BACHELOR THESIS

DESIGNING A DASHBOARD FOR ESPORTS HEALTH AND PERFORMANCE MONITORING

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ABSTRACT

This thesis explores the development of a health monitoring and performance analysis dashboard for esports players. The research investigates physiological and cognitive performance indicators affecting esports athletes, such as stress levels, sleep quality, hydration, and reaction speed. Moreover, they ways these indicators can be measured using different approaches. Using the Creative Technology design process, a prototype was iteratively designed, developed, and evaluated with esports players and coaches. Findings suggest that using different sources of data combining self-reported metrics with sensor-based analytics, can provide valuable insights for optimizing health and performance of Esports players. The study contributes to providing possible solutions to monitoring health challenges for esports players by proposing user-centered dashboard prototype.

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1. INTRODUCTION

1.1 What is Esports?

Esports, short for electronic sports, is a form of competitive gaming on digital platforms. Athletes put in cognitive and physical effort, which is often broadcast on media platforms. The esports industry has rapidly grown, with millions of players and viewers engaging worldwide. It's like traditional sports in its growth, with institutionalization, industry involvement, and similar issues [1]. Esports athletes utilize different cognitive skills like reaction speed, selective attention, inhibition, and working memory [2]. Moreover, these athletes require fine motor skills for controller inputs. Similar to traditional sports, esports demands a lot of practice and strategic thinking, making it a highly competitive field.

Esports cover a variety of game genres, each requiring different skills and team structures. Multiplayer Online Battle Arena (MOBA) games like *League of Legends* and *Mobile Legends* are the most popular, with peak viewership reaching millions in 2024 [3]. First-person shooters like *Counter-Strike 2* and *Valorant* are also highly popular, emphasizing teamwork and precision. Battle Royale games like *Fortnite* and *PUBG* challenge players to be the last standing. Notably, mobile esports are growing rapidly, with games like *Mobile Legends* gaining a lot of popularity.

1.1.1 Problem statement

Professional esports players, like athletes in physical sports, undergo extensive training to compete at the highest levels. They practice for long hours, often exceeding 10 hours per day, similar to the training regimens of professional athletes [4]. Esports athletes also participate in structured teams and leagues, similar to conventional sports [5]. Despite these similarities, the scientific research supporting traditional sports training has not yet been fully applied to esports. Research focusing on skill enhancement and performance improvement in esports is still very limited.

Like traditional athletes, esports players can sustain injuries during training. The literature highlights several health concerns for esports players, including stress, sleep disturbances, vision issues, musculoskeletal pain, overuse injuries, and metabolic disorders like weight gain. Behavioural problems such as addiction, violence, and aggression have also been documented [6]. However, few healthcare professionals are equipped to address the physical and mental demands unique to esports or to provide adequate care for related health issues [7].

Despite similarities to traditional sports, the physical activity in esports is less intense, focusing on fine motor skills and quick reflexes rather than physical endurance. Despite the lower physical intensity, the mental demands are considerable, often resulting in stress and mental fatigue. This underlines the need for a structured approach to managing the health and performance of esports athletes [5].

Because of this growth in the industry, athlete health becomes important to focus on and prevent issues. Issues like overuse and mental health issues are prevalent in esports athletes [8]. This is why there is a need for mental and physical health guidance and monitoring specifically for esports athletes.

While traditional sports have well-established tools and research for tracking athlete well-being, including wearable biometric sensors, recovery protocols, and personalized training schedules, esports lacks equivalent, specialized solutions. While some monitoring tools exist, they often lack integration, customization, and accessibility for Esports professionals and teams.

The goal is to integrate aspects of physical athlete training and coaching into Esports, improving player performance and well-being. This involves adapting methods used in traditional sports for the demands of Esports, such as nutrition, sleep, and physical activity.

The primary challenge is to develop a health monitoring and recommendation tool that meets the specific requirements of Esports players. This involves identifying the key health-related factors that impact performance, integrating various data sources into a platform, and establishing meaningful connections between health metrics and Esports performance indicators. Moreover, it is essential to understand the varied needs and preferences of players, coaches, and other stakeholders to create effective features for the prototype dashboard.

1.2 Research questions

This paper aims to answer the following research questions:

1. What are the key functional and non-functional requirements for an Esports health monitoring system?
2. How can an Esports health monitoring system be constructed?
3. How can user feedback and testing help the design to ensure it meets the specific needs of its end-users?

These research questions can be combined in one overarching research question which this thesis aims to answer:

How can an Esports health monitoring system be designed, realized and evaluated to meet the specific needs of its end-users?

1.3 Report outline

This thesis is structured as follows: Chapter 2 provides an overview of esports athlete health, covering both physical and mental aspects. Chapter 3 reviews the state-of-the-art health monitoring tools in both traditional sports and Esports. Chapter 4 presents the methodology, describing the research and design process. Chapter 5 covers ideation, including stakeholder analysis and user requirements. Chapter 6 specifies the chosen solution, outlining its technical aspects and data measurement methods. Chapter 7 details the realization process, including prototype design and development. Chapter 8 evaluates the prototype using usability testing with stakeholders. Finally, Chapter 9 concludes with key findings and recommendations for future work.

2. BACKGROUND

2.1 Esports player health

Esports athletes, like traditional athletes, face various health and psychological challenges. Esports players endure prolonged training hours, intense focus, and high-pressure environments, leading to a range of physical and mental health concerns. For example, one study found that 56% of esports athletes reported eye fatigue, while others experienced musculoskeletal pain and sleep problems, highlighting the importance of addressing health in this growing field [5]. This section explores the physical and mental health challenges esports players face and outlines potential strategies to optimize their performance and well-being.

2.1.1 Physical health for esports players

Esports training typically begins in the childhood of players at a young age. As esports athletes become more skilled, they may be invited to advanced competitions, but remain largely unsupported until they make a professional team or college scholarship. They are then exposed to, perhaps for the first time in their life, a coach and potentially health professionals. Compared to traditional athletes, esports players may have a lack of this supportive environment in their childhood. Meaning, they don't know how to deal with overuse injuries [7].

Esports athletes, much like traditional sports athletes, can encounter a variety of health issues during their training and competition routines. Apart from the commonly described problems such as eye fatigue, musculoskeletal pain, and overuse injuries [5], esports players also face several other significant health concerns.

Food and nutrition is a major factor contributing to Esports player performance. This is because food that is rich in protein, vitamins, and minerals can enhance cognitive performance and resilience in high-level athletes. In a study by [9], the majority of esports players who participated failed to reach the recommended intake levels for key micronutrients and important food categories such as dairy, fruits, and vegetables.

One prevalent issue is eye fatigue, reported by 56% of esports players. Neck and back pain (42%), wrist pain (36%), and hand pain (32%) are also common [5]. To improve the performance and well-being of these athletes, it is important to be aware of these issues and mitigate them as much as possible.

Hydration and the risk of overheating are important aspects to esports player performance. Maintaining hydration is crucial for good cognitive functioning in sports, while dehydration appears to impair cognitive performance, including decision-making skills [DEHYDRATION].

The intense concentration during gaming sessions often results in neglecting basic physiological needs, such as staying hydrated and maintaining a comfortable body temperature [10].

Sitting for prolonged periods is another significant concern. Despite being more physically active than regular video gamers [11], esports players still spend extensive time on screens, which underscores the need for a balanced routine to mitigate health risks, including cardiovascular problems caused by prolonged inactivity [6].

2.1.2 Mental health for esports players

Esports players encounter a range of mental health challenges similar to those faced by traditional athletes, often intensified by the unique demands of competitive gaming. To One major challenge is stress and anxiety [12], which come from the high-pressure environment where players must constantly perform at peak levels to maintain rankings and meet the expectations of their teams, sponsors, and fans. These psychological demands of competitive gaming, are highlighted as significant concerns [6]. This stress is comparable to what professional athletes in traditional sports experience, leading to elevated levels of anxiety and emotional strain [13].

Researchers identified 51 different stress factors affecting esports players. These include communication issues and the pressure of performing in front of live audiences. The stress levels of esports players are similar to those faced by professional athletes in high-stakes competitions like football and rugby [13].

Burnout is another prevalent issue among esports players, resulting from intense practice schedules and the pressure to perform continuously. This often involves long hours of gameplay with little rest, leading to physical and mental exhaustion. The culture of "grinding," where players practice excessively to hone their skills, intensifies the risk of burnout [12].

Sleep problems are also common, as irregular sleep patterns and insufficient rest are frequent among esports athletes. Late-night practice sessions and exposure to screens disrupt normal sleep routines, contributing to sleep deprivation and associated health problems [12]. Poor sleep quality is strongly linked to increased symptoms of depression and anxiety in this population [13]

Depression is a significant concern, this can be caused by the isolated and sedentary lifestyle that often accompanies a career in esports. Players may experience loneliness, especially if they lack strong social support outside of gaming [12]. The high demands and constant organizational pressures further contribute to feelings of depression [4].

2.1.3 Conclusion

While both traditional athletes and esports athletes compete at high levels of skill and strategy, their physical and cognitive demands differ significantly, leading to distinct health considerations. Traditional athletes engage in physically intensive training, focusing aspects like endurance, strength, agility, and recovery to enhance performance and prevent injuries. Their training routines include structured exercise, nutrition plans, and medical support tailored to this. In contrast, esports athletes primarily rely on cognitive endurance, rapid decision making, and fine motor skills, often requiring intense focus and reaction speed rather than gross motor coordination. This results in a different set of health concerns, including eye strain, musculoskeletal issues from prolonged sitting, poor posture, mental fatigue, and stress related challenges.

Additionally, while sports science research is well documented, esports athletes lack standardized guidelines for health monitoring, injury prevention, and performance optimization. Unlike traditional sports, where physical exertion naturally regulates sleep and metabolic processes, esports athletes often struggle with irregular sleep patterns, inactive lifestyles, and heightened psychological pressure, impacting both performance and well-being. Despite these differences, the demand for structured health support is equally important in esports, requiring tailored solutions that integrate mental, physical, and cognitive health monitoring to sustain peak performance over time.

2.2 Optimizing performance and well-being

Sleep is very important for esports athletes. [14] found that within a study of 27 esports players, players with better game performance spent more time sleeping. However, they also found that the sleep efficiency of these players was below recommended levels and below what is found in athletes in different sports. This could be caused by different factors, like blue light caused by the monitors used for gaming. According to [15], extended sleep leads to substantial improvements in daytime alertness, reaction time, and mood. This means extended sleep could most likely benefit esports athletes.

Traditional athletes rely on comprehensive physical training to enhance their performance. For esports athletes, incorporating physical exercise is essential to combat the sedentary nature of gaming. Programs such as cardiovascular exercises, strength training, and flexibility routines can help [5].

Nutrition plays a large role in the performance of traditional athletes and is equally important for esports players . A balanced diet rich in essential nutrients supports cognitive function and energy levels [9].

Esports athletes face high levels of stress due to intense competition [2]. This stress can cause increased cortisol levels and heart rate, similar to traditional sports. Effective stress management techniques, such as mindfulness and deep-breathing exercises, are crucial to help athletes stay calm and perform well under pressure.

Maintaining strong attention and focus is crucial for esports athletes. They need visual attention to react to everything that happens in complex games. Furthermore, they need the ability to track multiple objects at once, for example, looking at the map whilst communicating with their teammates. Training to improve these skills can enhance performance in fast-paced, strategic games.

Esports games often change, requiring players to adapt quickly. Cognitive flexibility, the ability to switch between tasks and strategies, is essential. Esports athletes must constantly update their game plans in response to new information and changes in the game.

Esports athletes need a strong working memory to hold and process information during gameplay. Inhibitory control, the ability to ignore distractions and focus on the game, is also important. Training these cognitive functions can improve decision-making and performance.

Managing emotions is also important in esports. Athletes often face anxiety and frustration during competition. Learning to regulate these emotions through techniques like cognitive-behavioural strategies helps maintain performance and recover from setbacks.

Staying motivated and setting clear goals are key to long-term success in esports. Athletes who set achievable goals and find personal satisfaction in their progress are more likely to stay engaged and perform better. Understanding what drives an athlete's motivation can help create effective training programs. A motivated esports athlete is happier and less likely to experience psychological issues.

Effective communication and teamwork are important in team-based esports. Developing strong interpersonal skills and a sense of teamwork can significantly improve performance. Good team

dynamics create a supportive and cohesive environment, enhancing both individual and team success.

2.3 Measuring health and performance indicators

Self-reported tests and questionnaires have become vital tools in both traditional sports and esports for assessing various psychological, emotional, and physical factors that contribute to athlete performance and well-being. These tools offer insights into an athlete's subjective experiences, helping coaches, trainers, and medical professionals develop personalized training regimens and intervention strategies. In esports, where mental and emotional states are closely tied to in-game performance, self-reported assessments can provide data that physiological metrics alone may not capture. This chapter explores the importance of self-reported tests, the types of commonly used questionnaires, and how they help optimize performance and well-being for athletes in both fields.

Self-reports help identify non-physical symptoms that may affect an athlete's performance, such as burnout, anxiety, or lack of motivation, which can go unnoticed by physiological tracking devices. Surveys assessing mental health, such as the Patient Health Questionnaire-9, revealed varying degrees of depression among esports athletes, with over half reporting mild to severe symptoms [16]. This underscores the importance of integrating mental health evaluations alongside physical activity assessments.

In sports, self-reported assessments such as the Rated Perceived Exertion (RPE), Profile of Mood States (POMS), State-Trait Anxiety Inventory (STAI), and Perceived Stress Scale (PSS) have been widely used to measure emotional states like anger, fatigue, tension, and stress, allowing for early detection of mental strain and overtraining. Similarly, esports athletes can benefit from mood and stress monitoring tools in a similar way, as it is can allow for timely interventions to prevent burnout and cognitive fatigue.

The Rated Perceived Exertion (RPE) Scale, commonly used in sports and fitness, measures how hard an athlete feels they are working during physical activity, typically on a scale from 6 to 20, with 6 being no exertion and 20 being maximal exertion. It provides athletes and coaches with a subjective tool to gauge workout intensity and its impact on fatigue and performance [17]. The RPE scale is useful because it correlates closely with physiological markers such as heart rate and oxygen consumption, making it a reliable indicator of exercise intensity without the need for complex equipment. This way it can also reflect how mental strain or stress may increase perceived exertion, even when physical effort is constant. While physical intensity may be low in esports, cognitive load, mental fatigue, and stress are often very high. Esports athletes can self-assess their perceived mental and emotional fatigue after training sessions, reflecting how mentally taxing gameplay is, similar to how physical athletes gauge their exertion during physical workouts. For instance, after several hours of gameplay or tournament participation, an esports player might rate their perceived cognitive effort using the RPE scale, where a higher score indicates greater mental fatigue and focus depletion.

Profile of Mood States (POMS) is a psychological rating scale used to assess transient, distinct mood states. It measures six different mood dimensions: tension, depression, anger, vigour, fatigue, and confusion [18]. This tool can help understand how mood changes correlate with an athlete's training load or performance dips. The State-Trait Anxiety Inventory (STAI) measures two types of anxiety: state anxiety (temporary and dependent on the situation) and trait anxiety (generalized and long-

term). By assessing how athletes feel at specific moments, these tools could be useful for helping to identify moods and anxiety before a tournament, so the team coach can help by intervening.

The PSS is widely used to measure the perception of stress. It evaluates how unpredictable, uncontrollable, and overwhelming athletes find their lives. In esports, where the mental load can be extreme due to long training hours and the high stress of competing in tournaments, this scale can help understand the cognitive stressors affecting an athlete's performance. Moreover, the Recovery-Stress Questionnaire (RESTQ) is a tool designed to systematically assess a person's recovery-stress balance. It measures how much emotional, social, mental, or physical stress someone is experiencing, and whether they have engaged in recovery activities or states in recent days to counterbalance that stress [19].

Several sleep quality questionnaires and self-reported tests are widely used to assess sleep patterns and disturbances, particularly in athletes where sleep is crucial for performance and recovery. The Pittsburgh Sleep Quality Index (PSQI) is among the most recognized, evaluating various aspects of sleep quality over one month, including sleep duration, disturbances, and daytime dysfunction [20]. However, this test is mainly focused on finding sleep related issues and This questionnaire is often employed in athlete populations to assess general sleep patterns and identify issues like insomnia or poor sleep quality, which can negatively impact recovery and performance. The Athlete Sleep Screening Questionnaire (ASSQ) is tailored specifically for athletes, focusing on identifying sleep disturbances and their impact on training and competition [21].

Questions	Score
1. How well did you sleep?	1 2 3 4 5 6 7 Poor Very good
2. Did you sleep well?	1 2 3 4 Not at all Very much
3. Did you have deep sleep?	1 2 3 4 Not at all Very much
4. Did you have difficulty in falling asleep?	1 2 3 4 Not at all Very much
5. Did you have difficulty staying asleep?	1 2 3 4 Not at all Very much
6. Do you feel refreshed after sleeping?	1 2 3 4 Not at all Very much
7. How many times did you wake up during the night?	0 1 2 3 4 5 Never 5 times

Figure 1: Self-rating Scale for Sleep and Awakening Quality (SSAQ) questionnaire

For Esports, self-reported tests allow for a universal understanding of an athlete's condition. In traditional sports, these assessments help in tracking mental fatigue, motivation, and recovery, which directly influence physical performance. For instance, an athlete might physically appear to be in top form, but self-reported fatigue or emotional stress could signal a need for reduced training intensity or psychological support. These tools also guide the customization of training plans, where coaches can adjust schedules based on an athlete's reported well-being. By providing personalized and subjective insights into factors such as stress, mood, fatigue, and sleep quality, these assessments enable coaches, trainers, and athletes to take steps to improve performance and well-being. For esports athletes in particular, where cognitive endurance is very important, these tools can play a role in maintaining focus, preventing burnout, and sustaining high levels of performance in competitive settings in Esports.

3. STATE OF THE ART

The objective of this state-of-the-art review is to explore existing dashboards and tools that utilize features to improve the health and performance of athletes. Firstly, dashboards and tools used for traditional sports athletes are examined. Since some issues that traditional athletes have are similar to those of Esports athletes, inspiration can be gathered from that and the features they use to address these problems. After that, Esports focussed tools will be examined. It is important to know what current Esports focussed tools look like and what features they implement. Finally, there are some specialized tools which could combine game performance metrics with health monitoring for Esports players. The goals is to identify key features of these tools and understand the methods they used in their implementation.

3.1 Traditional sports focussed health tools

3.1.1 Catapult

Catapult [22] is a company that developed a system that provides comprehensive athlete performance monitoring through GPS tracking, inertial sensors, and heart rate monitoring. The dashboard is aimed at professional athletes and offers real-time insights and detailed analytics on athlete load, movement, and overall performance. Furthermore, they focus on athlete health to not only optimize performance but also reduce the risk of injury and improve recovery.

Users can take advantage of using wearable technology to collect data, which is then processed and visualized through their online platform. They have the option to integrate AI to offer prescriptive analytics. In short, Catapult helps teams manage training loads, prevent injuries, and optimize performance by providing actionable insights.

3.1.2 Kitman Labs

Kitman Labs [23] offer a platform that focuses on integrating medical, performance, and wellness data. Furthermore, they provide injury analysis, treatment planning, and real-time reporting. The centralized dashboards allow for tracking all aspects of athlete health. The platform allows the user to import data from various sources, including medical records, training sessions, and standardized surveys to measure athlete wellbeing. They use machine learning to identify injury risks and recommend preventative measures.

This way, the Kitman Labs Athlete platform can aid medical and coaching staff in making informed decisions to enhance athlete health and performance.

