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APPLICATION OF SLIDING WINDOW BLOCKCHAIN ARCHITECTURE FOR INTERNET OF THINGS

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ABSTRACT: [l1]

The Internet of Things (IoT) has emerged as a transformative paradigm, connecting a vast array of devices and sensors to enhance efficiency, automation, and real-time data processing. However, the rapid growth of IoT introduces various security and scalability challenges that need innovative solutions. Blockchain technology has shown promise in addressing these challenges, offering decentralized and tamper-resistant data storage and communication. This paper proposes the application of a Sliding Window Blockchain Architecture (SWBA) tailored specifically for IoT environments.

The proposed SWBA combines the benefits of blockchain technology with the concept of sliding windows to create an efficient and scalable solution for handling the massive data generated by IoT devices. The sliding window mechanism enables the blockchain to focus on the most recent and relevant data, preventing the unnecessary accumulation of historical data. This not only enhances the scalability of the blockchain but also ensures timely and efficient processing of transactions.

The proposed SWBA for IoT presents a novel approach to address the scalability and efficiency challenges associated with integrating blockchain technology into IoT ecosystems. Through a combination of sliding window techniques and blockchain principles, this architecture aims to provide a robust and scalable solution, fostering the widespread adoption of secure and efficient IoT systems. Future research and development in this direction could lead to the realization of a more connected, secure, and resilient Internet of Things.

1. INTRODUCTION: [l3],[l7]

The Internet of Things (IoT) has emerged as a transformative force, connecting a myriad of devices to create a seamlessly integrated and intelligent network. This interconnected landscape, however, brings forth a plethora of challenges, ranging from data security to scalability, that necessitate innovative solutions. Blockchain technology has gained prominence for its decentralized and secure nature, offering a potential remedy to these challenges. This paper introduces the concept of Sliding Window Blockchain Architecture (SWBA) as a tailored approach to address the unique requirements of the Internet of Things.

Background: As IoT devices continue to proliferate across various domains, the sheer volume and velocity of data generated pose significant hurdles for existing data management systems. Traditional blockchain architectures, while robust, face scalability issues when applied to the dynamic and high-throughput nature of IoT transactions. SWBA seeks to bridge this gap by combining the principles of blockchain with a sliding window mechanism, creating a framework that adapts to the evolving demands of the IoT ecosystem.

Rationale for SWBA: SWBA aims to strike a balance between the immutable and transparent nature of blockchain and the dynamic requirements of IoT data. The sliding window concept enables the blockchain to focus on the most recent and relevant transactions, discarding older data that may no longer be critical. This approach not only addresses scalability concerns but also facilitates real-time data processing, a crucial aspect for applications that require instantaneous decision-making capabilities.

The primary objectives are to:

Introduce the SWBA framework as a solution tailored for IoT environments.

Explore the benefits of combining a sliding window mechanism with blockchain technology.

Investigate how SWBA enhances scalability, real-time data processing, and resource efficiency in the context of IoT applications.

Examine the security implications of SWBA for safeguarding IoT data in a decentralized manner.

Propose a consensus mechanism within SWBA that aligns with the resource constraints of IoT devices.

Blockchain is a great example of how it works. Bitcoin and other cryptocurrencies are examples of how blockchain works. Bitcoin is a decentralised payment system. It does not have a central authority that controls the supply of its money. The block size in Bitcoin Blockchain is limited to 1MB. Every 10 Minutes, a new block is mined. Most of the existing research suggests that blockchain can be used for the security algorithms and privacy algorithms in low-to-zero applications through its distributed network.

