
BLOCKCHAIN FOR HOME SERVICES

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0.1 Overview

We present a blockchain solution for various home services such as plumbing, electricity, etc. In each transaction, we know that there are two parties - the homeowner and the technician. They typically do not trust each other in their representations of themselves unless they have a long standing relationship beforehand. Our product seeks to dispel this mistrust by providing an accurate history of previous work and payments to them. We log all aspects of a particular work into our database + blockchain. In this work, we will discuss why blockchain is viable, the architecture and user flow from start to finish, different challenges, and competitors we will have in this market space.

0.2 Business Case

Large renovation projects are frequently perceived as high risk and high cost endeavors. This is largely because finding a trustworthy home improvement professional, such as a contractor, electrician or plumber, frequently feels like a hard, if not impossible task. Here, we define "trustworthy" as someone who will complete the promised work at a high standard. In fact, in 2011, consumer protection agencies recovered \$147 million in construction fraud on behalf of homeowners. Furthermore, it is estimated that there are 20,000 to 100,000 contractors that attempt to defraud homeowners each year. Common tactics used to trick customers include requiring payment upfront, excluding work from written contracts and charging for "unforeseen problems" that require extra work.

Our technology leverages smart contracts to provide an escrow service that protects both homeowners and home improvement professionals. For the former, we ensure that the promised work is completed before transferring money. And for the latter, we ensure that they are paid for all completed work articulated in the smart contract. Since work is explicitly described in contracts, and funds are guaranteed to transfer when work is completed, this framework makes existing fraud tactics ineffective. Additionally, note that this product need not be limited to large projects. Home improvement work may include smaller jobs, such as maintenance for electrical and plumbing.

Our business model includes taking a 5% commission fee of the smart

contract's value. Assuming a similar user and professional base as HomeAdvisor and an average job cost of \$250, we estimate a revenue of \$35 million. Note that this figure leverages data provided by HomeAdvisor in 2014, who received 400,000 service requests in January to March of 2014 and assumes 15% growth year over year.

We believe that our technology is novel and potentially disruptive. Currently, there is no other platform that is able to facilitate the same level of trust between homeowners and home improvement professionals. In addition to protecting the two parties, continued use of our platform allows us to maintain a full history of work done to a home. Depending on the contract, this may be as specific and descriptive as the type of tile and wall paper used - data that does not exist today. With the permission of the homeowner, buyers may be able to view this data as a supplement to inspections and at a low cost.

0.3 Blockchain as a Solution

Because these two parties of homeowners and home improvement professionals inherently do not trust each other, it would be beneficial if there were some immutable ledger of all of the work done on a house or all the work done by a maintenance person. A blockchain perfectly fits the job requirements.

In the Suichies model, the questions (and answers) are "Do you need a database?" (yes), "Does it require shared write access?" (yes), "Are writers known and trusted?" (no), "Do you need a trusted 3rd party?" (no), "Do you need to control functionality?" (yes), "Where is consensus determined?" (intra firm). So in our case, we want to have a private blockchain.

Similarly in the Karl Wustl and Arthur Gevais model, we find our blockchain use case to fall under the "Private Permissioned Blockchain."

Now that we have established the need for a blockchain, here is why the blockchain is useful for us. Immutability is key because homeowners cannot artificially modify the previous work done on the house and home improvement professionals cannot hide any of the poor jobs he or she has performed. This allows the two parties to have an inherent trust in the system because cryptographically, it is almost impossible to change history.

If these two parties trusted each other, there would be no problem. However, because of this lack of trust, we need an escrow or some "3rd party" to ensure

a proper transaction between the two parties.

Because of this inherent mistrust, other approaches such as a database or centralized network fall short. To be clear, we are only putting a hash of the necessary information of some maintenance work on the blockchain (i.e. a hash of the concatenation of the homeowner id, maintenance person id, home id, details of work completed, fees of the job). We are using an oracle (db) to store the data, so if the hash from the database doesn't match the hash on the blockchain, we know something is compromised. Without this blockchain, we cannot know if the data in the database has been modified. There might be logs of any accesses, but the hash ensures any modifications to be detected and thus increases the trust in the validity of the results returned.

0.4 Technology and Architecture

We use a permissioned blockchain - that is, only verified users have access to the blockchain. Our stakeholders include homeowners, maintenance workers, and interested buyers/renters. Each of these users have an account on the blockchain and their own private key and identification number. In addition, there is a private key and id associated with every home. Whenever a job is satisfactorily completed by a maintenance worker, the following details get logged:

- Homeowner id
- Maintenance person id
- Home id
- Contract code
- details of work completed (includes rating, fees, etc)

These details are then hashed and recorded on the blockchain. In addition, these details also get added to a database which is an oracle for our blockchain system.

