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An Innovative AI Blockchain Framework for Islamic Microfinancing

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Abstract

The digital economy has undergone significant transformations with blockchain becoming a household name in the fintech environment. Besides powering cryptocurrencies, blockchain technology enables power transactions in a variety of forms and enables decentralization which may reduce transaction costs. Islamic microfinance has become important with many new institutions arising in order to satisfy the demand for microfinance services while ensuring that these services comply with the *Shariah* Law. Cost of transactions and low degree of digitalization are the major obstacles with current solutions. We present an innovative blockchain artificial intelligence framework for the optimization of Islamic microfinance service provisioning as well as providing financial and transaction services in order to ease transactions and make them more secure and readily available. The framework was evaluated on a large dataset from the Central African Republic, and we could demonstrate strong performance of the AI-blockchain framework. The framework provides a viable solution for Islamic microfinancing to enhance transactions services and overcome some of the existing challenges with Islamic finance

Keywords: Islamic finance, microfinance, blockchain, artificial intelligence, decentralized ledger

1. Introduction

The digital economy has been a major game changer offering significant opportunities for individuals who do not have conventional access to the financial system (Dara, 2018). Conventional banking faces considerable challenges given the considerable cost incurred for consumers to access banking services. Specifically, low- and medium-income economies face considerable challenges in enabling more and more consumers to have access to financial services due to the significant overhead cost by conventional banks (Malim and Normalini, 2018). Most consumers in developing countries lack access to basic financial services, such as checking and savings accounts as well as loans (Gosavi, 2018). This implies that most of these individuals live primarily from paycheck to paycheck and have little to no savings. Furthermore, the opportunity cost and risk associated with aims to save on a monthly basis are hindered by the lack of adequate storage options, and the likelihood the funds will be at risk of being stolen. While there have been decades of efforts, conventional banking has marginally transformed the ability of these individuals to obtain basic banking and microfinancing options. Islamic financing has provided new opportunities for consumers to get easier access to Islamic banking services and experience a more equitable treatment when looking for financing (Mahadi et al., 2019).

1.1 Islamic microfinancing

Islamic microfinancing has increased tremendously in the last several decades. Poverty is one of the biggest challenges, and Islam actively encourages to do good to mankind and help their fellow men. More than three

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billion individuals live in abject poverty and the Islamic world experiences some of this hardship with more than 1.2 billion people experiencing poverty (De Haan et al., 2021). Both urban and rural communities in these countries experience poverty, which has been associated with high inequality in addition to low productivity. Microfinance has been considered as a valuable tool for supporting communities via providing them with crucial financing in order to reduce inequality and increase productivity (Jachimowicz et al., 2022). A fundamental question arises in terms of what the poor need in terms of financial services. Specifically, they are often faced with the challenge of outspending their income due to foreseen or unforeseen events. Generally, these events can be categorized into lifecycle events, emergency needs and investments (Beegle and Christiaensen, 2019). Lifecycle events are events that either taking place once or are recurring. Events that take place once are marriages, death, home construction or elderly care, while events that are recurrent are investments into education or festivals. Emergencies involve crises such as sickness or injury or the death of a family member that was earning a lifeline for the family. Furthermore, theft and natural disasters are a challenge that fall within the category of emergencies.

The last category is the opportunity to invest into land, businesses and other assets that may exceed the means of the individual. Micro-credit provides a solution to have these financial means in order to overcome the challenges. However, poor individuals need more than just credits, but also savings, money transfer facilities and insurance as well. Conventional microcredit in Muslim countries typically violates the prohibition of *riba* via charging interest rates on principle borrowed (Mohsin, 2020). While there are several Muslims who take advantage of the options of interest-bearing credit, a vast majority looks for options that do not violate *Shariah* law. Another form of financing is micro equity, which provides a micro-entrepreneur with micro venture capital, which can be in an Islamic form as trustee financing (*Mudarabah*), joint venture (*Musharakah*) or share-cropping (*Murabahah*). Another key component of microfinancing is micro-savings. Poor individuals face multiple challenges in that they have considerable demands on their low incomes and lack available deposit services that fits their needs and expectations. These individuals look for secure, and convenient deposit services that enable them to hold small balances and access these funds relatively easily. Accessibility to funds is a major challenge as many low- and medium-income countries face a lack of banks as well as low bank productivity (Mustapa et al., 2018). This makes it very challenging for normal individuals to use these banking services given the absence of being able to retrieve and deposit these funds. Furthermore, transferring money both domestically and internationally is another considerable challenge. Conventional money transfer services charge high commission fees for their services, which makes poor individuals who depend on these transfers very vulnerable (Nguyen, 2018). Furthermore, conventional shops such as those selling mobile phone cards and groceries are highly frequented by these individuals but they do not provide such services. Capable to provide these banking service would be a considerable benefit to the general population.

Microinsurance is another key area of interest for poor individuals. Shocks arising from natural disasters, death or sickness of family members may have a more significant impact on a poor's people ability to survive as compared to normal families (Schuster, 2021). Micro insurances provide low-income individuals with a safety net against unforeseen events and finance themselves from the subscription of a large pool of individuals or groups. In order for Islamic microinsurance to be effective, it has to be easy to understand and affordable and prioritizes the needs for those who need protection the most. The ideal Islamic framework is called *Takaful-Tawuni*, which is not-for-profit and takes on the form of guarantees by the members of the cooperative (Almulhim, 2019).

