

Applications of Blockchain Techniques in Pet Adoption Industry

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Abstract. The rescue rate of homeless animals in the shelter is only at about 30% nowadays, which implies that the others are mostly put to death by the shelter in order to save the resource for the newcomers. This article has combined the blockchain technology and pet adoption to save stray animals from this situation. By designing smart contracts for adoption and deploying them in the blockchain, an efficient and convenient way is provided to adopt pets. Moreover, privacy of users will be well protected due to the property of blockchain. It is also possible that owners who wants to send their pets away can receive an estimate date of adoption calculated using machine learning algorithm. By providing these features and eliminating privacy violation risks, people would likely to trust and be fond of this new way for adoption, therefore increase the probability for stray animals to find a new home. These results shed light on guiding further exploration of pet adoption related blockchain technology.

Keywords: Blockchain; Decentralized; Smart Contract; Pet Adoption.

1. Introduction

It is known that the blockchain technology has developed and progressed for decades until now. Based on the remarkable milestones that blockchain technology has achieved, its evolution can be categorized into three stages. The appearance of Bitcoin secure decentralized payment platform indicates the first stage, also called Blockchain 1.0, has started [1]. This phase mainly associates with digital coins. Afterwards, programmable transactions mechanism arrives with Blockchain 2.0, along with the usage of decentralized applications. Ethernet has provided people a platform to deploy smart contracts, i.e., the basic technology of programmable digital currency and programmable finance. The huge benefit of smart contract demonstrates a no-conflict and transparent method for people to transact money or exchange intellectual properties [2]. If stage one is called the decentralization of coins, stage two can be considered as the decentralization of the economic market. Eventually, the blockchain technology has reached its current stage. In blockchain 3.0, applications are not limited to the scope of economy or finance. The blockchain technology has contributed to various fields nowadays, e.g., medical, education, insurance, international payment. Not only, unbanked people will be able to store their digital identities on the blockchain so that they could get hold of bank services like loans [3]. Through the transformation of the blockchain technology, it could be easily told that our world is benefit more and more from all the applications on the blockchain. However, it should be known that blockchain technology is still at its beginning states. Decisions would need to be made before its usage to determine if the case is right for blockchain or not.

In this paper, the specific use of the blockchain technology on pet adoption will be introduced. Currently, pet adoption is becoming increasingly popular among the country. In 2021, around 65% of pet owners have adopt a rescue dog. However, only 28% of dogs and 31% of cats are rescued from Human Society each year [4]. A harsh situation now is that the number of pets waiting for adoption has surpass the amount of people willing to visit an adoption center and going through the complex procedure which required for adopting a pet. Therefore, some research has been done on the potential of blockchain technology on pet adoption. Gururaj stated that the blockchain technology provides security and flexibility to users, which offers users more convenient access in adopting pets and provides a better approach to the existing centralized system [5]. Truly, blockchain technology has given us a new approach to look at pet adopting. If adopters are provided with a handier way to adopt an animal, it is very probable that the rescue rate can go higher.

However, the exploration and research on pet adoption applications on blockchain is still too few. Owing to the low rescue portion of stray animals and the lack of study on how blockchain technology can improve this situation, in order to simplify the steps required for adoption, the potential of blockchain technology on pet adoption will be dug in this article. Just like Karim Quazzani, the CEO of Pawtocol (i.e., organization that create profiles of pets as an NFT in order to help place pets in homes), suggests that creating these profiles is a fascinating way to use NFTs. This usage of blockchain technology is meant to load the process of a stray animals pursuing homes online so that they would have a larger chance to receive help [6]. In this paper, some basic description on blockchain technology related to pet adoption will be presented first, then the design idea of the smart contract will be provided while a demo is also shown. Finally, the limitation and future outlooks of this application will be declared.

