May the ocean be with you! Botball & Environment

STEM Projects

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***Abstract*—Children's creativity and imagination is endless and our planet is endangered. Encouraging young people to do research and work on their innovative ideas to save the earth should be one of the major tasks of robotics competitions. There are many initiatives from children to change something for our environment. One of them is the underwater robot Shark, which was developed in order to raise awareness for ocean pollution. Now it is used in the competition PRIA Underwater. The Team Talentehaus set the goal to improve the robot, inform as many people as possible and make PRIA Underwater great and well-known! This paper focuses on environmental issues and presents ideas how children could be motivated, through robotics competitions, to think critically about ways to solve them.**

***Index Terms*—Botball, Environment, PRIA Underwater, Pollution, Future**

I. Introduction

Only after the last tree has been cut down /
Only after the last river has been poisoned /
Only after the last fish has been caught /
Then will you find that money cannot be eaten.
- Indian prophecy [1]

Botball is a future-oriented competition, but Climate Change threatens the future of our planet. [2] PRIA, the Practical Robotics Institute of Austria, founded a new robotic competition for raising awareness. The *Botball Underwater Competition* should persuade kids and teenagers to think about pollution problems of the seas. In this paper further ways for the Botball competitions are discussed, which have the goal to impact our future in a positive way. The society should be alerted that the life on our planet is threatened unless we changed our lifestyle.

OUR GOAL IS TO ENCOURAGE CHILDREN TO CARE ABOUT THEIR FUTURE!

A. Climate Change

Some people doubt climate change, but the facts tell a different story. It is more present than most think. Even though the American president Donald Trump is denying the climate change by saying *There is a cooling, and there's a heating*, the earth is sending different signals. The US is struggling to survive natural disasters like wildfires, mudslides and persistent hurricane damage. [3]

First, the term *Climate Change* should be clarified. Burning fossil fuels emits carbon dioxide and other greenhouse gases like methane and nitrogen oxides, which enhance the so called *greenhouse effect*. These gases accumulate in the atmosphere, where they reflect heat radiation from the ground back to the earth. As a consequence the temperature on earth is rising. This phenomenon is confirmed by studies, which show that between 1906 and 2005, the average temperature has risen by up to 1 degree Celsius. [4]

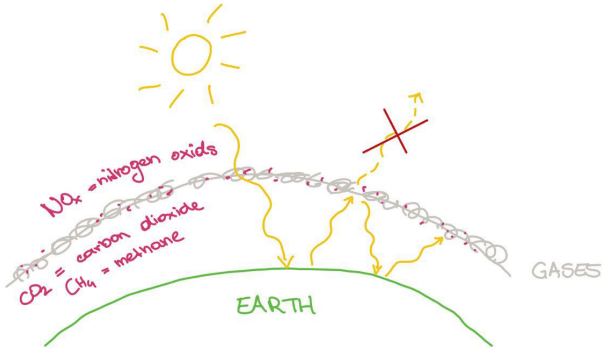

Figure 1. Graphical explanation of the greenhouse effect

B. Importance of the Oceans

About 70 percent of earth's surface is covered with water, so there is a correlation between the climate and the sea. Water plays an important role in the global heat circulation. The World Ocean Report [5] was written to raise public awareness. According to the report, something has to change soon. The climate responds slowly to human-caused changes, so the effects will probably get worse in future. The most important roles of the oceans are the already mentioned heat transportation and also oxygen production. About 50 percent of our oxygen is produced in the seas. [6] The other way round, global warming makes reefs die off and sea levels rise. But the oceans are facing even more problems: over-fertilization, oil pollution and waste, to name some of them.
Most people do not know how important the global waters are and how they are effecting our daily life. We set ourselves the task of changing this from an early age!

II. State of the Art

In the following section current options for cleaning the ocean, environmental initiatives and Botball's efforts towards saving the planet are described.

