A Sport Project and Its Future Applications: How to Implement Speculative Design to Fulfill Users' Needs

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ABSTRACT
Extended realities, along with other enabling technologies, can improve the way we perform professional and entertaining activities. This paper describes the possibilities created by future applications in the field of sports. These possibilities emerge from the analysis of various aspects of the project to evaluate the feasibility of the idea: studying the different opportunities created by extended realities and applied to learning processes, the possible technological needs have to be addressed in the near future to meet the users' needs within the sports system and to obtain significant benefits at an appropriate cost.

CCS CONCEPTS
• **Interaction Design**; • **Emerging Technologies**; • **User Characteristics**;

KEYWORDS
Speculative Design, Design of the new relations, Extended Reality, Artificial Intelligence, Sport

ACM Reference Format:
Stefania Palmieri, Alessio Righi, Mario Bisson, and Alessandro Lanniello. 2021. A Sport Project and Its Future Applications: How to Implement Speculative Design to Fulfill Users' Needs. In *2021 5th International Conference on Artificial Intelligence and Virtual Reality (AIVR) (AIVR 2021), July 23–25, 2021, Kumamoto, Japan.* ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3480433.3480439

1 INTRODUCTION
The proposed contribution stems from an ongoing research that has already produced an exhaustive technological and sector survey [1], which defines the sport field as one of the most promising to be researched for innovative XR and AI applications. It shows and describes the next necessary steps in order to create a concept that can be produced within the next decade.

Speculative design can be conceived as the creation of artifacts that live in a future scenario, developed from current trends, to engage others in dialogue and reflective thinking. It is not an effort to predict the future, but to create stories of possible future realities by questioning the implications on the present [2].

According to Dunne and Raby, the figure of the designer should not only pose contemporary problems, but he/she should also ask "How can we face the future challenges?". The future is complex and composed of many nuances because people are unpredictable and contradictory to the imagine we have of ourselves [3].

This methodology of design is not an exercise of style but it is based on knowledge of existing technologies and trends. One must consider probable futures, plausible but not impossible. In order for these futures to become tangible, the speculative designer creates "artifacts" that facilitate imagination and stimulate the creation of ideas and new points of view [4].

AIVR 2021, July 23–25, 2021, Kumamoto, Japan

ACM ISBN 978-1-4503-8414-8/21/07…$15.00
https://doi.org/10.1145/3480433.3480439

2 EVIDENCES OF THE DIFFERENCES BETWEEN EXTENDED REALITIES THROUGH CASE STUDIES RELATED TO LEARNING
After the analysis [5] of virtual, augmented and mixed reality technologies, we need to consider which of these technologies is going to be the most suitable for a sport product to be made. There are several studies that show how multi-sensory experiences can help the athletes in acquiring motor and mental skills through training [6].

Unfortunately, there are still not enough studies related to augmented and mixed reality applications within sport fields. The reasons concern the availability of dedicated tools and the underdeveloped ecosystem of applied researches. We can base the choice upon studies which have been conducted in other contexts and, then, compare them with our design requirements.

Before the presentation and the explanation of different case studies, we want to point out that the first aim of the project has to be the improvement of the sport performances: to achieve better results, we need to strengthen and develop the athlete's skills, character, emotive reactions, environment, through new learning and training methods. Learning in sports can be defined as "the behavioral modification that is the result of experiences that lead to the establishment of new configurations of response to external stimuli, represented by the succession of situations of movement and play" [7]. The learning phase involves a change in how one engages with opponents, teammates, game moments and situations [8]. There are several studies that compares augmented reality with virtual reality while used to improve the learning processes.

2.1 Virtual reality in museums

In recent years, the concept of digital museums has been introduced, exploiting new media and technologies to change the visual experience and make it more engaging.

