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RESEARCH ARTICLE

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BLOCKARC: A BLOCKCHAIN BASED SMART CONTRACT FOR REWARD SYSTEM IN E-COMMERCE

Pooja Patil[1], Aryan Singh[2] , Aryan Raut[3] , Aakash Sharma[4] and Adarsh Rathod[5]

[1,2,3,4,5] St. John College of Engineering and Management, Palghar, Maharashtra.

[1]https://orcid.org/0009-0001-9879-0164, [2]https://orcid.org/0009-0003-1075-3946, [3]https://orcid.org/0009-0004-8867-4794, [4]https://orcid.org/0009-0000-7560-3963, [5]https://orcid.org/0009-0001-8021-0715

E-mail: ppatil879@gmail.com, aryansi0109@gmail.com, aryanraut5218@gmail.com, as024harma@gmail.com, adarshady2203@gmail.com

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ABSTRACT

The increasing reliance on e-commerce platforms has amplified challenges related to transparency, trust, fraud, and inefficiencies in reward distribution systems. Existing centralized architectures fail to address these issues effectively. This paper proposes BlockArc, a blockchain-based smart contract framework designed to revolutionize reward systems in e-commerce. The system leverages a permissioned blockchain and smart contracts to automate reward distribution, enhance security, and ensure transaction transparency. The framework consists of four layers: Blockchain Layer, Smart Contract Layer, Application Layer, and User Roles, each addressing key challenges such as reward fragmentation, fraudulent transactions, and inefficient refund processes. Smart contracts autonomously handle reward issuance, redemption, and expiration while integrating oracles for real-world data validation. Security is reinforced using cryptographic hashing, Zero-Knowledge Proofs (ZKPs), and Role-Based Access Control (RBAC) to prevent fraudulent activities. A performance evaluation demonstrated 112 transactions per second (TPS) under moderate load, fraud detection accuracy of 100%, and a 37% reduction in operational costs by eliminating intermediaries. User satisfaction surveys indicated high levels of trust and transparency. The study concludes that BlockArc enhances e-commerce reward systems by improving efficiency, security, and decentralization, paving the way for scalable and interoperable blockchain applications in digital commerce.

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I. INTRODUCTION

E-commerce platforms have transformed the way trade and commerce are conducted, offering a seamless interface for transactions between buyers and sellers. However, as these platforms expand, they face critical challenges such as lack of transparency, trust issues, fraud, and inefficiencies in reward systems and product return mechanisms. Centralized architectures, which dominate the e-commerce landscape, are often unable to address these challenges effectively. The need for a decentralized, transparent, and automated solution has led to the exploration of blockchain technology and smart contracts as transformative tools for the e-commerce sector.

Centralized e-commerce platforms act as intermediaries, controlling various aspects such as payments, reward distributions, and dispute resolution. This centralization often results in opaque processes, high operational costs, and vulnerabilities to fraud. Reward systems, a critical feature of e-commerce, are plagued by fragmentation and inefficiencies. They often lack interoperability, limiting customers to specific platforms and reducing the overall value of loyalty programs. Similarly, the product return and refund process is fraught with delays and disputes, leaving both customers and merchants dissatisfied. These inefficiencies highlight the urgent need for a paradigm shift toward a decentralized and transparent approach.

Blockchain technology, with its decentralized and immutable architecture, offers a compelling solution to these challenges. By recording transactions on a distributed ledger, blockchain eliminates the need for intermediaries, ensuring transparency and security.

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Energy Efficient Data Transmission Using Rotational Invariant Strategy based Catch Fish Optimization Algorithm in IoT-WSN

Pandharinath Appasaheb Ghonge[1]* Subhasini Shivam Shukla[1] Baban Uttamrao Rindhe[2]
Sanjay Ramkrishna Sange[3] Arvind Mahadeorao Bhave[4]

[1]*Department of Electronics and Computer Science,*
St. John Collage of Engineering and Management, Palghar, India
[2]*Department of Electronics & Telecommunication Engineering,*
K. C. College of Engineering & Management Studies & Research, Kopri, Thane, India
[3]*Department of Information Technology, Shah and Kutchhi Engineering College, Chembur, India*
[4]*Department of Computer Science, R.T.M. Nagpur University, Nagpur, India*
* Corresponding author's Email: pandharinathg@sjcem.edu.in

Abstract: The Internet of Things (IoT) interconnects with various devices through the internet, which recently develops an application of Wireless Sensor Network (WSN) for data transmission. However, the existing traditional optimization-based methods used for minimizing energy consumption of node for energy efficient data transmission in IoT have failed to balance the nodes energy due to frequent network changes and unbalanced energy utilization of nodes. To overcome this, a Rotational Invariant Strategy based Catch Fish Optimization algorithm (RIS-CFO) is proposed to enhance the Cluster Head Selection (CH) and routing in IoT network. The proposed RIS-CFO adopts the dynamic nature of the IoT-WSN network by mimicking fish behavior to adapt and explore the solution space effectively, which results in optimal solutions. The RIS strategy increased the exploration ability of the CFO algorithm by searching in a rotation or encircling for individual and group collection to prevent stagnation and explore diverse solutions. The experimental results of the proposed RIS-CFO method attained energy consumption of 18 J and 43 J for 500 and 1000 nodes, which is less when compared to the existing approach DESFO.

Keywords: Catch fish optimization, Energy efficient cluster head selection and routing, Internet of things, Rotational invariant strategy, Wireless sensor network.

1. Introduction

Internet of Things (IoT) network is defined as a global network that produces a system to control and monitor the physical world by collecting, processing, and analyzing the data obtained from the IoT sensors/devices. This IoT network is based on a layered architecture that enables internet communication among the various physical devices in the heterogeneous environment [1]. Wireless Sensor Networks (WSNs) organise the sensor nodes individually and spatially to monitor the environment and observe the real-time data. This WSN network is developed to collect the scalar information through several physical sensor nodes, which are deployed randomly in the network [2-4]. However, the sensor node with limited energy constraints is the primary issue in both IoT-WSN environments that affect a huge number of time-based applications, which are utilized to track, monitor, manage and coordinate in different scenarios [5, 6]. Therefore, an effective routing technique is required to connect the devices and objects, which is one of the primary elements to improve the performance of the IoT-WSN, which results in efficient data transmission. To enhance the IoT-WSN performance, clustering is also a technique that is frequently used to arrange the physical devices into clusters and then the most appropriate node from the cluster is selected as Cluster Head (CH) to collect and transmit data from other nodes to the Base Station [BS]. The efficiency of the IoT-WSN

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