Towards a Decentralized Publication Platform with Authors Incentivized by Blockchain Technology

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Abstract **:***Concerns regarding fairness, quality, performance, cost, and accuracy arise when science is published, and peer-reviewed. The Open Access movement has failed to deliver on all its promises, and intermediaries' publishers can still enforce regulations and profit concentrations. Existing publication platforms have several serious flaws. First, rather than encouraging extensive knowledge sharing, access to publications on publisher-owned platforms is typically charged. Furthermore, most present publication systems are prone to inefficient peer review since reviewers are not properly compensated for delivering high-quality reviews. A decentralized publication system for open research using upcoming distributed technologies like Blockchain creates a transparent governance. In addition to a thorough analysis of the methods, resources, and strategies put out in the literature to deal with the problems brought on by the development of the proposed system, we propose an application that makes advantage of the Ethereum blockchain to address all these issues. The system promotes peer review and develops its own reputation ecosystem as a substitute for the dominant prestige structure now in existence in academic publication.*

Keywords: *Open access, Blockchain, Ethereum, Editorial Management, Decentralized Publication Platform, IPFS, Peer reviews*

1. Introduction

Nowadays, Scientific research is centered on publishing in prestigious journals. The number of papers published in various journals can be used to evaluate a researcher's career. The quality of a journal is determined by a variety of impact variables. One of the issues in academics is the obsession with publishing. A research project should, ideally, result in papers in indexed journals. This concept leads to certain research papers yielding to reviewers' requirements or journal editors, potentially decreasing the originality or uniqueness of the work. Universities are increasingly encouraging scholars to publish articles in high-impact journals, making them concentrate on their research efforts on producing publishable results.

With only a few exceptions over the ages, publications in science and peer review have been built on a paper-based paradigm. Peer review is the process of determining whether an article is suitable for publication. The document is reviewed by a group of "experts" in a certain field, who then issue this judgment. Furthermore, this procedure has been critiqued in several ways (Souder, 2010). The financial rewards of scientific distribution are concentrated in a few publishers, and neither the authors, reviewers, nor readers benefit financially. Even though the Internet's expansion has allowed for the creation of new options for research dissemination (Eysenbach, n.d.) and assessment (Strother et al., 2015), the benefits continue to be concentrated in the above-mentioned publications. The decrease in distribution costs made scientific knowledge more accessible to a wider audience, calling into question the function of traditional publishers (Whitworth and Friedman, 2009). Nonetheless, universities are typically responsible for covering the expenses of accessing the papers published in these journals, which can be an awfully expensive sum in some situations (Bergstrom and Bergstrom, 2004).

The Open Access and Open Science initiatives, on the other hand, have successfully decreased the cost of accessing knowledge for readers [6]. Traditional publishers' business methods (Larivière et al., 2015), which now combine charging readers and charging authors, have not been successfully challenged (Noorden, n.d.). Editors who delegate a paper's review to a group of reviewers must rely on them in advance. As a result, the range of disciplines that can be examined is limited to those in which the reviewers are specialists. To widen this scope, the internet provides access to specialists in a variety of subjects from all over the world. However, when it comes to trusting complete strangers, there should be a mechanism in place that anyone can use to locate trustworthy individuals. Because they provide a positive initial impression of an unknown individual, reputation systems are the answer to these challenges (Hendrikx et al., 2015). Finally, peer review has received a lot of criticism, but just a few alternatives have received attention (Ware, n.d.). In the literature, there were numerous recommendations for open peer review (Ross-Hellauer and Walker, 2017) and reviewer reputation networks.

This paper proposes the development of a decentralized publishing mechanism for open science. Some scientific knowledge is publicly available from publishers because of the success of the Open Access movement. However, their infrastructure continues to serve most of the material (i.e., servers, web platforms). The goal of the proposed approach is to transfer infrastructure control from publishers to the scientific community. Three crucial functions of science communication must be decentralized as a result. 1) the selection and appreciation of peer reviewers, including a system for rating the reputation of reviewers 2) the dissemination of scientific knowledge via the peer-to-peer IPFS network, which offers an Open Access by-design infrastructure; and 3) the communication surrounding the peer review process, which uses Blockchain to offer a transparent and decentralized platform for communications related to the open peer review process, such as paper submissions, reviewer proposals, or review submissions. The novelty of this system is that owners of the publication material, can directly get paid for their work from readers, in the form of cryptocurrencies. None of the existing systems discussed in the following sections provide an incentive for the author. The structure of the paper is as follows. Section 2 compares the various peer review techniques now in use and presents a taxonomy of publication system features, from the literature. The approach and an overview of the suggested system are provided in Section 3. A summary discussion and several insights are provided in Section 4. Finally, in Section 5, we report the research's conclusions.

