International Journal of Technology, Science and Engineering **ISSN: 2457-1016**

Vol. 6, Issue I, Jan-Mar 2023 http://www.bharatpublication.com/journal-detail.php?jID=25/IJTSE

Employability of Blockchain Deployment and Edge-Based Analytics in Enhancing Financial Transactions in Internet of Things(IoT) Systems

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ABSTRACT

The Internet of Things (IoT) is ushering in a new era of modernization, creating a world that is both undeniable and quantifiable. This transformative landscape empowers global citizens and businesses alike to manage their assets with unprecedented efficiency and sophistication. The evolving IoT ecosystem promises advancements in hardware, services, protocols, and software. Consequently, the future of IoT in India holds great promise, offering a robust platform for enhancing knowledge sharing, networking, and forward progress.

One significant paradigm within this evolution is edge-based analytics, a model projected to be fully implemented by 2020. This model dictates that 50% of IoT data will be processed, analysed, and acted upon at the network's edge—where it originates. This paper delves into the potential synergies between emerging blockchain technology and IoT edge devices, exploring how they can collaborate to unlock new monetization opportunities.

Furthermore, the paper explores the scope and benefits of edge-based analytics in shaping the future of IoT. By leveraging analytics at the edge of the network, businesses can gain real-time insights, improve decision-making processes, and enhance overall operational efficiency.

INTRODUCTION

By 2024, it is anticipated that there will be approximately 21 billion connected devices, significantly burdening network systems. The immense volume of data produced by these intelligent sensors and devices is predominantly processed in the cloud or data centers, which may not suffice in the long term. Thus, there is a pressing need for an alternative approach to manage this data influx, and that solution is edge computing.

In the edge computing model, sensors and connected devices communicate directly with a gateway device rather than relying on the cloud or a central server for processing data. This approach is better suited for handling and analyzing data generated by the Internet of Things (IoT) as it enables nearly instantaneous analysis. This capability is crucial for industrial applications that require prompt decision-making based on real-time data.

Moreover, edge computing offers economic benefits by reducing data management costs. By utilizing a gateway device, it bypasses the need for extensive cloud network infrastructure, resulting in less congested networks and lower operational expenses. Additionally, due to its standalone architecture, the network remains functional even if individual devices encounter issues, ensuring uninterrupted operation.

INTERNET OF THINGS

The Internet of Things (IoT) is ushering in a new era, characterized by measurability and quantifiability, enabling individuals and businesses to manage their assets with greater insight. Through IoT, numerous practical advancements are being realized, enhancing convenience, health, safety, energy efficiency, and comfort.

Moreover, IoT represents a significant avenue for wealth creation, with transformative impacts across various industries by fostering interconnectedness.

The IoT ecosystem encompasses hardware, services, software, and regulatory bodies, reflecting a comprehensive approach to implementation. With initiatives like the Government of India's "Digital India," "Make in India," and "Smart Cities" gaining momentum, IoT implementation is poised to drive sectors forward, facilitating the realization of these strategic objectives.

To maximize the potential of IoT, integration with blockchain technology at the edge devices is imperative. This integration ensures reliable and adaptable financial services for all transactions, contributing to increased productivity, efficiency, and customer satisfaction. By embracing blockchain, IoT platforms can enhance the scalability and integrity of revenue transactions, thus bolstering overall performance.

BLOCK CHAIN

A. The Concept of Blockchain

Blockchain, also known as distributed ledger technology, originated as a tracking database for Bitcoin transactions in 2009. Its purpose was to facilitate transactions without the need for central banks or intermediaries, using complex algorithms and consensus mechanisms to verify transactions. Blockchain is now recognized as a potentially disruptive force capable of revolutionizing the financial services industry, offering faster, cheaper, more secure, and transparent transactions. The blockchain network operates in a state of consensus, automatically verifying itself every ten minutes. This self-auditing ecosystem reconciles transactions in ten-minute intervals, with each set of transactions forming a "block." Two critical properties emerge from this: 1) Transparency, as data is embedded within the public network, and 2) Immunity to corruption, as altering any information unit on the blockchain would require substantial computing power to override the entire network.

B. How Blockchain Works

Step 1: Sender X initiates a transaction to send money to receiver Y.

Step 2: The first block representing the transaction is created online.

Step 3: The block is broadcast to all parties in the network.

Step 4: Network participants validate and approve the transaction.

Step 5: The validated block is added to the chain, creating a permanent, non-repudiable, and transparent record of the transaction.

Step 6: Receiver Y receives the money from Sender X.

C. The Convergence of IoT and Blockchain

Blockchain technology is seen as the missing link to address scalability, privacy, and reliability concerns in the Internet of Things (IoT). It can track billions of connected devices, facilitate transaction processing and coordination between devices, and offer significant cost savings for IoT manufacturers. This decentralized approach eliminates single points of failure, creating a more resilient device ecosystem. The cryptographic algorithms employed by blockchain enhance consumer data privacy. In 2018, IoT and blockchain will converge to enhance security and privacy, paving the way for new applications, hardware, and skill sets.

