April 6th, 2021

Dr. Shervin Jannesar
Dr. Andrew Rawicz
Dr. Craig Scratchley
School of Engineering Science
Simon Fraser University
Burnaby, BC, V5A 1S6

RE: ENSC 405w Project Proposal

Dear Dr.Jannesar, Dr.Rawicz and Dr.Scratchley,

The document attached to this letter is a formal proposal for the development of Levo Technologies' performance tracking barbell attachment, the Levo. The Levo product will allow weight lifters to record data reflecting their weight room performance, which can then be analyzed and used towards improving the athlete's capabilities.

This document puts an emphasis on what the Levo can and will do, its potential market, cost considerations, risks and benefits, and provides a high level overview of the Levo's systems. Finally, project planning and information on the Levo Technologies team is provided.

The Levo is the culmination of knowledge and experience gained at SFU during undergraduate studies by the Levo team. This project will demonstrate the application of engineering, physics, and kinesiology principles learned at SFU, and through our own research. The Levo Technologies team looks forward to the presentation of the Levo proof-of-concept prototype, and the continued development of the Levo.

Should you have any questions, or require further clarification on the attached documentation, the Levo, or Levo Technologies, please contact CCO Graham Fader at gfader@sfu.ca at your convenience.

Sincerely,

Natalia Page
Chief Executive Officer
Levo Technologies

Project Proposal for The Levo

Company 1

Matthew Chute: 301281840
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April 6, 2021

Executive Summary

Athletics have long been embedded in the story of humanity. Across all cultures and civilized times, people have challenged each other using events to showcase prowess in strength, speed and stamina. It has become accepted that the generation with the greatest athletes is always the most current one. This is largely due to the optimization of strategies and training methods. With the continued pursuit of athletes to become "bigger, faster and stronger" any technology or technique offering a competitive edge will find through use.

Data science in recent years has become increasingly widespread in nearly every field. Sports have adopted statistical analysis as a tool for elevating the performance of a team or individual. First seen in baseball, "sabermetrics" has become as important as scouting in modern sports for player evaluation. This data-hungry approach to sports naturally has applications beyond game observation. Combine events look to expand the number of measurable factors which a team can use when deciding which players to spend a draft pick on. From all this, it is evident that teams and organizations will use all the data available to find ways to improve and optimize their performance and development strategies. As it pertains to strength training, there is much less information readily available outside of typical counting numbers such as reps, and the weight moved. While more can be learned through video analysis, there is less which is quantifiable.

Levo Technologies is proud to present the Levo, a barbell attachable data collection tool. The Levo offers tracking of metrics related to the strength, explosiveness, and stamina of athletes during barbell exercises often used in strength and conditioning. By collecting data and making that which was previously trusting the "eye test" quantifiable, the Levo aims to help identify where an athlete excels and can improve to make an athlete bigger, faster, and stronger. Millions of high school athletes, hundreds of thousands of college athletes and thousands of professional athletes are aiming to improve their performance in North America alone. The Levo aims to assist these athletes in their pursuit of excellence.

The Levo utilizes a compact, lightweight sensor array and a variety of mathematical and physics-based principles which can track an athlete's movements during barbell exercises. This data is used to communicate the weight room performance metrics which matter most to an athlete, their team or their coach through a mobile application. This allows for a greater volume of information regarding development through weight training to be available for every athlete. Feedback for the user will be available on any barbell lift without requiring an observer to closely watch the exercise. Furthermore, it allows for a coach to collect data on many athletes simultaneously, which can increase their capacity to observe the team-wide effects of a training program and aid in the optimization of future programs for both teams and individuals.

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1 Introduction

Since the introduction of "Moneyball" by the Oakland Athletics in the early 2000s, sports have entered the "Data Age." The careful use of statistics, in-game planning, and training have become integral for the successful development of an organization's athletes. While sports differ in their field and practice measurements for success and development, nearly all athletes make use of weight training to some extent. The Levo is a barbell attachable performance data collection tool, designed for use during weight training. This document is the proposal for the development of the Levo in the courses ENSC 405w and ENSC 440. This document also provides the background and scope for the Levo, including a risk/benefit analysis and a high-level overview of how the Levo functions. Additionally, a full business analysis including the current market, competitive products, cost considerations, and potential funding sources for the Levo are explored. Finally, Gantt charts regarding project planning and team dossier are also included.

2 Project Overview

2.1 Background

There are a variety of methods and philosophies regarding the best way to weight train. For example, some methods rely on the time in which the target muscles are under tension, while others rely on fast, explosive movements from the target muscles. The commonality across these methods is the need for an athlete to exert force on the equipment. Many exercises including all Olympic lifts and the "BigThree" (bench press, deadlift and squat) are barbell-based exercises. Due to the high dependence on barbells in weight training, the Levo can be specialized to cover barbell exercises for at least its first planned production version. Performance breakdowns of the exercise can be generated from a collection of data about the movement of the bar during a set or rep. While different training methods and philosophies will use the data in different ways, the useful metrics will remain reasonably consistent. This consistency of metrics of interest allows the Levo to have used to a wider audience and not be tied to any specific training philosophy or program.

