Using Blockchain and Smart Contracts as a Centralized Cloud Alternative for IoT

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Abstract

The diffusion of Internet of Things (IoT) devices has paved the way for new methodologies to be used in data collection and processing, but challenges about their management and security still remain. Blockchain technology, originally introduced as the backbone of decentralized finance and payment systems, has evolved significantly since its inception. Its utilization can increase the security of stored data, considering immutability and cryptography as its main characteristics. Moreover, the introduction of smart contracts has enabled the possibility to execute code directly into the chain, allowing the its utilization as an alternative of traditional cloud computing. This work, using as a real world example an indoor air monitoring application, proposes a comparison of two BC, Ethereum and Fabric, as an alternative to traditional cloud systems using smart contracts.

Keywords

Internet of Things, Blockchain, Smart contracts, Comparison, Ethereum, Hyperledger Fabric

1. Introduction

The rise of the Internet of Things (IoT) has raised concerns about device security amongst large data exchanges. A solution explored in [1] is Blockchain (BC) technology, known for its immutable data ledger. An example of combining IoT and BC has been done in [2]. Blockchain also offers the capability to execute operations within the network, popularized by Ethereum smart contracts. This study examines an indoor air monitoring application, using temperature and humidity data, as a practical use case for Blockchain and smart contracts, comparing Ethereum and Hyperledger Fabric.

2. Our approach

This paper proposes the utilization of the BC and smart contracts as an alternative to traditional cloud computing for an IoT system. To demonstrate the feasibility of this concept a temperature and humidity monitoring application for air quality is developed. To combine the sensed temperature and humidity the Temperature Humidity Index (THI) [3] is used. It gives some

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information about the possible effects the sensed data can have. It is calculated as follows:

$$THI = (1.8 * T - ((1 - RH/100) * (T - 14.3))) + 32 \quad (1)$$

where T is the temperature in Celsius and RH is the relative humidity. Considering the value the index takes, different evaluations about the discomfort can be made as shown in Table 1.

Table 1
Discomfort Considerations

THI Values	Considerations
$65 \leq THI < 68$	Possible discomfort
$68 \leq THI < 72$	Little discomfort
$72 \leq THI < 75$	Discomfort
$75 \leq THI < 79$	Alert
$79 \leq THI < 84$	Danger
$THI \geq 84$	Emergency

Hyperledger Fabric is deployed on a local network using Docker, while Solidity is tested on the Sepolia network via Infura and MetaMask wallet. Fabric computation takes 6 seconds, Solidity takes 11 seconds due to network connection time. Solidity is a language specifically made for developing smart contracts, and it obeys to some of the principles of Ethereum, like maintaining a deterministic behaviour in the network. For this, it does not implement floating point numbers and the implementation of the fixed point type is only partial. In the proposed use-case the constants in Alg. 1 are rounded to the nearest integer. The usage of a general purpose language in Fabric, can make these technologies more flexible and adapt to execute more various and complex requests.

3. Conclusions

A real scenario is used to test smart contract capabilities and experiment with them, showing how they can enable the BC to be a true alternative to traditional cloud methods. Tests carried out in this work have illustrated that Fabric can be the better alternative, especially due to the actual limitation of the Solidity programming language.

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