Image Copyright Protection System Using Blockchain

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Abstract

Image theft and copyright issues have been increasing rapidly with the rise of internet. Therefore, copyright protection of images has become an unavoidable issue. Blockchain is a distributed database that provides a secure, yet transparent way to protect any type of records. Blockchain provides an effective way to prevent copyright violation by providing a proof-of-property solution. This paper has proposed a model of image copyright protection using blockchain. There are many methods to protect the images such as disabling right clicks, disabling external linking of websites, digital watermarking and many more. Adding a digital watermark makes it easier to identify that the image is copyrighted. Blockchain stores the images securely and also provides the proof-of-property for the copyright holder. This system also provides a cross-check functionality for commercial users to avoid copyright issue by checking whether the image is copyrighted or not.

Keywords— Blockchain, Copyright Protection, Decentralized, Perceptual Hash

I.   INTRODUCTION

Copyright ownership gives the owner the exclusive right to use the work. When a person creates an original work, fixed in a tangible medium, he or she automatically owns copyright to the work. Copyright protects original works such as literary, dramatic, musical and artistic works. Copyright protection is automatically provided under the Copyright Act 1968 and gives the creator of the work exclusive rights to reproduce it, commercialize it and be recognized as its creator. As with other forms of intellectual property, there is no authenticated method to see whether the material is copyrighted or not. Copyright material is protected from the time it is first written down, painted or drawn, filmed or taped. The storage of the copyrighted material needs to be done in a secure place and with the proof-of-property concept hence claiming the ownership of the copyright. The traditional database might not be the solution that can update or delete the data reducing the factor of security for the stored material. Blockchain can be an appropriate solution to securely store copyrighted material.

Copyright is one of those thorny issues that are always causing pain to creative types. After all, if you write something, make music, take a photograph, or in some other way create, in theory you should receive full recognition (and payment). In the US this falls under title 17, which deals with "original works of authorship", including literary, dramatic, musical, artistic, architectural, and some other intellectual works. Many websites host their content with the work that is unauthorized. The content creator may suffer loss in case the work is used for revenue purposes. The person that does not hold the copyright for the work gets paid for it. The creators may claim the work when the work is seen on an unauthorized website. But the proof-of-property record is not maintained in the case, so the creator

faces some difficulties in claiming the copyright content. Unfortunately, particularly with the vast free market that is the social media, it's increasingly common for people to feel they should get everything for nothing. The copyright holder is usually not get paid for their content and someone else takes their credit. It is more disappointing when someone earns money through the content created by another person.

Copyright data can be stored in various storage systems but blockchain is the ultimate solution to protect the copyright information. Blockchain is similar to a database but only supports create and read operations. Data is stored in form of blocks which are coupled to each other and hence form a long chain. The data in the blocks is in encrypted form that makes it difficult to crack or change. Each block contains the address of its previous block and the follow feature makes the blockchain immutable (i.e. no one can change the block in between of the chain). Blockchain works in distributed environment that makes it immune to failures providing a restore point from other blockchain in the network.

The rest of this paper is as follows. We summarize the reference papers related to proposed system and a brief description about the study is mentioned in section II. Section III discuss the use of perceptual hashing, digital watermarking and blockchain. Also, the algorithm used to calculate the hash value of image is stated. Finally, we conclude the paper in section VI.

II.   RELATED WORK

[1] describes blockchain as an innovative area used to store the records in secure form preserving the integrity. It can be applied to various fields including communication, transactions and many more. [2] proposes the method of image fingerprinting used to identify the image uniquely. Feature extraction is used in generating the fingerprint where the pixel values are used, hence generating nearly same hash values even if two images differ slightly from each other.

