Collateral-Free Trustworthiness-based Personal Lending on a Decentralized Application (DApp)

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Abstract: Most loans given by banks are secured loans and require the borrower to provide collateral as a guarantee for returning the loan principal and interest. With a secured loan, the lender can take over an asset provided as collateral if the customer cannot make the loan payments. In this paper, we propose a peer-to-peer personal lending platform that minimizes the requirement of collateral. The trustworthiness of borrowers is considered as an indicator of whether the borrowers will pay the installments on time. Borrowers' reliability is viewed as a function of their reputation and relationships. The lending platform is designed as a Blockchain Decentralized Application (DApp).

1 INTRODUCTION

The traditional loan application process is shown in Figure 1. Many loan applicants are rejected because they do not meet the terms and conditions (Malik & Thomas, 2012; Martínez Sánchez & Pérez Lechuga, 2016; Milian, Spinola, & Carvalho, 2019; Pokorná & Sponer, 2016; Setiawan, Suharjito, & Diana, 2019; Tang, 2019; Yang & Lee, 2016; Zhao et al., 2017). Banks and non-bank entities provide loans with terms and conditions that are sometimes not easy for borrowers to fulfill. Individual borrowers request loans for personal projects or urgent requirements. Small, medium-sized enterprises (SMEs) need loans to scale up their businesses (Liang, Huang, Liao, & Gao, 2017). Banks or financial institutions require collateral or guarantors to guarantee that borrowers return their loans. Collateral can be in the form of assets (i.e., houses, vehicles, savings, deposits, and securities)(Capital, 2018; Mammadli, 2016; Pokorná & Sponer, 2016). A guarantor is a person who gives some guarantee for the person or SME applying for loans (Abdou, Tsafack, Ntim, & Baker, 2016; Bilbao & Argentaria, 2018).

In addition, many documents may be needed during the loan application process. Administrative costs may be required at the time of submission. The required interest can also be more significant, making it burdensome for the borrower (Shen, Zhao, & Kou, 2020). There is also little visibility in the centralized process, so the borrower does not know the clear reasons for being accepted or rejected. Moreover, the traditional loan application is time-consuming.

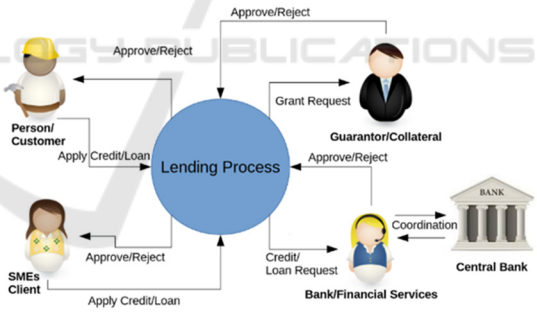

Figure 1: A traditional lending system.

Lending marketplaces offer loans that can speed up the lending process (Jagtiani & John, 2018; Malik & Thomas, 2012). However, they still require similar terms and conditions. The types of debt financing and estimated times for funding are shown in Table 1.

The percentage of approval studied for 100 borrowers showed that 45 are approved, and 55 are rejected in the traditional bank system. For cash advance lenders, 90 are approved and 10 are rejected. For alternative lenders, 70 are approved and 30 are declined. For large banks, 25 are approved, and 75 are denied (Capital, 2018). It is clearly difficult to obtain loans from the traditional lending systems.

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Table 1: Rates, Terms, and Speed of Funding (Capital, 2021).

Types	Rates (%)	Terms (years)	Funding (days)
Bank	6-10	3-7	14-30
SBA (Small Business Administration)	6-10	3-7	10-30
Line of Credit	5-15	1–3	7-30
Alternative	6-25	1-5	5-7
Cash Advance	1.16-1.55	3-24 months	1-3
Invoice Finance	1-2 (weekly)	1 – 90	1-3

On the other hand, Blockchain technology is emerging and successfully applied in many business applications, such as banking and financial services. Recently, Blockchain technology (Shao, Jin, Zhang, Qian, & Zhou, 2018) has been applied to Peer-to-Peer lending (Setiawan et al., 2019) and fintech (Anagnostopoulos, 2018). In 2013, peer-to-peer lending worldwide reached 3.5 billion U.S. dollars. Peer-to-peer lending is a new trend of the "sharing economy". P2P lending platforms allow lenders and borrowers to meet without going through a bank. A significant increase is estimated to be close to one trillion U.S. dollars by 2050. In 2018, mobile P2P payments' value reached U.S. $86 billion and continued to increase (Statista, n.d.).

