OceanArt: A Comprehensive Platform for Empowering Plastic Pollution Reduction in the Ocean

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1 Introduction

Recent decades have witnessed an acceleration of plastic densities in the oceans, posing a significant threat to ocean ecosystems worldwide. However, due to the lack of public awareness of ocean plastic pollution reduction, efforts to fight this crisis have been hindered. Governments and environmental organizations have taken various measures, from bans on disposable plastics to large-scale cleanup events. However, without widespread public support and participation, these efforts can only go so far.

Researches have illustrated the rapid increase in ocean plastic pollution. In 2015, at least 10% of the species encountering marine debris had ingested microplastics (S.C. Gall & R.C. Thompson, 2015 [2]). In 2023, the number of plastic afloat in the world's oceans was estimated to exceed 170 trillion (Eriksen et al., 2023 [1]). The danger of plastic pollution has also been discussed. Studies have demonstrated that human exposure to microplastics can cause the onset of inflammation, oxidative stress, and DNA damage, which potentially lead to cardiovascular and respiratory disease, as well as cancer (G. Zuri, A. Karanasiou, & S. Lacorte, 2023 [5]).

Despite growing awareness and efforts, effective solutions to this crisis remain elusive. Poor understanding of the science behind microplastics and cultural ideas about healthy and appropriate behaviour presents barriers to change (L. Henderson & C. Green, 2020 [3]). We have found that the existing methods are unable to effectively raise public awareness of ocean plastic pollution reduction because of the lack of interactivity and comprehensiveness. In response, this paper presents *OceanArt*, a comprehensive platform dedicated to empowering the reduction of ocean plastic pollution.

After our investigation, we raise a meaningful question of great research value: How can we develop a comprehensive and elaborate platform to evoke public awareness of preserving the marine ecosystem by reducing plastic pollution?

Specifically, our purpose is twofold but apparent and feasible. Encouraging more people to evoke their consciousness of the severity of white pollution and triggering them to react is our top priority, Meanwhile, we are determined to utilize technological means to assist accurate analysis, attractive publicity, united campaigns, and exciting incentives. We will focus on innovative methods to collect real-time data and demonstrate corresponding outcomes and status-quo. Visualization will definitely kindle your passion to devote yourself to the grand revolution. We will manifest how to participate in our worldwide community and make diverse contributions. Our notion is to advocate for more people to endeavor to protect our oceans by elaborating on our unique advantages, viable resolutions, and absorbing projects.

Our vision for the program is to contribute to maintaining a sustainable ocean by constructing a smart platform, which can evoke the consciousness of daily environmental protection for users. The platform will utilize modern technical means to provide sufficient data with respect to current pollution status to trigger attention and advocate instant actions. Meanwhile, the platform will include a forum for mutual interactions such as chatting, posting, and surfing. Regular offline activities will also be showcased so that can live up to our artistic requirements. The platform can release announcements for launching art exhibitions to attract interest and attention. Our prospect is to create a dynamic atmosphere where every individual, regardless of age or background, can serve as a meaningful role in safeguarding the oceans for generations to come.

2 Method

We advance our research question in two major methods. Firstly, we will conduct a data analysis to reveal the necessity of ocean plastic pollution reduction. Secondly, we will design our innovative platform based on elaborate analyses and launch relevant activities. Our platform will consist of three parts: **Statistics**, **Forum**, and **Art Exhibition**.

3 Discussion

3.1 Plastic pollution in China - A data analysis

Currently, ocean plastic pollution has become a global issue, severely disrupting ecological balance and threatening the survival of marine life. Here, we will further analyze the current state of marine plastic pollution in China. We use the data from the Ministry of Ecology and Environment of the People's Republic of China, and we collected raw data from *Bulletin of Marine Ecology and Environment Status of China* and here we present our analysis of ocean plastic pollution in China.