2.2 Scope

The Levo aims to track a variety of metrics related to athlete performance during barbell exercises. Through polling of collegiate athletes and strength and conditioning coaches metrics relating to the maximums and averages of force, acceleration and velocity were identified as the most important. While other metrics were identified as useful, they are calculated using the aforementioned velocity and acceleration metrics. Accurate collection and calculation of this data are essential for making the Levo a worthwhile product. The Levo will collect data on the athletes by being attached to the barbell during exercise where accelerometers and gyroscopes will provide data on the movement of the bar. This data will then be processed by embedded software on the Levo before being transferred to an application for the user to view and interact with. The Levo is a tool for the collection and communication of data only, the Levo will not provide training advice or recommendations on weights, exercises, or routines to the user.

The following is the list of metrics which will be recorded by the Levo for each exercise:

- Repetitions
- Peak acceleration, velocity and force
- Average acceleration, velocity and force
- Percentage drop off of peak acceleration, velocity, and force between reps in any set
- Percentage drop off of average acceleration, velocity, and force between reps in any set
- Performance over time of all of the above metrics.

2.3 Methods

2.3.1 Sensor Unit

The sensor unit for the alpha phase prototype consists of a six-degree-of-freedom (DOF) accelerometer and gyroscope unit. This unit provides three axes of acceleration placed orthogonally in a right-handed system (x,y,z), with gyroscopes providing angular velocity along the same axes. The acquisition of data in three axes allows for the isolation of individual directions of movement as well as calculations of the net movement of the barbell.

2.3.2 Onboard Processor

The sensor unit of the Levo will also have a chip for processing data and transmitting the data with a wireless transceiver. The processor unit will take in the acceleration and angular velocity data from the accelerometers and gyroscopes respectively and use that data to calculate other performance metrics. The data processing and sending are done following the conclusion of a set so that the data can be properly cleaned and as accurate as possible.

2.3.3 Mobile Application

The mobile application will be a hub for the user where they can access their data collected from the Levo, as well as additional features designed to keep our users coming back. Data from each of the user workouts will be stored here broken down into individual sets and exercises. The user will also be able to compare their metrics from different workouts, which provides insight into the users' improvements in their lifts. Additional features which will be added in the application to enhance the user's experience include achievement ribbons for performing certain actions while using the Levo. This feature will give additional reason to use the Levo on top of the collection of data, and will allow friends to compete and compare with one another.

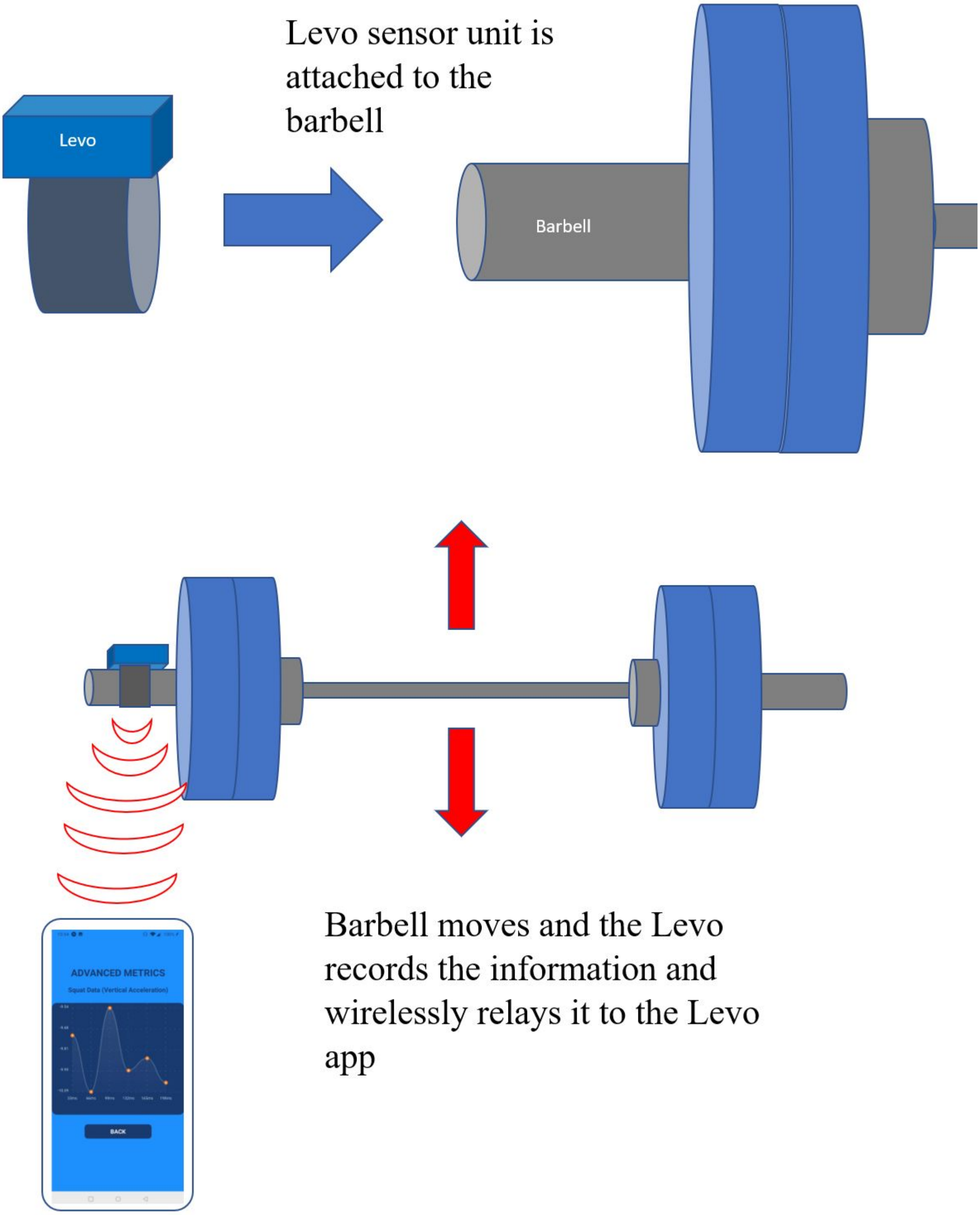

Figure 1: Illustration Of The Expected Use Of The Levo

2.3.4 Directional Actuation

While the pull of gravity does provide an acceleration reading which must be factored out to accurately reflect the athlete's movement of the barbell, the reading of gravity at rest allows for the assessment of the direction of movement with random orientations of the bar and sensor.