This implies that microfinance represents a key opportunity for low-income individuals that are typically excluded from the formal financial system. This disengagement causes these individuals not to be able to participate in the development process and take advantage of the economic opportunities, build assets and finance the education of their children. This causes these individuals to be trapped within a vicious circle of poverty.

A key feature of many developed economies is the support of entrepreneurship, which allows individuals to create new jobs and employ many more individuals. This job support creates wealth and employment for others and strengthens the economy. Microenterprise development is one of the core features of Islamic finance, with a strong focus on risk sharing and mutual success in the business relationship (Ahamad et al., 2020).

When looking at entrepreneurship, there are livelihood and growth enterprises that an individual may invest in. A livelihood enterprise is a state of entrepreneurship that an individual is pushed into in light of striving for more profitable alternatives. Programs for the development of livelihood enterprises have primarily the reduction of poverty as its main objective and seek to upgrade the productivity. The objective of growth enterprises is towards the development of an enterprise and uplifting it to a higher level of operationality as well as making it a firm sustainable business model. Also, the business looks to provide a comprehensive range

of services, including technical assistance and credit (Hamad and Adeyemi, 2021).

Table 1: Comparison between livelihood and growth enterprises.

Livelihood Enterprises	Growth enterprises
Part-time or seasonal enterprise to supplement income	Enterprise is main source of income
Involves rudimentary skills	Entrepreneur requires considerable skills and expertise
Surplus earnings are limited	Enterprise is mostly in a niche-market and has earnings to invest back into the business
High proportion is in livestock, backyard poultry and food processing	Most are in technologically or service-oriented businesses

Source: (Hamad and Adeyemi, 2021)

While both types of enterprise are helpful for poverty alleviation, there are considerable differences between those two (Table *1*). Growth enterprises are typically more sustainable and help in the growth of productivity as compared to livelihood enterprises. Islamic microfinance places a strong emphasis on mutual benefit and collaboration when dealing with entrepreneurs and conventional banks and financial institutions will rarely provide financing to new entrepreneurs that lack sufficient collateral (Antova and Tayachi, 2019). In the case of Islamic microfinancing, the collaborative effort between the lender and loan taker is a key to success and leads to sincere interest of the lender in the success of the business (Antova and Tayachi, 2019).

A major question arises in what kind of microfinance models are most beneficial. These institutions provide financial services that are focusing on the poor entrepreneurs that are fitted to their needs. The quality of the microfinance programs depends on how streamlined the borrowing process is, and how quick the loans are disbursed (Beegle and Christiaensen, 2019). Microfinance institutions have a particular strong niche market in overcoming some of the challenges related from individual collateral and form groups of individuals in order to access funding. This sharing of risk within the group as well as finding consensus is at the core of Islamic finance (Adamu, 2018). This implies that the repayment of the loans is the responsibility of the entire group which implies that if one individual defaults, it affects the credit score of the entire group (Baber, 2019). The peer pressure that arises from the joint risk sharing allows the group to overcome financial challenges jointly and avoid delinquency. In most instances, such microfinance programs are structured in the form of providing small credit amounts and have weekly repayment intervals (Fersi and Bougelbène, 2021). Furthermore, the overall duration of the microfinance program is short in comparison to conventional loans that may range over 20 or 30 years. The most famous model relating to this form of microfinancing is the Grameen Bank model. The model necessitates the careful targeting of the poor and requires extensive fieldwork by the staff. The groups typically consist of five members, that each other guarantee the loan (Baber, 2019). Considering the benevolence of Islamic finance, the model may be easily adapted to comply with *Shariah*. Another model is the Village bank model that establishes a local bank which is financed via external capital (Malim and Normalini, 2018). Any individual loans are paid on a weekly interval and the individual village bank then returns capital gradually to the agency implementing it. If the loans are paid by bank in full, then the bank is eligible for subsequent loans. This takes on the form of joint risk taking by the villagers and potential mutual support as the default of a loan would hamper the ability to receive further financing. *Shariah* compliance can be easily realized in many different forms and the benefit of the bank is that it may become after a certain period of time autonomous and self-sustaining (Schuster, 2021). Additional models may be the formation of a credit union, or in the form of a self-help group. The most promising model to be implemented in Islamic finance is the village bank model, as it allows to establish an institution that may serve the community over a long period of time and may provide services beyond the loan financing (Mahadi et al., 2019). Furthermore, institutionalization of the loan process makes it easier to ensure that Islamic finance provisions are followed, and the bank will be more efficiently integrated into the existing financial ecosystem.

When developing these financial solutions, it is key to understand that poor people not only need loans, but a variety of financial services, such as insurance, savings accounts and money transfer options. Providing poor

people with such access is a key to alleviate poverty and enables them to build wealth and prosperity (Mahadi et al., 2019). Furthermore, the microfinance financial system needs to be integrated into mainstream financial ecosystem, as well as ensure that these institutions are available over the long run. Technological challenges and cost of transactions and integration are major hindrances for these institutions to remain economically viable.

This outlines the challenges with conventional microfinancing where transaction costs are rather high. This is, both for conventional as well as Islamic microfinance options a key factor which reduces the impact microfinancing may have on lifting individuals out of poverty as well as providing financial service opportunities.

