FitOp: A Whitepaper on An Integration of IoT technology and Blockchain in the Fitness Industry

Sarah Mbawa 1774392

Digital Transformation and Scalability

4/1/21

Executive Summary

COVID-19 restrictions have affected our daily routines. The closure of gyms and sport centres have left fitness enthusiasts with creating alternative ways to keep up with daily exercise or sporting activities. The primary goal of **FitOp** is to provide a platform which aims to connect trainers with fitness enthusiasts and other parties such as government agencies (healthcare) and researchers by integrating Internet of Things (IoT) with blockchain technology. We aim to provide a trustworthy and secure platform that allows it members to collaborate and trade data without any interference from a third party. Our secondary goal is to promote and improve efficiency in wellness and fitness during the COVID-19 pandemic and even after. This platform runs on an Hyperledger Fabric and an Ethereum smart contract in order to ensure that all transactions amongst its members or stakeholders are private and user-controlled. In recent times, Blockchain technology have garnered remarkable attention due to the provision of features, such as privacy, accountability, transparency, and anonymity. On the other hand, IoT devices used for fitness or sporting activities such as smartwatches or fitness accessories face security threats. They have proven to have limited capacity in terms of privacy and storage, making it easier for security breach and also data produced by these devices possess a challenge for the existing platforms to process and analyse patterns to provide a secure and transparent environment. Therefore, a new solution is required to ensure data accountability, improve data privacy and accessibility, and extract hidden patterns and useful knowledge to provide adequate fitness services. The FitOp is a user-centred decentralized platform that aims to promote transparency, flexibility and trust.

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1.0 Introduction

In the past year, the fitness industry amongst other industries suffered severe financial losses due to the COVID-19 pandemic. The imposition of lockdowns and closure of fitness or sports schools had forced most people who had any sort of fitness routine to change and also contributing to the financial loss in this industry. Some fitness enthusiasts have found alternative ways to maintain or keep up with their previous fitness goals by downloading fitness apps and exercising at home and using wearable technology (fitness tracking) when going on socially distanced runs or hikes amongst other things. Nowadays, many chronic diseases have arisen due to laziness or inactivity, sustained stress and unhygienic food, which are the primary source of disability, death, and poor health (Jamil et al., 2021). Sustaining a healthy body is not only limited to a reasonable diet but more importantly, requires a scientific exercise habit. A large number of studies have proven that regular aerobic exercise is beneficial to human health and can improve the body's athletic ability and physical fitness (Shan & Mei, 2020).

2.0 Existing Problems in the Fitness Industry

Nowadays, the collection of health and sports information has gone through several stages of development (Shan & Mei, 2020). Although fitness mobile applications and wearable technology do provide (health and fitness-related) benefits to the consumers, they also pose new and relatively unpredictable challenging threats to data privacy and security (Fietkiewicz & Ilhan, 2020). Currently, the most prominent concerns with technology in fitness are Data privacy and security, especially since wearable technology encourages the collection, storage and sharing of health-related data, which might be perceived as more sensitive than the usual name-gender-age information, nowadays rather willingly shared on many social networks (Fietkiewicz & Ilhan, 2020). Another issue with these technologies is that a single collection of motion information parameters has been unable to meet people's needs, and the method of judging human exercise intensity also needs to be improved (Shan & Mei, 2020).

Health and fitness data are very sensitive, therefore, it is important to ensure data security as not to compromise data integrity. These data are helpful when analysing fitness training progress. In storing and processing health and fitness information on the edge, it is important to ensure that the data are not altered or falsified due to any reasons. The information can be modified according to the service providers' interest, so this information may not be reliable (Jamil et al., 2021). Therefore, it is important to verify whether this information has not been modified to promote data integrity. Recently, blockchain-based solutions are now being introduced to various industries to provide various security services. Blockchain technology is most simply defined as a decentralized, distributed ledger that records the provenance of a digital asset (Built In, 2020).

Blockchain technology ensures security and transparency in transactions. Recently, the need for blockchain technology amplified when a single microbe showed just how interconnected the world is and how fragile supply-chain networks and logistics providers are when unexpected demand for critical goods (Blank Rome LLP, 2020) arose due to the COVID-19 pandemic.

