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Introduction to Product Development and Management for Engineers and Computer Scientist

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Deliverable B

Needs, Problem Statement, Metrics, Benchmarking and Target Specifications

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Introduction and Expressed Client Needs

The team had their first meeting with the client in which we discussed with the client what were their expectations and specifications concerning the product. They enlisted their expressed needs as well as what the product was expected to do for the client. In this document we will summarize the client needs derived from their statements, and present a list of metrics to measure the performance of our device in satisfying the client's requirements, in comparison with some other devices found on the market.

According to the meeting, here are the observations and client statements obtained:

1. **Measuring Performance**
   - The client does not have any preference in the way the product has to measure the athlete's performance.
   - She was more inclined in having the product attached to some sort of equipment rather than on the athlete themselves.
   - The testing should be done for at most three times a season; any more data points would yield useless and would not aid in the analysis.
   - To test the product, the client does not have a preference on *who* the product is tested on, but she mentions that the testing must be done within the range of normal pro athlete testing.
   - She requires that a lot of testing is conducted so that the performance measured is able to be compared not only amongst athletes of the same team, but also overtime for the same athlete. The product therefore has to be adaptable for various testing.

2. **Data Output**
   - The previous outputs were done under the Arduino platform. She believes that this is the most optimal platform and suggests using a Arduino chip that instills Bluetooth technology which will guarantee that the product will not interfere with the athlete's performance.
   - She prefers that the data is outputted to the athletes and coaches in some sort of user-friendly way, such that the raw data is converted to data commonly understandable by the user.

3. **Accessibility**
   - A website or user interface platform can be put into work to ensure that athlete's data about their performance is readily accessible, such that they can easily compare their data amongst themselves.
   - The client is keen to make the product accessible to disabled athletes of the same sport.

4. **Product Requirements**
   - The client has no requirement with the material used for the product. She suggests making the product sustainable and environmentally friendly.
   - The client wants us to respect the budget instilled for the project.

Converting Client Statements to User Needs

Table 1. Converting Client Statements into User Needs

Client Statements	User Needs
The client does not have any preference in the way the product has to measure the athlete's performance.	The product detects and collects measurable data related to sports performance
She was more inclined in having the product attached to some sort of equipment rather than on the athlete themselves. She suggests using an Arduino chip that instills Bluetooth technology which will guarantee that the product will not interfere with the athlete's performance.	The product has no effect on the user's ability to perform.
To test the product, the client does not have a preference on *who* the product is	The product is accustomed to a big range of values that it can take into account.

tested on, but she mentions that the testing must be done within the range of normal pro athlete testing.	
She requires that a lot of testing is conducted so that the performance measured is able to be compared not only amongst athletes of the same team, but also overtime for the same athlete.	The product is adaptable for various testing.
She prefers that the data is outputted to the athletes and coaches in some sort of user-friendly way, such that the raw data is converted to data commonly understandable by the user.	The product outputs sufficient data in an accessible way.
A website or user interface platform can be put into work to ensure that athlete's data about their performance is readily accessible, such that they can easily compare their data amongst themselves.	The product data is centralized.
The client is keen to make the product accessible to disabled athletes of the same sport.	The product is accessible to disabled athletes.
She suggests making the product sustainable and environmentally friendly.	The product's materials are sustainable.
The client wants us to respect the budget instilled for the project.	The product is cost efficient.

Listing and Prioritizing User Needs

Please note that this is a ranking system of 1-5, 1 being the least of priority while 5 being of utmost priority.