Today many lending platforms are available supported by Blockchain technology, but they still require collateral (Norta & Leiding, 2019). ETHLend provides secured lending with the use of ERC-20 compatible tokens as collateral. Borrowers' trustworthiness (Bartoletti, Cimoli, Pompianu, & Serusi, 2018) is an alternative in a lending application so that borrowers are no longer burdened with collateral or guarantor since not every borrower can provide collateral. The problem is how to calculate trustworthiness. The evaluation for borrowers is only based on credit score until the present. Borrowers can apply for a loan in a lending platform with a credit score (Tunç, 2019).

In this paper, we summarize our contributions below. We design a lending platform, a completely decentralized and Ethereum-based platform on the blockchain. The trustworthiness score is calculated from collected information such as borrower profile, business activities, recommendation, and loan risk to minimize collateral. In addition, the platform aims for several other properties: Scalability: our lending platform should provide accessibility for borrowers, lenders, and investors in a large community. Cost-effectiveness: enable low-cost transactions. Transparency: all transactions of the system should be traceable and accountable. Automatic enforcement of terms: autonomous transactions by smart contracts as a legal agreement. Efficient: reduce the latency time for the transactions. Security: every user must be protected from unauthorized access. The remainder of the paper is structured as follows: Section 2 introduces related work and the state of the art of lending platforms. Section 3 presents our lending platform. Section 4 concludes the paper.

2 RELATED WORK

The WeTrust lending platform provides a user dashboard system with a trust lending circle and support by ROSCA, Ethereum Blockchain-based, autonomous, frictionless, decentralized. Sybill Attack Prevention, product (Mutual Insurance, Trusted Lending Circles), Country implementation (India, Latin America, China, USA). However, the weaknesses are that collateral (deposit on WeTrust wallet) is still needed and the involvement of a foreperson (Token, 2018). SALT Lending, support by Automated Lending Technology. Ethereum Blockchain-based, distributed ledger (Decentralized), Multi-Currency Support (USD, EUR, GBP, JPY, and RMB). In the countries implemented (Europe and current African Expansion), collateral is still required with automatic collateral technology and high deposit multi-variant product (Bilbao & Argentaria, 2018).

Table 2: Ethereum Lending Platform (Tran, 2019).

	SALT	BlockFi	ETHLend	Dharma	Compound	MakerDAO
Registration Required	Yes	Yes	Yes	Yes	No	No
Interest Rate for Loans (Min.)	5.99%	4.5%	Market	Market	Market	3.5%
Lend or Borrow	Borrow	Both	Both	Both	Both	Borrow
Loan-to-Value (Max.)	70%	50%	50%	Market	66%	66%
Own Token	Yes	No	Yes	No	No	Yes

BlockFi is a lending platform U.S. Dollar, profiling, register, Ethereum, and Bitcoin support. Loans security by Gemini, a New York trust company regulated by the New York Department of Financial Services, requires cryptocurrencies as collateral. Darma Lever is a P2P Ethereum-based lending, open marketplace, lending system, and borrowing terms. Crypto as collateral, alpha mode, and does not have its token. ETHLend is an Ethereum token platform ready for registration or profiling, which supports over 180 Ethereum tokens, Ethereum, Bitcoin, and LEND tokens as collateral. MakerDAO is Ethereum based. DAI stable coin decentralized finance application U.S. dollar support. The compound,

decentralized lending application behind MakerDAO relies on a wholly decentralized smart contracts system that can be accessed without permission or registration. Users can customize rates they want to lend out or pick which loans they are willing to accept, support Ether, and multiple ERC20 tokens. MakerDAO lending and borrowing support borrowers need to maintain a collateral value that is 150% of what they borrowers (Tran, 2019). A comparison of lending platforms is shown in Table 2.

3 OUR LENDING PLATFORM

To deal with the aforementioned challenges, we propose a DApp platform for Ethereum blockchain-based personal lending to assist borrowers in proposing and receiving loans. To this end, we reduce or eliminate the need for collateral by assessing the borrower's trustworthiness for the loan's repayment as shown in Figure 2.