1.2 Blockchain – revolution for the integration

Blockchain technology has been rapidly attracting interest from various Islamic countries and also the Organization of Islamic Cooperation (OIC). Crucial to note is that blockchain should not be equated to cryptocurrencies that have received mixed reception in terms of their permission to be utilized under *Shariah* Law. Blockchain technology has experienced growing utilization with many Islamic financial institutions implementing blockchain systems in order to make transactions faster and more efficient as well as derive the benefits associated from this technology (Kemmoe et al., 2020). Blockchain allows to build distributed and tamperproof ledgers which reduces the need for intermediaries, reduces the cost and finally increases both speed and reach. Another benefit is that blockchain technology increases transparency overall and allows to better trace business processes. For the Islamic financial system, blockchain technology may have considerable benefits, especially when it comes to Islamic microfinances. The first major benefit is that the transaction cost can be considerably reduced. Given that blockchain utilized a decentralized storage of data, individuals may just utilize their mobile phones in order to conduct payments as well as receive their funds. Smartphone penetration is high in most developing countries due to the availability of cheap smartphones and access to the internet via these smartphones. In contrast to more developed countries, many individuals and family do not possess a computer, which makes smartphones the primary form in which individuals conduct their transactions and do their financial business. Furthermore, blockchain technology supports complex financing terms, *Shariah*-compliant transactions and also support *Shariah*-compliant alternatives to conventional insurance.

The main benefits of blockchain are its transparency, control, security and real-time information (Chang et al., 2020). Transparency is a key parameter as it allows to trace transactions easily and also ensures that the transaction is legitimate and was really executed. Furthermore, the network access can be easily controlled and restricted which allows it to restrict the utilization of the blockchain to specific identified users. A major benefit of block is that the digital ledger cannot be altered, nor can data be changed as soon as they are entered. This reduces the risk of fraud as any attempted modifications can be determined and would require a substantial control of the blockchain. Finally, the information is available in real-time as the blockchain is updated for everyone simultaneously (Kemmoe et al., 2020).

These benefits will potentially and significantly reduce the cost associated with Islamic finance, given the higher cost associated with the back-end processing of Islamic finance companies. The main challenge that arises is the current lack of regulations for smart contracts and the missing of a global regulatory framework for these contracts. We present an innovative blockchain framework for Islamic microfinancing. The framework allows to utilize blockchain cost-effectively and efficiently to enable Islamic microfinancing, and also integrates advanced AI analytics to enhance allocation of financial credit and optimize the offering of financial services.

2. Literature Review

Blockchain and AI have gained considerable prominence in recent years. Blockchain has been posited as a game changer in decentralizing and democratizing the financial system not needing anymore a central authority to move the funds in between. AI has likewise found growing adoption in the microfinance industry in order to more efficiently allocate loans and provide financial services.

Lalitha and Soujanya (2019) present a sample blockchain framework for microfinance institution for conventional microfinance in India. The outline of blockchain is conceptual and addresses some of the basic factors of blockchain being utilized as the general ledger for replacing the general ledger of the bank. The authors primarily focus on the immutability of the blockchain transactions as the main benefit to prevent fraud, which is a considerable benefit of blockchain technology (Lalitha and Soujanya, 2019).

Mukkamala et. al. (2018) provides an overview of how blockchain may be utilized for general social businesses. The review article outlines how a native cryptocurrency for such businesses may be developed, as

well as the existing barriers in terms of infrastructure and technology that need to be overcome (Mukkamala et al., 2018). A particular focus of the article was on outlining the ability to strengthen trust into the social business and increase transparency. The authors presented several situations in which this may be beneficial and enhance efficiency and transparency.

Kshetri (2017) investigated whether blockchain may provide opportunities for major economic, political and social transformations in countries south of the hemisphere that are plagued by poverty and societal upheaval. Blockchain may bring with its transparency and trust, as well as ease of use an opportunity to enhance decision making, reduce fraud and increase trust in procedures (Kshetri, 2017).

Seyedsayamdost and Vanderwal (2020) investigated whether blockchain has a good societal impact and can assist in solving some of the global challenges. Based on the examination of three projects that have utilized distributed ledger technology, the authors outlined limitations with DLT solutions and provides policy recommendations (Seyedsayamdost and Vanderwal, 2020). The three projects analyzed include the cash transfer in Syria based on the World Food Programme, the illegal child trafficking in Moldova by the United Nations Office for Project Services and microlending to social enterprises in Brazil instituted by Moeda. The challenge of all these projects were that the distributed ledger technology was not utilized in its full form, but rather conventional intermediaries were replaced with those providing the blockchain technology. This implied the limitations that reduced the impact of the solutions and limited the potential deployment of these technologies.

Kunhibava et al. (2021) presented a comprehensive overview on the utilization of blockchain for *sukuk*. The authors concluded that the structuring of *sukuk* on blockchain can increase the transparency of the underlying assets and cash flows, in addition to reducing cost (Kunhibava et al., 2021). Furthermore, the number intermediaries and contract formalities may be significantly reduced, which would enhance efficiency in *sukuk* transactions.

Younas and Kalimuthu (2021) focused on analyzing the difference in growth between commercial banks and microfinance, specifically electronic monetary institutions that provide most of their services on mobile phones. This has necessarily led to a challenge to commercial banks facing new competition (Younas and Kalimuthu, 2021). The study shed light on the challenges of commercial banks that are likewise applicable to conventional microfinance institutions, and how mobile based solutions may provide an essential technological advantage to make it easier for individuals to deposit their money as well as acquire financing.