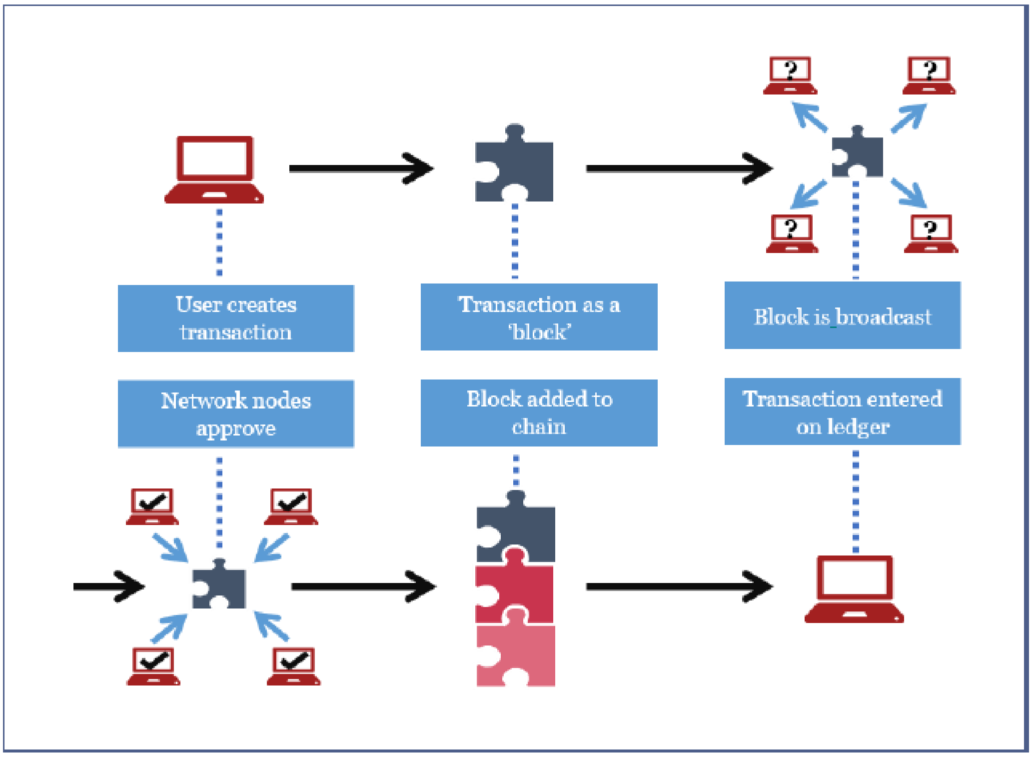

Figure 1. Block Chain Technology [7]

EDGE-BASED ANALYTICS

Utilizing an IoT approach in business offers numerous advantages, chiefly access to a wealth of data and enhanced insights. However, it also introduces new challenges. The sheer volume and speed of data collected when every device in the business process is online and communicating can strain even the most robust network infrastructure. In situations where timing is crucial, delays caused by bandwidth congestion or inefficient data routing can lead to significant issues.

To address these challenges, the concept of "edge analytics" is gaining traction. Also known as distributed analytics, it involves designing systems where analytics are performed at the point where data is collected. This is often where actionable insights are most urgently needed. Unlike centralized systems where all data is sent back to a data warehouse in a raw state for cleaning and analysis, edge analytics allows for data processing to occur at the edge of the system.

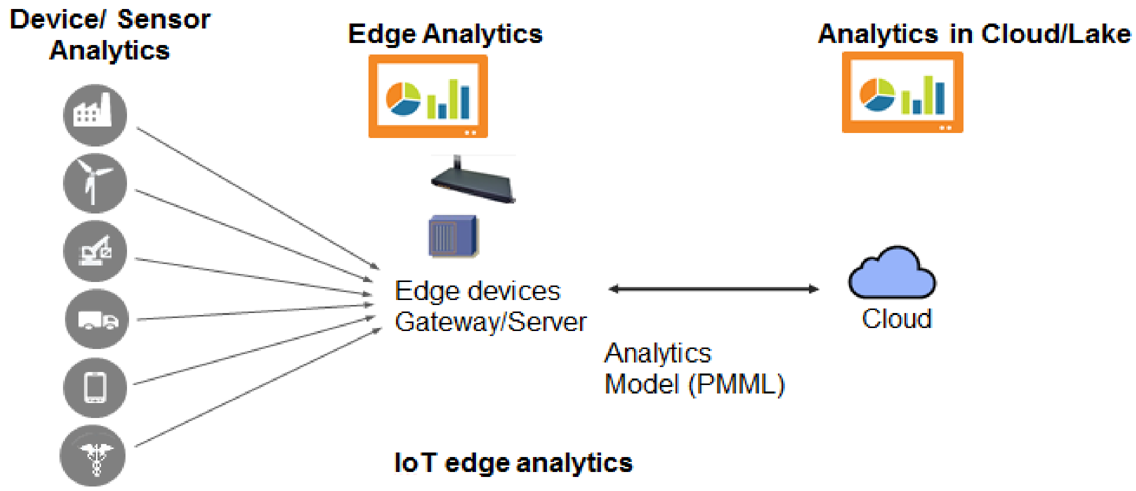

Figure 2. IoT edge Analytics [1]