Jasmine Joseph.et.al [3] suggests the use of watermarking to resolve all the malpractices done by the third parties and also to ensure the copyright protection. For these two methods are used which includes the chaos random number generation and data matrix. The first method shows that the secret information is encrypted with a secure hash algorithm with chaos random number generation. However, this method is more secure but with the increased hardware complexity, each technique is replaced with the data matrix and least significant bit methods. With the comparison of these two methods, the copyright information extracted from the watermark has good quality, less hardware complexity and is robust to various attacks. Watermarking ensures more security of image also the easy application of the algorithm is good factor to apply watermarking to images. The challenges identified in this type of protection method is that the proof-of-property is not maintained anywhere, and the copyright holder has no way to authenticate it.

Key features of a blockchain are stated in [4] and gives the basic information stating that blockchain is a distributed, ordered, back-linked list of blocks. Each block contains transactions that are hashed stored alongside the transactions. Each block also contains the previous block's hash, thus guarantees the chain's integrity back to the first block. However, such application might not always be appropriate or optimal; in many cases, a database and application logic might be better. [4][8] The paper portrayed about what are the key features of blockchain and revealed blockchain characteristics that can help determine blockchains appropriateness for an application. Following are the key features of blockchain - Immutability, Visibility and Transparency, Trust, Identity, Distribution, Workflow, Transaction, Inefficiency, Scalability, Maintenance, Standardization, Computational Complexity [12]. The main purpose to use the blockchain is immutability of the chain. As far as trust is concerned, it is not possible to update and delete data in the blocks. Security will be the priority even if the blockchain means to be distributed.

[5] The authors have carried out a through a well-defined study with the sole aim of collecting all relevant research areas and technologies on blockchain Technology. The first part explains about what blockchain is all about. Blockchain is a distributed database which maintains a list of records that goes on increasing continuously known as blocks that are secured from tampering and revision. Every block has its own timestamp and is linked to the previous block. [13] The technology of blockchain is an open, distributed ledger which can track and record transactions taking place between a buyer and a merchant or simply between two parties involved in an efficient approach. Second part gives a proposal about blockchain transactions and their salient features, which are Decentralization, Digital Signature, Mining and Data Integrity. Decentralization means having authority to all rather than having a central authority. Digital signature is an exchange of transactional value using unique digital signatures that rely on public and private keys to create an authentic proof of ownership.

The emphasis and difficulty of developing a photography website contains not only a whole design of the site and digitization conversion and repair of papery photos but also copyright protection of the image that is the site builder must focus on. In order to avoid a malicious tort and leak, author classified images and controlled browsing and downloading permissions of the classified pictures by using different techniques before web design and to make it easier author proposed the idea of digital watermarking. Thus, XUE Feng et al. [6],[9] proposed idea of adding digital watermark is the effective method to protect copyright. It embeds in multimedia data copyright information such as numbers, serial number, text, images signs, in order to do the copyright protecting and communication security, identification of data file and product label, etc.

Better availability and accountability along with high degree of security is provided by the blockchain. [7][14] discuss the applicability of the blockchain using cryptographic methods in vast areas such as bitcoin, smart contracts including the protection of copyright itself. [10] focuses on various legal-related aspects of the application of blockchain technologies in the copyright sphere. Functionalities of blockchain to implement the effective production management, copyright management, transaction management and users' behavior management for network media are stated in [11].

III. PROPOSED SYSTEM

This paper proposes the image copyright protection system using the blockchain technology along with the digital watermarking. Image needs to be uploaded on the blockchain network to enable copyright protection. Image uploading is facilitated by use of a web portal that sends image to the system's backend. Backend of the system is made up using blockchains which in turn is handled by the blockchain manager. Blockchain manager is a virtual entity that contains methods for validating the uploaded image with already existing images along with digital watermarking of the image. Digital watermark is a visible watermark placed on the image indicating that someone holds the copyright for the same.

The system features a tamper-proof, secure, irreversible, decentralized storage of the images on blockchain network. Blockchains in the system are managed by the blockchain manager (virtual entity) which incorporates many functions to enable storage, maintenance also adding and removing of the blockchain from the existing network.