2. Literature Review

A. Publication Systems

In 1665, a process for producing scientific papers was devised (Rodríguez, 1998). But it was 45 years later, in 1665, that the first scientific journal, *Philosophical Transactions of the Royal Society,* was published ("Over 350 years of scientific publishing," n.d.). Editors were responsible for reviewing the papers that will be published in these publications at the time.

Instead of editors examining all the papers, an alternate system was implemented roughly 100 years later, in which a team of professionals in a specific field decided whether each paper evaluated was good enough to be published or not. This marks the start of what is now known as "peer review" [16]. It's tough to assess the quality of a scientific paper, but we now have several options for doing so, both before and after publication.

During the peer review process, experts in a particular field assess a paper's quality, indicating if it is suitable for publication. These reviewers read the manuscript and provide feedback as well as an "acceptance score" indicating whether they believe the paper should be approved. Only the reviewers are anonymous in "single-blind" peer review. The authors' names and backgrounds are known to reviewers, but the reviewers' names and backgrounds are unknown to the authors. Both the authors and the reviewers remain anonymous during "double-blind" peer review. As a result, this procedure could be viewed as a prediction of a paper's quality prior to publication (Szklo, n.d.).

Publishers own many journals with high impact factors. Many significant publishers have been around since the start. Despite this, publishers continue to benefit from the system by serving as middlemen between those who develop science and those who consume it (Larivière et al., 2015). The scientific publishing process might be transferred to fairer and more honest mechanisms in an era where information replication is no longer a cost.

Academic conferences are managed using software called event management systems (EMS) or conference management systems (CMS).

EasyChair ("EasyChair," 2022), a web-based EMS extensively utilized by the community, is possibly one of the most well-known. The following tools are included in this system: 1) paper submission; 2) review assignment; 3) author, reviewer, and conference chair email notifications; and 4) conference proceedings preparation. Another EMS that gives the similar tools as EasyChair is OpenConf ("OpenConf," 2022). It is only ideal for conference, workshop, or seminar events because it lacks project management tools. For its users, OpenConf offers two licenses: a free but restricted community edition and a "Professional Edition" with additional capabilities like as web and mobile connectivity.

Journals, on the other hand, are usually not responsible for arranging a conference or workshop, therefore they are not concerned with matters like scheduling or conference chairs. Authors submit their articles, which are then allocated to reviewers and either accepted or refused for publication. There are numerous platforms known as Editorial Systems (ES) (Lev, 2016) that may be used to monitor this process.

The publisher "Elsevier" uses Evise ("Evise," 2022), a web-based ES, to oversee the editorial process. This platform allows users to create a profile in Elsevier's database, which they can then use to subscribe to the publisher's publications. It also includes tools for editors, such as one that allows you to find, invite, and manage reviewers from a single screen, and another that allows you to generate and manage personal personalized decision letters, among many more. Despite their widespread use, all these platforms are nonetheless bound by the antiquated publication process in use today. For example, reviewers are kept anonymous even after the study is published, which means they are rarely acknowledged for their efforts. However, there are initiatives to change this, such as the one put out by Publons (Rajpert-De Meyts et al., 2016), a platform that allows users to make all their peer review evaluations public. Publons aims to reduce the anonymity of this process by encouraging reviewers to be recognized for their contributions to the publication of such changes. However, making reviews public is not always practical, as certain publications or conferences do not allow this sort of data to be shared.

Despite their promises, alternatives to these systems based on decentralized technology are still in their infancy. Recently, a few suggestions have surfaced, none of which are now operational. Aletheia is one of the most promising, a peer review concept that uses cryptocurrency to tackle some of the peer review socio-technical issues (Tennant et al., 2017). It does, however, require a crucial threshold of research community participation, as well as a change in real methods and platforms before it can be implemented. Apps based on the blockchain have also been proposed, including voting and publishing storage. A vast number of scientific papers are available only to those who pay for them. To put it another way, a substantial portion of the world's population is deprived of scientific information. *TABLE I* depicts the article processing fee and features of the publication systems.

Table 1. Comparission of Key Features In Existing Systems.