The case study addressed by S. Girardi is interesting because museums are places of aggregation and interaction between very different people, so it is necessary to design an experience that suits all visitors. In these situations, "it can be seen that virtual reality experiences are more often reserved for dedicated rooms, events and specific contexts, while augmented reality manages to contaminate the museum entirely through fixed installations with which to interact during the visit or portable devices to take advantage of while proceeding independently" [9].

2.2 A tool to learn a job

Analyzing the research on the use of extended reality as a mean for professional training carried out by A.C. Boud, D.J. Haniff, C. Baber and S.J. Steiner at the University of Birmingham, it is evident the preparatory teaching role that these technologies can assume.

Extended reality should contribute to the development of manual skills which requires a certain level of visual and tactile concentration. Two systems were designed for the training trial: one devolved to the visualization of a product, which, therefore, performs the assembly tasks in the virtual environment; a second context-free AR system showing a static representation of the assembling sequence. The research shows that participants in the virtual experience were able to examine the assembling sequences, before the physical production of the object.

In contrast, subjects who experienced the second system were able to build the object in real life, while simultaneously accessing the virtual information as a guide. The connection between training and actual activity is more closely related than in the other conditions. Thus, AR can facilitate the rapid learning of simple tasks and it can improve performance time since training is conducted using real objects [10].

2.3 The interaction between mind and body

It is interesting, at this point, to understand how the virtual body and the user's mind interact with each other and eventually influence the user's behaviors in the environment.

The studies carried out by A. Thang, F. Biocca, L. Lim, show how VR environments are able to give back information about the position of the head and eyes, but they show limitations in the positioning of the body.

It is technically difficult to capture all the user's movements and features and to project them into an avatar within the VR environment in real time.

The fundamental difference between VR and AR environments is that the former is able to interact with the real world as well as the user's body and the body of an interacting person: in fact, instead of replacing perception in the natural environment, AR systems augment the human visual channel with computer-generated graphics.

This means, in conclusion, that instead of relying on proprioceptive memory (ability to recognize one's own body and its position without the use of sight), the user has real-time visual perception of every body movement. It has been observed that users of AR systems are generally more confident in making body movement than users in VR systems. The increased awareness of the user's body in AR environments also facilitates natural body movement [11].

2.4 Conclusions

The results of these studies show how the use of augmented reality may be more appropriate for sports training. The goal is to create a visual experience that relies on the training field: a context-sensitive system that allows to overlay images or any other media on the real environment, yet perceiving the context in which we are.

This solution would be optimal if the project will be implemented in the immediate present but the goals have to change if we want to design an experience for the future.

So, in addition to living training experiences that are similar to reality, in order to evolve such a service there is the necessity to integrate AI that can actively interact with us during the training. For these reasons, the best solution includes the possibility to interact with virtual elements projected in real environments, through a mixed reality.

3 TECHNOLOGICAL REQUIREMENTS TO CREATE A PRODUCT

3.1 Improve data gathering

By studying different visors and applications for extended reality, we can understand the importance of data collection to provide better experiences, especially if we deal with physical activity and interaction with digital objects.

We assume that physical activity and professional training must be carried out in a set environment, which requires appropriate equipment and spaces.

There are several suitable techniques to analyze human movement using AI. Whether it's motion analysis, motion intelligence, or intelligent video analysis, they are all aimed at understanding how people move and interact with the world. Emerging use cases for motion analytics include improving all aspects of sports and fitness, monitoring elder care, enforcing social distancing guidelines, retail analytics, and intelligent energy management.

Artificial intelligence can also be used to improve shape analysis and to help optimize an athlete's performance. MIT researchers working on the RF-Diary project built algorithms to observe people through walls using reflected radio waves. They trained artificial intelligence algorithms to interpret radio reflections with camera data to recognize 30 different actions, including sleeping, reading, cooking, and watching TV, with 90% accuracy [12].

