Functional Modules Sharing and Blockchain Based Validation in Office Automation Systems

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Abstract. Office Automation (OA) plays a very important role in our work. It makes the work easier and simpler. Smart office automation systems are widely used nowadays. However, almost all current OAs are based on the working flow and are centralized with many limitations. This paper presents the design and implementation of a brand-new mechanism. Unlike the traditional OA system, key of the new mechanism is to retrieve the main functionality from each company in the same office building, then many functional modules are shared with each other with cloud platform. In addition, the scheme of blockchain is deployed for the validation of the functional modules. We designed hash records for the blockchain sequences. Under this architecture, we implemented a decentralized blockchain mechanism for delivering transparent, secure, reliable, and timely functional blocks. This kind of consensus-based validation guarantees the security and reliability of the system.

1. Introduction

OA refers to the varied computer machinery and software used to digitally create, collect, store, manipulate, and relay office information needed for accomplishing basic tasks and goals. OA systems are configurations of networked computer hardware and software. New structures and mechanism of office automation came out in the past several years. Many office activities take place in various models, such that supporting for file system, communicating over departments, handing working flow, performing the functions of the ordinary offices, accessing database management, etc[1][3]. In traditional OA systems, each company in an office building must have all functionalities, as such HR, administration department, IT department, legal department. However, many departments are idle and wasted for most of time.

Because the enterprises in the same office building have geographically adjacent locations, we propose and implement a resource sharing based platform. Our new mechanism includes a novel architecture and blockchains based validation. In a traditional business building, enterprises located in the building are separated. We develop a platform which offers sharing functionalities of the companies. The platform provides open API for many companies in an office building. Each company may conduct further development based on the APL, thus creating exclusive cloud in the building. We also develop blockchain based validation for companies and their service modules. This kind cloud computing combines local transaction and service modules, upgrading traditional office building as a platform of service and transaction sharing as well as an entrance of business communities. The new mechanism is deployed in many buildings in Shenzhen and other developed cities by Goodycom company. Compared with tradition OA systems, our new system has many PROS. First, unlike
traditional OA systems, our new one offers the platform in which companies in an office building share their functionalities, producing an inter-connected office environment without redundant departments. Second, the blockchain based system is more secure because the joining is verifies by distributed structures.

2. Problem Formulation

2.1. Limitation of Traditional OA System
Inside the same office building, enterprises have the attributes of ID homology, mechanical sorting and geographical proximity. The office building thus forms a collection of geopolitical management for entry enterprises. However, the traditional centralized OA systems have many limitations. First, the enterprise geopolitical resources are silent. Geopolitical enterprises lack mutual business connection, ID data attested by office buildings are silent, and the geopolitical resources of enterprises gathered are idle. Second, the establishment of enterprise functional resources is repeated. At the same time, all enterprises have set up HR department, administrative departments, receptionists, conferences, legal departments and other functional departments or jobs. Inside the same office building, functional resources are highly repetitive and idle with low utilization.

2.2. The New Architecture
In view of the silence of the corporate geopolitical resources and the repeated idling of the enterprise functional resources, a two-way hedge design is carried out. The enterprises no longer retain all their functional departments. Rather, they produce the debris form of the production center, deploy the functional departments to the other enterprises in the same office building, and purchase functional services on demand. For example, if a building has n companies, $C_1, C_2, \ldots, C_n$. For company $C_i$, it shares its functionality, such as HR to other companies. For company $C_j$, it shares its functionality, such as law department. On the other side, $C_i$ and $C_j$ purchase other services from other companies. At the same time, based on the production capacity of the center, they upload public functional modules, supplying functional services to other enterprises. The geopolitical resources of office buildings are transformed into new business models, and office buildings become the trading market and sharing platform of functional resources of enterprises. The leasing management of traditional office buildings has been upgraded to share the functions of local businesses.