Recently, Blockchain Technology can is being applied to the fitness industry to create new opportunities for its stakeholders. Like other applications, Blockchain also offers a solution to verify the trustworthiness of the information (Jamil et al., 2021).

To create a solution to the problems stated above (Data Privacy and Security, Data Record Tampering), this paper proposes a health-fitness management technology based on the Internet of Things (IoT) and blockchain technology. To improve data integrity, FitOp uses the IoT devices for users' physical activity or health fitness data collection in real-time, and can be uploaded to the blockchain encryption technology for data processing, management and transactions. This platform will be accessible to anyone with a private key (members) at any time without the restrictions of centralized mobile applications and wearable technology.

3.1 FitOp: The Proposed Solution

FitOp is a user-centred decentralized health fitness technology built on the concept of IoT and blockchain technology. This platform intends to operate on the principles of transparency and privacy by providing its members with adequate workout sessions and verified payment transactions, all the while promoting trust between the clients and the trainers. It will also promote independence amongst its members, and they will have total control over their data and services. This platform is built using the Hyperledger Fabric which controls access to health fitness records. The blockchain is also powered by the Ethereum Smart contracts (ERC20 token) which is the fundamental of all transactions withing the platform. The platform consists of the following:

- Ethereum Smart Contracts: An enhanced smart contract-based intelligent fitness service in blockchain networks. Based on an enhanced smart contract enabled link and a real-time inference engine that infers new knowledge from the IoT environment and store the mined knowledge into the blockchain ledger. It will serve as an electronic agreement between the user and third parties to grant access to read and write user data.
- Encryption key: the system is based on a permission blockchain model, where the data collected from the user's IoT device is secured and can only be accessible to authorized members. They can access the system logs and transaction history with their unique key.
- A token/ cryptocurrency: This system will be driven by token utility and reward that can be used in the real world.
- Hyperledger Fabric: The platform will be permission-based, requiring users to sign up and login into the platform for them to use it.
- A data identity management solution to protect and give the members control of their identity data.
- A marketplace for data to be traded amongst members

3.2 The Proposed Ecosystem: FitOp as a Fitness Platform and its Platform Economy

FitOp will use blockchain technology, Ethereum smart contracts and cryptocurrency to provide a digital fitness platform. This platform will be user centres; meaning it will be powered by the users' health and fitness data and the trainers and other stakeholders' available services. FitOp is open to everyone and aims to provide a platform for connecting trainers, fitness enthusiasts, researchers, fitness equipment providers, IoT companies, government agencies etc. We aim to create a thriving ecosystem that provides value and improves people's lives. This platform aims to provide the following services:

- A decentralized mobile application that provides its members with tailored fitness courses and diet plans.
- A marketplace wherein stakeholders can collaborate, trade data, trade fitness accessories or equipment and book workout sessions with each other on the Ethereum Smart Contract network.

3.3 Blockchain in the Fitness Industry

Blockchain technology with decentralized computing characteristics such as a decentralized distributed database formed by combining various technologies such as mathematics, economics, cryptography, and network science (Shan & Mei, 2020), provides varied solutions to address these high concurrency problems in IoT (Shan & Mei, 2020). The unique characteristics of the blockchain can solve the trust and privacy issues faced in the development of the IoT, and provide technical support (Halstead et al., 2018) such as transparency, distributed storage, trust, and other aspects (Shan & Mei, 2020).

Other companies in the fitness industry have included blockchain in their platforms but there is a lack of integrating IoT with blockchain technology. Another problem has also been their onboarding processing. In 2016, Jaroslav created TrueGym, an Ethereum based blockchain fitness application that aims to educate people on how to exercise properly. They focused on using a machine learning approach to analyze fitness data acquired from trainers and devices to recommend training plans for their users (True Gym, 2021). Though they provide a blockchain application, the system lacked the use of a real-time inference engine using Hyperledger fabric and an incentive for onboarding users. Hence, this platform will be a more user-centred platform with an emphasis on onboarding members and providing them with services that will influence them to continue using the platform.