Dealing with items currently on the market, we can mention stereo cameras and 3D cameras instead. In short, a stereo camera has two or more lenses with a separate image sensor or film frame for each lens. This allows the camera to simulate human binocular vision and provides the ability to capture three-dimensional images, a process known as stereo photography [13].

One such camera is currently manufactured by Stereolabs: the ZED 2 is a stereo depth-sensing camera for perception in autonomous systems and spaces. It allows to map environments and uses a neural network for depth sensing. Thinking about the sports field, it allows to detect and track the figure of the human body in real time. It visualizes spatial relationships between people, places, and objects [14].

The two problems to be solved in the near future are latency and accuracy in the real playing field. The future of motion analysis will require teams to find ways to fuse data from different types of sensors to improve accuracy and reduce costs. In the future, neural networks could solve this difficulty in understanding simple human gestures.

This concept of improved data collection aims to reduce the amount of hardware an athlete would have to carry to get information and real-time tracking in the field. Greater accuracy and less weight to carry on the body are the concepts directly related to the second technological goal.

3.2 The ideation of a new visor for sport activities

There are several solutions available on the market to exploit the extended realities in different contexts of use, including sports. In order to conceive a product suitable for use in the reference sector, further design constraints must be considered: resistance to falls or abrasions, freedom of movement, weight distribution and containment, water resistance, etc. The main objective regarding these needs is weight reduction: the miniaturization of the technical components should facilitate the use without compromising the athlete's performance.

Will the proposal for the future have to optimize an existing product or to create something that has not yet been realized? If we base our reasoning on current innovations, which are not yet on the market, the most promising is Mojo Vision. The integration of the technology to display augmented reality with simple contact lenses could change all the assumptions for the viewer [15]. Obviously, we cannot consider contact lenses as the only tool to meet all of our athlete tracking and monitoring needs. We need to distribute the weight of the components on the body, along with sensitive support provided by the playing field as described in the previous paragraph.

A good example that shows how to distribute the weight on our body is the STATsports chest protector: the technical clothing allows to obtain information and statistics about the player. The product is frequently used both during training and during official matches. Most soccer teams use these statistics, in fact three quarters of Premier League clubs use these kind of GPS. Clubs can make use out of this real-time data during official matches as well [16]. These chest protectors have a control unit located on the upper back so that body movements are not compromised. This could be a great starting point to create something similar by introducing augmented reality.

3.3 The connection between Extended Reality and data gathering

In reference to the product, there is the necessity to have a stable system to use mixed reality during a physical activity as described in the previous paragraph.

In addition to this, we must not forget the need to track the athletes in order to obtain useful data for different reasons: analytics activities, injury prevention, input and output for mixed reality. To get this information it is fundamental to place specific sensors on our body. For example, in baseball, Trackman [17] measures the acceleration and velocity of incoming pitches, the exit velocity and trajectory of hits, and it extrapolates the final distance and path of the ball through the air. We find local positioning with the aforementioned STATsports and optical tracking in soccer with Catapult. The NBA generates ball and player movement data using SecondSpectrum. The NFL incorporates Zebra RFID technology with tags on shoulder straps, as well as in footballs, to communicate their location and movement on the field [18].

All this data contributes to the system's ability to monitor the action and condition of tags (such as dribbling or passing) based on their underlying motion characteristics. Combining this information with optical data from stereo cameras could create an optimal analysis that further helps in evaluating and quantifying situations that occur on the field. Keeping in mind the need for movement freedom, it will be important to select the right materials and fabrics without placing too much weight on the athlete.

3.4 The use of AI for training activities

What is interesting is the possibility to create entire virtual game situations. These experiences require the development of AIs to make these programs interactive.

The first example to take inspiration from is definitely video games. For almost thirty years, video game developers have been creating entertainment experiences that allow us to challenge not only our friends but also the game system.