Fig 1: Analysis of ocean plastic pollution (Visualization)

Table 1: Analysis of ocean plastic pollution (Figures)

Indicator	2018	2019	2020	2021	2022
plastic pollution in floating litter					
Avg. plastic quantity density (item/km^2)	2092	3387	4596	4255	2464
Avg. plastic weight density (kg/km^2)	21.2	5.7	8.2	3.3	2.4
plastic pollution in seabed litter					
Avg. plastic quantity density (item/km^2)	909	6142	6106	3973	2558
Avg. plastic weight density (kg/km^2)	15.9	14.7	10.5	9.2	47.5
plastic pollution in ocean					
Avg. plastic quantity density (item/km^2)	3001	9529	10702	8228	5022
Avg. plastic weight density (kg/km^2)	37.1	20.4	18.7	12.5	49.9
plastic pollution in beach litter					
Avg. plastic quantity density (item/km^2)	47090	228795	183319	117505	46282
Avg. plastic weight density (kg/km^2)	995	1493	1052	1403	2118

Marine plastic pollution has been increasing over recent years, causing significant damage to marine ecosystems. We have also observed that beaches, which are crucial parts of marine ecosystems, have been severely affected. Our data analysis indicates that the density of plastic pollution on beaches is dozens of times higher than in the ocean itself.

Despite the severity of marine plastic pollution, public awareness of this issue remains insufficient. To address this gap, we have designed *OceanArt*, a comprehensive platform that includes real-time statistics, forums, and art exhibitions, to empower plastic pollution reduction in the ocean. This platform aims to provide up-to-date information on marine plastic pollution, and by introducing art to our community, we want to encourage individuals to take action towards reducing this environmental problem.

3.2 Platform structure

3.2.1 Statistics

The first objective of our platform is to provide people with real-time and visualized statistics on marine plastic pollution. Through data visualization and data prediction, we aim to enhance public awareness of environmental protection.

I. Data collection

Our platform collects data from diverse sources to ensure more comprehensive and accurate insights into marine plastic pollution. On one hand, we closely collaborate with marine research institutes and governments to obtain authoritative data. On the other hand, in order to encourage environmental enthusiasts to conduct surveys for us, we will pay considerable rewards for any high-quality information. The image below illustrates how we collect data, using the Bohai Sea area as an example.

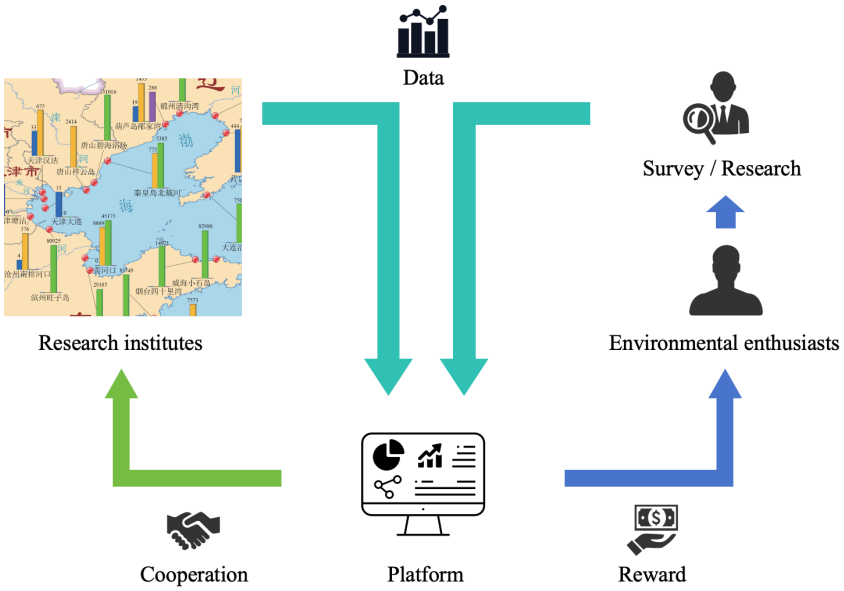

Fig 2: Data collection

II. Data visualization

By using open-source tools such as `Python` and `R` , we can achieve automated data visualization. As we demonstrated in the previous section, once the data is collected, it can be quickly visualized using the `R` language. This automation significantly enhances the efficiency and effectiveness of data analysis, allowing for immediate insights and rapid access to accurate information.

