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BLOCKCHAIN-BASED PAYMENT SYSTEMS TARGETING SMALL BUSINESS ACTIVATION AND DONATION PURPOSES

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ABSTRACT

Involving reliable, trustworthy, and transparent features of blockchain technology in payment systems is an indispensable criterion for boosting businesses and increasing the efficacy of different processes. In this regard, our paper provides a non-trivial study of embedding blockchain technology into the payment systems of initiating a small business as well as donating procedures in disaster-based applications. For this purpose, current standard instructions for both cases are first analyzed. Then, the drawbacks of the current payment system in these applications are elaborated. Next, the way the proposed blockchain framework leads to the growth of traditional payment systems and flourishes the previous business processes of corresponding cases. The underlying mechanism of the smart contracts associated with blockchain technology is also highlighted using graphical and pseudo-code-based representation. The contributive framework that is described in this paper can be considerably useful to promote the application of the donation system particularly when it comes to urgent circumstances.

***KEYWORDS*:** Blockchain, Payment systems, Smart contract, Entrepreneur, Charitable donations

1. INTRODUCTION

Blockchain technology is a recent sharing framework of information that has absorbed attention in various fields, specifically financial applications, due to its specific features including transparency, immutability, and trustfulness. Blockchain removes the necessity of the presence of a third party to monitor and validate the transaction between trading parties. Blockchain is a transparent platform since all involved parties share their transaction/asset data in a decentralized structure. As for a distributed network, each node has the same access to the authorized information as well as other nodes ensuring the transparency of this structure (Lu, 2019). Furthermore, the stored information on a blockchain is immutable and cannot be modified owing to its interlinked hash values. Hash converts an input parameter with a variable length to a fixed-sized output by satisfying two properties. Firstly, the input cannot be decoded from the output while secondly, no two input parameters have the same hash values (Aggarwal et al., 2019). By directly connecting customers and suppliers, blockchain cuts off additional costs caused by intermediaries (Lee, 2019). In the ecosystem of the blockchain, the trading parties have to prove themselves as legitimate members on basis of specific consensus algorithms. In other words, all participants of a block must agree on the fact that the newcomer has a valid transaction/asset. This validation is made using specific algorithms such as proof of work (POW) and proof of stock (POS) which

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are derivatives of the Byzantine Generals' problem (Nawari & Ravindran, 2019). This problem refers to an ancient concept of strategy-making about a battle plan when the generals of the army are geographically dispersed from each other and must reach an agreement before any attack. The leader of the generals dispatches a messenger to the subordinates as to whether to attack the enemy at a specific time or not.

This paper aims to explore how these features of blockchain could provide a synergetic promotion to small business growth and increase efficiency in the functionality of donation purposes in disaster-based applications. In terms of donations, it would be a critical aspect to improve the business process of a charitable foundation to leverage much more donors to help people in need survive (Saraswat et al. 2022). Improving the payment systems of charities that could seamlessly increase transparency is significantly important. Another maneuver of this community is to endorse entrepreneurship, family firms, and small businesses to spot the niches in the market and flexibility to respond to recession and inflation. In this regard, the government takes action to boost any sort of business using public power by introducing the business into the stock exchange. Nevertheless, small businesses could not afford the initial prerequisites for entering the stock market due to operating at a loss during their initial life cycle (Read, 2002). By delving deeply into such concerns, a transparent, truthful, and immutable sharing payment framework is a significant recourse to defuse the economic and social crisis (Webers & Staples, 2022).

Nakamoto (2009) mapped the concept of the Byzantine general problem out his/her crypto-currency called Bitcoin which was the first financial application of the blockchain. After the introduction of bitcoin and blockchain, researchers have conducted different studies to detect state-of-the-art economic advantages of blockchain. Cocco, Pinna, and Marchesi (2017) discussed the technological and energetic advantages and disadvantages of blockchain technology versus the standard methods in the banking sector. On one hand, it was implied that the most reliable consensus algorithm (i.e., POW) incurred high electricity and hardware expenses. On the other hand, the blockchain-based systems cut off costs associated with consumed electricity by ATMs, gas consumptions by bank's employees and massive waste of paper. They concluded that the current low number of transactions per second (i.e. 7 on average) impeded the progress of blockchain technology introduction in the banking sector. Wu and Liang (2017) provided a platform design to facilitate the standard inter-bank fund transfer process by entailing blockchain technology. Their analyses of the Chinese foreign exchange trade system demonstrated that a successful inter-bank transaction involves a sequence of different tasks involving five parties. Consequently, in that system, if one task failed, the entire transaction process would be blocked. Meanwhile, their proposed blockchain-based system reduced the number of involved parties to two individuals while it did not terminate the transaction with uncompleted tasks according to the content of a smart contract. They also implied that blockchain technology could play a significant role in other public payment scenarios, e.g., charitable donations. Bhattacharya, White, and Beloff (2017) elucidated the application of a blockchain platform for exchanging leftover foreign currencies of travelers. They emphasized embedding charity affairs, as one of the most common ways for disposing of the leftover currencies, into the corresponding blockchain platform. Raluca, Chris, Kate, and Chris (2018) proposed a qualitative case study research design on larger UK charity organizations that set out to employ blockchain solutions to address its requirements.

