Blockchain-based Universal Loyalty Platform

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***Abstract* —** Loyalty Programs are reward programs offered by a company to customers who frequently make purchases. However, there are major issues with traditional loyalty programs like low redemption rates, expiring of points, customer acquisition costs, and the nuisance of keeping track of multiple loyalty programs. Blockchain provides a solution to a number of these issues. This paper explores the issues of the current loyalty programs and how Blockchain technology can be used to tackle the underlying issues of traditional loyalty programs. Finally, we propose our own Blockchain-based universal loyalty platform, which aims at making loyalty programs more beneficial for customers, thereby increasing customer retention rates as well as more convenient for companies to have their own loyalty program. This system aims to integrate individual loyalty programs into a unified platform that will allow transfer and exchange of loyalty points between users and promote co-branding among various companies located worldwide.

Keywords – Blockchain, Blockchain Loyalty, Loyalty Program, Universal Loyalty Program, Hyperledger Fabric, Stellar Blockchain

I. INTRODUCTION

Loyalty programs play a crucial role in improving the revenue of a company. According to a study done by Bain & Company, an increase in customer retention rates by 5% leads to an increase in profits by about 25%-95% [1], so ideally, an effective loyalty reward program can enhance the customer experience. However, implementing and maintaining loyalty programs can be difficult, as stated by the report by 3Cinteractive in 2016, that 70% of consumers don't sign up for a loyalty program due to the inconvenience and time required to complete registration. The report also indicates that only 18% of consumers know how many loyalty points they have for their favorite brands [2]. According to Reuters & Affinity Capital Exchange (2017), an estimated USD 500 billion in points are left unredeemed by members. This shows that while loyalty programs have become pretty common, companies need to invest to make them attractive to customers. Customers appreciate more personalized and shared loyalty programs. Moreover, there are also security risks involved in loyalty programs. Given the vast amount of personal customer data a company holds, the risk of a privacy breach is apparent [3]. Blockchain can help in addressing these issues. As a trustless distributed ledger, Blockchain allows participating agents, which in this case of loyalty rewards programs include loyalty reward program providers (brands) to interact in one system without intermediaries and without compromising privacy or competitiveness [3]. This system creates a centralized platform for storing loyalty points of different brands and therefore, enhances the flexibility of management of these points for customers. Customers can access their loyalty rewards from different brands via a single digital wallet. Thereby resulting in increased engagement of users. This system also aids in building a contract between companies, which will help in creating a direct point of contact via the system. A major problem for companies is the sharing of sensitive data during co-branding. This system will also benefit loyalty program providers to function in a universal platform without compromising data privacy.

II. HOW BLOCKCHAIN CAN IMPROVE TRADITIONAL LOYALTY PROGRAMS

A. CUSTOMER'S PERSPECTIVE

- In traditional loyalty programs, the user does not own the points, and the points have no value except on the issuing platform. The points issued are stored on the company database. Moreover, the company can decide to devalue the points at their own disposal. This sort of loyalty program is heavily biased towards the company. Since, in a Blockchain-based loyalty program, the "points" ownership details are publicly available and belong to the customer, customers will always have full control of and transparency about their loyalty programs and points. The company cannot devalue the points.

- Most of the companies offer loyalty points for a brief period of time after which it gets expired and thus, the customer is compelled to spend it before the deadline. However, using Blockchain, the points will be recorded on the immutable network and so, the points cannot get expired.

- Traditional loyalty programs are limited by usage. The company reward points cannot be used in any other platform and virtually possess no value outside the company loyalty program. However, Blockchain-based loyalty programs allow sending and receiving of points as well as exchanging of points directly or thereby, indirectly increasing customer privileges.

- The security of customer data is of major importance to any user and company. In a traditional system, the data is stored in databases that are vulnerable to attacks by hackers and thus, privacy is breached. In Blockchain, ownership data is replicated across many 'nodes' around the world and is stored in an encrypted format, which is a highly secure and available system.

B. COMPANIES' PERSPECTIVE

- Increased user engagement as brands who register to the universal platform will tap into a large loyalty community of existing customers, which makes it easier to boost new loyalty programs and attain a wide customer reach.

- Blockchain-based loyalty programs offer a cost-effective alternative to traditional programs. This is mainly because the peer-to-peer nature of blockchain reduces the need for intermediaries. Merchants pay third parties huge amounts to service credit cards tied to loyalty points. This also greatly reduces the transaction fee involved.