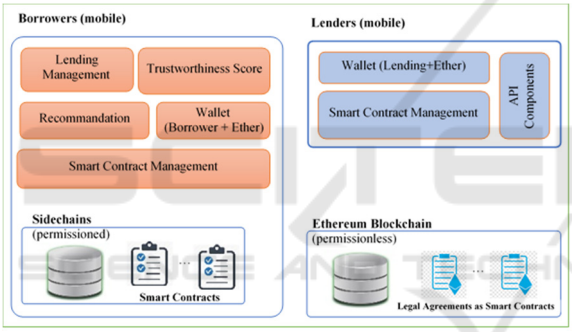

Figure 2: DApp platform for blockchain-based personal lending.

3.1 Trustworthiness Score

Underlying beliefs or personality factors contribute to credit scores. Four factors include impatience, impulsivity, risk tolerance, and trustworthiness (Arya, Eckel, & Wichman, 2013). It seems reasonable to expect a lower credit score associated with the payments process if there is evidence of impatience with current and future consumptive activity with borrowing. A higher loan application risk implies the possibility of not being able to pay the installments. Impulsive individuals who have difficulty resisting the temptation to borrow for consumptive needs will increase debt.

A lack of trust can also cause a bad credit score due to a lack of trustworthiness and failure to meet obligations. And finally, credit scores can be significantly affected by financial risk-taking because those who accumulate debt will experience repayment difficulties. Credit score using a third party based on information reported by the applicant, such as the FICO score. This credit score estimation uses measuring tools: risky attitude, trustworthiness, and time preference, and impulsive survey measures so that it can be used to determine the correlation of behavior of creditors as reflected in the credit score. The standards of impatience, trustworthiness, and impulsivity affected credit scores, as reported in (Tunç, 2019). We define the trustworthiness score in term of four variables, namely profile_score, activity_score, social_recommendation_score, and loan_risk_score, as follows Equation (1):

$$Trustworthiness_{score} = Profile_{score} + Activity_{score} + SocialRecommendation_{score} + LoanRisk_{score} \quad (1)$$

Where:

Trustworthiness_score: Borrower credit score
Profile_score: Personal information of Borrower.
Activity_score: Business activity or job information of Borrower.
SocialRecommendation_score: The recommendation value of Borrowers from Recommender.
LoanRisk_score: Information of the record from another loan of Borrower.

3.2 Users Management

Figure 3: User management process.

The public key is used to create account addresses similar to bank identities or like account numbers in traditional banking. The private key will be required when signing transactions originating from the account (Figure 3). Each node on the network can verify its signature (Dingman et al., 2019; Zhong, Wu, Xie, Guan, & Qin, 2019).

3.3 Functionality

The system functionality is offered to three actors: Borrowers, Lenders/Investors, and Recommenders. The borrower actor can access direct use cases, including: Create Account, Loan Proposal/Request, Join Investment Group, Withdrawal, Payment Installment, and Delete Account. The borrower actors fill out a form username and password. In the loan use case, the borrowers' actor put the loan request into the system by determining the loan amount and period. After the loan application has been received, the borrower actor can make payments according to the agreement's dates. In the last use case, the borrower actor can delete their account if they have finished paying off installments.

The investor actor can: Create Account, Fund Accounts, Create Investment Units, Manage Investment Units, Withdraw Funds, Delete Accounts. Create User Account use case, and investors actor only creates an account if it has never been created before. If successful in creating an account, the investor actor can access the Fund Account use case and make a transfer balance that will be used for investment. The investor actor can access the Create Investment Units case to make an investment selection after transferring funds. In this use case, the investor actor determines the allocation of funds for the type of investment desired. If the investor actor has finished investing, they can withdraw all funds in withdrawal funds use case. If the investor actor does not continue the investment, the investor actor can delete their account in the Delete Account use case. The recommender actor can access the trustworthiness score use case to give a recommendation score to borrowers. The Lenders/Investors can use the trustworthiness score to make a loan decision.

3.4 Lending Management

Lending management will provide how the borrowers request some loans, terms, and conditions. Trustworthiness score gives the borrowers scores from the system after registering with a default value for the first time. The recommendation provides the borrowers with a person who can give good recommendations to propose some loans. An essential part of our lending platform is a recommendation that aims to reduce dependence on collateral. Some borrowers' users give good comments. The number of other users who make recommendations will cause the loan application to be granted or not. Investors will get a message that there are new borrowers who are recommended to be given loans. So that may help convince investors to approve their loans.