2.3.5 Acceleration

Accelerometer measurements following scaling will output reading in units of "gs." 1 g is equivalent to 9.81 meters per second squared. The sensors are also direction-dependent, meaning that they can differentiate between an acceleration upwards and downwards. At rest, the accelerometer readings will output a magnitude of one g plus noise. By sampling the noise over some time and finding its mean value, the mean noise can be subtracted off the read value to more accurately reflect the physical situation. Following the subtraction of noise, the values read are multiplied by 9.81 meters/second squared to make the units of the data in meters per second squared rather than gs. The effects of gravity are also subtracted from the accelerometer readings so that only the applied acceleration is recorded by the Levo. Each reading is placed into a python list which at the end of the set will be a chronological sequence of the applied accelerations to the bar and by extension the Levo.

2.3.6 Velocity

Velocity is the first integral of acceleration with respect to time. Integration of discrete points can be done using the trapezoid rule to yield real time results. Noise in the acceleration data will create an error with a time dependence upon integration. This is visible in the velocity vs time graph generated from integrating velocity with the velocity data moving up some slope, M. The velocity data, and the regions of interest are illustrated in the figure below:

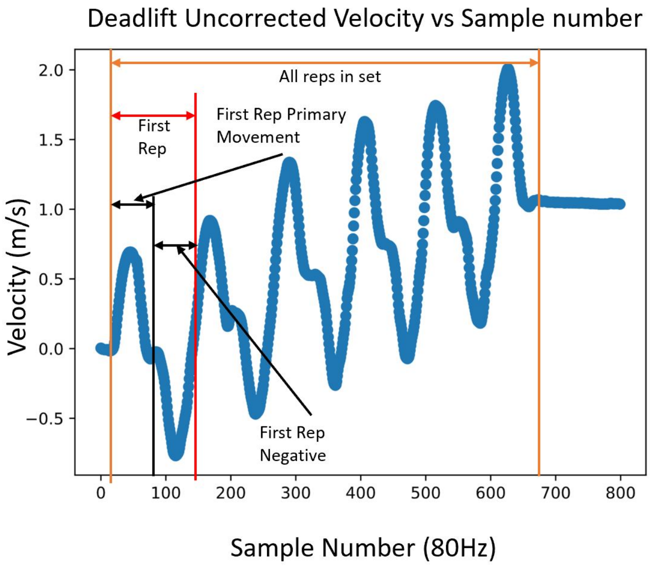

Figure 2: Regions of Interest For Velocity Data

By taking a first degree polyfit of the data, the accumulation of error can be found and subtracted out. This correction is illustrated in the following graphs:

