# Web 3.0 Applications Supported by Artificial Intelligence and Blockchain Technologies

## Special Issue Introduction

Web 3.0 is a term used to describe the next generation of the internet that is being built on blockchain technology. It is expected to have a significant impact on society by decentralizing power and control over social media platforms and other mediums of cultural interaction. Web 3.0 gives power to the actual participants in the cultural economy – the creators and the community. With Web 3.0, communities can be more than just consumers of culture – they become active participants in the creator economy. They can become owners and decision-makers in that role instead of just being fans. While research on various aspects of Web 3.0 applications is progressing at a very fast pace, this is only the beginning. There are still a number of issues that have to be explored in terms of the design, implementation and deployment Web 3.0 applications and the enabling technologies. For example, various issues that need to be addressed include extendibility and interoperability of blockchain, NFT based authentication technology based on digital wallet, reward method-based consumer's efforts, Web 3.0 business model etc. This special issue focuses on these issues and present the state of the art in Web 3.0 with AI and its applications.

This special issue is intended to serve as the spring-board for gathering and disseminating experiences gained in implementing and integrating Web 3.0 and Artificial Intelligence applications. Among a large number of high-quality submissions, the following seven articles have been selected to be included in this special issue. The lead article titled "The Future of Digital Authentication: Blockchain-Driven Decentralized Authentication in Web 3.0" by Jungwon Seo presents an innovative Web 3.0 authentication technique, designed for a user-centric internet environment. It defines the essential features of such systems and introduces a new approach using smart contracts. The proposed approach utilizes mother and child token in conjunction with the lock smart contract to ensure secure authentication. The approach has been thoroughly tested against various security threats,

including man-in-the-middle, replay, and brute-force attacks, and the results very promising.

The second article by Jungchul Seo, Younggyo Lee and Young Yoon titled "Self-sovereign and Secure Data Sharing through Docker Containers for Machine Learning on Remote Node," proposes a data-sharing model that guarantees the integrity, confidentiality, and availability of data to each other. It constructs a trust execution environment logically independent of the user's host to protect the owner's rights and interests through self-sovereign data control in a distributed environment of the Web 3.0 system. This article has a number of practical applications in the real world. The third article is titled "Ethereum Smart Contract Account Classification and Transaction Prediction Using the Graph Attention Network," by Hankyeong Ko, Sangji Lee, and Jungwon Seo. This article explores the application of a Graph Attention Networks version 2 (GATv2) model in analyzing the Ethereum blockchain network. Their results demonstrate the effectiveness of the heterogeneous graph model in improving node embedding expressiveness and enhancing transaction prediction accuracy. This article also offers practical tools for analyzing DApp flows within the Web3 ecosystem, facilitating the automatic prediction of Contract Account service categories and identifying active Decentralized Application usage.

The fourth article contributed by Mohammed Alkhathami and Imam Mohammad Ibn Saud, is titled "Collaborative Task Offloading in Edge Computing Enabled Web 3.0." This article proposes a novel algorithm that solves the challenges of load imbalance at the edge nodes resulting in large queue sizes and increased task delays. Their proposed technique identifies the edge nodes with a large network load and pairs them with a lightly loaded edge node that can handle some of their network load. The edge node pairing is based on the Gale-Shapley stable matching algorithm. They present a detailed simulation-based performance evaluation showing a reduction in task delay by 20% and task deadline miss ratio by 68%. The fifth article is presented by KaiHsiang Chan, and Young Yoon, which is titled "Web 3.0 Chord DHT Resource Clustering." This article explores the impact and challenges of new user behaviours in the Web 3.0 environment on distributed networks. Specifically, it proposes a new variant of the Chord algorithm, which uses two different Chord rings for resource clustering: one based on the hash of resource names, and the other based on the hash of IP addresses.

The sixth article titled "User Authentication Techniques Using Dynamic Soulbound Token," is written by Yunjae Joo and Jungwon Seo. This article introduces a user authentication technique that utilizes dynamic Soulbound

Token (SBT) to tackle challenges associated with the oracle problem in decentralized environments. The approach uses dual smart contracts local and global-along with blockchain tokens, removing the need for intermediary verification processes. The proposed method improves security by allowing users direct control over their authentication data. This mitigates the risks associated with centralized authorities and man-in-the-middle attacks. The final article is contributed by Aleksandar Tosic, which is titled "Run-time application migration using Checkpoint/Restore in Userspace." This article presents an empirical study on the feasibility of using Checkpoint/Restore in Userspace (CRIU) for run-time application migration between hosts, with a particular focus on edge computing and cloud infrastructures. In addition, it provides experimental support for CRIU in Docker and offers insights into the impact of application memory usage on checkpoint size, time, and resources. The findings and experimental support for CRIU in Docker serve as a useful reference for future research on performance optimization and application migration using CRIU.

This special issue has discussed several aspects of Web 3.0 Applications Supported by Artificial Intelligence and Blockchain Technologies. We sincerely hope that the readers will find the seven articles included in the special issue useful and spur further research in improving the design and implementation of Web 3.0 applications.

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