3.4 Players in the FitOp Platform

Clients/Trainees

Members will have direct access to a trainer who will cater to their requirements and provide them with hands-on training on a customized diet based on their health and intake requirements. All exercise sessions and fitness activities will be tracked by one of our or users' preferred wearables. Our wearable; FitWatch will track the user's real-time body and mental data during exercise and wherever the user wants. The user has the sole right to upload and manipulate data collected in this watch. We will not interfere or collect at all (Read and Write Privilege).

For data to be considered valid during a transaction, the user has to show proof of work (in this case proof of actual fitness activity is measured by the heart rate, task, body temperature, body movement and duration). A valid fitness data can then be uploaded to the ledger and can be traded or shared with third parties by the user.

Trainers

These can either be expert trainers or intern trainers. In the case of an expert trainer, the trainer would provide their services on the app and interested clients can contact them on the app and negotiate a workout price rate with them for a time. They will be provided with the opportunity to take on a maximum of 20 clients per period of 6 months, this is done to not overwork the trainers and for them to also provide their clients with quality sessions. With every positive review or rating they get, their chance to take on new clients will improve, in order words, they gain points for every positive client review. These points will be accumulated to earn tokens. They can also earn more tokens by collaborating with third parties to give expert interviews and recommendations. All reviews will be verified to remove any bias. Trainers are allowed to invite new clients to the app and can earn points on whether or not the clients decide to work with them.

For intern trainers, they can only take on a maximum of 10 clients for a period of 6 months. They will also earn points based on reviews and can also collaborate with expert trainers. For this, they will earn an agreed-upon percentage of the expert trainer's points. All trainers must show valid proof of work before points are awarded. They can also be allowed access to the client's data per the client's incentive.

Researchers

Researchers will have to sign on to the app to use the system. They can collaborate directly with the clients and all transactions will be handled on a smart contract. They can earn tokens and points by trading expert reviews and solutions created with governmental agencies and other third parties.

Government Agencies

In the case of healthcare officials, they will also have to sign in and buy tokens to access the system. They can collaborate directly with the clients, trainers and researchers. They can also provide services such as diet plans and medical consultations on the platform.

IoT companies

These companies can sell their fitness wearables and accessories and also collaborate with trainers, trainees, researchers, and government officials. They will also have to sign in and buy tokens to access the platform.

Fitness Equipment Providers

These companies can rent or sell their equipment and collaborate with trainers, trainees, researchers, and government officials. They will also have to sign in and buy tokens to access the platform.

Transaction

All transactions on the blockchain will follow the Ethereum Smart contract network. All members possess unique encrypted keys that they only have access to.

4.0 FitOp Platform Economy

FitOp's Initial Coins Offering (ICO) will be first offered in a Crowdsale to allow members to purchase ExoCoin, a ERC20 token and to also contribute to further improvement of the platform. We aim to issue 100 thousand ExoCoin equivalent to 5 thousand Ether (ETH).

4.1 Token Utility

The ExoCoin will be used for all transactions occurring on the platform. Members will subscribe and pay for the product and services using the ExoCoin. We intend to develop wearables that will be sold on the platform. To reduce inflation, when a token isn't used during a particular period, it will depreciate by 1.5% to encourage spending and discourage hoarding. To encourage token outflow, the following can be done within and outside the ecosystem:

- Use tokens to pay for services (e.g., workout sessions, buy data)
- Use tokens to buy fitness accessories.
- Token can be transferred or lent to a friend or family's wallet.
- Token can be exchanged for physical cash.
- Token can be converted to other cryptocurrencies.
- Tokens can be used to book appointments with third parties.

4.2 How to earn Tokens (Onboarding Process)

The main focus of this platform is to get the members to stay and use the services on the platform. To promote that, we will offer opportunities to earn financial rewards in the form of a cryptocurrency; ExoCoin. ExoCoin is a virtual currency that can be bought on our platform

and would be tied to the European Euro so as not to influence its price due to the exchange rate of the ExoCoin. The token can be earned or obtained through the following ways:

- It can be purchased on our platform for physical cash at a transaction rate of 1 Euro = 0.50 ExoCoin.
- When a user login into the app for the first time, they would be given 2 ExoCoin to be used on services provided on the platform (this is done to promote the site).
- Members will earn 60 points for every Token earned by the first client onboarded to the platform; 80 points for the second client and 200 points for the 5th client brought to the platform. A total of 500 points from this process will result to 20 ExoCoin.
- And for every referral to this platform, the user will get 2 free ExoCoin.
- If a user shares their data with any third party, they will be paid at an agreed price in ExoCoin.
- For every true and real data (data will be verified by the proof of work concept), you upload per daily exercise the user will get 50 points. A total of 10,000 points will result to 150 ExoCoin.
- Wallets can be shared between friends and family; that is you can transfer tokens.