III. Data prediction

One of our biggest innovations in our platform is data prediction. Through data prediction, people can immediately understand the significant impact their environmental actions can have on marine ecosystems. Here is our specific method.

Consider the plastic density on a specific beach. Through data collection, we have gathered the plastic density data from previous days $x_1, x_2, \cdots, x_{n-1}$, with today's data being x_n and tomorrow's data being x_{n+1} . Both x_n and x_{n+1} are currently unknown. Meanwhile, assume we have a model $\mathcal{A}$, which can predict the next day's data based on historical data, i.e. $\mathcal{A}(x_1, x_2, \cdots, x_m) = \hat{x}_{m+1}$, where $\hat{x}_{m+1}$ is the model's prediction of the next day's data.

Suppose a user collected some plastic waste, created an art work using the waste, shared it on our forum, and then sent it for recycling. After calculations, it is determined that the user's environmental protection actions have reduced the plastic density in this area by δ . To further encourage this user to take more actions towards reducing ocean plastic pollution, we will estimate his/her contribution in this way: Firstly, we estimate the plastic density of today and tomorrow, i.e. x_n and x_{n+1} , which are previously unknown. The estimating process is as follows:

$$\mathcal{A}(x_1, x_2, \cdots, x_{n-1}) = \hat{x}_n \rightarrow \mathcal{A}(x_1, x_2, \cdots, x_{n-1}, \hat{x}_n) = \hat{x}_{n+1}$$

Then we need to consider the impact of this user's waste collection. We calculate $\Delta = \hat{x}_{n+1} - \hat{x}'_{n+1}$, where

$$\mathcal{A}(x_1, x_2, \cdots, x_{n-1}, \hat{x}_n - \delta) = \hat{x}'_{n+1}$$

So it is estimated that because of his/her action of environmental protection, the plastic density in this area will decrease by Δ tomorrow, and we will report this data to this user to encourage more people to fight plastic pollution in the ocean.

When considering model selection, i.e. the implementation of model $\mathcal{A}$, we choose **L**ong **S**hort-**T**erm **M**emory (LSTM, Sepp & Jürgen, 1997 [4]) , which structure is as follows.