3.1.3 Panega Sports

Panega Sports [24] offers a dashboard solution that integrates performance tracking and management for sports teams by aggregating data across multiple sources. Key functionalities include customizable dashboards, health and readiness assessments, and training load management, enabling a holistic view of athlete performance. The platform supports data import from various devices, allowing teams to monitor training progress, fatigue, and injury risk.

The platform’s design emphasizes straightforward data visualization, which combines diverse metrics for an overall performance overview. By monitoring metrics such as workload and readiness, Panega Sports aligns with traditional sports dashboards in its approach to injury prevention.

3.2 Esports focussed tools

3.2.1 Esports Charts

Esports Charts [25] is a platform that offers comprehensive analytics for esports teams and events, tracking viewership data, tournament results, and player statistics across various games and platforms. The diverse visualization options make it an attractive tool for showcasing data effectively.

3.2.2 Game performance analytics tools

Leetify, Blitz.gg, and Mobalytics [26], [27], [28] each provide performance analysis and improvement tools tailored to individual esports players but differ in their specific offerings and game focuses.

Leetify specializes in analysing performance in Couter Strike, using in-game stats to provide personalized insights and recommendations for skill improvement, showcasing the potential for targeted, game-specific analysis in esports. Blitz.gg, supporting games like League of Legends and Valorant, offers real-time statistics, performance analysis, and improvement suggestions by aggregating data from game API's and analysing match histories. Mobalytics takes a more visual approach, delivering in-depth analytics, personal performance metrics, and video tutorials to help players identify strengths and weaknesses, using machine learning to enhance player feedback. Together, these platforms highlight how individual-focused dashboards in esports leverage in-game data, machine learning, and personalized insights to further enhance player performance.

3.2.3 FitGMR Performance Team Dashboard

The FitGMR Performance Team Dashboard [29] is an Esports platform dedicated to tracking the physical, mental, and cognitive well-being of players. The dashboard includes modules for assessing fitness levels, mental health, lifestyle habits, and training analytics. This platform incorporates both biometric data and subjective assessments.

The dashboard's design reflects the needs of esports, placing additional emphasis on cognitive and mental health metrics, which are less prominent in traditional sports dashboards. FitGMR's focus on comprehensive wellness tracking highlights the evolving demands of esports and its distinct performance metrics.

3.3 Specialized tools

3.3.1 AthleteMonitoring.com

AthleteMonitoring.com [22] provides a platform for tracking athlete health and performance across both traditional and esports domains. The dashboard features wellness monitoring, training load, injury surveillance, and customizable reports, helping coaches track and enhance athlete performance. The platform allows data input from self-reported metrics and wearables, creating an integrated view of each athlete's well-being.

Machine learning is employed to identify trends, perform risk analysis, and generate automated reports, with a focus on real-time feedback. Like traditional sports platforms, AthleteMonitoring.com emphasizes preventative monitoring to reduce injury rates and optimize player output.

3.3.2 Sports Data Valley

Sports Data Valley is a collaborative platform designed to improve athlete performance, health, and research outcomes by using data. The platform integrates and analyses various types of sports data, providing an overview of athlete performance through multiple options of data integration.

It is possible as a researcher to use machine learning and AI to analyse large datasets. This way you are able to discover patterns and predict outcomes. It also supports research collaboration among researchers, athletes, and sports organizations, contributing to the development of evidence-based methods.

Personalized dashboards for athletes and coaches give personalized performance metrics, health indicators, and training recommendations. This enables monitoring and adjustment of training plans based on this data. Because coaches and the athletes get personalized dashboards, it is possible to hide certain sensitive data so that athletes are not able to look at each other's data.

Furthermore, it is able to tracks health metrics such as sleep patterns, nutrition, and mental well-being. Data security and privacy are ensured through different protocols and compliance with regulations, giving athletes control over their data.

3.3.3 Esports dashboard proposal

In a previous project, an esports dashboard proposal was made by [30]. This project builds upon research that has been previously done to develop an esports dashboard proposal.

3.4 Conclusion

The analysis of existing data dashboards for esports and traditional sports reveals several key features and methodologies essential for developing a robust e-health monitoring and recommendation tool tailored to esports players. The following features were present in the tools and dashboard that were analysed;

- Data integration from multiple sources
- Real-time insight and game analytics
- Personalized dashboards and privacy
- Injury prevention and health monitoring

- Advanced analytics and machine learning

Traditional sports tools like Catapult, Kitman Labs, and Panega Sports emphasize performance tracking, injury prevention, training load management, and real-time analytics, often integrating wearable devices. These functionalities are transferable to esports, particularly for optimizing physical health and managing workloads.

Esports-focused tools such as Leetify, Blitz.gg, and FitGMR prioritize game-specific analytics, cognitive performance, and mental health. Platforms like FitGMR highlight the importance of integrating cognitive and lifestyle metrics, which is especially important for esports athletes.

Specialized tools, including AthleteMonitoring.com and Sports Data Valley, link both domains by combining self-reported data and physiological sensors, offering personalized insights, injury surveillance, and training recommendations. Features like data privacy, real-time feedback, and AI-driven analytics make them well-suited for customizable dashboards.

By adopting these features and, an e-health monitoring and recommendation tool can meet the specific requirements of esports players, helping them to enhance their performance, prevent injuries, and maintain health and wellness.

4. METHOD

For this project, the Creative Technology design process by [31] will be utilized. This design process introduces a structured design methodology for the Creative Technology bachelor program at the University of Twente. The process is divided into four phases: Ideation, Specification, Realization, and Evaluation.

4.1 Ideation Phase

In the ideation phase, the design process begins with the question: "How can we use data to improve the health and performance of esports players?" This phase involves divergent thinking to explore multiple ideas and possibilities. In literature, different ways of measuring performance and health of esports players where found. These crucial data metrics such as physical health indicators (heart rate, sleep patterns) and game performance statistics (reaction time, accuracy) are used when finding functionalities for the dashboard. Conducting user interviews with esports players and other stakeholders helps to understand their specific requirements for the tool. Furthermore, existing tools and dashboards are explored to gain insights. After that, multiple concepts are generated with a focus on different aspects and features.

4.2 Specification Phase

During the specification phase, multiple prototypes of the esports data dashboard are developed and iteratively evaluated to refine the design. The focus shifts to converging on a specific solution through building and testing these prototypes to gather user feedback and adjust both functionality and user experience. Initial versions of the dashboard are created, incorporating key metrics identified during the ideation phase, such as in-game performance data. These prototypes are then tested with a small group of stakeholders to gather usability and functionality feedback. Based on this feedback, the design is refined, improving the functional aspects of the dashboard. At the end of the specification phase, there will be a practical specification of the features of the dashboard, making sure the functional and non-functional requirements are met.

4.3 Realization Phase

In the realization phase, the chosen solution is developed in detail. Key components, such as data collection modules (integrating wearables and game APIs for real-time data acquisition), data processing algorithms, and the user interface. Each component is then implemented: data collection systems gather the necessary information, algorithms process this data to provide actionable insights, and the user interface is designed to be user-friendly and intuitive. These components are integrated into a functional prototype. The dashboard is tested such that it meets the initial specifications.

4.4 Evaluation Phase

The evaluation phase of this thesis involves evaluating whether the final prototype meets the initial requirements and user needs. User testing is conducted with a group of esports players and stakeholders to gather feedback on the dashboard's effectiveness and user experience. Reflection on the design process identifies if the features of the dashboard are effective. Necessary adjustments are made based on feedback and evaluation results to finalize the dashboard, ensuring it effectively enhances player health and performance.

4.5 Conclusion

By following these phases, the Creative Technology design method provides a iterative approach to developing an esports data dashboard that balances technological exploration and user-centred design, leading to a prototype made for its intended users.

5. IDEATION

In this chapter, various ideas and potential directions for the project are explored, building on the existing literature and state-of-the-art research. It begins with a brainstorming session focused on Esports, followed by identifying key performance and health indicators relevant to esports athletes and methods for measuring them. A stakeholder analysis is then conducted to ensure the prototype is aligned with their needs, including an impact analysis to assess stakeholder influence. Additionally, stakeholder personas are presented. From this, a list of dashboard features is ideated. Finally, a list of functional and non-functional requirements is presented.

5.1 Understanding the problem

The first step of the ideation process was brainstorming about esports as a whole.

+add description, why the brainstorm? Who did the brainstorm? In red: Esports athlete and indicators of physical health and mental health that affect performance.

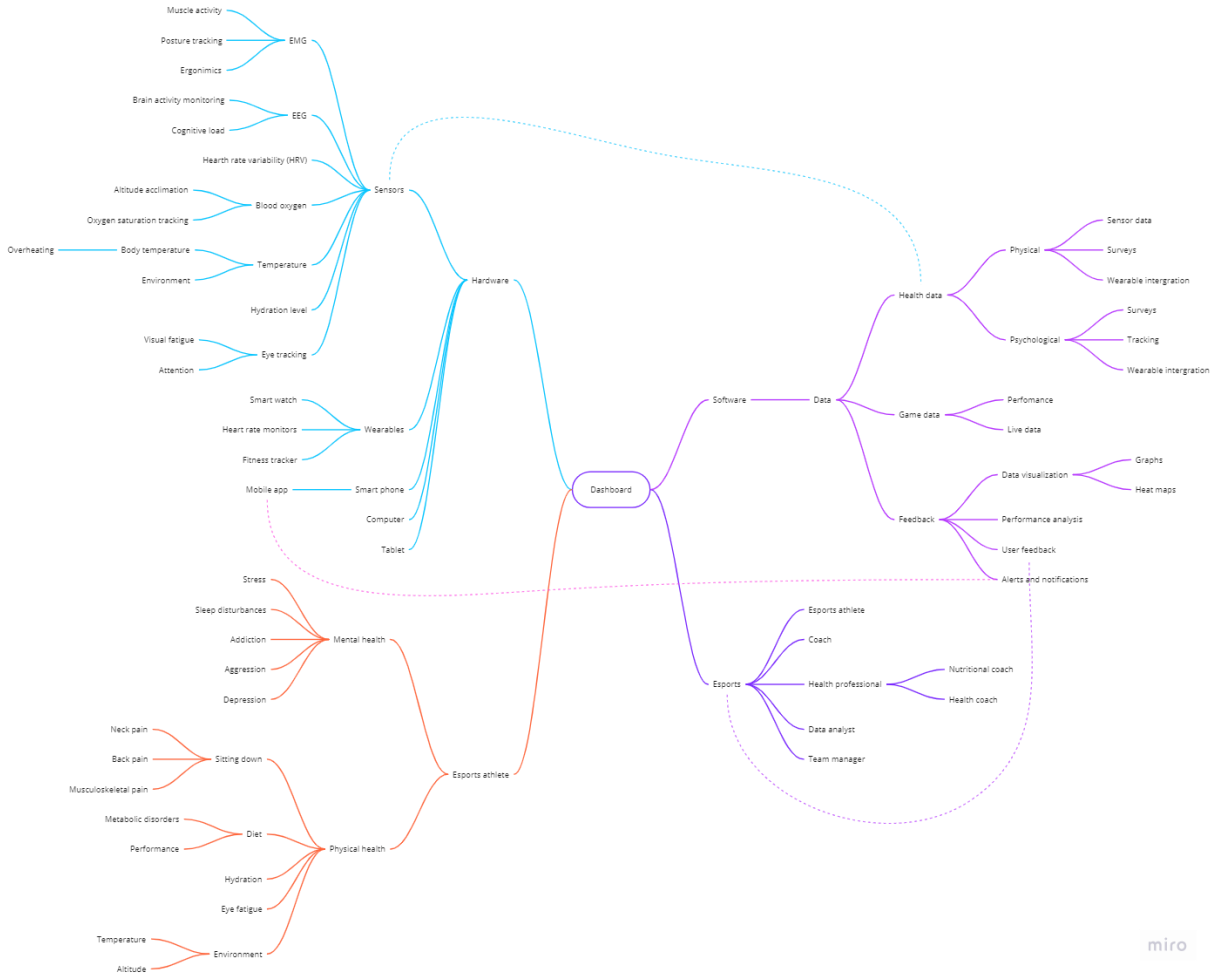


Figure 1: Mindmap about different aspects of Esports athletes for the design a dashboard

5.2 Measuring Performance and Health Indicators

Based on literature, numerous health and performance indicators were found that affect esports athletes. For the development of the prototype it is important to list these indicators. Moreover, how can these indicators be measured? After that, these measuring methods of the indicators can be evaluated based on practicality of implementation and importance.

Tabel 1: Health and performance indicators for esports athletes and measurement methods

Indicator	Measurement methods
Sleep	Sleep tracking device Smartwatch Sleep dairy Polysomnography Pittsburgh Sleep Quality Index (PSQI) Athlete Sleep Screening Questionnaire (ASSQ)
Hydration	Smart water bottle Urine colour chart Body weight changes Bioelectrical impedance device Hydration wearable sensor
Stress	Psychological questionnaire (PSS) Hearth rate variability wearable Cortisol level measuring device
Environment	Ambient temperature sensor Wearable temperature sensor
Cognitive performance	Reaction time computer-based test Reaction time measuring mobile app Psychological questionnaire (POMS) Mood diary application Alertness cognitive performance test (PVT) Rated Perceived Exertion (RPE)
Eye health	Screen time tracking software Visual acuity test Eye tracking camera
Physical well-being	Fatigue Assessment Scale (FAS) Performance metrics Intensity self-report Posture monitoring device Webcam posture tracking
Nutrition	Dietary logs Blood test Nutrition analysis application

These measurement methods can be grouped into different categories, namely: wearables and devices, questionnaires and self-reports, tests and assessments, and applications. These different approaches can be used to monitor and evaluate the well-being and performance of esports athletes. Different methods have their strengths and limitations. This way, a combination of the different methods can be used to make the most effective prototype. In the next chapter, Specification, these methods will be assessed to find out what methods should be used in the final prototype.

5.3 Stakeholder analysis

5.3.1 Esports team structure

Professional esports teams are often structured similarly to traditional sports organizations. The players, who are the core members of the team, specialize in specific roles or characters within their games. Each player's expertise and role are critical as they directly influence the team's strategy and performance during matches.

Coaches play a critical role in developing game strategies, guiding the players' training routines, and making crucial decisions during competitions. They also oversee the psychological and physical well-being of the players, ensuring they are prepared and able to perform at their best.

Analysts contribute by studying game footage and data to discover strategic advantages. They help refine the team's gameplay and prepare them for upcoming matches by analysing the opponent's playstyles, strengths, and weaknesses. Their insights are invaluable for crafting strategies that can give their team a competitive edge.

Support staff, including managers and health professionals such as nutritionists and physical therapists, provide logistical and health support for the esports athletes. This is to make sure athletes perform at their best. Managers handle administrative tasks and logistics, while health professionals ensure the player's physical and mental well-being to prevent burnouts and injuries.

Sponsors and partners are necessary for the financial support of esports teams. They provide the resources needed for the team to compete while gaining exposure through branding and marketing associated with the team's success. In 2021, 833.6 million dollars in revenues, over 75% of the total market, came from media rights and sponsorships [32].

5.3.2 Stakeholder impact analysis

To help identify different ways stakeholders have an impact on the design of the dashboard, Mendelow's Power-Interest grid can be utilized. Mendelow's Power-Interest Grid helps to classify stakeholders based on their power (ability to influence the project) and interest (level of concern about the project outcomes). Each stakeholder gets plotted on the grid based on their power and interest. The grid is divided into four quadrants. Based on the stakeholder's position on the grid, it's possible to develop strategies to manage stakeholder expectations and involvement in the tool's implementation.

List of stakeholders:

- Esports players
    - Manage their own performance and health using data from different sources
- Esports coach
    - Review performance and health data of all players in the team to gain insights
- Esports analyst
    - Uses performance data for strategizing and performance optimization
- Esports team manager
    - Is interested in the overall team performance and well-being of the players
- Medical coach/trainer

    - Monitor the physical health and mental well-being of the player. Prevents overuse injuries and burnout
- Team sponsors and investors
    - Are interested in team and player performance to justify sponsorships
- Esports fans
    - Interested in interesting non-sensitive performance metrics of the team and players
- University of Twente
    - Has its own esports team and wants to research different aspects of it.
- Tool's developers
    - Build and maintain the tool, make the best tool for all stakeholders

These stakeholders can be classified based on their power and interest in the project as follows:

High influence, high interest

1. Esports players: these are the primary users of the tool and are directly affected.
2. Coaches and Trainers: they use it to optimize player performance and health.
3. Medical coach/trainer: monitor the health and well-being of the coaches to prevent overuse.

High influence, low interest

1. Tool's developers: need to know a lot about the usage of the tool, are less interested in the use of the tool themselves.

Low influence, high interest

1. Esports analyst: can provide strategies based on data. They are not the primary decision makers.
2. University of Twente: contributes to the project but does not control it

Low influence, low interest

1. Teams sponsors and investors: Interested in high level metrics of the team, not involved in usage of the tool.
2. Esports fans: Curious about performance statistics, they have little impact on the tool.

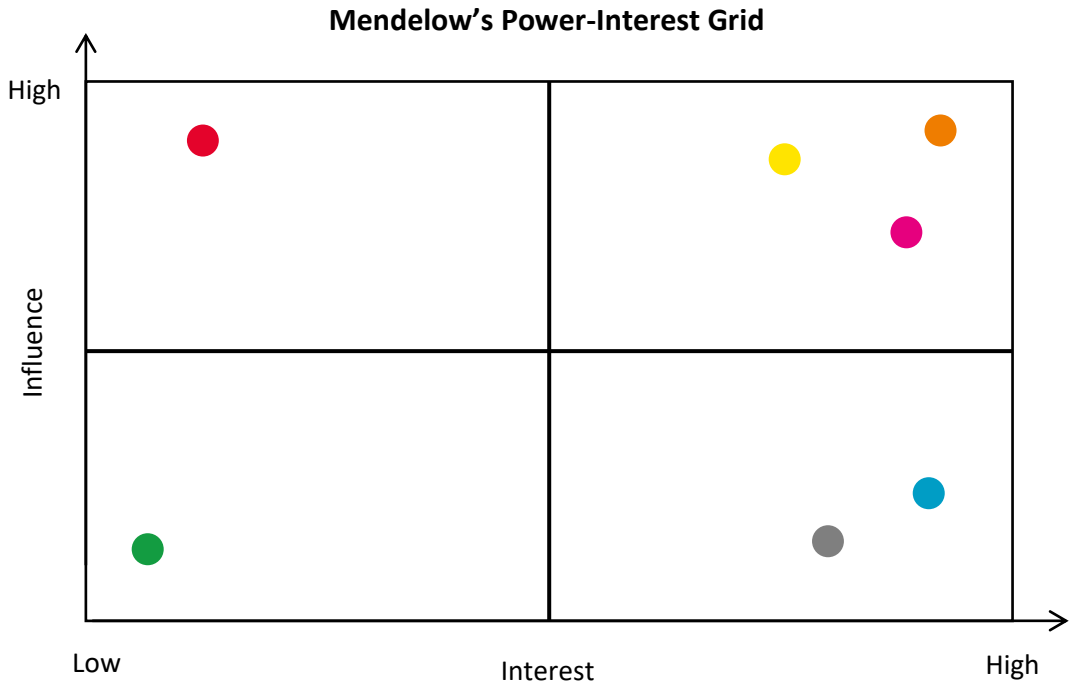


Figure 2: Stakeholder impact using Mendelow's power-interest grid

5.3.3 Sports coach interview

For this project, it is important to know about different aspects of Esports. In this case, an interview with a top sports coach was conducted. To know more about ways performance is measured and what kind of health monitoring is done for sports athletes.