For Trainers on the platform, tokens can be earned by the following ways:

- For every client you book and maintain classes with, you get 4 free ExoCoins.
- For every client you onboard to the platform, you get 10% of their earnings for 3 months.
- If a trainer successfully trains a client for a minimum of 100 days or sessions, they will get 5000 points. They will need a total of 10,000 per 5 clients to get 200 ExoCoin.

For Researchers

- For every completed transaction with a trainee, you will get 35 points (data purchase). and with a trainer, you get 35 points (collaborations and possible interviews).
- For any completed transaction with a government agency, you get 30 points.
- If you invite or onboard 3 trainees, you get 50 points each and for 3 trainers you get 50 points each.
- For every government agency you refer to this platform, you will gain 100 points each.

For Government Agencies

- For every completed transaction with a trainee, you will get 35 points (data purchase). and with a trainer, you get 35 points (collaborations and possible interviews).
- For any completed transaction with a researcher, you get 30 points.
- If you invite or onboard 3 trainees, you get 50 points each and for 3 trainers you get 50 points each.
- For any other government agency you refer to this platform, you will gain 100 points each.

For IoT companies and Fit Equipment Providers

- For every completed transaction with a trainee, you will get 35 points (data purchase). and with a trainer, you get 35 points (collaborations and possible interviews).
- For any completed transaction with a researcher, you get 30 points.

- If you invite or onboard 3 trainees, you get 50 points each and for 3 trainers you get 50 points each.
- For any other government agency you refer to this platform, you will gain 100 points each.

5.0 Relevant Concepts Used in designing the FitOp Platform

Hyperledger Fabric is a platform for distributed ledger solutions underpinned by a modular architecture delivering high degrees of confidentiality, resilience, flexibility and scalability. This architecture allows for solutions developed with Fabric to be adapted for any industry, thus ushering in a new era of trust, transparency, and accountability for businesses (Hyperledger, 2020). Owing to the high sensitivity of Health and personal information, in both a social and legal sense, a closed blockchain such as Hyperledger Fabric helps retain the necessary privacy required for the FitOp platform. Hyperledger Fabric has proven to be a better solution for managing access to health records, as it accommodates multiple layers of permission (Verma, 2018). Thus for the proposed platform, the members have total control over what data will be made accessible to the public. This will be possible via the “channels” feature in Hyperledger Fabric if the clients need transaction isolation, and the “private data” feature if they’d like to keep data private while sharing hashes as transaction evidence on the ledger (private data can be shared between “collection” members, or with a specific organization on a need-to-know basis) (Coin, 2021).

5.1 Ethereum Smart Contracts

This platform is built on the Ethereum Smart Contract network. A smart contract is a program that runs on the Ethereum blockchain. It's a collection of code (its functions) and data that resides at a specific address on the Ethereum blockchain and are defined by rules like a regular contract, and automatically enforce via codes, balances and send transactions over the Ethereum network (Ethereum, 2021). This means once a transaction is verified and approved, the token from FitOp; EcoCoin, will be transferred to the other user. To promote data integrity and security, smart contracts are made free from users' control and are deployed after being granted permission on the network. The original codes of the contracts cannot be edited but will update with every new transaction that executes its function. Every executed smart contract will run on the network as programs.

5.2 Benefits of FitOp

FitOp will not only provide a decentralized platform for fitness enthusiasts and researchers or government agencies for collaboration and transactions but will also promote health and fitness by rewarding proof of work amongst its members. This platform aims to promote Transparency and Trust in transactions and operations amongst its members by giving them control of their data and services. All workout bookings, buying and selling of data and fitness accessories can be transacted fairly with a decentralized ledger keeping records of all smart contracts. These Public smart contracts will serve as proof for all verified transactions.