2. Basic Description of Blockchain Smart Contract

To successfully create a decentralized application on pet adoption, the most essential part is the design of the smart contract. There are several functionalities that could be achieved including keeping track of the pets' and adopters' information, setting up a virtual lost and found center etc. Firstly, it is necessary to determine a form to store pets' and adopters' info. It is critical to record all details about the pet so the adopter can choose the one that fits them the most, that information includes the vaccination, breed, age, etc. Considering the complexity of these information, an array of struct fits best for this task. Besides the basic information of pets and adopters, a unique id is assigned to each of them for management convenience. The contract also contains a "remaining fund" variable in order to support transactions.

After determining how to store data, registration functions are provided for both pets and adopters. In this smart contract, original owners of the pets are rewarded if they register their pets. The amount of ether given can be decided by the deployer of the contract. Additionally, to decrease the possibility that someone abandon their pet purposely to get ether, each address is only allowed to register for 5 pets at most. As for the adopter registration, the contract records minimal information for contact purpose. It should be noted that assertion to prevent multiple registration from the same address must be inserted.

The core function of this contract is the actual adopting function. Eligibility of the pet and adopter must be checked. This process must be operated by the adopter him-/herself, request from other addresses different than the register address would not be accepted. The adopter would also need to pay ether to the contract, while the amount is also based on the contract deployer. After adopting, the pet should be marked adopted in its information to avoid repeat adopting.

Finally, this contract implements a lost and found center which helps the adopters to find their lost pets. This feature includes three functions: report lost, report found, and report receive. An adopter can report if his own pet has gone lost. This step requires the adopter to deposit a certain amount of ether into the contract temporarily. Next, if anyone found his pet, they can report while their contact information is recorded for the adopter to get in touch. Lastly, if the adopter receives the pet, the ether they deposit will be transferred to the founder.

It is worth pointing out that security must be considered in this contract, especially the functions that includes ether transfer. For pet registration and report pet receive, where the contract needs to pay ether, reentrancy attack must be prevented when implementing these functions. Smart contract techniques have developed for quite a while; however, some security problems still exist. According to Cecchetti et al., because of the smart contracts' interacting service structure in various trust domains, they have generated the most obvious reentrancy susceptibility which makes them unsafe against attacks [7]. Thus, it is crucial that the deployer is aware of this vulnerability while implementing the contract. Reentrancy attack can happen if a contract causes control flow to an extraneous contract by calling fallback functions including call, send or transfer, while renewing its state afterwards. In this case the state of the contract would be incomplete after transferring flow

control, which allows the attacker to proceed with various unexpected operations, e.g., call the function again or another contract [8]. In order to protect the contract, critical information must be updated before the transition happens so that the attacker would not be able to halt the contract and keep extracting ether.

3. Application in pet adoption

There are already plenty of humane society in the country. However, they cannot replace the significance of an online platform in pet adoption. As this article has mentioned, people might not have the time or energy to go through all the adopting procedure in an animal shelter. Thus, an online application could be their best choice. However, as Alsuwailem et al. stated, one of the most serious problems that cause people not willing to adopt pet online is that there is no credible platform satisfies their demand since there is no guarantee that the privacy of users is 100% safe. Or even worse, platforms can be created by fraudulent sellers. The occurrence of deception of consumers has risen a considerable amount [9], which is almost impossible to completely eliminate that risk for a regular online platform. Hence a decentralized application (dApp) introduce above should be perfect in order to avoid this awkward situation. The benefit of a decentralized application is that the worries of a carrier might leak users' privacy does not exist. Smart contract automatically runs on the blockchain, which can connect the adopter directly to the owner. Users can manage their account transactions by utilizing their public and private keys. A third party does not and cannot interfere the process or acquire users' data during it. Furthermore, machine learning algorithm can be designed and implemented to the application by the deployer to predict the time it takes for pets to be adopted. Some pet owners who intend to give their pets away may have urgent situations where the pet cannot stay at home for very long. In some cases, pets can be deserted if the owner cannot wait anymore. By constructing predicting models using machine learning algorithms, owners will be provided an estimate time interval for their pets to be adopted, thus decreasing the rate of pet abandoning. Zadeh et al. has resolved a negative correlation between the adoption speed and the pet's vaccinated status, photo numbers and fee required in a constellation plot (shown in Fig. 1) [10].