To provide copyright protection to an image there are three steps to follow:

A. Image Uploading.
B. Image Verification.
C. Acknowledge Copyright Protection.

A.   *Image Uploading*

Uploading of the images is facilitated by the use of web portal where the user can either claim the copyright or check the image for any copyright issues if the images is to be used commercially. The image will be passed on to the blockchain manager which will broadcast the image to blockchains for further validation.

B.   *Image Verification*

One of the methods of comparing the images is pixel by pixel comparison which takes lot of time. In case of the blockchain, hundreds of images are to be compared with the uploaded image. Thus, this method will not be efficient in comparing the images. Below is discussed the algorithm of phash which calculates hash value of image based on pixel features. Hence, comparing the hash values is easy and fast rather than comparing the whole image.

In this step the image hash will be calculated and cross-verified with all the blockchain records and thus giving the result whether the image already exists in blockchain or not. Image hash is a 64-bit value that is obtained by resizing the image to 8×8 array and then doing some changes to the images such as gray scaling, averaging the pixels, etc. After that the brightness value for each pixel is considered and appended to get 64-bit hash value.

Algorithm- PHash :-

To find the hash value of an image.

Pre: Requires jpg/png/jpeg image

Post: Hash value of given image is obtained as result

1. Reduce the size of the image.
2. Reduce the color of the image (i.e. convert the image to grayscale).
3. Calculate the average pixel colors of the image.
4. Calculate the brightness value of each pixel for every pixel in image.
5. Appending the result of previous step will result in hash value of length that is equal to size of reduced image.

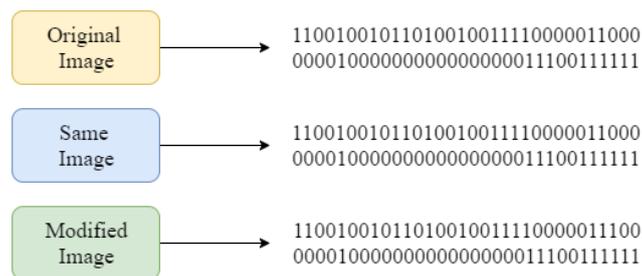| Original Image | → | 1100100101101001001111000011000
0000100000000000000000111100111111 |
| Same Image | → | 1100100101101001001111000011000
0000100000000000000000111100111111 |
| Modified Image | → | 1100100101101001001111000011100
0000100000000000000000111100111111 |

Fig 1: Hash values of different and same image

These hash values are derived from the characteristics of the image meaning that the same images will have same hash value. Small modifications in the image change the output hash value but the hamming distance formula can be used to find out the amount of change in two images. By using the following algorithm, the images are compared and they get the same hash values if the images are equal. Also considering the case of images with changes the hamming distance will help to identify the amount of difference between the images.

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After the 64-bit hash values are obtained they are converted to 16-bit hex value for ease of handling. Hash value of the image to be compared is sent over the blockchain network where the obtained values are compared with pre-calculated hash values to find out the similarity between the images. Similarity of two images can be calculated by using the formula given below:

Similarity = (1 - (X - Y) / 64.0) * 100)
Where
X = hash value of 1st image
Y = hash value of 2nd image

If the similarity is above the threshold value, image is rejected and the user gets acknowledgement about the request or else if the image is accepted then it is added to all the blockchains as a new record and image is digitally watermarked implying that the image is now copyrighted. User get a receipt containing the unique id to claim copyright on the system.