Video games in recent years have made great strides in graphics processing thanks to the technological advancement of today's computers, but the future of video games goes towards the emotional interactions between AIs and us. The existent products allow to test the edges of current gaming technologies while highlighting today's limitations: there are no human emotions or human decision-making. This problem concerns companies, developers, and startups that are developing human-like AI: emotional and responsive. The work revolves around the algorithm's ability to read, extrapolate, and portray emotions enabling a higher level of play. This is not intended to become a necessity to create machines capable of passing Touring tests, however, it would be interesting to be able to challenge an opponent knowing that they are making human-like decisions. The ultimate goal remains to create an experience as close to real activities as possible [19].

3.5 From intuitive to native interfaces

We considered as a goal the capability to interact with digital representations in the mixed reality system. Compared to a simple interaction situation, where we can give voice commands or interact with gestures, during a sports training session we expect the AI to react to our sport-related movements.

In order to achieve these reactions, after we get the computer to recognize our movements as a command, the AI will have to be programmed to receive those commands and to process a response in order to interact with our movements.

We can make a parallel in a different field of application: autonomous driving. In emergency situations, especially at high speeds, advanced autonomous driving systems are working a lot on the unexpected that can be encountered while driving a vehicle that must respond immediately to a possible obstacle. In 2019, Tesla released autopilot safety numbers to show that autopilot is safer than a human driver in average driving conditions. Autopilot is primarily used on highways, which have fewer accidents than city streets because driving conditions are much easier [20]. Since every Tesla is connected, the system is able to use the billions of miles of real-world data collected from all cars to understand the different ways accidents happen [21]. These data are not intended to show the capabilities of the vehicle but to make people think about the sudden situations that the system in these cars might face: an example of how to deal with real situations by receiving completely natural and sudden gestures or events as input.

4 USERS' NEEDS

4.1 Athletes' needs

These actors have a strong need to improve its performance through physical and mental work obtaining an optimal state of health to face competitions. To carry out these activities, it will be necessary to deepen the knowledge around data.

When interpreted carefully, the data collected offer exceptional insight into an athlete's current form. All these data have a common purpose, which is to create a huge repository of sports data dedicated to analyze current or future performance. Many professional athletes, especially in team sports, have realized that they have no data which could be used to analyze the ups and downs during their careers [22]. Being able to have their data and collect them with a universal tool, could make it easier to collect and use them for the protection of all athletes.

Extended realities along with data collection technologies and artificial intelligence, allow the creation of new multi-sensory experiences. Work on the field differently, communicate with trainers and coaches, live in the first person, and recreate game situations to study their movements and those of opponents.

Decision-making is a skill that can make the difference between success and failure in sports. Good decision making is supported by perceptual-cognitive skills that allow athletes to assess the environment and choose the best solution from a range of alternatives.

There is growing evidence that perceptual-cognitive training can be used to improve the performance of athletes in a competition. This is an excellent opportunity to create a realistic and interactive training environment [23].

4.2 Supporters' needs

Amateur athletes, team supporters, and fans of individual athletes have always had a desire to meet and train alongside their favorite professionals. Driven by the "success" motif, fans of participatory sports, sports in which fans also play, will find new ways to learn (and compete) with professional athletes.

When we think about the future fan, we need to consider the way these changes affect the way in which people identify themselves with sports, teams, and athletes. These factors underlying fan behavior, analyzed by psychology, are stable concepts. It is the powerful emotional connection that fans have with teams and players that explains why, as a market, sports are worth an estimated 600 to 700 billion euros and growing faster than global GDP [24].

Without fans, there would be no professional sports. Yet, for too long the role of the fan has been relegated to the passive spectator: they should watch and do little else. But with growing tools to express themselves and get involved in the action, they are now entering an era of an active fanbase. Fans have always had an impact on sports. Their mere presence has been shown to influence the performance of athletes.

The media with which fans express themselves become part of the narrative of the event. Supporters continue to share and produce media in huge volumes. The sheer volume of fan content is driving social media channels to explore ways to filter and surface influential fan content and make it part of the narrative, exemplified by Twitter Moments and Snapchat Stories [25].

