

Design and Development of an asset lifecycle and location tracking app with Blockchain and IoT

S. Swetha Naidu¹, K. Sheena², V. Lakshmi Prasanna³

¹⁻³UG Student, Dept. of Electronics and Communication Engineering, Vasireddy Venkatadri Institute of Technology, Nambur, Guntur, Andhra Pradesh, India.

Abstract - This era of Digitalization with rapidly growing technologies have impacted the world in a great way and the business world has its own race of evolving in it. Assets are the key elements of every organization and keeping a track of them is very important. Any manipulation in the assets can damage the organization to its roots and tracking them manually is very impractical. Usually, asset transferring involves a manufacturer, vendor, contractor and consumer. The previously used method for asset tracking is by collecting the data from the IoT device attached to the Asset but there can be a chance of data tampering. We came up with a smart asset tracking system using IoT and Blockchain that keeps a record of them from creation to deletion. For IoT integration, we have taken the support of the IBM Watson IoT platform and node-red to handle the process of device scanning as the asset is being transferred. Instead of a physical device, we created a node-red app that acts as a device to triggers these scans. We created a local Node.js application that gets notified whenever a scan happens and invokes transaction.



Fig -1: Blockchain

Key Words: Asset tracking, IoT device, Blockchain, IBM Watson platform.

1. INTRODUCTION

An asset lifecycle is a series of stages involved in the management of assets in the organization; it travels a long way in between its creation to disposal and tracking them either by scanning the barcodes attached to it or by using RFID is referred to as asset tracking. For example, a manufacturer creates an asset and sells it to a vendor, the vendor then creates a lease with the contractor which includes keeping an account of how much deposit to be paid and how much to be paid back. Information of such transactions has to be tracked and recorded without third-party access or tampering with data.

A network of connected devices is referred to as the Internet of Things (IoT). Blockchain is an immutable ledger that is designed to store information in a way that is difficult to intervene and tamper with. Blockchain and IoT working together as a combination offers secure data records.

We proposed an Asset tracking method which is a powerful combination of blockchain and IoT. Blockchain enabled asset tracking enables greater traceability and efficiency.

1.1 TOOLS AND TECHNOLOGIES

Docker- Docker is basically an open-source software platform that makes the process of creating, shipping, running, managing and deploying applications anywhere within containers easy. Docker plays a crucial role in the development of the distributed Blockchain application.

IBM Watson IoT platform- The Watson IoT platform provided by IBM is an entirely managed and cloud-hosted service which makes it simple to acquire data from IoT devices.

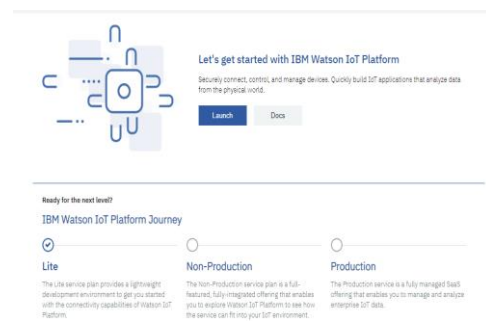


Fig -2: IBM Watson IoT Platform

VS Code- Microsoft Visual Studio Code is a source code editor which has powerful features. A wide range of programming languages is available on VS Code like python, java. It also has many extensions for web development debugging. It is available for Windows, Linux and macOS.

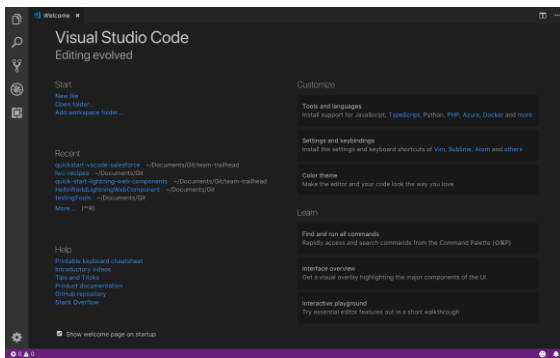


Fig -3: VS Code

IBM Blockchain Platform Extension-The IBM Blockchain Platform extension helps the developers in creating, testing and debugging smart contracts, connecting to Hyperledger Fabric environments, and build distributed applications that execute on the blockchain network.

