

CYBATHLON 2024 The Third Edition

What's New and What's Different?

By Charles Bara ^{ID}

In the ever-evolving landscape of assistive technology and human-machine interaction, the CYBATHLON 2024 promises to be a groundbreaking event showcasing the latest advancements in the field of assistive technologies. The CYBATHLON 2024 aims to foster an even greater inclusion of people with disabilities in society. As we are on the road toward the next edition of this unique competition, expect new disciplines and tasks, a global multihub format, and integrated elements of artificial intelligence (AI). Let's explore what's new and different for CYBATHLON 2024 than the previous two editions in 2016 and 2020.

CYBATHLON 2016 AND 2020

CYBATHLON [1] 2016 [2] and 2020 [3] represented significant milestones in the advancement of assistive technology and the promotion of inclusivity. In its debut in 2016, the event brought together 56 teams from 25 nations, showcasing groundbreaking innovations across six disciplines. This marked the beginning of a journey to bridge the gap between people with disabilities and cutting-edge assistive technologies.

Fast forward to 2020, when the second edition of CYBATHLON continued to push boundaries and foster global collaboration. Despite challenges posed by the pandemic, the event evolved into the CYBATHLON 2020 Global Edition, with 51 teams from 20 countries partici-

pating remotely. This adaptation underscored the resilience and determination of the CYBATHLON community to overcome obstacles and uphold its mission of inclusivity.

One notable evolution between the two editions was the refinement of tasks and challenges. While the core disciplines [4] remained the same, such as the brain-computer interface (BCI) race [5], functional electrical stimulation (FES) bike race [6], arm prosthesis race [7], leg prosthesis race [8], exoskeleton race [9], and wheelchair race [10], new elements were introduced to reflect real-world scenarios faced by people with disabilities (Figure 1). Tasks, like negotiating

winding stairs in the exoskeleton race and identifying objects by touch in the haptic box task in the arm prosthesis race, added complexity and realism to the competition. In the FES race, people with complete spinal cord injuries were provided with FES devices, allowing them to pedal on a cycling apparatus. In 2016, they completed five laps on a circular track, covering approximately 750 m, while in 2020, the distance increased to about 1,145 m.

CYBATHLON 2024

The third edition [11] of ETH Zurich's [12] CYBATHLON is set to take place from 25 to 27 October 2024. Building



FIGURE 1. The arm prosthesis race during the CYBATHLON Challenges at ETH Zurich in 2022 May. (Source: CYBATHLON/Alessandro Della Bella; used with permission.)

on the experiences from the last installment, this edition benefits from a global multihub format: Zurich hub in the Swiss Arena [13] near Zurich and team hubs at different locations globally. As many as 83 international teams [14] from academia and industry are ready to compete. When it comes to the discipline tasks that the teams and their pilots will have to tackle and overcome, here's what Roland Sigrist [15], cohead of CYBATHLON, has to say: "Compared to the rules for the 2016 and 2020 editions, we are incorporating a greater degree of unpredictability and a wider spectrum of tasks into the 2024 tasks." For example, before the race, wheelchair pilots will not know the order in which they will encounter steps of differing heights and must react to the situation in the heat of the moment. This requires the teams to develop even more robust, functional, and dynamic assistive technologies for people with disabilities. Based on this, the organizers promise increased acceptance of new user technologies.

On the road to CYBATHLON 2024, new disciplines and formats have been introduced, marking significant advancements in the competition's scope and inclusivity. These include the

vision assistance (VIS) and assistance robot (ROB) races, offering innovative challenges for persons with visual impairments and severe limb limitations. The event has evolved with the introduction of the CYBATHLON Challenges, a platform for teams to engage with end-users and test their systems competitively. Embracing virtual technology, CYBATHLON now hosts virtual races, like the BCI and FES bike races, fostering global participation and sustainability. With elements of AI and enhanced accessibility features, CYBATHLON 2024 promises to be a groundbreaking event driving innovation and inclusivity in assistive technology.

NEW DISCIPLINES

In addition to the six existing disciplines from the last two editions, two new ones have been added to CYBATHLON on the road to 2024: a race using smart visual assistive technologies for the blind (VIS) and a race using assistive robots (ROB) for people with severely limited use of their arms and legs.

The VIS [16] is the first CYBATHLON race for people with visual impairments (Figure 2). For people with vision impair-

ments, tasks like finding specific products in a supermarket or noticing unexpected construction work during their daily commute can be immensely challenging. Modern technologies are making their everyday tasks easier and AI, augmented reality, and GPS are providing new options for the blind. However, with 2.2 billion people [17] living with moderate to severe visual impairments worldwide according to the World Health Organization [18], creating assistive technologies that are accessible for everyone can be a challenge.

The ROB race [19] includes aspects of human-robot interaction, environment recognition, and object manipulation (Figure 3). In this discipline, the participating people with disabilities (pilots) must work together with the robot to recognize and manipulate various objects and avoid obstacles on the track. Assistive robots offer the potential for people with disabilities who have severe impairments of the upper limbs to become more autonomous and independent.

NEW FORMAT

The CYBATHLON road to 2024 started with the first competition: a new format called the *CYBATHLON Challenges* [20]. The Challenges offer teams the opportunity to involve people with disabilities in their development process from the very beginning to test their assistance systems in a competitive situation. The competitions were expected two to three times during the four years in several or all eight CYBATHLON disciplines until CYBATHLON 2024.

The Challenges occur in a global multihub format: at the teams' home institution (team hub) and the Zurich hub in Switzerland set up by the CYBATHLON organizers. It consists of one to four tasks per discipline from the Races and Rules for the CYBATHLON 2024 [21]. Each team is given two attempts at the competition task; the team that completes all tasks the fastest wins the race. However, the pilots in the FES bike race will have only one attempt.



