WORKING DRAFT: CHRONOBANK - PHASE 2: LABORX DECENTRALISED MARKETPLACE

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Abstract. In Phase 1, Chronobank introduced labour-hour tokens which represent the average value of one labour hour. This phase involves the design and construction of a decentralised platform capable of making labour exchange as easy as riding a taxi with Uber. This white paper describes a decentralised marketplace where people of real-world professions will be able to sell their labour to any participating client of the system. LaborX is a proposed implementation of the described system.

This is a draft version of the white paper prepared for community review. A Bounty of 1000 TIME tokens (an equivalent of 10 BTC) will be divided between the best contributors. To participate, join our #whitepaper Slack channel. To a get Slack invite, visit https://chronobank.herokuapp.com

1. Introduction

In 2009 (the same year that Bitcoin emerged), Uber, a mobile application which revolutionised the taxi business, was developed. The easy to use, fast and comfortable service made Uber a worldwide company with $1.5 billion in revenue. Uber removes the middleman – in its case, the taxi dispatcher - from the buyer/seller equation, allowing each driver to be his boss and work independently of a central company[1].

Similarly, LaborX aims to revolutionise the labour hiring industry by providing an open and decentralised ecosystem. It has the potential to benefit both highly skilled workers, who prefer independence or a more flexible work schedule, as well as low-skilled labourers who will be able to find flexible part-time work when it is convenient for them. LaborX targets offline workers providing real-life services which cannot be done remotely or supervised by special software.

The Problem. Currently, numerous agencies are providing centralised services which offer to hire workers listed in their internal databases. The reputation of such a system is fundamentally linked to the centralised agency which verifies and endorses the workers within the system. Further, such systems often fail to disclose employee's experience, reputation, or past jobs. The situation is complicated even more by inflated agency fees and a plethora of agencies to choose from for any particular job.

Proposed Solution. The LaborX Platform is a decentralised system that not only provides a labour hire marketplace but also is capable of automating (at least in part) the process of hiring individual workers given specific contract work. This includes the selection and vetting of workers based on the main attributes, such as availability, location, a field of work, skills, and reputation. This system leverages blockchain technology, specifically Ethereum, for its core systems and can therefore significantly lower operational and maintenance costs relative to competitors in the labour-hire industry. Moreover, the public nature of Ethereum will allow participants to view all worker's previous experience and recommendations. The system will also utilise the commercial side of blockchain enabling immediate payments for completed work. In addition, decentralisation allows the system to be global, autonomous, and versatile in the sense that workers and clients can accept a variety of location-independent currencies, in the form of any ERC20[2] compatible tokens (such as Labour Hour tokens[3]).

Contributions. This paper provides a high-level overview of a blockchain-based decentralised labour hiring system and its conceptual realisation in real world applications. Section 3 provides an overview of the base system components and processes including minor technical details. Section 4 provides economic considerations in brief, regarding the real-world deployment of this system and its feasibility. Section 5 describes the rating system that allows the community to have control over LaborX. Section 6 is focused on interface features. Section 7 details how privacy issues are handled.

2. Design goals

We aim to make short-term employment as accessible and rewarding as long-term employment, giving workers the flexibility to determine their schedules while being paid a fair rate for their time, expertise, and reputation. We plan to achieve this through the LaborX platform, which will enable trading of labour time at market rates. A decentralised reputation system will facilitate feedback for each entity, allowing employers to hire the most competent professionals. It will also enable individual workers to secure payment in line with their training, skills, and experience.

LaborX system is designed specifically to target workers in the labour industry (areas such as cleaning, plumbing, gardening, etc.). The system is intended to be distributed and have no central controlling authority. This means that it wouldn't be controlled by any single individual or company, but by a set of publicly verifiable predefined rules. Anyone can fork, modify and redeploy the system, like it can be done with the Ethereum network itself[4].

The system has to satisfy the following usage requirements:

(1) The client should be offered a selection from the most competent workers based on their search preferences.
(2) Workers that have higher ratings should have higher compensations.
(3) A worker can set their own rate.
(4) Both the client and the worker should have a rating.
(5) Both the client and the worker can reject a given sealed job contract (see more at Section 3.2).
(6) The worker always receives money for the time they spent on labour.
(7) The client should be able to stop work at any time.
(8) The system should vet clients and workers that have bad ratings.
(9) The client could pay with any ERC20 cryptocurrency, should the worker accept these tokens.