Jayasinghe, Cobourne, Markantonakis, Akram, and Mayes (2018) introduced a generic blockchain-based philanthropic model to explore the benefits of this solution in terms of donation transparency, reducing transaction costs, donation speed, and provision. In their model, they enabled the donors to trace whether the donated funds are effectively spent or not using a standard pay-to-public key hash. As for the transaction methods, they suggested the Rootstock platform which converts a Bitcoin currency into a smart Bitcoin one. After publishing a contract on the Rootstock network, it is observable for every existing node. To trigger the smart contract, the foundation would spread a message between the nodes by paying a small initialization transaction fee denoted as Gas. To authorize a certain transaction event in the network, the smart contract looked for two or more private keys of nodes' participants before its broadcast. Saleh, Avdoshin, and Dzhonov (2019) devised the functionality of a blockchain platform for both the donor and charitable foundation. For a donor, entering his/her donation information through a unique address besides information about the flow of funds between different needy applicants could be desirable. In terms of a charity foundation, recording information

about donations plus exporting reports to the justice system and public announcements could be vital. The way blockchain technology could increase transparency and simplify transactional reporting in the philanthropy scope is described. They also conducted a comparative analysis on the choice of the existing blockchain platforms based on a number of criteria such as block size, transaction per second, and consensus protocol.

Despite the aforementioned studies, our paper has focused on charitable applications at times of natural disasters. Besides, in contrast to that studies, our proposed instruction for initiating small businesses has provided an in-depth basic technical programming detail about the content of the smart contract. Accordingly, this paper extends the literature associated with the payment system using the combination of running small businesses and urgent donation purposes. The paper is also different from the previous ones in recommending a smart pseudo code for the use of crowdfunding. In the rest of the paper, the customized inter-bank transaction is discussed in Section 2. Section 3 explains a trustful payment framework for defining a specific smart contract to define the financial turnover in the case of specific endorsement packages. Section 4 focuses on boosting small businesses by employing the terminology behind crowdfunding while Section 5 concludes our work and offers scopes for future research.

2. SMART CONTRACT FOR PAYMENT MANAGEMENT OF DONATION PURPOSES

In charity applications, it is indispensable for donors to discover how their donations are spent and what their exact contributions in resolving a crisis are. Any sort of uncertainty could drastically reduce the number of donors and decrease the efficacy of covering the needy group. As a prime instance, let's refer to recent earthquake and flood disasters. Many celebrities, non-profit institutes as well as public organization introduced their bank accounts to encourage philanthropy in public. Afterward, these groups distinctively identified the people without shelter and consequently acted to fulfill their basic requirements. As a result of such isolated philanthropy, the distribution of vital commodities between the target people went to extremes. The damaged cities could not have been efficiently resurrected by introducing multiple donation payment sources and distinctive identification of the disaster's victims. Besides that, there was a myriad of foreign donors who could not supply their financial support due to the time-consuming interbank transaction. As a result, the first blockchain-based charitable donation foundation has been initiated in 2018 by Binance Charity (Alam, Gupta, & Zameni, 2019).

Fig 1 illustrates a hypothetical case of managing the donations related to aiding victims of a disaster in a traditional way. Simply, it is shown how such management could lead to ineffective and chaotic consequences. Meanwhile, Fig 2 indicates how a blockchain platform and its smart contract feature could remove the drawbacks. Precisely, if there is a smart contract, all donors from around the globe could contribute to their desirable types of charities. To do so, the contract entails three types of roles including a donor, a needy individual, and a validator. The validator in a blockchain verifies the accuracy of an event such as a transaction and the qualification of the members of a new block (Xu et al., 2017; Zheng, Xie, Dai, Chen, & Wang, 2017). Here, the validator checks whether the registered individual as a needy one certainly satisfies the initial pre-requisite or not. Notably, the initial pre-requisite of categorizing an individual as a needy one could be specified by defining a rule.

