Objective(s): <i>(Needs Statement)</i></p> | <p>This activity is concerned with having required space for the physio and how much interaction they need to have with soccer players.</p> |
| <p>Decision to be Made <i>(The 'why' of doing your observation)</i></p> | <p>The reason behind doing this test is to plan space and adjustability according to how much physiotherapists interact while testing the player.</p> |
| <p>Target (individual or group) <i>Selection criteria used: age, sex, income, education, location, specific target, special interest etc.)</i></p> | <p>Target could be a physiotherapist, coach or trainer who is basically testing the player at the given time.</p> |
| <p>Observation Method <i>Notes, Photos, Audio, Video, Scaled Mockup, Other</i></p> | <p>Observation will be done via videos currently available of england premier league training sessions.</p> <p>Observation will also be done live in the humber center watching players go through a testing phase.</p> |

| | |
|---|--|
| <p><i>II Set-up of Observation Session</i></p> | |
| <p><i>Date (tentative):</i></p> | <p>The timing is set to be this Wednesday(2022-11-23) afternoon after the design and research method class.</p> |
| <p><i>Location:</i></p> | <p>Humber Athletics</p> |

| | |
|---|--|
| <p><i>Activity to be undertaken</i></p> | <p>Observation of the players. Observation of the coaches and trainers Observation of the physiotherapist</p> |
| <p><i>Equipment Required: (Real / scaled mock-up)</i></p> | <p>Full size treadmill, Bench Press machine, Squat machine</p> |

Scope

Need for the Product or Service

What is the need for the product or service for your thesis topic?

Background

Performance Readiness Evaluation (PRE)

What is measured can be improved! The API Performance Readiness Evaluation (PRE) is a complete, bio-mechanical strength, flexibility and movement analysis to isolate an athlete's structural compensations, muscular imbalances, athletic movement restrictions and injury risk factors.

Needs Statement

Evaluation plays a very important role in large sports clubs where major money is spent on purchasing new players, and the buyers are very careful to ensure all players go through a complete fitness evaluation to make sure they are fit enough to play.

There is a need that can be solved to help managers/coaches/buyers have accurate data about each of the players they are choosing to invest in. Currently, many different steps are completed on different machines and people take manual notes in addition, which is often not accurate.

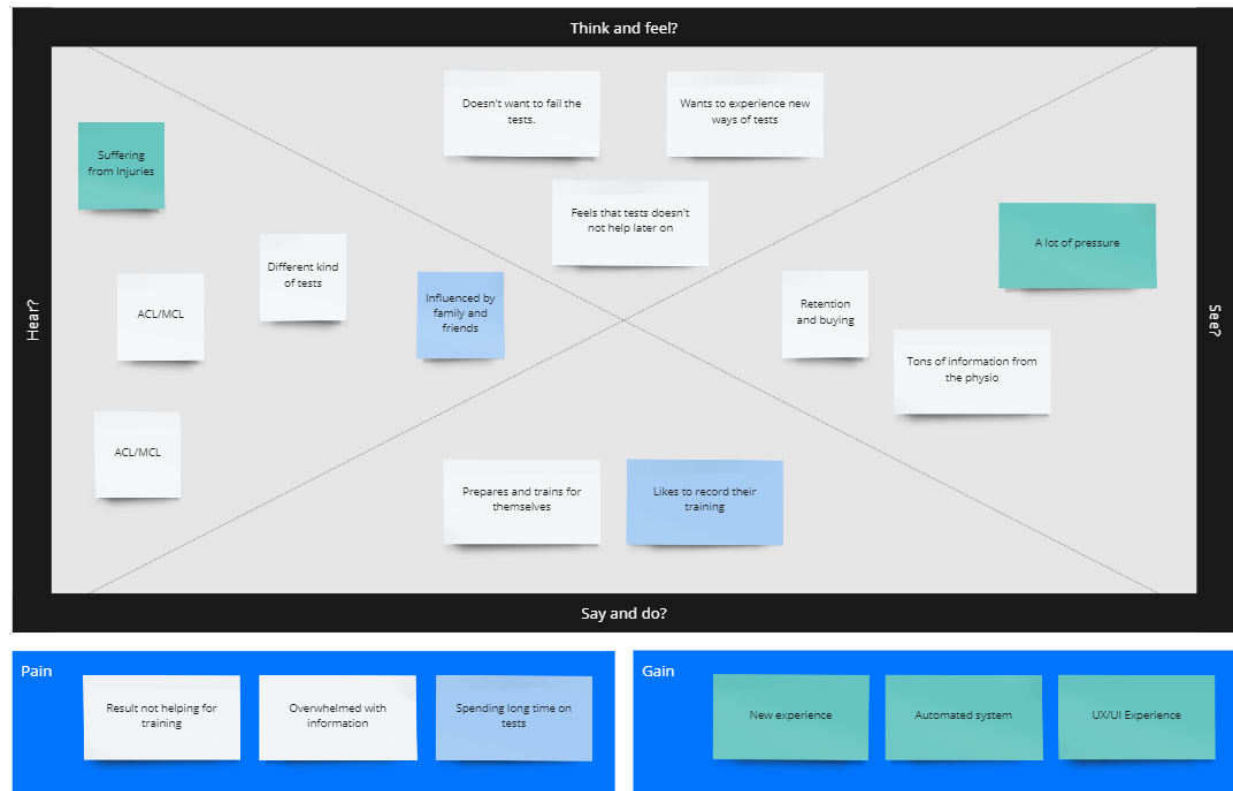
How is this need being addressed currently?

(Current products and services)

1. There are multiple apps available which can track user movements, measure heart rate and other diagnostics of the player.
2. There are physical machines which are used to check an athlete 's running ability and Strength & weight lifting abilities.
3. There are also data driven performance evaluations which I am not planning to move forward to.

Appendix B Contextual Research (User)

The designer conducted interviews with players, coaches, and rehabilitation facilities to gather information on the problem of the current soccer fitness evaluation process. By conducting these interviews, the designer gained insight into the challenges faced by users, such as the need for multiple machines, lack of space, and time-consuming processes. Through this research, the designer was able to understand the user's needs and perspectives and incorporate them into the design process. The visuals of the interviews provide a clear representation of the context in which the design problem exists and helps to guide the design process towards a more user-centric approach.



Primary, Secondary and Tertiary Users

Primary Users - Athlete's, Physiotherapist

Secondary Users - Coach, Trainer, Club Manager, Player Agent

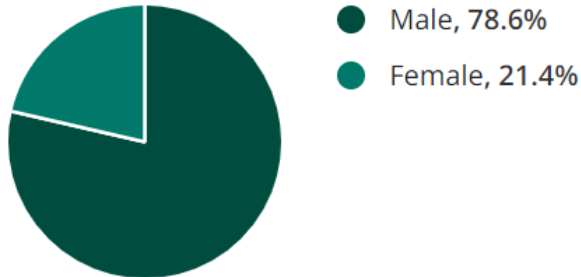
Tertiary Users - Club President, Head Coach, Club Owner

Key words:

1. Soccer athletes + Demographic
2. Professional Soccer athletes + Demographic
3. Professional Soccer athletes + Market research
4. Professional Soccer athletes + Average Training

Demographics:

Gender :



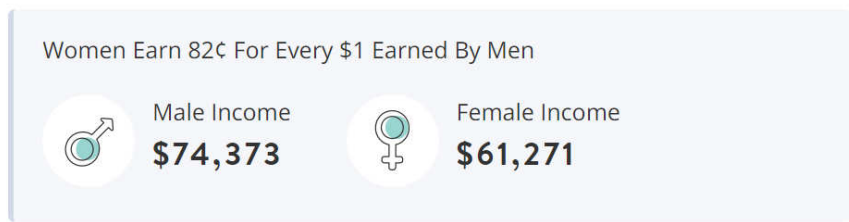
Average Age:

Men - 27

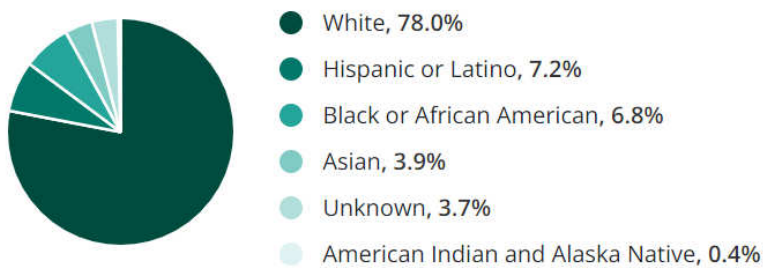
Women - 25

Income :

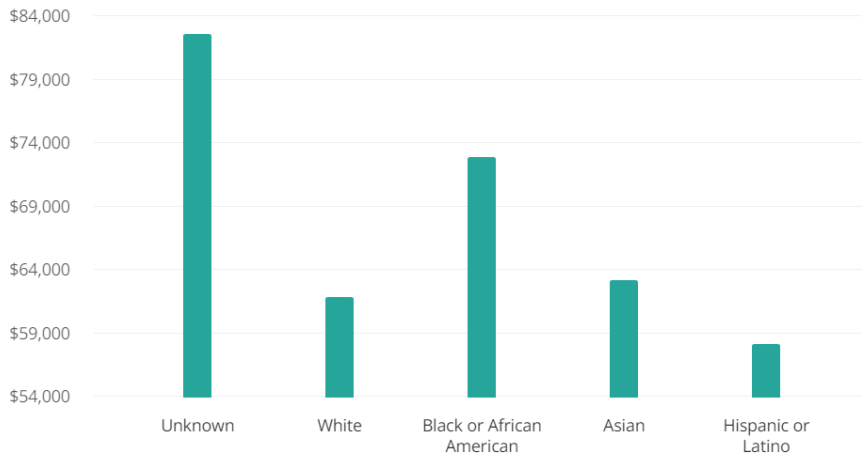
Gender Pay Gap For Football Player



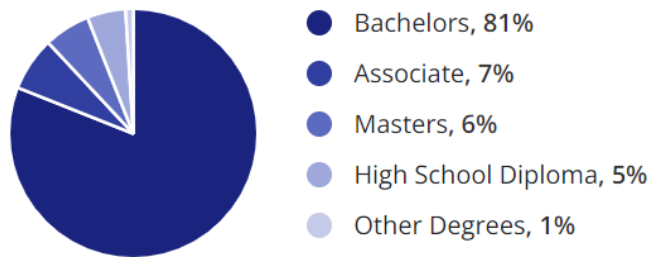
Race :



Wage Gap :



Education



Reference:

1. [How Often Do Soccer Players Train? \(Pain And Gain\) o 2022.](#)
2. [Professional Soccer Player Demographics and Statistics In The US](#)
3. [Professional Soccer Players Are Peaking Later, Shows New Research](#)

Summary Of Demographics:

The Main primary user for this thesis study is the Soccer player. 21.4% of professional soccer players are women and 78.6% of professional soccer players are men. Average age for men is 27 and for women is 25. Women's income is lower than mens as women earn 82 cents for every dollar earned by men. The most common ethnicity among professional soccer players is White, which makes up 78.0% of all professional soccer players. Comparatively, there are 7.2% of the Hispanic or Latino ethnicity and 6.8% of the Black or African American ethnicity. The most common degree for professional soccer players is bachelor's degree 81% of professional soccer players earn that degree. A close second is associate degree with 7% and rounding it off is master's degree with 6%.