3. System overview

The decentralised nature of this system allows clients to hire workers using the Ethereum blockchain. Thus the core features of the system will run as a set of smart contracts[5], making the system available for use independently of any particular user interface realisation. These contracts will govern the behaviour of the system, dictate the agreements between parties, and serve as a public ledger containing profiles of clients and workers.

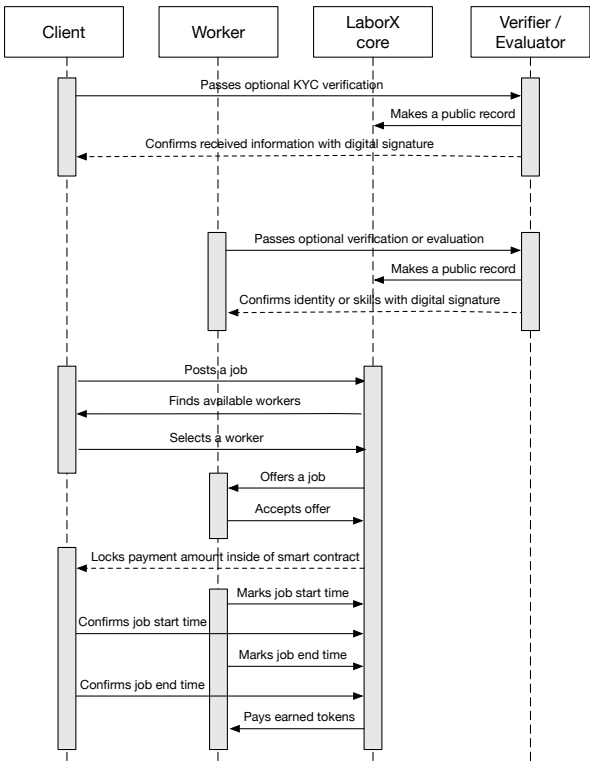

Figure 1. Sequence diagram

[1]Additional requirements are detailed in section 3.2

3.1. Actors

This section defines the six most important entities within the system: the client, worker, evaluator, verificator, provider, and the LaborX core (whose functionalities are depicted in Figure 1).

The client - a person or party that requires work to be completed. They create job(s) with key attributes (such as field of work, skills required, etc[1]) which gets posted to the ledger. The client then retrieves a list of available and qualified workers which they can select based on preference. The worker(s) may then accept the job and provide approximate estimates for the amount of time required to complete it. At this point, the system will allow the client and worker(s) to begin direct communication, should it be desired. Then the client has to agree on the estimations given by the worker. Upon agreement, a smart contract will facilitate the withdrawal of funds (equivalent to the value of the estimated hours of work) from the client's account to an escrow-like smart contract on the blockchain. The funds will then be released on a per-hour basis to the worker as work is completed. To ensure correct hours are paid, a stop-start timer is used. As a worker arrives, they seek approval from the client to begin the timer and commence the paid work period. The same is done at the end of the period or work segment. The client can revoke the job before it begins and can withdraw the deducted funds from the escrow-like smart contract. The client may give a rating to the worker upon job completion/termination and optionally a recommendation.

The worker - any person or party seeking jobs who is capable of working and getting paid. A worker creates a public profile containing labour scopes, working hours, and other relevant information. Based on this profile, a worker would be offered by LaborX to clients for jobs matching their labour scopes. If selected, a worker will be notified and asked to provide time estimates to complete the specific job. The worker is then able to contact the client to finalise details (if needed) before finalising the agreement. The worker should then arrive at the negotiated time to begin the work. The approval to start/stop the timer for paid work can then be given by the client, as described above. Upon completion/termination of a job, the worker can rate the client and optionally provide additional comments.

The evaluator. The highest ranked members of a community will be able to evaluate and confirm corresponding skills of workers, building a chain of trust. In this way, clients will be sure that the assigned worker has all the required skills for completing the job. Workers will be required to have a high rating and enough activity points to become an evaluator. Evaluators may verify and endorse skills of other workers ensuring clients have a more accurate description of their potential workforce. Workers with endorsed skills will typically have a greater chance to be selected for any given job by the LaborX core. After performing worker's skill assessment the evaluator publishes a record in blockchain. Evaluator's profile displays statistics of appraised workers and evaluator's reputation among LaborX users depends on it.