	EMS/ CMS/ ES				
Key Features	EasyChair	OpenConf	Evise	Publons	Aletheia
Paper submission				-	
Submit review	-				
Rate review	-	-	-		
Decentralized	-	-	-	-	
Author Incentive	-	-	-	-	-
Open access by design	-	-	-	-	
Article Processing Charge (APC)	£90.00 - £275.00	Starts at $250.00 per use	Can cost up to $9900!	-	No longer maintained.

( ) Available, (-) Unavailable

The comparison table shows that none of the systems provide an incentive for the author, the proposed system on the other hand will allow authors to get rewards from readers at tips for the paper they publish. These tips will be rewarded as cryptocurrencies to the author. Aletheia is the only decentralized system but is no longer active. Publons allows to import publications from ORCID, Web of Science

or Reference managers. Paper submission is not available but public reputation system for reviewers is available.
EasyChair has an Article Processing Charge that can vary from £90.00 - £275.00 depending on the license. If also comes with services to manage conferences. The one-time cost for OpenConf starts at $250.00 per user. There is no free trial available for OpenConf. Evise's Open access and Hybrid access submission differs according to the research area (Can cost up to $9900!).
Before a paper is published, its quality is evaluated through a process called peer review. To assist editors in deciding whether an article should be published, independent researchers in the relevant field evaluate submitted manuscripts for originality, validity, and significance.
Closed peer review is more usual, while the open peer review is gaining popularity, and both forms of reviews are encountered by authors and reviewers. Closed review has two versions, as will be detailed, and postpublication review (PPPR) is now being used in several journals. Each method has its own set of benefits and drawbacks.

A. Closed peer review

Closed peer review is a mechanism in which at least one of the parties involved in the review process–usually the reviewers–does not reveal their identity. Traditional peer review is usually single blind review or double-blind review. There are two types of closed reviews: single blind and double blind. In a single blind review, the author is unaware of the names of the reviewers. The reviewers, on the other hand, are aware of the writers' names, connections, and credentials. The writers and reviewers in the double-blind approach are unaware of one other's identities and institutional connections. This traditional model has long been known to have serious problems and has been criticized of being untrustworthy (Fang et al., 2012; Hames, 2014; Ross-Hellauer et al., 2017a), being unaccountable, and allowing social and publication biases to flourish (Kravitz et al., 2010; Kriegeskorte, 2012), and having a lack of incentive for reviewers (Benos et al., 2007).

B. Open peer review

Open peer review, as contrast to closed peer review, is a system in which authors and reviewers are acquainted throughout the process. Authors and reviewers' identities may be published alongside each other in an open review, with the option of include reviewers' reports. Reviewers' contributions are acknowledged by the publication of their names in the journal. Reviewers' contributions are acknowledged by the publication of their names in the journal. Critics, on the other hand, argue that open review may lead to less honest, critical, and rigorous evaluation by viewers fearful of retaliation. Critics contend that knowing the authors' identities, reputations, and institutional affiliations could influence the review process and lead to a biased result. We also think it is feasible that some reviewers are being too critical to look more rigorous to their peers.

C. Other peer review approaches

Advances in electronic publishing technology have recently permitted the establishment of a new type of review known as 'post-publication peer review' (PPPR), which occurs after the article has already been published. PPPR was initially only accepted as a complement to the peer review process, not as a stand-alone procedure (Azam Ali and Watson, n.d.). PPPR can be classified as either "primary PPPR" or "secondary PPPR." After first editorial checks, an unreviewed article is published in main PPR. It can then be formally reviewed by invited reviewers, like F1000 Research and Copernicus journals do. The article is published after initial editorial checks in secondary PPPR; however, it is available for review by volunteer reviewers. In both cases, the authors make changes to the manuscript in response to the PPPR criticisms, and the article eventually becomes a peerreviewed publication (Azam Ali and Watson, n.d.). (RossHellauer et al., 2017b) summarizes the benefits and drawbacks of the traditional peer review process compared to the open review process. TABLE II is a summary of different review approaches.