The presented research has outlined some significant progress in the area of how blockchain can be utilized for Islamic microfinancing. However, there is still significant uncertainty arising from how AI combined with advanced blockchain solutions can assist Islamic microfinancing in becoming more efficient, reach a wider target audience and make a significant contribution to alleviating poverty and providing financial services to the poor.

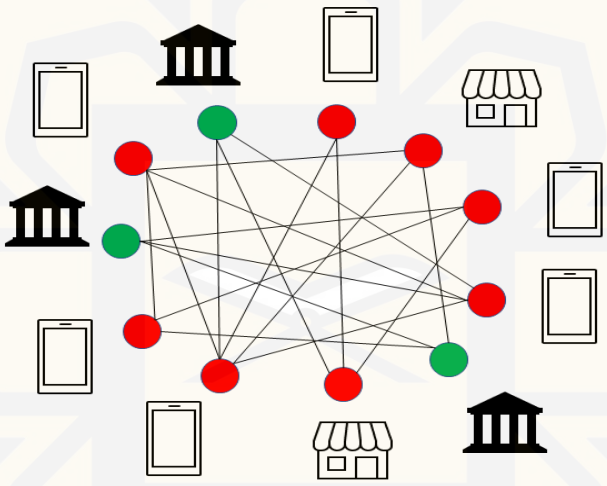
3. Conceptual Framework

We have developed a new AI – blockchain framework for Islamic microfinancing. The framework consists of a blockchain transaction ledger that records any interactions between the Islamic microfinance institutions and the individuals, providing both loan and other financial services, such as checking and savings accounts. The framework incorporates a blockchain that acts as the decentralized ledger allowing to add blocks of transaction and other information to block, making this immutable (Zahid et al., 2018). Furthermore, the blockchain also powers the transactions of the microfinance institution and enables via a mobile phone application to perform all its transactions, take out loans and perform refinancing. Furthermore, the e-wallet also provides the community with a payment platform, allowing them to pay easily with their mobile phone at various vendors, as well as receive their payments via the platform. The framework is illustrated in Figure 1 and consists of various members of the network. The blockchain distinguishes between validator nodes that can add members, validate the transactions and have primary control of blockchain, and the member nodes that can solely conduct or receive transactions. The validator nodes are the individual Islamic microfinance institutions that provide the financial services to the members, and the member nodes represent either businesses or Islamic microfinance members. Member nodes can only initiate or receive transactions, which is essential in order to avoid that member validate their own transactions, which may be subject to fraudulent activities. Maintaining the trust and oversight of the Islamic microfinance members is a key objective of the framework, as it ensures

that the Islamic microfinance institutions can invalidate members in case they default as well as maintain control over the blockchain transactions. While modern cryptocurrencies pride themselves with the decentralized nature, challenges arise from ensuring that the transactions on the blockchain are legitimate and for *Shariah* compliant transactions. Recent years have demonstrated that bitcoin and other cryptocurrencies have been prone for being utilized by criminal networks and for illegal activities. Ensuring that such transactions are prevented, and only legitimate transactions can be carried out is paramount in order to maintain the public trust into the framework. Therefore, a validator node is essential in order to police the blockchain framework. Furthermore, the validating institutions allow them to control the members of the blockchain as well as remove any individuals that violate the established blockchain framework rules. This ensures a powerful enforcement mechanism, as any violators may face being excluded from the framework.

The framework was developed in Python and features both an integrated blockchain environment as well as optimized loan and financial services provisioning to the individual Islamic microfinance members.

Figure 1: Graphical illustration of blockchain architecture for Islamic microfinancing. The nodes in green are validator nodes, and the nodes in red are member nodes that can initiate or receive transactions.



4. Results and Discussion

In order to demonstrate the Blockchain AI framework on microfinancing, we utilized a dataset of approximately 40,000 members of an Islamic microfinancing institution in the Central African Republic which may utilize blockchain to be the ledger for their transactions. The dataset was augmented with data based on general demographic, income and societal norms if the data was not complete. The reference data were taken from a variety of sources, such as European Country of Origin Information Network, World Bank, International Monetary Fund, and the United Nations statistics (Austrian Red Cross, 2019; Kouame et al., 2020).

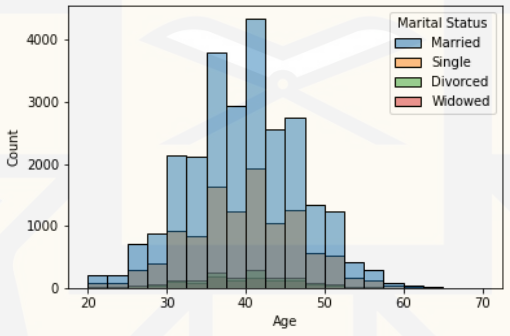
Table 2: Dataset parameters categorized according to personal data, Islamic values and financial data.

