Integrating Blockchain with Local Public Service System

Vinayak Ashok Bharadi, Purva Pramod Ghag, Sukanya Rupesh Chavan, Shivani Shivram Gawas, and Atiya Kazi

Abstract A smart city is having various types of offices, which are having different types of data. These departments are related to each other. In some cases, if the user wants to access a particular type of data of any local governance department then that data is available for the user, during the process sometimes the data may be hacked and modified by third party entity. Therefore, for removing such drawback, we are using blockchain technology here. In this paper, a blockchain-based system is proposed for bringing trust and integration between different subunits of local public service systems. The existing systems are working in silos; the proposed system uses Azure Blockchain Workbench for integrating such units and bringing sync and trust between them. This results into faster and secure operation at both the administrative as well as consumer (public) end.

Keywords Blockchain · Smart contract · Peer-to-peer · Ledger

1 Introduction

As we know nowadays, the sensitive and confidential information is hacked by any unauthorized user. The unauthorized user will manipulate the data and that data will be a breach in some cases. To overcome this hacking we are using trusted

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technology called blockchain. Blockchain is the general-purpose technology, which is most important for security purpose. Creating blockchain for local governance with Microsoft Azure is a secure way to exchange information between servers and client, which is required for authentication and trust [1]. In smart cities, the government provides different types of services to citizens. Government-related blockchain applications are including digital identity, the storing of important and fair decisions, marital status, business licenses, passports, criminal records, and even tax records. Further research is recommended to compare the variety of initiatives and to analyze the source of benefits. In our system, a user will request for collection of data from citizens, devices, and assets. The requested data can be broadcast to peer-to-peer network consisting of computers, known as nodes. This network of nodes validates this collection of data and user's status using password verification algorithms. This verified data can involve data belonging to transportation systems, law enforcement, water supply networks, waste management, hospitals, and other community services. Once data is verified, the data is combined with other data to create a new block of data for the blockchain ledger. The new block is then added to the existing blockchain, in a way that is permanent and unalterable and then this data can be forwarded to any requesting user on a timely basis [2]. We cannot modify the data once the blockchain is created otherwise the whole chain of blocks consisting of data will be a collapse. Single database is replaced by distributed ledger, which consists shared information that information is restricted and provides high security and accessibility.

1.1 What Is Blockchain Technology?

A blockchain is a growing list of records called blocks, which are linked to each other using a cryptography system. Each block contains cryptographic hash of the previous block, a timestamp, and data. A blockchain is resistant to modification of data. An open distributed ledger can record transactions between two parties. For use of distributed ledger blockchain, manage peer-to-peer networks collectively adhering to protocol for internode communication and validating new blocks. Satoshi Nakamoto invents a blockchain in 2008 to serve the public transaction ledger of the cryptocurrency bitcoin [3]. Blockchain technology can collect multiple areas. The primary use of this technology is distributed ledger for cryptocurrencies. Public blockchain and private blockchain are the two types of the blockchain. In public blockchain, it has no access restrictions and the private blockchain is permissioned that is the private blockchain is restricted (Fig. 1).

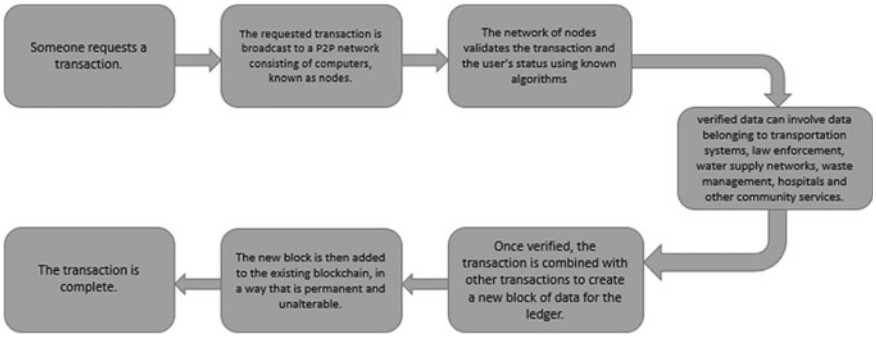

Fig. 1 Functionality of blockchain

2 Existing System

Banarjee [4] proposed a blockchain-based SCM for bringing transparency and authenticity. At Infosys, they implemented the blockchain protocol with a three-layer architecture, based on Oracle and SAP at the application layer and the blockchain at the bottom layer. Huckle et al. [5] explored how the Internet of Things and blockchain technology can benefit shared economy applications. The focus of this research understood how blockchain could be exploited to create decentralized, shared economy applications that allow people to monetize, securely, their things to create more wealth. Here the authors have proposed a system based on blockchain and integrating it with the local governance. The systems under consideration are registration of birth and death, police station, marriage registrar, ration card at the district level.

