

BLOCKCHAIN AND INTERNET OF THINGS OPTIMIZATION FOR SUSTAINABLE DEVELOPMENT OF HOSPITALITY INDUSTRY

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ABSTRACT

The internet of things and Blockchain technology are revolutionizing the hospitality industry and enabling better services for future customer. Blockchain technology, which is more scalable with the internet of things to give a better understanding for the hospitality business, makes it possible to create the safest most transparent, and most reliable environment. It provides the advanced optimization, success rate with modernization secure channel for service payment, supply chain management, loyalty, quality of services to the hospitality industry. In this research, the maximum success rate of optimization of Blockchain and internet of things is examining and finding the future requirements to improve the customer loyalty and customer satisfaction. This is focused in the use of the Blockchain and internet of things to improve the customer trust, loyalty and satisfaction using customer satisfaction parameters for sustainable future development.



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1. INTRODUCTION

According to a global Blockchain assessment, the success rate for sustainable development is expected to rise by 80% by 2030. Blockchain technology and the internet of things play a big part in the hospitality sector for sustainable growth and for providing more client-focused services that raise consumer satisfaction. As part of the sustainable goals agenda, waste reduction, cost reduction, poverty alleviation, and scalable industry development toward consumer pleasure are all priorities for future advancements. The degree of customer

satisfaction is closely linked to sustainable development and amenities like food quality, location, transportation, and other associated services. The Indian economy and GDP (gross domestic product) will be significantly impacted by the 6% growth in customer needs by 2030–2050. Blockchain and the Internet of Things can make the hospitality sector safer, more efficient, and more forward-thinking for improved customer service, which is reflected in the degree of customer happiness. The Blockchain is the cornerstone of the future development of digital hotels, as shown in figure. This is discussed in the figure 1 that how Blockchain is playing the

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significant role to achieve the customer satisfaction level through using the digital things and administrator also getting the digital role of the technology by using Blockchain services (Dogru et al., 2018). Through this figure this is understood that future customer is using he smartphones, devise, multimedia devices, Internet of things based devices with internet connectivity that is making much easier to connect the services and taking the advantages of the Blockchain services to get the

transparency and accuracy with secure mechanism in the form the check-in check-out process and bill payment (Tariq Hasan et al., n.d.). Through Blockchain services that is clear that a customer can get the feedback of the previous customer for particular hotel and can provide the better feedback for the future customer that is the base of the future customer satisfaction level (Flecha-Barrio et al., 2020).