To implement such mechanism, we organize a three-tier platform. Tier one is the connection with employees and business. Employees communicate their employers with normalization and high viscosity via OA. Tiers two is that many companies conduct commercial and usual communications with each other by functionalities sharing cloud. Tiers three is that buildings sharing their information with building functionalities sharing cloud. A building performs data exchange and information communication by other exclusive clouds. In this way, a building is a communication platform rather than a rental space. Figure 1 shows the information communication mechanism and figure 2 shows the three-tier structure.

![Figure 1. Information communication mechanism](image-url)
A company in a building offers its functionalities to other companies with exclusive cloud. It also purchases services from other companies. There are many validations in the mechanism. Based on the first ID authentication of the enterprise’s location information, the cloud continues to authenticate for the second times, making the enterprise’s production capacity as the local function supply module. At the same time, we guide all accreditation agencies to conduct third authentication based on consensus mechanism, and jointly certify the functions and capabilities of local suppliers. Once the three validations are completed, the neighbouring business in the same building is upgraded as the demand party and supplier of the SAAS functional module. Hence the local supply and demand relationship of the functional resources is created.

2.3. Blockchain Based Validation
We use blockchain based approaches to perform the validations. Blockchain was initially applied as an approach based on cryptography to provide an alternative mechanism for the trust between transacting parties [7]. This scheme enables the agreement by hash function. The information concerning single transactions is gathered in ‘blocks.’ These blocks are reviewed and verified by the network and added in a chronological order on the computers of all participants of the network.

Blockchain is a decentralized data structure to store transactions transparently, chronologically, and tamper-proof in a distributed network [4]. This technology consists of a chronologically ordered chain of blocks. Each block contains information about valid network activities since the last addition of the previous. The link between the blocks is achieved via cryptographic hashes that connect block by block and thus build the chain. This approach ensures that transactions cannot be modified after data has been approved by all nodes.

Essentially, A blockchain is a sequence of hash-chained records Once you’ve seen record N, you can’t change anything in the past[8]. Some procedure for adding blocks to blockchain. In our organization, each company is encapsulated as seven tuples: (city, street, street No., name of building, room No., functional structure, main business).

We use SHA1 hash to map each seven tuples to a string output. Each output is distinct. 

\[ H(\text{the 7 tuples of } Ci) \rightarrow Ui \]

We take the 7 tuples as an input, then produce a 256 bits fixed-length output. When a company joins the shared platform, provides its services, or purchases services from other companies, it needs to be validated by blockchain approach. In our mechanism, record N contains a commitment to record N-1, which contains a commitment to record N-2, which contains a commitment to record N-3, and so on.
Figure 3. A sequence of records linked together

A sequence of records linked together is shown in figure 3. Each record contains the hash of the previous record. If an attacker changes a payload, then the attack will be detected and forwarded to future records as indicated in figure 4.

In our mechanism, when a company $C_i$ intends to perform action, for example, $C_i$ wants to provide a service to the cloud platform, its credential will be validated by our hash chain. If any attacker changes record $j$, then the future record $j+1, j+2 \ldots$ will be changed. Hence the attack will be detected.

Figure 4. A tamper case

To further verify our algorithm, we tried to implement it with Ethereum [10], which is an open source blockchain-based distributed computing application platform. It is mainly used to build and implement smart contracts functionality. The implementation is over Ethereum Virtual Machine. In the programmable Blockchain, we created our own operations. Our application ran smoothly in EVA and verified our algorithm. Hopefully, the details will be published in a future paper.

3. Conclusion
In this paper, we presented a novel AO structure. In this structure, each company in an office building provides its service to other companies via sharing cloud platform. A company does not have to have all functional departments. They share their services of each other. In addition, we use blockchain based validation to verify the actions of the companies in the platform. If an attack takes place, it will be detected. We combine business process management and Blockchain technology together,
producing a novel sharing cloud platform-based OA structure. Our implementation reveals that a tamper-proof process history for improved auditability and provides insights how Blockchain technology can be used for business process management.

4. References
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