5.3.4 Data perspectives

There are different perspectives on displaying data to the users of the tool. Namely, displaying data to the esports player, displaying data for the coach or team manager and displaying data to the supporting staff like health professionals. Each of them should be able to view different aspects of the team. The esports player itself is focused on their individual performance data. The coach or team manager is interested in an overview of the team's performance, whilst also being able to view individual performance and health-related insights. The supporting staff's main focus is on gaining insight into player health.

5.3.5 Stakeholder Persona's

A persona is a fictional, detailed representation of a typical user based on research and insights about the end-users. It includes information about the user's goals, motivations, behaviours, pain points, and demographics. Personas can help empathize with users and keep their needs at the centre of the design process. In ideation, personas are particularly useful because they provide a clear and relatable reference point for brainstorming solutions, prioritizing features, and ensuring that the product aligns with user expectations.

5.3.6 Marc, Player and Coach

Name: Marc van Dijk
Age: 24
Role: Player and Coach for the University of Twente Esports Team
Game: League of Legends

Background

Marc is a Master's student in Computer Science at the University of Twente. He has been playing League of Legends competitively for six years and has achieved Diamond rank in solo queue. In addition to playing, Marc also serves as the coach for the University of Twente's esports team, mentoring newer players and devising team strategies for tournaments.

Marc's dual role as a player and coach makes him a key figure in the team. While he focuses on improving his gameplay, he also analyses team performance, manages training schedules, and provides feedback to players.

Goals

- **As a player:** To improve his reaction time, maintain peak cognitive performance, and achieve a higher rank in League of Legends.
- **As a coach:** To help team members improve their individual and team play, prevent burnout, and guide the team to win tournaments.

Motivations

- Marc is passionate about esports and wants to pursue a career in coaching or esports analytics after his studies.
- He values evidence-based methods for performance improvement and is eager to integrate health and performance data into training.

Challenges

1. **Time management:** Balancing his own training as a player with his responsibilities as a coach is challenging.
2. **Lack of insights:** He struggles to find tools that effectively correlate health metrics like sleep or stress levels with in-game performance.
3. **Team stress:** Some players on the team experience high stress, which affects their consistency and team performance.

Technology Use

- Marc uses gaming dashboards like OP.GG and Mobalytics to track in-game performance.
- He owns a smartwatch for monitoring basic health metrics (e.g., heart rate and sleep).
- He often creates Excel spreadsheets to manually track player performance and compare it to health-related factors.

Needs from the Dashboard

1. **Health Monitoring:** An easy way to track his and his players' physical activity, sleep, and stress levels.
2. **Performance Insights:** Detailed analytics that compare physiological data with in-game performance metrics.
3. **Team Management Tools:** Features to set benchmarks, track progress, and identify areas for improvement.
4. **Customizable Feedback:** Alerts and feedback tailored to individual players' needs to prevent burnout and improve performance.

5.3.7 Sophia, Casual-Competitive Player

Name: Sophia Müller
Age: 20
Role: Player for the University of Twente Esports Team
Game: League of Legends

Background
Sophia is a Bachelor's student in Psychology at the University of Twente. She started playing League of Legends three years ago as a hobby and quickly became skilled enough to join the university's esports team. Unlike her teammates, Sophia is more casual about her approach to gaming and prefers focusing on her gameplay instincts rather than relying on analytics or health tracking tools.

Sophia has a natural talent for the game and excels in team fights and shot calling, often acting as the team's in-game leader. However, she doesn't actively monitor her health or performance outside of the game, believing that "playing more" is the best way to improve.

Goals

- To improve her rank and performance in tournaments while still balancing her academic life.
- To enjoy gaming as a fun and social activity, avoiding burnout or unnecessary stress.

Motivations

- Sophia enjoys the camaraderie and competitive environment of being part of the esports team.
- She values her natural gaming skills and prefers to focus on strategies rather than external metrics.

Challenges

1. **Health awareness:** Sophia doesn't track her health metrics and often ignores the impact of poor sleep or stress on her gameplay.
2. **Performance improvement:** Despite her talent, she wants to optimize her esports performance.

3. **Time balance:** She finds it hard to dedicate consistent time to both gaming and her studies, leading to irregular practice schedules.

Technology Use

- Sophia uses gaming platforms like OP.GG for basic stats but doesn't dive deeply into performance analytics.
- She doesn’t own or use any wearables or apps for health tracking.
- Her focus is on gameplay rather than tools, preferring to rely on her skills and team feedback.

Needs from the Dashboard

1. **Simplified insights:** Easy to understand feedback about how lifestyle factors like sleep or stress may affect her gameplay.
2. **Minimal setup:** Features that don’t require her to wear or sync additional devices.
3. **Motivational features:** Visuals and insights that encourage her to adopt small, actionable changes for performance improvement.
4. **Team integration:** Tools that show her individual contributions to the team’s success without overwhelming her with data.

Quote
"I just want to focus on playing my best and having fun with my team. If the data can show me one or two easy ways to improve, that’s all I need."

5.3.8 User stories

User stories are concise informal descriptions of a feature or requirement, written from the perspective of the end-user [33]. They typically follow the format:

"As a [type of user], I want [an action] so that [a benefit].".

This structure helps clarify who the user is, what they want, and why it matters. Generating user stories helps make the tool more effective and user-friendly.

- As a player, I want to track my daily physical activity so that I can maintain my fitness level for better cognitive performance.
- As a coach, I want to view performance statistics of my team so that I can identify areas for improvement.
- As a player, I want to log my sleep patterns so that I can see how they affect my reaction time.
- As a player, I want to complete self-reported well-being surveys so that I can monitor my emotional well-being over time and see how it affects my gameplay.
- As a coach, I want to compare a player's physiological data with their in-game performance so that I can identify correlations and suggest improvements.
- As a player, I want to receive feedback on my posture during training so that I can avoid long-term physical injury.
- As a coach, I want to set performance benchmarks for individual players so that progress can be tracked over a period.
- As a player, I want to view trends in my health data so that I can make better decisions about lifestyle adjustments.
- As a coach, I want to receive alerts about players' well-being so that I can take measures to prevent burnout or injury.
- As a player, I want to track my daily stress levels so that I can manage my mental well-being effectively during training and competitions.
- As a health specialist, I want to analyse physiological data such as heart rate and sleep patterns so that I can provide better advice on recovery and health.
- As a team manager, I want to compare individual players' performance data so that I can identify strengths and areas for improvement.
- As a coach, I want to view my teams sleep and stress levels so that I can adjust my training accordingly.
- As a system, I want to switch profiles so that I can get specific views for players, coaches and managers.

5.4 Requirements

Once we have identified the stakeholders and their needs, the next step is to gather the requirements for the esports performance and health monitoring tool.

5.4.1 Ideation dashboard features

Below there is a list of dashboard features that were contrived by brainstorming. These draft dashboard features serve as inspiration for the final prototype.

Tabel 2: Ideation dashboard features including description

Number	Feature name	Feature description
1	Screen time tracker	Monitors daily screen time and suggests breaks and alternative activities.
2	Physical activity log	Tracks physical activity and recommends exercises to balance sedentary periods.
3	Posture monitoring	Uses sensors to ensure proper sitting posture and provides real-time feedback.
4	Sleep tracker	Integrates with sleep monitoring devices to track sleep quality and duration.
5	Stress and Emotional State Tracker	Uses self-report tools and physiological data to monitor stress levels and emotional states.
6	Cognitive training programs	Provides exercises and games to enhance cognitive functions such as memory and attention.
7	Communication and Team Dynamics Analysis	Analyses in-game communication to improve teamwork and coordination.
8	Game performance metrics	Logs detailed in-game metrics such as reaction times, accuracy, and decision-making efficiency.
9	Personalized health and performance feedback	Offers feedback based on data collected, highlighting areas for improvement.
10	Ergonomic and lifestyle recommendations	Provides tips and reminders for ergonomic setup, nutrition, hydration, and regular health check-ups.

5.4.2 Functional requirements

These are the essential functions that the tool must perform. Functional requirements define the specific behaviour or functions of a system. For Esports players, this includes tracking health metrics, providing personalized health recommendations, and integrating with existing training regimes.

Tabel 3: Functional requirements with MoSCoW priority

Topic	Requirement	MoSCoW Priority
Player performance statistics	Display game statistics.	Must have
	Display personalized performance statistics.	Must have
	Display cognitive performance statistics	Must have
Health and wellness Monitoring	Track physical demand	Must have
	Track mental well-being and stress	Must have
	Track cognitive demand	Must have
	Track sleep statistics	Must have
Data visualization	Data visualization in various ways (charts, graphs, heatmaps)	Must have
Health feedback	Include feedback options for performance and health changes (like dehydration or overexertion).	Must have
	Include alerts for performance and health changes	Must have
Activity planner	Display schedule for esports activities	Must have
Data security and Privacy	Ensure secure data handling, making sure health data is not stored	Must have
	Ensure privacy compliance	Must have
Customizable dashboards	Allow customization of dashboard layout.	Should have
	Allow customization of which metrics are displayed	Should have
Training load management	Monitor activity load for various activities	Should have
	Assess player readiness for upcoming Esports tournaments	Should have
Collaboration features	Enable sharing of performance insights with coaches and staff	Could have
Integrate external data sources	Support import/export from fitness trackers, training apps or nutrition apps	Could have
Social and Community Features	Community leaderboards or esports player performance comparisons	Won't have

5.4.3 Non-functional requirements

These are the qualities that the tool must possess. This could include performance requirements like response time and uptime, usability requirements like user-friendly interface and easy navigation, and security requirements like data privacy and secure access.

Tabel 4: Non-functional requirements including description

Nr.	Non-functional requirement	Description
1	The dashboard is not overwhelming	Participants do not feel overwhelmed by information when using the dashboard
2	The dashboard is intuitive to use	Participants have no problem finding features in the prototype
4	The dashboard has a responsive layout	The dashboard has responsive elements that scale to different screen sizes
5	The dashboard is reliable	Interactions in the dashboard work consistently
6	The dashboard should maintain a coherent visual style	Typography, colour schemes and icons should be coherent throughout the dashboard
7	The dashboard is easily readable	Colour used are colorblind friendly and text contrast complies with WCGA guidlines
8	The dashboard is updateable	The prototype should support updates to quickly iterate on the design
9	The dashboard allows users to view information quickly	Charts and other information are labelled and not cluttered to view information at a glance
10	The data of the dashboards users is private	Any user data from testing should be stored securely and the prototype should not save any user data

6. SPECIFICATION

During the specification phase, multiple prototypes of the esports data dashboard are developed and iteratively evaluated to refine the design.

6.1 Measuring esports athlete health

In the previous chapter, different concepts were explored that focus on different aspects of esports athlete health and performance. Furthermore, a large list of indicators was given based on findings in literature. For these indicators there are different methods of measuring. Some are more suitable than others for esports. For example, an smartwatch can be obtrusive for the athlete while gaming with a mouse. This way, a suitable device or sensor has to be chosen to be used for the prototype.

6.1.1 Measuring stress in esports athletes

An important way to measure stress is done by measuring the Hearth Rate Variability. Devices such as the *WHOOP Strap, Empatica E4, Fitbit Sense*, and *BioHarness 3* monitor HRV. Most of the devices are wearables op your wrist. A device on the wrist can be obtrusive for esports athletes since they need to move their wrist freely to accurately move their mouse or other controller. This way, a device such as the *BioHarness* could be a more suitable option since this is a harness that is worn below your shirt on the chest. Or the *Garmin HRM-Pro Plus*. It is also possible to measure cortisol levels in the blood or saliva of the esports athlete. Whilst being more intrusive, this is something that can be done once a month to reveal chronic stress levels.

Tools like the Perceived Stress Scale (PSS) and State-Trait Anxiety Inventory (STAI) can be used regularly to assess an athlete's psychological state. These self-reported measures help identify stress patterns and potential triggers. Furthermore, apps such as Moodpath and Headspace allow athletes to log their moods and stress levels over time. This can provide valuable data that can inform the esports team about psychological issues.

6.1.2 Measuring posture and physical health issues in esports athletes

It is possible to measure posture using a webcam. This way, the athlete is not impeded in any way by sensors. Posture correction wearables such as the *Upright GO*, are small devices that vibrate to correct posture are also available.

6.1.3 Sleep monitoring for esports athletes

Many smartwatches, such as *the Apple Watch, Fitbit Sense, or Garmin Venu*, offer sleep tracking features that monitor sleep stages, sleep duration, and sleep quality. Sleep headbands, like the *Muse S* or *Dreem 2*, typically use EEG sensors to track brain activity during sleep, providing more detailed insights into sleep stages and quality. The *Oura Ring* is a smart ring that is capable of tracking sleep stages (light, deep, REM), heart rate variability (HRV), body temperature, and movement to provide a detailed analysis of sleep quality. It gives readiness scores to help athletes understand how well they recovered overnight.

6.1.4 Measuring nutrition and hydration

Hydration can be monitored using smart water bottles like *HidrateSpark*, which track water intake, or advanced hydration sensors integrated into wearables that assess hydration levels through sweat analysis. Nutrition, while harder to track in real time, can be evaluated through self-reported food

diaries or apps like *MyFitnessPal*, enabling athletes to log meals and analyse macronutrient intake. Although direct measurement of nutrition is time-intensive, providing athletes with guidance on balanced diets and supplement use supports overall health and performance.

6.1.5 Reaction speed

Reaction speed can be an important indicator for esports athletes. A simple way to measure reaction speed is using Human Benchmark[1]. This website has a test in which the screen turns green after a random time and measures the amount of milliseconds it takes the user to press the mouse. This can be utilized to test the reaction speed of esports athletes. When reaction speeds are worse than normal, this could indicate a problem such as bad sleep quality, as sleep is related to reaction speed.

6.1.6 Conclusion

Selecting the right sensors and methods for measuring esports athlete health requires balancing accuracy, intrusiveness, and suitability for the gaming context. Key indicators such as stress, sleep, well-being, and physical activity are important to monitor.

Smartwatches are cost-effective and versatile, offering HRV measurement for stress estimation, sleep tracking, and physical activity monitoring. However, their potential to impede wrist movement during gameplay limits their application in some cases. Alternatives like the BioHarness or chest-worn HRM devices offer a less intrusive option for stress monitoring.

Sleep can be monitored using non-obtrusive wearables like the Oura Ring, which provides comprehensive recovery insights, or headbands that offer advanced EEG-based tracking for detailed sleep analysis. However, most esports athletes won't own these devices and aren't willing to spend a lot of money. Self-reported tools like the Perceived Stress Scale (PSS), *Moodpath*, and *Headspace* apps complement these methods, allowing psychological states and well-being to be logged and analysed regularly.

Posture monitoring through webcams can help ensure ergonomic safety without hindering gameplay. However, they do require a computer to run posture monitoring software which has to be designed and evaluated separately. Reaction speed tests, like the Human Benchmark tool, offer simple yet effective insights into cognitive performance, with variations highlighting potential issues like poor sleep. These reaction speed tests can be completed every day since they don't take much time.

Nutrition also has an effect on esports performance, however, it is very time consuming for the esports athlete to record what they eat. The same goes for hydration, an esports athlete might not want to buy a smart water bottle. Instead, the esports player, coach, or other user of the dashboard could receive alerts and notifications which reminds the importance of hydration and give nutrition related tips.

Intrusive methods, such as heart rate monitors, cortisol level testing, or EEG-based sleep tracking, often provide highly accurate physiological data, enabling precise analysis of stress, fatigue, and recovery. However, these methods may be disruptive to gameplay, as wearing bulky sensors or undergoing frequent biometric testing can interfere with an athlete's fine motor control, comfort, and overall focus. On the other hand, non-intrusive methods, such as webcam-based posture

[1] https://humanbenchmark.com/tests/reactiontime

tracking, self-reported stress questionnaires, or sleep tracking through smartwatches, offer a more seamless and user-friendly experience without interfering with gameplay. However, these methods may sacrifice accuracy, as self-reports are subjective and need to be filled in consistently to provide comprehensive health insights.

The combination of wearables, self-reported tools, and software solutions gives a good balance between functionality and athlete comfort, whist giving insight into what affects their gameplay and makes sure they are ready for tournaments.

6.2 Directions for the Esports health monitoring tool

Based on the research and tools explored, three potential approaches have been identified for developing the prototype of the e-health dashboard. Each offers advantages and challenges, which will be evaluated in terms of feasibility, customization, and functionality.

6.2.1 Using Sports Data Valley

Sports Data Valley provides a comprehensive platform for data integration and analysis. By utilizing their "Researcher" plan, it is possible to do the following:

- Import and analyse data from various sources
- Leverage pre-built features and functionalities for visualizations
- Combine questionnaire data with other metrics within Jupyter Notebooks, offering a robust environment for exploratory analysis and reporting.

This option is valuable for quickly prototyping a functional dashboard with real-world data and advanced analytics. However, customization is limited to the features provided by the platform, which may restrict tailoring the tool specifically to esports athletes or specific features.

6.2.2 Building the dashboard in Python

Developing the dashboard from scratch using Python offers full control over the design and functionality. Libraries and tools could include:

- Panel: a versatile tool for creating interactive web-based dashboards.
- Various Python plotting libraries such as Matplotlib, Plotly, Bokeh or HoloViz for advanced data visualization.

This approach provides maximum flexibility to meet specific requirements. However, it requires significant development time and effort, including learning advanced web-development skills and ensuring the interface is user-friendly.

An alternative could be using Dash, which provides a straightforward way to integrate interactive data visualizations, built on Plotly, directly into web-based dashboards.

6.2.3 Prototyping in Figma

Creating a prototype in Figma allows for visualization of the dashboard's layout and design. This approach has the following benefits:

- Fast and intuitive creation of professional-looking prototypes.
- High focus on user experience and interface aesthetics.
- The potential to export designs into code (for example HTML and CSS) for later functional implementation.

While this method is ideal for quickly iterating on design ideas and gathering feedback, it lacks built-in functionality. Adding interactivity and analytics capabilities will require additional development steps, potentially increasing complexity if transitioning to a functional tool.

6.2.4 Developing a web-based prototype

Using a JavaScript-based framework like React can be a hybrid solution for a functional and visually attractive dashboard. Advantages include:

- Allows integration of real-time data, such as heart rate sensor data or game data.
- Scalability for future enhancements and feature additions.

This option allows for high customization while ensuring the interface is nice to look at. However, it requires expertise in JavaScript, which can increase development time and complexity compared to simpler tools. It also might be hard to implement features like profiles without creating a functional backend.

6.2.5 Evaluation of prototype development solutions

The Pugh Matrix is a decision making tool that helps compare multiple alternatives against a set of criteria. It works by selecting a baseline (datum) and then rating the other options relative to that baseline using + (better), 0 (equal), or - (worse). This method allows for a structured evaluation of different solutions and helps identify the best approach based on a balanced comparison.

For this evaluation, the different prototype development approaches are compared against the functional and non-functional requirements of the esports health monitoring tool and solution specific criteria such as ease of use of the solution and development time. The datum (baseline) chosen is Sports Data Valley because it provides an existing infrastructure for analytics and visualization, which serves as a useful reference point.

Tabel 5: Development solutions Pugh Matrix

Criteria	Sports Data Valley (Baseline)	Python Dashboard	Figma	Web-based prototype
Customization	0	1	1	1
Data integration	0	1	0	1
Visualization features	0	1	0	1
Ease of Use	0	-1	1	-1
Development time	0	-1	1	-1
Interactivity	0	0	1	1
Scalability	0	1	-1	1
Security and privacy	0	-1	0	-1
User experience	0	-1	1	0
Total	**0**	**-2**	**4**	**2**

6.2.6 Conclusion

For this project Figma will be used. The main benefit is because most requirements and features of the prototype can be realized in Figma. The only downside is that the dashboard will not be fully functional but rather only display what it would look like if it were implemented. Since development time of this solution is lower than the other solutions, using this approach, end users can be asked to evaluate the tool in earlier stages of the design.

