

# **[ Security and Privacy Preserving Schemes in Smart Homes using Blockchain]**

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the degree of

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under the supervision of **[ Dr. Priyadarsi Nanda ( Principle  
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## CERTIFICATE OF ORIGINAL AUTHORSHIP

I, *Amjad Qashlan* declare that this thesis, is submitted in fulfilment of the requirements for the award of *Doctor of Philosophy* in the *School of Electrical and Data Engineering / Faculty of Engineering and Information Technology*, at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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## ABSTRACT

**E**merging technologies such as the Internet of Things, sensors, and communication networks have been integrated into traditional homes to provide a wide range of smart home services to simplify and improve people's lifestyles. However, as the Internet of Things has grown in popularity, so have the concerns it poses. As a result, concerns like data privacy, security, and decentralisation of IoT systems present substantial threats to the future of smart home IoTs.

This thesis presents efforts towards a blockchain-based smart home framework which supports data confidentiality, differential privacy, and robustness. The thesis achieves three novel contributions. We first deploy a private blockchain using Ethereum smart contracts for a smart home to ensure only the homeowner can access and monitor home appliances. The smart contracts are designed to allow devices to communicate without the need for a trusted third party. Our prototype demonstrates three key elements of blockchain-based smart security solutions for smart home applications: smart contracts, blockchain-based access control, and the performance evaluation of the proposed scheme.

Next, we propose an authentication scheme that integrates attribute-based access control using smart contracts with an ERC-20 Token (Ethereum Request For Comments) and edge computing to construct a secure framework for IoT devices in a smart home system. The edge server provides scalability to the system by offloading heavier computation tasks to edge servers. We present the system architecture and design and discuss various aspects of testing and implementing smart contracts.

Finally, we conduct a performance evaluation to demonstrate the feasibility and efficiency of the proposed scheme. The core features that blockchain technology is leveraged upon are a trust-less environment, immutability and transparency, which come at the cost of a lack of data privacy. Therefore, we propose a privacy-preserving architecture for smart home-based blockchain. The architecture utilises differential privacy machine learning algorithm to send private IoT smart home data to the cloud and achieve data privacy. The main objective of the model is to protect privacy with high accuracy when aggregating the data from traffic analysis, linking and mining attacks by adding Gaussian noise. The implementation of our model ensures better accuracy and improved model utility. The goal of the privacy protection scheme used in our architecture is to enable smart home data to be used without disclosing privacy and provide published data to different service providers with lower information loss and higher data utility.



## DEDICATION

*To my honorable parents ( Mohammed & Mena ), my soulmate ( Hesham ) my lovely little  
angels ( Saja, Yosif, Salem and Maaax )  
and to the memory of my Father-in-law ( Salem ), I wish we were around in your last days.*

...



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## LIST OF PUBLICATIONS

### JOURNAL PAPERS :

1. **A. Qashlan**, P. Nanda, X. He, and M. Mohanty, Privacy-preserving mechanism in smart home using blockchain, *IEEE Access* 9 (2021) 103651-103669. **Impact factor of 3.367**
2. **A. Qashlan**, P. Nanda, and M. Mohanty, Differential Privacy Model for Blockchain based Smart Home Architecture, Submitted to *Future Generation Computer Systems Journal (FGCS)*, Under review, **Impact factor of 7.187**

### CONFERENCE PAPERS

1. **A. Qashlan**, P. Nanda, and X. He, "Security and privacy implementation in smart home: Attributes based access control and smart contracts," in 2020 IEEE 19th International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom). IEEE, pp. 951- 958. **(Rank A)**
2. **A. Qashlan**, P. Nanda, and X. He, "Automated Ethereum smart contract for blockchain based smart home security", in *Smart Systems and IoT: Innovations in Computing*, Springer, 2020, pp. 313-326



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