The verifier - a worker who offers services to verify clients and workers in a particular region (See the functionality in Figure 1). The fundamental role of verifiers

is to check required documents for their respective areas, such as work permit, certificate, injury insurance or other types of insurance. These entities are essential to adhere to local laws, enhance security, and potentially minimise spam issues. Both parties (clients and workers) may choose a single or many verifiers to review their documents, based on their rating and popularity. Each worker has a public profile and private data. The public profile is available in the blockchain and is accessible to everyone. The private data is verified and electronically signed by a verifier. It is only available to a client after they enter into a contract with the worker (more information is given in Section 7).

The provider - an entity who has created a job board. The nature of the blockchain means that participants are pseudonymous by default. This opens wide opportunities for spammers, marketing bots and other parties whose behaviour would be disruptive for LaborX. The decentralisation of the system means that there is no single authority who can ban these entities. A proposed solution is to give participants ability to create job boards, where the creator is also the moderator. Each board would have a rating from other participants and each participant having a threshold of activity points would be able to vote up or down on boards. The job board creator will be able to appoint other members as moderators. Each board member having sufficient activity points would be able to flag any suspicious entry for review and receive activity points for helpful reports. The boards would be filtered by tags and sorted by rating in the client application to easily remove/filter all junk boards. The job board creators also can enforce requirements for the clients and workers that want to use the board. They could include a requirement to pass verification by one of the listed verifiers, to have at least specified minimal rating, to perform a job in defined fields of work, to accept payment in selected cryptocurrency, to be located in specified area etc.

LaborX core - a sub-system of the LaborX platform encapsulating the majority of the core inner functionality and blockchain-dependent logic. This system provides the mechanisms that allow jobs, profiles, and other public data to be stored in the blockchain. It is capable of searching for available workers in job boards based on location, field of work, and skills thus giving clients a choice to pick worker(s) that best suits their needs. After a client makes this selection, LaborX core provides the functionality that sends notifications to the worker to accept/decline a specific job via Ethereum events. LaborX core is also responsible for calculating, storing, and retrieval of rating on the blockchain. Every client and worker will have a rating which increases/decreases as recommendations accrue after jobs are completed.

3.2. LaborX core functionality

LaborX core is a complex system powered by the Ethereum network. It contains all users' public profiles, completed jobs with description, executor, status, and mutual ratings. However, considering the system complexity, we have chosen to distinguish LaborX core from LaborX DApp. LaborX DApp functionality will include interface for creating profiles, verification, evaluation, searching workers, concluding contracts etc (see Section 6 for full description of features). This section will provide a more specific description of the key parts of LaborX core and we will postpone further discussion of LaborX DApp to Section 6.

A job object (the programmatic object relating to a real-world job) will contain a location, provider used and work description. The work description includes attributes such as field of work, job due date, address of ERC20 token contract (that will be used for payment), required skills, and further optional job-specific requirements. A client would be capable of searching through the list of workers in job boards or choosing a familiar worker. Fields of work and required skills can be selected from a list offered by the smart contract. A location is also a selectable parameter that will typically represent a city/region. If a city/region is large, then a district/sub-region may be specified. A city/region includes all of its districts/sub-regions. A location is used to map workers to nearby clients. Precise addresses (for job locations) will be revealed to workers once the job has been mutually agreed on and solidified by the smart contract. A job due date can be a present or future time. If the current time is selected, then LaborX returns all currently available workers ready to start a work now. If instead a future time was chosen, then the system will find workers available to work at the chosen time. Once the worker accepts the job, the smart contract will publicly mark the worker as busy, preventing further bookings in that period.

LaborX Core	**LaborX DApp**
Contains all ratings and recommendations	Calculates and displays rating
Contains full job history	Performs search over all completed jobs
Contains all payment logic	Provides a user-friendly payment interface
Contains all profiles	Shows profile data in an informative way
Stores public profile data	Handles public and private data
Needs time for transactions to be mined	Compensates LaborX response time by reactive and fast user interface
Is based on smart contracts	Is a client-side application written in JavaScript