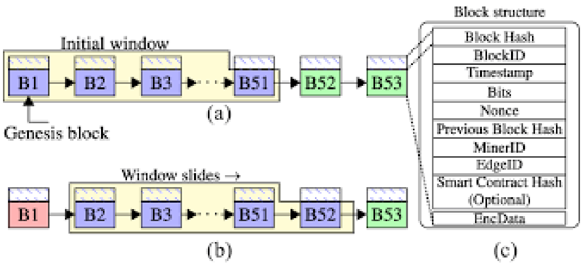


Fig.1: Block Chain Architecture

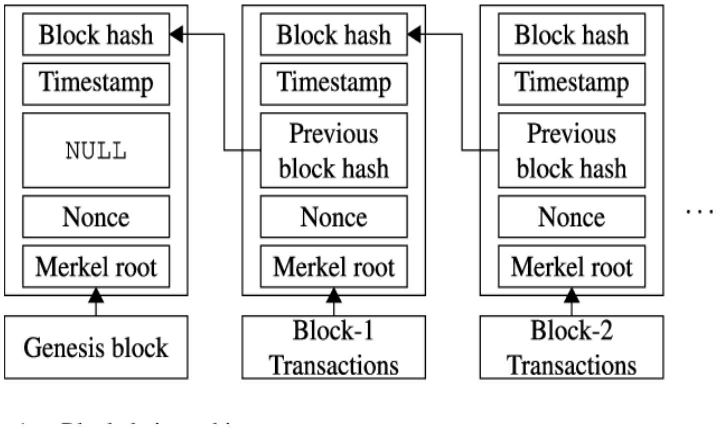


Fig.2: Sliding Window Blockchain Architecture

2. EXISTING SYSTEM: [l4]

The conventional blockchain approach is ill-suited for IoT applications with real-time data streams due to the computationally intensive Proof-of-Work mechanism. As the computational requirements increase, utilizing blockchain for IoT becomes impractical, presenting two primary challenges: (i) computational complexity and (ii) scalability.

Scalability refers to the limitations on the number of transactions a blockchain can handle within a specific time frame. For instance, consider Bitcoin, a well-known blockchain-based payment system that operates without reliance on a central authority to secure and control its money supply. In the Bitcoin blockchain, each block has a restricted size, capped at 1 MB, and a new block is mined approximately every ten minutes.

Interestingly, existing literature suggests that blockchain, with its distributed architecture, can be implemented as one of the data security and privacy solutions for IoT applications.

The computational complexity of blockchain depends on two key factors: the difficulty level and the size of the Merkle tree. In a Merkle tree, each leaf node is associated with the hash of a transaction's data, while non-leaf nodes are labelled with the cryptographic hash of their child nodes' labels.

3.PROPOSED SYSTEM: [l6]

We present a novel blockchain architecture designed specifically for IoT environments, with a particular focus on smart home applications. Smart homes play a crucial role in monitoring, analysing, and reporting the state of a household. These intelligent residences utilize IoT-connected devices to automate and oversee various in-home systems. It's worth noting that a smart home can be viewed as the fundamental unit within a larger smart city ecosystem. The standardization of security in smart homes not only bolsters their functionality but also contributes to the overall security of a smart city, forming a mutually beneficial relationship.

Within a smart home, real-time data streams are generated by sensors, enabling the monitoring of the home's current status, analysis of energy consumption patterns, and investigation of any potential accidents. The advantages of this approach include:

Enhanced Accuracy: The real-time data from sensors leads to more precise insights and decision-making.

Increased Security: The proposed blockchain architecture offers heightened security, crucial for safeguarding smart home systems.

4.RELATED WORK : [l2],[l8]

1.A Review on the Use of Blockchain for the Internet of Things.

The Internet of Things (IoT) is ushering in a future where numerous everyday objects will be interconnected, capable of interacting with their surroundings to gather information and automate tasks. Realizing this vision necessitates various critical elements, including smooth authentication, data privacy, security, resilience against attacks, straightforward deployment, and self-maintenance. These essential attributes can be facilitated by blockchain technology, originally conceived alongside the cryptocurrency Bitcoin.

In conclusion, we outline several recommendations to serve as guidance for future researchers and developers in the realm of Blockchain for IoT (BIoT). These suggestions address key challenges that must be addressed before deploying the next generation of IoT applications.