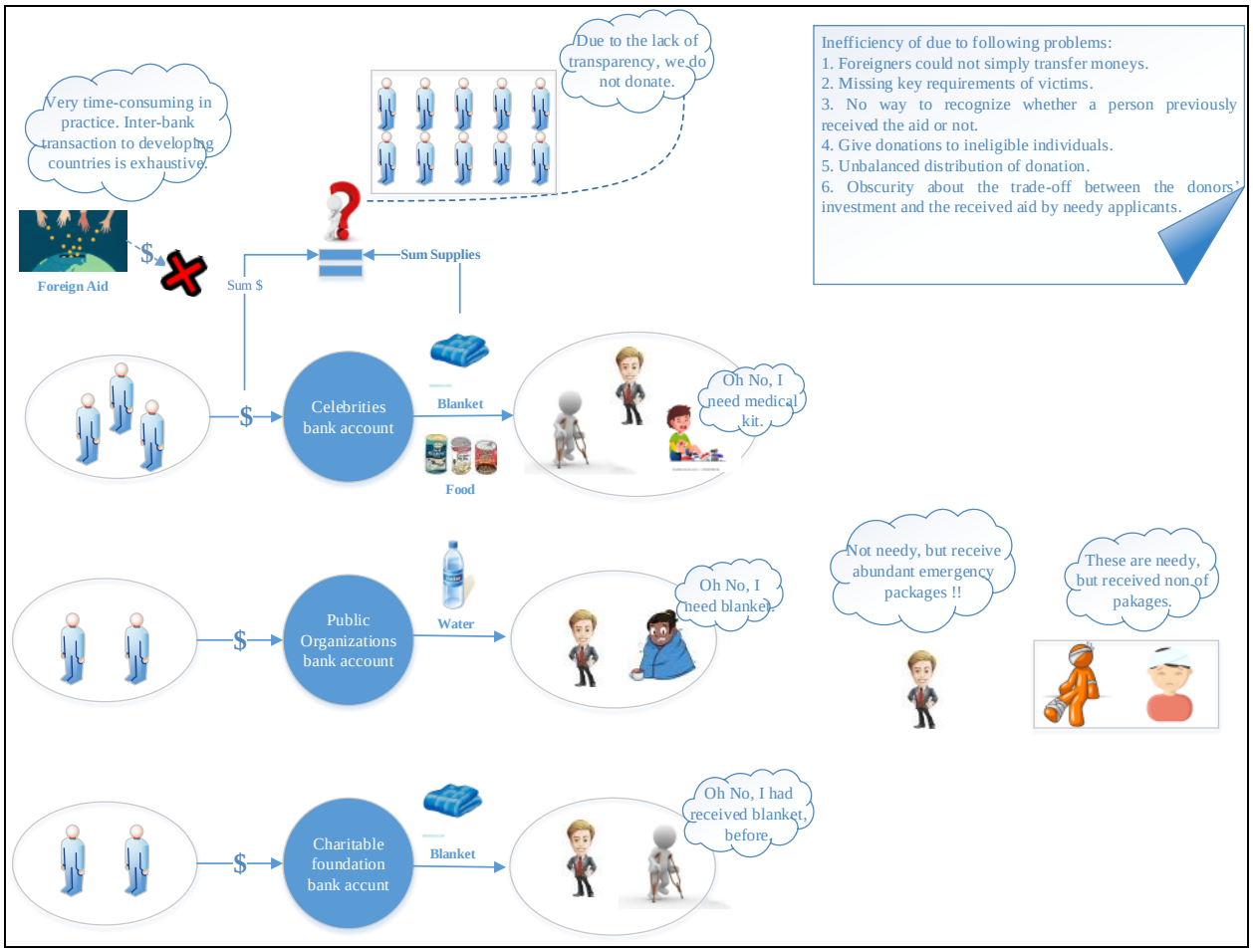

Fig.1. Traditional payment management of donations

To exemplify, a rule could indicate whether the individuals with a periodic income below a specific value or the victims who have lost their capital in the disaster-based damaged zones are subject to donations or not. In the smart contract, the donors could register, select their specific charity case, and consequently pay their deposit. Under the consensus mechanism, such a transaction would be stored in a new block. On the other hand, the applicants could register for receiving donations while validators have to provide tangible proof for the members of the contract about whether the corresponding applicants are needy or not. By identifying and entering the needy applicants into the platform, they would issue their request for receiving donations. Now, the payment function would be triggered by observing a rule which devises the amount of money that could be allocated to any needy applicant. Repetitively, the accuracy of transactions is first proven by the consensus mechanism, and then it would be added to the distributed ledger with the smart contract.