Table 1. Responsibilities distribution of LaborX core and LaborX DApp

3.3. Billing and penalties

Billing will be governed by the following scheme: Once a worker's estimates have been approved by the client, a smart contract withdraws the required tokens/currency from the client's account. If the work takes more time than initially estimated and approved by the client, then the smart contract verifies the client's balance and automatically withdraws additional funds to account for the overtime. As this is an automatic process, the worker can continue to work freely and be sure that their overtime will be paid. This procedure repeats hourly. The process stops if either the job is paused, or marked as finished, or the client runs out of money, or the smart contract reaches

a maximum withdraw limit[2]. If this limit is reached, the smart contract may ask the client to increase the maximum withdrawal limit. If the client declines, the job is considered finished, and any remaining funds are released to the worker. If the worker works less than the estimated time, the difference is transferred back to the client. Part of the tokens paid for the job is automatically withdrawn as a fee (see more at Section 4). Worker has an ability to pause and continue job timer at any time. If the client is not satisfied with the worker, their accountability, or their work they can cancel the job at any time. Nevertheless, the client is required to pay a minimum of one hour (which is a minimal time unit that can be paid). The client may then leave a negative recommendation and rating that will negatively flag the worker for future clients. A negative rating will also adversely affect evaluator's reputation. If the worker doesn't start work within the agreed time, the client will not be charged but is still able to rate the worker and leave a comment. It should be noted that client does not pay the worker's transportation time and expenses. Instead, they should be included in the worker's individual rates.

3.4. Scalability and contract upgrades

The implementation of LaborX DApp, specifically the search and worker selection, will allow the system to be easily scalable. Yet, due to the systems complexity, it is probable that software bugs will be discovered. Therefore, a mechanism to upgrade smart contracts and core system functionality will be required. LaborX will use the following approach:

(1) Application data will be stored in contracts that are separated from business logic.
(2) Each record will contain a version number.
(3) Each contract will have a constant external interface.
(4) No migration can happen without a user's consent.

In this way, contracts can be upgraded without the need to migrate data. Switching to a new contract version is the smart contract equivalent of accepting terms of service, updated by a service provider. Each user will have an option to either migrate to a new contract version or to continue using the current one.

[2]This is typically double the estimated total price, but can be adjusted on a per-job basis

