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# BeSharing: A Copyright-aware Blockchain-enabled Knowledge Sharing Platform

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**Abstract**—In response to the coronavirus pandemic, COVID-19, the use of online media and teaching tools has soared, leading to rampant cheating and plagiarism. To provide a better online environment, A copyright-aware Blockchain-enabled Knowledge Sharing platform named as *BeSharing*, enables students to share part of their assignments or ideas without the worry of being plagiarized. Thanks to blockchain technology which ensures the safety of encrypted shared files and the immutability of the shared records, the intellectual property rights of students can be protected whenever plagiarism issues occur. At present, we have released the platform with the realization of relevant functions and finished the alpha test. We believe this platform has great potential to foster collaboration among students while protecting their ideas.

**Index Terms**—blockchain, Ethereum, IPR, sharing, encryption

## I. INTRODUCTION

Facilitated by the advances of remote education and online teaching with virtual learning environment (VLE), online classes, online homework, online exams, etc., are taking an increasing proportion in the teaching process [1]. Compared with traditional face-to-face education, remote education is not limited by time, distance and other external factors. As an important part of online education, online knowledge sharing can be done in many ways, e.g., OneDrive, Github, and Moodle. However, sharing knowledge through social media or personal cloud storage space has raised the concern of plagiarism and breaches of code of conduct. This is because they do not offer reliable intellectual property protection, and have limited ability to track down plagiarism and apply punishment actions [2]. The use of centralized sharing platforms improves the scope of sharing, but it is vulnerable to malicious attacks that lead to damage to users' intellectual property rights and cannot guarantee the authenticity of sharing records [3], [4]. Therefore, we propose a novel online knowledge sharing platform based on blockchain technology (e.g., Ethereum, and Metaverse-related concepts [5]), named **BeSharing**. Next, we describe the overall framework and implementation details of the solution.

## II. SYSTEM DESIGN

### A. Framework

The overall framework for BeSharing is shown in Figure 1. There is a sever with a database working as the bridge between students and the blockchain network. By using the browser on personal computers, students can access the resources on the server and use the services to log in, share and request works

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The project *BeSharing* is launched at: [www.besharing.net](http://www.besharing.net).

from others. There are seven steps to interact with BeSharing platform. In step 1, the blockchain identities are created on their own devices when students register for their accounts. In step 2, students can upload their work to the server and the files can be stored in the database. In step 3, the uploaded files are encrypted by the key, which is generated with a seed and specific sequence. The seed is uploaded to the blockchain. Whenever a student wants to request others' work, they should ask for permission which is step 4. Then, in step 5, they can obtain the seed from blockchain and generate the key to decrypt the corresponding file. Meanwhile, the activities are recorded in step 6. Finally, in step 7, only teachers can check requesting log in the blockchain and arbitrate the plagiarism when excessive similarities are detected by the third-party plagiarism checker.

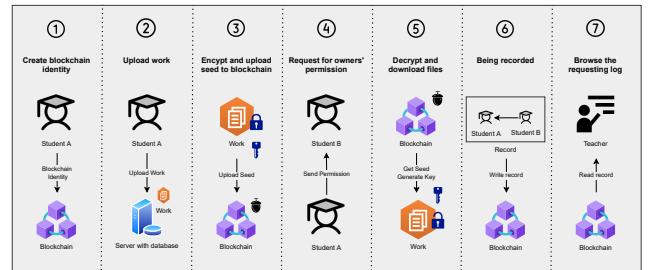


Fig. 1. Framework of BeSharing

### B. Implementation details

1) *Blockchain Network Design*: To meet the demand for a simple, universal and highly efficient knowledge sharing experience, Ethereum [6] is chosen as the blockchain platform in BeSharing. As the students cannot be burdened with paying the high transaction fee (gas) in Ethereum or earning the fee by mining with their devices, we take an ether distribution method [7], where a huge amount of ether is deposited in the genesis account initially to a distributor account, and the genesis distributor account can send ether to each newly created account. With the ether distribution method, users can get enough fees from the genesis account to ensure that they have enough gas to use the network, regardless the incentives mechanisms that may be introduced later.

2) *Smart Contract Implementation*: In BeSharing platform, there are accounts with credentials on the Ethereum (blockchain identities) for students and teachers shown in Figure 2, which are generated according to the user's personal information, allowing users to interact with the smart contract.