Table 2. Types of Review Approaches Summarized

Approach	**Characteristic**	**Advantage**	**Disadvantage**
Single blind	Reviewers are aware of the authors' names and affiliations.	Reviewer anonymity is ensured, allowing them to provide candid criticism.	Reviewers may make critical remarks or provide negative feedback.
Double blind	Authors and reviewers are completely unaware of each other's identities or affiliations.	The privacy of the reviewers is protected, allowing them to provide candid feedback.	Reviewers may make critical remarks or provide negative feedback. In specialized fields, reviewers may still be able to identify the author.
Open peer review	The identities and affiliations of authors and reviewers are known to each other.	When delivering feedback, reviewers are more courteous and constructive.	Fear may cause the reviewer to be less honest and critical of the product, resulting in a less honest and critical review.
Primary PPR	After first editing checks, a manuscript is published. The article will be reviewed by invited reviewers.	The paper can be discussed by a larger number of individuals.	It is possible for people to be unnecessarily harsh or nasty.
Secondary PPPR	After first editing checks, a manuscript is published. Volunteers serve as reviewers. Various publishers have different requirements.	The paper can now be discussed by a larger audience.	Unnecessarily harsh or negative people can exist.

3. Methodology

The decentralization technologies that the proposed system depends on are described in this section. It is suggested to use Blockchain to offer consistent behavior and IPFS to distribute content in a distributed system framework.

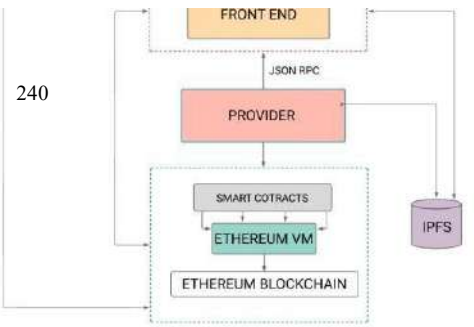

Figure 1 Overall Design Architecture
Source: Author

The architecture depends on two platforms: Ethereum Blockchain for the system's logic and state; and IPFS for distributed archiving of papers. Ethereum (Buterin, n.d.) is an innovative technology that enables the development of distributed applications that run over any size and trustless network of nodes. Ethereum is built on the blockchain technology of Bitcoin, which is a public database where anybody can see all transactions. Ethereum implements this concept by deploying and executing code snippets on a distributed network using its own blockchain. These code pieces are known as "smart contracts," and they must be uploaded to the blockchain to be performed. Ethereum, on the other hand, has its own coin, "Ether." This currency not only behaves like Bitcoin in that it allows users to trade money, but it also acts as a fuel for the smart contracts' code execution, allowing them to execute their core operations for a modest amount of Ethereum.

The proposed system includes IPFS for distributed archiving for papers. IPFS is a distributed file system that is used to store all the papers that are submitted to the platform. This assures that all data is durable, free, and accessible, and that it is not reliant on a single server. It is a peer-to-peer filesharing technology that stores files in a distributed network using cryptographic hashes. IPFS is a BitTorrent-based protocol that works similarly to HTTP. It is like a massive git repository where anyone may save, distribute, and exchange files.

Messages and transactions can be signed using a Signer, an abstraction of an Ethereum Account, and signed transactions can be sent to the Ethereum Network to carry out state-changing activities. MetaMask offers an intuitive way to manage Ethereum user IDs and connects to IPFS and Ethereum through JavaScript clients. MetaMask is a decentralized program that aids with the execution of transactions on the Ethereum network. It can be installed as a plug-in in the web browser, and it will be activated anytime the user does a transaction on the blockchain network. It serves as a link between a decentralized web app and the blockchain network. Connecting to the main Ethereum networks, as well as any other custom Ethereum network, is feasible with MetaMask. It has an Ethereum wallet management feature as well as an account management feature. Keeping several accounts in different or the same blockchain networks is therefore simple. It also has a feature that allows you to retrieve your account.

Providers make nodes available to businesses and individual developers as a tool that enables them to create decentralized apps more quickly without having to invest their own engineering effort in maintaining and administering nodes. A more resilient web is made possible by Infura's (“Infura,” n.d.) IPFS API and dedicated gateway, which connect apps of all sizes to distributed safe storage. Infura offers scalable, dependable, secure, and user-friendly APIs for IPFS and the Ethereum network. The infrastructure of an IPFS or Ethereum node is not a concern for developers. Angular will be used as the framework to implement the front-end of the proposed system.

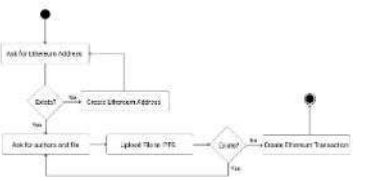

Figure 2 Use-case diagram of the system
Source: Author

The use-case diagram describes the scope and key features of a system. The diagram above also shows how the system and its actors interact with one another (Figure 2).