Table 2. Ranking Justification

#	Priority	User needs	Justification for Ranking
1	5	The product detects and collects measurable data related to sports performance.	This is the ultimate goal of the creation of the product which will ultimately lead to the satisfaction of the client.
2	1	The product's materials are sustainable.	The client did not show any preference with the materials of the product.
3	3	The product categorizes data depending on the type of sport techniques.	Though it would be an incredible asset for the product, it would only be added if and only if we can properly respond to higher client needs (e.g., Output the data for the users in an understandable way).
4	5	The product has no effect on the user's ability to perform.	By hindering the ability for the athlete to perform, results received from the product would instantly be falsified as the athlete would not be performing to the best of their ability.
5	4	The product measures several athletes in a time-efficient manner.	Since we do not know how many athletes will be using our product at the same time, it is important to take that variable into account and ensure that

			the product can store the data of each athlete without any data-overload or buffering.
6	4	The product outputs sufficient data in an accessible way.	The accessibility of the output of the data is important as it will ensure that our users/client can ultimately understand what they are seeing (i.e., no confusion or queries; data output is straight to the point)
7	4	The product is cost efficient.	Since we have a budget, it is quite important that we realize this cost constraint and that we do not create solutions that are not feasible around that budget.
8	4	The product saves data long term to compare in the future.	One of our client's biggest desires is for athletes to be able to compare their own data at least three times over the season (start, mid, end) to essentially be able to see their progress over time.
9	2	The product is accessible to disabled athletes.	Our client was indifferent if we were to make the product accessible or not to disabled athletes.
10	5	The product covers an athlete's performance range.	The target users are professional players so the product needs to measure performances on that level.
11	3	The product data is centralized.	Although it can become an asset, as it will allow athletes from the same team

			to compare each other's statistics, the main focus is to be able to output the data of each athlete separately.
12	5	The product is lightweight, portable, durable and waterproof.	This ensures that the product does not hinder the athlete's ability to perform as it won't be in the way. Furthermore, regardless of the strength/performance of the athlete, the product will not break and subsequently falsify data.

Problem Statement

Athletes and coaches are looking for a portable, durable and waterproof product that effectively measures their performance and outputs it via a user-friendly platform that allows constant comparison of statistics amongst themselves and their team.

Metrics

Table 3. Metrics

Metric #	Needs #	Metric	Priority	Unit	Type
1	1,5,10	Maximum and minimum speed measurable	5	m/s	F
2	1,5,10	Maximum and minimum impact force measurable	5	N	F
3	1,5,10	Maximum distance recordable	3	m	NF
4	1,10	Record trajectory	3	Binary	NF
5	2,12	Choice of materials	2	list	NF
6	3,8,11	Maximum data storage	4	GB	F

7	3	Data sorting	3	Categories	NF
8	4,9,12	Maximum weight	5	g	F,C
9	4,9,12	Maximum size of device	5	cm3	F,C
10	5	Set up time	4	s	C
11	6	Output data as graphs	4	Binary	NF
12	7	Maximum cost	4	CAD	C
13	8	Adaptability to parasports	2	Binary	NF
14	12	Minimum life expectancy	5	Years	C
15	12	Waterproofness	5	m	F
16	11	Centralization of the data	3	Binary	NF

*F: Functional

*NF: Non-functional

*C: Constraint

Benchmarking

There are a few devices currently available in the market, but they have their limitations as to what they measure. Below are descriptions of products that measure athlete stats.

Watch Tracker: Generally monitors running and wellness statistics such as distance covered, heart rates, and more. A FitBit is one of the most popular products in the market for watch trackers.