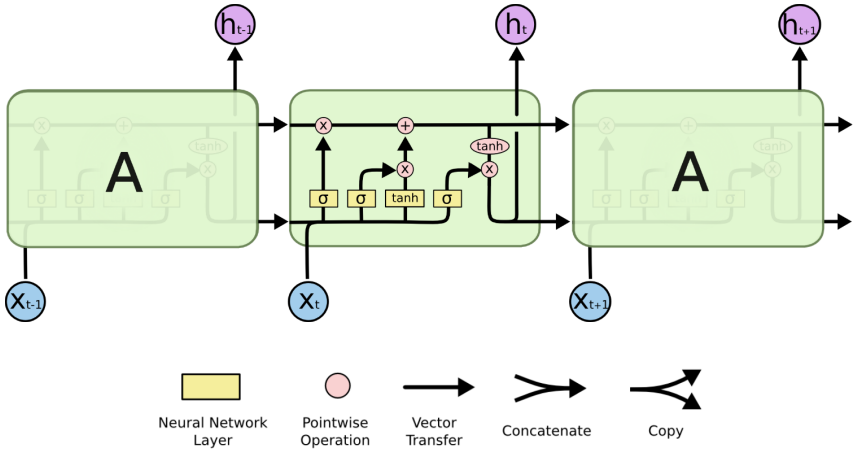

Fig 3: LSTM network overview

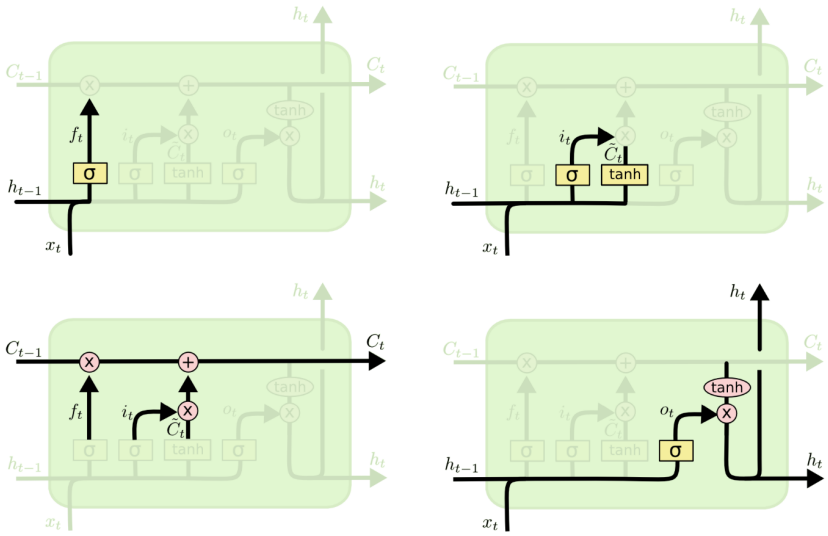

Fig 4: LSTM network detail

We need to train the following model using the data we have collected. For example, we need to provide historical data concerning the density of plastic on a specific beach, i.e. $x_1, x_2, \cdots, x_{k-1}$. Training the model on $x_1, \cdots, x_{k-1}$ can give us a pre-trained model $\mathcal{A}_{k-1}$, which can predict future values and can be easily updated in real-time.

$$
\begin{aligned}
f_t &= \sigma\left(W_f \cdot [h_{t-1}, x_t] \; + \; b_f\right) \\
i_t &= \sigma\left(W_i \cdot [h_{t-1}, x_t] \; + \; b_i\right) \\
\tilde{C}_t &= \tanh(W_C \cdot [h_{t-1}, x_t] \; + \; b_C) \\
C_t &= f_t * C_{t-1} + i_t * \tilde{C}_t \\
o_t &= \sigma\left(W_o \cdot [h_{t-1}, x_t] \; + \; b_o\right) \\
h_t &= o_t * \tanh\left(C_t\right)
\end{aligned}
$$

The advantages of LSTM network are as follows:

- **Flexibility**: By training our model on more complex data, such as temperature and beach population, our model can better predict the result.
- **Robustness**: The architecture of LSTMs allows them to be relatively robust to noise in input data.
- **Effectiveness**: Once our model is pre-trained, we can update it in real-time with only the addition of new data points, without the need for full training.

Here is the structure of our data prediction process.