FIGURE 2. The VIS race during the CYBATHLON Challenges at ETH Zurich in March 2023. (Source: CYBATHLON; used with permission.)

The first Challenges in May 2022 [22] included one task per discipline. The second Challenges in March 2023 [23] incorporated two tasks in each discipline. And the third Challenges in February 2024 [24] included four tasks in each discipline from the Races and Rules CYBATHLON 2024.

NEW TASKS OR RACES

On the road to 2024, CYBATHLON has introduced new tasks [20] for the BCI race and FES bike race disciplines. The new BCI game represents potential future applications of assistive technology when compared to the previous CYBATHLON editions. As CYBATHLON tasks aim to represent challenges in the daily life of people with disabilities, the pilots tackle tasks related to holding a position for some time and waiting, operating a computer menu to communications, and steering and controlling an assistive technology, such as a robotic arm or a wheelchair. The new FES bike race is a stationary cycle race in a virtual scenario in which several FES pilots compete against each other at the same time. With these races, CYBATHLON focuses more on sustainability and increased inclusion. Pilots can participate from anywhere in the world and do not necessarily need to travel to Zurich.

Furthermore, the virtual nature of BCI and FES bike races presents significant advantages for pilots and teams globally and promotes sustainability by eliminating the need for extensive travel, aligning with sustainable practices by minimizing environmental impact. Teams from diverse corners of the world can participate in the competitions without the logistical challenges associated with a physical presence, democratizing access to the event and fostering greater inclusivity. As a result, CYBATHLON's embrace of virtual technology enhances global participation and contributes to a more environmentally conscious approach to competitive events.

In 2016, teams in the wheelchair race faced a challenge with straight-edge stairs, initially mastered by only one team. By 2020, 90% of teams overcame this obstacle. To introduce a fresh

challenge, organizers have introduced winding stairs for CYBATHLON 2024, presenting a new technological hurdle alongside the familiar straight stairs.

ELEMENTS OF AI

With disciplines like BCI and the addition of two new ones, the ROB and VIS races, one of the most exciting parts of CYBATHLON 2024 is the increased incorporation of AI into assistive technologies. Pilots navigate the courses with the assistance of AI algorithms, allowing for more adaptive and responsive control of their respective technologies. This integration aims to enhance the overall user experience and performance, opening up new possibilities for people with different levels of physical abilities in a real-world scenario.

GLOBAL PARTICIPATION AND COLLABORATION

CYBATHLON has always been an international event, but 2024 promises

even broader global participation. Teams from diverse countries are expected to bring their innovations in assistive technologies and compete on the world stage. This promotes fair competition and encourages closer collaboration among researchers, engineers, and innovators worldwide. The sharing of ideas and experiences undoubtedly accelerates the advancement of assistive technologies, benefiting not only the advanced countries but also low- and middle-income countries. Beyond CYBATHLON event participation, it is envisioned that many scientists, researchers, and engineers will collaborate more and more with people with disabilities

when developing and designing assistive technology to make them more user-centered and affordable technologies.

ENHANCED ACCESSIBILITY FEATURES

In the spirit of promoting inclusivity for people with disabilities in all spheres of

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FIGURE 3. The ROB race during the CYBATHLON Challenges at ETH Zurich in March 2023. (Source: CYBATHLON; used with permission.)

life, CYBATHLON 2024 will emphasize the integration of enhanced accessibility features in the competition infrastructure. The event organizers are working closely with experts and engineers in universal design to ensure that the venues, tracks, tasks, and technology interfaces are as accessible as possible for all participants and spectators. This is evident from the uniform venues and infrastructures and event management at the main hub in Zurich and the team hubs in different countries.

VIRTUAL SPECTATOR EXPERIENCE

Recognizing the importance of global accessibility, CYBATHLON will organize the competition around its global hubs, thus providing an immersive virtual spectator experience. Leveraging advanced streaming technologies featuring subtitles in multiple languages, sign language interpretations, and audio descriptions, audiences across the globe can witness the competition in real time. Moreover, the audience will have the option to explore interactive features on and about the races on the CYBATHLON website. This addition aims to connect a broader audience with the event, raise awareness about the potential of assistive technologies, and provide a platform for dialogue to foster greater inclusion for people with disabilities in society.

TECHNOLOGICAL ADVANCEMENTS IN ASSISTANCE SYSTEMS

CYBATHLON has propelled innovation in assistive technology by engaging end users directly in the development process, addressing real-life challenges faced by individuals with disabilities. Tasks in the competition mirror daily life obstacles, serving as a platform to showcase cutting-edge advancements worldwide. To foster innovation, minimal eligibility criteria are set, ensuring fairness and safety for participants. Over the years, initiatives like MyLeg [25], Scewo [26], and TWIICE [27] have transitioned from prototype to commercial products, demonstrating

CYBATHLON's impact on technological transfer.

CONCLUSION

CYBATHLON 2024 is set to mark a significant milestone in the advancements of assistive technologies, highlighting both the potential of human-machine cooperation and the continuous expansion of opportunities in this field. The introduction of new disciplines, AI integration, new multihub format, refined and new tasks, global participation, enhanced accessibility, and a virtual spectator experience all contribute to making CYBATHLON 2024 a must-watch event for those interested and involved in the future of assistive technologies and greater inclusion of people with disabilities in society.

AUTHOR

Charles Bara, CYBATHLON ETH Zurich, 8092 Zurich, Switzerland. E-mail: charles.bara@cybathlon.com.

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