6.0 Future Plans

Though we provide a platform that promotes security, privacy, transparency and flexibility, we aim to further improve by using Artificial Intelligence (AI) to evaluate users' statistics and provide virtual trainers. We also aim to collaborate with leading tech-based companies to provide AI solutions and with manufacturing companies to provide fitness accessories and equipment.

6.1 DApp built on Atra

Attached is a link directed to a prototype of what FitOp would look like. It was built on Atra and contains a marketplace, a message board in which anyone can post and an exclusive space for members to make proposals.
https://console.atra.io/app/02306b93-bb54-472f-80a1-5caec9a5108d

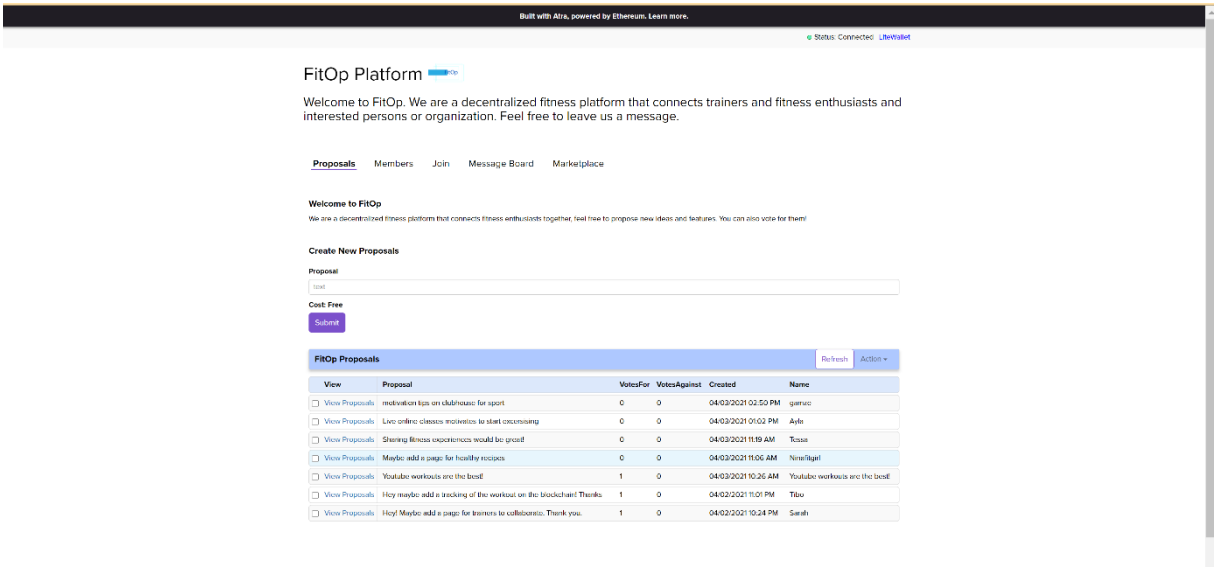

Fig.1: FitOp Platform

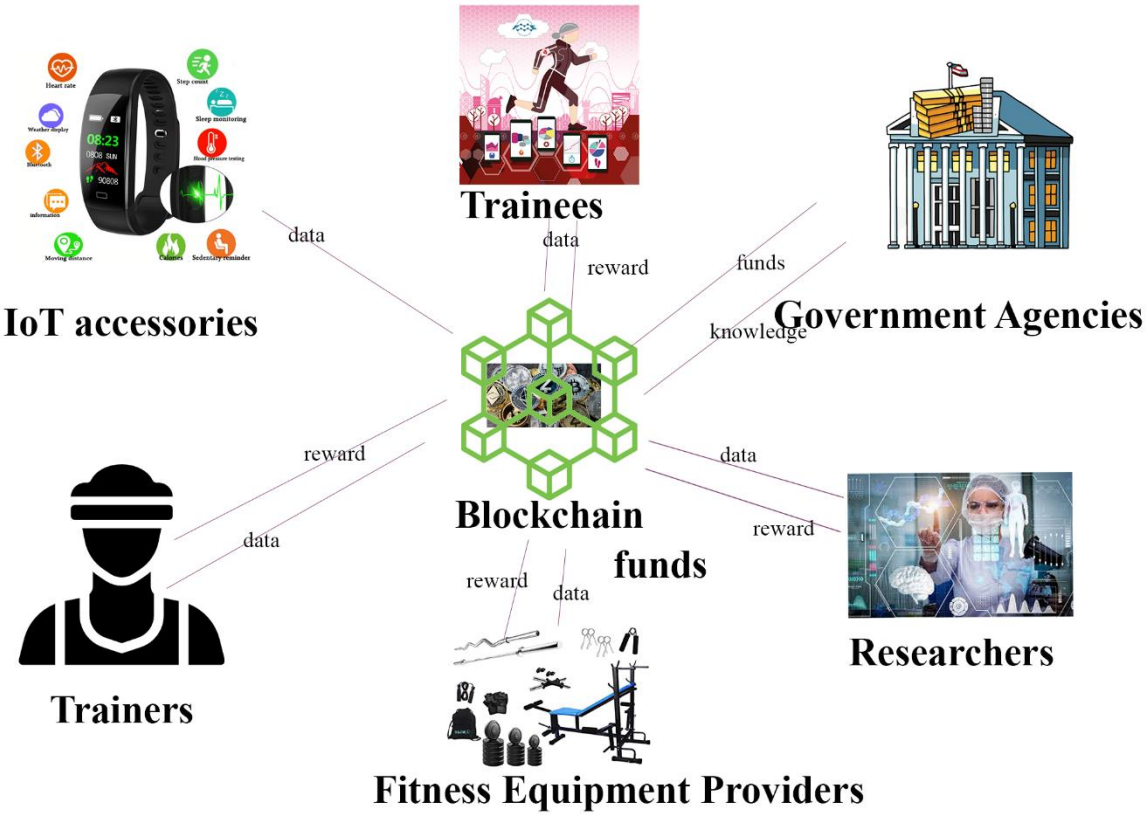

Figure 2: FitOp Ecosytem

References

Blank Rome LLP. (2020, December 9). The impact of COVID-19 on blockchain advancement. JD Supra. https://www.jdsupra.com/legalnews/the-impact-of-covid-19-on-blockchain-15757/

Built In. (2020). What is blockchain technology? How does it work? Tech News, Trends & Professional Development Resources | Built In. https://builtin.com/blockchain

Coin, G. (2021, February 16). *Hyperledger fabric*. Medium. https://glpcoin.medium.com/hyperledger-fabric-4b2704f5f6d8

Ethereum. (2021). Introduction to smart contracts. ethereum.org. https://ethereum.org/en/developers/docs/smart-contracts/