2. Internet of Things for ambient assisted living: Challenges and future opportunities:

Blockchain technology has the potential to significantly impact the Internet of Things (IoT) by addressing various challenges associated with security, trust, and data integrity. However, it also presents its own set of challenges.

Challenges related to integrating blockchain with IoT:

Latency: Real-time data processing is crucial for IoT applications, but most traditional blockchains have slow confirmation times. Using faster consensus algorithms like Delegated Proof of Stake (DPoS) or Proof of Authority (PoA) can help reduce latency. **Resource Constraints:** IoT devices typically have limited computational power, storage, and bandwidth. Running a full blockchain node can be resource-intensive. Lightweight blockchain protocols or edge computing solutions can mitigate this issue. **Energy Efficiency:** The Proof of Work (PoW) consensus algorithms, employed in systems like Bitcoin, entail substantial energy consumption. Switching to more energy-efficient consensus mechanisms such as Proof of Stake or hybrid PoW/PoS models can help mitigate the environmental footprint. **Security:** While blockchain can enhance security by providing tamper-resistant ledgers, it's not immune to attacks. 51% attacks, smart contract vulnerabilities, and private key management are ongoing security concerns. Robust encryption, multi-signature wallets, and regular security audits can help.

Potential solutions related to integrating blockchain with IoT

Private Blockchains: Deploying private or consortium blockchains for specific IoT use cases can address scalability and privacy concerns while still benefiting from blockchain's core features. Edge Computing: Perform data processing and validation closer to the IoT devices at the edge of the network, reducing the load on the main blockchain. **Blockchain as a Service (BaaS):** Leveraging BaaS providers like AWS, Azure, or IBM can simplify blockchain implementation, reducing the resource overhead for IoT devices. The choice of blockchain platform, consensus mechanism, and security measures should align with the specific requirements of the IoT application to harness the benefits of blockchain technology while mitigating its limitations. The choice of blockchain platform, consensus mechanism, and security measures should align with the specific requirements of the IoT application to harness the benefits of this technology while mitigating its limitations.

5. IMPLEMENTATION: [l10]

Blockchain technology provides decentralized data storage, which means that information is saved across multiple nodes instead of centralized storage, where data is stored on a single server, the author describes an idea to secure IOT devices utilizing this technology. Decentralized data storage offers the ability to receive data from any node that is currently online and has great security because only one data store will verify the hash value of every node. Due to memory, CPU, and energy consumption limitations, verification of the hash of all nodes requires a lot of processing and cannot be used with IOT tiny devices. The author presents the Sliding Window approach as a solution to tackle this challenge, where a fixed window size is employed to store all Blockchain transaction hash values.