The smart contract design for BeSharing is shown in Figure 2. There are five functions which are *upload()*, *requestdata()*, *request()*, *getRequestLogLength()*, and *getRequestLog()* to

operate the data structure stored in the blockchain. The first function can upload the seed in the structure. The following two functions are designed to get the seed and be recorded into the structure of requesting records. The final two functions only allow teachers to search the information in requesting records. As for data structure, there are two kinds of structures in the smart contract of BeSharing for storing uploaded keys and requesting logs.

To provide services to users, the interaction between users and smart contracts is inevitable. Thanks to the interface provided by Web3j, which is a lightweight Java class library based on the JSON-RPC framework, allowing programs to integrate nodes on the Ethereum blockchain network. Through its APIs, the smart contract is converted to a java class with functions that can be directly called by other java classes.

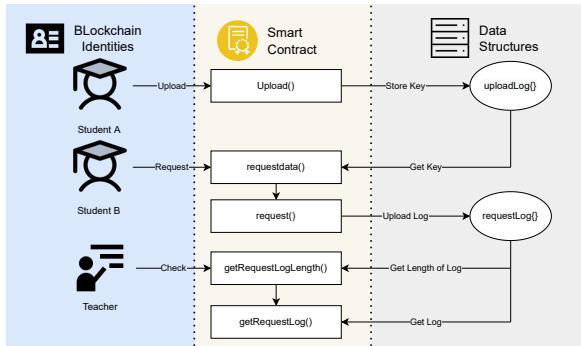


Fig. 2. Smart Contract Implementation

3) *Back-end server design:* To provide a highly interactive service for users, the web application of BeSharing is constructed on a server based on Browser/Service architecture so that users can visit the platform conveniently with a browser on their computers or phones. Apache Tomcat 9.0, which is an open-source Java Servlet container, is deployed on the server to provide the pages and following functions:

- **Creating accounts with verification** is realized by writing and reading the information of students stored in the database shown in Figure 1. There is also a stage of activating newly registered accounts by calling classes in *javax.mail* to send the email with verification to students.
- **Uploading assignments and encryption** as steps 3 and 4 shown in Figure 1 ensures the security of the uploaded files. We use *java.io.File* class to receive the uploaded files, which are encrypted on the server. We take Advanced Encryption Standard (AES) as our encryption method with particular seed generated from a 6-digit random number and a specific sequence to create the 128 bits key. The specific sequence and the seed are stored in separate back-end entities, which are the server and blockchain respectively.
- **Sharing actively and passively** are two methods of sharing assignments for students on BeSharing platform. A 6-digit sharing code can be generated randomly, which are stored in the database with information from the corresponding file. In addition, the information of the uploaded files can be displayed on a forum so that every

student can make requests, and owners can determine whether to share upon requests. To realize this function, we set a table in the database to store the requesting messages and set a boolean value to determine the state of being agreed or disagreed.

- **Requesting and being recorded** as steps 5 and 6 in Figure 1 are the core functions for the BeSharing platform, which can significantly prevent the appearance of cheating and plagiarism. Similar to sharing assignments with others, students can get the files via sharing code or the permission of the file owner. To decrypt files, the seed to generate the key should be obtained from the blockchain by invoking the function in the smart contract. Meanwhile, the smart contract has the function to write the requesting logs in blocks whenever there is a request for the uploaded seed stored in the blockchain so that no one can get the seeds without being recorded.
- **Browsing requesting logs** as step 7 in Figure 1 is the exclusive privileges for teachers. There is a function in the smart contract to search for the requesting log stored in the previous blocks. Meanwhile, to avoid breaches of privacy of sharing records, a built-in account-based access control is provided for checking the request logs.

The server is managed by the university or education board, protecting the security of the information of students. The server and blockchain network work as the independent back-ends with essential interactions such as key uploading, request logs writing and browsing. This highly decoupled back-end design guarantees the security and scalability of BeSharing platform. A breach of server has no impact of data privacy and data integrity, but resulting service outages.

### III. CONCLUSION

In this demo paper, we have demonstrated the framework and implementation details of the BeSharing platform. We have finished the alpha test for BeSharing to facilitate students to share their ideas in certain courses and protect them from being plagiarized. We hope the BeSharing platform can be rolled out to other schools and serve more students in the future, promoting the sharing of good ideas and the protection of intellectual property.

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