Fietkiewicz, K., & Ilhan, A. (2020). Fitness tracking technologies: Data privacy doesn't matter? The (Un)Concerns of users, former users, and non-users. Proceedings of the 53rd Hawaii International Conference on System Sciences.https://doi.org/10.24251/hicss.2020.421

Halstead, M. E., Walter, K. D., & Moffatt, K. (2018). Sport-related concussion in children and adolescents. *Pediatrics*, *142*(6), e20183074. https://doi.org/10.1542/peds.2018-3074

Hyperledger. (2020). Hyperledger-fabric documentation. A Blockchain Platform for the Enterprise—hyperledger-fabric documentation. https://hyperledger-fabric.readthedocs.io/en/release-2.2/blockchain.html

Jamil, F., Kahng, H. K., Kim, S., & Kim, D. (2021). Towards secure fitness framework based on IoT-enabled blockchain network integrated with machine learning algorithms. Sensors, 21(5), 1640. https://doi.org/10.3390/s21051640

Jamil, F.; Hang, L.; Kim, K.; Kim, D. A novel medical blockchain model for drug supply chain integrity management in a smart hospital. Electronics 2019, 8, 505. [CrossRef] 21.

Shan, Y., & Mai, Y. (2020). Research on sports fitness management based on blockchain and Internet of things. https://doi.org/10.21203/rs.3.rs-37955/v1

Verma, M. (2018, September 19). *EHR-solution-hyperledger-fabric-composer-poc*. GitHub. https://github.com/mahima-verma/ehr-solution-hyperledger-fabric-composer-poc

True Gym. (2021). *True Gym Whitepaper*. https://truegym.io/