USER BEHAVIOR: Information Search

Frequency -

Training time - 3 Times per week during Pre season

5 Days Per week During regular season

Average 4-6 Hrs per week.

Average Timetable-

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|-----------------------------------|----------------------|------------------|----------------------|---------------|----------|----------|
| Meeting | Meeting | Meeting | Meeting | Meeting | Game | Recovery |
| Warm-Up | Warm-Up | Team Training | Warm-Up | Warm-Up | Game | Recovery |
| Specialized Training (e.g. speed) | Specialized Training | Recovery Session | Specialized Training | Team Training | Game | Recovery |
| Gym Sessions | Gym Sessions | | Gym Session | | Game | Recovery |
| Lunch | Lunch | Lunch | Lunch | Lunch | Game | Recovery |
| Team Training | Team Training | | Team Training | | Game | Recovery |
| | Extra Training | | | | Game | Recovery |




Group and solidarity:



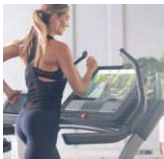


Training is usually done in groups and with multiple trainers for usually around 4 to 6 hours a day for 5 days a week during the regular season.



Testing is usually done alone in most cases when it is done inside, however some of the tests such as bleep tests and yo-yo tests are done on field along with many players.

C Field Research (Product)

Product (Benchmarking)

| Products | Image | Features | Challenges |
|---|---|---|--|
| <p>The Catapult PLAYR Smart Coach System</p> |  | <ul style="list-style-type: none"> -Monitors ten core metrics including distance, sprints and speed - Improve performance & Reduce the risk of injury by monitoring your workload. -Manage rehabilitation to support return to play. - Develop coach to player communication with Catapult One. -Unique to Catapult, Movement Profile quantifies the physical load from multi-directional movements. | <ul style="list-style-type: none"> -Product can only be used outside and on field. -Uses GPS to track the runs which constraints the ability to record inside. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric plus has no cardiac metrics too. |
| <p>STATSports Apex Athlete Series GPS Performance Tracker</p> |  | <p>GPS Performance Tracker allows athletes to track game data live using 14 different metrics. Using the tracker app, access stats for heart rate, max speed, total distance, number of sprints, time in red zone and more.</p> <p>Wireless syncing sends information directly to your chosen device. You'll have the ability to compare your stats with other Apex users worldwide.</p> | <ul style="list-style-type: none"> -Product can only be used outside and on field. -Uses GPS to track the runs which constraints the ability to record inside. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric plus has no cardiac metrics too. |
| <p>APEX ATHLETE SERIES GPS PERFORMA NCE TRACK USR EDITION</p> |  | <p>Real-time performance data at your fingertips to help you become fitter, faster and perform at a higher intensity.</p> <p>Increase your max speed and sprint capacity, and test yourself against the pros.</p> | <ul style="list-style-type: none"> -Product can only be used outside and on field. -Uses GPS to track the runs which constraints the ability to record inside. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric |

| | | | |
|---|---|---|---|
| | | | plus has no cardiac metrics too. |
| Polar Unite Heart Rate Monitors |  | Get personalized daily workout guidance to inspire you, 24/7 heart rate and activity tracking to motivate you, and automatic sleep and recovery applications to help you understand your body better. It's time to live life to the fullest: every shape, every size, every step of the way - everybody, unite! | -Product can only be used outside and on field. -Can only do too much, doesn't provide the body fat ratio or oxygen recovery metric plus has no cardiac metrics too. |
| MRI,CT and ultrasound machines |  | Not the area of focus | Not the area of focus |
| NordicTrack EXP 7i Folding Treadmill - iFit Enabled |  | -NordicTrack EXP 7i Treadmill features a 7" (17.8 cm) full colour smart HD touchscreen -iFIT® enabled for interactive training sessions, streaming global and studio class workouts and connected fitness tracking -30-Day iFit membership included -3.0 CHP smart-response motor -Tread Belt: 20" x 60" (50.8 x 152.4 cm) -FlexSelect™ cushioning & Automatic trainer control | -expensive plus need membership. -it can only work inside -doesn't do metrics for oxygen level and cardiac level. |
| Seimen's Healthineers |  | Not the area of focus | Not the area of focus |
| Skillrun live 7000 |  | Designed to train the pillars of athletic conditioning and performance, Skill Run is a treadmill like no other. Developed side-by-side with academic and research institutes, professional trainers and athletes, it takes performance training to new heights. | expensive plus need membership. it can only work inside doesn't do metrics for oxygen level and cardiac level. |

| | | | |
|------------------------------|---|--|---|
| <p>Bowflex treadmill 22</p> |  | <p>The Treadmill 22 is our top-of-the-line cardio experience that provides the coaching, motivation, and variety you crave to keep you immersed in your fitness journey.</p> | <p>expensive plus need membership. it can only work inside doesn't do metrics for oxygen level and cardiac level.</p> |
| <p>Bowflex velocore bike</p> |  | <p>Track the metrics you lean on most.</p> <ul style="list-style-type: none"> • Time • Interval* • Distance (km or miles) • Calories • Burn Rate (calories per minute) • Heart Rate • Cadence • Resistance | <p>expensive plus need membership. it can only work inside doesn't do metrics for oxygen level and cardiac level.</p> |

KEY BENEFITS

| Benefits | Repetition |
|-----------------|------------|
| Comfort | 8 |
| Easy to wear | 4 |
| Burn Calculator | 3 |
| Resistance | 7 |
| Cadence | 1 |
| Burn rate | 1 |

| | |
|------------------|---|
| Calories counter | 4 |
| Skill run | 4 |
| Activity tracker | 6 |
| Max Speed | 3 |
| Sprint Capacity | 3 |
| Distance | 5 |
| Sprint | 6 |
| Communication | 5 |
| Unique | 2 |
| Movement | 5 |
| Pro test | 7 |
| Speeding | 5 |
| Finger print | 3 |
| Strength | 7 |
| Styling | 6 |

Key Features

| Features | Repetition |
|-----------------|-------------------|
| Frame | 5 |
| Modularity | 7 |
| Single runner | 3 |
| Treadmill | 6 |
| Soft bench | 1 |

| | |
|--------------------|---|
| Massage seat | 1 |
| Oxygen mask | 4 |
| Weight machine | 4 |
| Heart Rate machine | 6 |
| Vo 2 max machine | 3 |
| Burn calculator | 3 |
| Grip | 5 |
| Handle | 6 |
| Ruber | 5 |
| Fingerprint | 2 |
| Weights | 5 |
| Jump machine | 7 |
| Soft grip | 5 |

Benefit Table

| Keyword | Frequency |
|------------------|------------------|
| Comfort | 8 |
| Resistance | 7 |
| Activity Tracker | 6 |
| Communication | 5 |

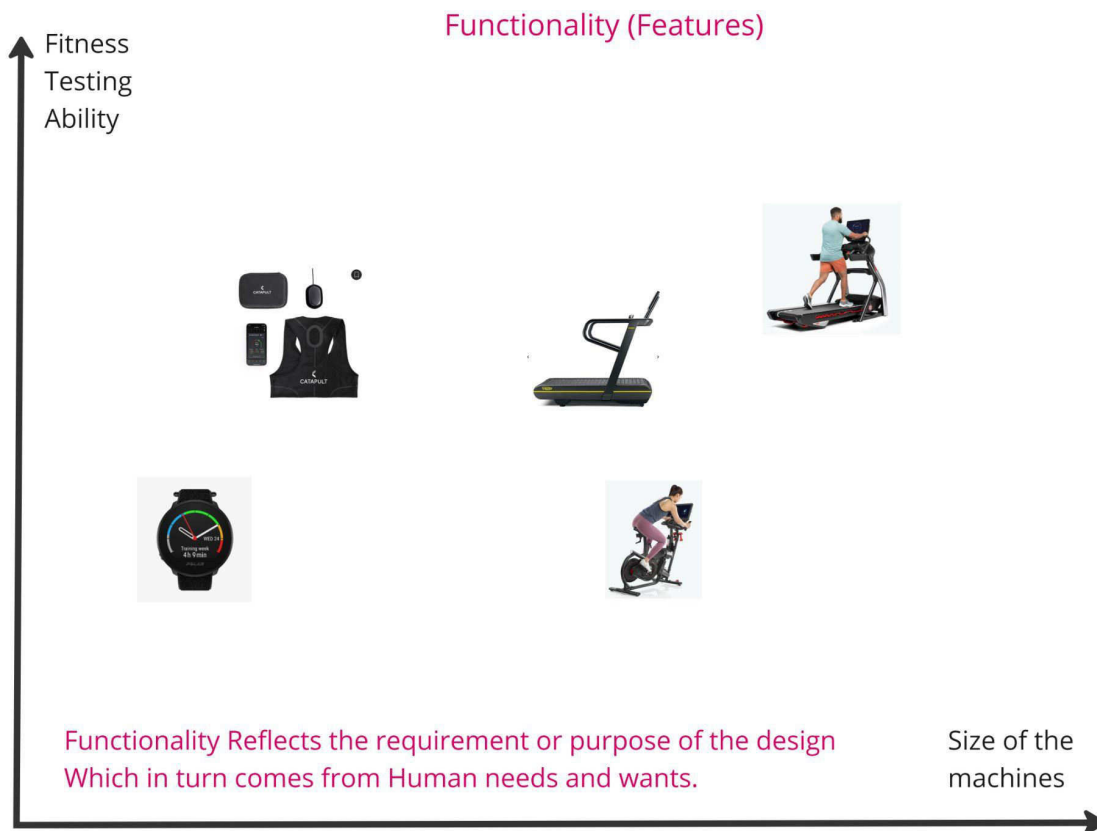
Feature table

| Keyword | Frequency |
|----------------|------------------|
| Modularity | 8 |
| Heart Rate | 6 |
| Treadmill | 6 |
| Jump Test | 5 |

D Result Analysis

Functionality benchmarking was carried out to determine common functionality amongst the product grouping as well as market differentiation.

Characterizing the functionality was carried out using the data set collected for the features, selecting most common features, and comparing two features in an x-y graph.