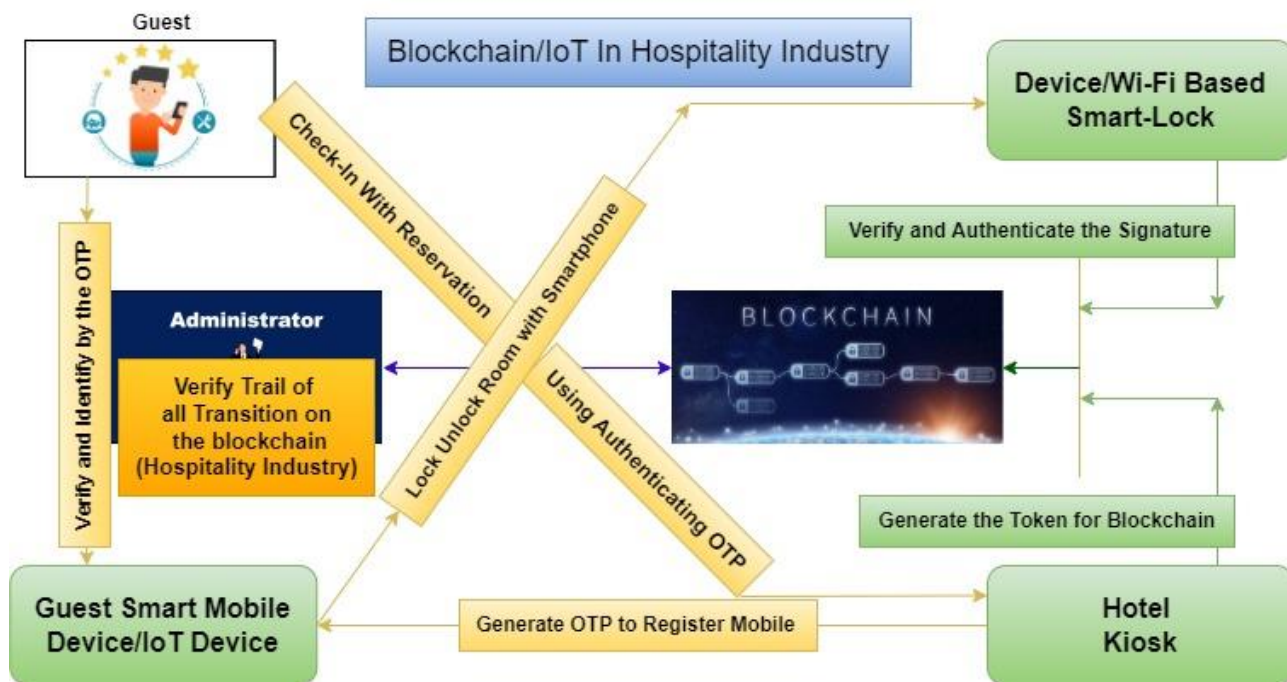


Figure 1. Blockchain/IoT in Hospitality Industry

Moreover, Hospitality industry is one of the larger industry among the service sector in India and world. World is focusing in the sustainable development of hospitality industry because the size of the hospitality industry is more than 23 billion in the year 2029. This is the faster at 16% more than another service sector in India is impact of 2% of the Indian GDP (Narayan et al., 2022). In addition the customer satisfaction level play the significant role to increase the population in this field. So that is need to use the enabling technology so that Blockchain and internet of things has the significant role for sustainable development and to increase the customer satisfaction level. Furthermore, we are exploring the detailed contribution of the Blockchain and Internet of things in the sustainable development of the hospitality industry (U. Sharma & Gupta, 2021).

The main contribution in this paper is:

- We are presenting to enhance the significance factor of the Blockchain and internet of things in the sustainable development to make the transparent and secure to the hospitality industry.

- We are proposing the futuristic scenario of the technological combination to make the sustainable development.
- We are also providing the secure analysis to increase the customer satisfaction level to improve the hospitality industry and more sustainable.

2. LITERATURE REVIEW

In this section, we are describing and examining the hospitality industry with Blockchain and internet of things with customer satisfaction level using enabling technologies. In orders to follow that the process including the data collection form authenticated source such as Scopus index and after collection it is evaluated along with the technology used in this scenario of research (Iranmanesh et al., 2022). Furthermore, scientometric analysis will be done for the findings and research gap to evaluate the technology in the field of hospitality industry. Blockchain covers various technology and field such as financial field, security system, Internet of things to provide the security and scalability (Bodkhe et al., 2019).

In addition, furthermore the scientometric analysis is completed after collected the paper form the reputed database. The process of the scientometric analysis is as: in the first phase we have collected the paper from the database and segregated in reputed journal paper and

conferences (Cai et al., 2024). Journal paper has been reviewed and analysis done for scientometric analysis. Statistical package for social science (SPSS) has been used to complete the process that we can see in the figure 2(a) and 2(b).

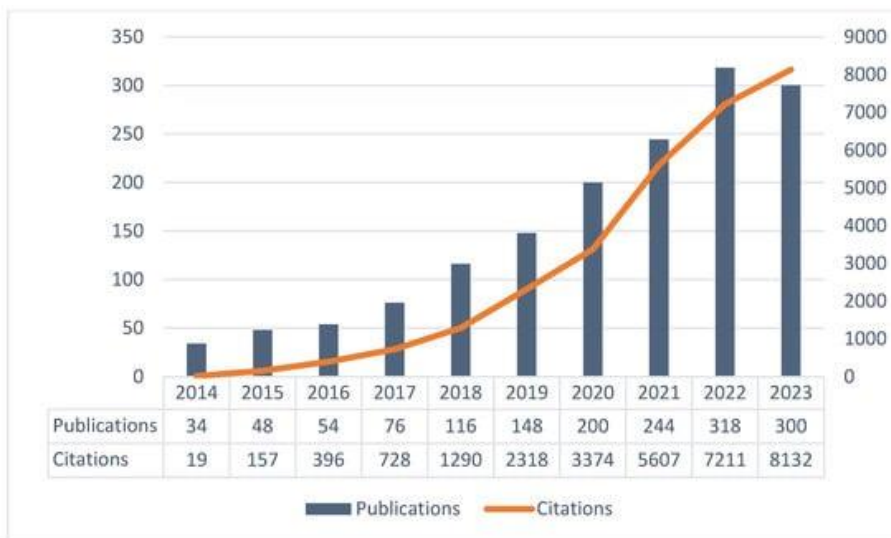


Figure 2(a). Scientometric analysis and Citation Level of the past related papers