- In traditional systems, loyalty points normally form a balance sheet liability and are accounted for as deferred revenue for the company [2]. Using Blockchain, branded points do not impact the company's balance sheet as the users directly own the points.

- Blockchain-based platforms help in building business relations across the world. A company can collaborate with companies based anywhere, conveniently and securely.

III. BACKGROUND

Before exploring how blockchain can be used to create an ecosystem which allows brands to run their loyalty programs, it is important to shed light on some of the aspects of Blockchain technology.

Blockchain, at its core, is a peer-to-peer distributed ledger that is cryptographically secure, append-only, immutable (extremely hard to change), and updateable only via consensus or agreement among peers. Every peer maintains a copy of the ledger. The peers execute a consensus protocol to validate transactions, group them into blocks, and build a hash chain over the blocks [4].

A. PERMISSIONLESS AND PERMISSIONED BLOCKCHAIN

Public or permissionless blockchain are open to participation for everyone without a specific identity. Public blockchains are fully decentralized. Bitcoin is an example of a public blockchain. Private or permissioned blockchains, on the other hand, control read, write access to the blockchain using privileges [12]. A permissioned blockchain provides a way to secure the interactions among a group of entities that have a common goal but which do not fully trust each other, such as businesses that exchange funds, goods, or information [3].

In our proposed system, we plan to use two blockchain technologies, Stellar - a public blockchain, and Hyperledger Fabric - permissioned blockchain. Stellar is an open-source public blockchain which allows decentralized exchange of points based on a concept called offers [6].

To allow co-branding between companies, the system should allow parties to establish and enforce an agreement between the companies. Smart contracts using blockchains like Ethereum allow two or more parties to automate contractual agreements in a trusted way. However, transactions in permissionless blockchain that leverlages PoW for its consensus model are executed on every node. B2B contracts created for co-branding may require privacy control to protect sensitive business information from being disclosed to outside parties that also have access to the ledger. This prompted us to make use of Hyperledger Fabric which is a private, permissioned distributed ledger technology designed for enterprise use [7].

We study how Stellar and Hyperledger Fabric are incorporated in our system in Section V.

B. SMART CONTRACTS

Smart Contract or chaincode in context of Hyperledger Fabric is a program that runs in a Docker container isolated from endorsers.

Each smart contract has a unique address and are stored on the blockchain. The smart contracts are invoked by addressing a transaction to it. Based on the information mentioned in the triggering transaction, it is executed automatically [4]. The terms of the contract or the business logic can be decided by the members of the network. Smart contracts aim to perform trusted transactions without the need of a trusted third party.

C. *HYPERLEDGER FABRIC*

Hyperledger is an open source collaboration hosted by the Linux Foundation to promote cross-industry blockchain technologies.

One of the projects under this collaboration is Hyperledger Fabric. Hyperledger Fabric is a modular system for deploying and operating permissioned blockchains.It is the first blockchain system that allows distributed applications written in standard, general-purpose programming languages such as Java, Go and Node.js.

For enterprise use, permissionless blockchains are not able to deliver essential requirements like identity of participants e.g Know-Your Customer (KYC) regulations in financial transactions. Hyperledger has been designed for enterprise use [7].

Hyperledger Fabric provides the required confidentiality required for business using the concept of "channels". Hyperledger Fabric network consists of fundamental elements called "peers". They host ledgers and smart contracts. Hyperledger Fabric provides an SDK using which applications can connect to peers, invoke chaincodes to perform transactions [8]. Peers in a Hyperledger Fabric network can create "channels" between a group of peers who are allowed visibility to set of transactions. Only this group of peers have access to the smart contract and the transaction data. This ability can be effectively utilized to incorporate co-branding between companies ensuring confidentiality of data. Moreover, this also ensures that the system is protected from a malicious contract [9].

D. *STELLAR BLOCKCHAIN*

Stellar is an open-source, decentralized payment platform that allows for fast, cross-border transactions between any pair of currencies. Stellar allows fast and cheap transactions, with everyone on the network reaching agreement about transaction validity within a few seconds [10].

Stellar's unique distributed exchange policy allows trades between different assets. An asset is anything of value like dollar, bitcoin, gold or loyalty points. Another important attribute of Stellar is that while any one can join the network, financial organizations can choose to transact with, specific organizations whom they trust and can obtain proof before on boarding an end user as their customer.