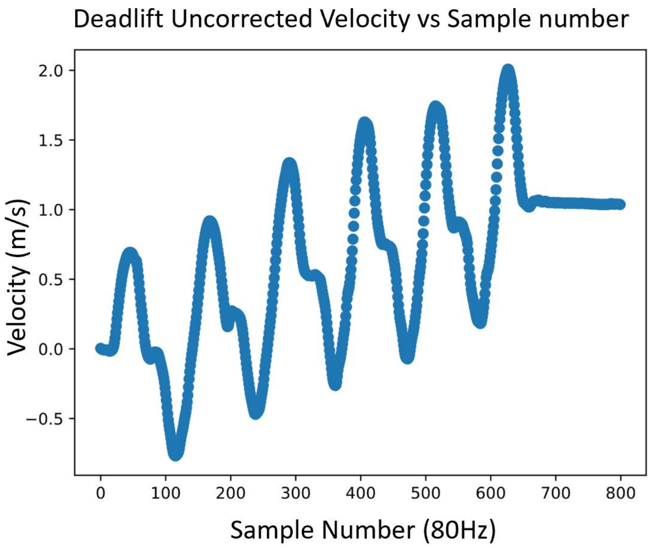

Figure 3: Uncorrected Velocity Data

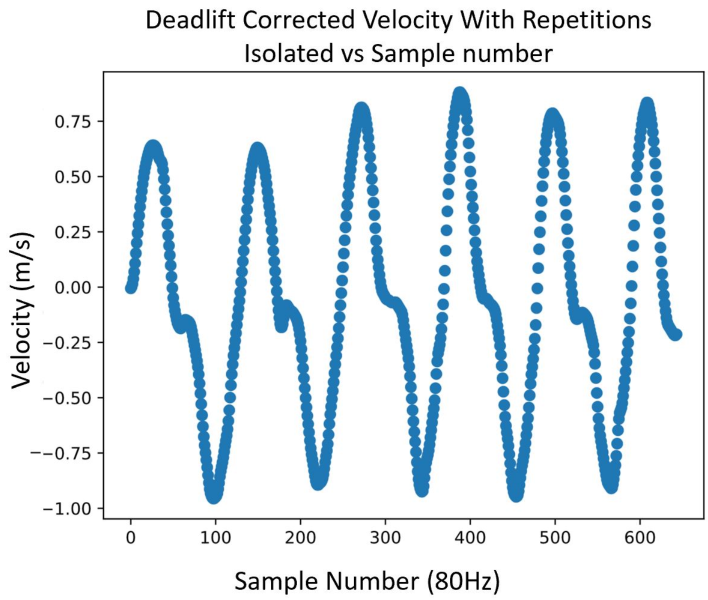

Figure 4: Corrected Velocity Data With Set Isolated

2.3.7 Average and Peak Metrics Within Reps

During exercise, the time of interest for repetition is when a velocity in the direction of the end position of an exercise is being applied to the bar. For most exercises, this is when a bar is pushed in a direction opposite to the pull of gravity. if the direction gravity is pulling is defined as the negative direction, then the region of interest for the rep becomes the times when the velocity is positive. After identifying the regions of interest, extracting the average and maximum values in these regions can be done by summing the velocity readings and dividing this sum by the number of samples within the region. Maximum value can be determined by comparing each value within the region and keeping only the largest one.

2.3.8 Comparing Reps

With the boundaries for the regions of interest found during the extraction of peak and average values, comparing the reps graphically becomes trivial. The data is windowed to only plot the region of interest of the rep and shift its start time to the origin. Plotting all the reps in a given set allows the user to easily see how their repetitions differed from each other. This can be seen in the following figure:

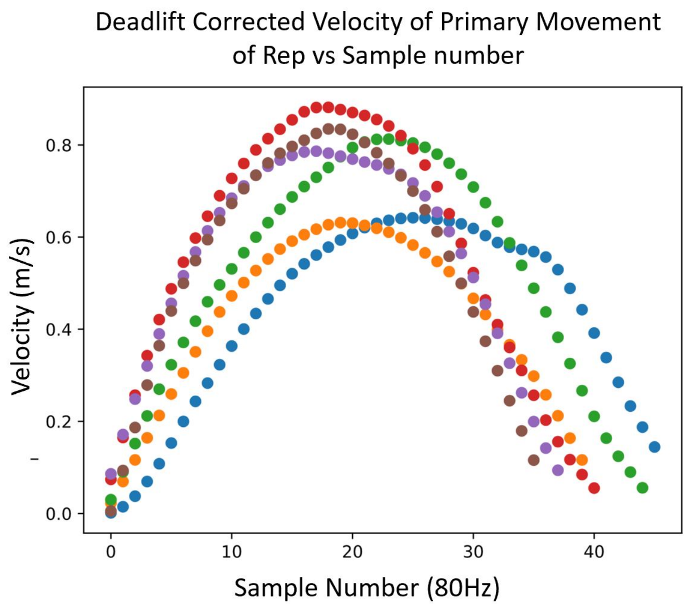

Figure 5: Corrected Velocity Data Isolating And Comparing Each Rep In The Set

3 Business Analysis

3.1 Market Analysis

The main target markets of the Levo will be high school, college, and professional athletes. According the research done by the National Collegiate Athletic Association there are over 8 million high school students participating in athletics in the US alone. At the collegiate level, there are over 400,000 thousand NCAA athletes participating in athletics at 1098 universities in United States of America and Canada [1]. Additionally, at the Olympic level, there were 2952 athletes at the most recent Winter Olympics [3], and 11,384 athletes at the most recent Summer Olympics [2]. These abundantly large markets of potential users are the source of which Levo Technologies hopes to gain a majority of their users.

3.2 Competition

Several products are currently available to professional and student-athletes, but many of them offer a limited data set and the price of these products is high. The goal of the Levo is to enter into this market that allows users more information at a lower price so student-athletes can easily buy and use the Levo, and experience athletes better tool to give the extra edge in competition

3.2.1 Bar Sensei

Bar Sensei is an electronic sensor and velocity-based training app for the athlete. It provides various measurements such as power, bar speed, and POP-100. However, there are many downsides to the

Bar Sensei, and that is the device is huge and clunky compare to the Levo. The Bar Sensei also requires multiple sensors to the barbell whereas the Levo only requires the Bluetooth module. The companion app that comes with Bar Sensei is also iOS specific. The Levo app is cross-platform which does not hinder any athletes or weight lifters with different mobile devices.

Figure 6: Bar Sensei [6]

3.2.2 Eleiko Bar Sensor

Eleiko Bar Sensor provides more data to users than the Bar Sensei, but the sensor is limited to specific barbells produced by Eleiko. This does not allow users to attach to any barbell which limits the gym that does not hold Eleiko barbells. The product is also not currently in the sale and still in the development phase.

3.2.3 FLEX Sensor

FLEX sensor is a barbell sensor that is limited to measuring velocity and rep, whereas the Levo provides more data set that a user might be interested in. Like the Bar Sensei, the FLEX sensor is limited to iOS and iPad apps, and not on Android. FLEX Sensor is also listed as USD 495.00 as the time of writing, which is expensive for most new weight lifters.

Figure 7: Flex Sensor [7]

3.2.4 Push Band 2.0

Push Band 2.0 is sold as a system that includes a portal, band and an app. However, their training is very restricted to velocity-based training whereas the Levo does not impose any training methodology on the users.