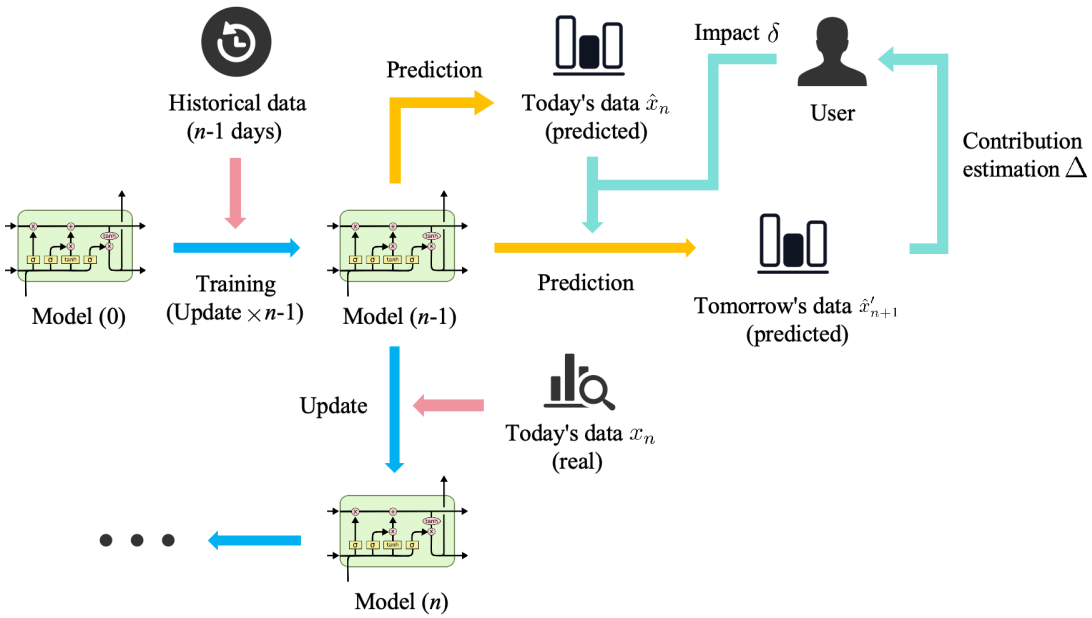

Fig 5: Data prediction process

3.2.2 Forum

Constructing a forum in platform aims at enhancing the public awareness on the severity of ocean plastic pollution through diverse interactions. The conscious of protection aligning with activities we plan to launch, will contribute to the reduction of ocean environmental problems.

It is anticipated that all users can interact with others, acquire comprehensive information, and become immersed in art related to ocean plastic. We hold the prospect that each member can freely express their valuable

perspectives, share significant experiences, build together, or devote themselves to environmental protection causes in other ways.

I. Interaction Perspective

It is generally believed that combined efforts are essential for a single platform to become much more robust. Furthermore, shared intelligence is crucial to innovative ideas and united strengths, which can be generated from mutual interactions. The power of propagation can extend to the trigger attention of all forum users, even for a wider range.

Therefore, we consider it indispensable to inlay a forum, which may generate more mutual interactions. First of all, it will contain all necessary functions for broad communications. To be more specific, users will be available to post their own ideas with text, pictures, videos, or other creative forms. In response, the capabilities of replying, quoting, and relaying are also provided. We will implement a following and followers system, and a regularly updated leaderboard collecting popular and influential sharing. The forum will utilize advanced algorithms to deliver accurate content matching certain interests and requirements. Serving as a traditional social, it can supply immersive interaction experiences.

II. Information Perspective

We firmly believe that visualized data and charts contribute to the enhancement of environmental protection. Secondly, it is truly compelling to upload meaningful and significant news from state institutions, prominent organizations, and renowned media.

In order to fulfill this target, we will individually separate a section, which demonstrates our autonomously analyzed data and charts. We will manage to connect it to more online and professional digital platforms to ensure its accuracy. We will go one step further to guarantee it instantaneous, and link and compare it with other key indicators. For journalism, users can surf the forum for up-to-date and hot topics, which will be listed as a single column. So it serves as an opportunity to have a glimpse at the overview of the entire sector, We promise to make all the statistics and information open source, which means all users can feel free to download them for scientific research or organize a publicity campaign. Through the spread and popularization of refined information, it will exert a tremendous impact.

III. Artistic Perspective

We hold the viewpoint that it is beneficial to propose innovative and romantic components in our forum, which will be attractive to the whole society. The forum will include artistic space that welcomes ample and diverse mind sparks.