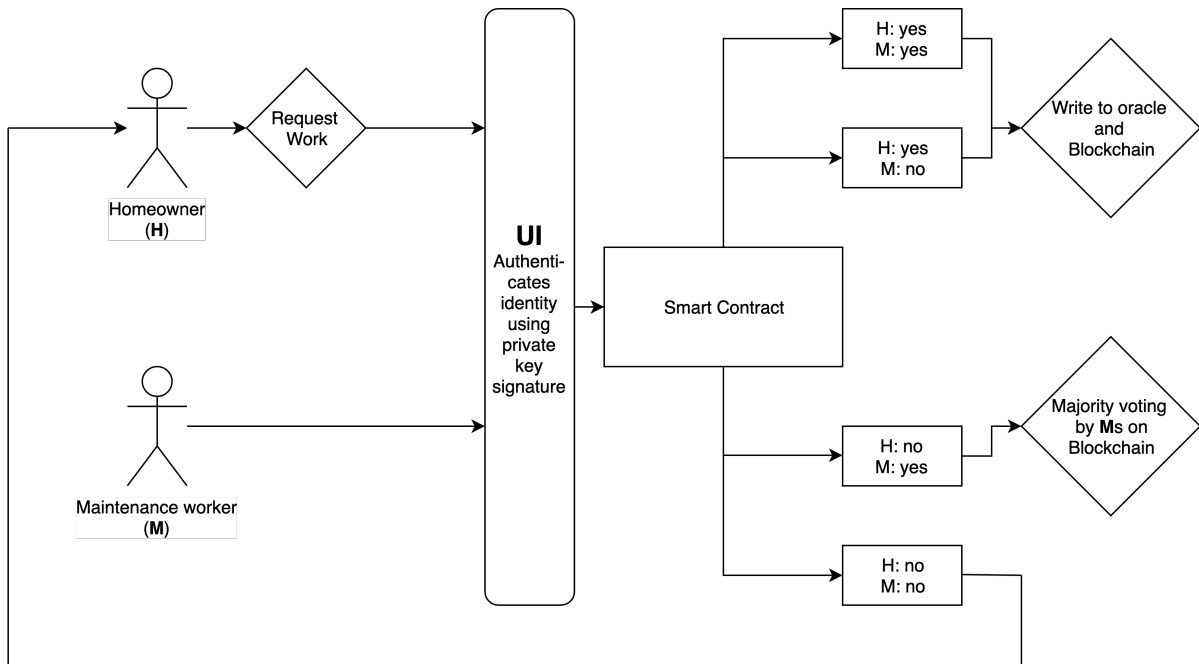


Figure 1: Workflow of Homeowners using the blockchain to get maintenance issues fixed

In figure 1, we show the workflow of how the homeowners and maintenance people interact with each other on the blockchain.

The homeowner requests a job to be carried out by a maintenance worker by interacting with the user interface of the system. The identity of the user is verified as follows: When the user makes a request, he/she digitally signs it with his or her private key. The public key of the user is then used to verify the user's ownership of the private key.

The homeowner and the maintenance worker then enter into a smart contract, which triggers a payment transaction from the homeowner to the maintenance worker when the contract gets executed.

The maintenance worker and the homeowner interact with the UI to say whether they think the job has been completed or not. If the homeowner is satisfied with the job, he signs "yes, it is completed" and this leads to the transaction being written to the oracle and the blockchain.

If both the homeowner and the maintenance person agree that the job was not carried out, the homeowner begins the process of finding someone to fix his maintenance issue again and nothing gets written to the blockchain or the oracle.

If the homeowner feels the issue has not been resolved and the maintenance worker thinks it has been, then to resolve this conflict of interest there is a voting done on the blockchain by all the Maintenance workers. A picture, video, or any other form of relevant data metrics is uploaded to the blockchain which will allow them to decide.

In all the cases, along with signing and saying whether the job was completed, the homeowner also rates how satisfactory the fixing of the issue was by interacting with the UI. This gets logged withing the details of the work completed. When other homeowners are looking for suitable maintenance people for their homes, this information gives them an idea of whom to prefer hiring.