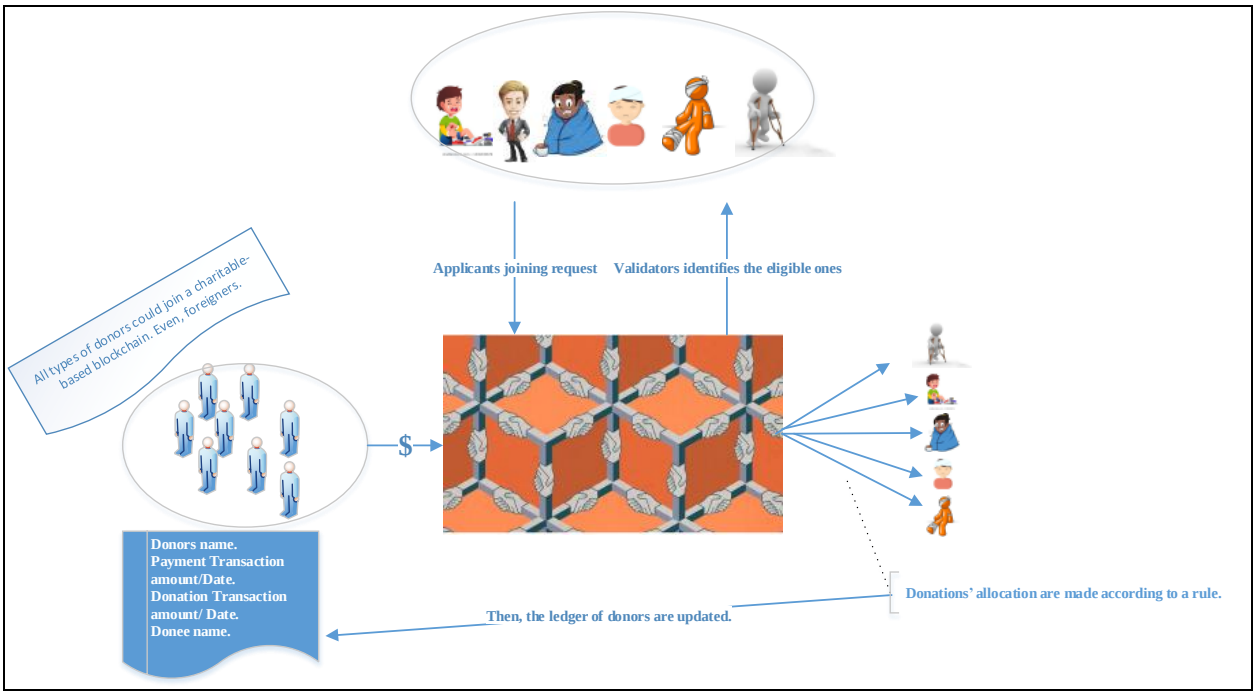

Fig.2. Blockchain-based payment management of donations

3. SMART CONTRACT FOR BOOSTING SMALL BUSINESS

As has been implied before, small businesses are driving forces behind the flourishing of the economy in critical circumstances. Unfortunately, the stocks of such businesses could not probably be supplied in the securities exchange market due to the lossmaking behavior at its initial lifecycle. In response, a blockchain platform could gain the trust of the public to contribute to initiating and booming such businesses by guaranteeing self-crystal-clear monitoring of the payment system. Fig 3 schematically represents how an entrepreneur could afford his/her prospective investments whether relying on securities and exchange markets or a blockchain platform. In our case, being disappointed in involving in the securities and exchange market, the entrepreneur turns to a blockchain platform. Then, he/she publishes the contract terms according to the instruction provided in the flowchart.