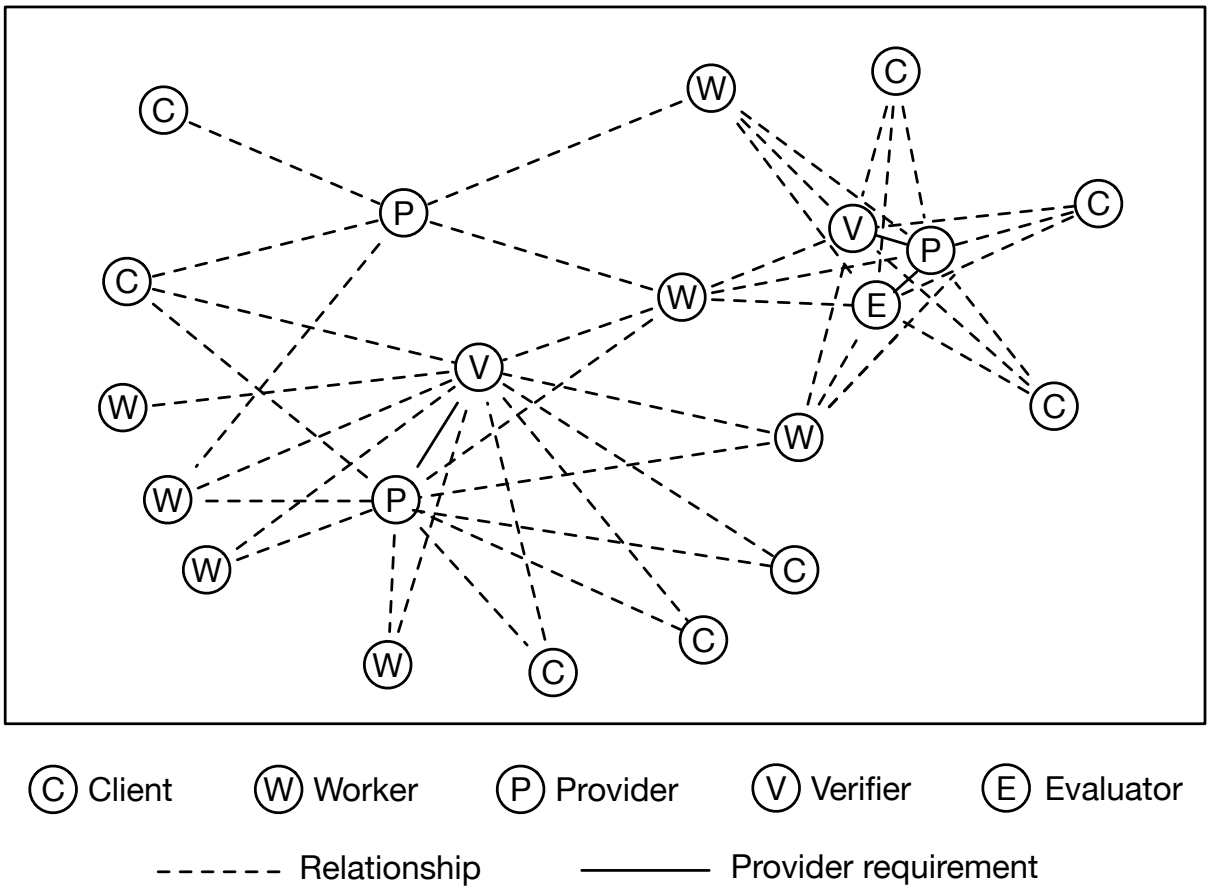

Figure 2. Relationships between different parties inside decentralised LaborX system

4. Economic model

LaborX is a multi-currency service that will support any token that complies with the ERC20 standard[2] including, but not limited to, Labor Hour tokens. A simple multi-currency wallet capable of receiving and sending any supported ERC20 token will be integrated into the LaborX platform. Users will be able to pay and get paid by tokens they choose from a list of supported on job boards tokens. Providers may list local currencies, allowing communities to pay for jobs in unusual digital assets, should both the client and the worker accept the currency by selecting the job board.

As mentioned in the previous section, the LaborX system will deduct 1%[3] from each completed job part of which will go as a revenue to TIME token holders and other part to providers for their services. Provider receives payment only for completed jobs posted on provider's job board.

4.1. Benefits

For clients. There are numerous benefits for clients. Because of smaller mediator fees than in traditional labour hiring companies, the resulting work price will be lower. Decentralisation of the service makes it fast, reliable, secure, and permanently available. A public worker rating system ensures that clients are seeing profiles of real workers along with their unique histories and therefore genuine ratings. The ability to pay with a variety of digital tokens makes the system universal and not tied to any particular country/region. Furthermore, LaborX will implement an easy to use interface, paying serious attention to UX.

For workers. Benefits for workers are also significant. Due to lower fees than in traditional labour hiring companies workers may ask for higher hourly rates. The most skilled and responsible workers with the best ratings will be highly sought after and may, therefore, demand a higher hourly fee than their not-so-amazing colleagues. For the first time in the labour hire industry, diligent and attentive workers will be rewarded for providing better services. The decentralised nature of LaborX will not only guarantee that workers will get paid, but will enable real-time payment to the worker as the work is completed. Since the system is fully automated, the workers will be able to plan their schedules corresponding to their preferences.

5. Rating and activity points system

For every worker and client there are two metrics called rating and activity points. The first describes how well a client or worker performs their duties and is dictated by their partners. The second is a point system based on all LaborX activity.

The better the individuals rating (based on previous work), the higher the price they are be able to demand for an hour of work. After a job is completed, both the client and worker are asked to rate to each other. The rating is in the range between 1 and 10, where 1 corresponds to a total disaster and 10 represents exceptional work.

The rating system will be time and quantity aware. By this, we mean that older ratings should contribute less to the current rating than recent ratings (i.e., the ratings are recency-weighted). This means, for example, a bad rating accrued a year ago by a worker, can be redeemed by a series of recent good ratings, thus restoring the reputation of the worker.

Activity points are used only in the LaborX DApp and have a crucial security role by limiting the amount of available functionality to newcomers. This limits threats such as spamming, posting advertisements with ambiguous links, or evildoers trying to overload the system with an infinite job posting.

Every new user begins with a single activity point which will automatically increase when performing various actions inside the app (see Table 2). An alternative way to gain activity points is by verifying one's identity with various verificators or by passing skill assessment with an evaluators. The activity points count will always be greater than or equal to 1.

An example of activity point elevators are given in Table 2. Some of the proposed features that will require some amount of activity points is given in Table 3. The listed values in these tables are examples only and may change during the implementation and system testing period.