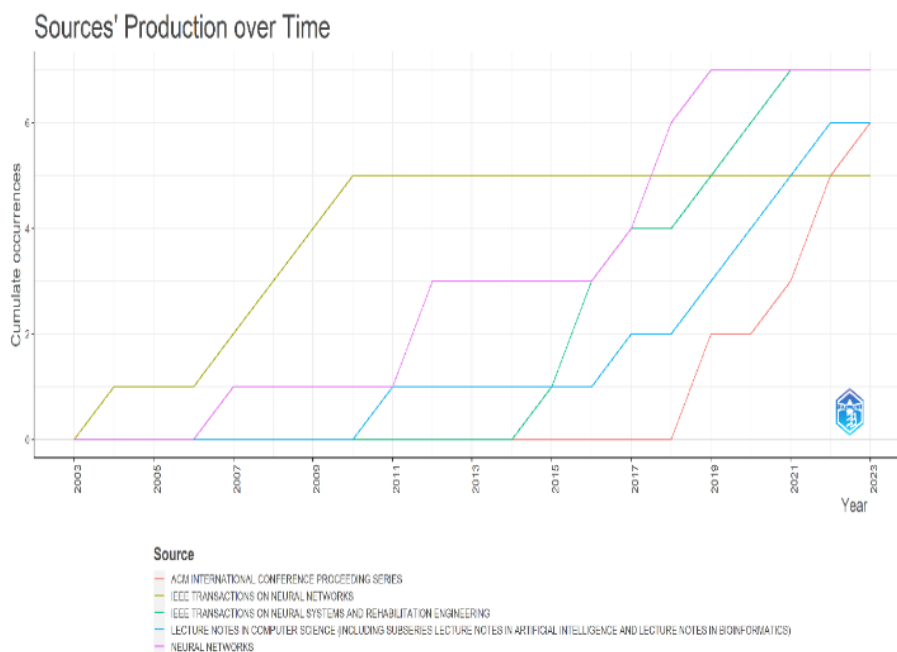


Figure 2(b). Scientometric analysis and graph of publication in past years

Technology Blockchain and Internet of things has been widely used for the development of the hospitality industry (Zhou et al., 2021). It provide the bridge milestone to digitalize this industry for the customer and for the hotel admins also. In the scientometric analysis chart we can see that in last 20 year technology is providing the main role to enhance the facility and transparency for the customer and business. Majorly in and after 2010 most of the technology is used in the sustainable development of the hospitality industry but

Blockchain and internet of things has provided the new intervention and spring-up the technology the facilities, security and transparency for the hospitality industry (Adel et al., 2023). Customer satisfaction is fully depends on the facility, security, easy access and rewards that is possible through technology involving in the hospitality industry. In addition, however, certain more intricate changes must be made before the newly coded transaction may be entered into the ledger. According to technology, Blockchain in the Hospitality and Tourism Industry, the entire ledger must

adhere to specific guidelines for the secret code, often known as the "hash code" or "hash value" (Firdaus et al., 2019). This change adds a series of numbers or letters, referred to as a "nonce," to the code, requiring a computer to perform intricate computations.

This operation is outsourced to "miners," or those outside the peer-to-peer network with sufficient computer power to do the task, due to its time commitment and high IT skill requirements (Ntefua Saah & Choi, 2023). Basically a customer is the backbone to create new footprint for any business for future customer. Customer satisfaction is most important because a customer is a leader to grow the business and to evaluate the new ideas for the satisfaction level towered the business (Mohajerani & Miremadi, 2012). Understanding the connection between visitor expectations and experience is essential to fulfillment. Examine your target audience's demographics and values. For instance, families anticipate amiable and individualized service, whereas business travelers anticipate speed and efficiency (Kandampully & Suhartanto, 2003).

The degree to which hotel guests are satisfied with the facilities and services offered by the establishment is known as guest or customer satisfaction. It serves as a gauge for how well the experience fulfilled the expectations of the clients. For instance, basic guest needs and expectations should be met by a friendly greeting, quick check-in, and a tidy room (Kandampully & Suhartanto, 2000). Since it's preferable to under promise and over deliver once a guest arrives, make sure your expectations are reasonable.

To manage expectations and acquaint guests with your property, think about sending pre-arrival messages or emails. Next, determine how your hotel personnel can surpass your clients' expectations in order to surprise and pleasure them (Srinivas Rao & Charan Sahu Professor, n.d.). Provide free upgrades to unoccupied rooms or leave personalized touches in their stay, like a heartfelt welcome card or gift box. Guest satisfaction can be achieve through the technology uses in the services (S. Sharma & Srivastava, 2018). Digitalization the new revolutionized model for the future in the hospitality industry because customer is much aware about it and using the technology to save the time and cost.



Figure 3. Customer satisfaction Parameters

Customer satisfaction can be major through the customer satisfaction parameters. In figure 3 there is customer satisfaction parameters are shown. Their customer satisfaction parameters is the basic and important parameters for all the customers (Ramnarayan et al., 2024). Many more satisfaction parameters may be there

such as exercise facilities, guide facilities, currency exchange facilities, international language converter facilities and many more according to the level of the hospitality industry (Su et al., 2017). Using these parameters we can get the better customer satisfaction levels using technologies in this particular era.



Figure 4. Customer Satisfaction level along with the satisfaction parameters

In figure 4 shows the customer satisfaction graphs in terms of the customer satisfaction levels that shows in figure 3. The above graph is created based on the existing customer and the customer satisfaction parameters. Technological impact we can see in the customer satisfaction level is changed when any of the hospitality industry is changing the level of the technology used for the customer (Kumar et al., 2023). In order to better comprehend the positive and negative attitudes of hotel guests, a text analysis of customer reviews was also conducted. We concentrated on determining the characteristics that set one hotel apart from another, and then we used these insights to advise hotel management on how to enhance operations, increase visitor pleasure, and overall set themselves apart from the competition. Five hotels' customer reviews and ratings were analyzed and compared using data from the Trip Advisor website. Techniques for statistical data analysis were employed to

Determine the most crucial characteristics that should be prioritized when selecting hotels in order to guarantee that the expectations of guests are fulfilled (Li et al., 2013). The study's main findings, which were based on text analytics, showed that travelers seek out nice rooms, hotels with pools, and excellent service. Hotels are getting maximum rating from the customer and providing the better customer satisfaction level to the customer. This can be more satisfactory when we used the latest technology such as Blockchain and internet of things and other enabling technology to serve the customer (Assaf & Magnini, 2012). In the table 1, there is the findings and the research gap based on the literature review and analysis. This research gap and finding will lead to improve the integration of the Blockchain and IoT in the hospitality industry.

