A Comprehensive Review of Integrating IoT and Blockchain Technologies in the Implementation of National Education Policy in education sector

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Abstract - *This paper explores the synergistic application of Internet of Things (IoT) and blockchain technologies to bolster the successful implementation of National Education Policy (NEP) initiatives in the education sector. As education undergoes transformative changes, the integration of these technologies offers promising solutions to address challenges related to data security, transparency, and efficiency. The proposed framework includes leveraging blockchain for secure student data management, credential verification, and decentralized learning platforms. Concurrently, IoT devices are employed to create smart classrooms, automate attendance tracking, enable real-time monitoring, and enhance the overall learning experience. The use of blockchain ensures the integrity of examination processes and resource allocation, while smart contracts automate agreements among stakeholders. While highlighting the potential benefits, this paper also emphasizes the need for careful consideration of challenges and collaborative efforts among educational institutions, government bodies, and technology providers. The envisioned integration of IoT and blockchain technologies has the potential to revolutionize the education landscape, fostering a more secure, transparent, and efficient educational ecosystem aligned with the objectives of the National Education Policy.*

Key Words: Internet of Things (IOT), Blockchain, National education policy(NEP), Security, communication

1.INTRODUCTION

In the wake of the evolving landscape of education, the successful implementation of National Education Policy (NEP) mandates a proactive embrace of innovative technologies to address emerging challenges. This paper explores the integration of two transformative technologies, the Internet of Things (IoT) and blockchain, to enhance the realization of NEP objectives within the education sector. The convergence of these technologies holds the promise of fostering a more secure, transparent, and efficient educational ecosystem, aligning with the principles and goals outlined in the NEP.

The advent of NEP signifies a paradigm shift in educational strategies, emphasizing holistic learning, technological integration, and adaptability. As institutions strive to meet these objectives, there arises a critical need to harness technological advancements that not only fortify data security and privacy but also streamline administrative processes and enhance the overall learning experience. In this context, IoT and blockchain technologies emerge as key enablers, offering solutions to various challenges encountered in traditional education systems.

This paper delves into the potential applications and benefits of integrating IoT and blockchain technologies in the context of NEP implementation. The ensuing discussion encompasses a spectrum of educational facets, ranging from secure student data management, credential verification, and decentralized learning platforms facilitated by blockchain, to the establishment of smart classrooms, automated attendance tracking, and real-time monitoring enabled by IoT devices. Additionally, the role of blockchain in securing examination processes and resource allocation, coupled with the use of smart contracts for automating agreements, is explored.

While illuminating the transformative potential of these technologies, this paper also acknowledges the need for a comprehensive understanding of associated challenges. Infrastructure requirements, data privacy concerns, and the imperative for collaborative efforts among educational institutions, government bodies, and technology providers are essential considerations in the successful deployment of IoT and blockchain in education. Through this exploration, the paper endeavors to contribute insights that can guide educators, policymakers, and technologists in leveraging these technologies effectively to usher in a new era of education aligned with the vision of the National Education Policy.

2. LITERATURE REVIEW

The paper highlights the role of Blockchain in IOT.The BC is a chain of verified and cryptographic blocks of transactions held by the device connected in a network.The blocks data are stored in the digital ledger that is publicly shared and distributed.The BC provides secure communication in IOT

network. The BC-IOT integration approach has a lot of remarkable opportunities. [1]

The paper discusses on how blockchain and IOT can be used to provide solution in education sector. BC can be used in the management of certificates, retrieval of certificates and handling. Making lecture plan for students IOT can be used for effective feedback analysis Student feedback relates to lecture quality IOT can be used to monitor student reaction so that lecture quality can be tracked effectively. [2]

This paper discusses the challenges of IOT centralized model like [3]

- *Single Point of Failure*
- *Security and privacy*
- *Scalability* - Centralized IoT model works well with limited IoT devices if number of IoT devices increases the network gets complex and scalability issues arises.
- *Accessibility and Diversity-* Heterogeneous IoT devices connected to centralize IoT model causes difficulties to access the network.
- *Cost* - The cost involved to maintain high capability hardware and software of centralized server and database.
- The integration of smart contracts and IoT leads to secure sharing of information and provides automated services to the users.