7. REALISATION

7.1 Steps in Designing the Prototype

First, we start with looking at the requirements. These can be translated to features in for the dashboard. Moreover, the user stories in 0 can be used to make user flows. A user flow is that path a user takes to complete their goal. For each user goal the specific steps the user would take to achieve this goal is mapped out, for example, using a flow chart. These user flows are used to design the interactions in the prototype.

The next step is making a structure for the pages using a sitemap. The sitemap is a structural visualization of the navigation menu. Since only the design of the dashboard will be focused on, this sitemap does not have to be functional, however, it is used for the interactive part of the dashboard.

7.2 Design guidelines

Design guidelines:

- **60-30-10 rule:**
  According to this rule, in any design, 60 percent of the area should be covered by the dominant colour, 30 percent by the secondary colour, and 10 percent by the accent colour. These proportions help create balance

- **Use colours consistently, distinctly and intentional:**
  Colour should be applied throughout a UI consistently and be compatible with the brand it represents.
  Colour should create distinction between elements, with sufficient contrast between them.
  Colour should be applied purposefully as it can convey meaning in multiple ways, such as relationships between elements and degrees of hierarchy.

- **Use proper contrast:**
  According to the Web Compatibility Accessibility Guideline [34] , the visual presentation of text and images of text has a contrast ratio of at least 4.5:1.

- **Affordance**
  Elements of the user interface should visually indicate how they are used; for example, clickable buttons should look pressable.

- **Prioritize relevance**
  The most critical data and feedback are highlighted by using bolding or accent colours to emphasize it.

- **Glanceability**
  When something is glanceable; this means enabling users to understand information quickly and easily [35]. The information displayed in the dashboard should enable users to receive information easily, quickly, and at a glance.

7.3 Dashboard colour palette

For the design of the dashboard it is important to consider the colour palette. The colour palette can have impact on how the dashboard is perceived. So not only does it make the dashboard appealing, it has effect on the user. For example, how serious the dashboard is perceived.

The Elaboration Likelihood Model (ELM) suggests that people process information through two routes: central (focused on logical evaluation) or peripheral (influenced by cues like visuals). How to colour palette is chosen can act as a peripheral cue, influencing users' emotional reactions and perceptions of trustworthiness and professionalism.

For example, a dashboard using calming blues and greens might be perceived as more reliable and health-focused, encouraging users to engage more deeply with the data. In contrast, an overly bright or clashing palette might cause distraction or reduce trust, leading users to dismiss the tool's value [36].

Colours have strong psychological associations and can influence how users perceive and interact with digital interfaces like dashboards [36]. By applying colour theory, the dashboards usability and impact can be enhanced. For instance:

- Blue: Often associated with trust, stability, and professionalism. It's widely used in health and tech platforms to evoke calmness and reliability.
- Green: Linked to growth, balance, and health. It's effective for promoting well-being and aligning with health-focused content.
- Red: Represents urgency, energy, or warnings. It can draw attention to critical alerts but may also evoke stress if overused.
- Yellow: Associated with positivity and energy but can also signify caution. It's best used sparingly to highlight key areas.
- Neutral tones (such as gray and white): Provide balance and help create a clean, professional appearance without overwhelming users.

For the design process, some colour palette variations where tested on a mock-up website *Realtime Colours.*

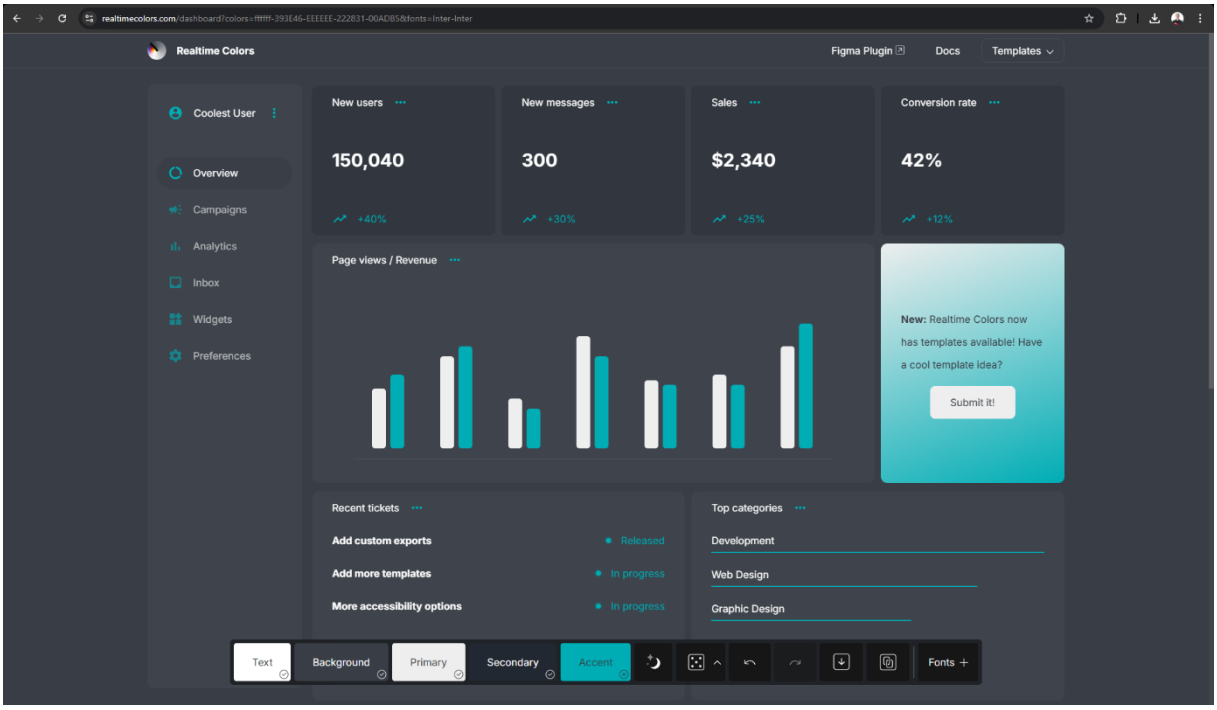


Figure 3: Dark colour palette dashboard design

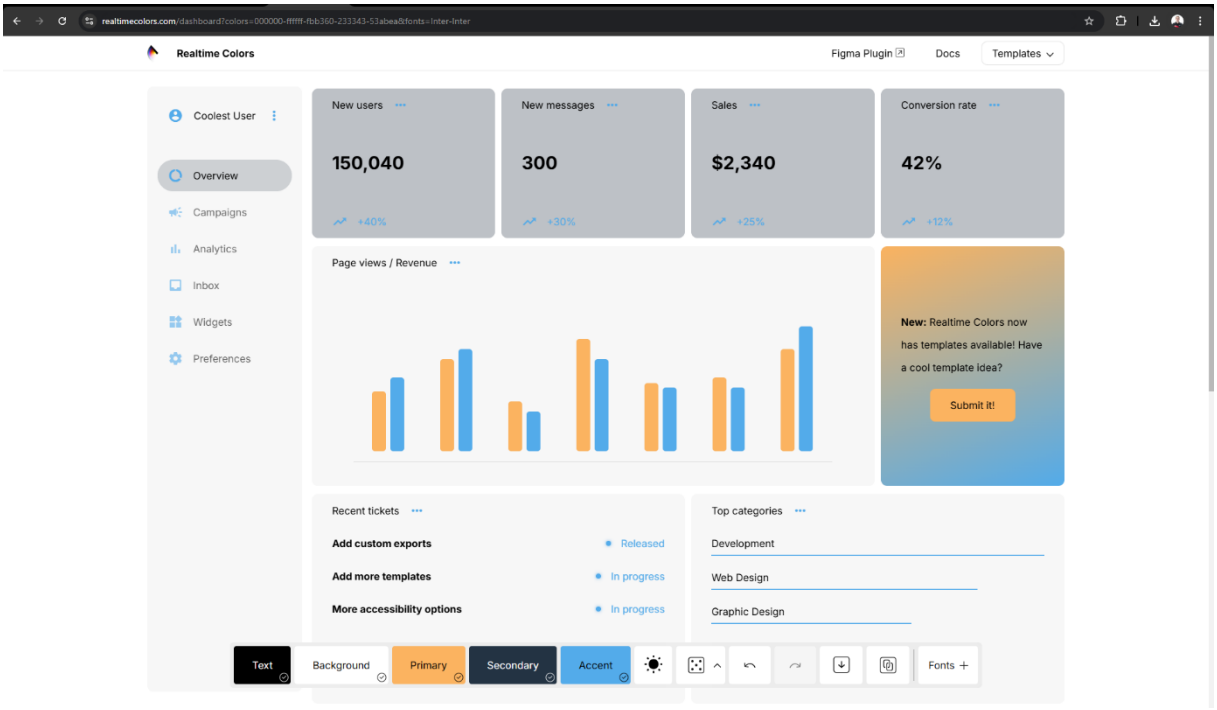


Figure 4: Light colour palette dashboard design

7.4 Dashboard Sitemap

Like any website, it is valuable to create a sitemap. A sitemap is map of the pages on your website, or in this case for the dashboard prototype. It gives a visual presentation of the website and it can help organize content and navigation. This way, it is easier to make for a good user experience.

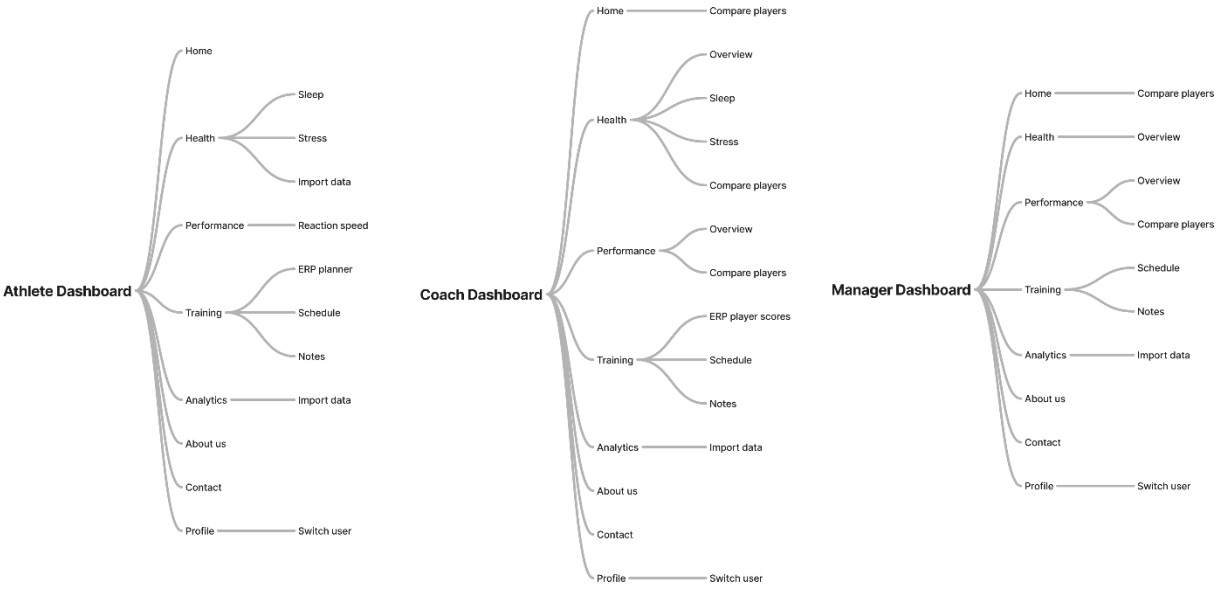


Figure 5: Dashboard sitemap with specific view depending on role

7.5 Dashboard features

Health page:

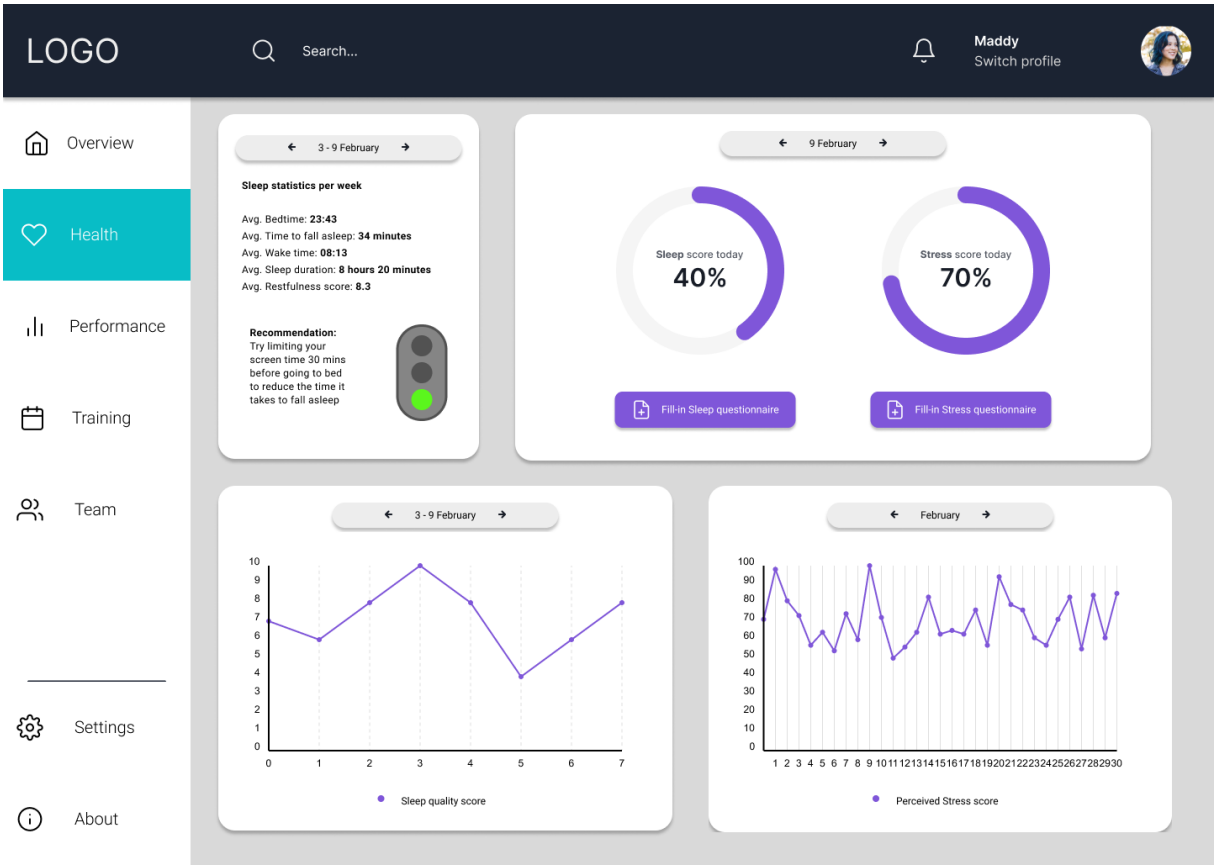


Figure 2: Dashboard health page

Sleep quality questionnaire. Based on two well-known sleep quality questions, namely the Sleep Quality Scale and the Consensus Sleep Diary.

1. Single-Item Sleep Quality Scale (SQS)
   Question: "How would you rate the quality of your sleep last night?
   Scale: 0 = Very poor, 10 = Excellent

2. Consensus Sleep Diary (CSD)
   Bedtime: "What time did you go to bed last night?"
   Sleep Latency: "How many minutes did it take you to fall asleep?"
   Wake Time: "What time did you wake up this morning?"
   Sleep Duration: "How many hours of actual sleep did you get?"
   Restfulness: "How rested did you feel upon waking?" (Scale: 0 = Not rested at all, 10 = Fully rested)

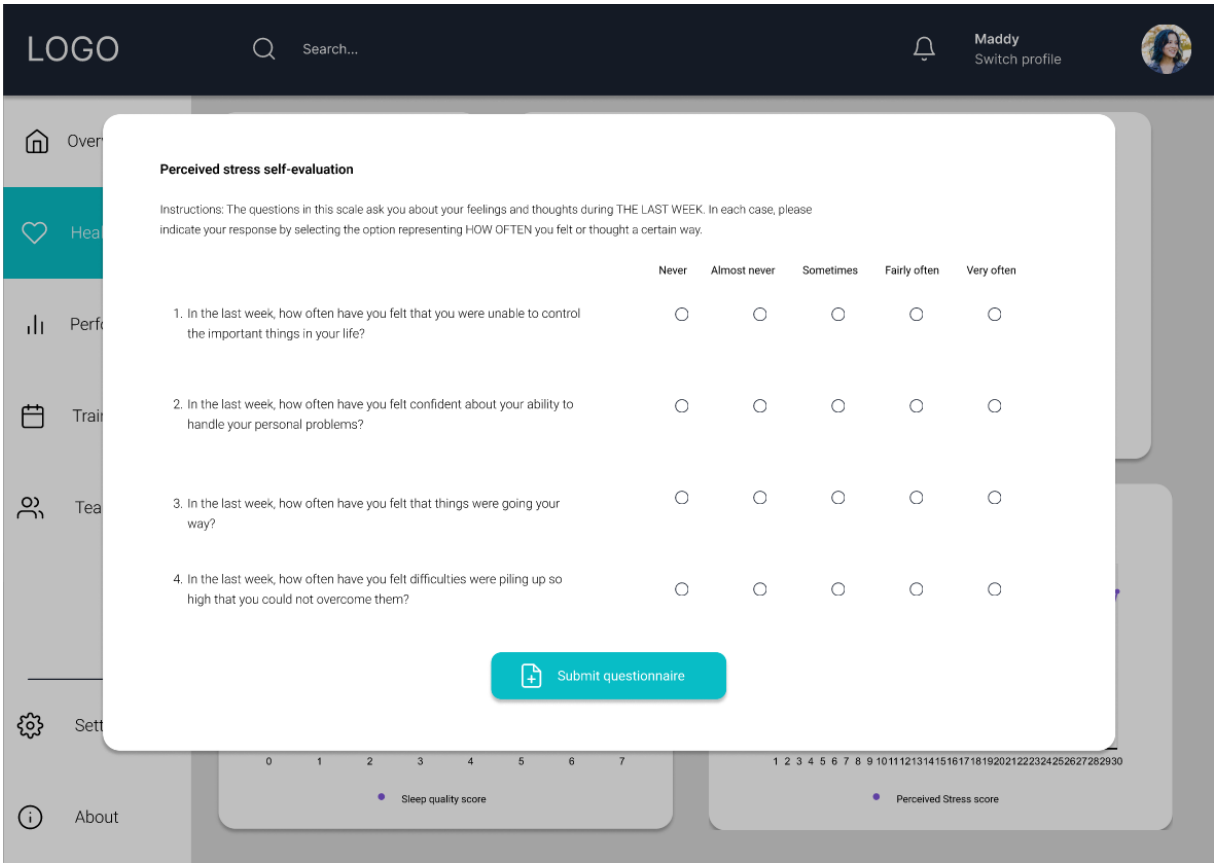


Figure 3: Dashboard perceived stress evaluation form

Mental well-being and stress is gauged via the Perceived Stress Scale (PSS). This scale is adapted to be measured weekly, however, it is possible for users to edit the period in which stress is measured.

Instructions: The questions in this scale ask you about your feelings and thoughts during THE LAST WEEK. In each case, please indicate your response by selecting the option representing HOW OFTEN you felt or thought a certain way. (Rated on a 5 point Likert scale on frequency: 0 = Never, 5 = Often)

1. In the last week, how often have you felt that you were unable to control the important things in your life?
2. In the last week, how often have you felt confident about your ability to handle your personal problems?
3. In the last week, how often have you felt that things were going your way?
4. In the last week, how often have you felt difficulties were piling up so high that you could not overcome them?