Figure 8: Push Band 2.0 [8]

3.3 Cost Consideration

The estimated costs for each item are split into two different stages: the Alpha stage for proof of concept, and the beta stage where we would implement and prototype our design.

Function	Components	Quantity	Price/Unit	Total Price
Hardware	6-Axis IMU Sensor Hub	5	$9.402	$47.01
	Bluetooth 5 SoC Module	5	$7.29	$36.45
	Raspberry Pi 4 - 8 Gb	1	$112.99	$112.99
	microSD card - 32 GB	1	$12.73	$12.73
	Solderless Breadboard	3	$4.99	$14.99
	Dupont Wires	1	$13.99	$13.99
Sub total				$238.16
Miscellaneous	Tax (12%)			$28.58
Total				$266.74

Table 1: Alpha Stage - Proof of Concept

Function	Components	Quantity	Price/Unit	Total Price
Hardware	Bluetooth 5 Transceiver Module	3	$13.00	$39.00
	Micro B USB Female Plug	5	$1.29	$6.45
	Battery	2	$3.00	$6.00
	Regulator	5	$3.00	$15.00
	Resistors (SMB)	10	$1.00	$10.00
	Capacitors (SMB)	10	$1.50	$15.00
	ARM32 Processor	2	$10.00	$20.00
	Printed Circuit board	3	$15.00	$45.00
Sub total				$156.45
Miscellaneous	Tax (12%)			$18.78
	Additional Allocation (15%)			$26.28
Estimated Total Cost				$201.51

Table 2: Beta Stage - Functional Prototype

While IMU Sensor Hub and Bluetooth Module are listed under Alpha Stage, both modules will be integrated into the beta stage of the device. They were purchased in the Alpha stage for purpose of understanding and testing the modules for the prototype stage. The Alpha stage does not include additional allocation of the budget since all the parts are already been purchased and are going through development at the time of writing. Additional allocation of 15% is added on the Beta Phase in case there are unforeseen events that would require additional cost that might incur.

3.4 Potential Funding Sources

3.4.1 Engineering Science Endowment Fund - ESSEF

The Engineering Science Endowment Fund, also known as the Engineering Science Undergraduate Student Project award, is facilitated by the Engineering Science Student Society for various undergraduate activities. The award is based on meeting individual qualifications and categories for the activity. On an individual level, all students must meet a 2.0 GPA and registered for 9 credit hours of normal graded courses in terms of eligibility. As for the activity categories, there are four main categories for qualification, which will be requested under Category B - Entrepreneurial. Category B expects the applicant(s) to have a working prototype and a brief business plan. The assessment rating criteria are: pragmatic, cost-effective, and visionary.

3.4.2 Wighton Engineering Development Fund

The Wighton Development Fund provides students with a project that satisfied the criteria of practicality, which could run parallel with special project courses. The proposal is required by applications which include: Abstract, Outline, Purpose, Methodology, Technology Transfer, Market outlook, Budget, and list of team members.

3.5 Personal funding

If both applications for the funds are not accepted, all the group members have to agree to split the cost even, with the discretion of each member of the group.

4 Risks and Benefits

As new products are being created and released there will always be risks and benefits towards the customer that companies need to be aware of, Levo Technologies is no exception. By identifying early on in the production phase the potential risks and benefits will further help optimize the Levo when it is ready for market release. The following sections list all potential risks as well as benefits that outweigh current risks to justify the production of the Levo.

4.1 Risks

Levo Technologies strives to do its best to minimize the risks associated with the Levo, however, we can never assume that no risks remain. The first concern is Levo's accuracy. Despite Levo technology's efforts to ensure accurate data is provided to our athletes, unpredictable errors can occur that will skew the data. This can cause problems for coaches making recommendations for their athletes to improve on, or athletes may get a false sense of what they are striving or struggling in. This can lead to athletes pushing themselves in areas they are weaker in which can cause long-term injury. However, to ensure that this does not happen, several steps are taken both within the hardware and software so that the data processing will be as accurate as possible

Another concern is that the Levo is a wireless device, which will emit a radio frequency (RF). RF's are a type of non-ionizing radiation that can cause atoms to vibrate and ultimately heat up which can cause severe injury such as severe burns to nearby users. However, the RF energy must be extremely high (energy from radar for example) for it to be damaging to the human body [4]. Levo Technologies made sure that all wireless transmissions made from our attachable Levo to the mobile application are no stronger than those emitted from cell phones or wireless networks. RF energies from these common devices are not strong enough to cause significant heating and are perfect for everyday use [4].

There are also risks with electrical surges being conducted across any gym barbell or weight lifting equipment. The hardware team has made sure that all electronics making up the Levo unit will be encased in a waterproof casing. This will make sure that no electrical current is conducted through the metal bars causing a dangerous shock to the user nor cause damage to the unit from being exposed to sweat or spilled water.

4.2 Benefits

Levo Technologies strives to improve athletic performance on the field and in practice for both an athlete's personal growth, and performance within a team dynamic. Many athletes are competitive in nature and push themselves to outdo their peers, as well as take pride when they win a game or tournament. They like to see progress in their physique and performance, but other than "feeling" that a game or a lift went well, there is not much out there that can tell an athlete or coach what exactly they are doing well or what improved. Using Levo's calculated metrics and visual graphs, athletes and coaches can see how fast they are going an exercise, reps they complete, endurance during an exercise at a certain weight. By pinpointing what exactly the athlete can improve on training can be optimized for their needs and become more beneficial in the long run. Also, utilizing the mobile apps goals and achievement medals will further cater to an athlete's competitive nature as they share with their teammates and see who achieved a larger weight class or increased their endurance. This will increase team morale and drive them to further push themselves to do better, all while enjoying themselves. In a team dynamic, coaches can analyze each athlete's strengths and weaknesses to provide the best training regiment as well as optimize which players are best suited for each position on a sports team; increasing chances of winning their games and taking home the championship title.

