
Designing Blockchain Technology to Transform Rural Communities

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Abstract

Mexican immigrants contribute large sums of money to their hometowns. But, these donors' mistrust in their native government has driven them to work independently, and consequently have more limited impact and scope. Prior work has explored open government platforms to build trust and facilitate collaborations between citizens and governments. Open governments use audit institutions to revise transactions and provide transparency. However, these approaches assume that strong audit institutions are in place, which is rare. In the case of Mexico, although the government has made great efforts to have trustworthy audit institutions, immigrants are still wary of them. Instead, we explore the potential of blockchain as a way to enable financial reviews without requiring human intervention. We discuss how our approach powers collaborations between immigrants and governments that transform rural communities in Mexico. We conclude with an overview of the design implications of our work.

Introduction

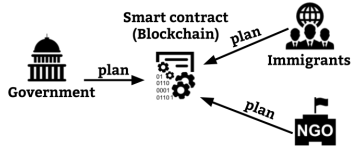
Immigrants are people who leave their hometown and settle down in another country to pursue better lives [15]. One of the largest corridors of human immigration is between Mexico and the US. Before 2013, at least 13 million Mexican immigrants had moved to the US [13]. Immigrants send money back home in the form of remittances,

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1. Collective Milestone Setting



2. Cash flow visualization



3. Community evaluation

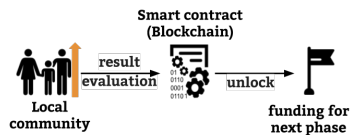


Figure 1: Overview of CivicGov , which has three stages: 1) United Milestone Setting 2) Cash Flow Visualization 3) Community Evaluation.

not only to assist their families but also to sponsor community development in their mother countries [12]. For decades, Mexican immigrants contributed their knowledge [8] or wealth [6, 10] and constructed various projects that benefited their native communities. These donations from Mexican immigrants are especially meaningful to small towns, as their total value can amount to seven times the local government's budget [8].

Despite their good intentions, most of these efforts usually have low impact and are executed on a small scale [8]. The main reason for this result is: immigrants are averse to collaboration with the government; preferring to supervise and complete projects independently [9]. Without the help of well-established institutions, it becomes much harder for citizens to lift an effort off the ground and create large-scale change.

Previous research explored how open models fought corruption within government structures and increased citizens' trust in these institutions [2, 3]. The idea behind these transparent governments is: their honesty will (in the long run) encourage partnerships between citizens and the state. Open government models focus on: presenting how the underlying administrative procedures of the government work to citizens, provide complaint mechanisms [7], and allow citizens to maintain and review public records without interference from corrupt officials [3]. Some open government models also leverage social media to supervise officials [5]. These models depend heavily on strong audit entities [7] because adopting open governments also means increasing the workload of watchdog groups [7], which is not always viable. These approaches also assume the auditors employed are not corrupt, and citizens trust them. To promote collaborations between governments and citizens, it is important to

consider solutions that do not necessitate heavy personnel overhead, or assume trust in human auditors.

In this paper, we introduce **Citizen and Immigrants Verifiable Incorruptible Collaborative** platform with **Governments**, or CivicGov for short. CivicGov is a decentralized platform that uses blockchain technology to assist immigrants, local citizens, and governments cooperate; without requiring individual, human managers. CivicGov integrates blockchain technology to systematically help fight corruption by enhancing fiscal transparency. Increasing accountability of all government financial transactions builds citizens' trust in these institutions. CivicGov blockchain technology algorithmically enforces the agreements between governments and citizens. This helps citizens by removing the necessity for faith in human officials' audit abilities or motives. It also lessens the burden on internal accounting departments that would otherwise need to invest resources to supervise projects. Being decentralized also reduces the power that governments have at any point in time by distributing the influence over projects. This strengthens the citizen-government alliance, as citizens feel empowered through participation. We tested CivicGov in collaborations between Mexican immigrants and governments that transformed rural Mexican communities. We finish by discussing the design implications of our research, strengths, and limitations of utilizing blockchain technology for these types of citizen-government collaborations.

CivicGov

Openness is one of the primary ways trust is built between citizens and institutions [2, 3]. The Open Government Partnership (OGP) is a multi-national organization consisting of 70 countries promoting open government. It declared: to have an open government it was necessary



Figure 2: Example of resulting collaborations between immigrants and governments that our system facilitated. Here, the collaboration resulted in the installation of hundreds of efficient stoves in rural Mexico from the company Infrarural <http://infrarural.com/>



Figure 3: Example of resulting collaborations between immigrants and governments that our system facilitated. Here citizens are completing one of the stages of the community project: they are building stoves in a particular rural community.

to follow three principles: transparency, civic participation, accountability [1].