In the current system for getting birth- and death-related data, which can be filled handwritten way and with the help of technical equipment like typewriters or computers. If the user wants the head of registers or other public authorities who verify these records and documents will sign, get birth and death records, then it. In case, user loses the records then the new record is generated by the registry with the original receipt and written application [6]. However, this exchange of transaction is not secured in some cases. Further, the different subunits are working in separation and many times their transactions are independent on an operational basis but connected or dependent on a legal basis. Therefore, we have to make transactions integrated, secure and prevent access from unauthorized users and avoiding data manipulation and deletion.

3 Proposed System

In the paper, a blockchain-based approach is proposed for bringing trust and integrity between different departments of the local government subunits at district level.

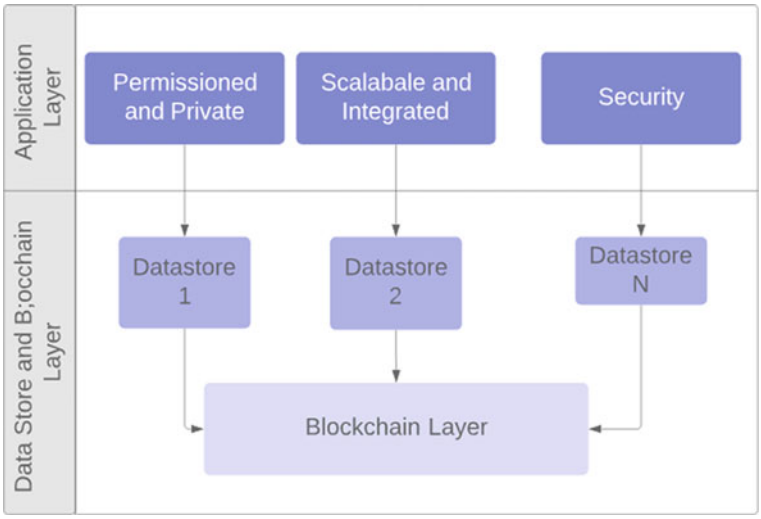

Fig. 2 Proposed system layered view

Police department, Marriage Registrar, Birth and Death registrar, Ration Card office, and Local maternity homes are the different units or the nodes of the blockchain. This will be a three-layer system. At the top, there will be the application layer, later the distributed data storage layer and the underlying blockchain layer as shown below (Fig. 2).

For the timely collection of data, user will log into a system that will act as the registration. A Portal is linked to a smart contract in the blockchain network. The user will use a unique reference number (URN) for logging in. All relevant information (hospitals like birth, death, and stillbirth) shall be updated to editable fields in the smart contract. The smart contract moves to peer-to-peer node, for the validation and review of the information and the user will digitally sign the data. The smart contract forwarded to the admin's node, where the admin validates each field in the 'smart form' with a binary response (valid or invalid). If all fields in the smart form are valid, a unique digital hash value associated with that form is generated, which is stamped to the record and updated to the blockchain. A corresponding record will be generated as a data/file that will now be updated to the citizen's similar account, printed with a unique digital hash value [2] (Figs. 3 and 4).