Consequently, we will launch a project on the forum that supports a distinct art square. Sharing original works or innovative ideas related to art is encouraged, and it can be processed with the assistance of smart technologies. It is worthwhile to mention we will give away incentives for persistent high-quality content makers and community contributors, which means all users possess the chance to claim free rewards. We will also help promote compelling and excellent posts to wider platforms. We will establish partnerships with pioneers from the art field to offer abundant activities. By committing constant involvement, even newbie forum users can participate in this integrated art feast and get intoxicated with the art value.

3.2.3 Art Exhibition

To encourage more people to engage in our protection movement, art exhibitions both online and offline should be considered. The online exhibition will serve as a long-term section of the platform. Besides, we will also hold annual offline exhibitions to show what achievements and progress we have made this year.

The online part of our art exhibition mainly constructs of two parts: Great Art, Works Bazaar and Offline Highlights, which means we can try to support ourselves simply by our artwork business. Here is a picture to showcase our ”Art Exhibition” section.

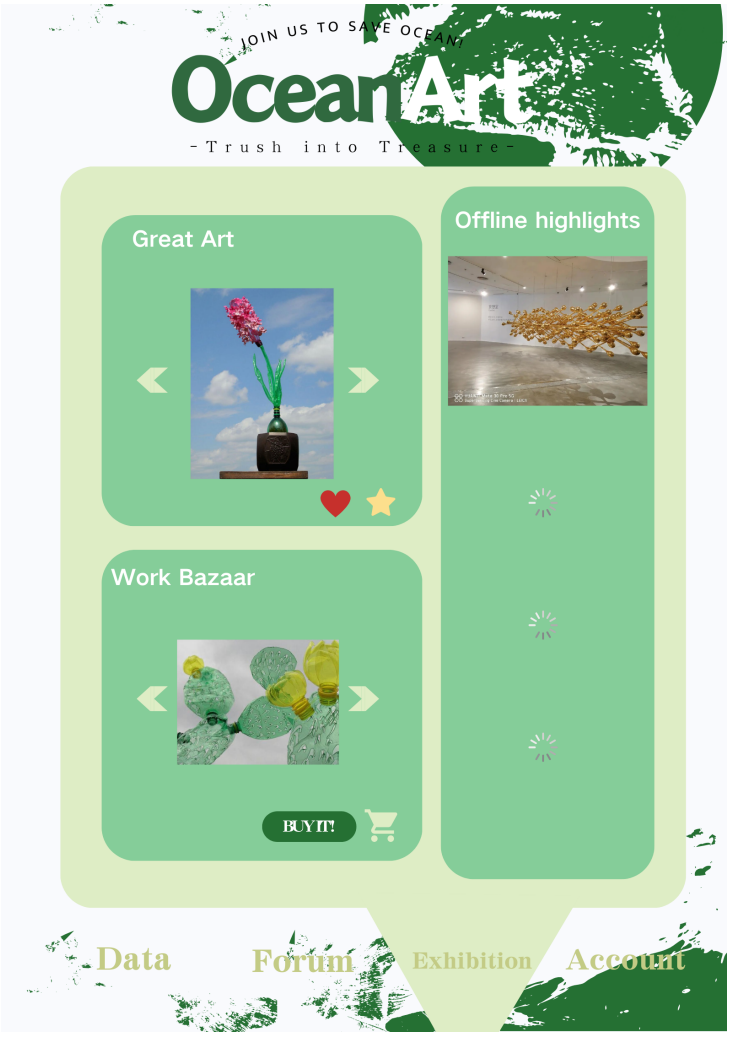

Fig 6: Art Exhibition section

I. Financial Perspective

i. Attracting Sponsors and Donors

Eco-themed art pieces can gain market recognition due to their uniqueness and the strong messages they convey, thus acquiring economic value. Art exhibitions that focus on white pollution often resonate with individuals and organizations that are environmentally conscious. By showcasing the artwork and its message, these exhibitions can attract sponsors who are willing to support both the physical exhibitions and the digital platforms that promote them.