6. EXPERIMENTAL RESULTS:

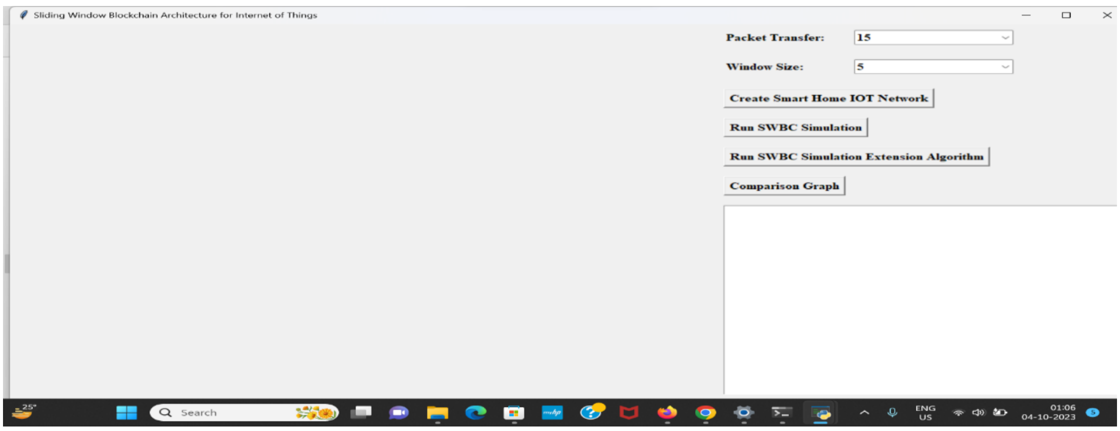


FIG 3: HOME SCREEN

The packet transfer is 15 and the window size is 5. The block chain can store data for up to 5 blocks. If the data is more than 5 blocks, the old block will be removed and sent to the cloud for storage and the new block will be stored in IoT memory. On the above screen, all the red circles are home IoT and the blue colour circle is IoT cloud.

The IoT cloud will receive the data from IoT upon full IoT window. Click on 'Run SWBC Simulation' to let each circle sense data randomly and while the sensing circle label changes to red colour.

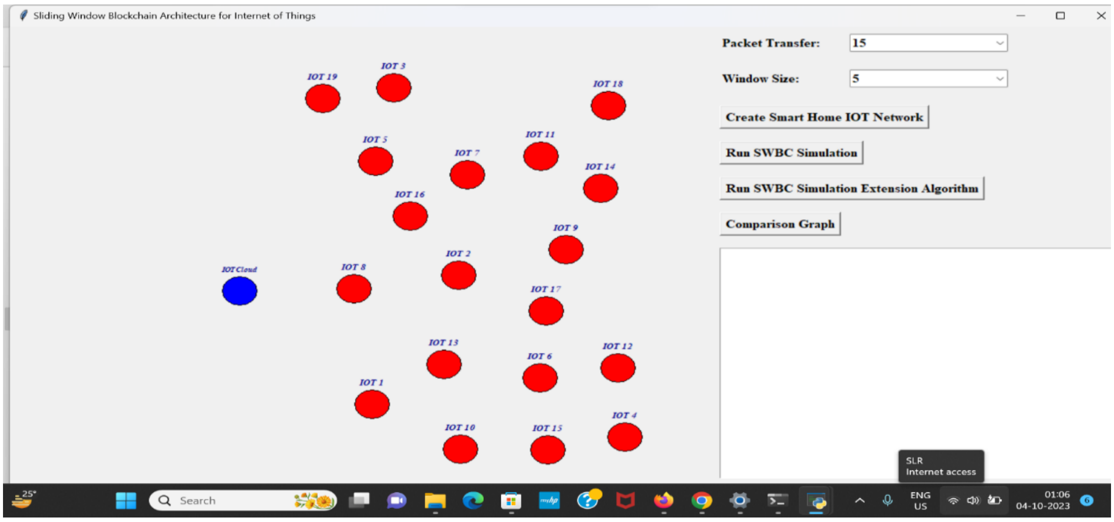
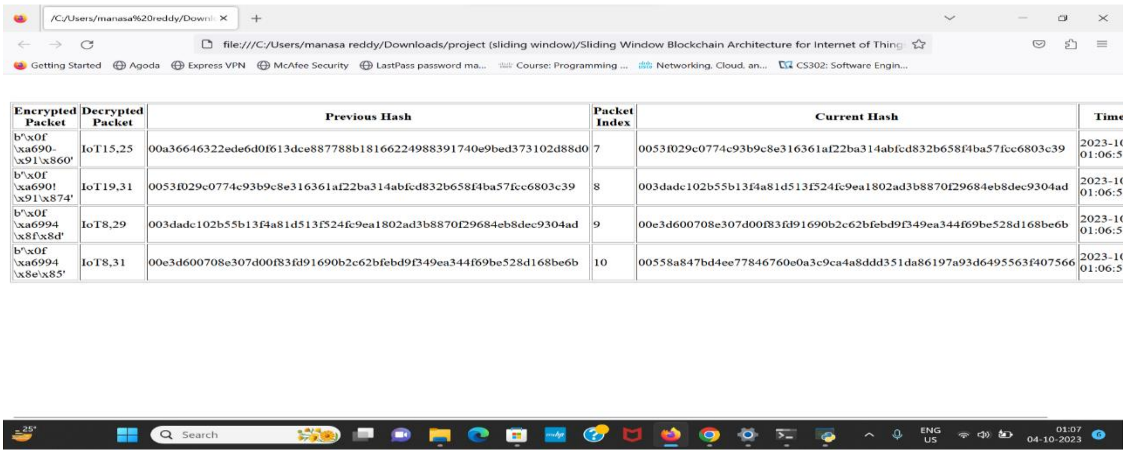