Any user interacting with the system can have three roles including the reader, author, or reviewer. Authors are authenticated using their MetaMask wallet addresses. The author submits the paper and obtains rewards with cryptocurrencies. The reviewer can openly review the submitted papers, as a result gaining a reputation. The reader is able to search papers, tip authors for their work with cryptocurrencies, and preview the papers. The system’s paper submission activity flow is shown below. (Figure 3)

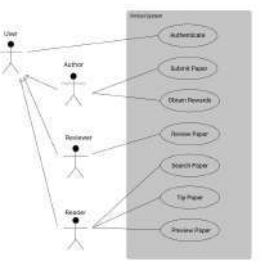

Figure 3 Paper submission activity diagram
Source: Author

To submit a paper, a transaction containing the Ethereum addresses of the authors must be transmitted. A node will upload this file to IPFS, and the resulting address will then be added to the transaction. If the paper exists in IPFS then the paper is already owned by another author this user will be notified and prompted to submit another paper. The system as a platform consists of several inputs the manuscript or the publishing material itself is an input to the system. The meta data required for the publishing material is also entered by the author. The reviewers can publicly review the published material by providing feedback.

First the author (generally could be anyone using the platform) submits the research material to the platform, the file uploaded is converted to a byte stream which is then deployed to the IPFS through a provider named Infura. Once the file is deployed to the IPFS a hash of the IPFS address is returned. This and the metadata are then saved to the Ethereum blockchain using Solidity Smart Contracts. Once the data is stored in the blockchain the published research material is openly available for anyone in the platform to access. Users are free to give feedback to the author through reviews.

The output is a distributed application (dApp) that allows researchers to publish their work and gain rewards in the form of cryptocurrencies. The publish material is openly accessible to anyone in the platform. Users who are willing to encourage the author can tip the author with some amount of Ether.

4. Discussion

In addition to enabling new modes of research distribution, distributed technologies like blockchain and IPFS may finally fulfill the promise of Open Access. Decentralizing and opening the infrastructure increase the system's transparency

and accountability and might open new opportunities for innovation. Since the suggested system is geared toward giving authors an incentive, it does depend on the use of cryptocurrencies. The peer review approaches mentioned have their own pros and cons as from the literature. The nature of the proposed system highlights the issue of using peer review methods such as closed and open peer review. The lack of a centralized authority makes managing the reviewing process cumbersome, on the other hand peer review approaches such as secondary PPR provides motivation to the reviewer to gain reputation by providing reviews. The openness made possible by making the peer review process public raises questions about fairness and privacy while also enabling the development of a reputation system for reviewers. Despite the difficulties, we are certain that decentralizing the scientific processes would create a whole new field with effects we cannot possibly predict. Soon, we plan to evaluate the results of the conducted survey on the peer review approaches conducted, to analyze the drawbacks of various methods. All communications with the platform are recorded in a chain of blocks, making them all publicly accessible. Regarding peer review anonymity, this could be a significant issue. In peer reviews, anonymity of reviewers and authors is routinely employed to enhance the process's fairness. Single blind evaluations allow anonymous reviewers to constructively evaluate an article without worrying about the authors' replies. Additionally, double blind evaluations enable the impact of individual biases to be lessened. Finally, open review models suggest that authors and reviewers be acquainted. However, reviewers' anonymity can also be exploited against them. The lack of sanctions meant that the system didn't prevent unfair or substandard reviews.

5. Conclusion

The goal of decentralized Science is to challenge the technical infrastructure that underpins conventional publishers' middleman role. The existing publication platforms charge the author and reader in some cases which is a challenge to the scientific community. As a result of the success of the Open Access movement, certain scientific knowledge is now freely available from publishers. However, their infrastructure continues to provide most of the material (i.e., Servers, web platforms). Because they own the infrastructure, they have control over the scientific community that creates the material. It is also important to keep in mind that peer reviewing is a volunteer activity, which means that reviewers are not paid for their time and typically conduct evaluations on their own time. It is critical to make this task as pleasant and enlightening as possible. Recognizing reviewers for their contributions by publishing their names in the publication or awarding them honors and cryptocurrencies can be a successful tactic.

For open research, a decentralized publication system, which will improve the availability to those who are unable to access paid content. Students will have more material and funds will be able to go back into teaching, if schools and universities do not have to pay costly fees for access to a small range of research papers and instead have a vast range of papers available for free. If more individuals read more scientific studies, there will be statistically more people who connect the links and uncover scientific discoveries. Finally, the financial benefits of publishing might be dispersed across the scientific community, allowing for new types of project funding.

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