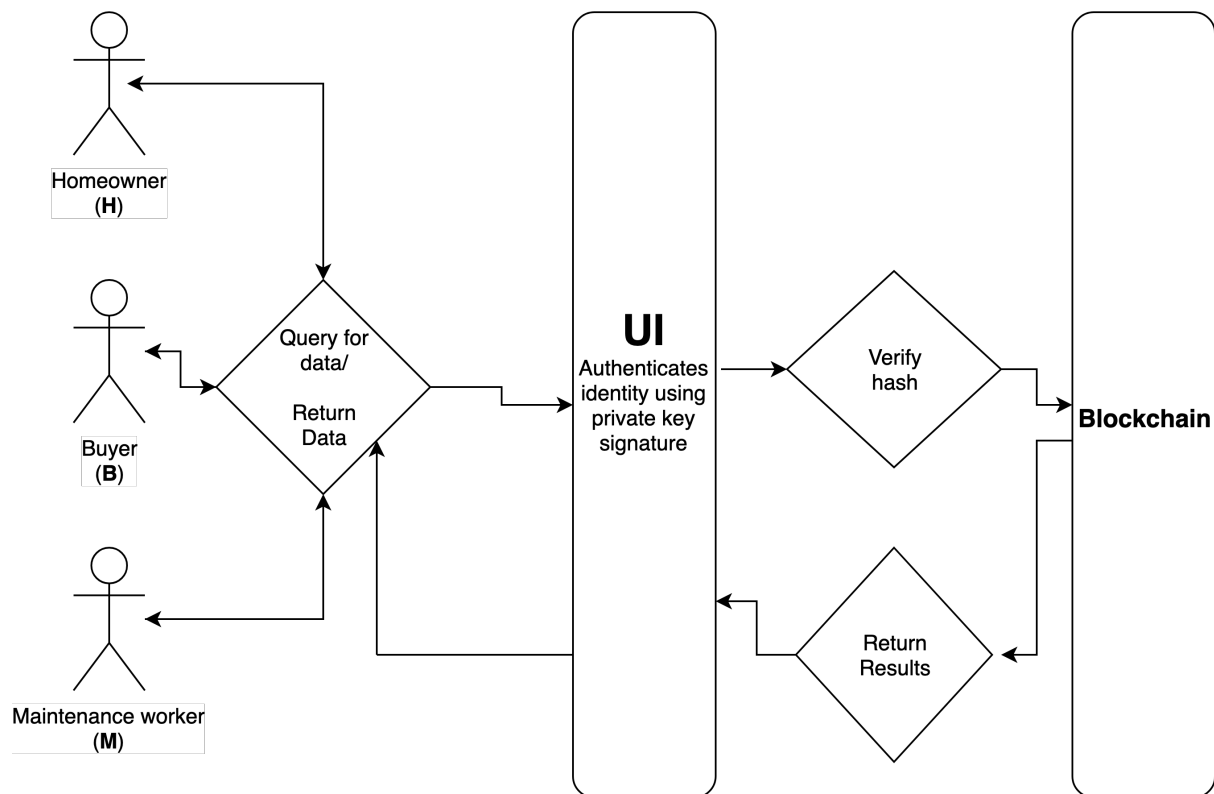


Figure 2: Workflow of users getting information from the blockchain

In figure 2, we depict how the oracle is used by users. The main feature

is that it is not completely accessible to everyone. Homeowners can only view transaction history on their homes, and details of jobs done by maintenance workers. Maintenance workers can view homeowners. Maintenance people cannot view other maintenance workers, and homeowners cannot view other homeowners' details. A buyer that is interested in looking at house should be able to see homeowners, and if the buyer is interested in a particular house after getting in touch with its homeowner, he will request to view the history of the maintenance fixes in the homw and is given a copy of it. All of these queries are done through the UI of the system, and the identity of the users is verified by their digital signature that uses their private key. The UI collects the data, hashes it, and verifies the hash with that on the blockchain (to ensure there is no discrepancy), and then the returns a copy of the data back to the user.

0.5 Challenges and Competitors

0.5.1 Challenges

One of our main challenges is the verification that a particular job was completed. In our current design, a response of "yes" from the professional, "M", and "no" from the homeowner "P", results in a vote from professionals on the platform based on before and after videos or images. The majority vote dictates if the contract is executed.

There are several challenges with this approach. Firstly, users may not feel that voting is a good use of their time and the incentive for a higher ranking in the recommendation engine may not be sufficiently strong. In the worst case, no users vote on a smart contract and it is never executed. A potential alternative may be to tokenize our blockchain and give tokens to those who vote. However, unlike Bitcoin, we do not know the "ground truth", making it difficult to decide who the coin should be awarded to.

Secondly, it may take a long time to obtain enough votes for a confident or statistically significant decision. This creates a negative experience for "M" and may prevent them from using the platform in the future.

Thirdly, images and videos may not provide enough or the correct kind of data to make an informed decision. For example, identifying if foundation was correctly installed may require additional metrics that we do not currently

capture.

Finally, although extremely unlikely, a misjudgement by the experts on our platform may be extremely expensive for either M or P. Even if these experiences are rare, they may be sufficiently negative and influence large portions of our user base through word of mouth. An alternative is to retain in-house experts that would travel to sites to determine if a job has been completed. This however, is inefficient and costly.

0.5.2 Competitors

To our knowledge, there is no company that leverages blockchain and smart contracts in the same way. However, there are many competitors that try to connect homeowners to professionals. ANGI Home Services, owns 11 similar brands who share a similar mission and reported \$1.07 billion in profit in 2018. One of their core brands, HomeAdvisor, strives to create an online marketplace for local home improvement professionals. Their main value proposition is that they pre-vet contractors, so that homeowners don't have to. Instead of charging a commission on the job, professionals are charged for every lead and a flat rate for an account. This model has received significant criticism, as many claim that the presented leads are often not valuable. Even more significantly, unscrupulous contractors were able to create accounts on HomeAdvisor through loopholes.

Since no money is transferred until the satisfaction of the contract's terms has been verified, our platform provides true protection for the homeowner. In short, our technology incentivizes honesty, a model that few competitors have embraced.