Like a traditional ledger, the Stellar ledger records a list of all the exchanges which is a part of every account on the network. The Stellar ledger stores offers that individuals made to purchase or sell digital assets. Offers are public commitments to exchange one type of credit for another at a predetermined rate. The ledger becomes a marketplace for offers.

IV. LITERATURE SURVEY

There are few platforms which have used blockchain technology to solve the inefficiencies in traditional loyalty programs. In this section, we discuss some of these platforms and the differences and the shortcomings in them.

A. *Qiibee*

Qiibee provides a standardized plug & play platform which allows brands to easily issue their own tokens with the "LoyaltyToken Protocol" using Qiibee's QBX token issued on the Ethereum platform. After companies have decided their budget for loyalty programs, they can issue their loyalty token by staking QBX tokens through the qiibee protocol on different blockchains. The QBX token is on the public Ethereum chain and it acts as the backing asset for each loyalty token [3].

Popular blockchains like Ethereum which are usually chosen to build projects on, soon become susceptible to slow transactions with high fees. Qiibee uses cross-chain bridges with which data can travel seamlessly between blockchains. The cross-chain bridge enables communication between Ethereum and the loyalty blockchain. The loyalty tokens are then sent to the brand account who are given the ability to issue them to customers accordingly [3].

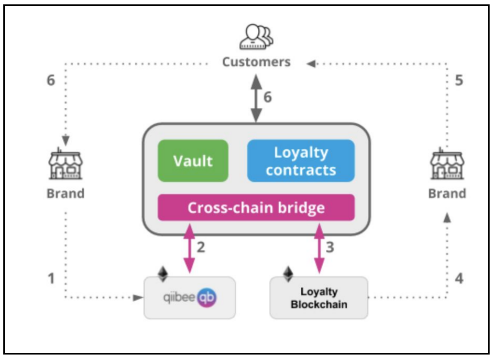

Fig. 1. Overview of Qiibee ecosystem

However, our platform makes use of the Stellar blockchain. To understand why we use Stellar, we must first study the differences between Stellar and Ethereum with respect to factors which may affect our platform.

Parameter	Stellar	Ethereum
Blocktime (w/ Confirmations)	2-5s	5m to 1h+
Transaction Costs	Very low	High
Multi-Asset	Built-in	Custom App via Smart Contracts
Distributed Exchange	Built-in	Custom App via Smart Contracts
Compliance Mechanism	Built-in	No

Table 1: Comparison between Stellar and Ethereum

The given table illustrates a high level comparison between Stellar and Ethereum. Stellar outperforms Ethereum in terms of the number of transactions per second (10,000 transactions per second) and the time to verify transactions (approximately 3-5 seconds). Moreover, the transaction cost in Stellar is 0.00001 XLM (1XLM = 0.05718 USD), which is significantly lower than the transaction cost of Ethereum. Additionally, Stellar provides the built-in feature of multi-asset and distributed exchanges which avoids the need for creating a custom application like in the case of Ethereum which makes implementing the loyalty platform less complex.

B. Loyyal

Loyyal has partnered with the Dubai Future Foundation to create a proprietary tourism incentives program powered by blockchain and smart contract technology. It uses blockchain and smart contract technology to drastically reduce the costs of setting up and operating a loyalty program. They utilise the Hyperledger Fabric "private channels" to ensure private, secure transaction sharing between companies.

Hyperledger Fabric is a private blockchain where proof of payment required by transactions before transferring assets is not an easy process. When only Hyperledger fabric is used for the loyalty platform, smart contracts are used to create an asset definition for loyalty coins. This compels to have at least one bank on the network who helps in conversion of fiat currencies to loyalty points and vice versa.The problem faced in this technique is that loyalty points are restricted to the network and it is necessary to have a bank involved for the conversion.

Thus, we use the integration of Stellar blockchain and Hyperledger to get rid of the problem as the transactions or payments done in the form of tokens or loyalty points can be deployed to use without the involvement of any bank.