Table 1. Table representation for research gap and finding

SN.	Reference Paper Conclusion	Research gap/Findings
1	Basic IoT, Blockchain is used to facilitate the hospitality sector for improvement	IoT and Blockchain for security, transparency.
2	Emerging technology and intervention for security	Advanced Technology for customer
3	Blockchain and Internet of things to facilitate the customer	Service quality and control for customer satisfaction
4	IoT, Blockchain, economy factor to improve the hotel business	Apply secure services for the customer using dedicated device
5	Technology, Blockchain and IoT for customer service	Moreover, block of things is required in future
6	Advance technology, future and economy using technology in hotel industry	Scalability is required using Blockchain and IoT
7	Customer satisfaction, IoT, Blockchain for industry	Need of the dedicated device for personalization of the customer need using IoT and Blockchain
8	Customer satisfaction and hotel industry using Blockchain and IoT	IoT and Blockchain enabling device for the customer uses and to improve the customer satisfaction levels.

In this table the research gap and findings indicates that there is more scope to add the Blockchain and internet of things in the hospitality (Luo et al., 2021). We shall get deeper into how Blockchain and IoT are not just influencing but also completely changing the hotel booking process as we read this article (Parra-Sánchez, 2024). We'll examine how these technologies work together, as well as real-world case studies and their useful applications, giving you practical advice on how to remain ahead in this quickly changing environment. It's time to participate in this revolutionary story that is rewriting the future of hotel reservations (Siccardi & Villa, 2022). Customer satisfaction will be increased through the technology used because in this computing era and in future maximum percentage of the customer is using the smart and IoT enable device who want the secure platform for all the related activity such as booking process, option check, past feedback of the hotel and future rating of the hospitality industry (Ottenbacher et al., 2006).

3. BLOCKCHAIN TECHNOLOGY IN HOSPITALITY INDUSTRY

Despite its reputation for being impenetrable, the fundamental idea behind Blockchain is fairly simple, and it has the potential to drastically alter industries from the ground up. Blockchain is one of the most significant technological stories of the past ten years, but beneath the surface commotion, there isn't always a deep, clear understanding of what Blockchain is, how it works, or what it's for (Saraf et al., 2024). It covers the network in distributed form to serve more and more technological era. Blockchain makes it possible to store information and interactions in a transparent, enduring, and unchangeable manner. Therefore, anything that has worth, whether it be a concrete object or something more intangible, can be traded.

Data and transactions can be permanently, irrevocably, and transparently recorded thanks to Blockchain

technology. This, in turn, enables the exchange of anything valuable, be it that which is tangible or more immaterial (Rana et al., 2022). In the hospitality industry there is many option to integrate with internet of things and Blockchain to provide the secure mechanism. Hospitality industry has the online transactions and other many option so there is requirement to add the secure mechanism in it. In addition, Data and transaction

recording is an essential aspect of business (Erceg et al., 2020). This information is frequently handled internally or by a third party, such as brokers, bankers, or attorneys, which adds time, expense, or both to the company's operations. Thankfully, Blockchain circumvents this drawn-out procedure and speeds up the transaction, saving time and money. Contrary to what most people believe, Blockchain and Bitcoin are not interchangeable.