Data Columns	Type
Gender	**Personal Data**
Age	
Job	
Marital Status	
Number Children	
Wife is working	
Number of mobile phones	
Number of children studying	
Knows Blockchain	
Zakat Amount Paid per Year	**Islamic values**
Participates in Islamic volunteering	
Committed crimes	
Number of crimes committed	

Went to Islamic school?	
Number of financial services	**Financial Data**
Monthly Salary	
Monthly Overall Income	
Monthly Loan repayment	
Monthly expenditure	
Number successfully repaid loans	
Number defaulted loans	
Value of collateral	
Expected Annual Transaction Volume	

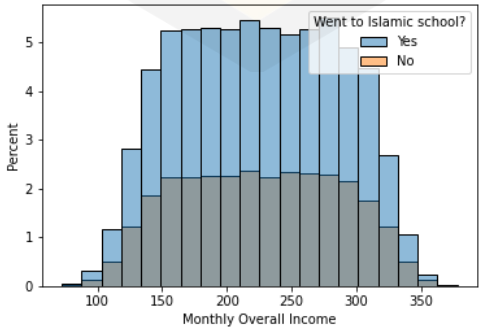
For the blockchain-AI framework, we analyzed initially the dataset to discern potential correlations and relationships within the data in order to optimize the provisioning of financial services and loans. The collected data for each individual member is outlined in Table 2. The collected data were categorized into three different types; personal data, data related to Islamic values and financial data. When analyzing the factors impacting Islamic microfinancing eligibility, personal factors as well as financial conditions are the most important decision-making variables. These are also the key parameters when analyzing expected volumes of transactions that will be conducted via the blockchain framework, allowing to provide targeted offers to the members. In Figure 2, we outline the age distribution in the dataset, as well as the marital status. The distribution indicates that most of the applicants were married with a few being single, and a lesser number being divorced or widowed. This is expected given that societal norms and family relationships play a critical role within the society, encouraging individuals to get married and have children.

Figure 2: Histogram of the age distribution and marital status



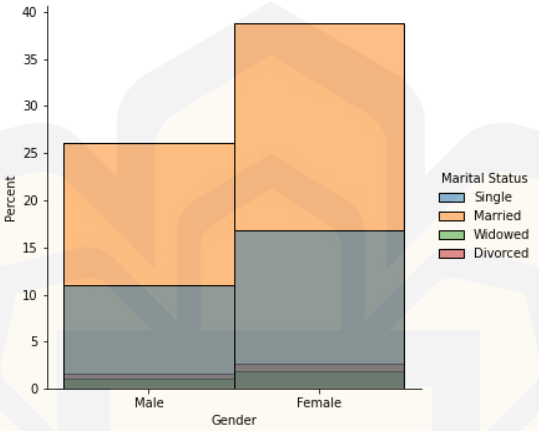
Another keen interest was the determination whether the attendance of an Islamic school affected the overall income of the individuals. Based on the distribution and a statistical analysis, there was no clear indication that this is really observable within the data.

Figure 3: Histogram comparison of monthly overall income versus attendance of Islamic school



In order to understand gender induced effects on the marital status, we visualize the distribution of the data in Figure 4 their distribution and color each by their marital status. The data outline that almost 38 percent of the women are married, while around 17 percent are single. The overall statistics outlines that the dataset contains more women as compared to men in the dataset. Given that normal income of men is typically higher than for women, with many Islamic micro financed businesses primarily being run by women, this is mirrored in the dataset.

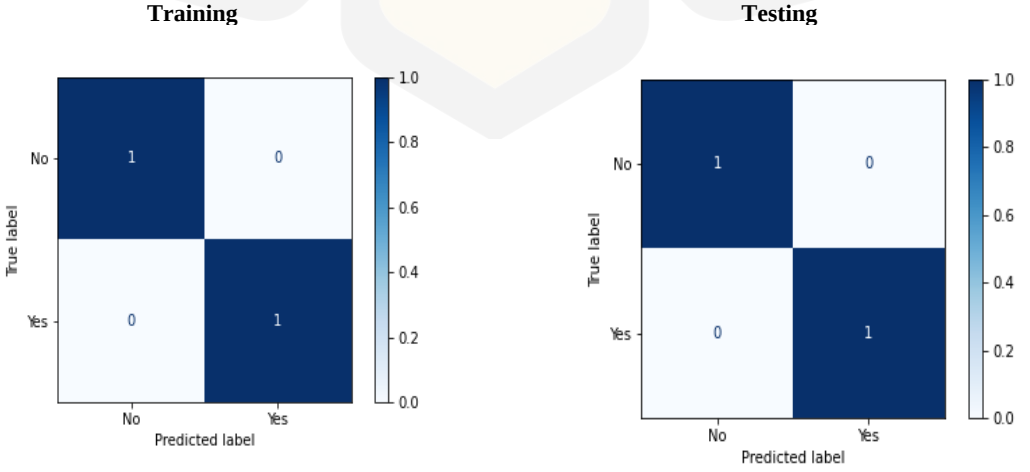
Figure 4: Comparison of distribution of male and female according to their marriage status



Having analyzed the data, we then aimed at developing a data-driven framework to optimize the allocation of Islamic microfinance capital within the community based on the blockchain transaction framework. A key objective of the framework is to provide in real-time whether an individual is qualified to obtain Islamic microfinancing services or not. Furthermore, the maximum loan amount that can lead to reliable repayment will also be determined. Additionally, the credit risk is going to be evaluated addressing both the risk of potential default and financial engagement.

In order to evaluate the performance of the framework for the loan qualification of individuals, we performed a confusion matrix comparison. The framework performs both on the training and testing dataset well, achieving perfect accuracy scores (Figure 5). This strong estimation performance is due to a variety of reasons. The first reason is that there is strong correlation between the monthly income, and collateral value in determining the qualification for financial services. Higher income individuals with sufficient collateral qualify easily for an Islamic microfinance loan due to the increased likelihood of them being able to pay back the loan. Furthermore, the criminality of the individual may also impact the estimates significantly.