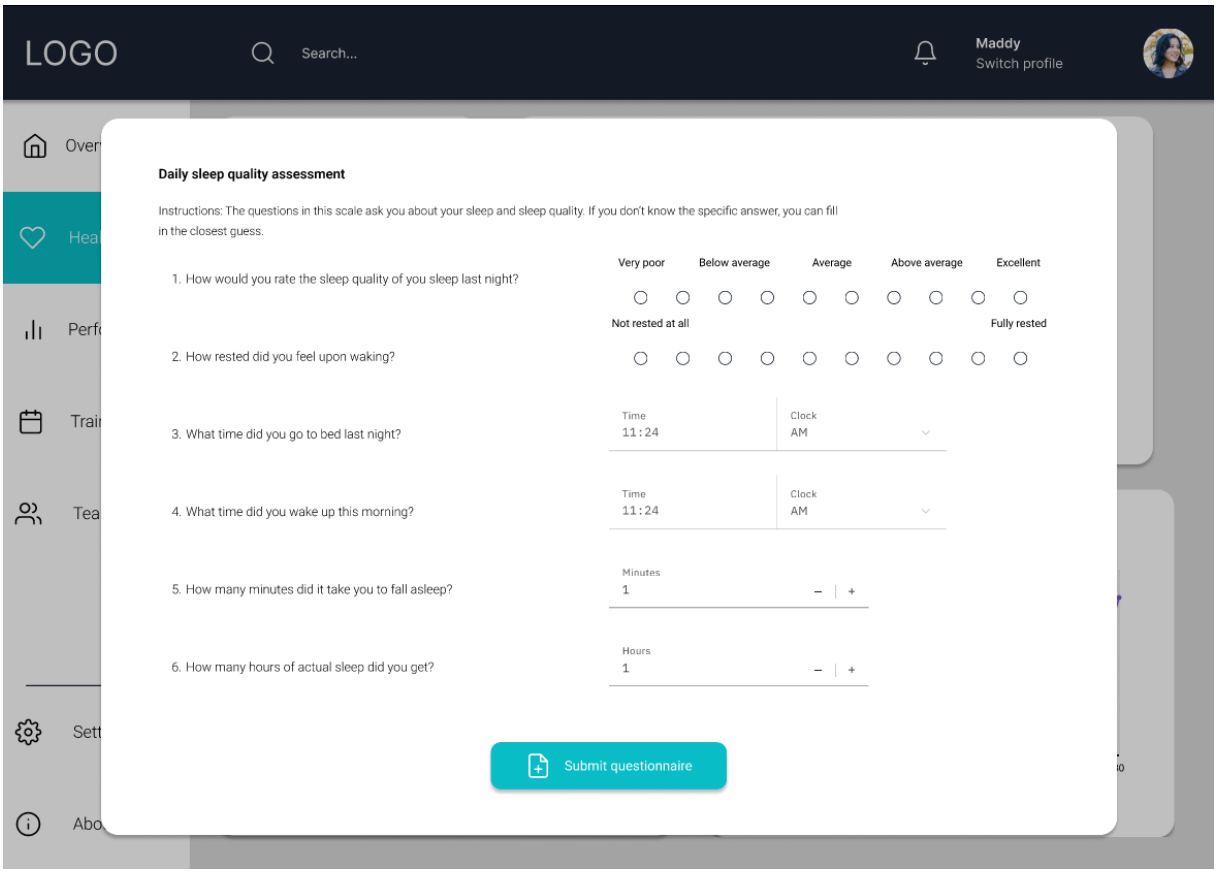


Figure 4: Dashboard sleep assessment form

Feedback:

From the sleep questionnaire, the user will be given a sleep score which is displayed, also the history of sleep scores is displayed as a graph. The same type of feedback will be used for the perceived stress scale scores. Additionally, when the user scores high stress, a traffic light will give an orange light. When this high stress continues for a set time, the traffic light will turn red, indicating that the user or coach should intervene.

Training page:

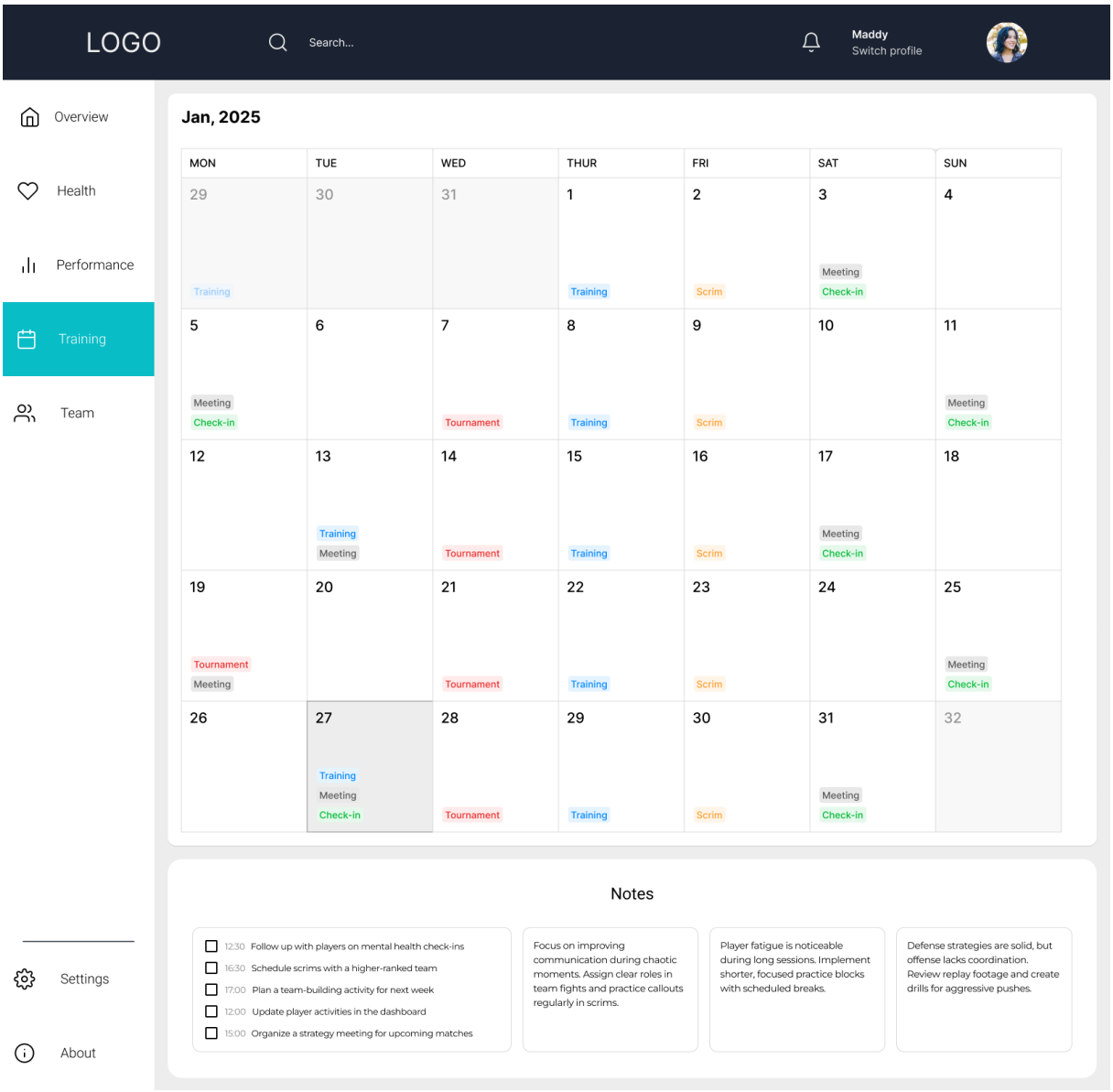


Figure 5: Dashboard training page

In the training section of the tool, it is possible to view the agenda and see upcoming events, like training sessions, tournaments and other competitions.

The user is able to input details of an activity accompanied by a Task Load Index. The activity can be specified, for example, a ranked game, tournament or training using a drop-down menu. The Task Load Index gives an indication on how the user perceived the activity. This can be used in combination with other subjective scores like sleep quality to make correlations.

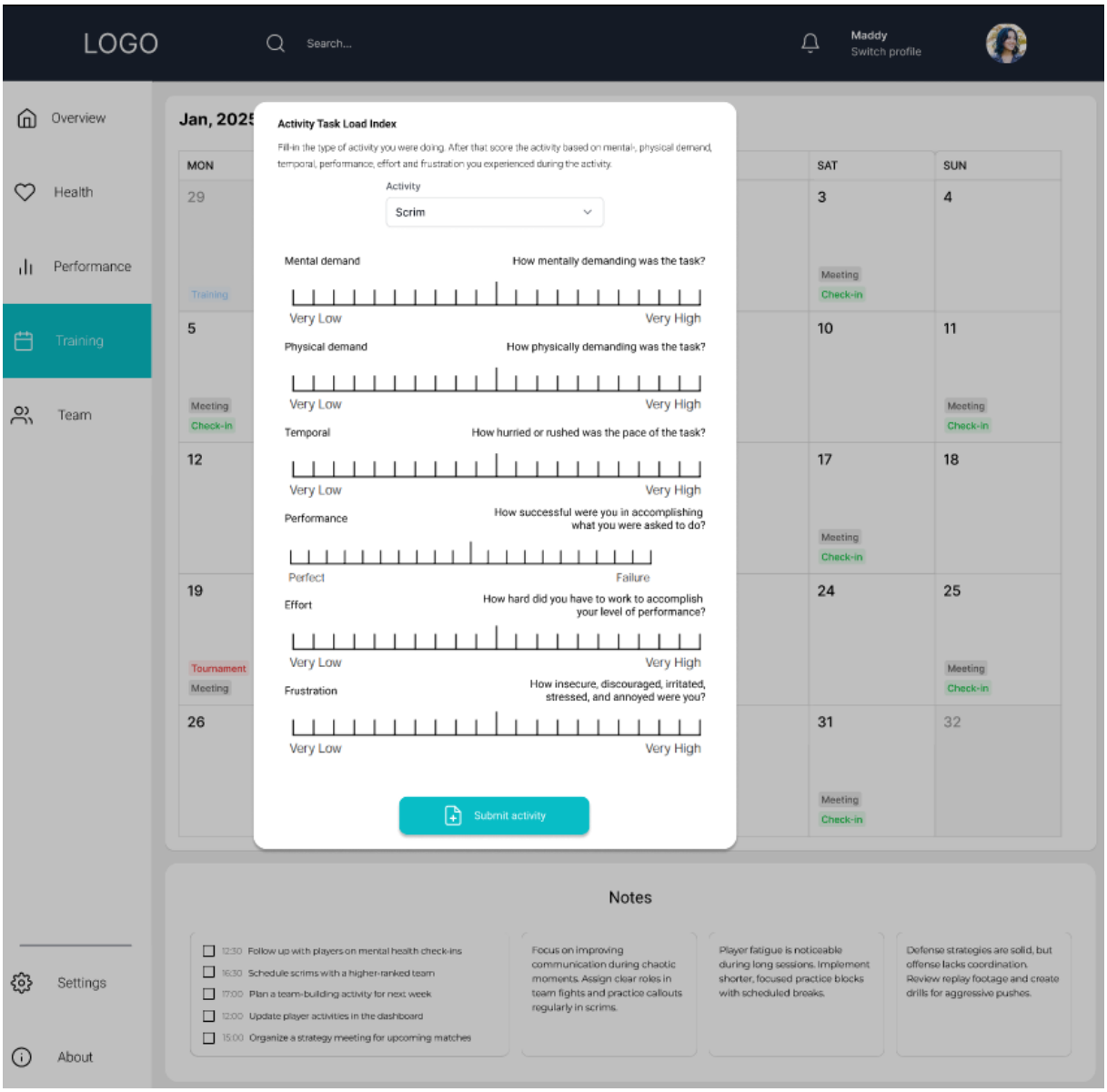


Figure 6: Dashboard activity task load form

Furthermore, via the performance tab of the dashboard, the user can do a reaction time game and submit their score. As the user does this each day, the reaction speed can be tracked over time.

Performance page:

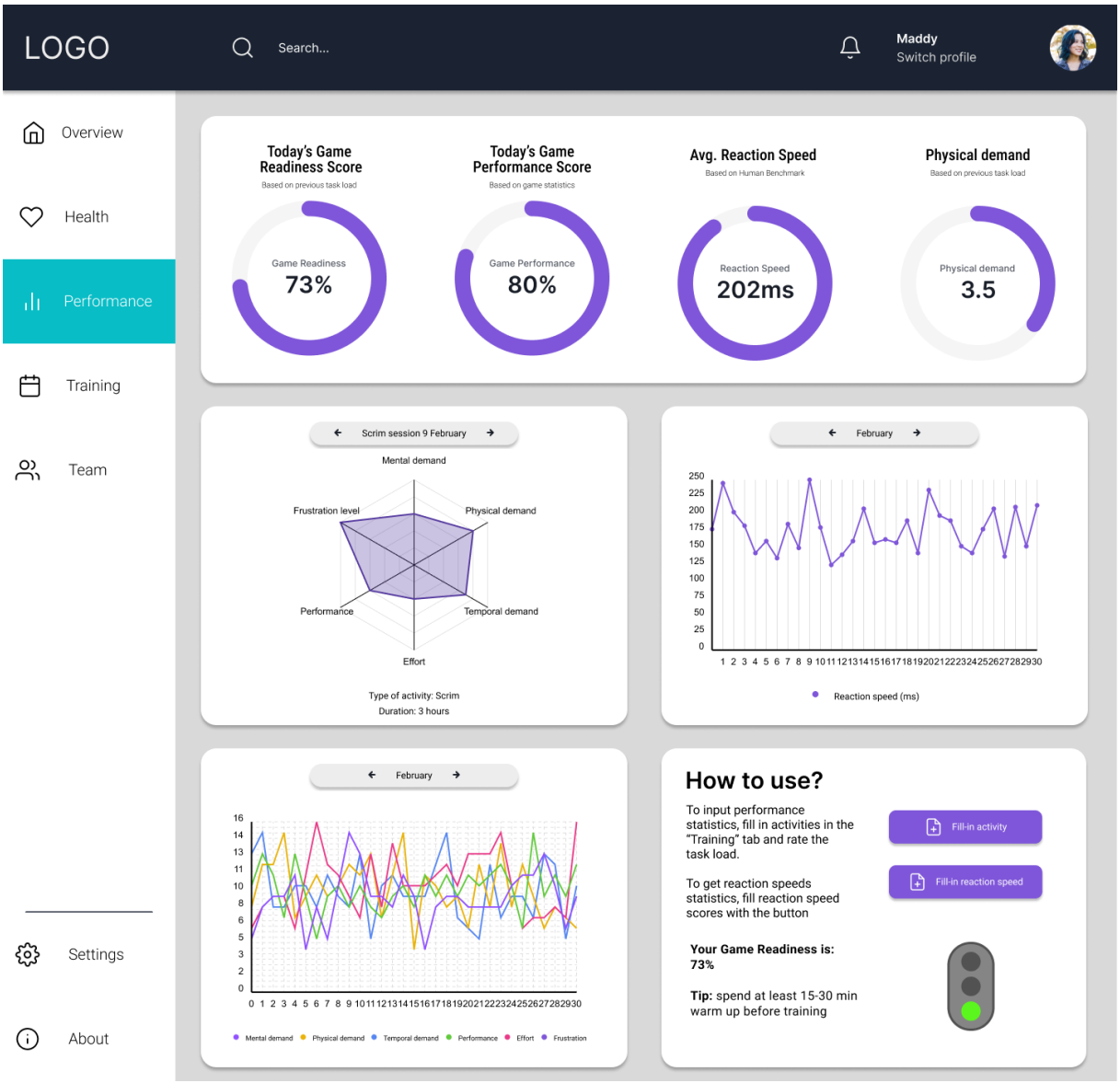


Figure 7: Dashboard performance page

On the performance page, the user is able to view performance statistics based on the activity task load from the "Training" page. On this page, the user is able to see historical data on the task load and reaction speed. Furthermore, separate activities can be viewed and a radar graph is shown with the task load indicators. Additionally, the Performance page has buttons to fill-in an activity (on the Training page) and fill-in reaction speed. The user

Notifications and alerts features:

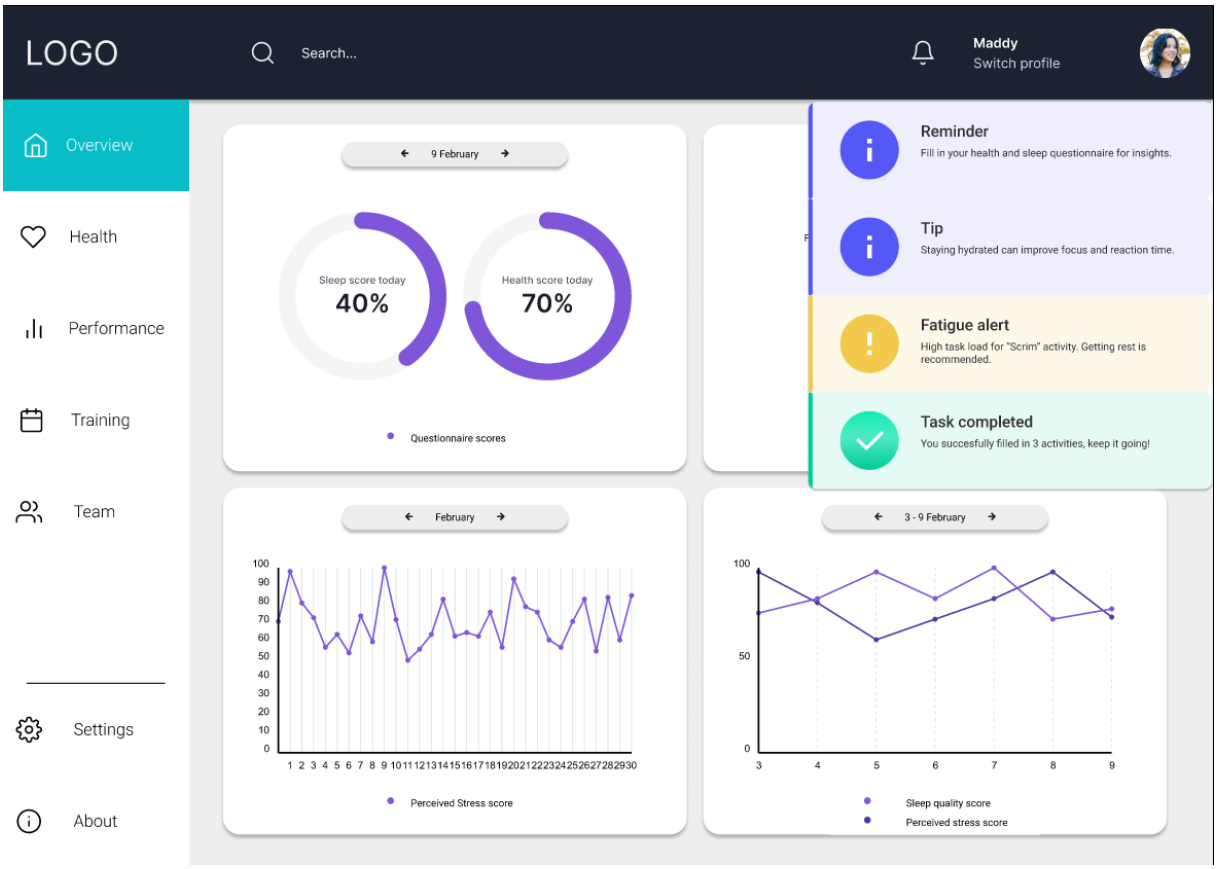


Figure 8: Dashboard notifications and alerts

On the top right of the dashboard, the user will get notifications for various features of the dashboard. Namely, reminders to fill in the questionnaires for sleep and stress gauging. Also, alerts are given to warn the user when stress levels are high, or sleep quality was low. The user will also receive notifications with tips on staying hydrated and tips about nutrition, as they are important to help their performance.