Figure 1: https://images.app.goo.gl/cFvBTv1aUzP64fow9

Playermaker: A 6-axis motion smart sensor is inserted into 2 silicone straps that can be put over cleats and it is used to track soccer specific metrics. It can also be used to track your progress over time by comparing and benchmarking with oneself, friends, teammates, and elite players using their app.
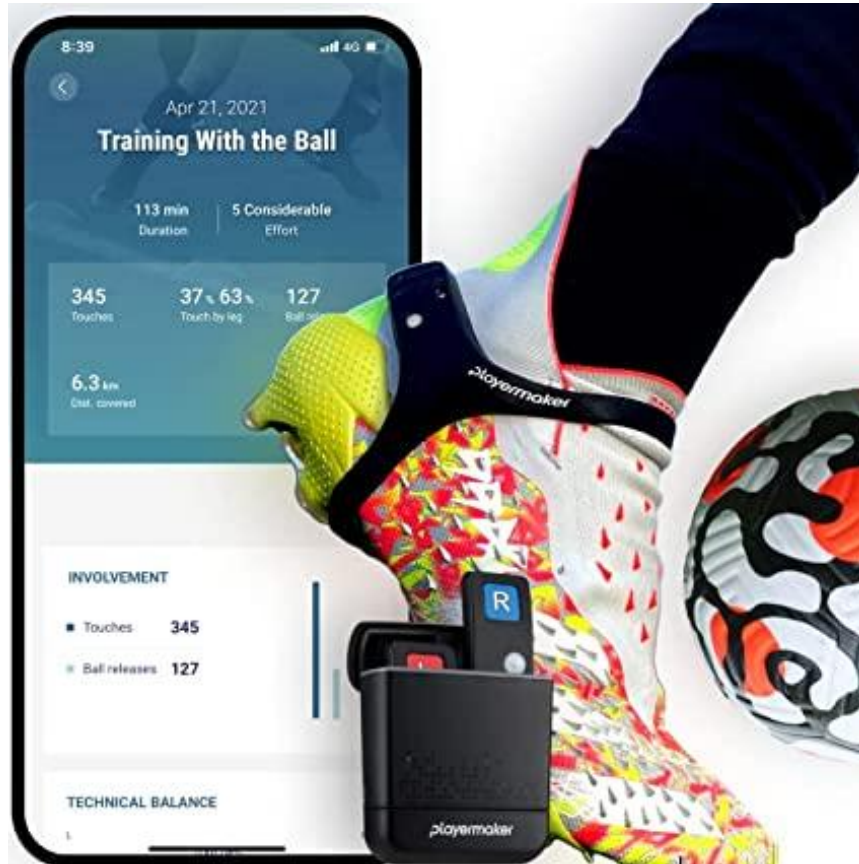
Figure 2: https://images.app.goo.gl/1AQR1NKZqrRgG79o8

GPS Performance Tracker: It is a vest with a GPS tracker attached to track overall running performance. It tracks metrics such as total distance, maximum speeds, intensity and strain levels, and more. One of the most popular products in this market is the STATSport GPS Tracker.
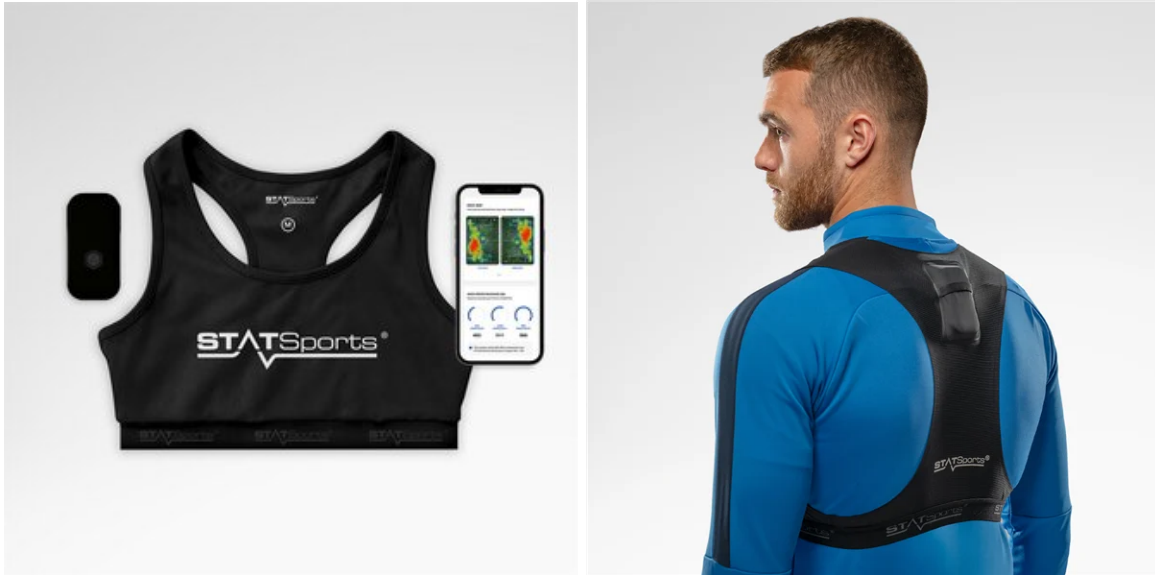
Figure 3.a   3.b