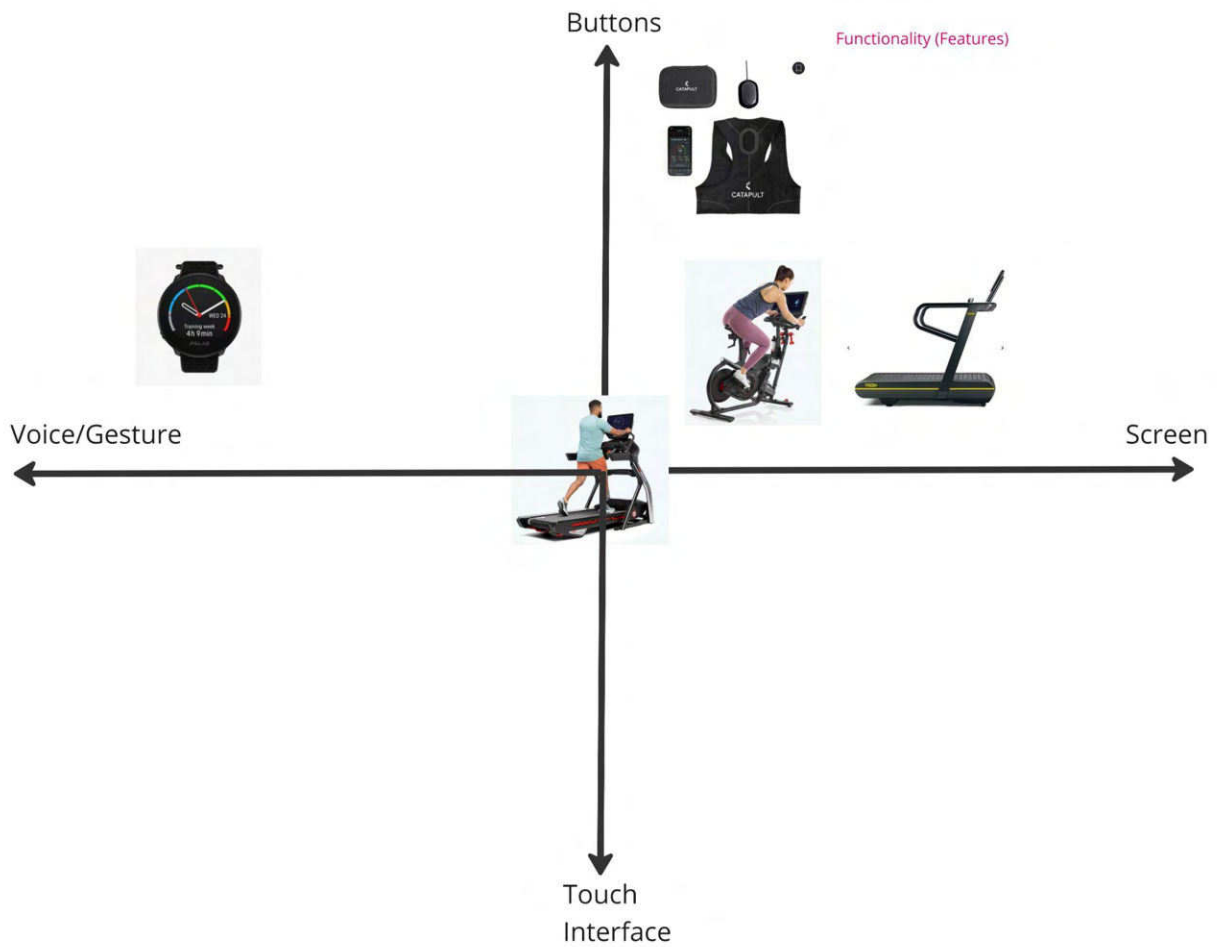
Takeaways

- There is no connectivity between the machines.
- All the tests are currently done separately. There are hardly 3 tests which can be covered together.
- Half tests are done inside and the other half are done on the ground. Which loses the Data connectivity.

2.2.3 Interface

User interaction was carried out to determine common interface practices in the product category. Characterizing the functionality was assessed by benchmarking using the data set collected for the features, selecting most common features, and comparing two features in an x-y graph.

| Features | Bowflex velcore bike | Bowflex treadmill 22 | Skillrun live 7000 | Polar Unite Heart Rate Monitors | TATSports Apex Athlete Series GPS Performance Tracker |
|-----------------|----------------------|---|---|---|---|
| | |  |  |  |  |
| | Interface | | | | |
| Buttons | * | * | * | * | * |
| Screen | * | * | * | | |
| Touch Interface | | * | | * | |
| Voice/Gesture | | * | | | |








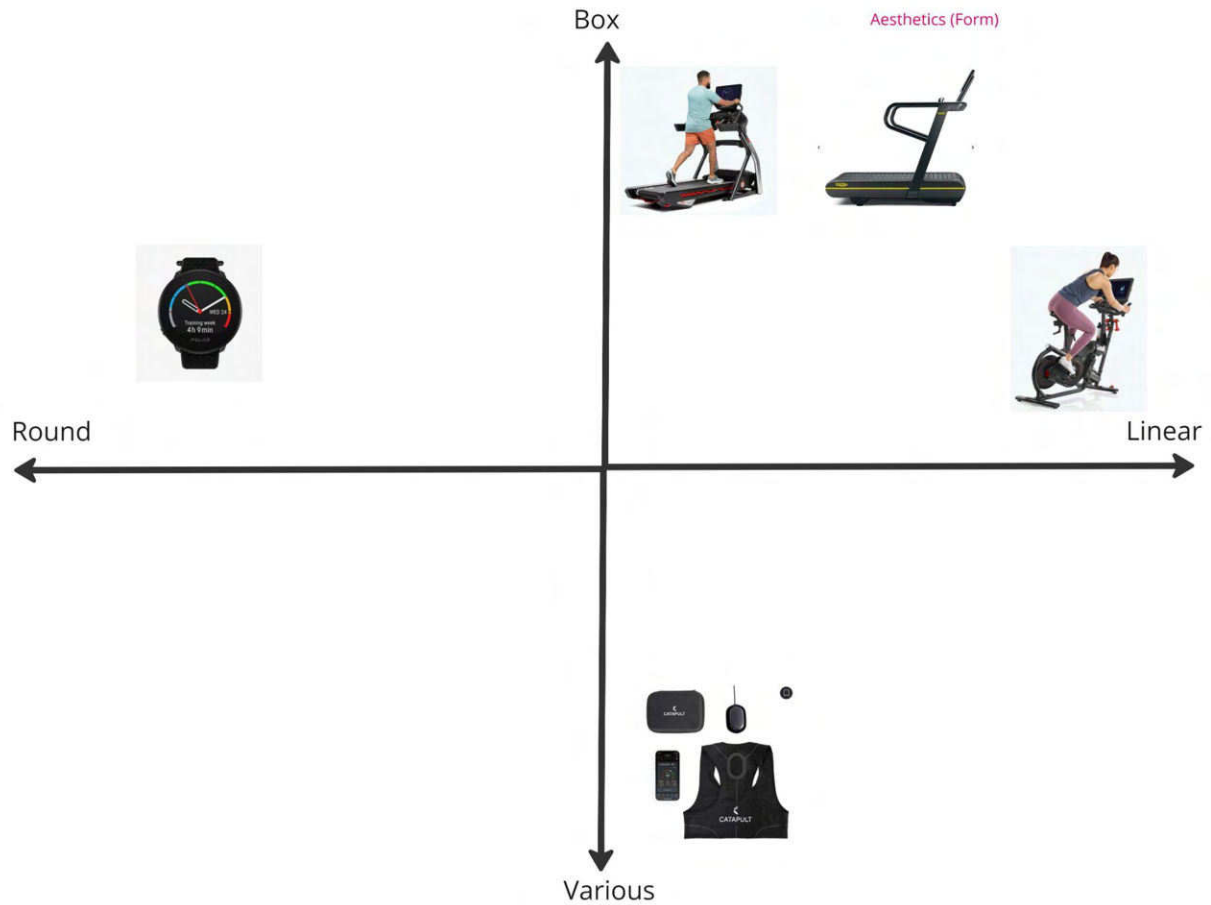
Design Takeaways

- a) Button
- b) Screen
- c) Touch Interface
- d) Gestures, voice activated

2.2.4 Aesthetics

An aesthetic assessment was carried out to determine trends in styling for this product category, and to characterize the specifics of those styling trends. This was assessed by benchmarking products and applying Elements of Design across products, and then comparing two features in an x-y graph.

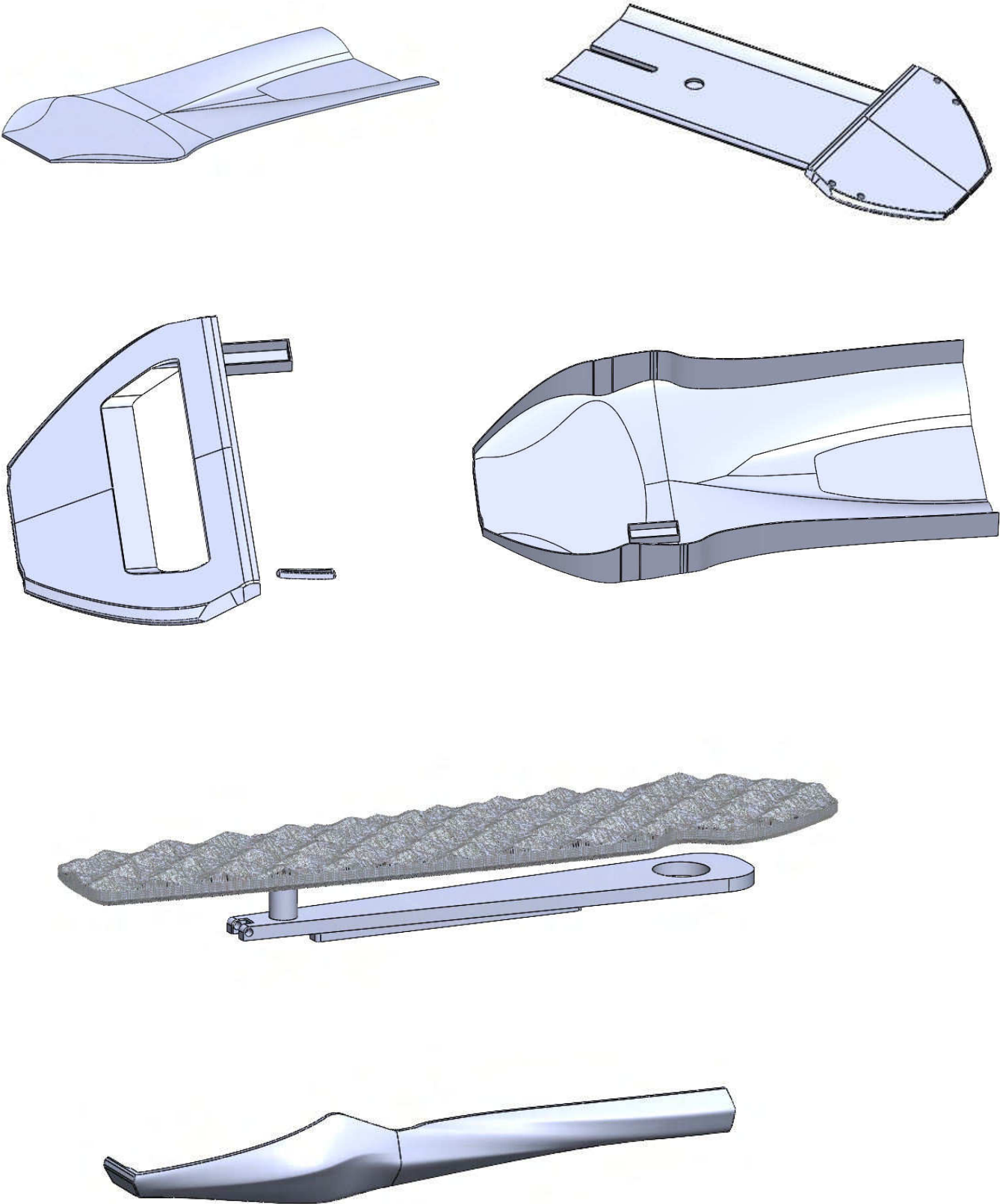
| | Bowflex velcore bike | Bowflex treadmill 22 | Skillrun live 7000 | Polar Unite Heart Rate Monitors | TATSports Apex Athlete Series GPS Performance Tracker |
|--------------|---|---|---|---|---|
| Overall Form |  |  |  |  |  |
| | Styling and Aesthetics | | | | |
| Shape | Linear | Box | Box | Round | Various |
| Style | General Bike | Modern | Minimalistic | Modern | Body wear |
| Balance | Straight | Top balance | Top balance | Hand balance | Symmetric |
| Pattern | Bars | Treads | Treads | Rubber | Fabric |