FIG 4: create smart home IoT network

The IOT 2 label is receiving data and the label colour changes to red This simulation will be executed for 15 packets transfer For each transfer sensor, random selection will be made In the text area, we can see which IoT sensor is receiving data and its sense value separated by comma symbol In the next line, we can see AES encrypted data and then we can see mining



Encrypted Packet	Decrypted Packet	Previous Hash	Packet Index	Current Hash	Time
b'\x0f \xa690- \x91\x860'	IoT15,25	00a36646322ede6d0f613dce887788b18166224988391740e9bed373102d88d0	7	0053f029c0774c93b9c8e316361af22ba314abfcd832b658f4ba57fcc6803c39	2023-1(01:06:5
b'\x0f \xa690! \x91\x874'	IoT19,31	0053f029c0774c93b9c8e316361af22ba314abfcd832b658f4ba57fcc6803c39	8	003dadc102b55b13f4a81d513f524fc9ea1802ad3b8870f29684eb8dec9304ad	2023-1(01:06:5
b'\x0f \xa6994 \x8f\x8d'	IoT8,29	003dadc102b55b13f4a81d513f524fc9ea1802ad3b8870f29684eb8dec9304ad	9	00e3d600708e307d00f83fd91690b2c62bfebd9f349ea344f69be528d168be6b	2023-1(01:06:5
b'\x0f \xa6994 \x8e\x85'	IoT8,31	00e3d600708e307d00f83fd91690b2c62bfebd9f349ea344f69be528d168be6b	10	00558a847bd4ee77846760e0a3c9ca4a8ddd351da86197a93d6495563f407566	2023-1(01:06:5

FIG 5: SWBC simulation

Upon sending the packets, the aforementioned dialogue box will appear, providing us with the total number of packets sensed and the duration it took to process the window size of 5. Additionally, it will display the total sense and send packets, which in this case is 15. On the screen below, we can observe the most recent block stored in the IoT memory.