4 Implementation and Results

The system is implemented on Azure Blockchain Workbench. The Azure Blockchain Workbench is the fastest way to get started with blockchain on Azure. This tool allows developers to deploy a blockchain ledger along with a set of relevant Azure services

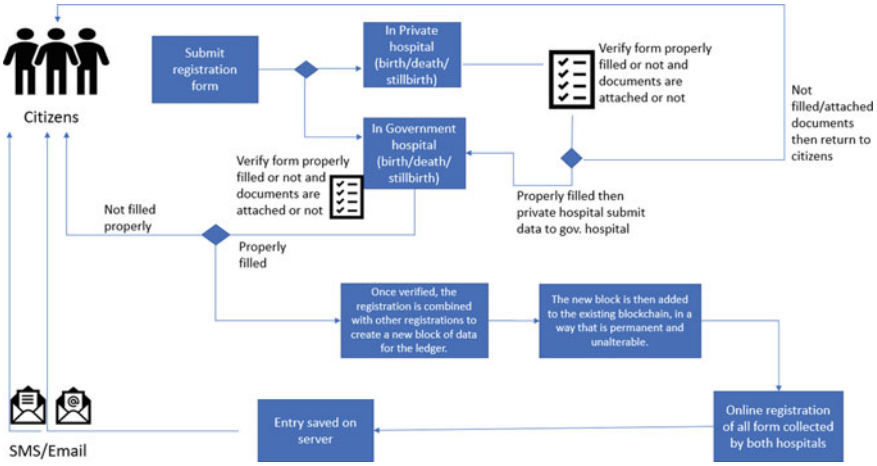

Fig. 3 Example of smart contract

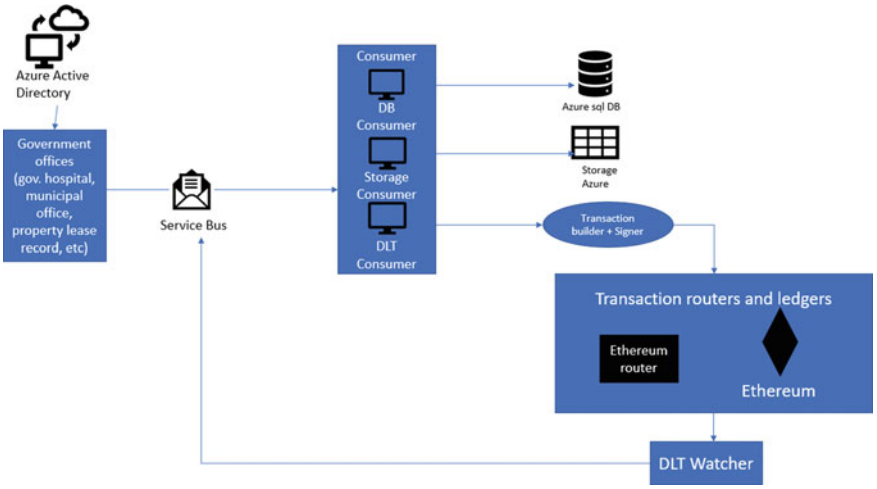

Fig. 4 Proposed architecture of blockchain on Microsoft Azure workbench

most often used to build a blockchain-based application. The blockchain has the following Azure services being provisioned

- 1 App Service Plan (Standard)
- 1 Application Insights
- 1 Event Grid Topic
- 2 Azure Key Vaults
- 1 Service Bus Namespace
- 2 SQL Databases (Standard S0)
- 2 Azure Storage accounts (Standard LRS)
- 2 Virtual Machine scale sets (ledger nodes and workbench microservices)
- 2 Virtual Network resource groups (each with Load Balancer, Network Security Group, Public IP Address, Virtual Network)
- Optional: Azure Monitor.

The central node on the Azure Blockchain Workbench has the following configuration:

Validator node virtual machine size—Standard D2s v3
Number of virtual CPUs—4
Load balancing
RAM—16 GB
Storage performance—Standard SSD (Fig. 5).

The blockchain was configured with the JASON configuration file.