Node-RED - Node-Red is an open-source visual programming tool made by IBM for connecting hardware devices, Application Programming Interfaces (APIs) and online operational facilities together as a part of the Internet of Things (IoT).

- An IoT device scans the asset through RFID or barcode as it moves from one location to the next. The device can then be mimicked in this fashion.
- The node-red simulated IoT device will send a scan event to the IBM Watson Platform.
- A local application listening for the scanning events invokes a transaction after a scan takes place.
- Lastly, the ledger will be updated with the asset's current position.

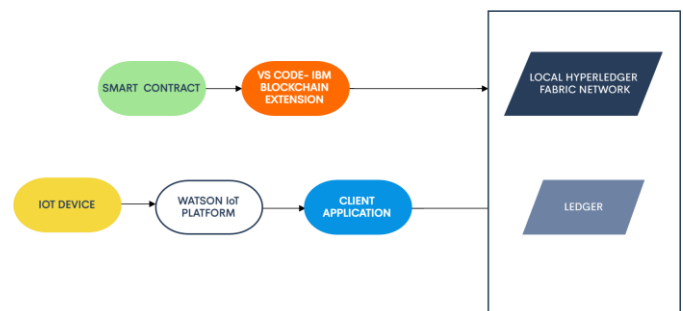


Fig -5: Flow chart

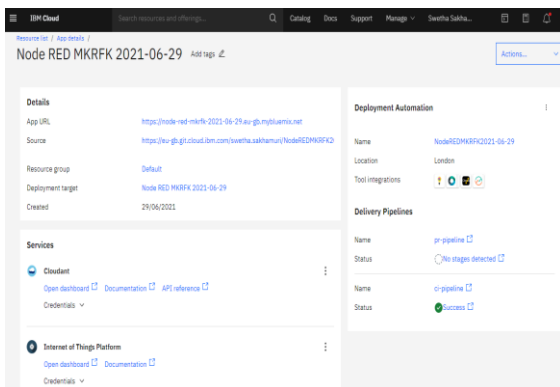


Fig -4: Node-RED App

Smart contracts- Smart contracts are computer programs that run when certain criteria are satisfied and are stored on a blockchain platform. They are usually used to automate the execution the given agreement so that all the participants can be known about the outcome without any intermediate involvement.

1.2 FLOW

- Initially, a smart contract needs to be created, packaged and deployed on a Hyperledger Fabric using the IBM Blockchain Platform Extension for VS Code.

2. METHODOLOGY

Initially, we have to create an account in the IBM cloud. In the catalog of the IBM cloud, we have to choose the Node-RED app service and create the app by providing the app name. Once the app is created, add the Internet of Things platform service. Now the app is ready to get deployed. Once the app is deployed, we will get a Node-RED app URL and Watson IoT platform URL.

In the Node-RED app, we need to import a JSON file to create a flow for our simulation. This Node-RED will be acting as a simulated device for scanning assets at different locations. In the Watson IoT platform, we have to register a device and an app to facilitate communication between the Node-RED app and Watson IoT Platform.

The received events from the Node-RED can be seen in the recent events section of the registered device. The API key and Authentication token of the app should be saved for further reference.