More importantly, the application provides a pet finding system where adopters would be able to find their lost pets which are registered in the contract. Research has shown that pet owners can experience extreme sorrow if their pet has lost, thereby damaging their wellness [11]. In this case, this feature would ensure a larger chance that the lost pets getting found and reported to the adopter so that they won't panic.

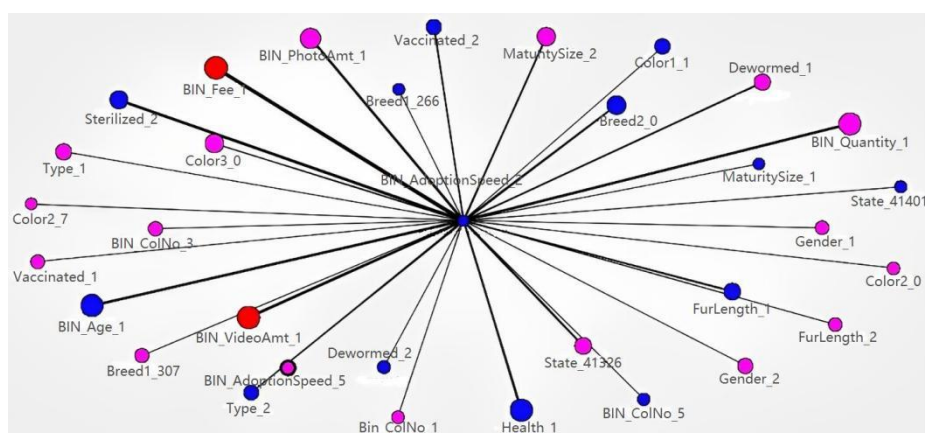


Fig. 1 Constellation plot [10]

4. Demo

A demonstration of how this decentralized application will appear after deploying as illustrated in Fig. 2. The front-end design should not only consider the basic functionality, but also the aesthetics

of the site. As for the appearance of the site could affect the willingness of the adopter, creating a comfortable feeling can be crucial. For each pet, their info is displayed under their image. This includes their name, breed, age, vaccination status, and contact information. Each function in the contract is connected to a button in the site. If someone wish to adopt, they can easily access the current owner’s information and contact them. The “find” button is right next to adopt, which allows people to report lost animals. Users can also navigate to a specific pet by searching its petId, which is assigned to pets after registration. The register buttons for pets and adopters are shown on the left. After clicking, people can fill in information as the blanket presented in Fig. 3.

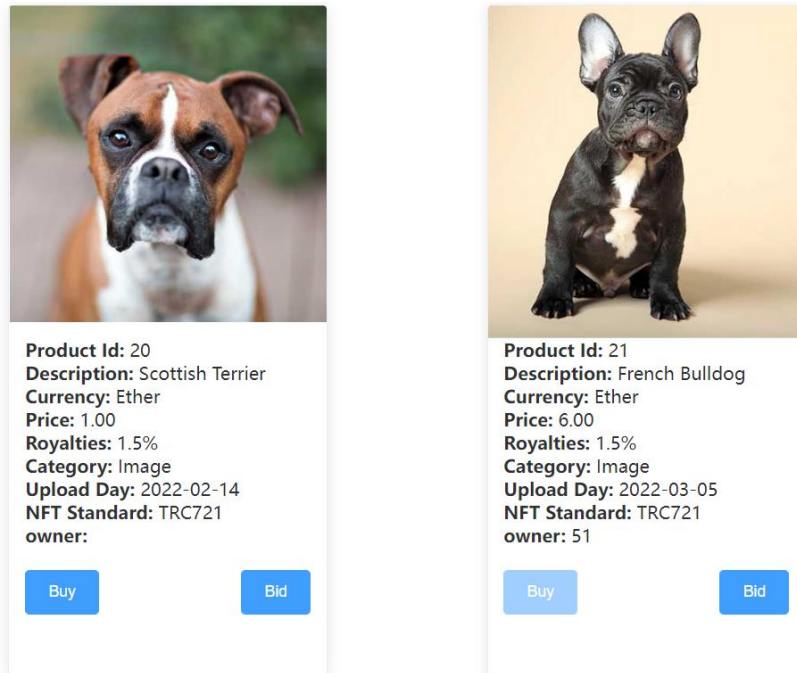


Fig. 2 The appearance of the demo decentralized application (Photo credit: Original)