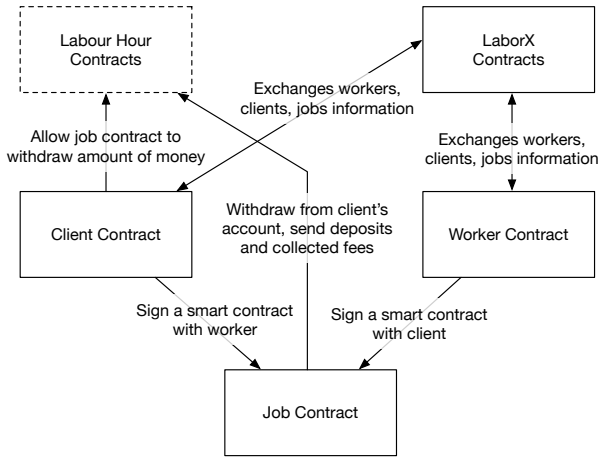

Figure 3. Contract interaction diagram

Action	AP effect
Fill in profile information	+5 points
Upload a photo after registration	+5 points
Complete a job, get rated N (1 <= N <= 10)	+N points
Pay a worker for a job, get rated N	10+N points
Pass verification	+10 points
Pass evaluation	+10 points
Flag content which is later removed	+5 points
Flag content which is later approved	-1 points
Post content which is later removed	-15 points

Table 2. Actions that affect activity points

[3]Percentage may change during the implementation and system testing period.

Action	AP required
Post to a job board	10 points
Vote up	25 points
Post links	25 points
Flag content for review	25 points
Vote down	125 points
Add items to global job board catalog	125 points

TABLE 3. Actions that require activity points

5.1. Rating and activity points growth example

Action	Rating	AP
New worker registers an account	undefined	1
Fills in profile information	undefined	5
Uploads a photo	undefined	10
Posts to a job board	undefined	10
Completes a job, gets rated 9	9	19
Completes a second job, gets rated 8	8.5	27
Posts some nudity pictures which are banned	8.5	12

TABLE 4. Rating and activity points growth example

6. LaborX DApp features

6.1. Verification and evaluation

One of the top priorities of the LaborX platform is to ensure that every client is comfortable letting workers into their house/workplace and every worker is provided with a safe workplace environment. To this end, LaborX is designed with specific focus on worker/client confidence. This is achieved through decentralised verification and evaluation features. They will offer a range of verification possibilities allowing workers to choose those that suits them best. The following gives a non-exhaustive list of possible options[4]:

- **Verification.** Entities with high reputation could serve as verification hubs and be paid for their services by workers. They will check that worker's documents correspond to the worker's identity, scan documents, publish document hashes[6] in the blockchain and confirm this action by signing the hashes with their digital signature (see Section 7 for more information).
- **Evaluation.** The highest ranked members of a community will be able to evaluate and confirm corresponding skills of workers, building a chain of trust. In this way, clients will be sure that the assigned worker has all the required skills for completing the job.
- **Evaluation by Clients.** Any verified client may advertise individual worker's skills after completing the job if some of them are exceptional. This information would be used to separately promote the workers who are constantly rated 10/10.

[4]This list has not yet been finalized

6.2. Workers selection

According to the current model, the governing smart contract returns a selection of workers that fit the criteria of a given job posted by a client. The LaborX DApp takes preference of workers who have more completed jobs and higher ratings. The system may grow such that the ratio of workers to jobs becomes quite large. It is therefore important that the LaborX DApp does some advanced filtering. This means that the application should not show all workers capable of performing a given job, instead select only several of the available best workers with varying rates and ratings. In this way, the most competent workers will get more work and will be paid more for their reputation. Clients may also use different custom filters that will help them to find the most fitting worker to suit their needs. They may also pick specific workers they are already familiar with. The application will also utilise smart filtering to minimise the worker intersection between clients. This is crucial for the system, especially when considering similar jobs.

6.3. Multi-currency support

The LaborX platform will include multi-currency support, making sure users can use different ERC20 tokens to purchase labour. Each LaborX provider will be able to set cryptocurrencies that will be permitted for payments on their job boards. Clients and workers who choose a job board, agree to use one of the supported methods of payment.

6.4. Search

High load testing and analysis would be performed while developing LaborX to determine exact implementation and architecture of the search system. The main part of a search logic should be performed in the LaborX LaborX core. Only Ethereum transactions that write to blockchain have gas limit and cost Ether. The search operation is read-only, therefore it would perform computations on user's Ethereum node and will not require paying Ether. A worker-to-job matching will include complex queries and therefore require a significant amount of computational power of the machine where Ethereum node software is running. Therefore LaborX DApp could handle part of the filtering and caching logic on client's side. This approach will significantly improve the user experience.