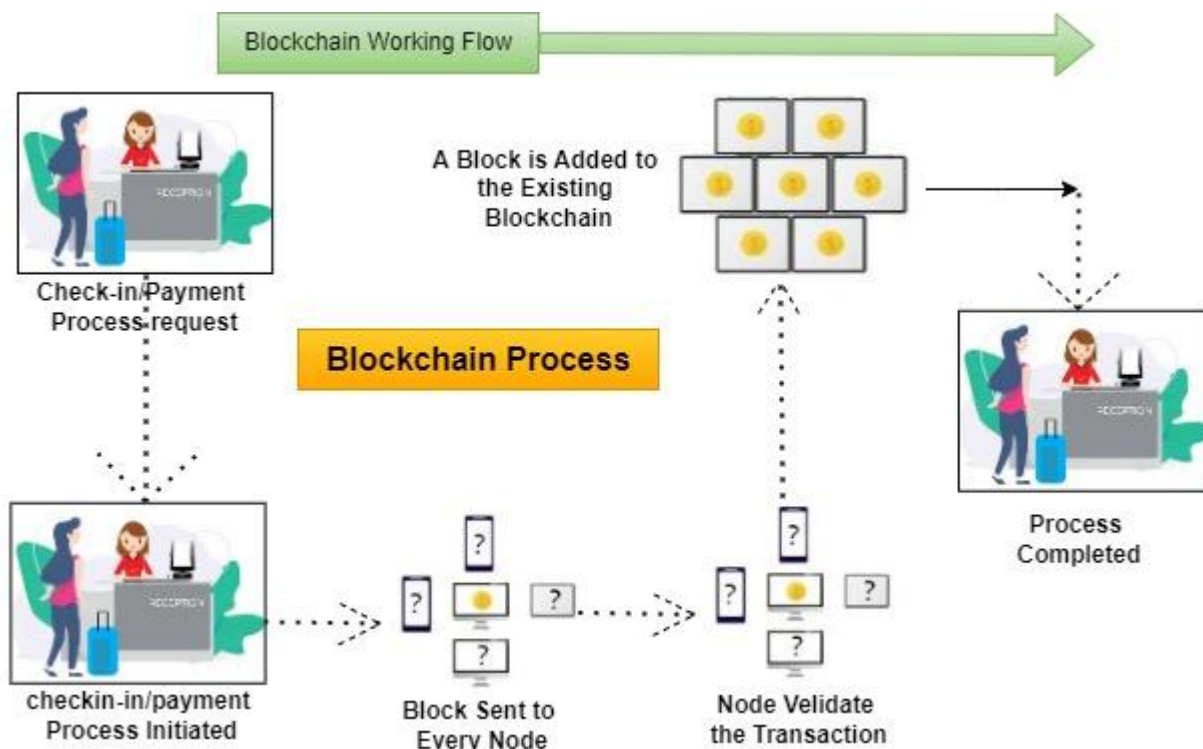


Figure 5. Blockchain Process/working for hospitality industry

Although Blockchain technology may enable a wide range of applications across different industries, including manufacturing, supply chain management, finance, and more, Bitcoin is a currency that depends on Blockchain technology for security (Önder & Gunter, 2022). Real-time guest information can be obtained by hotels through the use of Blockchain technology, which will increase operational efficiency. A Blockchain-enabled payment and check-in procedure, for instance, will speed up the check-in process for visitors and raise customer satisfaction (Tepe & Ajjee, n.d.). In order to enhance their services and boost customer happiness, hotels can also monitor the movements of their visitors as we can see the flow in the figure 5.

Hotel operators can get Blockchain training and set up a platform where visitors can exchange data in order to employ Blockchain technology for hotel operations. In this figure 5 the process of the check-in and payment has been initiated at the first level then through Blockchain technology the request block id added to the existing block for payment and check-in. after add in process of the clock the process is completed (Khanna et al., 2020). This is smooth secure and transparent process enhancing facilities by the Blockchain process in the hospitality industry.

4. INTERNET OF THING (IOT) IN HOSPITALITY INDUSTRY

The term "Internet of things" refers to the combination of hardware and physical devices, including sensors, input devices, cameras, actuators, and other output devices. Depending on the topic, it consists of several gadgets that you can use to process data or signals between devices or via the internet (Gajić et al., 2024). In the hospitality industry internet of things consist the multiple devices for customer feedback collection and analysis using different devices to achieve the customer satisfaction level using technologies towards the interest and basic need of the hotel customer (Pelet et al., 2021). Internet of things help to customer in multiple ways in shopping, gaming, booking and other facilities to track the customer journey and simplify the automation for hospitality industry. The linked devices through the network and used to transmit the data among the nodes and on the internet, intent of things play the significant role for the customer. The basic concept of the IoT in the hospitality industry used to automate the facilities such as booking, check-in, check-out and other customized services by the customer that is useful parameters to achieve the customer satisfaction level (Raman et al., 2023). A network of

linked devices enables hotels to automate every part of their services as the Internet of Things (IoT) in the hospitality industry develops and expands. By enabling

an integrated, personalized, and customized journey with your hotel brand, the internet of things unlocks the secret to generating exceptional guest experiences.