About page:

The about page gives information on the project and contact information.

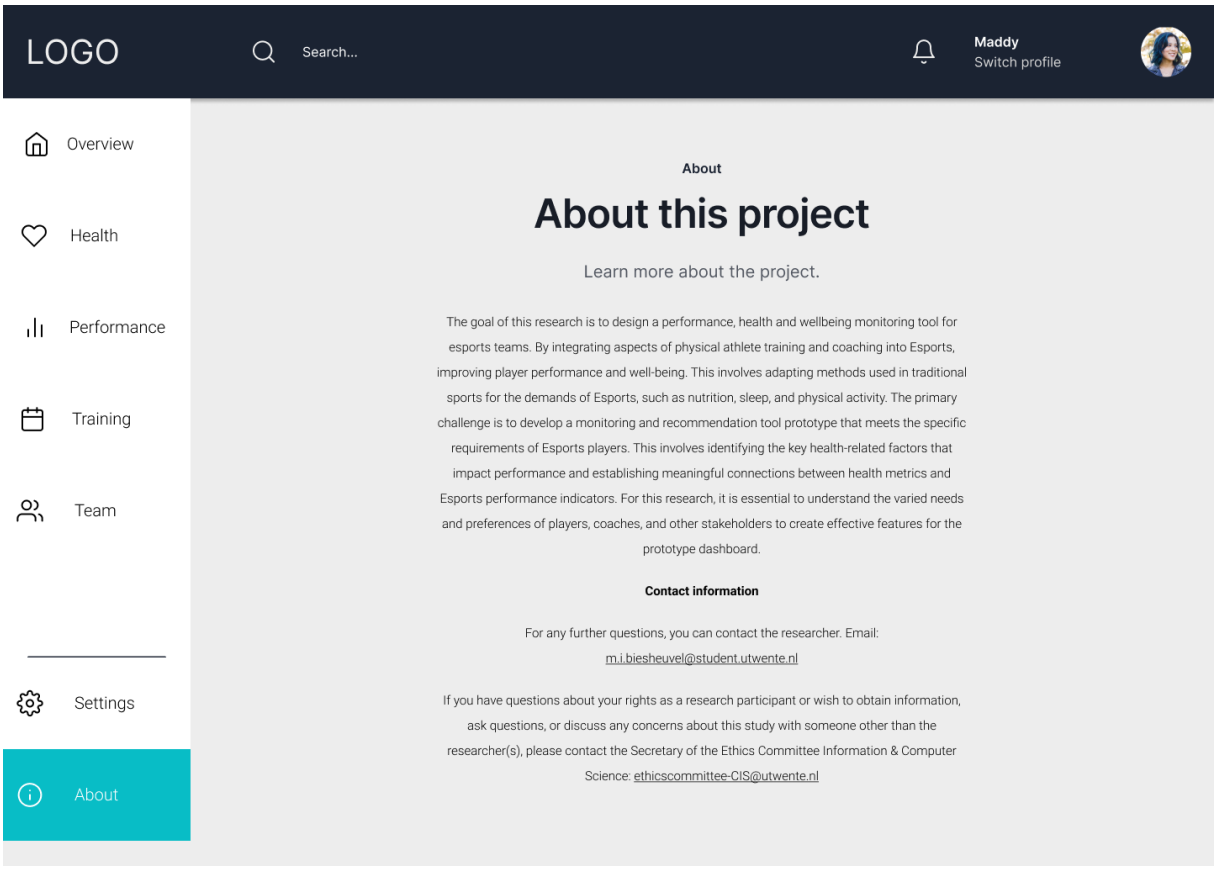


Figure 9: Dashboard about page

Overview page:

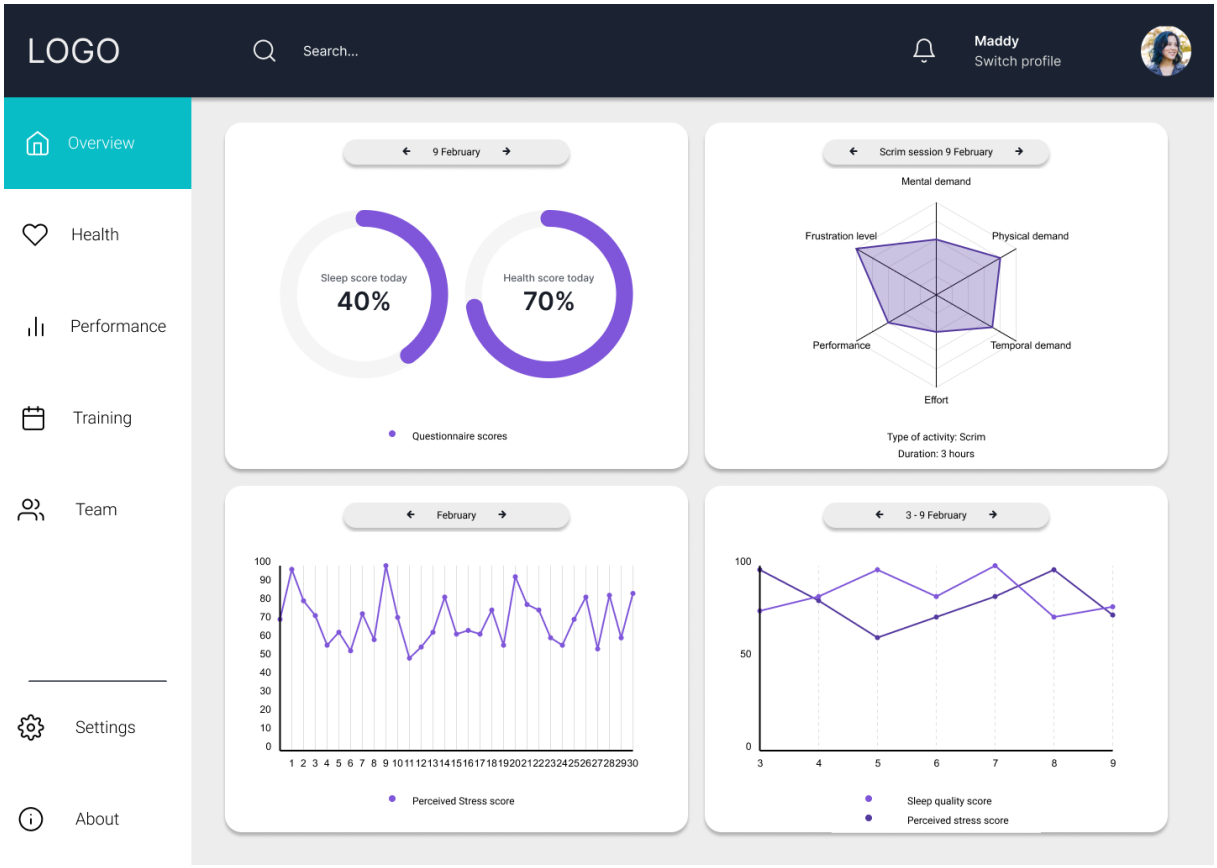


Figure 10: Dashboard overview page

In the overview page, the user is able to view their different health and well-being statistics on one page. Additionally, statistics are given based on recently completed questionnaires. The graphs display the data over a certain time period. The user is able to view different performance and health graphs and switch their time period. This makes so that the overview page can be used to compare and correlate health and performance statistics.

8. EVALUATION

For the evaluation of the dashboard and the ideas regarding this project, a usability study will be conducted with different stakeholders. Table 1 shows different aspects and details of this process.

8.1 Semi-structured interviews

As part of the evaluation of the dashboard prototype, semi-structured interviews were conducted. A semi-structured interview relies on asking questions within predetermined themes. However, these are not set in an order or phrasing. The interview themes and questions can be found in 11.2. The questions and themes are adapted from the requirements of Chapter 5.4, as these requirements were used to realize the dashboard.

For the semi-structured interviews, the different types of users will be divided into separate sessions. This means that esports athletes would be in the same session, however, the esports coach or analyst would have their separate sessions. This separation makes sure the feedback is contextualized, allowing for a more focused evaluation.

The session begins with an introductory questionnaire. The first part is about the participant's role related to esports. The second part is to categorise the type of gamer, using the Type of Gamer (TOG) scale [37]. The TOG scale is constructed as a measure to categorize gamers into different categories. The categories are: non-gamers, casual gamers and hardcore gamers. For the user testing, it is important to test with stakeholders, so the people that will be using the tool. The tool is aimed at people who take gaming seriously. Thus, the type of gamer scale is to measure their affinity with gaming. A non-gamer or casual gamer can be less likely to adopt such a dashboard, as they do not take gaming as seriously. The dashboard is designed for esports athletes and thus professional gamers.

Questions of the semi-structured interview include topics such as their level of Esports competence, whether they use wearables to measure health indicators, and whether they utilize tools to track mental status. Participants will also be asked about their experience with gaming dashboards or other performance tracking tools.

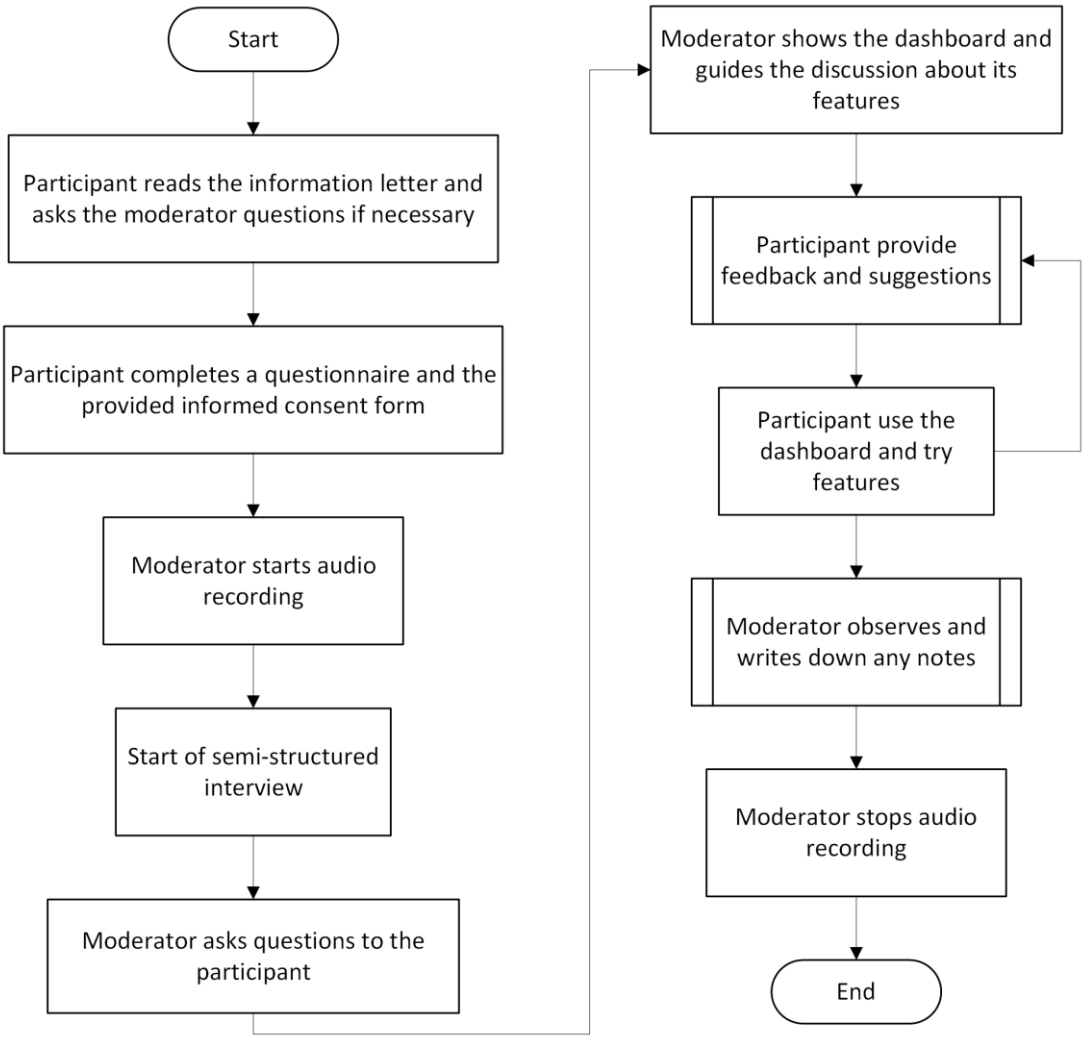


Figure 11: Semi structured interview plan flow chart

Tabel 6: Usability testing details

Test Objectives	The primary goal is to evaluate whether the proposed health dashboard prototype meets the initial functional and non-functional requirements. The test will focus on qualitative feedback to understand user experience, feedback on features, and areas for improvement.
Population	The evaluation will involve different stakeholders. Participants should be familiar with Esports. Since the dashboard is meant for gamers, their affinity with gaming is measured. This is done using the Type of Gamer (TOG) scale is used.
Test Methodology	Semi-structured interviews will be conducted to gather detailed input on the prototype. This approach allows flexibility to explore participant feedback while focusing on specific themes such as usability, design, and functionality. Aditionnaly, a focus group will be held.
Test Environment	The usability sessions will be held in person in a quiet and comfortable setting to ensure minimal distractions. The participants will interact with the prototype on a laptop or desktop during the interviews. During the focus group, the prototype will be presented on a large screen.
Test Materials	Participants will be guided through the dashboard features and asked open-ended questions to assess their impressions and suggestions. Additional materials include an interview guide with topics, printed information letters, informed consent forms, post-it notes and a laptop
Procedure	Participants will be briefed on the purpose of the test and assured that the feedback only concerns the prototype, not their performance. Semi-structured interviews and the focus group will involve discussions about the proposed dashboard and its relevance to their needs. Interviews will be recorded (with consent) for further analysis.
Metrics	Qualitative data will be the primary focus, including participant feedback and recorded suggestions. Insights will be categorized into themes, such as strengths, usability challenges, and improvement opportunities. The fulfilment of functional and non-functional requirements will also be assessed.
Reporting	Transcriptions of the audio recordings and written notes will be analysed for findings. The results are sorted by topic/theme. In the conclusion, these findings will be assessed whether they align with the initial requirements.
Timeline	The timeline will include phases for participant recruitment, interview sessions, data analysis, and reporting. Interviews are scheduled to take place between January 13 and February 4.
Ethical Considerations	Participants will provide informed consent before the interviews and will receive an information letter outlining the test details. Their data and feedback will be kept confidential, and they will have the right to withdraw at any time.
Resources	The test will require access to the prototype, a laptop or desktop for participants, an interview guide, and a device for sound recording, such as a smartphone or audio recorder. A moderator will facilitate the interviews.

8.2 Semi-structured interviews results

During the interviews, notes were taken and the audio was recorded, with permission of the participant. The audio recording was transcribed and using the notes and transcription the interviews were evaluated. The findings were grouped by theme and subject.

General feedback

- **Dashboard design:**
    - Both participants appreciated the clean and professional design.
    - The former player suggested the layout is "easy on the eyes," which is crucial for users spending long hours gaming.
- **Navigation:**
    - Both participants found the dashboard intuitive to navigate.
    - The player commented on the simplicity of accessing features, which is important for quick use between gaming sessions.
- **Information presentation:**
    - The coach highlighted that the dashboard provides an "at-a-glance" understanding of health metrics, a feature they valued.
    - Both participants recommended making key data points (like stress or fatigue levels) more prominent.

Feedback on Features

- **Most useful features:**
    - The player appreciated the trends and historical data visualization for self-tracking.
    - The coach emphasized the importance of correlating physiological data with in-game performance to adjust training strategies.
- **Missing features:**
    - The former player suggested adding a note-taking feature to log contextual events, such as stressful matches or illnesses, for better interpretation of data.
    - The coach proposed the integration of benchmarks or thresholds for health metrics, with warnings when players deviate from optimal values.
- **Self-reporting tests:**
    - The player expressed interest in submitting well-being and sleep tests, but suggested adding a quick survey option to reduce effort.

- The coach recommended tailoring questions to reflect esports-specific stressors, such as pre-tournament anxiety.

Data and measurement

- **Wearable devices:**
  - The player mentioned not using any devices currently but expressed interest if the dashboard offered actionable insights.
  - The coach uses a smartwatch and stressed the importance of seamless integration between the dashboard and existing devices.
- **Sleep and Gaming Performance:**
  - Both participants agreed on the importance of understanding the impact of sleep quality on performance.
  - The player suggested including a gamified element to encourage tracking sleep patterns or other indicators.
- **Health and Performance Metrics:**
  - Stress levels were identified as the most impactful metric for performance.
  - The coach recommended granular insights, such as session-specific stress versus baseline stress.

Practical Use and Suggestions

- **Integration with Current Tools:**
  - The coach suggested linking the dashboard with team management tools for broad performance tracking.
  - Both participants emphasized the need for easy export options to share data with other people and roles within the team.
- **Possible barriers:**
  - The player mentioned that regular use would depend on the dashboard's ability to provide correlation on sleep and stress statistics and performance.
  - The coach highlighted the value of using the dashboard during off season training to prevent burnout.

8.3 Focus group

Alongside the semi-structured interviews, a focus group was hosted with students participating in the Esports Minor given at the University of Twente.

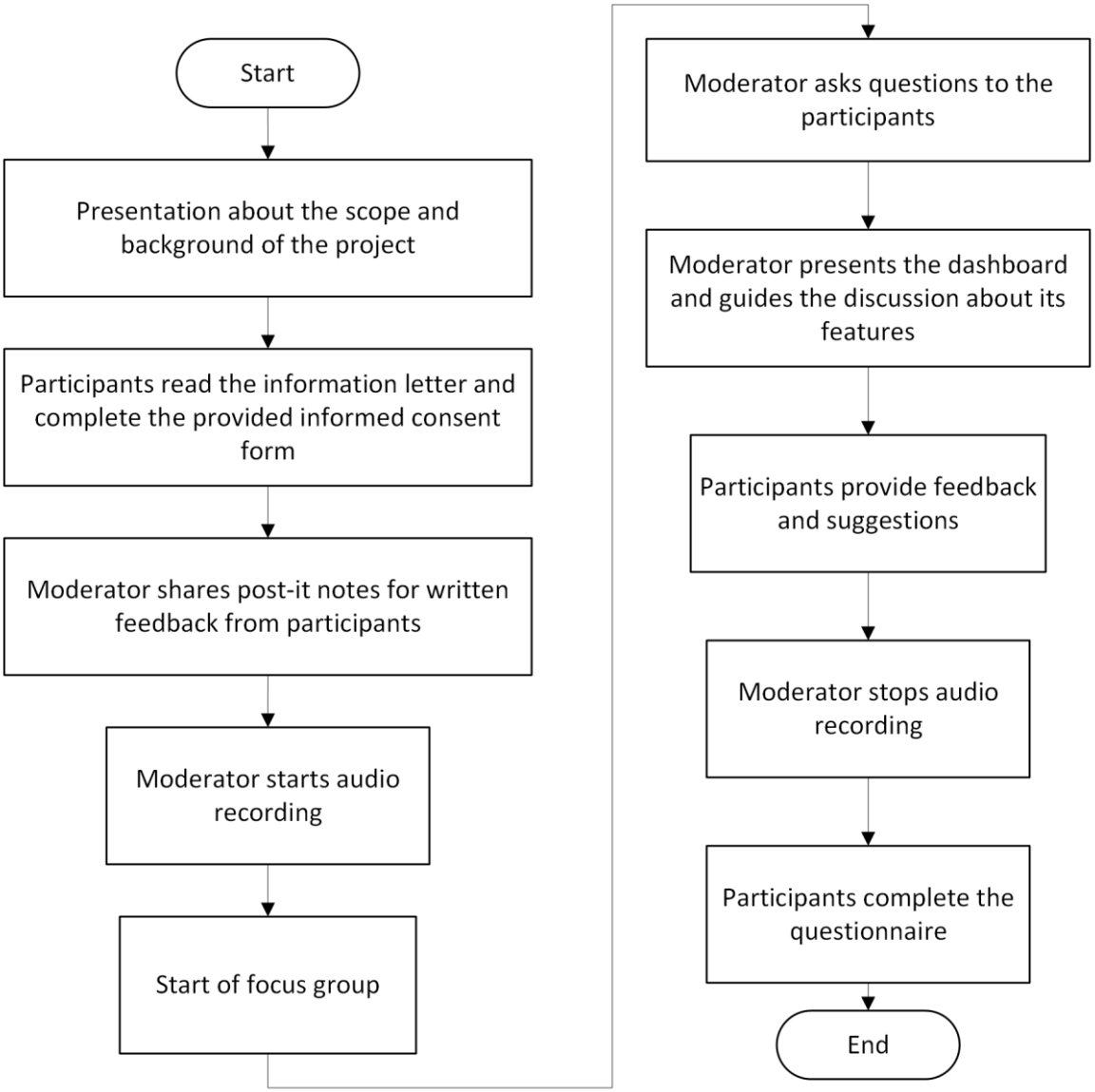


Figure 12: Focus group evaluation plan flow chart

The focus group session was aimed at gathering feedback on the usability, features, and overall effectiveness of the esports health monitoring dashboard. A total of 10 participants, including some players and coaches, provided feedback on the design, usability, functionality, and potential improvements.