6.5. Messaging

LaborX will use a messaging system with an underlying protocol like Whisper[7], enabling client and worker to establish an encrypted connection. These messages could be used to exchange job details, address, confidential instructions, etc. The exact realisation will be decided at the time of development (specified in the LaborX road map), taking into account the potential research and new possibilities that will be available in 2017.

6.6. Features to be developed

Other features that are planned for LaborX but not described in this white paper include moderation and arbitration system powered by providers, usage of IPFS for data storage, and the Truffle framework for smart contracts on Solidity. The LaborX DApp will have a modern responsive interface (see, for example, the 'Post new job' and 'Edit worker profile' wireframes in the appendix A).

7. Privacy

It is truly unsafe to publish sensitive, private data in a blockchain. However, we have to eliminate the possibility of a worker re-registering to reset their profile. Therefore, we have to maintain a balance between anonymity and notoriety. To achieve this, each worker will have a publicly available blockchain profile containing their nickname (first name and the first letter of their surname), small photo, field(s) of work, skills, rating, rate, activity points, approximate location, a list of completed jobs and payments. Optionally, a worker may apply for a document verification or a skill evaluation (see Sections 3, 6) which will be reflected in his public profile and confirmed by the electronic signature of the governing party. There will be a data set which will never appear on the blockchain. This includes, but is not limited to, the exact geolocation of the client and the worker, additional private instructions for the worker, document scans.

Hashes[6] of private data blocks will be published on the blockchain to prove that they have not been altered. These hashes should also be electronically signed by submitter of the stored information and linked to the worker's public profile. In this way, only the signature and hash of the sensitive information will be publicly available, and any confidential data may be stored without revealing it to the public. An entity which gains authorised access to the information will also be able to check the signature to prove the origin of information.

LaborX smart contracts will automatically link all accomplished jobs, ratings, and skill ratings to the users' public profiles, enabling possibility to gather statistics and count ratings.

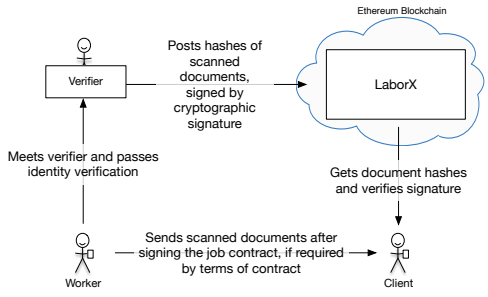

Figure 4. Verification of documents

8. Conclusions

This white paper proposes a decentralised system designed to revolutionise the labour-hire industry. It will be capable of automatically matching available workers to corresponding jobs according to their location, field of work, skills, and reputation. Using the Ethereum blockchain as a basis, this system can significantly lower fees for system maintenance, relative to traditional systems offering a similar service. Moreover, decentralisation makes the system autonomous and global as it runs on Ethereum and is capable of using any currently existing ERC20[2] tokens. This innovative system is only made possible by recent advancements in blockchain and cryptographic technologies. Leveraging these technologies this system allows people to trade human labour - the most fundamental unit of economic value.

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Glossary

activity points: is an integer in a range of 1 to infinity which measures positive contribution to LaborX ecosystem. The more activity points the user has, the more advanced actions they can perform. See the full list in Table 2. 2, 3, 5

client: is a person that has some work and needs to get it done. Client posts a job and pays for it. 2

DApp: is an abbreviated form for decentralised application. A DApp has its back-end code running on a decentralised peer-to-peer network. Contrast this with an app where the back-end code is running on centralised servers. 3–7

evaluator: a highly rated worker with lots of experience and reputation which prove they are a master in their field of work and thus can verify skills of other workers. 2, 5

job: is some work or task to get done. Job can be a list of tasks but all within one field of work. 2

job board: is a publicly available database managed by the creator. It will be implemented as a smart contract in Ethereum network. More information in Section 6. 3, 5, 6

LaborX core: this is a sub-system of the LaborX platform encapsulating the majority of the core inner functionality and blockchain-dependent logic. 2, 3, 6

ledger: is a publicly available database that holds information. It will be implemented as a smart contract in Ethereum network. 2

provider: is an entity which offers its services to connect clients and workers through a job board because of legal, security, or spam issues. Anyone can become a provider, and both parties (a client and a worker) could choose which providers they trust. Providers get paid for their services by receiving a percentage of job payment fees. 2, 3, 5–7

rate: amount of money that will be paid hourly to a worker. 1, 2, 6, 7

rating: is an integer in a range from 1 to 10 (where 1 is a disaster and 10 is perfect) which measures the quality of work done by a worker. LaborX uses rating to select workers for a job. 2–6

verificator: a worker with flawless reputation who offers services of verification for documents and identity of other entities. 2, 5

worker: is a person that is assigned to fulfil client's job and get paid for it. 2