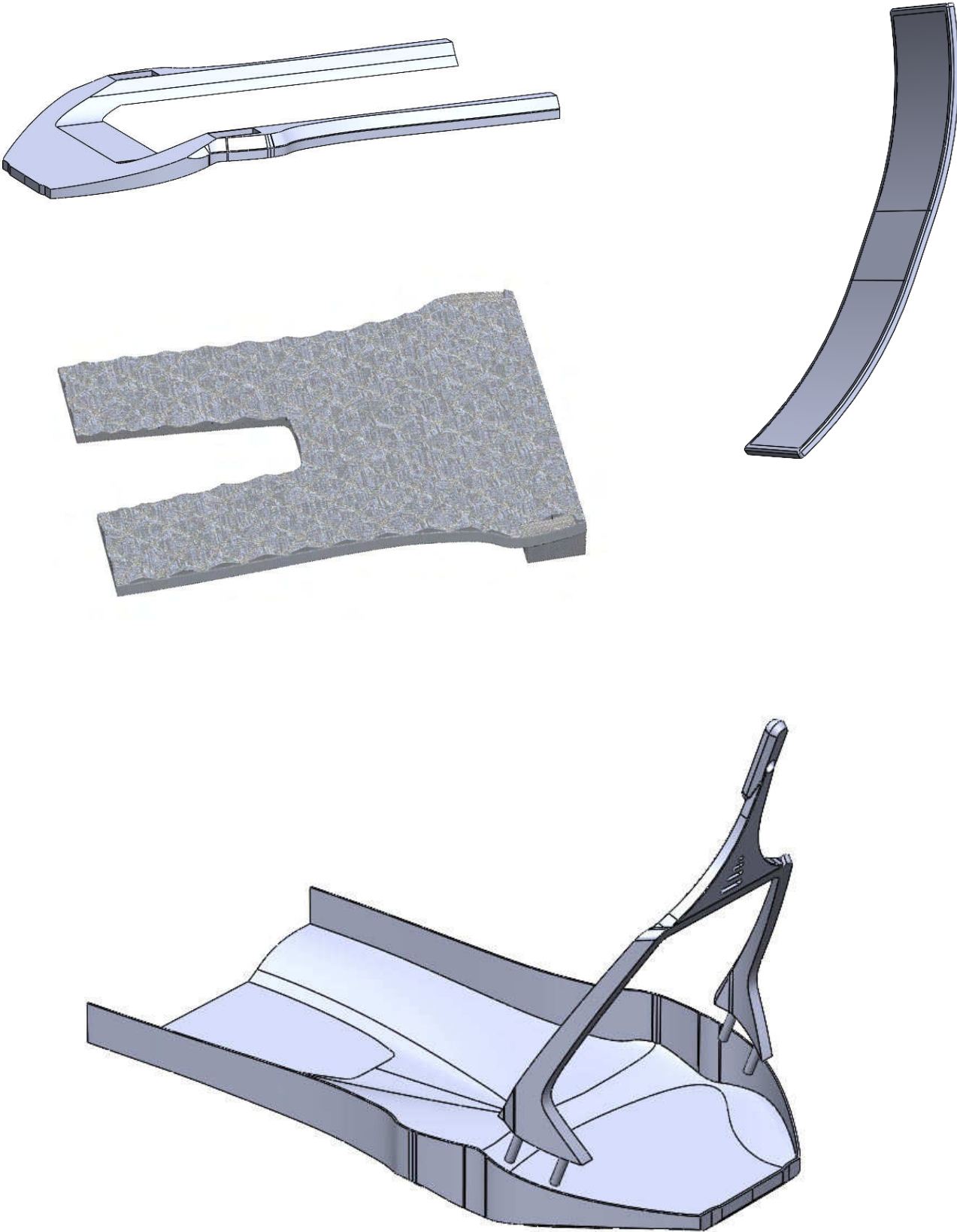


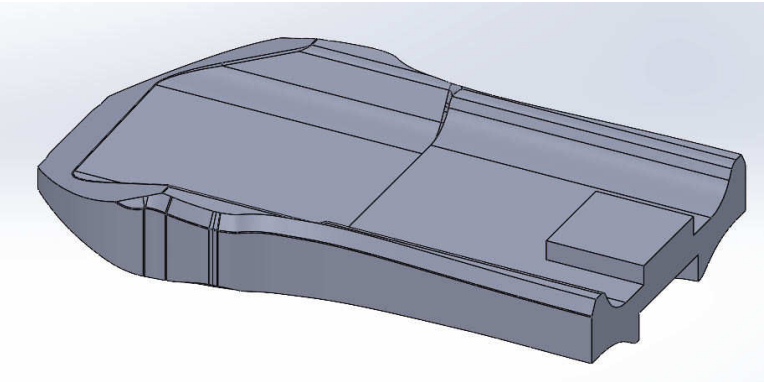
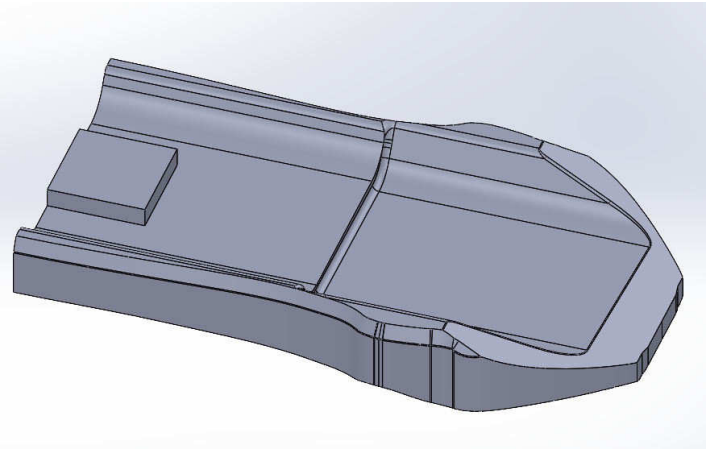
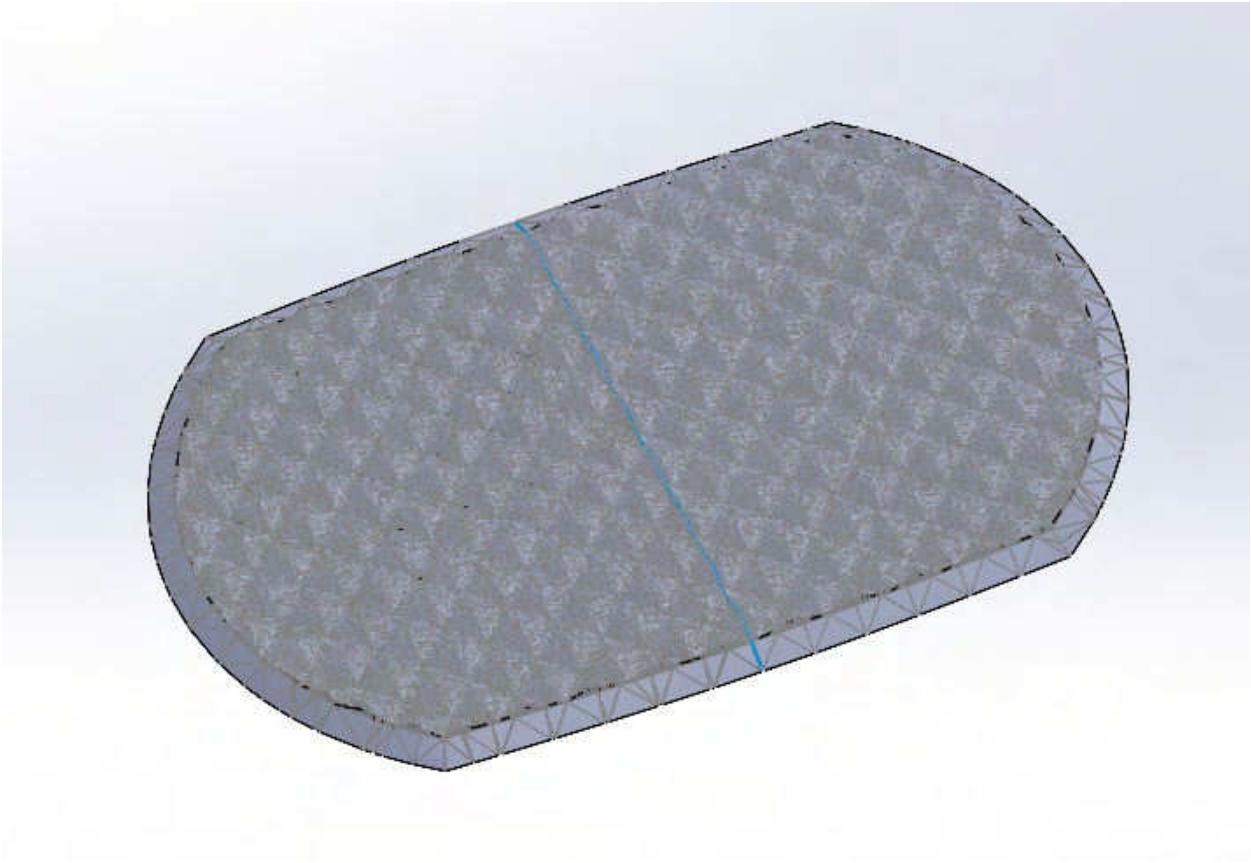
Design Takeaways