(a) Link: https://images.app.goo.gl/bWodynJA7M3VkLDA8
(b) Link: https://images.app.goo.gl/ziihkShEmqxe6MKY9

Installed Club Sensors: Sensors are inserted into the top of golf clubs and bottom of tennis rackets to track strokes and evaluate shots on affiliated watch or app. The Garmin Approach CT-10 is the product that offers some of the best results in the market.

Figure 4. https://images.app.goo.gl/dCvubkroaUY47pzk9

The table below compares and contrasts metrics with the four products available in the market that track athlete statistics. The information in the table below was retrieved from each product's direct website to ensure accuracy in information. It is color coded where green has the highest point of 3, yellow has 2 points, and red is 1 point. This color system demonstrates which product is most aligned to this project's user needs and metrics.

Table 4. Benchmarking of Watch Trackers, Playmaker, and GPS Performance Tracker with Metrics

Metric #	Metric	Watch Trackers - for running (ex. FitBit)	Playermaker - for soccer	GPS Performance Tracker (ex. STATSports)	Installed Club Sensors (ex. Garmin Approach CT-10)
1	Maximum and minimum speed measurable	Average person range	No limitations	No limitations	No limitations
2	Maximum and minimum impact force measurable	0	Yes, but it is the impact of feet hitting the ground and the soccer ball hitting the foot.	0	No limitations
3	Maximum distance recordable	No limitations	No limitations	No limitations	No limitations
4	Record trajectory	No	No	No	Yes
5	Choice of materials	Flexible, durable elastomer and anodized aluminum.	Silicone.	Recycled 76% polyester, 24% elastane, Mesh 86%	Metal and plastic.

				polyester, 16% elastane. GPS is metal.	
6	Maximum data storage	Can store daily totals for up to 30 days.	N/A. Data storage can grow since it is all stored on the app.	N/A. Data storage can grow since it is all stored on the app.	N/A. Data storage can grow since it is all stored on the app.
7	Data sorting	No	Yes, it is sorted into technical analysis, tactical analysis, physical analysis, gait and load analyses, and video automated tagging.	No	Yes it is sorted into what type of technique is used to hit the ball.
8	Maximum weight	80 g	28.3 g	1100 g	272 g
9	Maximum size of device	Variety of size but generally smaller as it is designed for a human wrist. The wristband can vary between 140mm to 220mm. Screen size: 3.73 x 1.67 x 1.29 cm	Size is meant for the cleat that it is being attached to. The sizing is not suitable for a racket based sport.	Variety of size but vest only covers chest area allowing free range motion for limbs. The adult vests can vary between 21 cm to 122 cm around the chest area.	(1.27 L x 1.27 W x 2.79 D) cm - circle shaped
10	Set up time	It's a one time setup that can be easily done by using their instruction	The setup to sync the product to the app is a one time	The setup to sync the product to the app is a one time	The product is a one time setup. The syncing between the

		manual.	process. Wearing the product is very easy as well.	process. Wearing the product is very easy as well.	app and product is also a one time setup.
11	Output data as graphs	Yes, on the affiliated app.	Yes, on the affiliated app.	Yes, on the affiliated app.	Yes
12	Maximum cost	$330	$149/6 months subscription $239/year subscription $299/24 months subscription	$619	$40/sensor
13	Adaptability to parasports	Yes, Fitbraille app can be installed and it uses vibrations for Braille. Another option is voice assistance.	No	No	No
14	Minimum life expectancy	5 years	1 year warranty	1 year warranty, battery powered.	Battery life of up to 4 years and battery is replaceable.
15	Waterproofness	Water resistant up to 50 meters	Water resistant	Not waterproof, but is weather resistant and can handle general rainfall and sweat.	Water resistant up to 1 m for 30 minutes
16	Centralization of the	Yes, it has an	Yes, it has an	Yes, it has an	Yes, it has an

	data	app.	app.	app.	app.