A. Ocean Cleaning

In this section initiatives for cleaning the ocean are discussed and presented.

1) Seabin Project: This project is as easy as it seems. The basic principle is: *If we can have rubbish bins on land, why not have them in the ocean?*. It looks like a bin, it works like a bin and it should be like a bin! The Seabin is floating on the surface of calm waters and sucks in water that is containing plastics. The waste is caught by a filter inside the bin in an estimated amount of about 1.5 kilograms per day. [7]

2) The Ocean Cleanup: This plan was developed by a 16-year old boy. He was scuba diving and saw more plastics than fish, so he set out to find a solution, for cleaning the water. The technology is passive, that means that the plastic is caught by making use of the tides. Barriers are placed in the oceans, where the plastic pieces are caught. The whole system does not need any electrical power, which makes it truly energy efficient [8]

B. Environmental Initiatives

There are many children-started organizations and programs to convince grown-ups to change their mind. Botball has the power to support young people and give them the possibility to express their fear and develop solutions.

1) Plant-for-the-Planet: In 2007 a 9-year old student founded the initiative, with the goal that children all over the world plant one million trees in each country. Every tree can transform about 10 kilograms of carbon dioxide into oxygen per year. The *Trillion Tree Campaign* says there are about 3 trillion trees currently on earth. If we added another trillion, these plants would convert about a quarter of the emissions of human. [9]

2) ECO - Environmental Children's Organization: 12-year old Severn Suzuki founded this organization with other friends. Their ambition is to fight for future generations, so in 1992 the girl spoke in front of the United Nation to clarify that it is her future politicians should think of, not only their current success. [10]

C. Environmental Competitions

After a long search, a good representation and summary of environmental competitions was found on the internet. [11] After analyzing them there are many film challenges, writing tasks and poster contest. Unfortunately, there is a lack of robotic environmental competitions. Only one, the Genius Olympiad [12], is focusing on solving environmental problems with autonomous technology. This competition is hosted in America and in the last years hardly any Europeans have participated. Botball could take responsibility and use its scope to encourage even European, African and Asian countries to take part.

D. PRIA Underwater

An organizer and sponsor of Botball, named PRIA (Practical Robotics Institute of Austria), invented a new robotics competition to support environmental protection, especially ocean conservation. The PRIA Underwater game document is about cleaning the oceans. The robot is provided by PRIA and is called *Shark*. [13] It was developed by Reinhard Grabler, under an open source license so that everybody can use and evolve it. At the 2017 competition, the task was to program the robot so it could dive in a swimming pool, avoid nets and collect plastic fragments like ping-pong balls. In this way, children get to know environmental problems and start to think of plausible and innovative solutions.

1) Current version of the Shark: The shark, which is shown on picture 2, consists of a 3D-printed chassis that encloses a pipe. The electronic parts of the robot are located in this gray PVC-pipe. The hedgehog-controller represents the control unit. Some sensors of Botball-kit (e.g. a camera) are used for the orientation of the robot. Moving is the most difficult and complex part of the Shark. For diving and controlling a syringe and a motor on each side is used.

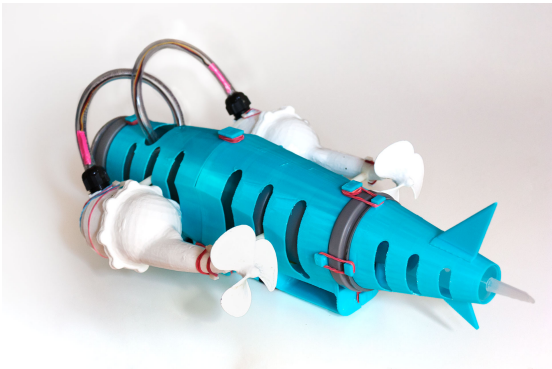

Figure 2. Shark

III. Concept

A. Make PRIA Underwater great!

The *Team Talentehaus* started an initiative to support the PRIA underwater competition. They attended *First Lego League*, where they had to do a research project. The team chose to develop the Shark robot and persuade other teams to attend PRIA Underwater. A survey conducted at the First Lego League competitions in St. Pölten and Bregenz shows promising results. About 150 students at the age of 10 to 16 were asked if they will take care of our environment in the future, after informing them about current developments and dangers. As shown in figure 3, nearly every student wants to change something in his life concerning environment.

