Blue Artificial Intelligence: Protecting Oceans, Inspiring Citizens

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Introduction

As the boundaries between human creativity and machine intelligence blur, we find ourselves at the dawn of a new era in environmental conservation. There are more than 163,000 species on the IUCN Red List [1], with over 45,300 species threatened with extinction. Among them, over 1,550 of the 17,903 marine animals and plants assessed are at risk of extinction, with climate change impacting at least 41% of threatened marine species [2]. Our research, positioned at the intersection of Artificial Intelligence (AI), human creativity, and Citizen Science, seeks to revolutionize how we monitor, protect, and engage with oceans and marine biodiversity.

To achieve this, we have developed the 'Blue AI,' an innovative framework for data analysis and educational programs rooted in AI, specifically tailored for ocean conservation. We envision a future where Citizen Science, empowered by the Blue AI, not only advances scientific research but also cultivates a profound societal bond with the oceans. Engaging people across all generations, particularly youth, we aim to inspire them to tackle challenges such as reversing climate change and addressing the ongoing environmental crisis. This synergy between human creativity, AI, and citizen participation will empower individuals to become active contributors to ocean conservation, fostering collective responsibility and motivating innovative solutions for a more sustainable planet. Our work establishes the foundation for a convergent approach, combining data analysis, machine learning, generative AI, and creative methodologies to engage communities globally. Through this lens, we explore the transformative potential of combining Computational and Citizen Science with creative human input to drive sustainable environmental action.

Blue AI: Pioneering the Future of Marine Conservation

Blue AI represents a novel framework of AI specifically tailored for monitoring and preserving marine environments, with a particular interest for endangered species such as cetaceans and sea turtles, which serve as indicators of ocean health. We have designed, implemented and validated AI-driven systems for species photo-identification, monitoring, habitat and behavioral modeling, providing novel insights into the habitat use and migration patterns of cetaceans and sea turtles [3-10]. This comprehensive approach enhances our understanding of the interplay between marine species and their habitats, ultimately contributing to more effective conservation strategies.

We have sifted through large amounts of data collected by citizen scientists and researchers alike, thanks to collaborations with other research units, particularly the Jonian Dolphin Conservation [11], an NGO dedicated to marine mammal conservation in the Central-eastern Mediterranean Sea.

By integrating Blue AI with Citizen Science, we are expanding the reach of marine research beyond traditional academic and institutional boundaries. This democratization of science amplifies our conservation efforts while creating more globally informed and engaged communities. A future challenge is to develop user-friendly platforms that make AI-based solutions and the results of the scientific research easily accessible to citizen scientists, ensuring they can meaningfully engage with the tools and insights we generate.

The role of Creative Minds

Beyond technical solutions, we are investigating the role of creativity in shaping AI-driven environmental strategies. How can AI and human creativity work together to inspire innovative

conservation approaches? Can AI evolve beyond a data processor to become an effective partner in tackling complex environmental issues? What role does creativity play in empowering citizen scientists, particularly young people, to think beyond conventional solutions when addressing sustainability challenges?

We believe that in the pursuit of technological innovation, human creativity remains indispensable. Creativity not only complements AI but catalyzes new forms of knowledge production and engagement, especially within Citizen Science. Drawing inspiration from lateral thinking methods and interactive dialogue techniques, we have pioneered new approaches to AI that emphasize creative problem-solving in science. Through educational programs and interactive workshops, we engage young citizens in thinking laterally about the environmental challenges we face and envisioning unconventional solutions aided by AI. Our hands-on experience with these young minds has shown that when they are encouraged to explore creative solutions for environmental conservation, they develop critical thinking skills and become passionate advocates for a sustainable future. Though we are still early in this journey, the enthusiasm and fresh ideas we have seen point to a promising future. Their growing awareness of environmental issues, combined with their creative problem-solving skills and responsible use of AI, positions young citizens as future advocates for ocean conservation. We are confident that as they continue developing their ideas, their influence will ripple through their communities, mobilizing local actions, fostering partnerships with conservation groups, and sparking dialogue on sustainable policies. This early engagement sets the foundation for long-term impact, where today's creativity leads to tomorrow's solutions.

Conclusion and Future Directions

Looking ahead, our vision for the convergence of Blue AI and Citizen Science involves building a more inclusive, secure, and transparent ecosystem. Ensuring ethical and equitable AI in Citizen Science is paramount. AI systems must be designed to be bias-resistant and accountable, particularly when used in community-engaged science. This requires a multi-disciplinary approach involving AI ethics, data experts, and community stakeholders, which is at the core of our ongoing work.

Another key aspect of future development is expanding the reach and impact of cyberlearning—the use of new technologies to create effective new learning experiences that were previously impractical—in Citizen Science. AI-assisted learning platforms, gamified Citizen Science projects, and virtual workshops can engage new demographics, ensuring that participants of all ages and backgrounds feel included in the scientific process. These platforms, combined with machine learning tools, will enhance the ability of individuals and communities to learn by doing, increasing their scientific literacy while actively contributing to research and conservation.

Finally, collaboration between research institutions, universities, schools, NGOs, and local governments is essential to creating an inclusive Citizen Science ecosystem. This cooperation empowers diverse communities to actively contribute to conservation efforts, leading to greater impact.

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