V. PROPOSED SYSTEM

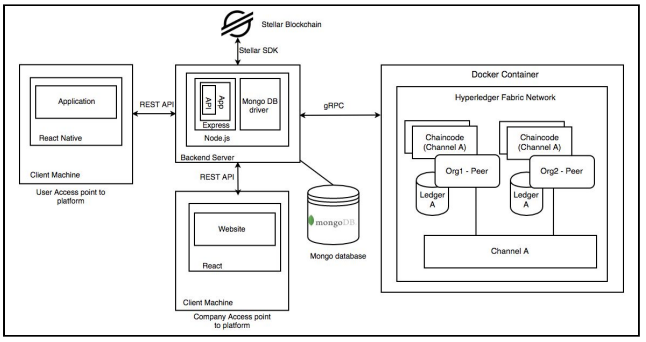

Fig 2. Architecture of proposed system

We propose a simple plug and play application that will be used by the customers to use their loyalty points to buy products. Customers can access the loyalty programs with the help of an app which makes tracking of all their loyalty assets from various companies very convenient. They can send and receive points, trade points with other customers, check their current balances, and be updated about the latest news from the registered companies. Thus, customers are benefited from various companies which has collaborated with the company who's points they own. Upon registration, a customer Stellar account is created. Each customer account will be associated with a unique Stellar account id. Stellar network allows the decentralized distributed exchange of any type of asset that people have added to the network. Its ledger stores both balances held by user accounts and offers that user accounts make to buy or sell assets. The Stellar wallet linked to the account id will store the loyalty assets pertaining to each brand (company) earned by that customer. The customer can trade the loyalty points earned from one company with the loyalty points earned from another company by making a trade offer. When an account makes a trade offer, the offer is checked against the existing order-book for that asset pair. An orderbook is a record of outstanding orders on the Stellar network. This record sits between any two assets. If the offer crosses an existing offer, it is filled at the price of the existing offer. For example, you make an offer to buy 100 loyalty coins of "Company A" for 20 loyalty coins of "Company B". If an offer already exists to sell 100 loyalty coins of "Company A" for 20 loyalty coins of "Company B", your offer will take that offer and the exchange is performed. Payments or exchanges in Stellar which in our case will be equivalent to a points trade are called operations. Every

transaction contains operations and has a base fee involved. It is very small—100 stroops (that's 0.00001 XLM) per operation. This provides a better alternative to Ethereum based platforms which are susceptible to slow transactions and high fees [11].

```
server.loadAccount(destSecret.publicKey())
    .then(function (receiver) {
        // console.log(receiver)

        var transaction = new StellarSdk.TransactionBuilder(receiver,{fee:100})

            //Creating Trust
            .addOperation(StellarSdk.Operation.changeTrust({
                asset: new StellarSdk.Asset(assetName, issrAccountId),
                source: destSecret.publicKey(),
                //limit: 10000000
            }))

            //Asset Creation
            .addOperation(StellarSdk.Operation.payment({
                destination: destSecret.publicKey(),
                asset: new StellarSdk.Asset(data.tokenname, issrAccountId),
                amount: "100000",
                source: issuerKeyPairs.publicKey(),
            }))

            //Selling 1 companytoken for 1 XLM
            .addOperation(StellarSdk.Operation.manageSellOffer({
                selling: new StellarSdk.Asset(data.tokenname,destSecret.publicKey()),
                buying: new StellarSdk.Asset("xlm"),
                amount: "1000",
                price:"1",
                offerid:0

             }))
            .addMemo(StellarSdk.Memo.text('1000 new asset to newAcc'))
            .setTimeout(20)
            .build();

        transaction.sign(destSecret);
        transaction.sign(issuerKeyPairs);
```

Fig 3. Operations - ChangeTrust, Payment, ManageSellOffer

```
exports.makeBuyOffer = async function(companydetail,senderdetail){
    console.log("Get Uber assets")
    console.log(companydetail,senderdetail)
    StellarSdk.Network.useTestNetwork();
    var hardikKeyPairs = StellarSdk.Keypair.fromSecret(senderdetail.accountSeed);
    var companyKeyPairs = StellarSdk.Keypair.fromSecret(companydetail.issuingAccountsecretKey)
    var server = new StellarSdk.Server('https://horizon-testnet.stellar.org');
    var transaction;
    server.loadAccount(senderdetail.accountId)
        .then(function (receiver) {
            console.log(receiver)

            var transaction = new StellarSdk.TransactionBuilder(receiver,{fee:100})

            .addOperation(StellarSdk.Operation.manageBuyOffer({
                selling: new StellarSdk.Asset("xlm"),
                buying: new StellarSdk.Asset(companydetail.tokenname,senderdetail.accountId),
                buyAmount: "1000",
                price:"1",
                offerid:0

             }))
             .addMemo(StellarSdk.Memo.text('1000 tokens sent to Hardik'))
                .setTimeout(100)
                .build();

                transaction.sign(hardikKeyPairs);
                console.log(transaction)
            server.submitTransaction(transaction);
            console.log('Buy offer created')
        })
```