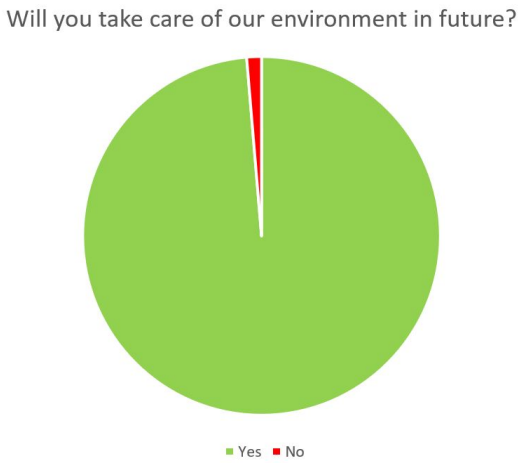

Figure 3. Survey results

Developing and improving things is our passion, therefore the idea of simplifying the embedded technology of the *Shark* was born. The goal is that everybody in the Botball-family is able to attend in the Underwater competition.

A controller, which is available (and cheap) all over the world replaced the high-end hedgehog-controller. For better autonomous control, the included sensors got revised. Reducing the errors and defects was also an important part of the new version. The Shark is an underwater robot, nevertheless water was the greatest risk for all the electronic parts. So this issue had to get fixed urgently.

B. Botball and Environment

Botball has a great coverage and influence all over the world. About 300 teams attend the competition every year. [14]
Team Talentehaus' demand is that Botball takes on a small part of responsibility for our planet and motivates children to develop innovative ideas. One way of doing so would be to let teams work on specific environmental issues in the game document (the annual competition explanation with background information), another the call for papers. According to the annual sponsors, the topics variate to inspire students for the (e.g. NASA sponsored a space-themed game). A great idea would be the ask environmental organizations if they could imagine to be a sponsor of Botball. Greenpeace, Global 2000 or others would be great partners to persuade KIPR of doing a *green competition*. In the next chapter four ideas are presented.

IV. Implementation

A. Modification of the Shark

The biggest problem of the current shark version was water proofness. All motors were replaced by water resistant ones, and coated with a plastic spray. These motors need no case, which helped saving space. The before used hedgehog-controller was overpowered for the Shark, therefore it was replaced with a *Raspberry Pi Zero*. The major benefit is that it is consuming less energy. The whole Botball-family should be able to work with the Shark, so simplifying the controls was also an issue. Brushless, waterproof motors provide easier programming and are maintenance-free. For saving the planet this is a markable benefit!

The shark was not equipped with any high-end-sensors. To add more controlling mechanisms a *10dof* sensor was added. [15] It is a combination of multiple sensors and consists of an acceleration sensor, compass, gyroscope, and a pressure sensor, which in combination allow for better orientation of the Shark. Further improvements were provided by using a better camera, a distance sensor and a switch on the end of the syringe. These upgrades allow for a detection of the end position of the syringe.

We have already implemented these changes with high success. As it can be seen on picture 4, the modified Shark is able to swim in our bath tube! We also tested it in a swimming pool.

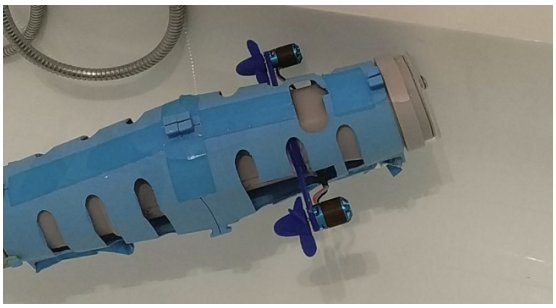

Figure 4. Shark

To sum it up, more safety was added by consuming less energy! Best conditions for a relaunch of the Shark!