We integrated the principles set forth by the OGP into community development projects in order to stimulate collaborations between immigrants and governments by building trust. We explore these ideas in our system CivicGov, a decentralized collaborative platform for immigrants, governments, and other institutions, such as non-government organisations (NGOs). Our system helps immigrants work with rural governments to endow and construct suitable projects that benefit their native communities. Our tool provides real-time monitoring of all transactions, assures that donations are spent on the community, and regulates the purpose of the donations.

To achieve decentralization and transparency, CivicGov employs blockchain based technology [11], specifically smart contracts [4] that manage the cash flow of the community development projects. Blockchain technology provides a public ledger (public database), that is stored on a distributed network; which is hosted on all the computers on the network. Therefore, data on the blockchain is accessible to everyone on the network [11]. Smart contracts are user-defined contracts that enumerate rules, controlling transactions and are stored on the blockchain [4]. While normal contracts outline a relationship and enforce the relationship via laws and authorities, smart contracts enforce the established relationship using code. Theoretically, smart contracts can be considered special, “trustworthy third parties”, which are publicly maintained. In our system we use smart contracts to ensure that all the donations and expenditures of the community development projects can be accessed through the public domain. Everyone can therefore see how the money is being used, and also have some safety that the money is

used in the way it was established.

Based on the principles of open government, CivicGov (presented in figure 1), consists of 3 main parts: 1) Collective Milestone Setting, 2) Cash Flow Visualization, 3) Community Evaluation.

1. Collective Milestone Setting

The aim of this step is to help immigrants, locals from rural communities, governments, and NGOs: (1) discover what improvements the community needs; (2) establish a suitable plan to address the community needs; and (3) fundraise and execute the established plan.

To enable more open collaboration and build trust, CivicGov redistributes the responsibilities and power of the government. The completion of the community project is divided into stages with milestones, which are collectively established by the stakeholders (donors, governments, NGOs, rural citizens). This reduces misappropriation of funds from the community development projects or practicing any type of corruption. No stage is given access to all of the funding (reducing the chances of illegal transactions, and the likelihood of embezzlement the funds.) In its execution stage CivicGov records the milestones and the funding distribution, which were negotiated collectively by immigrants, locals rural citizens, NGOs, and governments previously and established in the smart contract. Through the smart contracts, attention to the project execution is possible—due to the pre-determined milestones—without requiring any human supervisors. A smart contract holds the funds in escrow, which are disbursed according to a prescribed distribution and the pool of money is overseen by the “miners” on the network [4]. Notice how this work-flow reduces the workload and the dependence on the government audit officials, as the audit is now done automatically.

2. Cash Flow Visualization

In the interest of transparency, CivicGov records all money transactions – starting from the donations to the expenditures – on the public blockchain. Through the completion of the project, all information about the transactions and reallocations, such as the purpose, amount, recipient, sender, and timestamp, are recorded on the blockchain network. This enables the public to scrutinize whether the funds were used appropriately. Notice, that while the public can examine the records on the blockchain, it is hard for non-experts to recognize meaningful information without specific visualization tools. CivicGov incorporates data visualizations techniques to help the public easily check how the different actors are using the funding of the development projects.

3. Community Evaluation

Although blockchain make all the cash flow records publicly accessible, this technology can not evaluate the quality of the goods or services that are produced in each stage of the execution plan. Bribery, one common form of government corruption, occurs when businesses provide gifts or incentives to officials to ensure that governments will buy their products or offer preferential treatment; however, these products or services are normally inferior in quality [14]. To guarantee that the funding is not siphoned for bribes, CivicGov requests public inspections periodically throughout the execution of a project. Once the funding for a specific stage is spent, CivicGov automatically triggers the evaluation.

When the evaluation is triggered, citizens are asked to judge whether the expenditure adhered to the milestones and the results of the project meet the expected goals. Only if citizens agree that all the expenditures are proper, the smart contract will unlock funding for the next stage.



Figure 4: Example of resulting collaborations between immigrants and governments. Here we have a finished community project: an efficient stove deployed and being used in a particular rural community.

While crowdsourcing citizens helps us to measure the quality of an execution, we also hope that this will help citizens to see that all actors are indeed playing fair, which might help citizens to want to engage with the government, as they will see the plans completed and witness meaningful change ushered in to the community.

