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Guardians of Creativity: The Importance of Digital Copyright Protection

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With the rapid expansion of digital publishing and multimedia industries, copyright infringement of digital resources has become a serious concern. To address these challenges, this paper proposes a comprehensive digital copyright protection framework that integrates blockchain cross-chain technology with intelligent digital watermarking techniques. The framework leverages blockchain's decentralized, tamper-resistant, and transparent features to achieve secure copyright registration, ownership verification, and transaction management, while cross-chain technology enhances scalability and interoperability across platforms. Simultaneously, a high-security digital watermarking method based on singular value decomposition (SVD), two-dimensional wavelet decomposition, and chaotic logistic sequences is employed to embed robust and imperceptible watermarks in digital media. To further improve watermark robustness and invisibility, optimization algorithms such as genetic and gray-wolf algorithms are applied, considering the characteristics of the Human Visual System (HVS). In addition, smart contracts and the Byzantine Fault Tolerant (BFT) consensus mechanism ensure trustworthy automation of copyright enforcement and dispute resolution. Experimental and theoretical analyses show that the proposed hybrid system enhances the security, scalability, and reliability of digital copyright protection, providing an effective and trustworthy solution for digital content creators and platforms in open innovation ecosystems.

Keywords: Copyright Protection, Blockchain Technology, Cryptographic Method, Digital Watermarking

The present rapid development and deployment of new information technology for the rapid supply of commercial multimedia services has created a high need for dependable trustworthy safeguard copyright ownership systems for digital media content safeguarding ownership of digital photographs involves legally establishing intellectual property rights in Judiciary to prevent unauthorized use or duplication, modification, alteration, or distribution of a digital photograph. In accordance with the rules of each country, this approach may necessitate pre-registration of the copyright with an authentic independent entity. Following approval application, a copyright notice is required to notify and confirm copyright ownership.[1]

The arise of computerised data is always expanding as a result of the explosion of information. The internet has now become a strong source of information for end consumers; nevertheless, unlicensed and copyrighted information is also readily available, leaving them unclear about the authenticity of the content. On the other hand, establishing legitimate possession of computerised property is critical for content creators. Watermarking, cryptography, stenography are some of the technologies used to ensure the authenticity and legal ownership of digital content.[2]

Copyright identification is achieved through watermarking (a mark embossed on a sheet of paper). Digital watermarking is an effective information concealment technique widely used to combat unlawful reallocated, recognition, cloning digital content.[2]

Because duplicating and distributing computer-based media content takes so little time and effort, copyright violation safeguard is an essential concern for copyright owners and should be integrated into the utilization of online trading platforms. Today, the online platform has not discovered and adopted sufficient copyright safeguarding methods. This is in direct conflict with enabling safe exchange mechanisms.[3,4]

Digital Resource Copyright Protection

Copyright Registration

Copyright oversight achieves copyright registration of electronic material using the following process:

(i) First, digital resource owners apply for copyright registration of their work. After the application is submitted, it goes through an authentication process.

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(ii) If the authentication fails validation, the process stops there. However, if it passes validation, the application proceeds to the similarity (SIM) verification stage.
(iii) During this verification, the system checks how similar the submitted digital resource is to existing ones.
(iv) If the similarity score is below the threshold, meaning it is unique enough, the supervision chain proceeds to register the digital resource.
(v) If it is above the threshold, it indicates high similarity, and the registration may be rejected or reviewed again.
(vi) Once the resource is registered, the system initiates a network-wide consensus to confirm and update the distributed ledger with the new copyright record.
(vii) Finally, the process ends[5] as shown in Fig. 1.

Resource Trafficking and Copyright Modifications

The following describes how intellectual property transactions and transfers are carried out. When people want to buy digital materials of whom holder is un-identified they can look for the copyright regulations. As shown in Fig. 2, resource exchange triggers a copyright transaction self-executing contract, which transfers transaction amounts and changes copyright registration information.[5]

Protection of Copyright

When digital resources are shared, traded, or transferred, infringing behaviours are handled by the copyright arbitration. When infringement is detected, the owner of the digital resource's copyright submits, via the relay chain, the details of the violator and the infringement site to the copyright arbitration. After confirming the applicant's identity, the arbitration department checks the relay chain to digital sharing of resources and copyright supervision to see if there has been any infringement. If it has, violation analysing self-executing contract is activated, determining the extent of violation, settling the compensation amount, starting a national consensus, updating copyright enrolment ledger.[5] such particular procedure is shown in Fig. 3.

