# A Blockchain-Empowered Seamless Bicycle Offering Scheme through the Facilitation of Smart Contract

Anik Islam, MD Masuduzzaman, Arifa Akter, *Soo Young Shin
Department of IT Convergence Engineering,
Kumoh National Institute of Technology (KIT), Gumi, South Korea
Email: {anik.islam, masud.prince, nisha18, *wdragon}@kumoh.ac.kr

## Abstract

Bicycle is very popular in all over the world. Thus, the use of a bicycle is also increasing day by day. However, while moving to different places, they have to abandon their bicycle as taking a bicycle with them is not always possible. Therefore, they abandon their bicycle. Due to not having any recycle platform, bicycle stays there and after a certain period, it starts to decay. Thus, it pollutes the environment and blocks the space. Moreover, time and money are required to dump it. Instead, it can be reused and this can reduce the hassle. A blockchain-based bicycle platform is proposed to reduce the wastage of bicycles. In the proposed scheme, the owner, who owns the bicycle, posts information about bicycle offering in the network and seeker, who are looking for a bicycle, claim it. Moreover, Proof-of-Seeker (PoSE) concept is utilized to verify the claim of the seeker. A proof of concept is established to initiate the blockchain network to demonstrate the feasibility of the proposed scheme.

## I. Introduction

All over the world, bicycle riding is very famous because of having flexibility, availability, and cost effective. Due to having such benefits, people prefer to ride a bicycle to roam around or move from one place to another [1]. However, they cannot carry it with them before moving. Therefore, they leave their bicycles below the apartment or some other places. However, as there is no information or platform and other people cannot take it as no one is not sure that the bicycle has no owner or he/she is not sure that he/she allowed to take it or not. Thus, the bicycle remains there forever. After a certain period, the bicycles decays and becomes unusable. Blockchain is a distributed network in which each participant holds the same copy of the data and data are immutable [2]. Moreover, blockchain brings availability in the distributed computing world. Furthermore, the privacy of data can be ensured using blockchain very easily. Thus, blockchain can assist to establish a global platform to make offerings of the bicycle to reduce the waste of bicycles. A blockchain-based bicycle offering scheme is proposed in which bicycle can be shared among the participant via a smart contract, which is a topic that has not been explored yet to the best of our knowledge.

## II. Proposed Scheme

A blockchain-empowered bicycle offering scheme (termed as "BOS") is proposed in which an owner post the bicycle offering notice in the network and if it matches with a seeker then the seeker requests it with the facilitation of smart contract. The proposed BOS is illustrated in Fig. 1. The proposed BOS consists of several entities, such as user, blockchain, and IPFS. In BOS, there are two types of users, such as seeker and owner. Here, the owner entity owns the bicycle. When it is time, the owner offers the bicycle through BOS. Seeker entity seeks for a bicycle. If he finds any then he requests the owner immediately. Blockchain entity is a network where data of the offered bicycle is posted. Blockchain contains smart contracts. In the current blockchain design, it cannot hold the media files (i.e., image and video) due to being so large. Thus, interPlanetary File System (IPFS) entity is considered. IPFS is a distributed file sharing scheme which holds the media files. BOS utilizes IPFS network to contain the media information (i.e., image and video) shared by the owner of the bicycle.

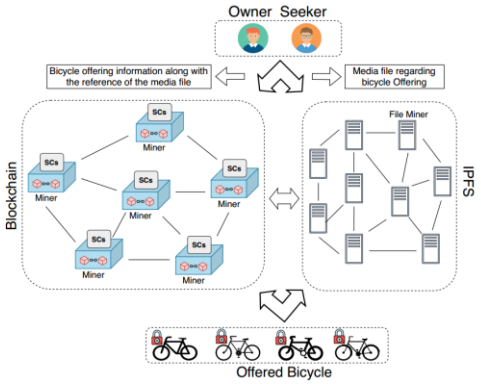


Fig. 1. The proposed system model.

## III. Registration

Prior to using BOS, users (i.e., owner and seeker) has to register in the system via a smart contract. Users can control the information. To register, the user has to provide residential no/social id, full name, contact no, address, and public key. Here, the public key is considered as an identity of the user. After finishing the registration, these information are stored safely in blockchain.

## IV. Bicycle Offering Process

First, the owner put a lock in the bicycle and add a paper containing the public key of the owner and a secret text for verification, as shown in Fig. 2. After that, the owner captures media data of the bicycle and post it in the network. The data is posted via a smart contract (named "Bicycle Offering Contract (BoC)"). BoC first posts the media files in IPFS and IPFS returns its reference of the location. Afterwards, BoC posts the bicycle information (e.g., location, model, color) along with the owner's public key and reference of the

media.