Discussion and Future Work

Prior work had identified that for open governments it was important to offer transparency, civic participation, and accountability [1]. We took these findings and designed CivicGov : a decentralized system that facilitates collaborations among immigrants, citizens, NGOs, and governments. CivicGov pushes a more democratic power balance between governments, rural citizens and immigrants, as it allows decentralized collaborations where all stakeholders can establish a plan, view all transactions and supervise the execution. Figures 2-5 show an example of how governments, social companies, and immigrants have started to use our system to collaborate.

We will evaluate our proposed model by helping the Mexican government to install our system for community development projects in rural communities. A critical aspect of CivicGov is that it helps to combat corruption with blockchain technology. This should facilitate immigrant, rural citizen and government collaboration towards benefiting rural communities. Moreover, by providing transparent reports and promoting the participation of rural citizens in the development projects (by requesting they help verify the transactions) we anticipate that trust will start to be built among citizens, immigrants, NGOs, locals, and governments. We will use direct observation, interviews to study CivicGov from five different angles: a) user adoption, b) how CivicGov changes immigrants' perceptions, their trust and willingness to collaborate with



Figure 5: Example of resulting collaborations between immigrants and governments that our system facilitated. Here citizens are completing one of the stages of the community project: they are building stoves in a particular rural community.

their home governments and institutions; c) corruption reduction; d) project completion rates; and e) community transformations through the projects completed.

In the following, we discuss design implications of our research.

Design Implications for Blockchain Developers.

One of the features of blockchain is “trustful”, which means that all the transactions (records) on the blockchain cannot be deleted or falsified. However, this does not guarantee that what is inputted into the blockchain is truthful. It could be that a corrupt official colluded with a company to increase the price or decrease the quality of the company’s products to keep the extra fees. Designers should consider this problem and think about how to overcome it. In our system design, we incorporated milestone setting and community evaluation stages where immigrants and governments could brainstorm their plan, budget, and review whether the expenditures are used judiciously. Throughout this process, the group can more easily flag and freeze corrupt transactions.

Blockchain designers should also consider that the value of cryptocurrencies, i.e., the currency units that are used in the blockchain, are constantly in flux and hard to treat as media of exchange in practice. Therefore, it might not be convenient to store the actual funds for the community project on the blockchain. To conquer the fluctuation problem, CivicGov only uses blockchain technology for recording. All of the funding for the community development projects are deposited in banks. However, this design also created a new middle-man problem, which blockchain technology promised to eliminate [11]. We are currently exploring the resolution of this problem through crowd-sourcing.

Design Implications for Civic Platform Developers.

Prior work had identified that in Latin America there is skepticism of the government [8]. To build trust, it is important not only to enable transparency, but also to provide ways to help citizens visualize that corruption is actually being fought. This could help change citizens’ mindset that “corruption is systemic in the country and no technological advancements will transform that reality.” In CivicGov, we encourage citizens and public to supervise and participate within the community development project. One of the purposes of this vigilance is to help citizens start to see that by integrating systems (blockchain technology) the plans they set with the government are effectively completed. This might facilitate more collaborations in the long-run.

Although policy and fiscal transparency are advantageous for enabling open governments and fighting corruption, not all information can be publicly available. This is because national security, personal privacy, and human rights must be balanced against the benefits of openness. Civic platform designers should think about how to effectively communicate these restrictions to end-users as they could lead to misunderstandings and the belief that governments continue to be corrupt and suppressing things. These mentalities could hinder important collaborations. It could also be helpful for civic platform designers to develop mechanisms to encourage governments to be more open about their work dynamics. The lack of such practices can generate unnecessary doubts and affect collaborations.

Authors

Chun-Wei Chiang is a graduate student in the Department of Computer Science at West Virginia University. He is also a research assistant in the Human Computer Inter-

action lab where he studies the application of blockchain technology and user interface design for Fintech. He currently explores how to intermix crowdsourcing and blockchain technology to facilitate large scale collaborations between crowds of immigrants and governments.

Eber Betanzos is currently the Vice Minister of Public Administration in Mexico where he focuses on developing public policies and programs to fight corruption and enable better citizen-government relationships. His office has pushed to have an open Mexican government (positioning Mexico in one of the top 10 most open governments in the world). Eber has a PhD in law, and is a specialist in Constitutional Justice and Human Rights. He is also the director of the Cyber Law Center in Mexico City that combines AI and law to develop civic technology for social change. Author of several books, articles and conferences on judicial law, human rights, the right to information, public policies and critical theory.

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