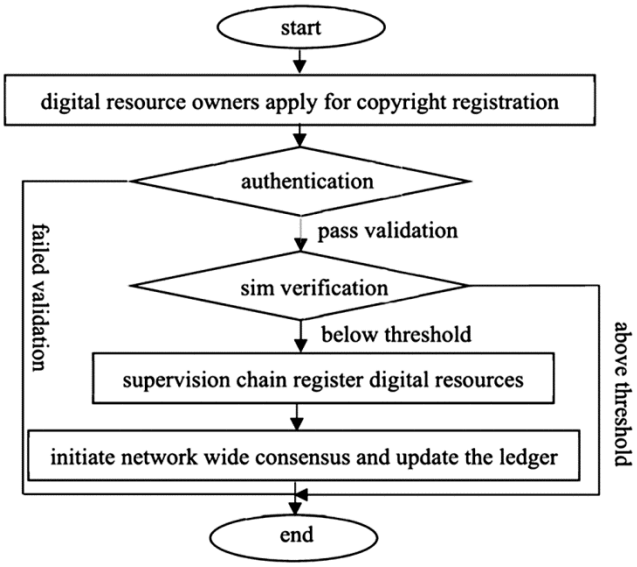


Fig. 1 — Copyright registration process

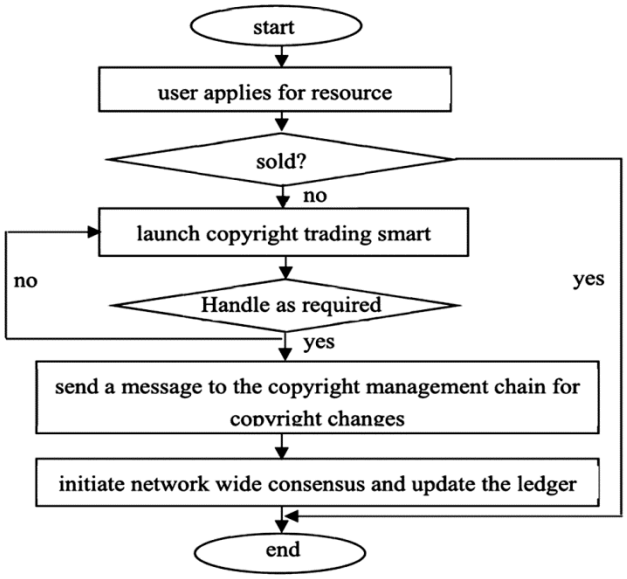


Fig. 2 — Resource trafficking and copyright modifications

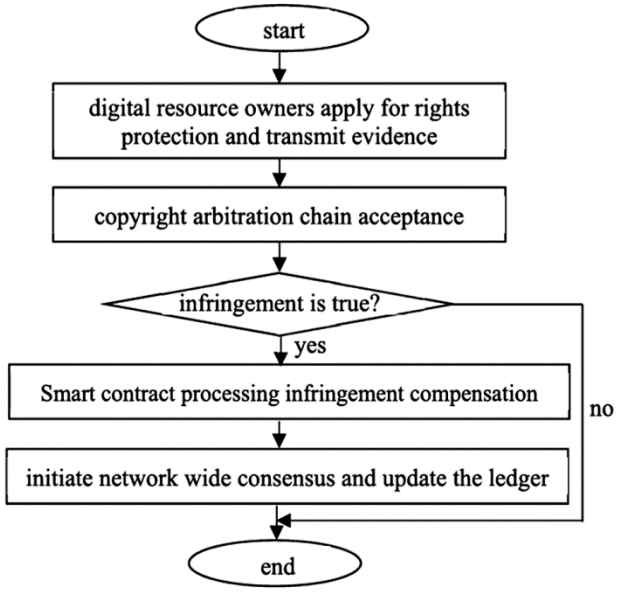


Fig. 3 — Protection of copyright

Digital Resource Analysis Plans for Copyright Protection

High computational performance, scientific rationale, and outstanding operability are characteristics of copyright protection mechanisms. The following is a summary of its benefits:

(i) First, copyright protection scheme can guarantee that the chain's digital resources are very unique. Before publishing digital assets to the blockchain, it is essential to compare them with resources from different offline platforms or databases. The resources can't be uploaded if the analysis's outcome indicates that they are very similar to the materials that are already available.

(ii) Second, just the resources' data or indexing information should be posted to the chain when they are highly original and linkable; the rest of the digital assets should be transferred to a

(iii) reliable cloud server.[7] This procedure increases the accessibility of copyright protection measures and conserves blockchain capacity for storage.

(iv) Third, CCPS relies on parallel and relay chains, incorporating arbitration and copyright monitoring. Only matching chains in parallel should be introduced in the event that additional business interaction is required, guaranteeing The interoperability solution's outstanding adaptability and improved availability.