There will be no credit score when creating an account, but the borrower can apply for a loan with a certain amount. The system will detect someone who requested a loan. The investors will see an opportunity, so there may be several prospective investors to provide loans. Investors may decide to bear the risk depending on the borrower's profile. Smart contracts as a legal agreement (investors and borrowers) are the core of the lending platform that we are proposing. Trustworthiness score and recommendations are significant factors in lending in this platform that can reduce collateral dependence.

3.5 Calculating the Trustworthiness Score

The trustworthiness score that we propose is a value of borrowers set by the smart contract so that both parties understand each other's obligations and risks that will be accepted. The variables include profile score, activity score, social recommendation score, and loan risk score as shown in Equation (1). The borrowers can request some loans with their trustworthiness score, which will determine the maximum loan. Trustworthiness scores will increase alongside the track record of payments from borrowers. The value will get better, and the borrower has the opportunity to get a larger loan in the next submission. The system will reduce the trustworthiness score if the investors and recommenders give a bad report to borrowers.

On the other hand, if investors get a borrower who has a good commitment, they may profit. The borrower will get a high trustworthiness score, so it will be easier to request loans in the next cycle with increasing loan plan limits. The smart contracts management at borrowers, lenders/investors, and recommenders' sides will handle each functionality from the available services on the Ethereum-based blockchain.

3.6 Sidechains and Ethereum

We propose reducing users' burden by installing the sidechains on the mobile application side in this lending platform. DApp platform lending platform Ethereum-based can handle complex transactions. The users feel more confident in making transactions. Setting up a recommendation to support the lending process and establishing a high level of trust—allowing users who have already done a transaction

without additional costs for making the same transaction will reduce the cost burden on making transactions. It can also control users' traffic (investors and borrowers) of this lending platform. It allows the user to download only the application client so that it is unnecessary to download the whole Ethereum-based lending platform and reduce the exchanged messages (transactions) through the internet to access the main blockchain (e.g., connectivity problems, internet not available). The weaknesses are to perform off-chain transactions will be increasing transaction time because all members must be approved. Transaction queueing will occur because each transaction needs action requires from other users and will impact additional time to process.

Blockchain technology is a combination of trust and consensus in a legal agreement between investors and borrowers, so there is no need to represent data, processes, and transactions on the blockchain to increase trust's expected value. The permissioned blockchain makes it possible to give privilege to all users (investors and borrowers), as described in one infrastructure that is complete. Users can obtain permission only through various applications and integration of multiple components, such as security, speed, immutability, scalability, resilience, and trustworthiness, including ledgers that cannot be changed except through the consensus.

3.7 Smart Contracts

On our lending platform, smart contracts will regulate conditions from the borrowers' and investors' sides, as well as determine the business logic from the borrowers' side to propose a loan. Investors can capture demand signals to offer an agreement between borrowers and investors regarding interest and other fees (also called gas) until both parties set up a contract. Our lending platform is allowed to maintain an access control layer (lending management) compared to existing blockchain-based lending. Users enable specific actions to be carried out only by individual investors or borrowers that can be identified and possibly with predetermined access rights. This smart contract requires a communication model to define a legal agreement as a smart contract.

In addition, the direct involvement of investors and borrowers in managing this lending platform can reduce the risk of failure associated with the execution of smart contracts and regulate the conditions for the existence of privilege given to each user (investor and borrower side) to keep the service running in the long run and the investor and borrower sides does not need to download the whole blockchain of a lending platform for the client.

4 CONCLUSION

We propose a personal lending platform that minimizes collateral by introducing a trustworthiness score and replacing the guarantor with a recommendation from family members, colleagues, peers, and small businesses. The transactions are conducted with smart contracts as an enforceable agreement between the borrowers and the lenders/investors. A recommendation will support trustworthiness scores at the borrowers' side and give decision-making at the investors' side. The platform is designed as Blockchain Decentralized Application (DApp), a rapidly growing technology, especially for fintech. The DApp architecture enables borrowers and lenders to transact in a P2P manner, thus eliminating the disadvantages of a centralized loan process.

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