BCI: BlockChain For Industry

Samia Aitouche[1], Subhasis Thakur[2]

[1] Professor in Laboratory of Automation and Manufacturing, Department of Industrial Engineering, University Batna 2, Algeria

[2] Dr. Research fellow, National University of Ireland, Galway

e-mail: s.aitouche@univ-batna2.dz, subhasis.thakur@insight-centre.org

Abstract— **The several benefits of the blockchain leaded us to propose the special track BCI (Blockchain for Industry). It concerns all the works related to the topics:**
- **Blockchain and knowledge management**
- **Blockchain and industry 4.0**
- **Monetary blockchain**
- **Non monetary blockchain**
- **Blockchain and Human Resource Management**
- **Sharing value via blockchain**
- **Technical and legal barriers to the use of blockchain**
- **Security in blockchain**
- **Anonymity problem in blockchain**
- **The future e-Government with blockchain**
- **The trends in popularization of blockchain**

Four papers were submitted to BCI, one concerns the blockchain in ehealth and 3 papers in solar energy systems.

Keywords-Blockchain; industry; solar energy review;ehealth.

I. INTRODUCTION

The blockchain constitutes a database distributed over a network of "blocks" and no longer contained in a single epicentre. This network is often likened to a general ledger in which we record all the data or transactions exchanged/passed within a company and with its external environment.

The advantage of this system is the security it provides, because this database is accessible by all users of this blockchain. It is qualified as tamper-proof since any information entered in the database is indelible and traceable. Each user can therefore see a possible change if there is an intrusion in the chain.

The usage of blockchain could have many advantages:

1. The transparency of this system could be interesting to use to follow all the stages of the life cycle of a product, from the raw material to the finished product. This would provide traceability to optimize logistics (delivery times, trace suppliers who have supplied non-compliant products, etc.).

2. One could imagine the use of "smart contracts". Sort of digital format contracts, they are materialized by codes inserted into a blockchain allowing the exchange of assets from one entity to another automatically (according to predefined management rules). These smart contracts would allow the automation of the production chain in addition to a traditional ERP (eg secure automatic raw material ordering when inventory levels are low). The blockchain is a research domain jointed to several domains: knowledge management, industry 4.0, monetary transactions, non-monetary transactions, Human Resource Management, Sharing value via blockchain, cybersecurity, e-Government, cryptography…etc.

Even the importance of the special track, we received only four works.

II. ANALYSIS OF BLOCKCHAIN IN SOLAR ENERGY SYSTEMS

By this review [2], we are trying to shed light on the usage of the blockchain technology in the solar energy systems represented by the photovoltaic systems. The information is extracted from 42 papers from SCOPUS database. We used abstracts and full papers to study quantitative and qualitative aspects. The general principle is self-consuming [1] the solar energy and trading the surplus, this system is called prosumer. Others papers combine PV (Photovoltaic) operators and consumers of energy (Fig.1).
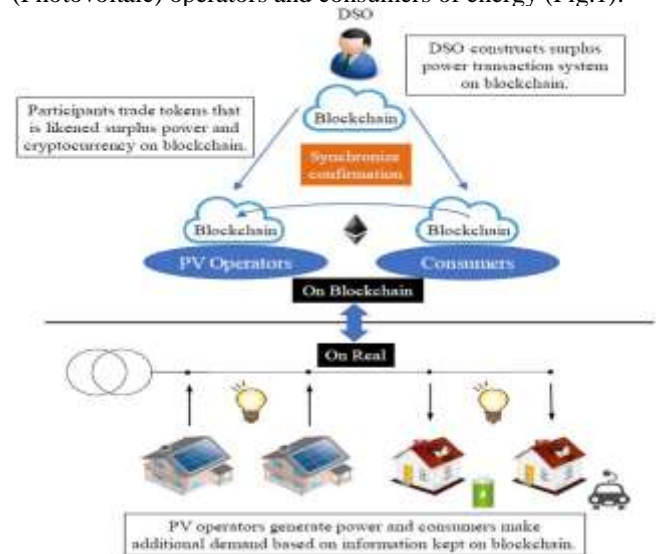

Figure 1.   Schema of an example of generation for trading solar energy [9]

The paper treats is a review treating two aspects of 42 papers concerning blockchain applied in solar energy systems: a quantitative study of the papers (scientific production by year, author, affiliation, country, document type, subject area and citations), then a qualitative analysis

containing authors' keyword analysis, problematics, their solutions and findings.