Transcript-based analysis was done and was supplemented by written post-it notes. On the post-it notes the participants were asked to write features they would expect to see in an esports health monitoring tool. Moreover, they were asked to write down what health aspects they thought were important to improve performance.

8.4 Focus group results

Figure 13: Feedback written on post it notes during the focus group

As with the interviews, the audio during the focus group was recorded. The audio file was subsequently transcribed to allow for analysis. The findings were grouped based on theme.

General feedback

Participants generally found the dashboard useful and relevant for esports athletes. The integration of health and performance metrics was seen as a valuable tool for both players and coaches. Some participants mentioned that while the dashboard covers key aspects, improvements in clarity and customization would enhance its usability.

Usability and navigation

While most found navigation straightforward, some users struggled to locate specific features. Data visualization was appreciated, but a few participants had difficulty interpreting graphs since in the prototype, some graphs did not have correct labeling.

Health and performance monitoring

Participants valued the combination of physiological data and self-reported inputs. There was a strong interest in seeing clear correlations between stress, fatigue, and in-game performance. Several participants suggested adding trend analysis to track long-term health and performance improvements.

Alerts and feedback system

The idea of real-time alerts was well received, but there were concerns about potential information overload.

Users requested:

- Customizable thresholds for alerts.
- Adjustable notification frequencies.
- The ability to disable alerts during gameplay to minimize distractions.

Personalization and user roles

Different user needs were highlighted, particularly between players and coaches.

Suggested improvements included:

- Role based views that display information based on the user type.
- A customizable dashboard that allows users to prioritize certain metrics.

Privacy and data

Participants were generally comfortable with data collection but emphasized the need for transparency.

Concerns included:

- Understanding how personal data is stored and used.
- The option for local data storage instead of cloud-based solutions.
- Clear privacy policies detailing who can access the data.

Additional feature requests

- Integration with wearable devices for automatic data collection.
- The ability to compare personal data against teammates or historical performance.

8.5 Conclusion

Multiple ways of including end-users in the design process were used to gather feedback on features presented in the dashboard. Firstly, during ideation, an interview was conducted with a traditional sports coach to get an idea of what kind of health and performance monitoring is done within regular sports. After designing the dashboard prototype, this was evaluated by conducting two semi-structured interviews with an Esports player, who was also a former team manager and a current Esports team coach. Moreover, a focus group was hosted with ten participants to further provide evaluation.

User feedback highlighted the importance of balancing detailed analytics with ease of interpretation. While the dashboard effectively tracks performance and health metrics, customization, personalization, and integration with existing tools are important for adoption. In Table 7, a summary of the usability testing results can be found. The results of this evaluation were used to further develop the dashboard.

Table 7: Usability testing results summary

Category	Findings from interviews	Findings from the focus group
Design	Positive feedback on clean and modern layout. The addition of a dark mode would be nice to have.	Mixed opinions on visual appeal; some participants suggested a more customizable dashboard.
Navigation and usability	Easy to navigate but some features were not immediately intuitive to know what they did.	Some participants struggled with menu organization and suggested clearer labeling
Feature usefulness	Coaches valued performance analytics; players found tracking tools helpful but wanted more insights.	Strong interest in stress and well-being tracking, but concerns about data overload.
Data and measurement	Both participants use an online performance statistics dashboard. There is interest in integrating sleep and reaction time tracking.	Many participants do not track health metrics yet but are open to passive tracking solutions.
Feedback and alerts	Coaches wanted alerts for performance dips. Players preferred to have optional feedback.	Concerns about too many notifications. Thus a preference for personalized reminders and alerts.
Integration with other tools	Players already use other performance tracking tools; integration seen as valuable.	Desire for compatibility with existing esports analytics and wearable devices.
Barriers and challenges	Personal health data must be private. Using the tool could be a learning curve for new users.	Resistance to additional workload of filling in form, so this should be customizable.

9. CONCLUSION

Esports athletes, like traditional sports professionals, face significant physical and mental health challenges. Despite the industry's rapid growth, existing health monitoring solutions are largely tailored to traditional sports, lacking customization for the unique demands of esports.

This research addresses the gap by developing a user-centred Esports health and performance monitoring dashboard, integrating self-evaluation tools. This was done by answering this overarching research question:

How can an Esports health monitoring system be designed, realized and evaluated to meet the specific needs of its end-users?

The esports health monitoring system is designed with narrow collaboration with its end-users. From the proposed functional and non-functional requirements, a prototype dashboard in Figma was designed and realized using a human-first approach. With this, the first research question was answered, namely: “What are the key functional and non-functional requirements for an Esports health monitoring system?”

This brings the second research question: “How can an Esports health monitoring system be constructed?”. To realize the Esports health monitoring tool, different directions were evaluated. The chosen direction was to make a dashboard in the prototyping tool Figma. For this, design guidelines were developed and features were realized.

After constructing the dashboard prototype, it is essential to evaluate it. This is done by answering the final research question: “How can user feedback and testing help the design to ensure it meets the specific needs of its end-users?”

Usability testing confirmed the proposed approach’s potential to provide insights for its end users. The participants of the user testing expressed interest in such a tool, stating that they would want to incorporate an implementation of the prototype into their team. They emphasized the importance of correlating physiological (sleep, stress) data with in-game performance so they can adjust their training strategies.

The usability study, conducted with esports players and stakeholders, provided valuable insights into the prototype’s effectiveness in meeting both functional and non-functional requirements. The evaluation process, which included interviews and a focus group, allowed for the assessment of how well the dashboard supports player health and performance monitoring.

A table is constructed to assess whether the constructed functional and non-functional requirements were met.

Assessment of functional and non-functional requirements

Table 8: Assessment of functional requirements

Requirement	MoSCoW Priority	Completed?	Comment
Display game statistics.	Must have	Yes	Game statistics are included in the dashboard features
Display personalized performance statistics.	Must have	Yes	The prototype tracks personal performance metrics
Display cognitive performance statistics	Must have	Yes	Reaction speed tests and cognitive load indicators are included
Track physical demand	Must have	Partially	Activities can be rated on their physical demand but physical activity is not tracked
Track mental well-being and stress	Must have	Yes	Uses self-reported Perceived Stress Scale (PSS)
Track cognitive demand	Must have	Yes	Activities can be tracked on cognitive demand, effort, performance and frustration
Track sleep statistics	Must have	Yes	Sleep tracking is included using self-reported questionnaires
Data visualization in various ways (charts, graphs, heatmaps)	Must have	Yes	Different variations of graphs are present
Include feedback options for performance and health changes (like dehydration or overexertion).	Must have	Yes	Users are given feedback through a traffic light and receive notifications
Include alerts for performance and health changes	Must have	Partially	Users can get alerts but it is not functional when health changes
Display schedule for esports activities	Must have	Yes	A schedule can be used to add Esports activities
Ensure secure data handling, making sure health data is not stored	Must have	Yes	No data is stored and dummy data is used for the prototype
Ensure privacy compliance	Must have	Yes	Users first have to login with their email and password. They are not able to see data of other users
Allow customization of dashboard layout.	Should have	No	Dashboard features are fixed in the prototype
Allow customization of which metrics are displayed	Should have	No	Dashboard metrics are fixed in the prototype
Monitor activity load for various activities	Should have	Yes	Different activities can be selected and rated using the NASA-TLX
Assess player readiness for upcoming Esports tournaments	Should have	Yes	Based on task load, a game readiness score is given to the user
Enable sharing of performance insights with coaches and staff	Could have	No	Users are not able to share data
Support import/export from fitness trackers, training apps or nutrition apps	Could have	No	Integration of external apps is not present in the prototype

Community leaderboards or esports player performance comparisons.	Won't have	No	Leaderboards are not present in the prototype

Table 9: Assessment of non-functional requirements

Non-functional requirement	Completed?	Comment
The dashboard is not overwhelming	Yes	Evaluation indicates the dashboard is not overwhelming
The dashboard is intuitive to use	Yes	Users found the navigation intuitive
The dashboard has a responsive layout	Yes	The prototype is responsive and fits to different screen seizes
The dashboard is reliable	Yes	Features work consistently throughout the dashboard
The dashboard should maintain a coherent visual style	Yes	Design guidelines ensure consistency in the dashboard
The dashboard is easily readable	Yes	Color contrast and typography follow accessibility guidelines
The dashboard is updateable	Yes	The dashboard prototype can be easily adjusted and updated
The dashboard allows users to view information quickly	Partially	Adjustments in labelling and information of features were incorporated in the final design
The data of the dashboards users is private	Yes	No sensitive data is stored

The assessment of the functional requirements demonstrated that the prototype successfully visualizes the integration of performance statistics, health tracking, data visualization, and user feedback mechanisms. This is done through sleep and stress statistics and cognitive performance metrics, although users suggested additional options for data filtering and customizability. In terms of data visualization, the prototype shows various graphical representations such as charts, and graphs.

While users can indicate the physical demand of activities, it is not possible to track their physical activity such as sports. It would be valuable to also be able to track their physical activity accompanied by the physical demand as this can be an important performance indicator.

The prototype dashboard included a notification and alert feature. However, alerts which provide notifications based on changes in health metrics were not realized. Since the prototype uses dummy data, it does not react to changes in health. When implemented this would be considered valuable, though some users requested adjustable alert settings to prevent notification fatigue.

A major drawback in the use of Figma as prototyping software is that layouts and information such as metrics are not customizable. The prototype is purposely designed such that content such as graphs has its own different elements. This means a design like this could be used when implemented to make the content customizable. Furthermore, the ability to share data is not implemented since the direction chosen for the prototype does not use real data that can be shared.

Participants of the usability study indicated that it would be helpful to integrate a calendar such as Google Calendar since this is what most people use. Additionally, it would be helpful to integrate

shortcuts to resources like Excel sheets or documents as teams use this for their training. While the requirement to integrate an external app was not met, this would be a valuable addition to the dashboard.

One of the functional requirements was to have leaderboards in the dashboard. While rated as "Won't have" in the ideation phase, participants were asked their opinions on this subject. Participants indicated that a physical activity leaderboard feature could provide additional motivation to work out more. However, participants also indicated that it could lead to people feeling bad because they work out less than others. This can lead to conflict in the team which is not good for motivation, meaning this feature could be counterproductive.

Regarding the assessment of non-functional requirements, the prototype was found to be intuitive and easy to navigate. The system supports multiple user roles, offering distinct login interfaces for players and coaches. This requires that when a player has an additional role within a team, the person needs to have multiple accounts, showing different profiles. While testing, some features of the prototype were not immediately clear, meaning the information was not understood quickly. This was adjusted in the final prototype to provide more labelling and information regarding the use of the activity feature.

The positive reception of the dashboard suggests that Esports athletes increasingly recognize the value of health monitoring. Using the approach presented in this thesis, important health indicators can be monitored without having to use any technological devices. This would make the dashboard easy to implement for teams who don't want to invest in such monitoring devices or who find them obtrusive.

10. DISCUSSION AND FUTURE WORK

The dashboard successfully integrates performance and health monitoring into a single tool, helping esports athletes track performance indicators such as stress levels, sleep quality, and reaction time. However, several areas for improvement and further development have been identified through stakeholder feedback and usability testing.

One limitation of this study is the reliance on a small sample size for testing. In total 12 participants were included in the usability study. Future studies should incorporate a larger user base to improve generalizability.

Foremost, the tool could be further iterated toward a functional design. While the current prototype serves as a proof-of-concept, developing a fully functional version remains a priority. With this, new challenges in designing the dashboard will likely arise. Testing a functional prototype with the University Esports Team would provide valuable real world feedback, allowing for more iterative improvements.

One of the insights was the perception of the dashboard's colour scheme. The choice of a light themed, health focused design was positively received, as it distinguished the tool from conventional esports dashboards, which often feature dark, high-contrast "gamer" aesthetics. This design choice aligns with the goal of positioning the tool as a serious health application rather than a performance analytics platform. However, some users expressed interest in a dark mode option. Implementing a toggleable dark mode with the same colour palette could improve user engagement and allow customization.

Regarding functionality, the prototype currently focuses on the performance indicators reaction speed, stress levels, sleep tracking and cognitive and physical demand. However, additional health factors such as nutrition and hydration monitoring could be incorporated to expand the scope of health tracking. These elements play a role in cognitive performance and recovery, making them valuable additions to a comprehensive esports health tool. Since something like a nutrition dairy already exists, an app like that could be integrated into the dashboard. The same is true for other wearable devices. In the prototype, this is visualized, however, this did not display real physiological data.

A useful direction future research involves conducting more long term study to assess how continuous health monitoring influences Esports players performance and well-being over extended periods. By tracking health indicators, researchers can identify trends and their effects on cognitive and physical performance. Additionally, analysing the correlations between different health metrics can provide deeper insights into how these factors interact. For example, the relationship between stress levels and reaction speed or sleep quality and cognitive demand during trainings. Such findings could help provide personalized recommendations, allowing players to optimize their training schedules, recovery strategies, and performance based on their individual health data.

In chapter 6.2, directions for the implementation of an esports health monitoring tool were laid out. The directions can help with making the choice how such a dashboard can be functionally realised. Sports data valley offers the best match as for making a functional version of the prototype. However, there are some differences in how it can be implemented. For example, it is currently not

possible to use the NASA-TLX form in Sports data valley. So, to be able to measure task load, a different approach should be chosen.

To have better accessibility, a mobile application of this dashboard could be realized. A mobile application can have the benefits of being able to access the dashboard wherever possible, when a laptop of desktop is not available. The prototype is currently intended as a web application and is responsive. This way, the design is easily adapted to be able to use on a mobile device, either in a browser or dedicated application.

This study represents an important step toward bridging the gap between sports science and Esports performance monitoring. It contributes to Esports science by addressing the gap in structured health monitoring for esports athletes, an area that remains underexplored compared to traditional sports science [6].

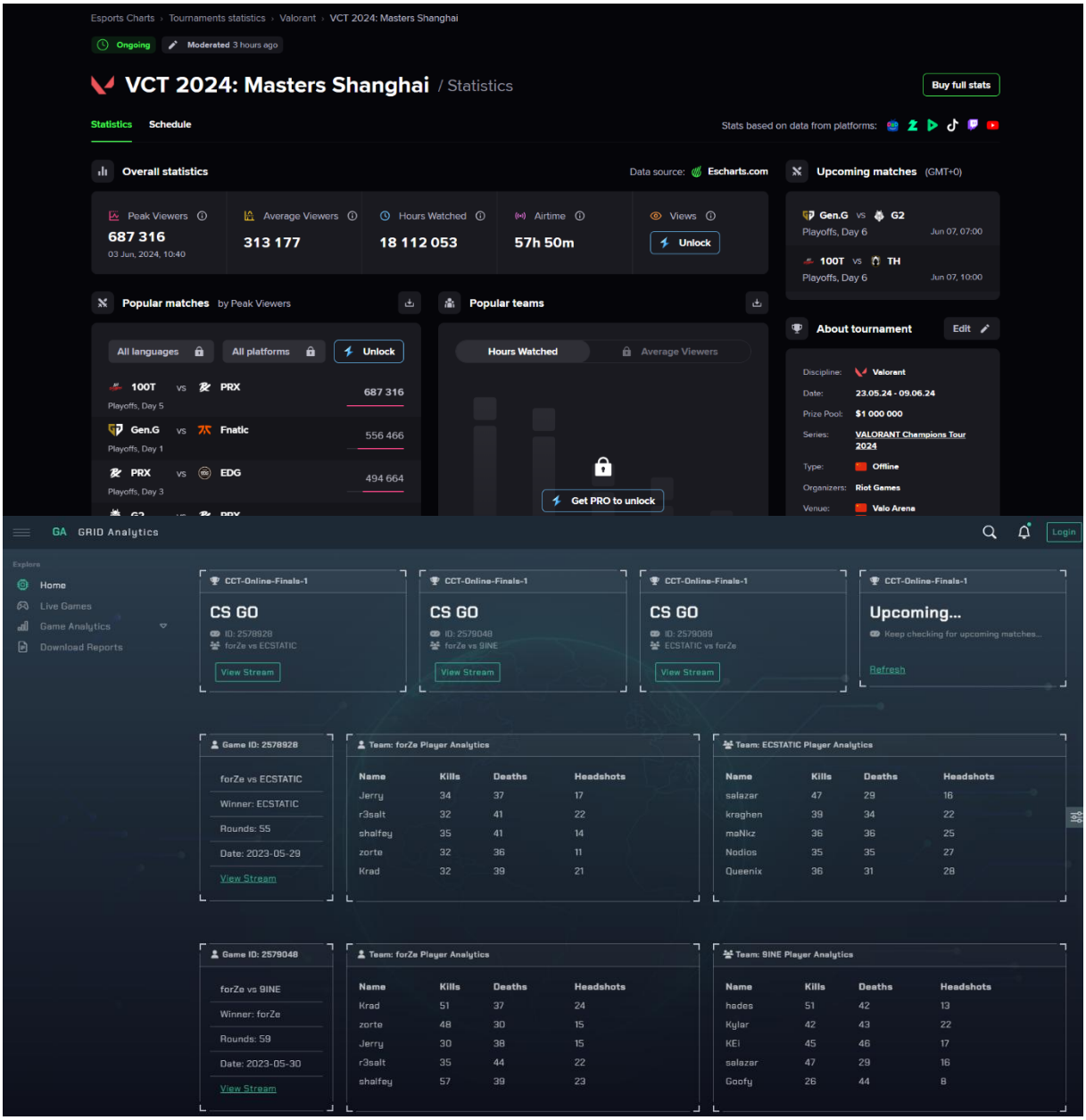
The health and performance monitoring tool developed for Esports has the potential to be used in cognitive performance intensive fields, where stress, mental fatigue, and well-being directly impact performance. One such area is competitive chess, where cognitive endurance, decision-making speed, and stress resilience are important. Research on chess players has shown that prolonged mental exertion decreases decision accuracy [38]. By integrating self-reported stress levels, reaction time assessments, and sleep tracking, this tool could help chess players optimize their mental stamina and identify signs of cognitive overload before tournaments.