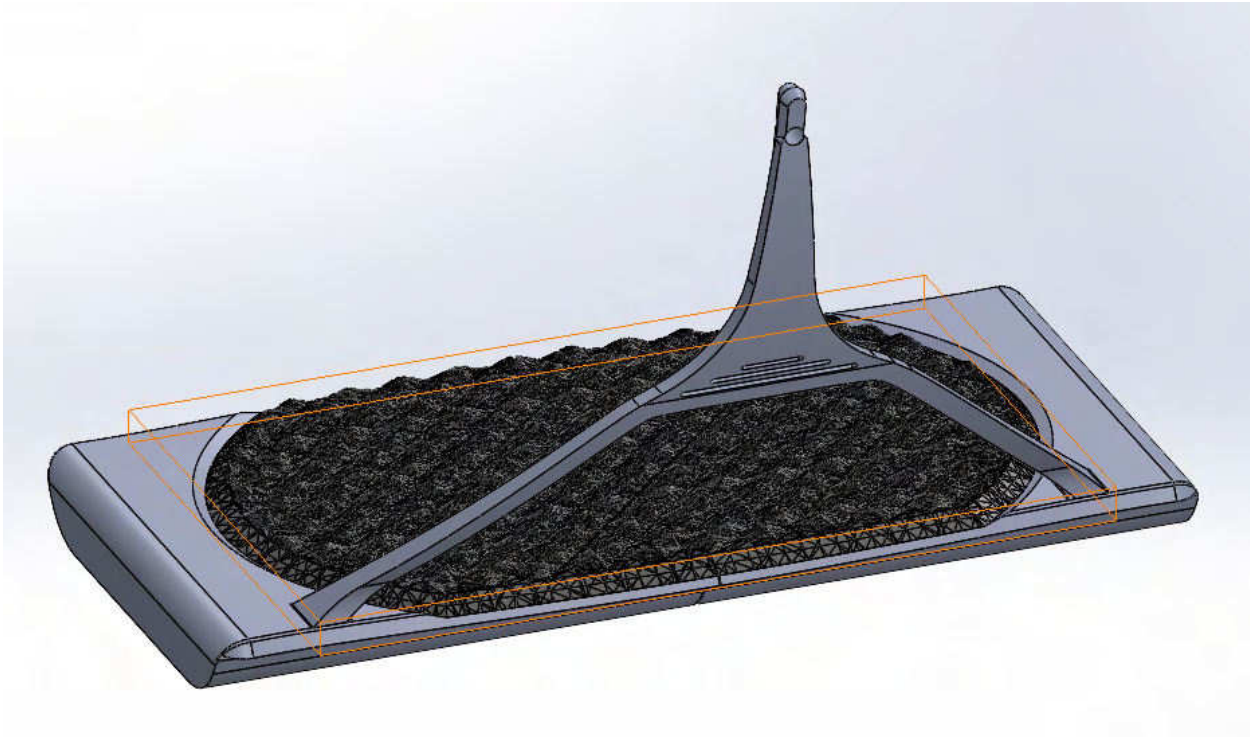
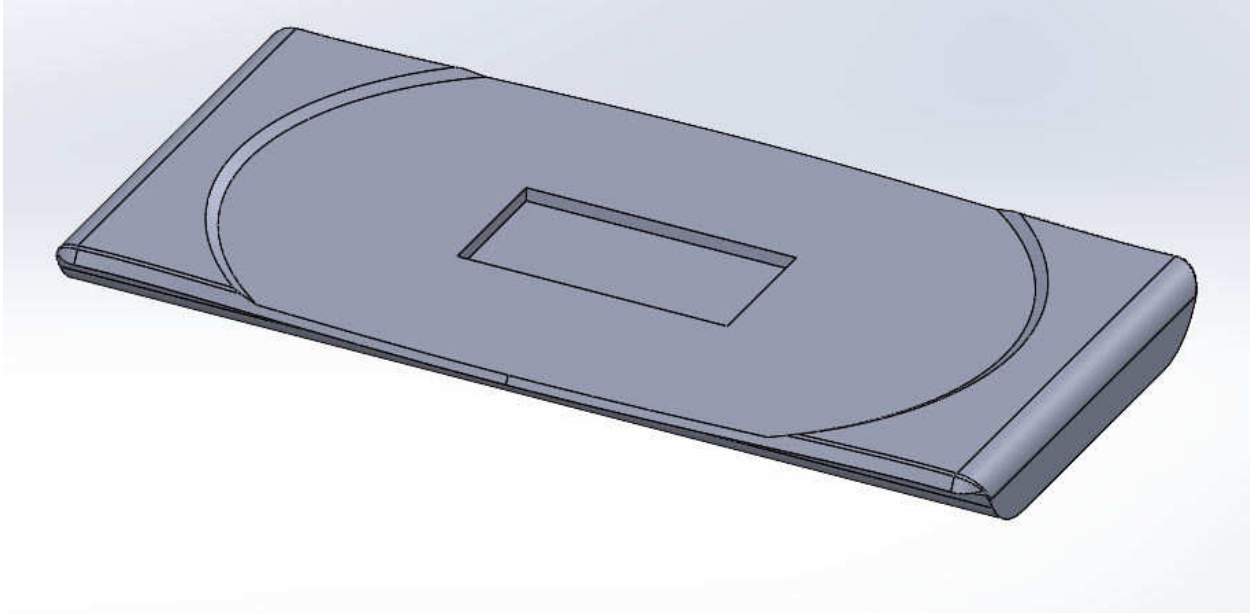
- a) Product mostly is in the form of Linear and box.
- b) Style is modern yet minimalist.
- c) The balance is symmetrical in most cases.
- d) Sustainability must be mixed with construction.

Appendix E CAD Development









Appendix F Physical Model Photograph

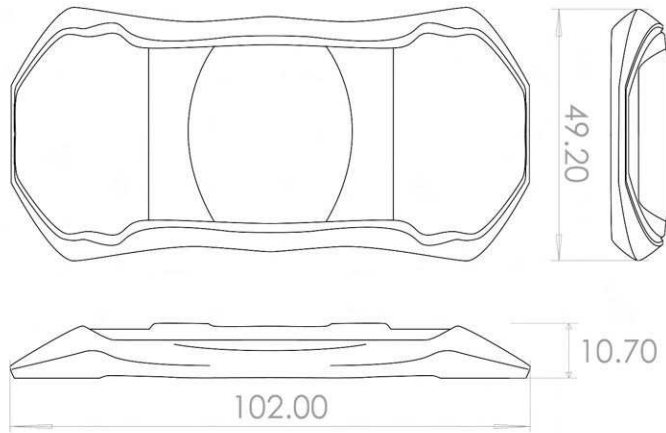




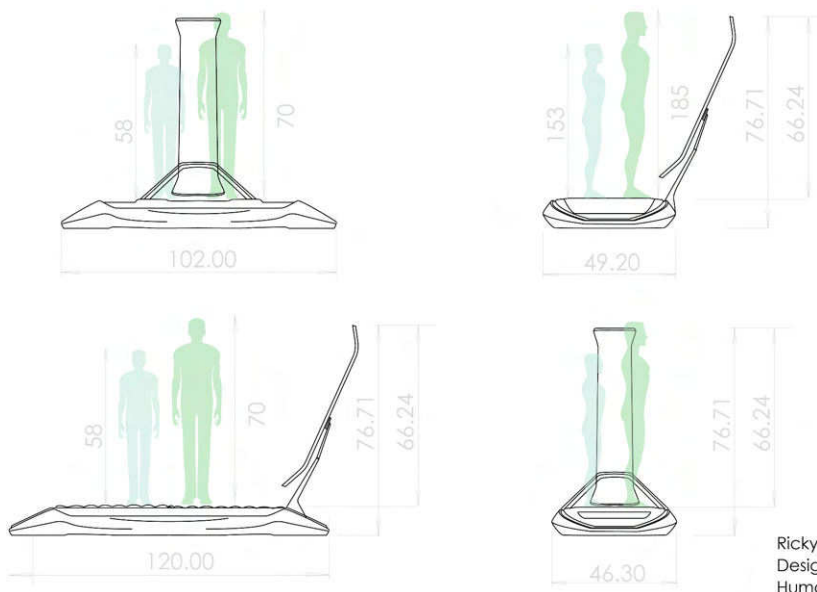




G Technical Drawings



Ricky Saluja
Design Fabrication
Runner platform
Scale- 1:12



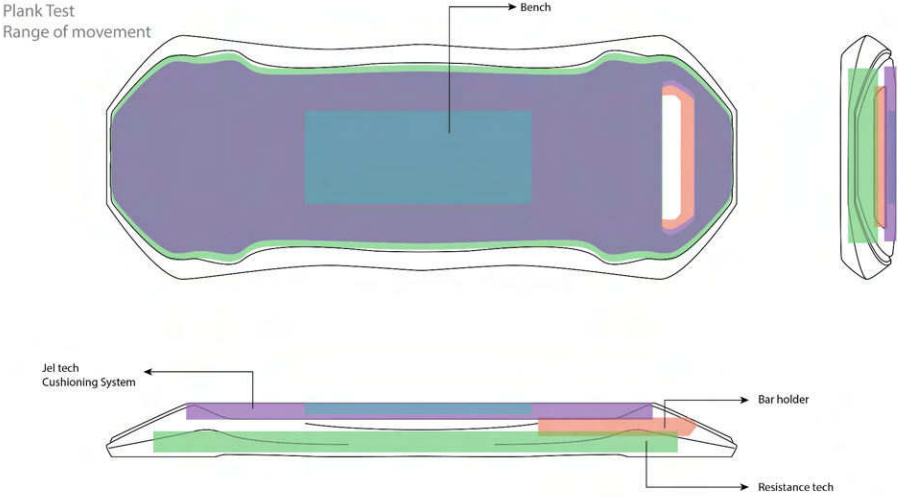
Ricky Saluja
Design Fabrication
Human Reference
Scale- 1:22