The main problematic treated in the literature is how to transform a simple comsumer to a prosumer by injecting the surplus of production in the grid selling it to neighbors and in his turn buying from their solar system when the batteries are discharged. To facilitate these operations, the blockchain is the best information layer to protect this trading offering a decentralised and secured plateform. A P2P network is the most adequate architecture to support this plateform. A cryptocurrency will make the trading more fluent. The prices of energy generally depend to the rules of offer/demand of the local or metropolitan market of solar energy. Knowing that the blockchain technology itself is a big consumer of energy, it is important to be autonome and a consumer a renewable energy like solar energy. This work may be usefull to developper of blockchain plateforms and the producer of energy solar to take benefits boths from their combination. In a future work, we will show oher studies aspects from this collection of papers like: used protocols and consensuses, smart contracts, statistical methods, used data in blockchains…etc.

III. BLOCKCHAIN BASED DECENTRALIZED HOME ENERGY MANAGEMENT SYSTEM USING DOUBLE AUCTION

Due to increasing concern about climate change, local energy market has been revolutionized with the increase in the use of solar photovoltaic, electric vehicles, smart home appliances, and demand response. These technologies used in the residential sector provide new opportunities for home energy management system (HEMS) to manage peak hours and gain incentives. In this paper [3], authors develop a blockchain-based smart meter and home energy management system that can collaboratively participate in energy consumption to maximize energy from renewable sources and reduce peak load. A fully decentralized blockchain-based system is used for trading energy using cooperative game theory. Smart meters are enabled with a lightweight blockchain client that provides detailed information about energy consumption and controls the appliances from installed HEMS. Lightweight blockchain clients can be deployed on the smartphones of the owner of these smart meters. A test-bed is constructed with 100 users, with 25 houses with 3kWp rooftop PV. The simulations are done for two seasons: winter and summer. In the summer season, the generation is high; however, in the winter season, consumption is higher than the generation, which can cause voltage rise and increase in reactive power. Different case studies and scenarios are carried out to show the proposed model's effectiveness. The results show that blockchain-based trading algorithms can impact individual users to manage energy consumption with high incentives.

A. Blockchain Architecture

Authors will use Blockchains and decentralised data storage to execute the auction-based energy trade. They will use a permissioned blockchain with prosumers, DSO, utility companies, and miners as the participants. They will use Inter-planetary File Systems (IPFS) as a decentralised data store (Fig. 2).
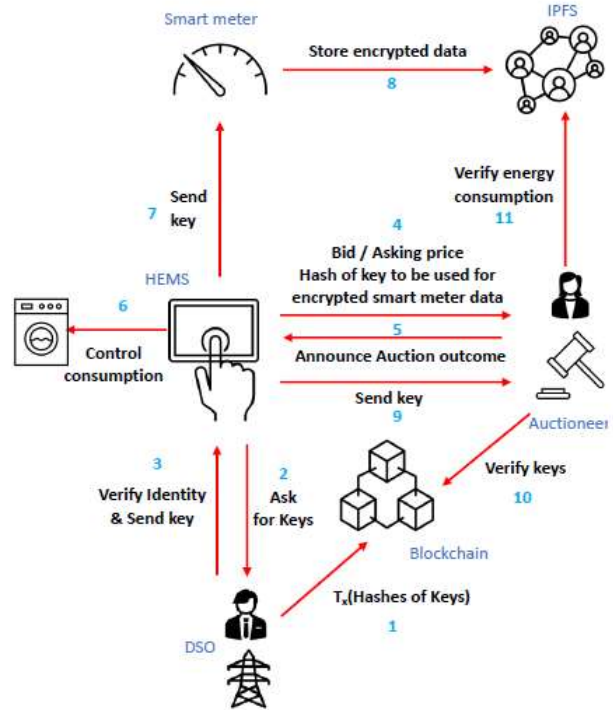

Figure 2. Blockchain architecture [3]

A trading algorithm is proposed in this work that allows users to trade energy from each other using double auction mechanism. Authors used Blockchains and decentralised data storage to execute the auction-based energy trade. A test-bed is constructed with 100 users, with 25 houses with 3kWp rooftop PV. The simulations are done for two seasons: winter and summer. Different case studies and scenarios are carried out to show the proposed model's effectiveness. The results show that blockchain-based trading algorithms can impact individual users to manage energy consumption with high incentives. In future, we will provide a detailed formal security analysis of the blockchain architecture of the energy trade. Moreover, the proposed work will be compared with other HEMS available to check its effectiveness.