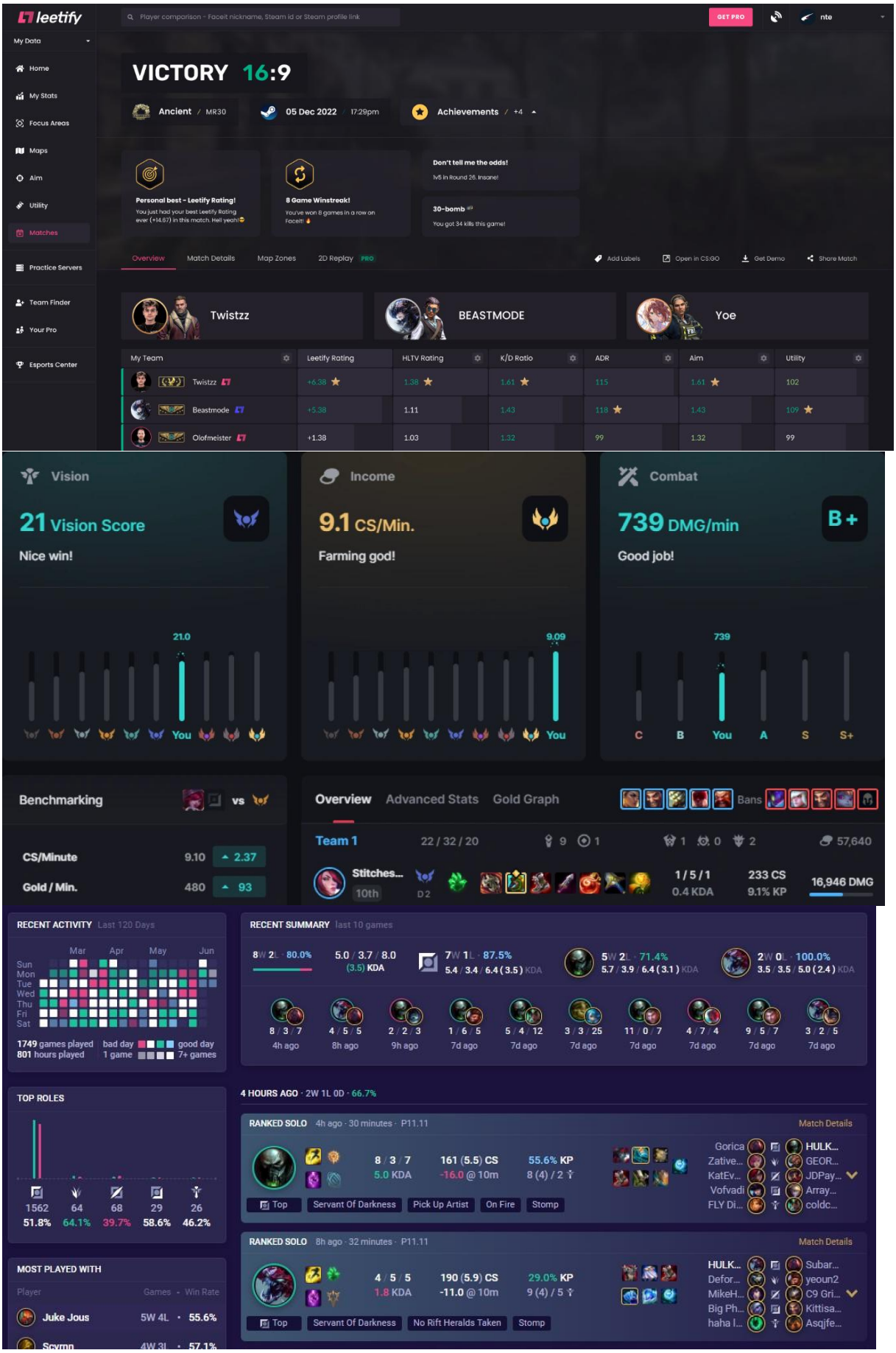
Beyond competitive gaming, the tool could also be adapted for corporate environments, particularly for employees in high-stress roles. Implementing a well-being dashboard that tracks stress, cognitive performance, and sleep patterns could offer employees insights into their mental health and suggest interventions, such as break scheduling or workload adjustments.

Finally, this research contributes to digital health monitoring methodologies by demonstrating how self-assessment tools can complement objective data, similar to how mental health screening tools have been integrated into athlete performance platform.

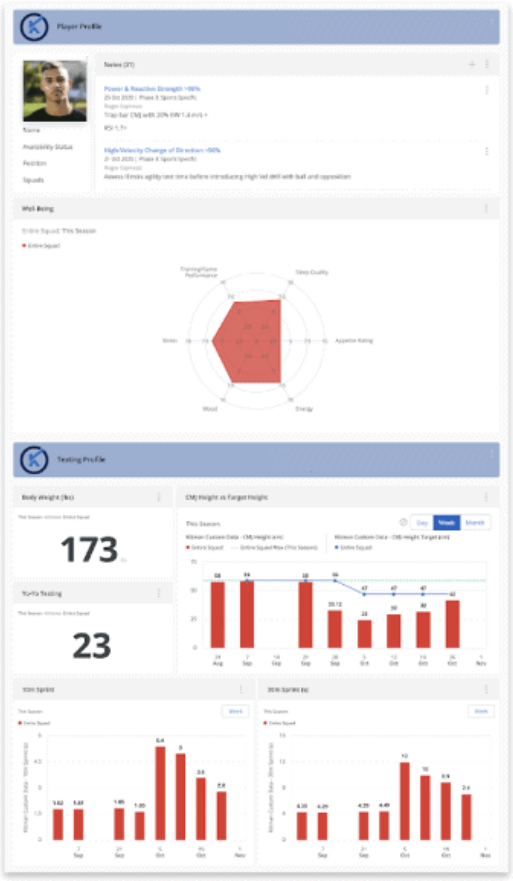
11. APPENDICES

11.1 Appendix 1: State of the art dashboards

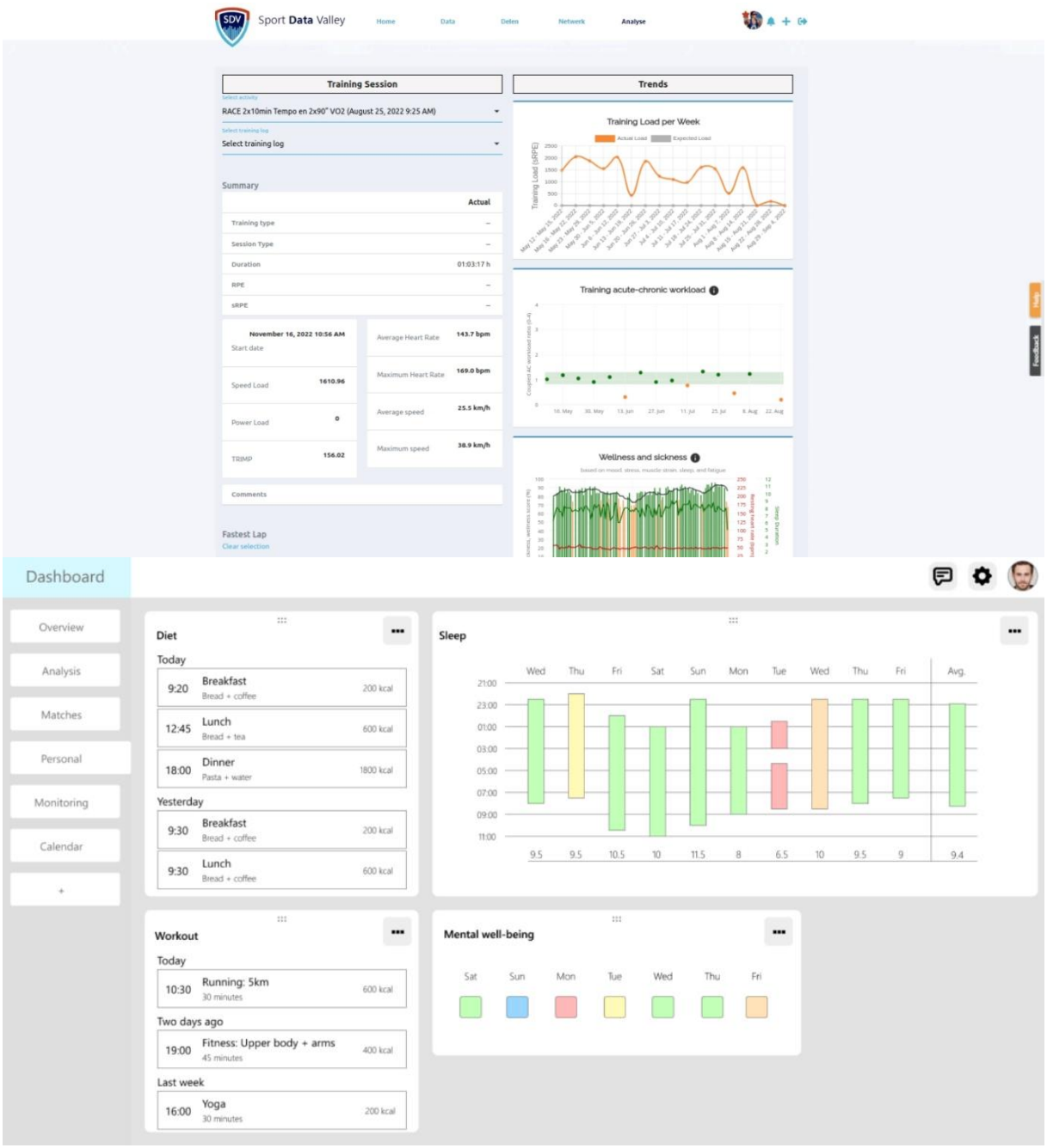



leetify
Player comparison - Faceit nickname, Steam id or Steam profile link
GET PRO
My Data
Home
My Stats
Focus Areas
Maps
Aim
Utility
Matches
Practice Servers
Team Finder
Your Pro
Esports Center
VICTORY 16:9
Ancient / MR30
05 Dec 2022 / 17:29pm
Achievements / +4
Personal best - Leetify Rating!
You just had your best Leetify Rating ever (+14.67) in this match. Hell yeah!
8 Game Winstreak!
You've won 8 games in a row on Faceit!
Don't tell me the odds!
1v5 in Round 26. Insane!
30-bomb
You got 34 kills this game!
Overview
Match Details
Map Zones
2D Replay PRO
Add Labels
Open in CS:GO
Get Demo
Share Match
Twistzz
BEASTMODE
Yoe
My Team
Leetify Rating
HLTV Rating
K/D Ratio
ADR
Aim
Utility
Twistzz +6.38 1.38 1.61 115 1.61 102
Beastmode +5.38 1.11 1.43 118 1.43 109
Olofmeister +1.38 1.03 1.32 99 1.32 99
Vision
21 Vision Score
Nice win!
21.0
You
Income
9.1 CS/Min.
Farming god!
9.09
You
Combat
739 DMG/min
B+
Good job!
739
C
B
You
A
S
S+
Benchmarking
vs
CS/Minute 9.10 2.37
Gold / Min. 480 93
Overview
Advanced Stats
Gold Graph
Bans
Team 1
22 / 32 / 20
9
1
1
0
2
57,640
Stitches...
10th
D2
1 / 5 / 1
0.4 KDA
233 CS
9.1% KP
16,946 DMG
RECENT ACTIVITY Last 120 Days
Mar
Apr
May
Jun
Sun
Mon
Tue
Wed
Thu
Fri
Sat
1749 games played
801 hours played
bad day
1 game
good day
7+ games
RECENT SUMMARY last 10 games
8W 2L · 80.0%
5.0 / 3.7 / 8.0
(3.5) KDA
7W 1L · 87.5%
5.4 / 3.4 / 6.4 (3.5) KDA
5W 2L · 71.4%
5.7 / 3.9 / 6.4 (3.1) KDA
2W 0L · 100.0%
3.5 / 3.5 / 5.0 (2.4) KDA
8 / 3 / 7 4h ago
4 / 5 / 5 8h ago
2 / 2 / 3 9h ago
1 / 6 / 5 7d ago
5 / 4 / 12 7d ago
3 / 3 / 25 7d ago
11 / 0 / 7 7d ago
4 / 7 / 4 7d ago
9 / 5 / 7 7d ago
3 / 2 / 5 7d ago
TOP ROLES
1562 51.8%
64 64.1%
68 39.7%
29 58.6%
26 46.2%
MOST PLAYED WITH
Player
Games
Win Rate
Juke Jous 5W 4L · 55.6%
Scymn 4W 3L · 57.1%
4 HOURS AGO · 2W 1L 0D · 66.7%
RANKED SOLO 4h ago · 30 minutes · P11.11
Match Details
8 / 3 / 7
5.0 KDA
161 (5.5) CS
-16.0 @ 10m
55.6% KP
8 (4) / 2
Top
Servant Of Darkness
Pick Up Artist
On Fire
Stomp
Gorica
Zative...
KatEv...
Vofvadi
FLY Di...
HULK...
GEOR...
JDPay...
Array...
coldc...
RANKED SOLO 8h ago · 32 minutes · P11.11
Match Details
4 / 5 / 5
1.8 KDA
190 (5.9) CS
-11.0 @ 10m
29.0% KP
9 (4) / 5
Top
Servant Of Darkness
No Rift Heralds Taken
Stomp
HULK...
Defor...
MikeH...
Big Ph...
haha l...
Subar...
yeoun2
C9 Gri...
Kittisa...
Asqjfe...


catapult
live
Welcome,
demo
Logout
Home
Reports
Organise
Settings
Help
Players
Sessions
Drills
Show Filters
Peter Daicos
#35
DOB: 2010-01-19
Height: 179cm
Weight: 78kg
Debut Year: 1979
Recruited From: Collingwood
Configure Table Statistics
Export to CSV
Print Page
List of sessions for 'Peter Daicos'
Sessions Statistics
Player Statistics
+ Add New Chart
Delete Chart
Modify Chart
Use the links at the top of the Reports page to navigate your data. The 'By Player' view will show all data grouped by player, the 'By Session' view will group data by game and/or training session and 'By Drill' will group by drill type. For each of these views there are additional options available such as filtering by win/loss, by player position and by drill category.
Last sessions stored successfully:
1. Monday Test
2. Maz Training 15-12-10
3. Mazenod Training
4. Semi Final
5. Mazenod Training 28th
6. Mazenod Training 26th
7. Catapult vs Dan Green
8. Rovinna high intensity sprints
9. Round 21
10. Round 20
Files stored unsuccessfully in the last month:
Copyright © 2010 Catapult Sports Pty. Ltd.
Website Version: Live2.2
Sessions Statistics
Avg Duration (minutes) / Avg Workrate
Avg Distance (metres)
110
88
66
44
22
0
3,000
2,400
1,800
1,200
600
0
Training 1
Training 2
Training 6
Training 7
Training 8
Training 12
Round 1
Round 18
Round 19
Mazenod Training 26th
Semi
Mazenod
Avg Duration
Avg Distance
Avg Workrate


Player Profile
Testing Profile
173
23


Performance
Total Distance
593
9.8
55
58
Injury Profile
16
13
6
5
3


Sport Data Valley
Home
Data
Delen
Netwerk
Analyse
Training Session
RACE 2x10min Tempo en 2x90" VO2 (August 25, 2022 9:25 AM)
Select training log
Summary
Actual
Training type
Session Type
Duration
01:03:17 h
RPE
sRPE
November 16, 2022 10:56 AM
Start date
Speed Load
1610.96
Power Load
0
TRIMP
156.02
Average Heart Rate
143.7 bpm
Maximum Heart Rate
169.0 bpm
Average speed
25.5 km/h
Maximum speed
38.9 km/h
Comments
Fastest Lap
Clear selection
Trends
Training Load per Week
Actual Load
Expected Load
Training Load (sRPE)
Training acute-chronic workload
Wellness and sickness
Help
Feedback
Dashboard
Overview
Analysis
Matches
Personal
Monitoring
Calendar
+
Diet
Today
9:20 Breakfast
Bread + coffee
200 kcal
12:45 Lunch
Bread + tea
600 kcal
18:00 Dinner
Pasta + water
1800 kcal
Yesterday
9:30 Breakfast
Bread + coffee
200 kcal
9:30 Lunch
Bread + coffee
600 kcal
Sleep
Wed
Thu
Fri
Sat
Sun
Mon
Tue
Wed
Thu
Fri
Avg.
21:00
23:00
01:00
03:00
05:00
07:00
09:00
11:00
9.5
9.5
10.5
10
11.5
8
6.5
10
9.5
9
9.4
Workout
Today
10:30 Running: 5km
30 minutes
600 kcal
Two days ago
19:00 Fitness: Upper body + arms
45 minutes
400 kcal
Last week
16:00 Yoga
30 minutes
200 kcal
Mental well-being
Sat
Sun
Mon
Tue
Wed
Thu
Fri

11.2 Usability testing interview questions

1. Engagement questions
    - Are there any features or ideas you expected to be included in such a dashboard concept?
    - Do you wear any devices like a smartwatch while gaming, and if so, what do you use them for?
    - Do you use any tools to measure your game performance?
2. Exploration questions
    - Which physical or mental health factors do you believe have the biggest impact on your gaming performance?
3. Motivation
    - What is your background and role in Esports?
    - What are your primary goals when it comes to managing your health and performance as a gamer or coach?
    - What motivates you to track your health metrics or performance data, if at all?

After explaining the concept of the project:

4. Concept introduction
    - Do you think a tool like this could be helpful in managing your health and performance? Why or why not?
    - Are there any features or ideas you expected to be included in such a dashboard concept?
5. Practical use
    - Do you feel that the dashboard could help you better understand the connection between your health habits and gameplay?
    - Do you feel this dashboard aligns with your goals, such as improving performance, preventing injuries, or maintaining well-being? Why or why not?
    - What would encourage you to use such a dashboard regularly?
    - Are there any potential challenges or barriers that might prevent you from using such a dashboard?

After showing the dashboard prototype:

6. Design

- What are your first impressions of the dashboard's design and layout?
- What do you think of the colour schema? Is this important for you?
- Is the information on the dashboard presented in a way that allows for quick understanding? Why or why not?

7. Useability
    - Is it easy to navigate through the dashboard? Why or why not?
    - How do you feel while navigating the dashboard—do you find it intuitive, overwhelming, or somewhere in between?
    - Are there any features or sections that you found confusing or difficult to use?
8. Features
    - Which feature(s) do you find most useful, and why?
    - How would you see yourself using this feature in practice?
    - How relevant are the features of this dashboard to your role?
    - Are there any features you expected to find but didn’t? If so, what are they?
9. Data and measurement
    - Do you wear any devices like a smartwatch while gaming, and if so, what do you use them for?
    - Do you use a smartwatch to measure any health data?
    - Do you measure your sleep quality in any way?
    - Would you wear a smartwatch at night to get insights into the effects of sleep on gaming performance?
    - Do you use any tools to measure your game performance?
    - Are there any tools or devices you already use that you wish could integrate with this dashboard?
    - Would you see yourself using this dashboard alongside other tools or devices you currently use? If yes, how would you integrate them?
    - How often do you want to submit a self-reported test to gauge well-being or sleep?

- Which physical or mental health factors do you believe have the biggest impact on your gaming performance?

10. Feedback

    - Would you find automated feedback or alerts from the dashboard helpful? If so, what kind of feedback would you like to receive?

    - How frequently would you prefer receiving updates or notifications from the dashboard (for example, real-time, daily, weekly)? What would these notifications be about?

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