Financially, the Levo provides plenty of benefits. As stated earlier in the document, there is no shortage of athletes and this will be a market that will never die out. Sports have been around for approximately 3000 years, and they continue to be popular to this day [5]. However, very few performance tracker devices have been made and all of which either, focus on one type of training, utilize or need a camera and are very expensive to produce. The Levo provides multiple different training metrics, does not need a camera and is relatively cheap to produce. For potential stakeholders looking to invest in our company, now is the optimal time to do it. With few performance trackers out there, not a lot of athletes and sports teams are optimizing their training, therefore, those teams who can get access to the Levo as early as possible will have a major advantage over the other athletes in their league and will be in high demand.

5 Project Planning

The Levo will undergo 3 separate stages of production, beginning with the current phase which is the proof of concept, then the engineering prototype, and finishing with the final production model. The plan for the proof of concept can be summarized with the following 6 milestones:

- Requirements document complete (Feb 2nd)

- Levo Technologies established (Feb 18th)
- Design of Levo complete (Mar 26)
- Alpha Hardware complete (April 20th)
- Alpha App complete (April 20th)
- Finish planning phase of Levo production (April 24th)

Each of these milestones are accompanied by crucial steps in the production of the Levo which are outlined in the Gantt chart shown in the pages below.

The goal of the engineering prototype of the Levo is to take the software that was developed on the Raspberry Pi and adapt it onto hardware that is much easier to produce and much easier to handle and use for a user. This involves integrating Bluetooth on the production hardware we've chosen for our in-house designed PCB and adjusting the software to work with the different sensors, and also developing the software app to a more polished and user-friendly state. These points will be met with the following milestones.

- Levo physical product assembled (July 8th)
- Hardware in QA testing state (July 29th)
- Levo produced and ready for QA testing (Aug 3rd)

As with the proof of concept, each milestone can be broken down into multiple stages of the production of the Levo outlined in the Gantt chart.

As for the production model of the Levo, more strenuous testing will have to be done on a much wider user base to identify where the product could be improved from an app perspective and what features are the user would be interested in after they've been using the Levo for a long period. The lifetime of the physical product will also be analyzed to see if the durability of the product holds up as expected and if the hardware could be optimized for better cost efficiency and battery life.