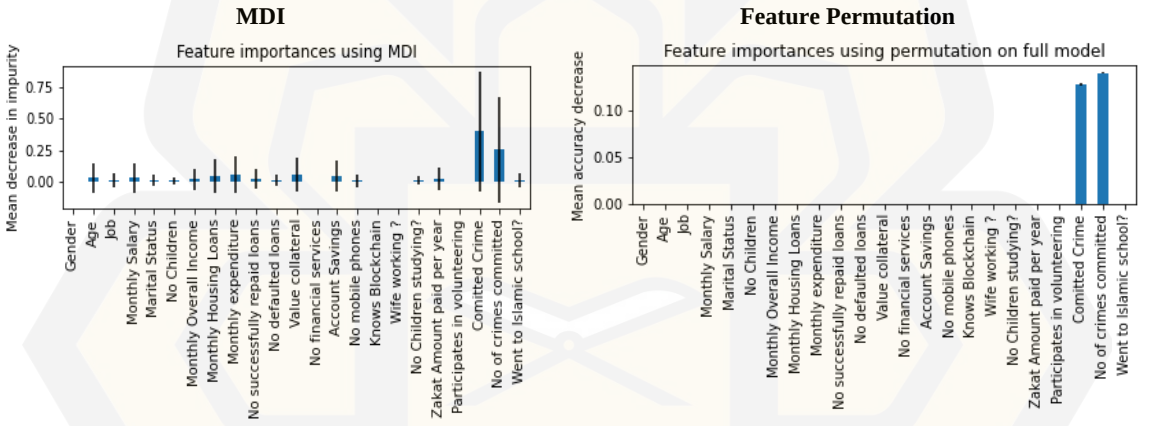
Figure 5: Confusion Matrix plot for the qualification of individuals for an Islamic microfinance loan



In order to evaluate which features have the strongest impact on the estimation, we determined the feature importance based on mean decrease in impurity and feature permutation. Determining the feature importance based on the mean decrease in impurity calculates both the mean and standard deviation of the accumulation of the impurity decrease within each of the trees, and then both the mean and the standard deviation are used to measure the impact. For the determination of the feature importance based on permutation, these features are computed based on left-out test set and have the advantage that they are less susceptible to a bias towards high cardinality features.

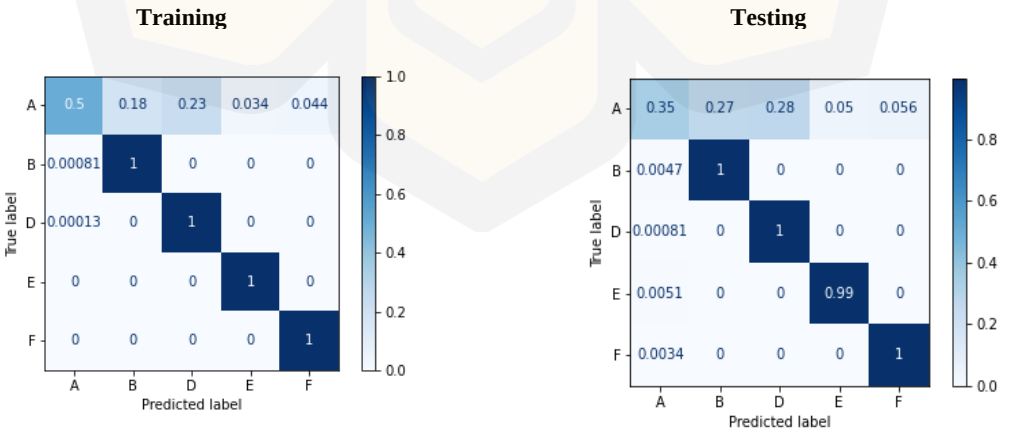
In order to ensure robust feature importance calculations, we compared the results for both versions and displayed the results in Figure 6. The results clearly indicate that the number of crimes and whether a crime was committed are the most essential features determining whether someone qualifies for a loan or not. This is a key pillar in Islamic finance to observe the deeds of the individual, especially when it comes to following the commands of Allah to be law-abiding and support the society.

Figure 6: Feature importance for both mean decrease in impurity, and feature permutation for the qualification of individuals for an Islamic microfinance loan



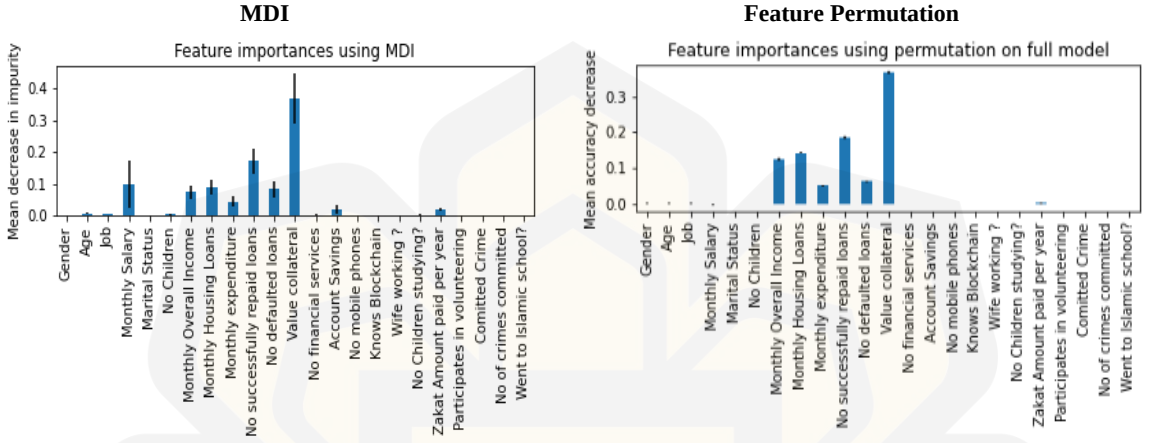
Based on the qualification for loans, we then evaluated the credit risk for the individual Islamic finance loan takers. The credit default risk was categorized into five categories ranging from very low risk (A) to high and severe risk (F). We display in Figure 7 the confusion matrix for both the training and testing dataset. The credit default risks are well determined with highly correct classification for both the training and testing dataset.