The current use of digital entertainment services versus watching sport events is an example of the changes in behavior of younger supporters. The goal is to create a tool to interact with athletes. This system can also change the method of approaching physical sports by taking a cue from eSports.

4.3 Teams' needs

Sports teams, along with sports federations, are other users that play a key role within the system. The companies must protect the sportsman because he/she represents an investment for them. To be able to win matches, trophies, and awards, it is necessary to invest in the training and the care of the athletes.

To better analyze this type of company, let's start by observing the profit system: formation, sale, and resale of players or coaches within a club framework; the sale of tickets; public or private partnership contracts; media rights; merchandising. To produce an event, several stakeholders are needed, such as athletes, public organizations, media, private partners, fans, technical suppliers, etc.

Each stakeholder makes a significant commercial contribution to organizations that produce the events. Resources can be categorized based on each stakeholder's contribution: reputation (influences the cost of media rights), partnerships (sponsors), connections (public relation services), physical resources such as facilities and territories (ticket sales), brands (product and merchandising), and athletes (buying and selling athletes and merchandising). All resources interact with each other. Therefore, it is not the resource itself that is mostly important, but what it gives back to the other resources. For example, athletes/coaches help in creating club's reputation, and conversely reputation can attract athletes [26].

From 1998 to 2018, sports revenues flowed predominantly from television. From 2019 to 2040, the shift to streaming services will continue through the acquisition of sports rights by tech giants like Amazon, Facebook, Alibaba, Netflix, and Tencent, which will increasingly bundle sports content into their existing subscription services. This bundling will also fuel doubts about the future viability of sports rights acquisition as a stand-alone proposition [27]. In terms of the content distribution mix, it will be crucial to have a cross-channel strategy due to the increasingly fragmented media environment. The enjoyment of new content could open up sports entertainment services to new audiences. The key to the success of future events should be fans satisfaction, both on-site and remotely, through the broadcast products.

4.4 Sports companies' needs

Sports companies, on the other hand, provide all the technical equipment necessary to carry out these training sessions and to improve physical performance during competitions: game equipment (such as balls, rackets, goals, baskets, etc.) and technical clothing. But what could be the future of these companies?

Let's take today's market leader as a reference point: Nike. One may think that to sell technical apparel you need a good image and great marketing tools.

Today, thanks to continued investment in technology, Nike has transformed from a sports company to a technology-focused company, generating over $34 billion of revenue in 2017 alone [28]. Since 2009, Nike's patents have nearly doubled, outpacing direct competitors. This has allowed them to maintain a competitive advantage. Nike collaborates with several technological companies making truly unique and innovative products.

What sets Nike apart in the competition is its network of inhouse professional athletes, a long fitness background, and a greater strength in software development which helps it to design a seamless UI [29].

In 2016, it created an interesting concept to change training methodologies: Rise 2.0 is a fully connected basketball platform that consists of a training app, an advanced tracking system, and a digital LED basketball court. Through the connection between these three peripherals, the platform allows coaches to create a variety of drills and measures, evaluate and improve the performance of any player training on the fully responsive basketball court. Coaches can customize drills based on specific skills, players, or teams. The tracking system detects positioning, speed, and acceleration, capturing real-time data during practice and games. Over time, the data adds up, creating detailed profiles of individual players, and, as a result, the coaching app can recognize players' strengths and weaknesses and suggest the best way to progress [30].

Nike aims to use these technologies to improve the design process and the final product. "Augmented reality is a new type of experience for many consumers and poses many challenges for them," says Josh Moore, vice president of design and UX at Nike. "Over the past few years, we've done a lot of experimentation and created new features in our SNKRS app, where we've learned a lot about how to successfully use augmented reality. Specifically, we know that we need to guide our users along the journey at their own pace so that they can understand as they go along." [31].