4.6 Design Resolution

Tests Covered

- Bench Press
- Squat Test
- Push Up Test
- Jump Test

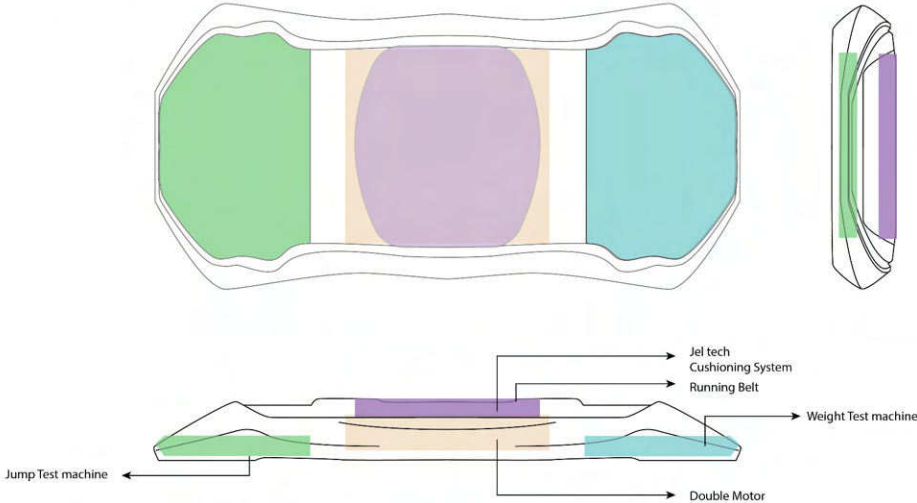
Plank Test
Range of movement



Ricky Saluja
Workout station
Design schematic

Tests Covered

- V02 Max Test
- Speed test
- Bleep test/ yo-yo test
- T-test



Ricky Saluja
Running Platform
Design schematic

Appendix H Bill of Materials Info/Data

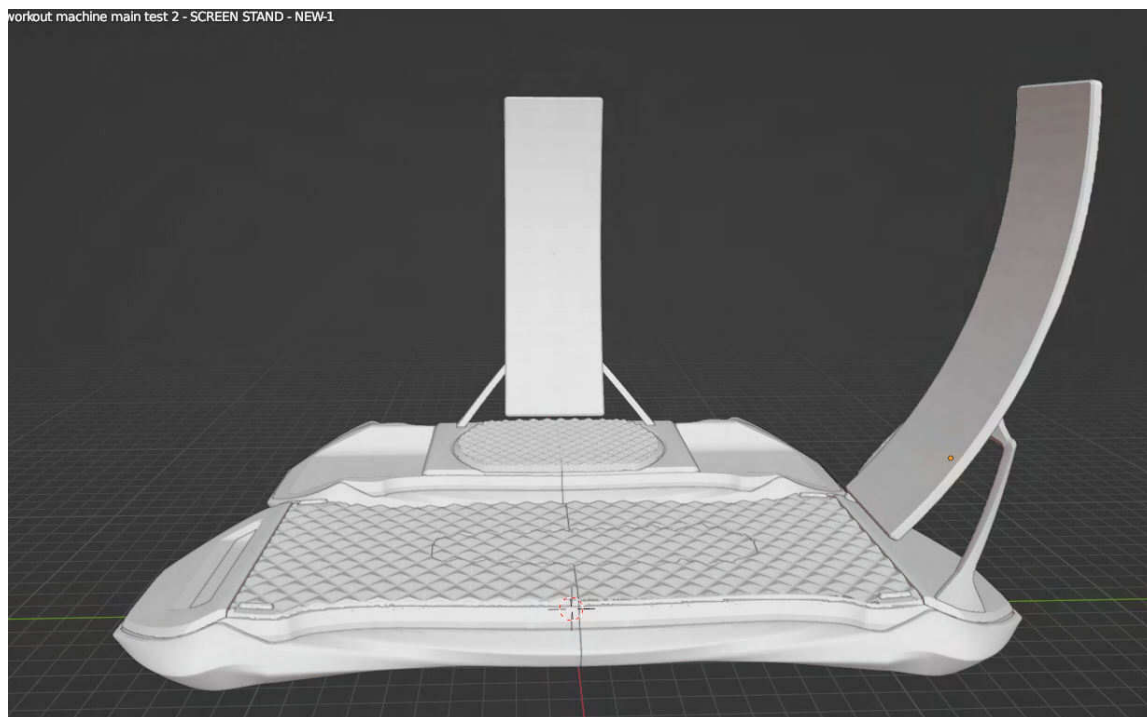
| | A | B | C | D |
|----|----------|-----------------------|-----------------|------|
| 1 | ITEM NO. | DESCRIPTION | MAIN MACHINE | QTY. |
| 2 | 1 | Jel tech Bed 1 | Workout machine | 1 |
| 3 | 2 | Jel tech bed 2 | Workout machine | 1 |
| 4 | 3 | Bench top | Workout machine | 1 |
| 5 | 4 | indication light | Workout machine | 4 |
| 6 | 5 | bench light | Workout machine | 4 |
| 7 | 6 | fabric for bench | Workout machine | 2 |
| 8 | 7 | matt leather for top | Workout machine | 2 |
| 9 | 8 | Aluminium sidebody | Workout machine | 4 |
| 10 | 9 | dark steel side | Workout machine | 2 |
| 11 | 10 | weight bar | Workout machine | 3 |
| 12 | 11 | inside base | Workout machine | 2 |
| 13 | 12 | upper base | Workout machine | 2 |
| 14 | 13 | inside bracket | Workout machine | 4 |
| 15 | 14 | top metal wire holder | Workout machine | 4 |
| 16 | 15 | inside body wire | Workout machine | 4 |
| 17 | 16 | casted stand | Workout machine | 1 |
| 18 | 17 | screen back | Workout machine | 1 |
| 19 | 18 | glass screen | Workout machine | 1 |
| 20 | 19 | Aluminium sidebody | Runner machine | 4 |
| 21 | 20 | dark steel side | Runner machine | 4 |
| 22 | 21 | Jel tech Bed 1 | Runner machine | 2 |
| 23 | 22 | wire padding | Runner machine | 8 |
| 24 | 23 | inside base | Runner machine | 2 |
| 25 | 24 | upper base | Runner machine | 2 |
| 26 | 25 | inside bracket | Runner machine | 4 |
| 27 | 26 | top metal wire holder | Runner machine | 4 |

| | | | | |
|----|----|---|--------------------------------|-----|
| 25 | 24 | upper base | Runner machine | 2 |
| 26 | 25 | inside bracket | Runner machine | 4 |
| 27 | 26 | top metal wire holder | Runner machine | 4 |
| 28 | 27 | inside body wire | Runner machine | 4 |
| 29 | 28 | casted stand | Runner machine | 1 |
| 30 | 29 | screen back | Runner machine | 1 |
| 31 | 30 | glass screen | Runner machine | 1 |
| 32 | 31 | Treadmill pad | Runner machine | 1 |
| 33 | 32 | metal rod | Runner machine | 1 |
| 34 | 33 | 4" metal wire | Runner machine | 12 |
| 35 | 34 | 5/16" Body screw | Runner machine | 1 |
| 36 | 35 | Motor 1 | Runner machine | 1 |
| 37 | 36 | Battery storage | Runner machine | 2 |
| 38 | 37 | Cap piece | Runner machine | 12 |
| 39 | 38 | base cover | Runner machine | 4 |
| 40 | 39 | 316 Stainless Steel Ultra-Low-Profile Socket Head Black-Oxide Alloy Steel | Both total | 28 |
| 41 | 40 | Socket | Both total | 36 |
| 42 | 41 | Head Screw | Both total | 62 |
| 43 | 42 | black-Oxide Alloy Steel Socket | Both total | 104 |
| 44 | | Captive Pins | total parts including hardware | 344 |

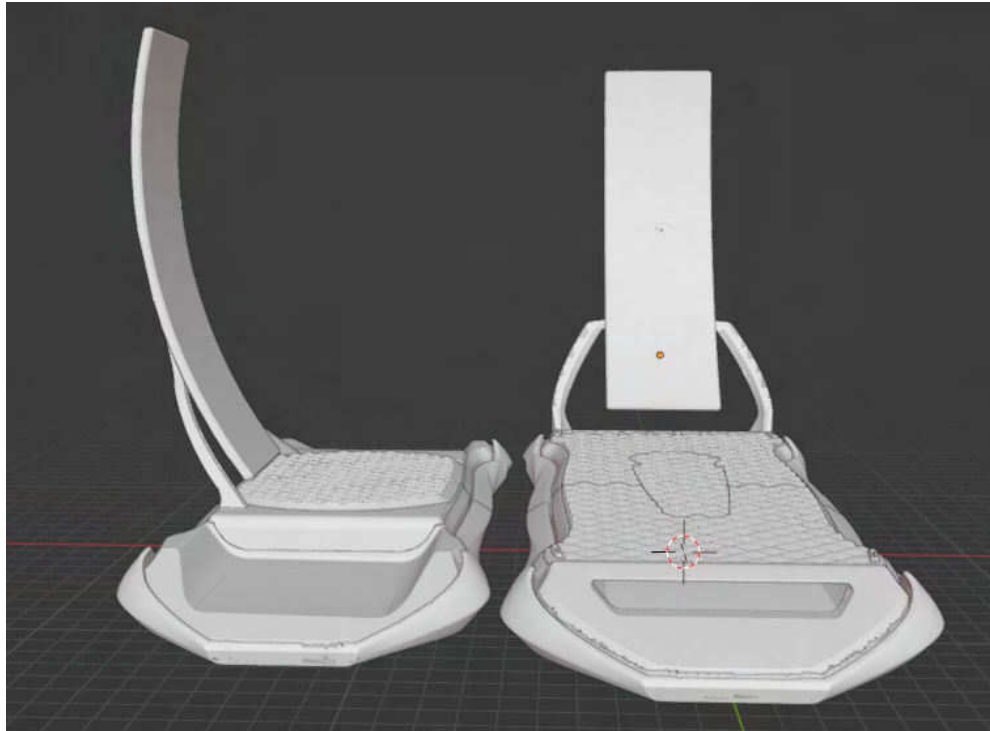
Appendix I Sustainability Info/Data

Reducing Footprint Size:

Studies have shown that reducing the footprint size of fitness test machines is an effective way to expedite the testing process which currently takes a long time and different test zones and while keeping the effort to minimize their environmental impact. For instance, a study by Green et al. (2019) found that reducing the footprint size of fitness test equipment can significantly reduce the amount of resources required to manufacture, transport, and operate the equipment. This reduction in resources, in turn, reduces the carbon footprint of the machine (Figure-A&B). Same policy is supposed to be followed in the development of the workout and running machine.



(Fig-A)



(Fig-B)

Sustainable Materials:

The use of sustainable materials in the manufacturing of fitness test machines is another important aspect of reducing their carbon footprint. Research has shown that using environmentally friendly materials, such as recycled plastics, biodegradable materials, and renewable sources of energy, can significantly reduce the environmental impact of the production process (Smith, 2021). The materials chosen to manufacture both sets of machines will represent the idea behind sustainability.





Conclusion:

In conclusion, the development of sustainable fitness test machines for soccer athletes is a crucial step in promoting environmentally responsible practices and reducing the carbon footprint of fitness testing equipment. Efforts to reduce the footprint size and use sustainable materials in the

manufacturing process can have a significant impact on the environment and contribute to a more sustainable future. Further research is needed to explore the effectiveness of these efforts and to identify additional ways to make fitness test machines more environmentally friendly.