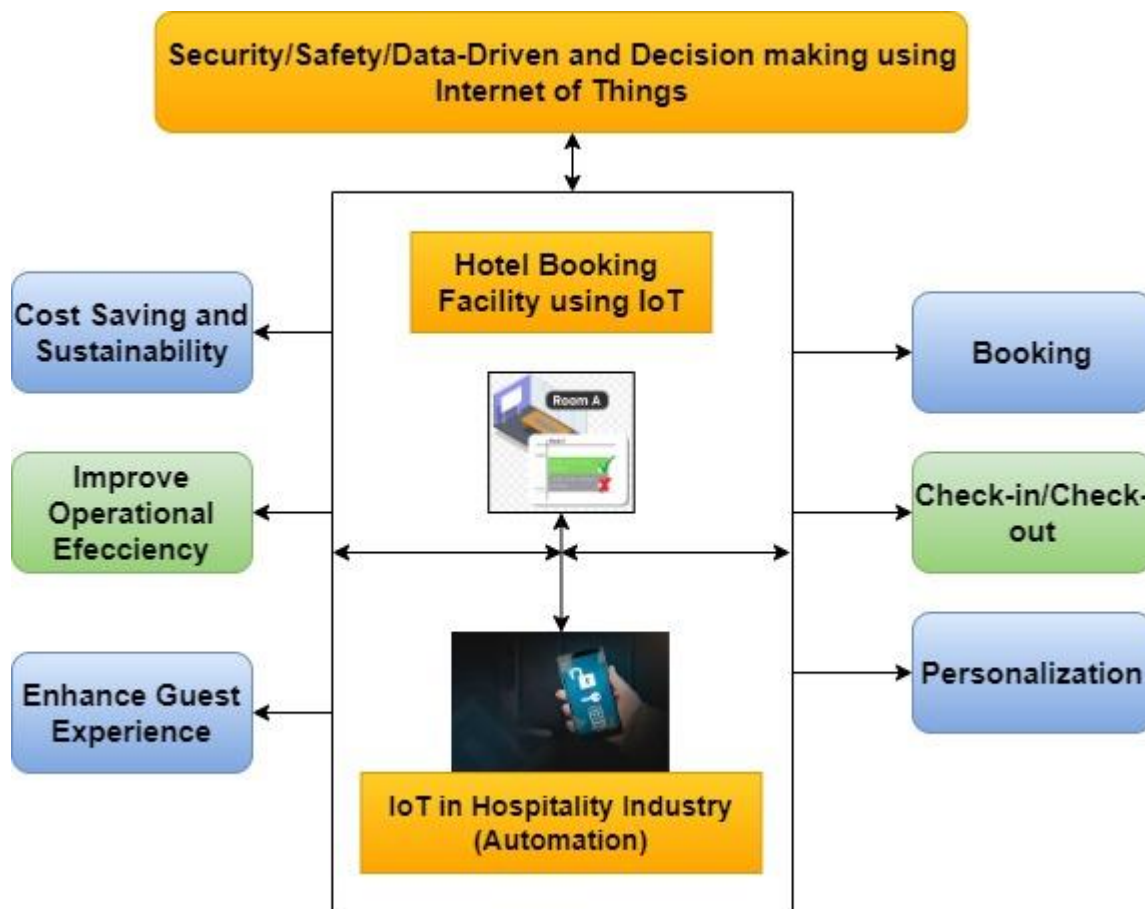


Figure 6. Internet of things and facilities in Hospitality industry

In the figure 6 there is the representation how IoT is playing the significant role in the hospitality industry. Using Internet of things there is automation is possible to facilitate to the customer in hotel booking and all other facilities such as decision making based on the provided options (Verma et al., 2024). Personalization such as amenities, services, gym facility, transportation, internet, laptop, and yoga, kid’s entertainment facilities and other facilities such as shopping. In the present world, technology has the advantage, and remaining relevant in the hotel industry involves staying ahead of the curve (Naveed et al., 2024). Today’s visitors need a smooth, creative, and progressive experience rather than merely comfort. Enhancing operational efficiency and redefining brand perception are two important aspects of IoT integration in the hospitality industry (Nadkarni et al., 2019). These all the services is possible through the internet of things with minimum cost and time.

These all the facilities makes the better guest experience and help to develop the sustainable environment for the future customer. It also improve the operational efficiency with quality and services. The growth of the customer influence the market size for the future and economy of the country growth for sustainable

development (Infante-Moro et al., 2021). Overall hospitality in the biggest industry of the world where every year customer and passenger is increasing and technologies and facilities are the first need of the customer.

Using the latest technology and after best experience always increase the customer satisfaction level. When customer safety is a concern, this system is quite helpful. Real-time data facilitates efficient staff allocation and can pinpoint the precise location of assistance in an emergency(Car et al., 2019). Visitors take note of this proactive strategy. They see a well-run company that cares about their comfort and safety and makes adjustments as needed. This strengthens the IoT’s solid, contemporary reputation in the hospitality sector.

5. CONSCIOUS MECHANISM USING BLOCKCHAIN AND IOT

The automation of the hospitality sector for long-term and sustainable growth is based on Blockchain and internet of things technology. These technologies work together to make the automation to provide the accuracy,

transparency, security and sustainability in hospitality development and services. The Internet of Things has already been used by many companies in the hospitality sector because it provides a number of important advantages that are particularly pertinent to lodging establishments (Suanpang et al., 2024).

These advantages include improving consumer satisfaction and enabling businesses to reduce their energy expenses. Regarding the latter, hotel managers can use IoT technology to improve the conditions in their establishment, give visitors a more customized experience, and cut down on wait times. In terms of operations, automation and real-time data can assist businesses in seeing issues early on and even averting some issues altogether. Blockchain used in this system to facilitate the system for security. For this Conscious mechanism we have design and developed the hardware device that use the IoT and Blockchain for the customer feedback process and make customer enable to use the technology help to improve the customer satisfaction level (Nasr et al., 2018).

5.1.1. IoT Enable Device Development

The IoT device we have designed using Nanojetson board as the central device connected with the peripheral device display device, camera, keyboard, mouse, speaker and power supply. Based on the literature review we have designed the customer satisfaction parameters. Our customer satisfaction parameters are; Location and accessibility; Fooding and lodging; Room Services and amenities; Cleanness and facilities and Staff and management cooperation (Erdem & Barakazi, 2023).