Figure 7: Confusion Matrix plot for the credit default risk of individuals for an Islamic microfinance loan



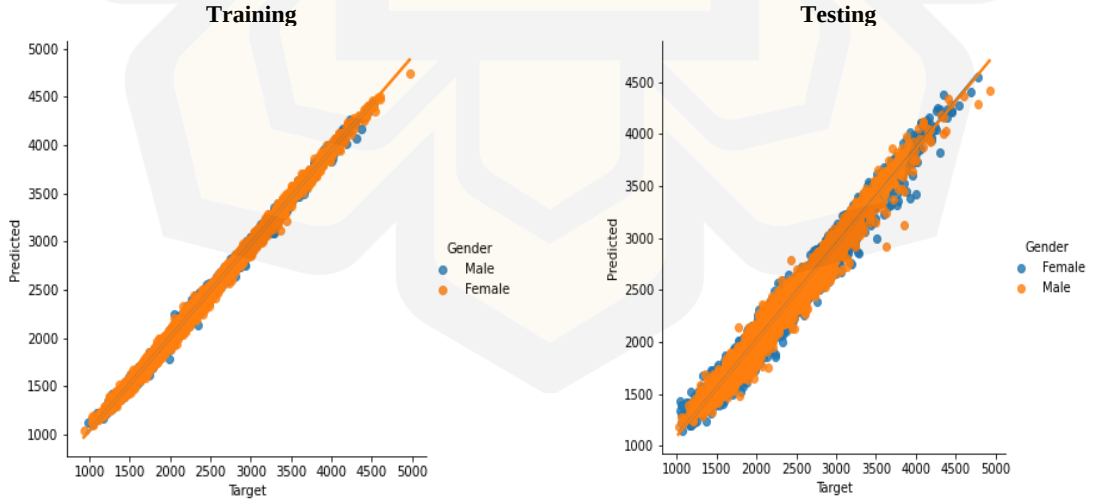
In order to evaluate the feature importance impact on the various risk categories (Figure 8), we can observe that the value of the collateral is one of the most crucial parameters, next to the number of successfully repaid loans. These results agree with the focus of Islamic microfinancing to ensure honesty and have the loans backed by adequate collateral.

Figure 8: Feature importance for both mean decrease in impurity, and feature permutation for the credit default risk for an Islamic microfinance loan



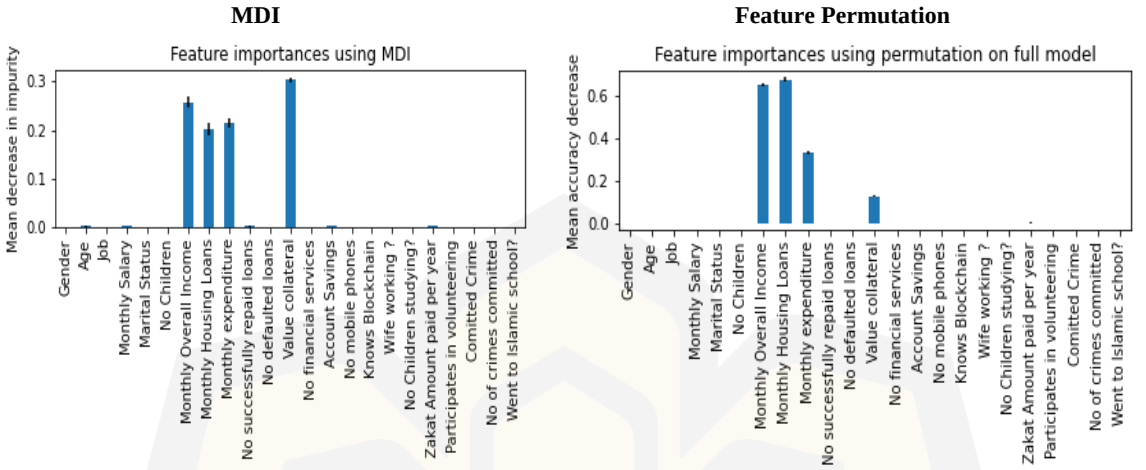
In order to estimate the maximum that an individual can loan, we developed a random forest framework for the estimation of the maximum loan amount. The estimation results for the training and testing dataset are presented in Figure 9, outlining target vs predicted maximum loan amounts. Both results outline strong estimation results with the coefficient of determination being 0.9 and 0.85 respectively. A comparison in terms of male versus female indicates that the framework is sufficiently capable of determining accurately the maximum loan amount that is reasonable for the microfinancing loan.