B. Raising awareness with the Shark

Another use case for the shark could be educational without competitions. Together with the organization *Wasserkluster Lunz* [16], the Shark was improved. Children should get the possibility to explore domestic waters and find pollution. A net was mounted on top of the Shark, in order to catch floating waste in the water, which is in fact more than what is laying on the ground. In figure 5 the shark with mounted net is shown. This is not dangerous for fish, it is soft and the Shark is moving slowly, so fish can escape.

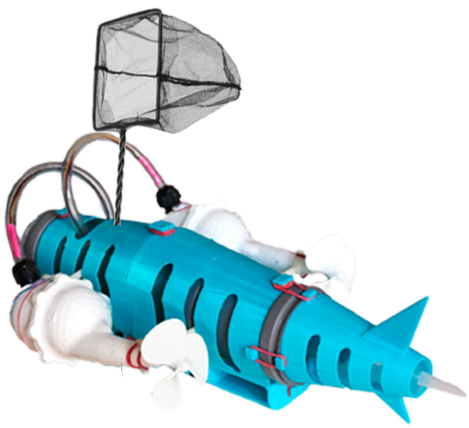

Figure 5. Shark with mounted net

By collecting donations, more Sharks could be built and provided for educational purposes. Together with teachers and classmates, local rivers and streams could be explored and cleaned.
To clarify, cleaning waters with Sharks will not solve the waste crisis. Much more important is, that children change their mind and avoid making more waste!

C. Game Table for Botball

Another idea is to integrate environmental problems not only in PRIA Underwater (which is unfortunately only available in one Botball region at the moment), but rather in the major Botball Game Document. So the whole huge Botball family can work on it.

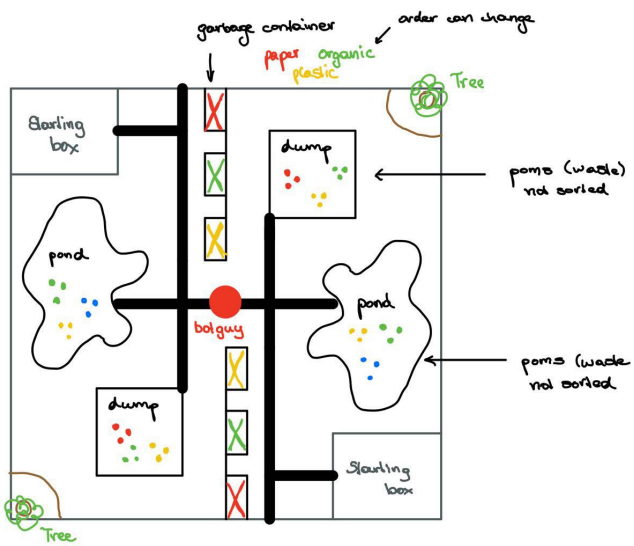

Figure 6. Draft of game table built

Figure 6 represents our idea of an *environmental themed Botball-Table.*
The task could include the separation of waste into plastic, organic and paper containers. Poms, which stand for waste could be on the dump. To increase difficulty, the dump could be a box where the robots have to grab inside. The pond represents the polluted oceans, which robots have to clean by taking the poms out of it. A special scoring area is the bed around the trees. Trees are good for our future, so we should water and fertilize them. Robots can take blue and green poms out of the pond or dump and place them in the bed to score points.

These are some basic ideas to include environmentalism into Botball. We request KIPR and PRIA to think about these ideas and may include some elements in future game documents!