For instance, consider a massive-scale CCTV security system. With thousands of cameras covering vast areas, hours of footage may be captured for every second of useful video. Much of this footage is likely irrelevant. Streaming such vast amounts of data in real-time across the network incurs significant costs and compliance burdens. Edge-based analytics addresses this by analysing footage within the cameras as it's captured. Useless footage can be discarded or marked as low priority, freeing up centralized resources to focus on valuable data.

Major companies like Cisco and Intel have embraced edge computing early on, positioning their gateways as edge devices. These gateways, traditionally responsible for traffic aggregation and routing, now also store and process data. Edge analytics enables preprocessing or filtering of data closer to its source. Normal data can be ignored or stored cost-effectively, while abnormal readings are sent for further analysis.

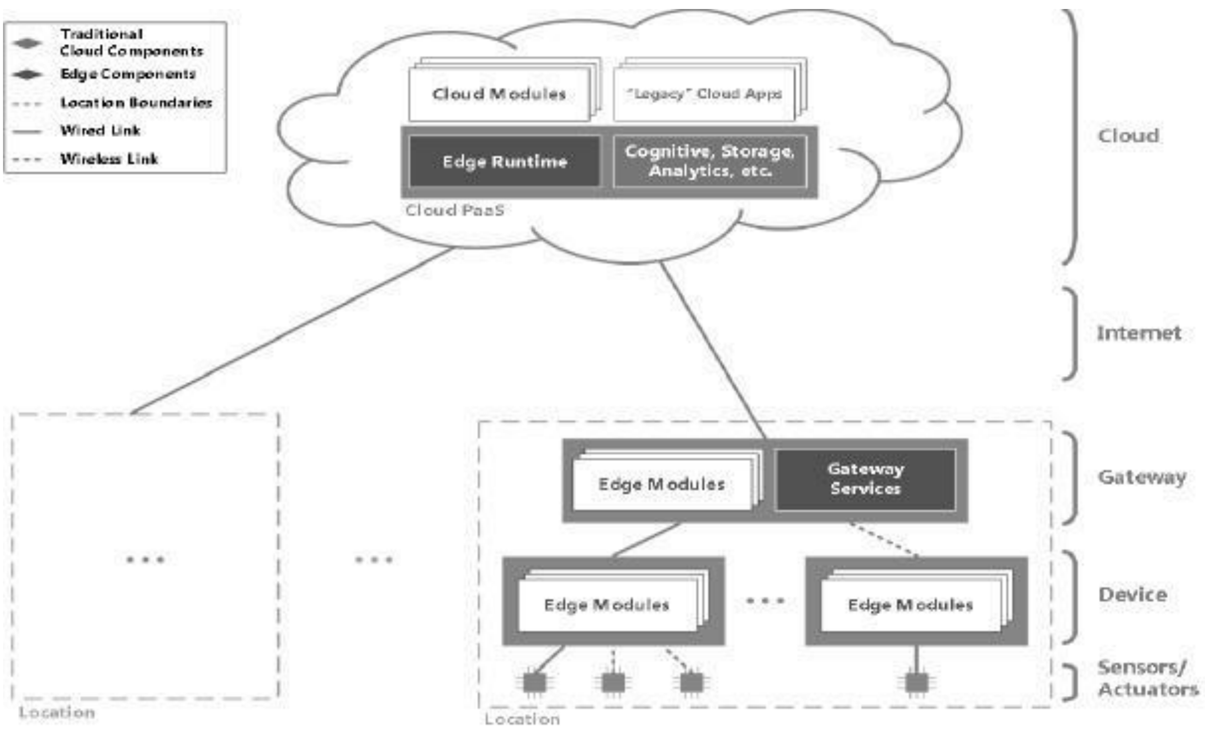

Figure 3. Edge Computing [6]

A. Factors for Using Edge Computing:

1) Privacy Preservation: IoT devices capture sensitive data, such as GPS coordinates or camera streams. Edge computing ensures sensitive data is pre-processed on-site, with only privacy-compliant data sent to the cloud for analysis.

2) Latency Reduction: Edge computing reduces network delays by implementing machine-learning algorithms directly on IoT devices, interacting with the cloud only when necessary.

3) Robustness in Connectivity: Applications running computations on the edge ensure continuity, even in areas with poor network coverage or limited connectivity, thereby reducing costs associated with expensive connectivity technologies.

CONCLUSION

The exponential growth of IoT-generated data necessitates smarter IoT edge devices. Edge-based analytics plays a crucial role in ensuring the success of IoT by enhancing computation, storage, and networking capabilities.

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