IV. A DECENTRALISED REPUTATION MANAGEMENT SYSTEMFOR INTERNET OF THINGS DATA MARKETPLACE

A correct reputation management system [4] can differentiate between low-quality and high-quality data providers in an Internet of Things (IoT) data marketplace.

There are challenges in designing an unbiased and secure reputation management system that can not be manipulated by wrong feedbacks or wrong aggregation of feedbacks. In this paper, we develop a decentralised reputation management system for the IoT data marketplace that prevents biased selection and aggregation of reputation feedback. The proposed reputation management system uses blockchain offline channels, which makes the solution secure, unbiased, scalable, and least costly. We prove the security and correctness of the proposed reputation management system and present its experimental evaluation using simulation of data marketplace and blockchains.

The proposed reputation management system is secure and correct as it will prevent biased feedbacks and incorrect aggregation of feedbacks to calculate reputation.

A. Blockchain in e-Health: Review

Healthcare has had a reputation for being a traditional business that is difficult to evaluate due to the realities of change and resistive to new ideas. Healthcare issues (such as privacy, quality of care, and information security) have gotten a lot of attention in recent years all around the world. Blockchain technology is becoming more widely recognized as a means for addressing current information mismanagement difficulties. It has the potential to improve immediate healthcare practices, such as health service delivery and care support quality.

The blockchain's immutability is a critical feature for healthcare data. It can protect health records, clinical trial outcomes, and regulatory compliance. Smart contracts are being utilized to show how blockchain can help with real-time patient monitoring and medical interventions [5]. Health Insurance Portability and Accountability Act (HIPAA) compliant solutions provide record protection while enabling access to patients and medical professionals.

Further blockchain applications include the pharmaceutical supply chain and the development of anti-counterfeiting mechanisms. While the development of new pharmaceuticals incurs significant expenditures connected to trials to evaluate the drug's safety and efficacy, the usage of smart contracts allows for a more efficient informed consent approach as well as improved data management and quality [6]. Providing patients with access to manage their own identities allows the informed consent method to be integrated while preserving the privacy of individual health data.

In the pharmaceutical industry, blockchain has the potential to assist the pharmaceutical business deal with the rising risks of counterfeit and unapproved pharmaceuticals. With integrated GPS and chain-of-custody logging, smart contracts for pharmaceuticals can be formed and then identified, similar to device tracking.

Within clinical trials, blockchain can be used to address issues such as falsified results and data removal that contradict the researcher's bias or the funding source's objective. Clinical studies will be more reliable as a result of this. It also enables for the creation of an irreversible log of trial subject consent. It is estimated that identifying a chain-of-custody in the supply chain may save the pharmaceutical sector $200 billion [7].

Many sectors of health insurance could benefit from a reliable record of events surrounding the patient pathway, such as improved incident reporting and automated underwriting operations. Contracts, such as automated payments for segments of the patient journey, could also be precisely stated and then implemented.

Certain researchers consider the blockchain technology as an industry 4.1 revolution, because it benefits from the industry 4.0 revolution and its technologies, in a decentralized Manner. In this paper, authors addressed a review of the use of blockchain technology in eHealth, because of its importance for the comfort of citizens and the promotion of a healthy society, especially after the pandemic experience of COVID-19, where the necessity and the importance of telework and ICT became more essential than before. The review begins by the essence of eHealth and its issues and the encountered problems in it. It responds to how blockchain can promote the eHealth in terms of management of the data of patient and its privacy, and the gains in time and facilities without a central authority. The decentralized management of the blockchain does not mean a mess or a loss of data; in contrary, it means the accountability of all members and the partners of the blockchain (patient, doctor, medical institution...etc). This is guaranteed by the good choice of the consensus algorithms to minimize time, energy consumption and consequently minimize costs. Several algorithms and other issues are discussed in this review paper to help researchers and software developers to discover and use the opportunity of blockcahin in eHealth. All the used rules consented by the partners of blockchain system for eHealth are automatically applied in the form of smart contracts. These latter allow the treatment of citizens by the same way, without subjectivity and favoritism.