Materials:

Here is the graph representing the material studies for the workout machine the designer is building for the thesis. According to this graph, the material consideration comes from the following four areas or parts such as bench, outer body, inside body and the fabric.

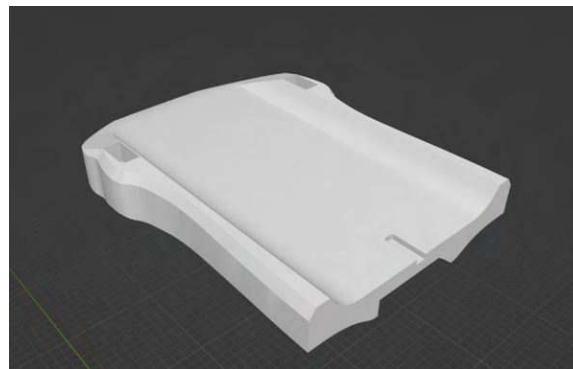
| Company name | Tonal | Paletton bench | Mirror | Oxe fit |
|--------------------------|---|--|--|---|
| Image |  |  |  |  |
| Material for bench | synthetic rubber | athletic PVC Vinyl | No bench listed for mirror | polyether based Polyurethane foam |
| Material for Outer Body | Carbon steel frame | Mineral silver coated aluminum | Lean steel | Composite alloy, matt black coated |
| Material for inside body | Black carbon steel | Composite steel and aluminum covers | Matt silver coated steel and mix of magnesium | Hollow body, uses steel and polyurethane on the bar |
| Material for fabric | recycled post-consumer polyester | Brand new polyester | No fabric used int he machine itself | Rubber with gel foam inside |

In the development of sustainable fitness test machines for soccer athletes, the following materials will be used based on the competition and benchmarked graph used above.

Recycled plastics pallets : Recycled plastic pallets (figure-1) is a very responsible choice for development of the inside base underneath the gel tech fabric due to their low cost, durability, and environmentally friendly nature. By using 100% recycled plastics in the inside part shown in figure 2, it will reduce the environmental impact of the production process while still not compromising the beauty of the machine.



(Fig-1)

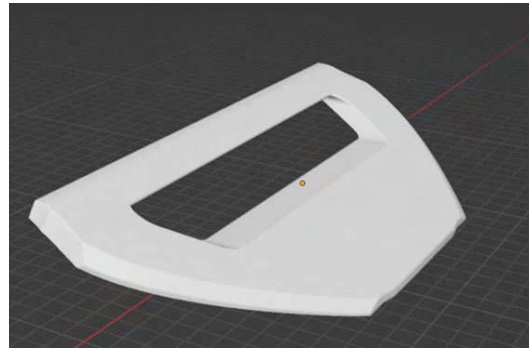


(Fig-2)

Post consumer materials: Biodegradable fiber (figure-3), such as biodegradable plastics and natural fibers, are becoming increasingly popular. By using it in the development of the side body (figure-4) where weight bars are stored will make the sustainability rating higher due to their environmentally friendly nature and ability to break down over time, it will have a greater impact in the longer run contributing to a more sustainable future.



(Fig-3)



(Fig-4)

Composite alloy- composite alloy (Figure- 5) is primarily the most sustainable choice taken from the competition products as it can be reused at a higher frequency more often than other steel. Matt silver coating with magnesium mixed in makes it an easy removable and clean source of materials to be used for outside composition (figure-6) of the workout machine.



(Fig-5)

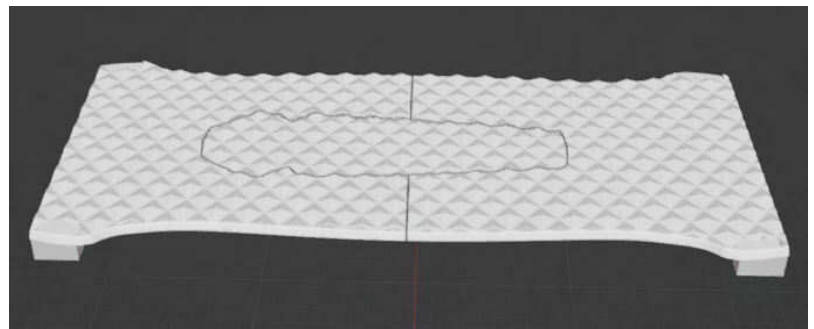


(Fig-6)

Athletic pvc vinyl- this athletic PVC Vinyl (fig-7) is a High Endurance material that is manufactured for gyms and workout equipment. This durable Athletic Vinyl is reinforced to withstand aggressive daily use and is built for rough and tough play. This will be used on top of gel tech material (Fig-8) where the player will perform major tests. It is highly sustainable and strong for the purpose of workout.



(Fig- 7)



(Fig-8)

Manufacturing Methods:

The following manufacturing methods will be used in the development of sustainable fitness test machines for soccer athletes:

Lean manufacturing: by using lean manufacturing methods, which focus on reducing waste and maximizing efficiency in the production process, it can create a big impact on resources. By

using lean methods, these companies are able to minimize the environmental impact of their fitness test machines and improve their sustainability. There are five principles to lean manufacturing (Figure- 9) which the peloton follows and the designer intends to follow while developing the workout machine.



(Fig-9)






Environmentally friendly production processes: by the use of environmentally friendly production processes, such as water-based printing and solvent-free adhesives, it will help to reduce the environmental impact of their fitness test machines.

Renewable sources of energy: Manufacturing companies are beginning to use renewable sources of energy, such as solar and wind power, to reduce the energy used during manufacturing of parts. By using the clean powered energy produced entirely by solar energy, reducing the dependence on non-renewable sources of energy will have a huge impact on the environment.

Benchmarking

The purpose of this benchmarking report is to provide an overview of the materials and manufacturing methods used in the development of sustainable fitness test machines for soccer athletes and to compare these methods with those used by leading companies in the industry. The report aims to identify best practices and opportunities for improvement in the sustainability of fitness test machines.

The following graph represents the rating designer has given based on comparison between their manufacturing methods and materials the other companies have used and how they have influenced the design strategy for the development of soccer fitness machine.

| Sustainability Rating done based on their methods and material | Bowflex velocore bike | Bowflex treadmill 22 | Skillrun live 7000 | Polar Unite Heart Rate Monitors | TATSports Apex Athlete Series GPS Performance Tracker |
|--|---|---|---|---|---|
| |  |  |  |  |  |
| | | | Rating out of 10 | | |
| Visible material | 6 | 6 | 7 | 8 | 9 |
| Inside Material | 8 | 7 | 8 | 10 | 10 |
| Recyclability | 7 | 6 | 6 | 5 | 10 |
| Manufacturing process | 5 | 5 | 5 | 8 | 7 |

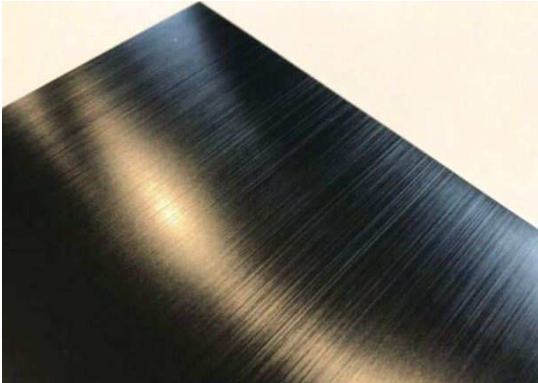
Listing below the materials for specific parts of the machines:

Recycled Rubber (Xderm) (figure 10)- used as the soft material which goes on top of gel structure to give the user comfort and no slip workout zone. This material is benchmarked from the peloton sitting platform.

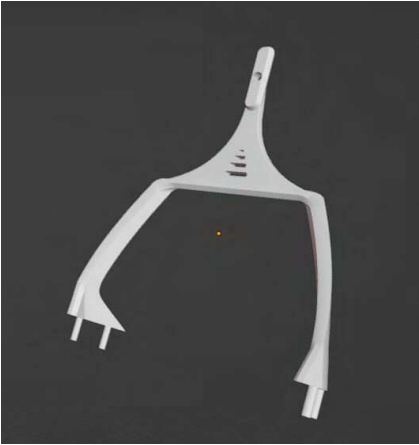


(Fig- 10)

Dark Aluminum (figure-11)- this material is used in the screen stand (figure-12) to hold a heavy screen while still being lightweight. This material is bench marked from the mirror.



(Fig-11)

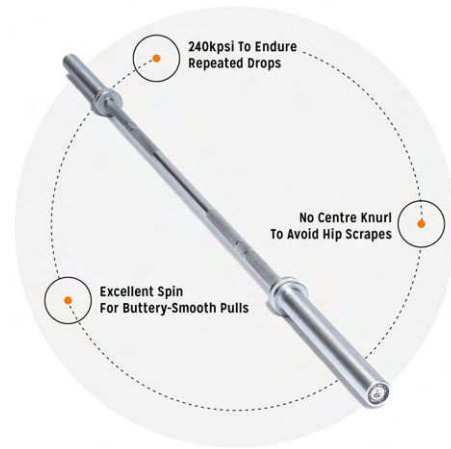


(Fig-12)

Recycled stainless steel (Figure-13)- this material is used in machinery of the parts and the lifting tube (Figure-14) along with the wire coming from the resistance machine.



(Fig-13)

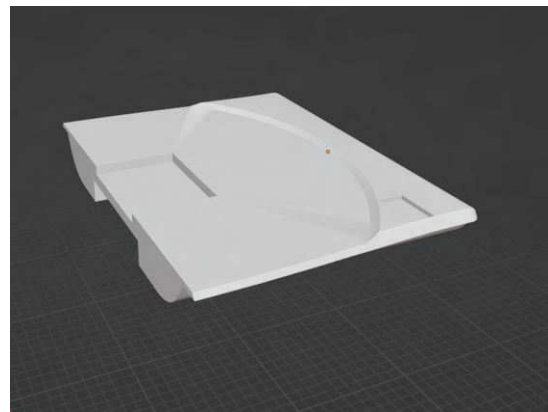


(Fig-14)

Recycled plastic pallets- this material is used to make the outer body cap as a highly exposed part. The part will be injection molded and put together as a hinge mechanism.



(Fig-15)



(Fig-16)

The development of sustainable fitness test machines for soccer athletes is a complex process that involves the use of environmentally friendly materials and production methods. Companies such as The mirror, paleton, LeanFit, and others are leading the way in the development of

sustainable fitness machines and setting a positive example for others in the industry. Further research is needed to identify additional opportunities for improvement in the sustainability of fitness test machines and to promote best practices in the industry.

Sustainability Statement

The findings of this sustainability report have had a significant impact on the design of the machine. The use of sustainable materials and environmentally responsible production methods ensures that the machine not only meets the needs of soccer athletes but also contributes to a greener future. The implementation of these sustainability aspects into the design of the machine reflects the commitment to promote sustainability and reduce its environmental impact.