D. Zero-waste Award

Not only technical skills are important in Botball. If a team wants to be successful, they will need even more skills. To sum it up, technical, social, writing and speaking skills are vital to achieve good results. There are awards for outstanding mechanical design, *Keep it smart and simple* and Spirit of Botball.
PRIA and KIPR could think of introducing a new award: ECO-Award. Criteria could be following the *Zero-waste policiy* or other environmental factors.

E. Research Paper for Botball

To support scientific research, the European concept of writing papers should be established in all regions. The call for papers could state one of the following topics to encourage young people to think about future problems.

Environmental Problems - think about a daily issue and try to work on finding a solution!
Save the ocean - implement innovative ideas!
Future4Future - encourage young people to fight for their future!

V. Conclusion

Our planet is endangered. To prevent a dark, unhealthy future, not only grown-ups, but also children and teenagers have to fight for it. It is our responsibility to take care and re-establish a healthy environment. Many promising ideas come from young, motivated and optimistic people. Various environmental organisations and initiatives lead by children confirm this hypothesis. It is undisputed that young people have a remarkable impulse to develop new ideas. Initiatives such as Botball or First Lego League, can reach thousands of children and teenagers. They should use their power and inspire kids to think about their future.

REFERENCES

[1] *Weissagung der cree*. Website, 2017. Available at: https://de.wikipedia.org/wiki/Weissagung_der_Cree; Accessed: February 02, 2018.

[2] *What is botball®*. Website. Available at: http://www.botball.org/what-is-botball; Accessed: February 15, 2017.

[3] McCarthy, Joe: *Trump confuses climate change and global warming in interview*. Website, January 2018. Available at: https://www.globalcitizen.org/en/content/trump-interview-piers-morgan-climate-change/; Accessed: March 17, 2018.

[4] *35 facts about climate change*. Website. Available at: https://www.conserve-energy-future.com/various-climate-change-facts-php.php; Accessed: March 06, 2018.

[5] maribus: *World ocean review*. Website, 2010. Available at: https://worldoceanreview.com/wp-content/downloads/wor1/WOR1_english.pdf; Accessed: April 6, 2018.

[6] Grabler, Reinhard: *How maritime robotics can save our oceans — reinhard grabler — tedxdonauinsel*. Website, August 2017. Available at: https://www.youtube.com/watch?v=U2Wr4IC6nKo; Accessed: April 8, 2018.

[7] *What's a seabin?* Website. Available at: http://seabinproject.com/the-product/; Accessed: March 06, 2018.

[8] *How it all began*. Website. Available at: https://www.theoceancleanup.com/milestones/how-it-all-began/; Accessed: March 06, 2018.

[9] *Aims and vision*. Website. Available at: ttps://www.plant-for-the-planet.org/en/about-us/aims-and-vision; Accessed: March 12, 2018.

[10] *Severn suzuki*. Website, 2017. Available at: https://de.wikipedia.org/wiki/Severn_Suzuki; Accessed: March 12, 2018.

[11] neubert, Joshua: *The best environmental competitions for students.* Website, December 2017. Available at: https://www.competitionsciences.org/2017/12/18/the-best-environmental-competitions-for-your-students/; Accessed: April 8, 2018.

[12] *Genius robotics*. Website. Available at: https://geniusolympiad.org/index.php/categories/robotics; Accessed: April 8, 2018.

[13] PRIA: *Shark*. Website. Available at: http://shark.pria.at/; Accessed: February 12, 2018.

[14] *Regions and teams*. Website. Available at: http://www.botball.org/regions-teams; Accessed: February 18, 2018.

[15] Townsend, Kevin: *Adafruit 10-dof imu breakout*. Website, September 2016. Available at: https://cdn-learn.adafruit.com/downloads/pdf/adafruit-10-dof-imu-breakout-lsm303-l3gd20-bmp180.pdf; Accessed: March 17, 2018.

[16] *About us*. Website. Available at: http://www.wasserkluster-lunz.ac.at/index.php/en/about-us; Accessed: March 17, 2018.