C.   *Acknowledge Copyright Protection.*

User gets a unique link from the system where he/she can claim the copyright image along with other information. The image is securely stored on the blockchain network and provides copyright protection.
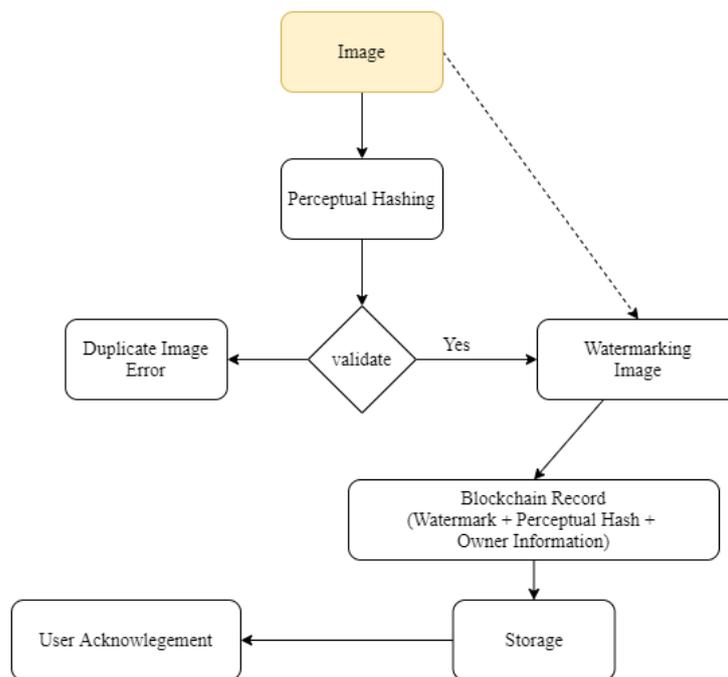

Fig 2: Working of the copyright protection system

Above figure depicts the system in an abstract way, where the image is perceptually hashed to allow the comparison between other images existing in the system. If the image is validated (i.e. it is original) the user is acknowledged with a receipt containing the hash value to claim copyright for image. A blockchain record is formed using all the data along with image hash and stored on the blockchain network via blockchain manager.

IV.   RESULTS AND DISCUSSION

The copyright protection of any image is done by considering a certain image. Before considering the copyright, the image should be selected by the user's choice. The user must be logged into the system

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using a username and a password which provides accountability for the records. User can opt-to signup for the system to get a username and password. After signup the account(email) of the user is verified by OTP(One-Time-Password). After the user enters a correct OTP, he/she is allowed to log into the system.

After the login is successful, user is provided with many options like upload, profile-check, etc. Considering the main aspect of the system mentioned in Fig.2 if user uploads an image then it is sent to the blockchain manager for further processing. Blockchain Manager is a virtual entity which stores/checks the image with the blockchains and handles other user activities. After receiving the image from user its hash value is calculated by perceptual hash function. The blockchain manager communicates with the blockchain via blockchain API. Before any data is requested all the blockchains are synced with each other to ensure that only recent data is taken into consideration. The blockchain is requested and copied into a local variable. The hash values in the blockchain are then compared with the presently calculated hash value (user uploaded image). The similarity of the two hashes are taken into consideration (blockchain's records and presently calculated hash value) and if any of the similarity is above 75% the image is not accepted. User get a message that the copyright is already held by someone along with the contact details of the owner.

In other case if none of the hash values matches given criterion then the image is accepted. The accountability holds a proof for uploading here and image is watermarked accordingly. The username of the owner along with the image's hash value and other details like date, image size, etc. is uploaded to the blockchain. After uploading sync operation is applied to all the blockchains to ensure all the chains are up to-date. The user gets a unique id (hash value) to claim the copyright on the system. Also, a link is displayed where the user can simply click and get a validity status of the uploaded image.

V.   FUTURE WORK

The system proposed in this paper work only for images and provide copyright protection using perceptual hashing and blockchain. In future the scope of this system can be extended to video files, presentations, and other copyright sensitive material such as educational material, audio file, music records, patents, etc. With increase in computing power the number of blockchains in the backend can be increased. Images supported in this system are png/jpg/jpeg which can be extended to support gif (moving images). Time required to compare the images can also be reduced with developments in comparison algorithms. Faster machines can also increase the security of the records by storing in large, complex blockchains.

VI.   CONCLUSION

In recent days, increasing content on the internet tends to increase the piracy leading to copyright issues. In this paper use of blockchain along with watermarking and perceptual hashing of images are mentioned that can provide protection for images from copyright violations. With increase in technology and new emerging algorithms this system can be extended to provide protection for vast variety of material such as videos, study materials, etc.

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