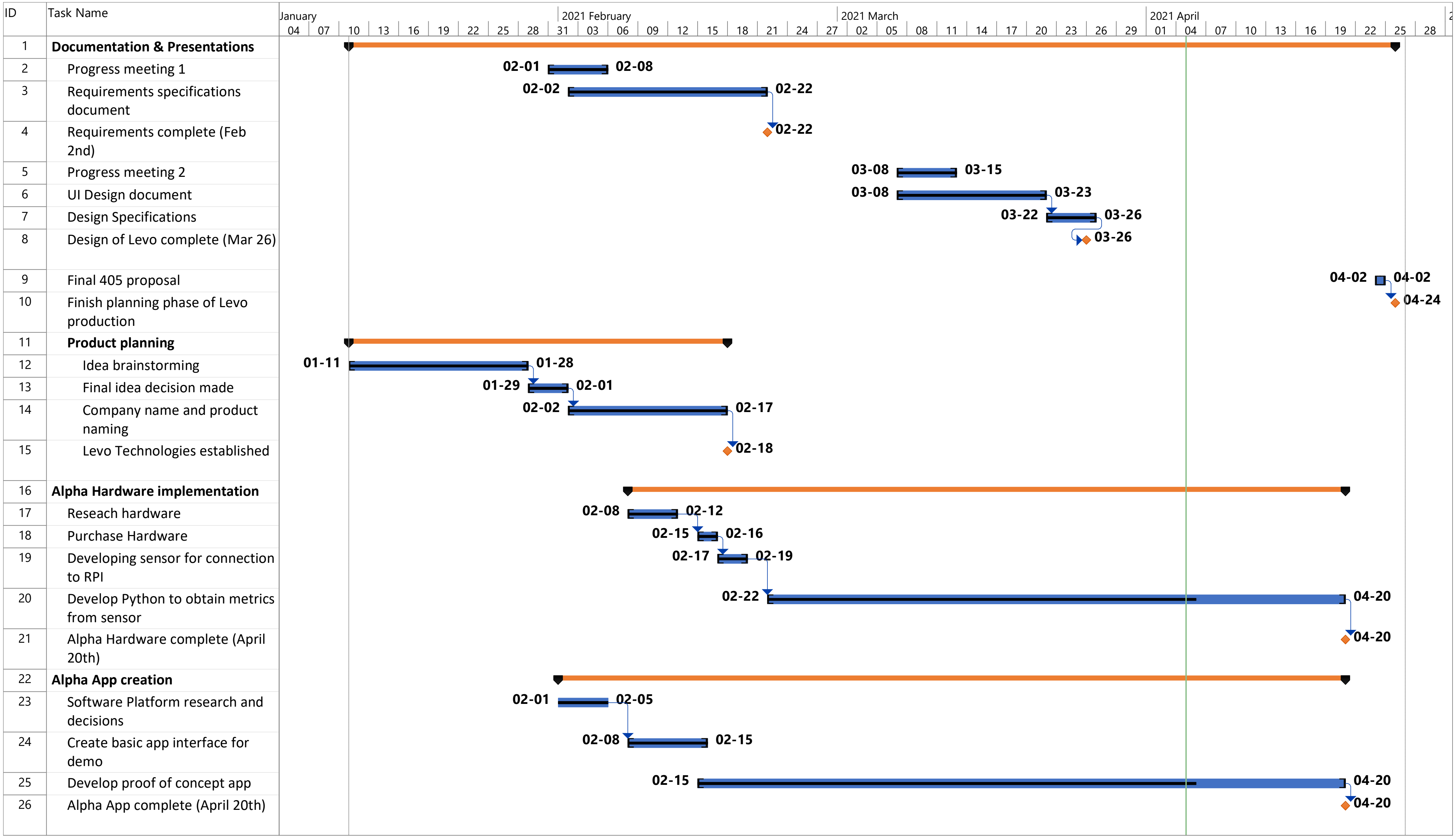

Figure 9: Alpha Stage Gantt Chart

ID	Task Name	Duration
1	**Beta Hardware implementation**	**64 days**
2	Adapt software to run on beta hardware	45 days
3	Design Levo PCB	16 days
4	Research how to get our PCB printed with parts	14 days
5	Research sensors to connect to IMU	9 days
6	Purchase sensors	1 day
7	Send parts for PCB creation	14 days
8	Send for re printing of PCB if needed	14 days
9	Testing PCB	30 days
10	Hardware in QA testing state	0 days
11	**Beta Structural development**	**19 days**
12	3D desing case for PCB	10 days
13	3D print case	2 days
14	Source strap for case	10 days
15	assemble product	2 days
16	Levo physical product assembled	0 days
17	**Beta app development**	**67 days**
18	App UI completed for UI focus group QA	44 days
19	QA on UI to ensure requirements are met	14 days
20	Adjust UI according to QA feedback	10 days
21	Bluetooth implemented in software	22 days
22	Cloud SQL database implemented to save user data	22 days
23	Levo produced and ready for QA testing	0 days
24	**Final product QA**	**12 days**
25	Final QA testing of app with focus groups	12 days
26	Full roll out of Beta App	0 days