To delve deeply into the instruction of the smart contract, let's build up its related content based on the pseudo-code of Fig 4. First, the creator of the smart contract must publish his address which is tangible in terms of the account term in the Solidity programming. Notably, Solidity is a programming language almost similar to Java script being provided by a handy blockchain platform, i.e., Ethereum. After announcing the owner's address, the interested contributors should be specified with a function. The predecessor of being involved in this contract is to accept paying a minimum contribution amount that is set by the owner. By joining any contributor, the total number of participants should be updated and counted up.

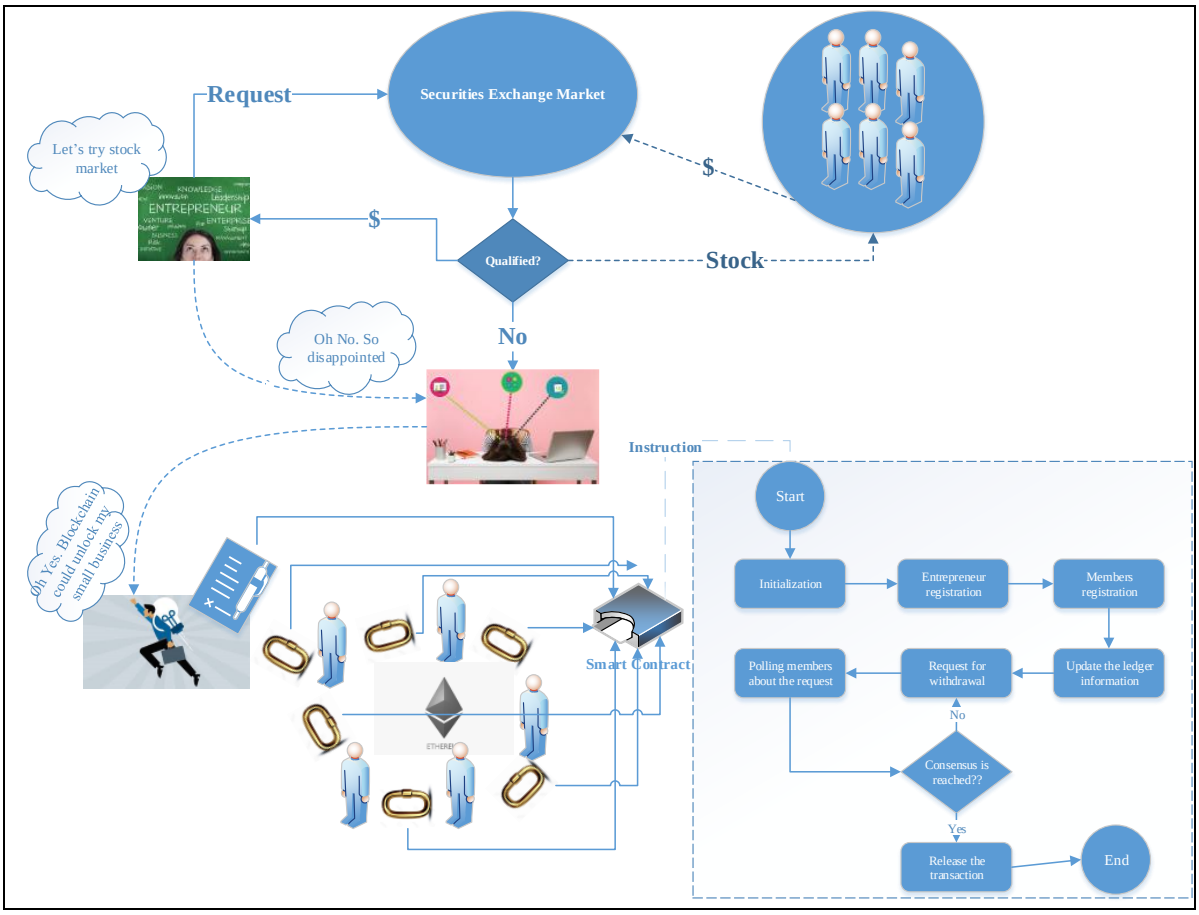

Fig.3. Initiating a business by an entrepreneur

To keep track of all contributors, a mapping should be conducted between any available address in Ethereum and those who accepted the contribution terms. The next step is to set a particular terminology for the withdrawal procedure. For this purpose, a description field should be considered to reveal the reason the contributor for taking out his money. Then, the withdrawal value of that contributor as well as the recipient address should be devised in the code of the smart contract. A Boolean true/false message should be communicated in Solidity to stipulate the request's status, i.e., whether the contributor has completed the request or not. For passing the request of the contributor, the content of the smart contract should be exactly followed. Assume that when 50% of the contributors have approved the request, the money could be released. Thus, the request is broadcasted within the chain and the summation of the approval votes is calculated. There is also a mapping function to highlight the address of individuals who issued their approval vote so that they could not take part in the withdrawal campaign anymore. Whenever the criterion is met, the required money is automatically transferred from the owner's account to the recipient's address. In this way, the smart contract is operated without the intervention of a third party such as too bureaucratic securities exchange market.

```
pragma solidity ^0.6.1 // Let Ethereum know your Programming language

contract BusinessBoost{ // Let's build up our smart contract up

address public Entrepreneur; // The owner's account

mapping(address=>bool) Applicants; //  Looking up in Ethereum to find contributor's addresses

unit Mindeposit; unit ApplicantsNo; // Minimum contribution level & counting applicants

struct Takeout { // A certain structure for taking out money with following features
```

```
unit Payback; string Request; address Receiver; // Parameter setting for payback fee, requesting and receiver account

bool done; mapping(address>=bool) Accept; unit AcceptNo // Completing status registering, the idea of other members, counting the confirmation No

}

Takeout [] public TotalTakeout; // Collecting taking out record in an array

constructor(address initiator, unit min) public { // Getting information of Entrepreneur

Entrepreneur = initiator;

Mindeposit = min;

}

function  members() public payable { // Registration protocol of contributors

if (msg.value >= Mindeposit) { // Execute if the payment is greater-equal to  minimum deposit