Figure 9: Regression plot for the maximum number of individuals for an Islamic microfinance loan



Finally, we investigate in Figure 10 the feature importance for the determination of the maximum loan amount. The results clearly indicate the collateral value, monthly overall income and expenditures are the key criteria determining the overall amount to be loaned. Interestingly is the difference between the MDI and feature importance based on permutation, where overall monthly income and housing loans represent the most important features.

Figure 10: Feature importance for both mean decrease in impurity, and feature permutation for the maximum loan value for an Islamic microfinance loan



In order to evaluate the expected annual transaction volume of the individuals with respect to the utilization of the blockchain, we illustrate in Figure 11 and Figure 12 the regression plots and feature importance analysis for the expected annual transaction volume that outline strong estimation performance. A key factor determining the annual transaction volume is monthly income. Furthermore, expenditures related to housing and overall living cost represent key parameters for the determination of how intensive and widely used the framework will be. The estimates are critical as it allows to provide differentiated services to members and address their Islamic finance needs.

Figure 11: Regression plot for the expected annual transaction volume of members of the Islamic microfinance institution

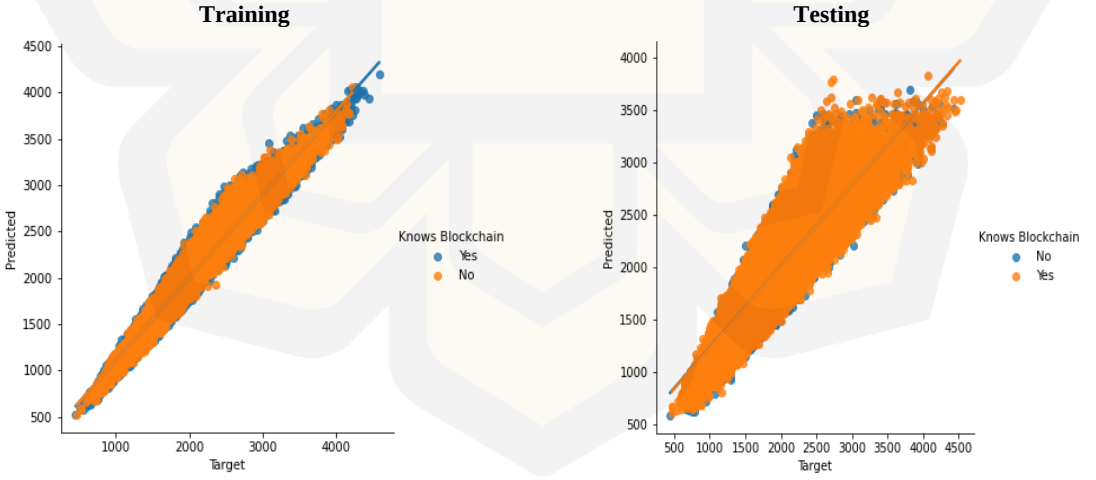
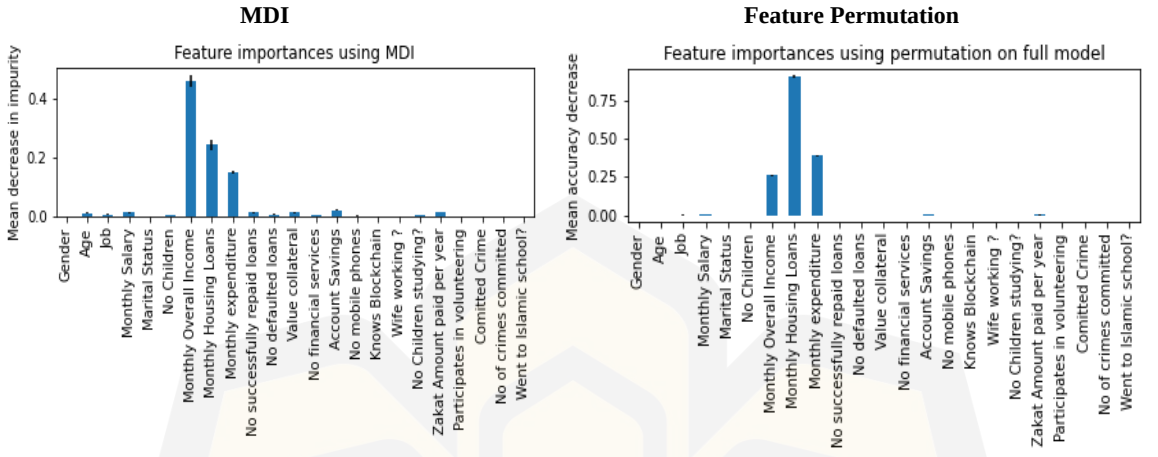


Figure 12: Feature importance for both mean decrease in impurity, and feature permutation for the expected annual transaction volume



5. Conclusion and Recommendation

We have demonstrated a novel AI blockchain framework for enhancing Islamic microfinancing. The framework incorporates both a blockchain framework for the recording of transactions and to increase efficiency of the Islamic microfinance transactions, in addition to an AI framework that allows to enhance decision making for individual members. The framework was evaluated on large dataset from the Central African Republic outlining its ability to improve efficiency of Islamic microfinance transactions and provide more targeted services depending on the characteristics of the member. This framework may be utilized by Islamic microfinance institutions to assess the risk of microfinance loans efficiently and robustly, allowing for an informed risk management decision.

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