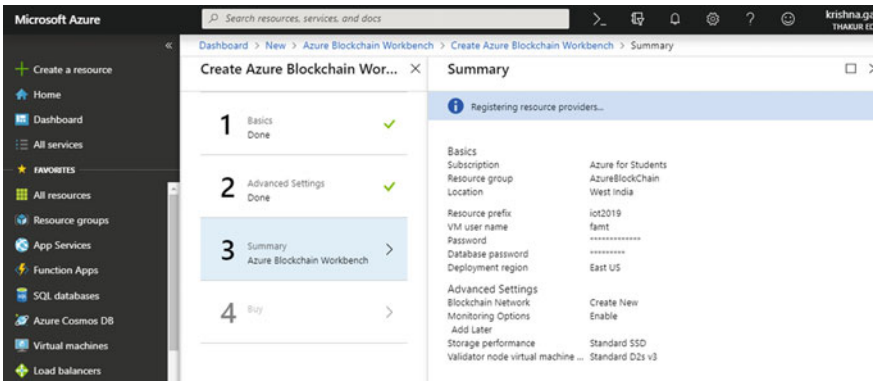

Fig. 5 Deployment of blockchain on Microsoft Azure Blockchain workbench

```
{
  "ApplicationName": "MahaeSevaBlockChain",
  "DisplayName": " MahaeSeva",
  "Description": "Integrating Local Government Services on
Blockchain",
  "ApplicationRoles": [
    {
      "Name": "Civil Hospital Maternity",
      "Description": "Details of Birth."
    },
    {
      "Name": "MahaeSeva",
      "Description": "Birth Certificate Issuing Authority"
    }
  ],
  "Workflows": [
    {
      "Name": "Civil Hospital",
      "DisplayName": "Report of Deaths Happened",
      "Description": "Records of Deaths in the locality",
      "Initiators": [ "Requestor" ],
      "StartState": "Request",
      "Properties": [
        {
          "Name": "State",
          "DisplayName": "State",
          "Description": "Holds the state of the contract.",
          "Type": {
            "Name": "state"
          }
          },
```

The abovementioned code sniplets describes typical contract for the maternity ward and civil hospital mortuary. When one incident of birth or death is reported, it will trigger a contract on blockchain. The different subunits of Azure Blockchain are listed in the following figure; this is a snapshot of Live Blockchain on Azure Cloud (Figs. 6, 7 and Table 1).

This shows the functionality of the blockchain in action, further the smart contracts have to be deployed on the blockchain and integrated with all the functionality of every unit's node.