Applicants[msg.sender] = true;

ApplicantsNo = ApplicantsNo + 1;

}

}

modifier EntrepreneurOriented () {if (msg.sender == Entrepreneur) {_;}} // Control the behavior of users

modifier ApplicantsOriented () {if (Applicants[msg.sender] == true){_;}} // Control the behavior of users

function TakeoutProcedure(unit Payback, string Request, address Receiver) public EntrepreneurOriented { // Take out function

Takeout memory AddTakeout = Takeout ({ // As any request is received update the beneath terms

Payback: payback, Request: Request, AcceptNo: 0, Receiver: Receiver, done: false

});

TotalTakeout. push(AddTakeout);

}

function TakeoutConfirmation (unit index) public ApplicantsOriented { // Confirmation procedure of taking out process

Takeout storage Takeout = TotalTakeout[index];

if (Takeout. Accept == false) {

Takeout. Accept[msg.sender] = true;

Takeout. AcceptNo = Takeout. AcceptNo + 1;

}}

function ConcludeTakeout (unit index) public EntrepreneurOriented { // Finalizing the taking out process by releasing the money

Takeout storage Takeout = TotalTakeout[index];

if (Takeout. AcceptNo >= ApplicantsNo  / 2) {

if (Takeout. done == false) {

Takeout. Receiver. Transfer (Takeout. Payback);

Takeout. done == true; }}}

}
```

Fig.4. Basic pseudo-code structure of a smart contract-based crowdfunding

4. CONCLUSION

The integration of blockchain technologies into traditional payment systems was the main concern of the current study. The payment system of two applicable cases has been explored among others to be improved using this technology. First, the traditional payment system associated with donation purposes was the focus of attention. As for the aid for victims of a disaster, we showed how traditional management of payment systems could lead to low efficacy of the corresponding charity functionality. The introduction of multiple sources of payment systems whose founders spent donations almost divergent caused a significant lack of transparency. Then, we demonstrated that a smart contract with a specific structure could surmount the drawbacks of the traditional payment management of donation activities. Second, the dilemma of entrepreneurs was discussed in terms of leveraging public investment in their small businesses. They could not enter their stock into the securities and exchange market while initiating their businesses due to non-profitability. However, smart contract-based crowdfunding was proposed to boost small businesses by providing a seamless payment system for interested contributors. By defining the basic fields and instructions of such a smart contract, the bureaucratic procedure associated with the stock market could be subverted. Although this paper contributes to introducing transformed payment systems in terms of donation purposes of disaster cases as well as small business activation problems, there are still considerable research gaps. As a prime case, future research can explore how the proposed smart contract for managing donation cases could be involved in critical planning like payment systems in the budget planning of huge communities. In this regard, the proposed pseudo code could be updated to satisfy the role-based communication between the involved parties within the corresponding scope.

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