(v) Lastly, CCPS incorporates many blockchain that are connected but separate from one another from the standpoint of transaction throughput. The issue of poor bandwidth for copyrighted transactions is successfully resolved by these blockchain, which create a significantly greater number of interactions per second than a single blockchain.[5,7]

Cryptographic Method-Based Copyright Protection

(i) Our approach provides three varying levels of dependability based on the degree of proof required for protection: human-based copyright assurance, copyright security with registered cryptographic keys, and copyright defence with C, utilizing shared cryptographic keys (Fig. 4).[1]

(ii) The current approach embeds and identifies an image's Authenticating Dataset as its embedded data, based on an image holder authenticating mechanism.[1]

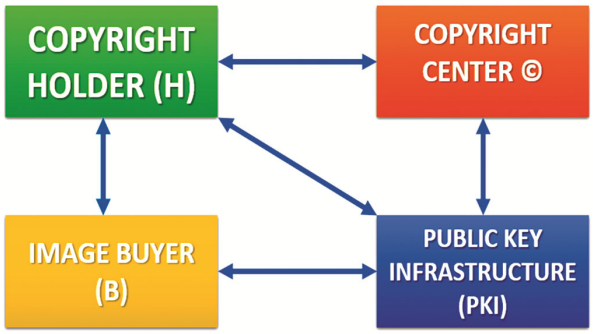


Fig. 4 — Copyright protection in cryptographic method

(iii) A perceptually adaptable spread spectrum methodology serves as the foundation for the applied picture owner authentication method. This method offers a dependable way to incorporate strong watermark.[2]

(iv) To include or extract a watermark in a spread spectrum technique, precise key parameters used to generate computed random sequences are required. These keys serve as cryptographic credentials regarding watermarks creation and confirmation. Network protection relies on exclusive information regarding secret passcodes, that ensure additional security. The current technique and equipment encode many watermarks in an image simultaneously, including a confidential investigation, visible signature, due to statistical independence of spread spectrum signals, which makes them almost-orthogonal.[1,6]

(v) The detecting water-mark is incorporated with a set random seed, allowing H to quickly search for his photographs on digital network. Toward locate the locations of his or her images, he or she must check only one embedding.[1,6]

(vi) The public watermark identifies images as copyrighted and provides ownership information. Concurrently, there is a private watermark that is secure and whose confidentiality is dependent on H secret code. Since H open code is registered, H may demonstrate that he is the sole individual with a sufficient secret code, hence, private watermark source.[1,2]

(vii) The system enables safe registration (reciprocal authentication consistency, irrefutability) of watermark imprinted images (data sets) on C.

(viii) C registers information derived out of the stage picture and generates a signed electronic copyright certificate, which is then broadcasted to H.

(ix) In case of a illegal external entity encodes authentication mark in similar picture, competing assertion of rights conflicts could be addressed since one and only party holds a copyright ownership document containing the embedded mark.

(x) That original watermarked picture was redistributed by the other party, who may be recognized as the cheating party because the image only has a certificate where both watermarking is included.

(xi) A public key infrastructure (PKI) is used for watermark enforcement with authorized cryptographic keys and copyright protection using C. On request, the PKI provides public key certificates, such as X.509 certificates, which include the party's authentication key, distinguishing title, digital time imprint. Each certification is encrypted using the public key infrastructure private key, and trust is established through the verification of public key[1].

Copyright Infringement

Ideas, like intellectual property, are constantly moved between suppliers and sought for on an idea platform. When ideas are expressed in some way on the internet, they become protected by copyright. If an idea is not published on a platform, it is considered personal property of the idea giver. Once published, ideas are granted a public attribute. The worth of knowledge commodities is difficult to quantify due to its universality, incomplete physicality, and ambiguity. Platforms continue to lack sufficient protection mechanisms, despite the fact that relevant regulations in China are being updated. After releasing their concept content commodity on the platform, idea providers are required to share copyright revenue with the platform in accordance with a specific agreement.

Generally, agreements proposed by platforms for owners of copyright only include a portion of their incoming rights. Certain rights are transferred and divested to the platform, such as replication rights created upon the posting of idea assets on the platform. This behaviour violates the full creative works rights of the holders of copyright. Authorship rights, the most fundamental copyright right, are the ability of copyright holders to sign their first names on their copies and creative works. The ownership rights of those who own copyright will be violated if shared knowledge is arbitrarily disseminated since the information may be illegally published by receivers, and copyright owners' signatures may be reproduced or falsified.[8]

Duration of Copyright

Copyright lasts for a range of times in various jurisdictions. A number of variables, including as the nature of the work, whether it has been released, and whether it was produced by a company or an individual, might affect how long the term is. In most parts of the globe, the default copyright period is the author's life plus fifty or seventy years of age. In the United States, most existing works are protected for a set number of decades after their creation or publication.[9]

Conclusion

The evolving digital landscape demands innovative and reliable mechanisms to safeguard intellectual property rights. This study demonstrates that the integration of blockchain technology, cryptographic algorithms, and digital watermarking establishes a robust and transparent framework for digital copyright protection. By leveraging the decentralization and immutability of blockchain, along with the authentication strength of watermarking and asymmetric encryption, this approach ensures the authenticity, ownership verification, and secure distribution of digital assets. Furthermore, the implementation of smart contracts facilitates automated copyright registration and enforcement, minimizing infringement risks. Overall, the proposed model promotes a secure and equitable digital ecosystem, reinforcing trust and accountability among creators, publishers, and consumers in the digital era.

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