These all the customer satisfaction parameters are basically based on the literature survey and scientometric analysis. Scientometric analysis process used to analyze the research citation and statistical analysis of the published paper on particular domain and citation matrix. The developed system basically used for the customer feedback process and analysis to predict the hotel rating and recommendation system to satisfy the customer need to improve the customer satisfaction levels (Di Battista & Valentini, 2007).



Figure 7. IoT enabler hardware device composition and implementation

This is to shown in the figure 7, there is the composition of the hardware to process the customer satisfaction based on the customer feedback analysis (Naveed et al., 2024). This hardware basically used to handle all the activity related to the hospitality industry such as booking, cancellation and other personalization services. The novelty of this hardware is to be secured and transparent because this is the hardcore coded device and it can be deployed on the hotel or another place through which any customer can perform the hospitality related activities.

Hypothesis

The factor of the hypothesis is include the relation and dependency of the customer satisfaction based on the customer satisfaction parameters. H0 hypothesis: There is significant impact of the parameters

“Location and accessibility, Fooding and lodging, Room service and amenities, Cleanness and facilities, Staff and management cooperation” on rating of the hospitality industry. H1 Hypothesis: There is no significant impact of the parameters “Location and accessibility, Fooding and lodging, Room service and amenities, Cleanness and facilities, Staff and management cooperation” on rating of the hospitality industry. So we have included the hypothesis because the customer choice can be majorly influence to the customer satisfaction parameters and it can make new future comments for the future development. The above IoT enabled hardware for the customer can be deploy on anywhere and is directly connected with the cloud server for further data processing.

5.1.2. Blockchain Integration with IoT for Conscious mechanism

The Developed IoT enable hardware integrate with the Blockchain mechanism to achieve the technology enhancement and intervention for customer to make the customer aware with the future technology for more security and accuracy. Blockchain offers hotels a great chance to improve service and personalize the guest experience. This technology makes it easier for hotels to obtain data and use it to enhance the guest experience in a sector that aims to be more customer-centric (Filimonau & Naumova, 2020). Hotels are able to customize the visitor experience because every encounter is recorded in real time. More security, simpler payment transactions,

easier access to data, process simplification, and less dependence on outside parties are all made possible by it. Let's examine this technology's advantages and applications in the hotel sector in more detail. In addition to its current applications, Blockchain technology has the potential to completely transform the hospitality and travel sectors in a number of ways. The field of loyalty programs is one possible application case Pantelidis, 2012). It is currently challenging for customers to redeem their points because loyalty programs are dispersed among several hotel chains, airlines, and travel agents. Blockchain technology has the potential to establish a single, transparent, safe, and platform-neutral loyalty program.