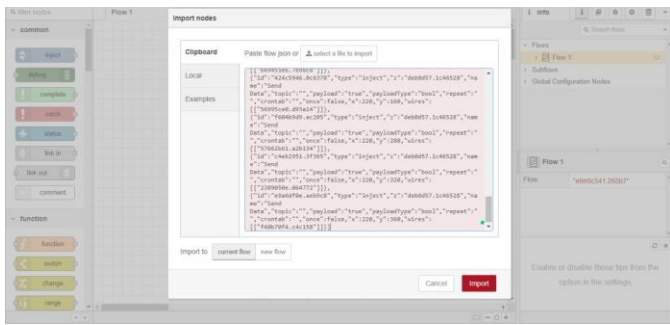


Fig -6: Importing Nodes

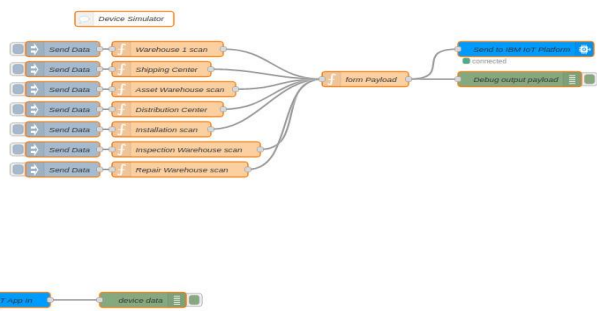


Fig -7: Asset Flow

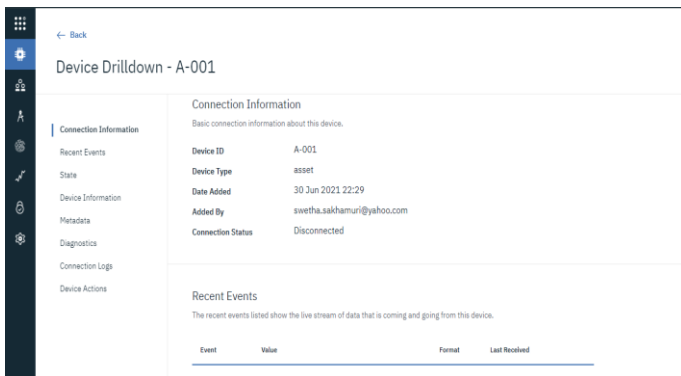


Fig -8: Watson IoT Platform

After installing the necessary tools, Asset tracking can be done in the following way. The local fabric needs to be started in the IBM Blockchain Platform Extension. The local fabric will start running if the docker is running on the machine. Then the smart contracts which are created should be packaged and deployed (installed and instantiated) onto the fabric network.

The IBM Blockchain Platform Extension provides an easy way to invoke transactions without writing an application or code for it. The invoked transactions can be evaluated or submitted onto the ledger according to our need.

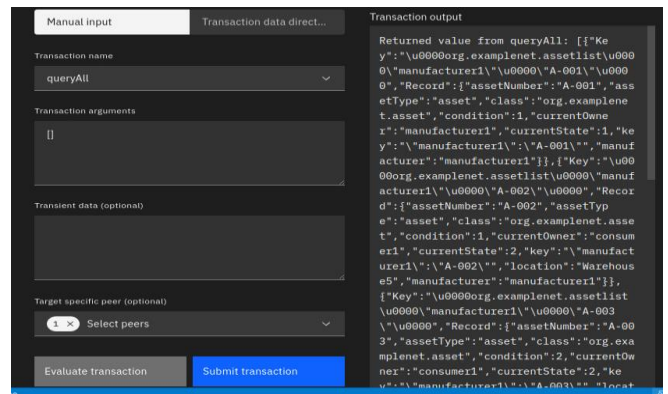


Fig -9: Invoking Transactions In VSCode

We need to start a local application which will listen to the scanning events and invoke transactions. After providing the necessary device credentials to the node.js app, the app will be ready to listen to the events on the connected channel. The received events will be updated on the ledger. We can invoke transactions that are provided in the smart contract to see if the location is updated or not in the ledger.