In summary, the final design of the soccer athlete fitness test machine includes the following sustainability aspects:

- Use of recycled and biodegradable materials
- Implementation of lean manufacturing processes
- Utilization of renewable energy sources
- Promoting environmentally responsible practices in the production process.

Appendix J Approval Forms & Plans

IDSN 4502
SENIOR LEVEL THESIS TWO

Humber ITAL / Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / WINTER 2023
Catherine Chong / Fredric Matovu

CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION

| | |
|-------------------------------|-------------------------------------|
| Student Name: | Ricky Saluja |
| Approved Thesis Title: | Improving Soccer Fitness Evaluation |

THESIS PROJECT – DESIGN APPROVAL FORM

| | |
|---|--|
| Design is reviewed and approved to proceed for the following: | <input checked="" type="checkbox"/> CAD Design and Development Phase |
| <p>Comment: Continue design refinement in CAD development, need to iron out detailing and product's features, pay attention to surfacing, components, and assembly methods for design feasibility. Viable holistic design thinking in conjunction with considerations into sustainability aspects. CAD development must be at least 75% complete for review before approval for fabrication.</p> | |

| | |
|---|--|
| Design is reviewed and approved to proceed for the following: | <input checked="" type="checkbox"/> Model Fabrication Including Rapid Prototyping / 3D Printing and Model Building Phase |
| <p>Comment: Waiting for CAD development review (as of Feb-21). Very good CAD progress, design completed, continue detail refinement, especially UI, once refined, fabrication of model can begin.</p> | |

| | |
|---|---------------|
| Instructor Signature(s): | |
|  | |
| Date: | 07 March 2023 |

PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE 2022



Certificate of Completion

This document certifies that

Ricky Saluja

successfully completed the Course on Research Ethics based on the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE 2022)

Certificate # 0000853500 **20 September, 2022**



K Advisor Meetings & Agreement Forms

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO



INFORMATION LETTER

Research Study Topic: How may we improve the performance evaluation process for soccer athletes?
Investigator: Ricky Saluja/ Rickysaluja60@gmail.com/ 4Topbank drive, Etobicoke, Canada
Sponsor: Humber ITAL, Faculty of Applied Sciences & Technology (IDSN 4002 & IDSN 4502)

Introduction

My name is Ricky Saluja, I am an industrial design student at Humber ITAL, and I am inviting your participation in a research study on various problems that include complex performance evaluation process for soccer athlete's and how the process of football medical works. The problems physiotherapists deal with while assessing the players; the trainers and coaches face problem with lack of knowledge about the player fitness level to design a training program efficiently. The results will be contributed to my Senior Level Thesis project.

Purpose of the Study

This study is being conducted as an aid in designing a Product which will help players to have a better understanding of their fitness level in terms of soccer, and can use the data to improve their training; Coaches and trainers will be able to create better game plans, and clubs will know whether they should invest in players. There is a need to simplify the procedure, allow physiologists and cardiologists to analyze the data more easily, and provide coaches and trainers with a report on the player's weak points and improve them. This study is primarily based on understanding ergonomics, human interaction design activities, and user experience aspects of the research area.

Procedures

Participation in this study will involve observation and documentation of your interactions with a machine, device, or equipment. During the interviews, you will also be asked questions about the machine / device / equipment you use and how you use it. As part of this thesis study, you will be asked to provide feedback on the ideas and solutions that have been derived.

Confidentiality

Every effort will be made to ensure confidentiality of any identifying information that is obtained during the study. In the case of being recorded visually, your face will be masked /blurred or hidden. The information and documentations (photographs) gathered are all subject to being used in the final presentation of the study.

Participation and Withdrawal

Your participation in this study is completely voluntary and you may interrupt or end the study and the session at any time without giving a reason or fear of being penalized.

If at any point during the session, you feel uncomfortable and wish to end your participation, please let the moderator know and they will end your participation immediately.

Humber Research Ethics Board

This research project /course has been approved by the Humber Research Ethics Board. If you have any questions about your rights as a research participant, please contact Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, Lydia.Boyko@humber.ca



HUMBER

Faculty of Applied Sciences & Technology

Bachelor of Industrial Design / FALL 2022 & WINTER 2023

IDSN 4002 /4502

SENIOR LEVEL THESIS ONE & THESIS TWO

INFORMATION LETTER

Conditions of Participation

- ✓ I understand that I am free to withdraw from the study at any time without any consequences.
- ✓ I understand that my participation in this study is confidential. (i.e. the researcher will know but will not disclose my identity)
- ✓ My identity will be masked.
- ✓ I understand that the data from this study may be published.

I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.

GARASH BATRA
Participant's Name

Aakash Batra
Participant's Signature

10/16/2022
Date

Project Information

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: +1 6475720877

Email: Rickysaluja60@gmail.com

My supervisor is:

Prof. Catherine Chong, catherine.chong@humber.ca

PARTICIPANT INFORMED CONSENT FORM

Research Study Topic: How may we improve the performance evaluation process for soccer athletes?
Investigator: Ricky Saluja/ Rickysaluja60@gmail.com/ 4Topbank drive, Etobicoke, Canada
Courses: IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

I, Aakash Batra, have carefully read the Information Letter for the project Reimagining Performance evaluation process for soccer athlete's, led by Ricky Saluja. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact Ricky Saluja at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

Consent for Publication: Add a (X) mark in one of the columns for each activity

| ACTIVITY | | YES | NO |
|-------------|--|-------------------------------------|--------------------------|
| Publication | I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Review | I give consent for review by the Professor | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Privacy

All data gathered is stored anonymously and kept confidential. Only the principle investigator /researcher, Ricky Saluja and Prof. Catherine Chong or Prof. Frederick Matovu may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, Lydia.Boyko@humber.ca or Ricky Saluja/ Rickysaluja60@gmail.com/ +1 6475720877.

Verification of having read the Informed Consent Form:

I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

AAKASH RATRA
Participant's Name

Aakash Batra
Participant's Signature

10/16/2022
Date

L Other Supportive Raw Data

Base on the scaled Problem Definitions (PD) for the top 3 topics, rank 1, 2, 3:

| Item | Detailed Metric | Scale 1 = Poor 10 = Excellent | | |
|----------------------------------|---|------------------------------------|------------|------------|
| | | PD 1 | PD 2 | PD 3 |
| 1 | Originality and uniqueness of subject | 8 | 9 | 9 |
| 2 | Clarity of the problem definition and your intent | 7 | 7 | 9 |
| 3 | Does it afford full-bodied human - interaction study | 10 | 7 | 8 |
| 4 | Does it afford full-bodied ergonomic and human factors study | 10 | 8 | 8 |
| 5 | Easily identifiable target market | 9 | 9 | 7 |
| 6 | Abundant and accessible resources/sponsors | 9 | 9 | 7 |
| 7 | Specific enough for in-depth study | 7 | 9 | 7 |
| 8 | Feasibility for completion | 9 | 10 | 7 |
| 9 | Does it afford a sustainability aspect? | 7 | 6 | 6 |
| 10 | Availability of good written research resources | 8 | 8 | 7 |
| 11 | Possibilities for a complex industrial design solution | 10 | 10 | 10 |
| 12 | Probability of it being published | 8 | 9 | 8 |
| 13 | Ability to measure the improvement made to the product/category (evidence-based design study) | 9 | 9 | 8 |
| Total for Each PD (/130) | | 111 | 110 | 101 |

a. **Research Question-** How may we improve Football Athlete's Performance Evaluation?

b. **Category-** Sports and Recreation

Project Title: Reimagining Athlete's Performance Evaluation Process

c. **Briefly explain what you know about this topic:**

There is no doubt that football is the most watched game in the whole world, and that brings big players and clubs fame and money. Every time a player is exchanged, purchased, or retained, a performance evaluation is carried out to predict his future performance. This process is very important for players to find out where they are weak, for coaches to know where they should focus when training, and for the clubs that invest a great deal of money in each player to have an understanding of what they need to do.

d. **Why did you choose this topic as one of the top three?**

Evaluation plays a very important role in large sports clubs where major money is spent on purchasing new players, and the buyers are very careful to ensure all players go through a complete fitness evaluation to make sure they are fit enough to play.

Currently, many different steps are completed on different machines and people take manual notes in addition, which is often not accurate. There is a need that can be solved to help managers/coaches/buyers have accurate data about each of the players they are choosing to invest in.

e. **WHAT is the problem definition that is being addressed?**

What is measured can be improved! The Performance Readiness Evaluation (PRE) is a complete, bio-mechanical strength, flexibility and movement analysis to isolate an athlete's structural compensations, muscular imbalances, athletic movement restrictions and injury risk factors.

Getting the real results out of the athlete takes a long time without being precise or efficient. In order to get the athlete's evaluation done, several different processes need to be followed. I want to simplify those processes and provide the players, coaches, and clubs with accurate and timely results.

WHY is this problem area important, from a micro - macro level?

It has become the world's most watched sport, which attracts billions of spectators to enjoy and have fun in this busy world. Clubs, coaches, and players are under huge pressure to perform above average in order to satisfy their fans, which is exactly where I aim to help clubs, coaches, and players to achieve their goals faster and with accurate performance results that will enable them to make better decisions.

HOW does this problem definition meet the thesis criteria?

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M Topic Specific Data

| Item | Detailed Metric | Scale 1 – Poor | | | | | | | 10 – Excellent | | |
|----------------------|--|----------------|---|---|---|---|---|---|----------------|---|-------|
| | | PD 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | PD 10 |
| 1 | Originality and uniqueness of subject | | | | | | | | 8 | | |
| 2 | Clarity of the problem definition and your intent | | | | | | | 7 | | | |
| 3 | Does it afford full-bodied human - interaction study | | | | | | | | | | 10 |
| 4 | Does it afford full-bodied ergonomic and human factors study | | | | | | | | | | 10 |
| 5 | Easily identifiable target market | | | | | | | | 9 | | |
| 6 | Abundant and accessible resources/sponsors | | | | | | | | 9 | | |
| 7 | Specific enough for in-depth study | | | | | | | 7 | | | |
| 8 | Feasibility for completion | | | | | | | | 9 | | |
| 9 | Does it afford a sustainability aspect? | | | | | | | 7 | | | |
| 10 | Availability of good written research resources | | | | | | | | 8 | | |
| 11 | Possibilities for a complex industrial design solution | | | | | | | | | | 10 |
| 12 | Probability of it being published | | | | | | | | 8 | | |
| 13 | Ability to measure the improvement made to the product/category (evidence-based design study) | | | | | | | | 9 | | |
| 14 | Proposal facilitates the opportunity of a tangible industrial design solution that meets the thesis criteria | | | | | | | | | | 10 |
| TOTAL (/140) | | | | | | | | | 121 | | |