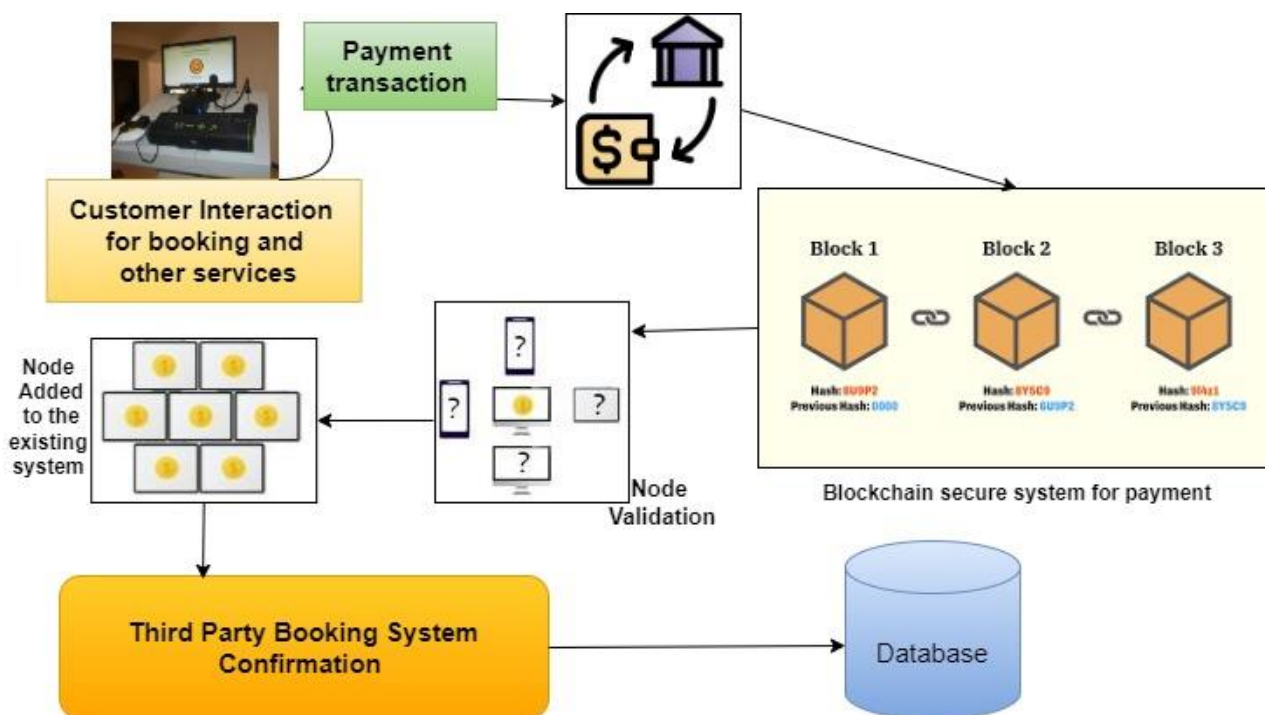


Figure 8. Conscious mechanism of Balockchain and IoT for Hospitality industry

In the figure 8, it is shows that the input method from the customer is completing using the developed hardware device consisting the IoT enable device. This system talking the input from the customer that is highly technology enabling device to provide the better service to the customer for providing the customer satisfaction based on the service value (Tyan et al., 2021). When a customer is booking a hotel or demanding something personalized things through the customer and making the payment through the gateway, it is using the Blockchain to serve the facilities to the customer secure payment. It provide the decentralized network service to the customer to provide the security and integrity of the service network. Many more benefits of the Blockchain with IoT in hospitality industry.

For individuals working in hospitality management, Blockchain technology offers a number of benefits, the most evident of which are security and stability. All data,

for example, is traceable and decentralized. When handling financial transactions, it can be crucial that the database never goes offline or is erased by a cyberattack. Travel agencies and clients can transact directly with

Blockchain hotel management software, facilitating real-time transactions free of intermediary fees (Erol et al., 2022). It streamlines hotel administration procedures and assists hoteliers and hospitality businesses in managing room availability and rates in real-time. Hoteliers throughout the world may now rent their properties globally, collect payments, and handle reservations with the help of Techno heaven's Blockchain Hotel Booking Technology. By cutting out the middleman, this Blockchain-based hotel booking technology lets hoteliers avoid the needless costs associated with using middlemen (Singhal, 2017). For hotel proprietors, Techno heaven has recently created a Blockchain-based hotel distribution system. With the use of Blockchain

hotel booking, we are now able to link travelers and travel suppliers directly, with the goal of making travel more affordable for consumers and profitable for suppliers. Since small and large businesses are placed in the same field, Blockchain hotel booking technology also makes it possible for all businesses to compete (Gangwar & Reddy, 2023).

Many more benefits of the Blockchain in the field of hospitality industry:

Secure: The hotel sector is increasingly exposed to security risks as a result of the abundance of data that is easily accessible. All data is traceable and decentralized thanks to Blockchain technology. Data cannot be deleted or taken down, even in the event of a cyberattack. The reputation of your hotel depends on your ability to protect guest data.

Transparent policy: Blockchain is helping the hotel sector become more transparent and trustworthy. The visibility and verifiability of transactions increase stakeholder trust. Better interactions and experiences are fostered as guests grow more confident in the integrity of services.

Loyalty for customer: Blockchain improves hotel loyalty programs. It provides a safe framework for managing loyalty points that guards against fraud and guarantees correctness. This increases client loyalty and involvement, which raises total visitor satisfaction.

Advanced Supply chain system: Blockchain technology guarantees transparent supply chain management in the hotel sector. You can see where the goods come from, which guarantees its quality and authenticity. Blockchain makes it simple to trace products, which lowers the risk of fraud and increases stakeholder trust. Using Blockchain ensures supply chain transparency by providing real-time product data access. By reducing mistakes and delays, it makes inventory management more precise and effective. This openness guarantees that visitors receive genuine, superior goods and services.

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6. DISCUSSION

The larger field of work for company and revenue generation is the hospitality industry. The addition of cutting-edge technologies like cloud computing, Blockchain, the internet of things, machine learning, and others aids in expanding and improving the facilities available to the public. The internet of things and Blockchain technology were utilized in this study to support the hospitality sector's consumer feedback system. The foundation of the hospitality sector is the client and their level of satisfaction. Blockchain technology improves the ability to connect resources, internal components, future facilities, and other components, while Internet of Things technology essentially offers appropriate and customized services to any domain. Businesses in the hospitality industry can benefit greatly from the integration of Blockchain and IoT. These technologies enable businesses increase operational efficiency, secure data, and preserve transparency by optimizing processes, enhancing customer experience, and guaranteeing data security. They are able to effectively compete in the contemporary corporate climate as a result.

7. CONCLUSION

Blockchain and Internet of things are the backbone of the technology intervention in the future computing era to serve the hospitality industry and gaining the customer trust. There are numerous advantages and applications for Blockchain in the hotel industry. Blockchain technology lets hotels get away from middlemen and third parties in the dynamic hospitality sector. Ensuring higher levels of security for hotel guests is essential in a digital age where data is the new currency. It can improve performance and provide your hotel with a competitive edge. To increase the customer trust there is need to improve the technology intervention in the hospitality industry so that customer can get the more satisfaction level. Because of this, Blockchain technology and hospitality software that can safeguard guests and enable hotels to become self-sufficient will only become more significant. In addition, moreover customer need security, personalization, transparent, time saving and low cost service from the industry that is possible through the technology integration using Blockchain and Internet of things in the future to maintain the sustainability.

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