The image shows a registration form titled 'Information' with a close button (X) in the top right corner. The form contains several input fields and two toggle switches. The fields are: Breed (text input), Age (spinner with value 1), Vet Phone Number (text input), Phone Number (text input), Address (text input), Disease (text input), Vaccinated (toggle switch, currently off), Desinsectization (toggle switch, currently off), Vaccine Confirmation Code (text input), and Birth (date picker showing 'select a date').
Fields:
- Breed: [text input]
- Age: [- | 1 | +]
- Vet Phone Number: [text input]
- Phone Number: [text input]
- Address: [text input]
- Disease: [text input]
- Vaccinated: [toggle switch]
- Desinsectization: [toggle switch]
- Vaccine Confirmation Code: [text input]
- Birth: [select a date]

Fig. 3 The pet registration page of the site. (Photo credit: Original)

5. Limitations & Prospects

The implementation solution provided in the article has a few constraints. Since the contract is deployed in the blockchain, there is no third party to verify the authenticity of the information that the pet owner supplied. This application will rely on the adopter themselves to verify the materials, such as vaccination history, directly to the owners. This disadvantage can have a very negative effect since our decentralized application was originally intended for users' convenience. Secondly, the balance of the reward system can be difficult to manage. If the reward to the pet owner is too little, the application might not have enough attraction to them. People might choose to directly dump their pet instead of registering for them, since the former is simpler. However, if we set the reward too high, there could be situation where people deliberately send their pets away to get the reward. Either case, the abandon rate could get higher, which should be avoided. Besides, the balancing problem, there also exist a flaw in the lost and found system, which is that the finders do not know where to report the lost pet since they might not use this application. Although a name tag with the site link and petId could solve the problem, it is still worth to think of a more efficient way. Putting aside these trivial issues, the pet adoption decentralized application has a huge disadvantage compared to the traditional help site adoption, is that there is no way to check the eligibility of the adopter. The help site would require the adopters to go through a series of procedures to examine if they are suitable to adopter a pet, like checking if the neighborhood they live in is pet friendly or not. Our application has discarded these steps for the sake of convenience, but it also increases the potential risks. Animals can go into a place that is harmful to them, which has violated the ultimate purpose of pet adoption.

These problems and weakness of the pet adoption decentralized application should be considered in the future studies. Solution to the background check of adopters should be designed and implemented. Keeping the convenience and security of this application while ensuring the qualification of the adopter, the two features can be complicated to combine, but totally possible. Furthermore, tracking system of the pets can also be developed. It is possible to achieve the goal by connecting the pet to IoT devices. In all, this application needs further perfection to improve user experience.

6. Conclusion

In summary, this paper has introduced the application of blockchain technology in pet adoption industry. By designing a smart contract, an adopter-to-owner, secure online platform can provide people with a convenient and reassuring adopting experience. Not only people will no longer have to worry about their privacy getting violated (e.g., the regular online platforms), but they will also have access to a nicer and faster way to adopt a pet. Besides, owners can have an approximation adopting date if machine learning algorithms are applied. Lastly, the lost reporting system provides a quicker way for the owners to find their lost pets and relieve them from sadness. Nevertheless, limitations including eligibility check still exist, thus require further study to solve. Altogether, this paper has pointed out an efficient way to save pets from becoming stray animal, while giving people a more convenient choice other than adopting in a traditional pet shelter. Hopefully the rescue rate of homeless animals can exceed 30% if the application is adopted. Overall, these results offer a guideline for studies on pet adoption blockchain applications in the future.

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