ii. Online Sales and Fundraising

Websites can facilitate the sale of art pieces, prints, or related merchandise, providing a direct source of revenue. As we have mentioned in our forum section, users can also donate their art pieces to our platform for sale to support ocean protection. In addition, online fundraising campaigns can be launched to support specific projects or the general operations of the exhibition.

iii. Supporting Local Artists

Providing a platform for local artists to showcase their work themed around plastic pollution not only supports their creative endeavors but also aids in their professional development. For artists, an annual exhibition serves as an opportunity to promote their work, increase visibility, and build a professional network, which in turn can facilitate the sale of their pieces and advance their careers. As feedback, these artists will share 10 percent of their earnings from those art pieces with our platform and they will be more willing to use their fans and fame to promote our website and our exhibitions.

II. Education Perspective

i. Awareness Enhancement

Art exhibitions featuring pieces crafted from discarded plastics and other white pollutants serve as a powerful educational tool. As a result, they can vividly illustrate the extent of plastic pollution to the public, making the issue more tangible and compelling. By transforming waste into thought-provoking art, our exhibition challenges viewers to reconsider their consumption habits and the environmental impact of single-use plastics.

ii. Innovative Thinking

We managed to set up a workshop in our exhibition both online and offline. The workshop may contain three parts: introduction sessions, technological demonstrations, and hands-on creations. If you like, you can either take it home or donate it to our exhibition. All in all, the process of creating art pieces stimulates innovative thinking by presenting novel approaches to material usage and artistic expression, which encourages our audience and users to think outside the box, both in terms of art creation and in addressing environmental concerns. As a solution, our special workshop can help to evoke people's enthusiasm for creating plastic artwork so as to reduce plastic use and improve waste management.

4 Obstacles & Solutions

Although the construction of our smart platform seems a grand innovation and revolution to the environmental protection sector in the long term, we are still confronted with demanding challenges in early stage. To satisfy the feasibility, we will decompose obstacles concealed in the process and proactively resolve encountering hurdles, go one step further to optimize the user experience, and expand our influence.

I. Budget Issues

In terms of successfully constructing the comprehensive platform, it is doomed to tackle the cost obstacle and manage our capital chain. Kernel development, promotion and publicity, multi-platform connection, real-time datum transmission and processing, offline activities organizing, etc, which should exert pressure on our long-term operations.

We will appropriately post environmentally-friendly related advertisements to generate revenues both online and offline. By seizing the chance to establish partnerships with like-minded enterprises, we are capable of collecting sponsorship for our offline activities and campaigns.

With respect to alleviating capital stress, we tend to align with companies, organizations, and foundations which are interested in our project or willing to make commitments to reducing ocean pollution. We will contact Venture Capital and Private Equity for our fund-raising. Technology support will also be beneficial to mitigate our dilemma in the early phase.

Since preserving our shared ocean concerns global citizens, we will spare no effort to establish a strong relationship with the national government for further assistance and promotion. That also corresponds with our ultimate theme of building a shared Earth with multi-party efforts. In that way, it will ignite an atmosphere of concerning about ocean white pollution.

II. Data Transmission

It is really tough to primarily obtain massive data and then filter out valuable statistics hidden inside to make the conclusion sound and reasonable. Transmitting in a flash is also a hard nut to crack, during which may incur malicious attacks from hackers or suffer from the loss or disorder of data.

In regard to security concerns, we will base on cryptography to encrypt our transmission. If we inflict bugs or receive constructive feedback, we will react instantly to undertake improvements. To overcome the bottleneck of speed, upgrading algorithms can significantly boost our efficiency.

We hold eternal confidence in building our technical team and the joint efforts from our platform community. In the meantime, our open-source initiative will attract prominent developers to collaborate to achieve long-term progress.

III. Community

Managing a harmonious community and cultivating an atmosphere of unity and mutual assistance will not happen overnight. It usually takes months to years to reach a general consensus about the entire project and core concept in a vast community. Furthermore, it is not a small feat to organize an elaborate offline activity, which requires the coordination of all parties.