This paper discusses the cybersecurity issues of the blockchain based IOT systems.The use of blockchain technology for the Internet of Things (IoT) can help solve various security and privacy issue. IoT systems are vulnerable to several security threats like data breaches, malware attacks and physical attacks Blockchain technology can be used to improve the security of IoT systems in a number of ways: [4]

- Encryption
- Authentication
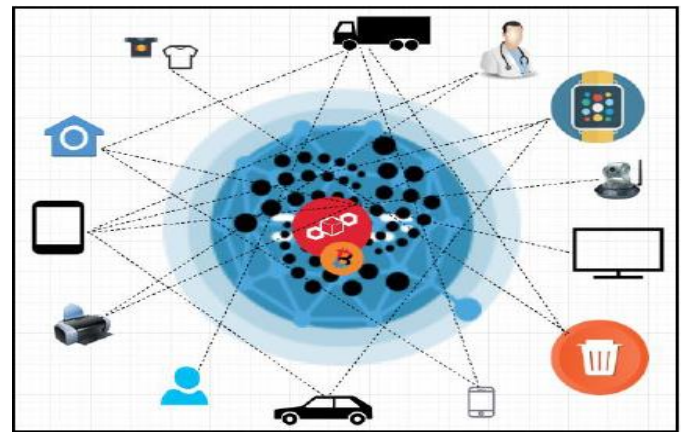- Access control
- Vulnerability management

Figure 1 : Blockchains and IoT

3. OPPORTUNITIES

The BC-IoT integration approach has a lot of remarkable opportunities. It opens the new doors for both together. Some of the opportunities are described as follows.

1. **Building the Trust between parties:** The BC-IoT approach will build trust among the various connected devices because of its security features. Only verified devices can communicate in the network and every block of the transaction will first verify by the miners then they can enter in the BC.

2. **Reduce the Cost:** This approach will reduce the cost because it communicates directly without the third party. It eliminates all the third-party nodes between the sender and the receiver. It provides direct communication.

3: **Reduce Time:** This approach is reduced the time a lot. It reduces the time taken in transactions from days to second.

4: **Security and Privacy:** It provides security and privacy to the devices and information.

5. **Social Services:** This approach provides public and social services to the connected devices. All connected devices can communicate and exchange information between them.

6. **financial Services:** This approach transfer funds in a secure way without the third party. It provides fast, secure and private financial service. It reduced transfer cost and time.

7. **Risk management:** This approach is played the important roles to analyze and reduce the risk of failing the resources and transactions

Fig -2: Opportunities in BC-IOT

4. NEP 2020 in engineering sector

NEP (National education Policy) is a **5+3+3+4** design covering children in the age group of 3-18 years. It is a reform in the current exams and assessment system.It focus on strengthening of teacher training, and restructuring the education regulatory framework in Higher Education, NEP, 2020 provides valuable insights and recommendations on various aspects of education that include moving towards multidisciplinary and holistic education,
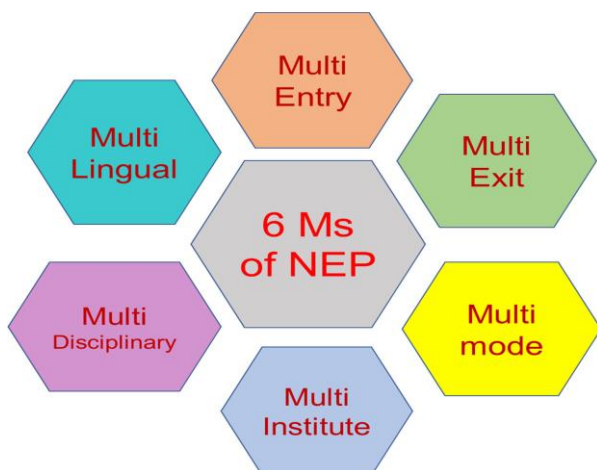