3. EXPERIMENTAL RESULTS

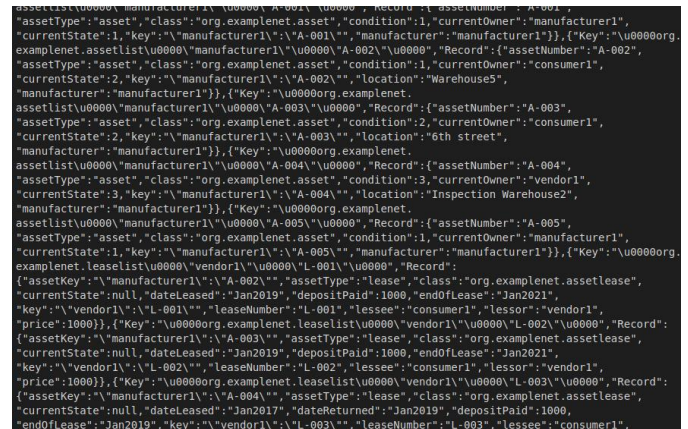


Fig -10: Contents of Ledger, before invoking the scan at Node-RED

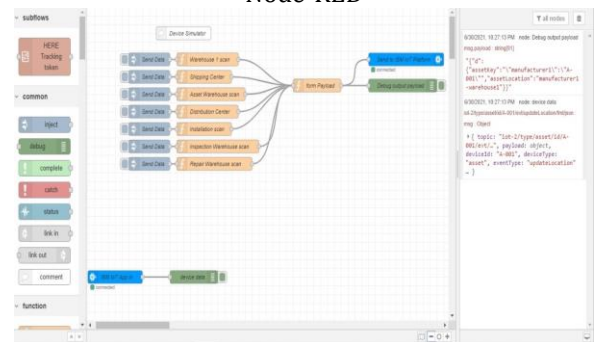


Fig -11: Scanning at NODE-RED app

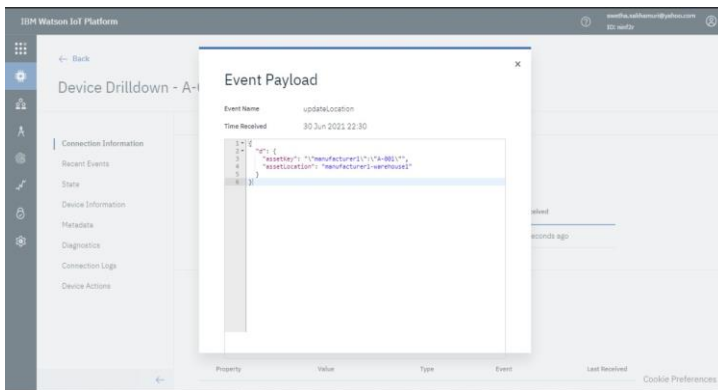


Fig -12: IBM Watson IoT Platform receiving Events

We can see the location “manufacturer1-warehouse1” of asset A-001 is updated on the ledger

```
assetList[u0000\manufacturer1\0000\A-001\0000",Record":{"assetNumber":"A-001",
"assetType":"asset","class":"org.exemplenet.asset","condition":1,"currentOwner":"manufacturer1",
"currentState":1,"key":"\manufacturer1\0000\A-001\0000","location":"manufacturer1-warehouse1",
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"manufacturer":"manufacturer1"},{"key":"\u0000org.exemplenet.
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"currentState":3,"key":"\manufacturer1\0000\A-004\0000","location":"Inspection Warehouse2",
"manufacturer":"manufacturer1"},{"key":"\u0000org.exemplenet.
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"currentState":null,"dateLeased":"Jan2019","depositPaid":1000,"endOfLease":"Jan2021",
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"endOfLease":"Jan2019","key":"\vendor1\0000\L-003\0000","leaseNumber":"L-003","lessee":"consumer1",
"lessor":"vendor1","price":1000}}
```

Fig -13: Final Contents of Ledger

4. FUTURE SCOPE

With Digitalization rapidly growing in every field, every organization needs to upgrade its methodologies for reliable and secure working. IoT and blockchain together form a very powerful combination in upgrading the business and provides a hassle-free working environment. Asset tracking methodology can be used in many other domains like in hospitals, schools and many more fields that reduce the load of manual tracking the assets.

5. CONCLUSION

Asset monitoring is critical in every organization, and it must be done in such a way that no data is tampered with, because assets account for a big portion of a company's overall value, and asset management is required to meet industry-standard norms. As a result, we can infer that Blockchain-enabled asset monitoring benefits all types of businesses by preventing theft, loss, and damage while also making all transactions secure and transparent. We created a minimal viable product that tracks assets in a low-code environment

and allows users to drag and drop pre-configured nodes. A complete application with full capabilities can be extended further with additional research and improvements in response to changing technology trends.

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