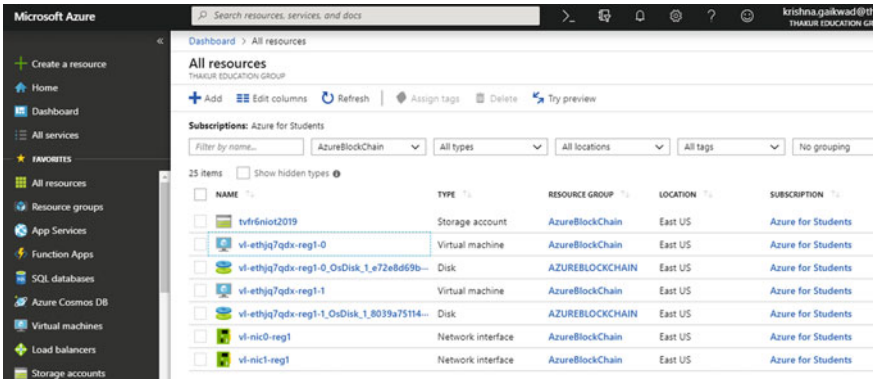

Fig. 6 Live Azure Blockchain

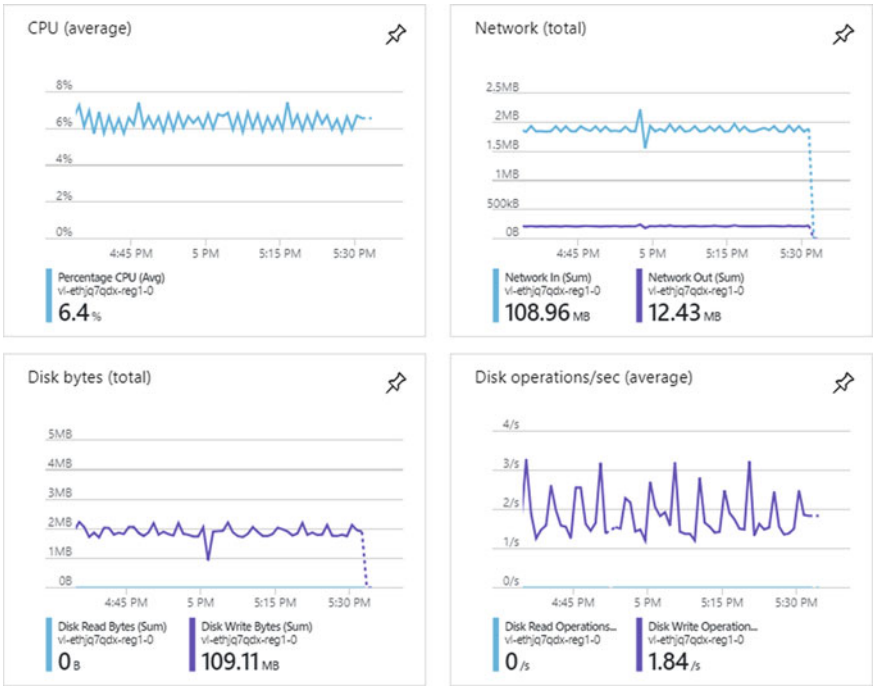

Fig. 7 Node parameters of blockchain in operation

Table 1 Azure Blockchain components

Service name	Type	Resource group
Network security group	Azure Blockchain	Azure Blockchain
ethjq7qdx-vnet-reg1	Virtual network	Azure Blockchain
ethjq7qdxstore	Storage account	Azure Blockchain
iot2019-e.g.-tvfr6n	Event grid topic	Azure Blockchain
iot2019-lb	Load balancer	Azure Blockchain
iot2019-lb-public-ip	Public IP address	Azure Blockchain
iot2019-plan	App service plan	Azure Blockchain
iot2019-sb-tvfr6n	Service bus namespace	Azure Blockchain
iot2019-subnet-workers-nsg	Network security group	Azure Blockchain
iot2019-tvfr6n	Application Insights	Azure Blockchain
iot2019-vnet	Virtual network	Azure Blockchain
poaAvailabilitySet-reg1	Availability set	Azure Blockchain
tvfr6n-iot (db-tvfr6n-iot/tvfr6n-iot)	SQL database	Azure Blockchain
tvfr6niot2019	Storage account	Azure Blockchain
vl-ethjq7qdx-reg1-0	Virtual machine	Azure Blockchain
vl-ethjq7qdx-reg1-0_OsDisk_1_e72e8d69b92548bead463d0d665f089c	Disk	Azure Blockchain
vl-ethjq7qdx-reg1-1	Virtual machine	Azure Blockchain
vl-ethjq7qdx-reg1-1_OsDisk_1_8039a75114e340eba85d9dbbe1e71364	Disk	Azure Blockchain
vl-nic0-reg1	Network interface	Azure Blockchain
vl-nic1-reg1	Network interface	Azure Blockchain
db-tvfr6n-iot	SQL server	Azure Blockchain

(continued)

Table 1 (continued)

Service name	Type	Resource group
ethjq7qdx-akv	Key vault	Azure Blockchain
ethjq7qdx-lbpip-reg1	Public IP address	Azure Blockchain
ethjq7qdx-oms	Log analytics workspace	Azure Blockchain
ethjq7qdx-vlLb-reg1	Load balancer	Azure Blockchain
ethjq7qdx-vlNsg-reg1	Network security group	Azure Blockchain
ethjq7qdx-vnet-reg1	Virtual network	Azure Blockchain

5 Conclusion

In this paper, we investigated how blockchain is innovative and used to access transactions in peer-to-peer networks. It provides transparency and avoiding fraud and corruption in smart cities. Information is accessed in an easy manner, which enhances the speed of access, which increases efficiency and transaction manners. The meaning of the word 'smart' which converted to 'smart city' which can help us to understand the requirements or needs of smart cities and which technology is used to adopt that requirements.

The blockchain technology contributes to make city smart by providing services for citizens. In this paper, we first gave an overview of blockchain technology [7]. Then we discussed what the needs of blockchain technology in local governance are and how it is implemented by using Microsoft Azure cloud service.

Following are the points, which can be modified, in the existing system:

1. Currently, we are working with Microsoft Azure for making blockchain. Instead of that, we can develop our private blockchain for our system.
2. Now we have created our blockchain using single machine and in upcoming days, we can use multiple nodes for our blockchain network.
3. Detailing of Smart contracts and deployment on the blockchain.
4. Database setup and integrating with the blockchain.

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