We will recruit sufficient moderators and admins to better manage the community and censor content on the forum. We will also establish a helping hub to settle all confusion with the power of everyone. Through setting up various tiers and awarding badges, all users are allowed to measure their commitments to our ecosystem, which also facilitates our periodic incentive distribution.

Complex as it is to hold offline events, but we will take as many factors as we can into account. Celebrities, authorities, and famous enterprises are invitees but also contributors to our campaign. Simultaneously, government support along with our expert team will arrange supplies, weather conditions, time schedule, site selection, and other details for each feast.

5 Conclusion

We have explained the advantages and obstacles associated with our OceanArt platform. To evaluate their impacts, we take three primary dimensions into consideration as follows.

OceanArt stands as an innovative platform dedicated to ocean plastic pollution reduction. By merging data insights, community engagement, and the power of art, we aim to elevate public awareness and drive sustainable behaviors. Meanwhile, we recognize the hurdles of funding, data security, and community coordination. Our strategic approach involves securing partnerships, enhancing technical infrastructure, and fostering a collaborative environment to ensure the platform's success and growth. What's more, The forum's artistic component is integral, offering a creative space for expression and innovation. Besides, the annual exhibition may depend more on reality, calling for community support. Both of them serve to deepen the understanding of plastic pollution's impact and encourage community involvement in environmental stewardship.

Now we are here to call to collective action. We urge individuals, organizations, and governments to join our mission. Together, we can incite a global shift towards environmental consciousness, protecting our oceans for the generations to come.

References

[1] Marcus Eriksen, Win Cowger, Lisa M Erdle, Scott Coffin, Patricia Villarrubia-Gómez, Charles J Moore, Edward J Carpenter, Robert H Day, Martin Thiel, and Chris Wilcox. A growing plastic smog, now estimated to be over 170 trillion plastic particles afloat in the world's oceans—urgent solutions required. *Plos one*, 18(3):e0281596, 2023.

[2] Sarah C Gall and Richard C Thompson. The impact of debris on marine life. *Marine pollution bulletin*, 92(1-2):170–179, 2015.

[3] Lesley Henderson and Christopher Green. Making sense of microplastics? public understandings of plastic pollution. *Marine pollution bulletin*, 152:110908, 2020.

[4] Sepp Hochreiter and Jürgen Schmidhuber. Long short-term memory. *Neural computation*, 9(8):1735–1780, 1997.

[5] Giuseppina Zuri, Angeliki Karanasiou, and Sílvia Lacorte. Human biomonitoring of microplastics and health implications: A review. *Environmental research*, page 116966, 2023.

A Plotting Code

```r
library(ggplot2)
library(reshape2)


data <- data.frame(
    Year = c(2018, 2019, 2020, 2021, 2022),
    floating_quantity = c(21, 50, 27, 24, 65),
    seabed_quantity = c(1031, 6633, 7348, 4770, 2947),
    floating_weight = c(24, 6.8, 9.6, 3.6, 2.8),
    seabed_weight = c(18, 15.9, 12.6, 11.1, 54.7),
    ocean_quantity = c(3001, 9529, 10702, 8228, 5022),
    beach_quantity = c(60761, 280043, 216689, 154816, 54772),
    ocean_weight = c(37.1, 20.4, 18.7, 12.5, 49.9),
    beach_weight = c(1284, 1828, 1244, 1849, 2506)
)
data_melted <- melt(data, id.vars = "Year")
plt <- ggplot(data_melted, aes(x=Year, y=value, group=variable, colour=variable))+
    geom_line() +
    geom_point() +
    facet_wrap(~ variable, scales = "free_y", ncol = 2) +
    labs(x = "", y = "Density", colour = "") +
    theme_minimal() +
    theme(legend.position = "none")
print(plt)
```