In general, the fourth product aligns the best for this project as it has the most green metrics, which in other words mean that it is found within our ideal margin of values.

Target Specifications

Since our target sports are tennis/badminton, all marginal values and ideal values are based on the above sports.

Table 5. Target Specifications

Metric #	Metric	Unit	Marginal Value	Ideal Value	Reason for choices
1	Maximum and minimum speed measurable	m/s	0-118.33	0-150	Cover the world's maximum badminton hitting speed to avoid unexpected situations
2	Maximum and minimum impact force measurable	N	>280	300	Simplified estimation done according to the maximum and minimum speed measurable in Metric #1 Conducted through testing (Nagwa)
3	Maximum distance recordable	km	>6.5	8	Average tennis players travel distance (Runners world)
4	Record trajectory	Binary	pass	pass	We want to determine rackets trajectory
5	Choice of materials	list	Metal, plastic, silicone, elastane, polyester, etc.	Aluminum cases/stainless steel cases, rubber	Flexible, durable, comfortable and sustainable materials

6	Maximum data storage	GB	N/A	N/A	Data storage can grow since it is all stored on the app.
7	Data sorting	Catego ries	Technical analysis, tactical analysis, physical analysis, etc.	Through the type of hitting technique	We want to cover most of the available techniques and analyze them in relation to the different types of hitting techniques.
8	Maximum weight	g	<50	25	We want to make the device light and convenient such that it does not hinder the ability of the athlete to perform; it should be a seamless device.
9	Maximum size of device (Screen)	cm3	<9	7.5	We want the product to fit on the racket, so it should not affect the performance of the athletes.
10	Set up time	mins	<10	5	The product should not in any way hinder the basic routine of an athlete; it should not take time for it to be set up.
11	Output data as graphs	Binary	support	support	Charting support makes it easier for athletes/coaches to count or analyze data.
12	Maximum cost	CAD	<50	30	This product must be within the budget approved at the start of the semester.
13	Adaptability to parasports	Binary	Yes	Yes	Although disabled athletes are not the primary clients of our products, our products

					can be accessible to people with disabilities.
14	Minimum life expectancy	Years	>1	3	The battery life is long enough to be used during multiple seasons and the battery is replaceable.
15	Waterproofness	m	1 - 50	1-25	Since it is not used for water sports, it doesn't need that high waterproof effect, but we still want it to have a sweatproof function.
16	Centralization of the data	Binary	support	support	Implementation through application

Reflection

The client meeting provided us with key information on the product we were tasked to create. Despite our client having no preference on the sport or specific measurement of performance for our project, they provided us with valuable information on how they would like the data obtained to be organized. Our client wanted to be able to properly and efficiently test players over a long period of time to see improvement in their fundamental skills. For example, if we were measuring the speed of a baseball bat swing, our client would want to be able to see the player's best and worst swings over a session along with a graph to display the data in a user-friendly manner. The client also wanted this data to be stored in some sort of database/website so players can easily compare their new tests with old ones to detect improvement in their skills. This way, not only can the data of each player be accessible, the players can also compare their own performance statistics with their teammates. One thing that stands out to be somewhat unclear is the level of skill the athletes will have as they use the product to test their performance. However, we have been recommended to use our own skills for the time being as a guideline.

Conclusion

This deliverable allowed us to empathize with the user to truly understand their needs and where their problem roots from. It is one of the most important steps in the Iterative Engineering Design Process as it ensures a proper recognition and understanding of what the problem is. It will allow us to guide ourselves during the next steps of the design process as we gather more information about the client.

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