This paper [8] is organized as follows; Section 2 gives a view on the meaning of eHealth. Section 3 presents some problems encountered in eHealth and Section 4 clarifies the need of blockchain in eHealth to solve some of these problems. Some types of used bockchains in eHealth are given in Section 5. Section 6 points the more adapted and benefic protocols or algorithms to eHealth. Section 7 highlights the use of smart contracts in eHealth. The methods of accessing and storing data are presented in Section 8. Section 9 inspects the benefits of IOT in eHealth and blockchain. Section 10 is devoted to Electronic Health Records. Section 11 analyses the respect of blockchain eHealth of GDPR (general data protection regulation) rules. Then, finishing by general remarks in a conclusion Section.

By this review, authors tried to find out how to resolve problems of central bureaucratic authority, replaced by a peer to peer network allowing decentralized responsibility, even the end user in certain blockchain solutions, while maintaining patient privacy, protecting the confidentiality of its health folder. The blockchain is still promising in the future for the health care domain and other domains.

V. Conclusion

The idea of special track BCI (Blockchain for Industry) comes from the conviction that the blockchain even not enough recognized by governments and particulars, and not enough known for its qualities in security and integrity of data, could play an important role in facing problems of frauds and falsification of data.

VI. Acknowledgements

The co-chair and the chair of the special track BCI have to thank the contributors for their interesting and applicable contributions and the organizers of EKNOW 2022 for the patience and perseverance to make the event successful.

References

[1] X Xiong, G. Qing,., and H Li,. "Blockchain-based P2P power trading mechanism for PV prosumer. Energy Reports", vol 8, pp. 300-310, 2022.

[2] N. Taferguennit, S.E.I. Bousiouda, S. Aitouche, R. Mangena, F. Djouggane and N. Sersa, Analysis of blockchain in solar energy systems, EKNOW 2022, Porto, Portugal, June 26-30, 2022.

[3] M. Sweta, T. Subhasis, B. John and D. Maeve, Blockchain based Decentralized Home Energy Management System using Double Auction, EKNOW 2022, Porto, Portugal, June 26-30, 2022.

[4] T. Subhasis, B. John , A Decentralised Reputation Management System for Internet of Things Data Marketplace, EKNOW 2022, Porto, Portugal, June 26-30, 2022.

[5] K. N. Griggs, et al., "Healthcare blockchain system using smart contracts for secure automated remote patient monitoring". Journal of medical systems, 2018, vol. 42. Issue 7, pp. 1-7.

[6] N. B. A. Razak, G. Jones, M. Bhandari, M. C. Berndt, and P. Metharom, Cancer-associated thrombosis: an overview of mechanisms, risk factors, and treatment. Cancers, 2018, 10.10: 380.

[7] Frost and Sullivan, "Why Healthcare Industry Should Care About Blockchain?" 2017. [Online]. Available on: https://ww2.frost.com/files/8615/0227/3370/Why_Healthcare Industry_Should_Care_About_Blockchain_Edited_Version. [retrieved : June 2022] Frost and Sullivan, "Why Healthcare Industry Should Care About Blockchain?" 2017. [Online]. Available on: https://ww2.frost.com/files/8615/0227/3370/Why_Healthcare Industry_Should_Care_About_Blockchain_Edited_Version. [retrieved : June 2022]

[8] R. Mangena, N. Taferguennit, S. Aitouche, S. E. I. Boussiouda, F. Djouggane, F. Mourri, Blockchain in e-Health: Review, EKNOW 2022, Porto, Portugal, June 26-30, 2022.

[9] T. Nagatsuka, K. Kushino, M. Sano, and N. Yamaguchi, "Congestion Dissolution of Distribution Systems in Local Power Exchange Systems for Surplus Photovoltaic Output Using Blockchain", In 2019 3rd International Conference on Smart Grid and Smart Cities (ICSGSC), pp. 193-199. IEEE, 2019, June.