What could be the future moves of this tech giant? According to several researches, one of the fields currently under development concerns smart clothing itself: the integration of sensors into clothing is a logical step in next-generation products [32]. Not only clothing is able to monitor body conditions during exercise in order to provide performance information, but the same technology could detect abnormalities that should prevent serious health problems. Nike could begin collecting these data to move into the health sector.

4.5 Video gamers' needs

It is interesting to talk about these users because the idea behind the hypothesized system could also attract users who are tied to digital gaming.

We are not talking about a niche of gamers since among the best selling games, there are the FIFA (soccer), NBA 2K (basketball), and NFL (football) franchises [33]. A research carried out by A. Stein, K. Mitgutsch, and M. Consalvo have precisely analyzed sports video gamers by collecting all previous researches carried out on them and performing further analyses.

In 2001, F. Shipman argued that the rhetoric of these games concerns "empowerment and role-playing". He asks the player to imagine themselves being a coach, with all the power to make decisions for the team. However, such games let the player perform solely as a coach or general manager, and not as a player, as they focus on managing a team rather than playing the sport [34]. Most players seem to create their calculations by relying on domain-specific knowledge of athletes and applying this knowledge in various ways [35].

Researches show that such games are focused on managerial tasks in ways that a coach or athletic director might undertake, with players responding in different ways to such challenges.

Whether alone or in a group, public or private, online or offline, the gaming event is defined not only through what happens during games and between teams, but also on what happens between players, spectators, and the broader games.

These games are not simply activities in their own right, but they should be contextualized as "an authentic extension of sports culture, because players were just as likely to talk about the lives of players, current team news, analysis of statistics, and other topical sports issues." [36].

It is inspiring to note how these video games take an interest about the world of sports. The media also operates at this juncture. The results of the study show that 95.3% of gamers (surveyed) are actively and predominantly interested in sports and that they are placing sports video games in a broader sports-related context. In addition to this interest, 74% have played that sport.

Another interesting point concerns the high percentage of players (95%) who say they have created a playable character in a sports game and indicate that they have recreated themselves as a playable character in that sport [37].

These games provide the player with not only a meaningful experience but also a deeper understanding of the sport and its rules and relationship to them. Sports video gamers develop unique, deep, and meaningful experiences through their game-play.

5 CONCLUSIONS

The responses to the questions in this research demonstrate the importance of games as facilitators for social interaction among friends and family, as well as systems that offer players a way to compete and engage in competitions that they feel will challenge their skills and abilities.

Therefore, a reduction of sports video games to a secondary or subordinate extension of television consumption or sports culture seems to underestimate the importance of video games as a driving factor in enhancing sports "fandom" in general. This finding suggests that it may be worth exploring in more detail how theories of sports fandom might overlap with the experience of playing sports video games.

Improving the athlete's condition requires a focus on the tasks performed by the people who work for the athlete: it means to provide new tools for coaches or technical trainers; to increase the data collection in order to analyze performance; to deepen injury researches; to create means able to evaluate new talent; and to create new immersive experiences dedicated to nurture the athlete's mindset.

The project also examined the entire ecosystem by describing new ways to express one's passion for sports. Amateur athletes, team supporters, sports experts, and even gamers have the opportunity to change the way they perceive sports and convey their passion through a gimmick that gives them the ability to create valuable content. Tying mixed reality to the need for data collection in sports has allowed the hypothesis of several opportunities to innovate the sports system. These advantages aim at achieving a professional rise of different figures that intervene within the training cycle.

The figure of the designer could be fundamental in managing the complexity that comes from the creation of systems with a strong innovative impact, but it is aware that there are a series of professional figures equally fundamental and highly enabling, such as developers, computer engineers and experts in the sports sector without who it would not be possible to assume innovative applications and ways of use. The research highlights the transversality and horizontality of the design discipline, indicating how designers must be able to manage complexity and integrate multidisciplinary skills in order to achieve the objectives.

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