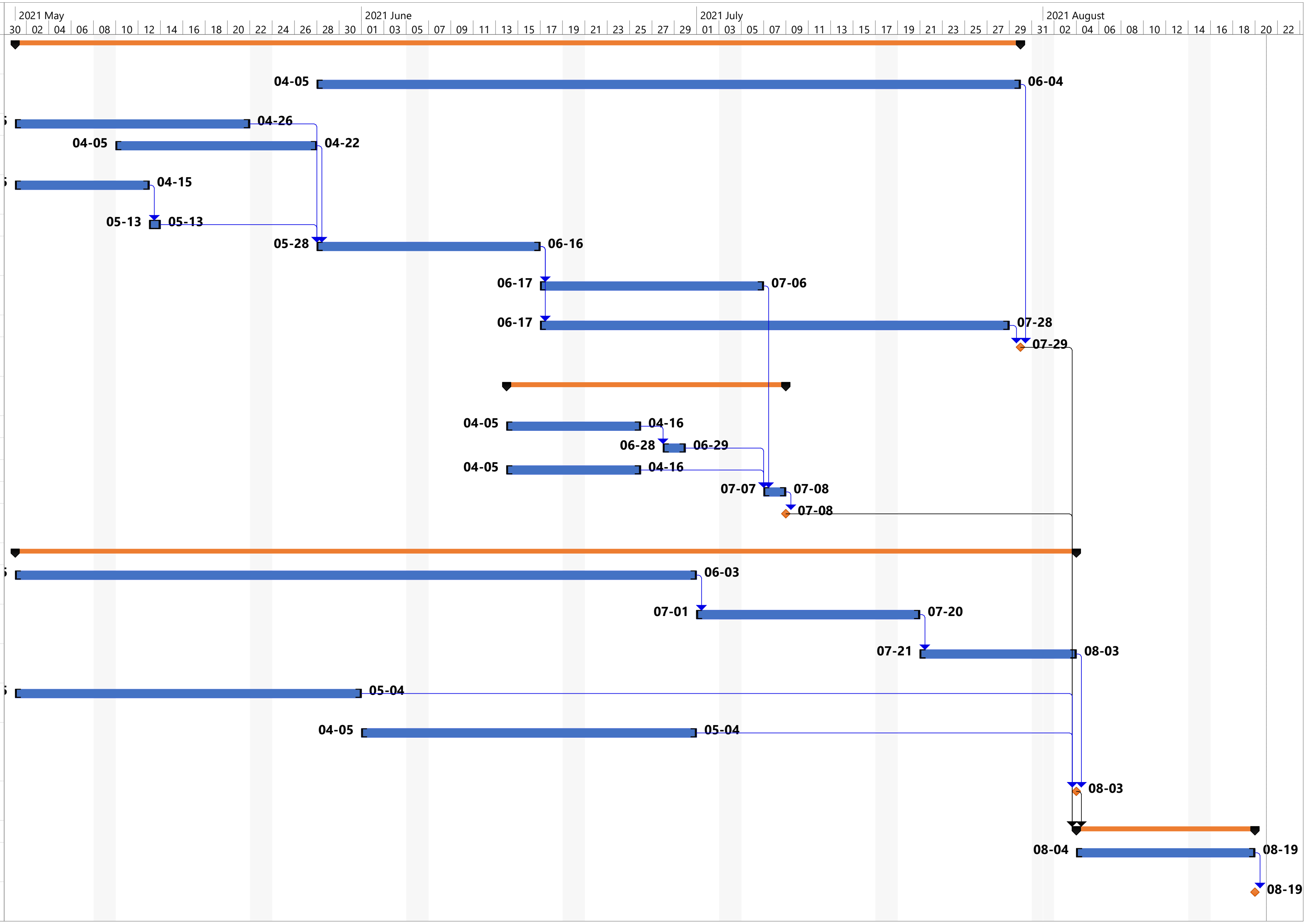

Figure 10: Beta Stage Gantt Chart

6 Company Details

Graham Fader - Chief Communications Officer (CCO)/ Chief Operations Officer (COO)
Graham Fader is a Electronics Engineering student with experience in signal and data processing in addition to knowledge of circuit deign. In addition to his experience with engineering through studies at Simon Fraser University, Mr. Fader was an NCAA wrestler for five years during his undergraduate career. This background adds a practical understanding of the needs for the Levo from an athlete's perspective.

Christopher May - Chief Hardware Officer (CHO)
Chris May is a Systems Engineering student with a strong interest and focus in micro controllers and networking hardware. With a background in IT services, Chris is very familiar with how technology works from a user perspective and great at debugging problems and documenting detailed solutions. While working at Microchip Technology Corporation, Chris gained valuable knowledge about PCB manufacturing and working with multi-layer PCBs and micro controllers which will be valuable for creating the PCB for the Levo.

Matthew Chute - Chief Software Officer (CSO)
Matthew Chute is a Computer Engineering student with interests in mobile application development and UI/UX design. During his time at Netgear Canada, he helped contribute to the development of Netgear's iOS mobile applications. Mr. Chute is looking forward to applying the knowledge which he learned, and helping Levo Technologies develop a user friendly, cross platform mobile application for their customers. He is also excited to apply his Python background, while assisting the COO in the ongoing development of Levo's embedded software.

Antonio Kim - Chief Information Officer (CIO)
Antonio Kim is a Computer Engineering student at Simon Fraser University. His experience consists of Quality Assurance Engineer at Counterpath Corporation, and Research Assistant in the Faculty of Applied Science under the supervision of Dr. Ash Parameswaran. Antonio's main interests are Artificial Intelligence, microelectronic fabrication, and communication network security.

Natalia Page - Chief Executive Officer (CEO)
Natalia Page is a Biomedical Engineering student at Simon Fraser University with experience in clinical research at Vancouver General Hospital under the supervision of Dr. Marinko Sarunic. She was responsible for the organization and conducting of research imaging, and most of the clinical imaging within the Eye Care Centre portion of the hospital. When not actively engaging with patients, Natalia was responsible for assisting the doctors with their research by providing automated solutions and image processing in MATLAB for Dr. Sarunic's lab. Her interests include optimizing prosthetic limbs for amputee patients and research in the field of biomechanics. Her skills in MATLAB, C, C++, data analytics, and knowledge in biomechanics allow her to be a strong support role to ensure saftey is considered for the athletes, and data is being taken and analyzed correctly.

7 Conclusion

The Levo capitalizes on the increasing prevalence of data analytics in athletics, and its utility in developing better athletes. The desire of athletes to improve is also a constant regardless of the sport or level of the athlete. Offering a more accessible and affordable package to athletes, teams, and organizations to improve their weight room gains justifies the design and production of the Levo. By targeting a large and stable market, and catering to an athlete's competitive nature drives a further need for our product which will provide a much larger return in profit. Utilizing the diverse skill sets of the company members, and following the detailed project plans put in place, the Levo can become a novel device of its kind changing how we view athletics for the better.

8 Glossary

CCO - Chief Communications Officer
CEO - Chief Executive Officer
CHO - Chief Hardware Officer
CIO - Chief Information Officer
CSO - Chief Software Officer
DOF - Degree of freedom
GPIO - General purpose input output
IMU - Inertial Measurement Unit
Levo - Product Name
Levo Technologies - Company Name
NCAA - National Collegiate Athletic Association OS - Operating System
PCB - Printed Circuit Board
Polyfit - A function that generates the coefficients for a best fit polynomial of specified degree.
Rep - a Repetition of a movement in exercise
Rep Negative - The Movement during a rep where the users target muscles are not actively performing the lift, often this is the movement to the position where the push in the rep will begin
RF - Radio Frequency
RPi - Raspberry Pi
Set - A group of repetitions done consecutively without placing the bar into a rest position on a rack or on the ground.
SFU - Simon Fraser University SMB - Surface Mount Board
UI - User Interface
UX - User Experience

References

[1] "Estimated probability of competing in college athletics" NCAA.org, 2020. [Online]. Available: https://www.ncaa.org/about/resources/research/estimated-probability-competing-college-athletics [Accessed Apr. 1, 2021].

[2] "The 2016 Rio Summer Olympics: By The Numbers," Forbes.com, 2016. [Online]. Available: https://www.forbes.com/sites/christinasettimi/2016/08/05/the-2016-summer-olympics-in-rio-by-the-numbers/?sh=30885a01fa18 [Accessed Apr. 1, 2021].

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