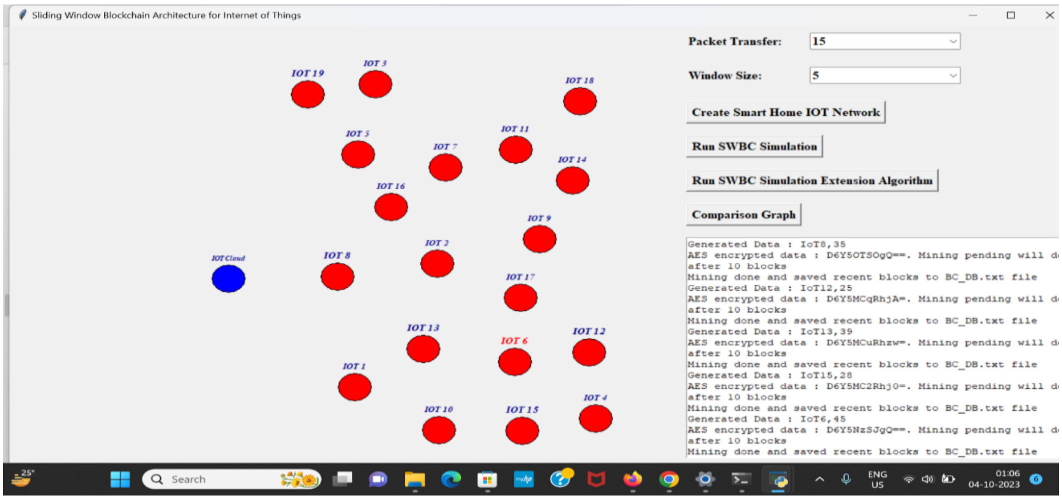


FIG 6: Blocks store at IOT memory

Upon sending the packets, the aforementioned dialogue box will appear, providing us with the total number of packets sensed and the duration it took to process the window size of 5. Additionally, it will display the total sense and send packets, which in this case is 15. On the screen below, we can observe the most recent block stored in the IoT memory.

7. EXTENSION WORK: [l11]

Extending the sliding window blockchain architecture for IoT (Internet of Things) involves enhancing the existing design to better suit the unique requirements and challenges of IoT devices and applications. The sliding window blockchain architecture is a mechanism that optimizes blockchain data storage by maintaining a sliding window of recent transactions while discarding older ones.

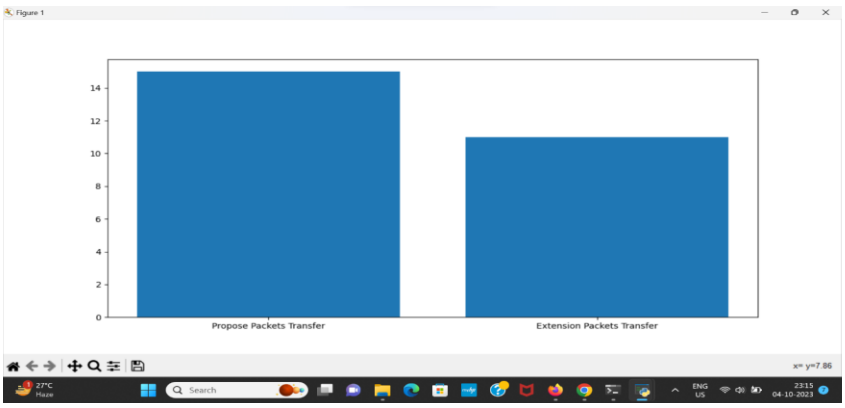


Fig.7: SWBC simulation extension algorithm

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After initiating, the Internet of Things (IoT) begins to detect and transmit packets, as displayed on the screen above. When IoT 11 turns red, it indicates that it is actively sensing and sending data. Once a total of 15 packets have been successfully transferred, the screen below will be displayed.

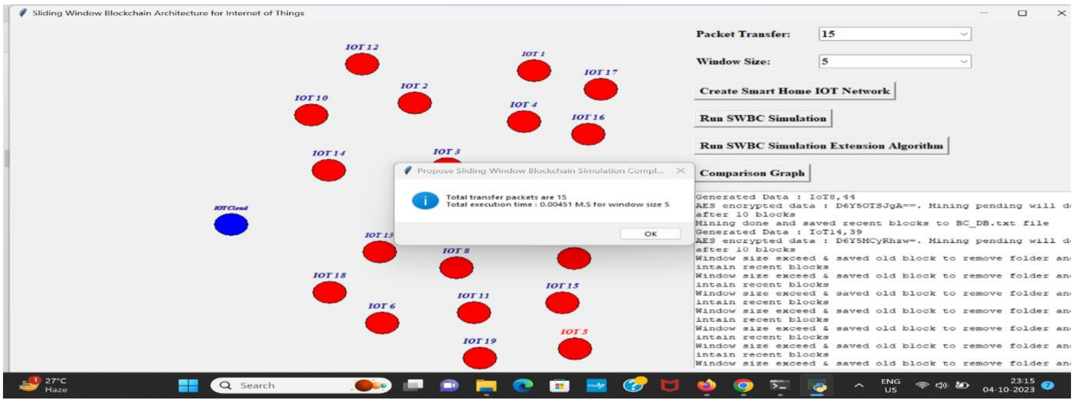

FIG 8: COMPARISON GRAPH

The algorithm name is represented on the x-axis of the graph, while the number of packets transferred is represented on the y-axis. By using the work application process, it is possible to save energy equivalent to 4 packets by only transferring 11 packets.