Fig -3: Features of NEP

NEP-2020 provides scope for flexibility in earning academic credits through different modes of learning to enable MXMEs (Multiple Exit- Multiple Entry) culture. However, technical institute have to assign minimum number of credits to be earned by the student for award of a certificate/degree. In this process, the students have to undergo following learning process to realize the MXMEs:

•Finishing school/ Bridge courses to orient the student aspiring for admission under MXME mode.
• In-house opportunities primarily at enrolled institute for start-up or for employability while exit at any level.
• NEP-2020 enables plenty of opportunity for every learner from undergraduate program to Ph.D. program. Therefore, the curriculum will be tailored in accordance with objectives of the program offering department in
the particular discipline, and vision-mission of the institute. Thus, during MXMEs the student have to undergo the finishing school/ bridge courses to become eligible for higher studies, as well as enhance their skills to meet the employability criteria, and also become a valuable resource to the society. The execution aspects of the 6 Ms mentioned in the previous section lies in the successful implementation of the Flexible Academic Program (FAP). The entire process of higher education is the interconnection of learning and the development of competencies, academic mobility at various stages of exits and entries, and integrating the diverse educational options to converge at the level of Masters and Doctorate degrees.

Semesters	1	2	3	4	5	6	7	8		9-12		13-16
Minimum Credits	20	40	60	84	100	125	140	160/172		200/250		350
Multiple Entry points	ENTRY		ENTRY		ENTRY		ENTRY	ENTRY		ENTRY	ENTRY	ENTRY
Student Support Programs (SSP)	Intensive Orientation	Finishing School	Bridge course	Finishing School	Bridge course	Finishing School	Bridge course	Finishing School	Finishing School	Bridge course / Finishing School	Bridge course / Finishing School	Pedagogy training
Degree/ Certification		Certificate		Diploma		B.Sc. Degree		B.Tech.	B.Tech. Honors	M.Tech.	M.S. by Research	Ph.D.
Multiple Exit points		EXIT		EXIT		EXIT		EXIT	EXIT	EXIT	EXIT	EXIT

Fig -4: Programme Scheme in engineering

5. Methodology

The main idea in this paper revolves around developing method for efficient implementing NEP in education sector by using IOT and Blockchain. So here we will have different department which will have control in determining particular action in administration. This action can include various things like monitoring student progress online, keeping track of academic progress, relevant courses completed by student. So each department will be responsible for the verification of credentials of the student.

IOT devices can be used for storing the course information(eg. Course completed and the certificate details) and the Blockchain can be used along with it to secure the information of the students. With this kind of system the employers can verify the employee details like the education background and the course studied. Stakeholders have to approve in order to grant the access of data.51% consensus

mechanism enables the security of the data. After the approval from the stakeholders the data can be accessed for the verification of candidate information by the employers.

Traditional IOT system involves centralized data server which can sometimes crash due to technical glitches and server attacks by fraudsters. Since all the data is stored on a central server it can crash as it is easy target of attack. So avoiding this centralized system we can use IOT along with Blockchain to implement a distributed ledger system. Here the data is with all the stakeholder of the system and the stakeholders can provide their consent whether to accept or reject any system.
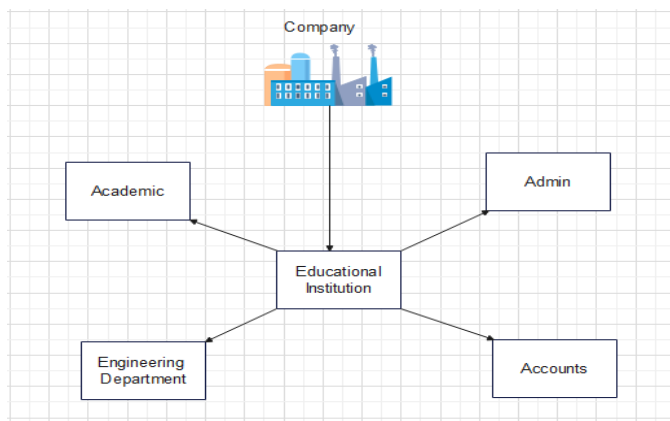