Fig 4. Operation - ManageBuyOffer

The platform also provides companies a website to access the platform. Companies can register to the platform on the website and will need to finish KYC before using the platform. Companies can choose other companies (registered to the platform) with whom they want to co-brand. As soon as they register, a Stellar account id will also be associated with each company token. A chaincode (smart contract) stored on the Hyperledger Fabric will be invoked which issues the creation of a token on the Stellar platform, linked to the company's account id. The code snippets(Fig 3 and 4)above depicts a function which creates a transaction with the following operations - Change Trust, Allow Payment of Assets and Manage Sell Offer. The Change Trust operation creates a trustline between the issuing account of the company and the distribution account. The Payment of Assets operation allows the distribution of Account to sell the company "points" or assets. In this code, the amount i.e. 100000 depicts the number of assets the company can issue. The Manage Sell Offer creates a sell offer which will then be added to the orderbook. This will allow companies to issue points to their customers. In case of transferring and exchanging points, each customer will create a Buy Offer which if matched will automatically trigger the transaction. These offers are created and validated via the seed associated with each account, ensuring security throughout [6].

The major concern for companies during co-branding is exchange of confidential data. Peers can use private channels which provides confidentiality and transaction privacy. We use Hyperledger Fabric channels to ensure secure co-branding between companies. The trade offers will be limited to companies in the channel. A chaincode which will define the business logic of the co-branding will be created. Only the companies in the channel will have access to the chaincode. Chaincode (smart contracts) defines parameters for a change of asset ownership, for example, ensures that all transactions that transfer ownership are subject to the same rules and requirements. Only if this requirement is satisfied will the trade offer be valid. The chaincode will also encode logic to correspondingly modify the asset data in the company databases. Companies can use analytics to track the customer's transactions and promote new offers. The role of the company is given in the below diagram.

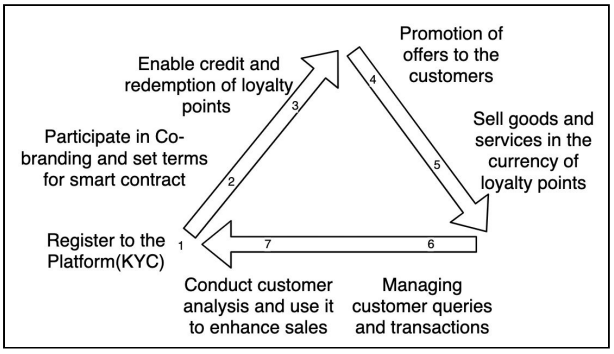

Fig 5. Companies' journey on the Blockchain-based Network

VI. BENEFITS OF THE PROPOSED SYSTEM

- Provides near real-time credit of reward points that can readily be redeemable.
- A common digital wallet can be used by participating loyalty providers to credit rewards. This will eradicate the problem of managing reward points offered by different companies or service providers. This also provides complete control to providers and consumers alike—the former being able to set the rules that will govern how customers can use the rewards, and the latter having full control to access and use these points as they deem fit.
- This can also allow customers to transfer unused points to a friend or family member registered on the same loyalty network.
- This solution makes it easier for new partners and vendors to join the program, in turn, giving consumers more options to choose from.
- Help registered merchants gain better access to customer sentiments, likes, and dislikes. Using this information, companies can customize their offerings to suit customer preferences, thereby serving as a customer acquisition and retention mechanism. This way, the solution can help in bringing down the cost of acquiring and retaining customers.
- The loyalty platform is not bound to one city, state, or country. The customers can benefit from a plethora of companies or service providers from all over the world who are registered to the platform.
- The use of permissioned blockchain rather than a public blockchain ensures the confidentiality of data between a group of companies wanting to collaborate.
- Stellar Blockchain provides high speed transactions with low fees as compared to other Blockchain platforms like Ethereum. Moreover, the system also avoids the cost incurred due to intermediaries.

VII. CONCLUSION

In this paper, we aim to eliminate the problems faced by traditional loyalty programs by proposing a Blockchain-based solution. It replaces regular promotion cards with mobile wallets and stores all transaction details in the blockchain system. Therefore, the usability of the system is increased and manufacturing companies can know the customers better. The customers can exchange loyalty points with any of the partnered merchants. Our system reduces the hassle of managing relations with a number of partner merchants. We propose a one-stop solution to creating, managing your loyalty program while giving an enriching user-experience to the people who use the loyalty points.

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