8.CONCLUSION:

IoT devices contend with resource constraints such as limited computational capacity, energy availability, and memory capacity. Consequently, traditional security algorithms are not viable for IoT applications. In response, we introduced a sliding window blockchain tailored to meet the specific demands of resource-constrained IoT networks, aiming to reduce memory overhead and constrain computational requirements.

Our experimental findings revealed the following insights:

(i) The computational time for PoW increases exponentially with each increment in the level of difficulty.

(ii) The total time required for adding blocks grows as the number of miners within the group increases.

(iii) An increase in the window size results in a linear rise in hash computation time.

(iv) Employing a randomized selection of difficulty levels for each block in a blockchain contributes to a reduction in the overall time required for adding blocks.

REFERENCES:

[l1]. "Sliding window Blockchain architecture for Internet of Things", Prescilla K, Associate Member, IEEE, Sarath Babu, Graduate Student Member, IEEE, and B. S.Manoj, Senior Member, IEEE. (Open-source vol.6, June 2019).

[l2]. "A review on the use of blockchain for IoT Things", T.M.F Carames and P.F Lamas (IEEE access,32 979-33 001, May 2018).

[l3]. "Blockchain in the IoT environment", A. Dorri (August 2016). [l4]. "Challenges and solutions of blockchain", S.S Kanhere, R. Jurdak (arXivpreprint:1608.05187).

[l5]. "Smarthome for building", IoT agenda online at https://internetofthingsagenda.com.

[l6]. "Smart Home Research", L. Jiang, D.Y Liu (International conference of ML and cybernetics August 2004).

[l7]. "Towards the definition of IoT", available on theinstitute.ieee.org (May 2015).

[l8]. "The Internet of things (IoT) for ambient assisted living", J. Wan, X. Gu, L. Chen (International conference for cyber-enabled distributed computing) Oct 2017.

[l9]. "Novel anonymous key establishment protocol for isolated smart homes", D. Abbas-in-ezhadmood(IEEE transactions April 2020).

[l10]. "The role of prediction algorithms in the mavhome smart architecture". S.K Das, D.J Cook, A. Bhattacharya (IEEE wireless communications, Dec 2002).

[l11]. "Blockchain-based credibility verification" C.Qu, M. Tao, J. Zhang(Security and communication networks).

[l12]. "Securing smart home", C. Lee, L. Zappaterra(Conference on communications IEEE Aug 2018).

[l13]. "Security challenges and security requirements of IoT", K. Choi, H.A Lee Choi (IEEE conference of Network security October 2014).

[l14]. "Blockchain technology in finance", P. Treleven, R.G Brown(vol.50, no.9 pp.14-17 September 2017).

[l15]. "To blockchain or not to blockchain: that is the question", V. Gatteschi, F. Lamberti (IT Professional, March 2018).

[l16]. "Introducing the IoT department", P.A Laplante, B. Bamba (IT professional, vol.20, no.1 January 2018).

[l17]. "Blockchain for healthcare and cloud-based security", C Esposito, A.D Santis(IEEE cloud computing January 2018).

[l18]. "Can blockchain strengthen IoT environment", N.Kshetri(IT Professional, bol.19, no.4 August 2017).

[l19]. "Towards an optimized blockchain for the Internet of things", A. Dorri, S.S Kanhere(In proceedings of the second international conference on IoT design. ACM August 2017).

[l20]. "Secure data uploading scheme for a smart home system", J. Shen, C. Wang(Information Sciences, Vol.453, pp.186-197 July 2018)