Fig -4: Proposed Idea

6. CONCLUSIONS

In conclusion, this review paper has examined the potential of integrating Internet of Things (IoT) and blockchain technologies as transformative tools in the realization of the National Education Policy's (NEP) objectives within the education sector. The synthesis of these technologies offers a compelling vision for an educational landscape characterized by enhanced security, transparency, and efficiency.

The exploration of blockchain applications in securing student data, streamlining credential verification, and fostering decentralized learning platforms underscores the technology's potential to address critical challenges in data management and authenticity. Concurrently, the incorporation of IoT devices in creating smart classrooms, automating attendance tracking, and facilitating real-time monitoring exemplifies how interconnected technologies can elevate the overall quality of the learning experience.

Moreover, the discussion on blockchain's role in securing examination processes, ensuring fair resource allocation, and the utilization of smart contracts for automating agreements emphasizes the potential for these technologies to bring about systemic changes in administrative and governance aspects of education.

However, it is essential to acknowledge that the successful implementation of IoT and blockchain in education is contingent on addressing challenges such as infrastructure requirements, data privacy concerns, and fostering collaborative efforts among stakeholders. These challenges necessitate a concerted commitment from educational institutions, government bodies, and technology providers to create an environment conducive to the seamless integration of these technologies.

As education stands on the precipice of transformation, the insights presented in this paper aim to guide educators, policymakers, and technologists toward harnessing the full potential of IoT and blockchain technologies. By aligning technological innovations with the objectives of the NEP, we can aspire to create an educational ecosystem that is not only adaptive to contemporary challenges but also paves the way for a future where learning is secure, transparent, and accessible to all. In essence, the fusion of IoT and blockchain technologies offers a promising trajectory for the evolution of education, marking a crucial step toward the realization of the NEP's vision.

7. Future Work:

While this review has provided valuable insights into the integration of Internet of Things (IoT) and blockchain technologies in the context of National Education Policy (NEP) implementation, several avenues for future research and development emerge. The following areas warrant further exploration and investigation:

1. Implementation Studies:

- Conducting in-depth implementation studies in diverse educational settings to understand the practical challenges, successes, and lessons learned. This could involve pilot programs or case studies to assess the scalability and adaptability of IoT and blockchain solutions.

2. Privacy-Preserving Mechanisms:

- Developing and exploring advanced privacy-preserving mechanisms within blockchain systems to address concerns related to data privacy. This includes investigating techniques such as zero-knowledge proofs or homomorphic encryption to ensure confidentiality while leveraging blockchain for educational data.

3. Interoperability Standards:

- Establishing interoperability standards for IoT devices and blockchain platforms within the education sector. This would facilitate seamless communication and data exchange among different educational institutions and systems, promoting a more cohesive and integrated ecosystem.

4. User Experience Studies:

   - Conducting user experience studies to evaluate the impact of IoT and blockchain technologies on various stakeholders, including students, educators, administrators, and employers. Understanding user perceptions and addressing usability concerns is crucial for widespread adoption.

5. Scalability Considerations:

   - Investigating and addressing scalability issues associated with both IoT and blockchain technologies. As educational ecosystems grow, it is essential to ensure that the proposed solutions can handle increased data volume, transaction throughput, and network demands.

6. Regulatory and Policy Frameworks:

   - Developing regulatory frameworks and policies that govern the use of IoT and blockchain in education. This includes addressing legal and ethical considerations, data ownership, and compliance with existing regulations to provide a clear and supportive environment for implementation.

By addressing these areas in future research endeavors, the education sector can continue to harness the potential of IoT and blockchain technologies, ensuring a sustainable, inclusive, and technologically advanced learning environment in alignment with the goals of the National Education Policy.

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