## V. Bicycle Requisition Process

After posting bicycle offering information in the network, the owner waits for a request from a seeker. Seeker post query in the system to get a suitable

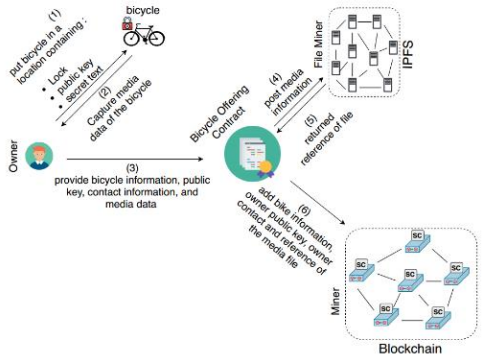


Fig. 2. Process for offering bicycles.

offered bicycle for him, as shown in Fig. 3. System returns results regarding the query. After finding a suitable bicycle, the seeker requests the owner to give

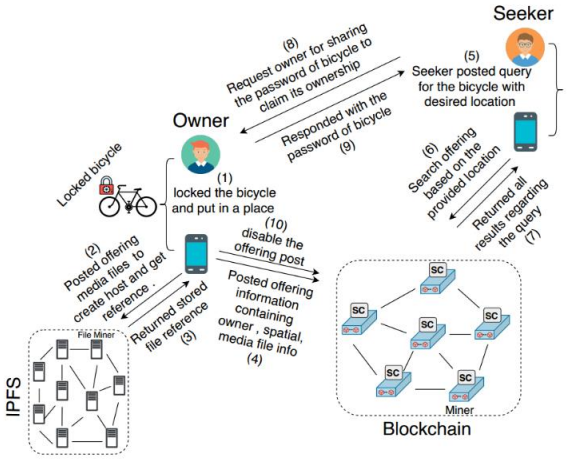


Fig. 3. Process for requisitioning bicycles.

the password of the bicycle so that he can take it. After sharing a password, the owner disables the post in the network.

## IV. Bicycle collection process

The seeker first sends a request in BoC for the bicycles. BoC collects every request for that bicycle and after a certain period, BoC generates a schedule for the seeker and notify them about their schedule. After that, BoC selects the worthy candidate one after another based on first come first serve process. If the selected candidate doesn't claim the bicycle within the period, the opportunity is given to the next candidate. To claim the bicycle, seeker arrives at the location and contact the bicycle owner for getting the password of the lock. Owner requests for the secret text and public key that is written on the bicycle. If the information doesn't match, the seeker cannot claim the bicycle. The opportunity is given to the next candidate. After a successful claim, the owner seals the bicycle for the seeker in the system and notify other candidates to check the bicycle that the seeker took it or not. If that seeker didn't take the bicycle then the new seeker can claim it. Thus, the system can verify the actual claim of the bicycle. However, no one may visit that place after getting sealed by a seeker. Thus, after a certain period, the offer will be disabled.

## IV. Performance Analysis

A proof of concept is established to demonstrate the feasibility of the proposed scheme. A blockchain network is built on the top of ethereum. 10 computers were used to build this network and each computer was worked as a mining node. The proposed scheme is built using python and web3.py was used as JSON-RPC to communicate with the network.

Fig. 5 represents the throughput of the network. From Fig. 5, it is observed that throughput is higher for the less number of miners that are presented in the network. With the elapsed of time, throughput decreases because the responsiveness of the mining nodes becomes slows when they continuously mining data. However, this decrease in the curve is very slow and after a certain time, it achieves an equilibrium state.

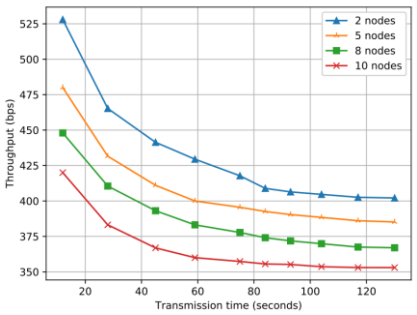


Fig. 3. Throughput of the network.

## V. Conclusion

We proposed a blockchain-based bicycle offering scheme in which owner and seeker can exchange bicycles with the assistance of a smart contract. However, a point system is needed to be proposed in the scheme so that users become interested to utilize this application and help the government to tackle this problem, which is kept for the future extension of this paper.


## ACKNOWLEDGMENT

This work was supported by Priority Research Centers Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science and Technology(2018R1A6A1A03024003).


## Reference


[1] D. J. Benedini, P. S. Lavieri, O. Strambi, Understanding the use of private and shared bicycles in large emerging cities: The case of sao paulo, brazil, Case Studies on Transport Policy 8 (2) (2020) 564 – 575.

[2] A. Islam, S. Y. Shin, Buav: A blockchain based secure uavassisted data acquisition scheme in internet of things, Journal of Communications and Networks 21 (5) (2019) 491–502.