Appendix A. LaborX Wireframes

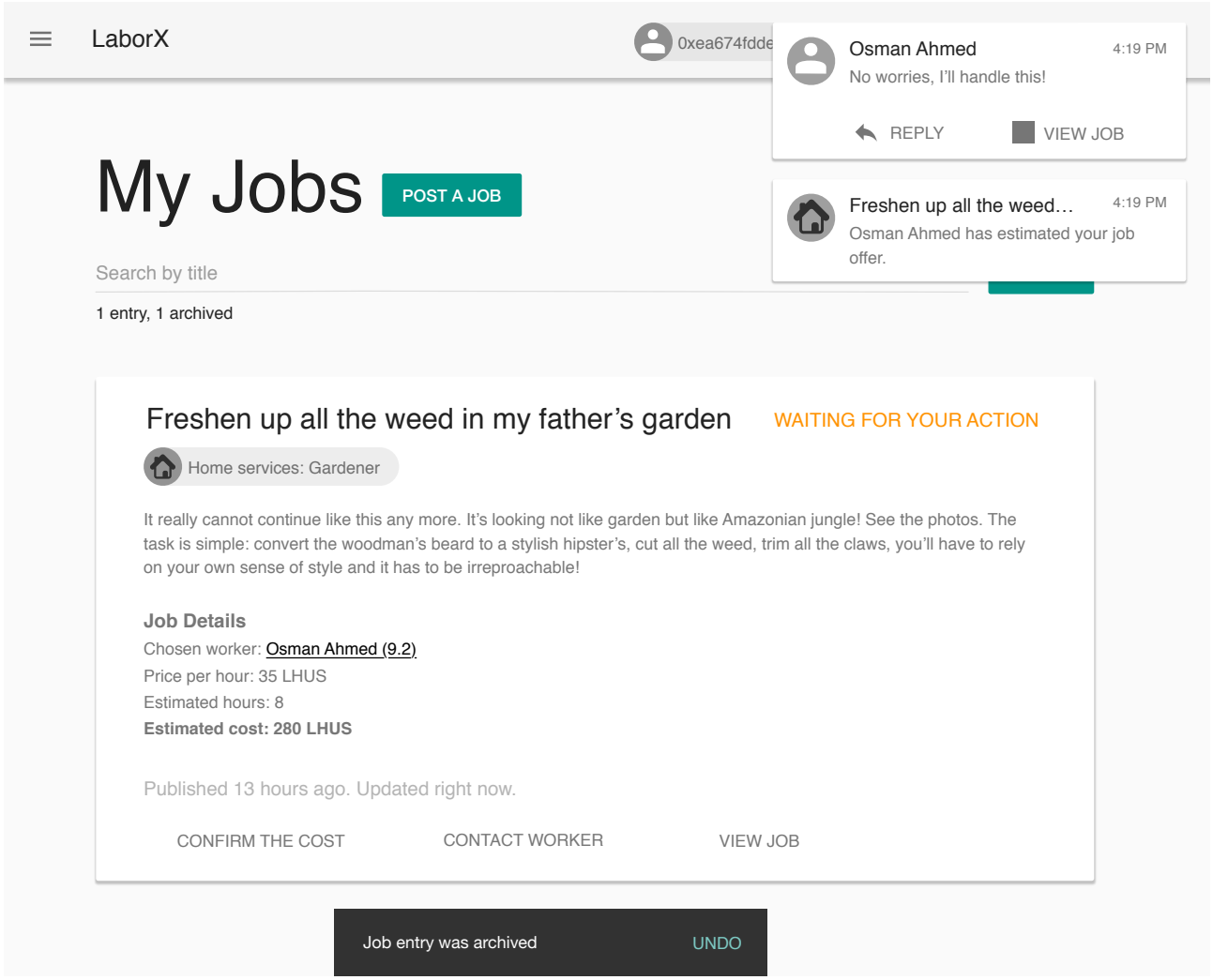

Figure 5. Client's jobs screen

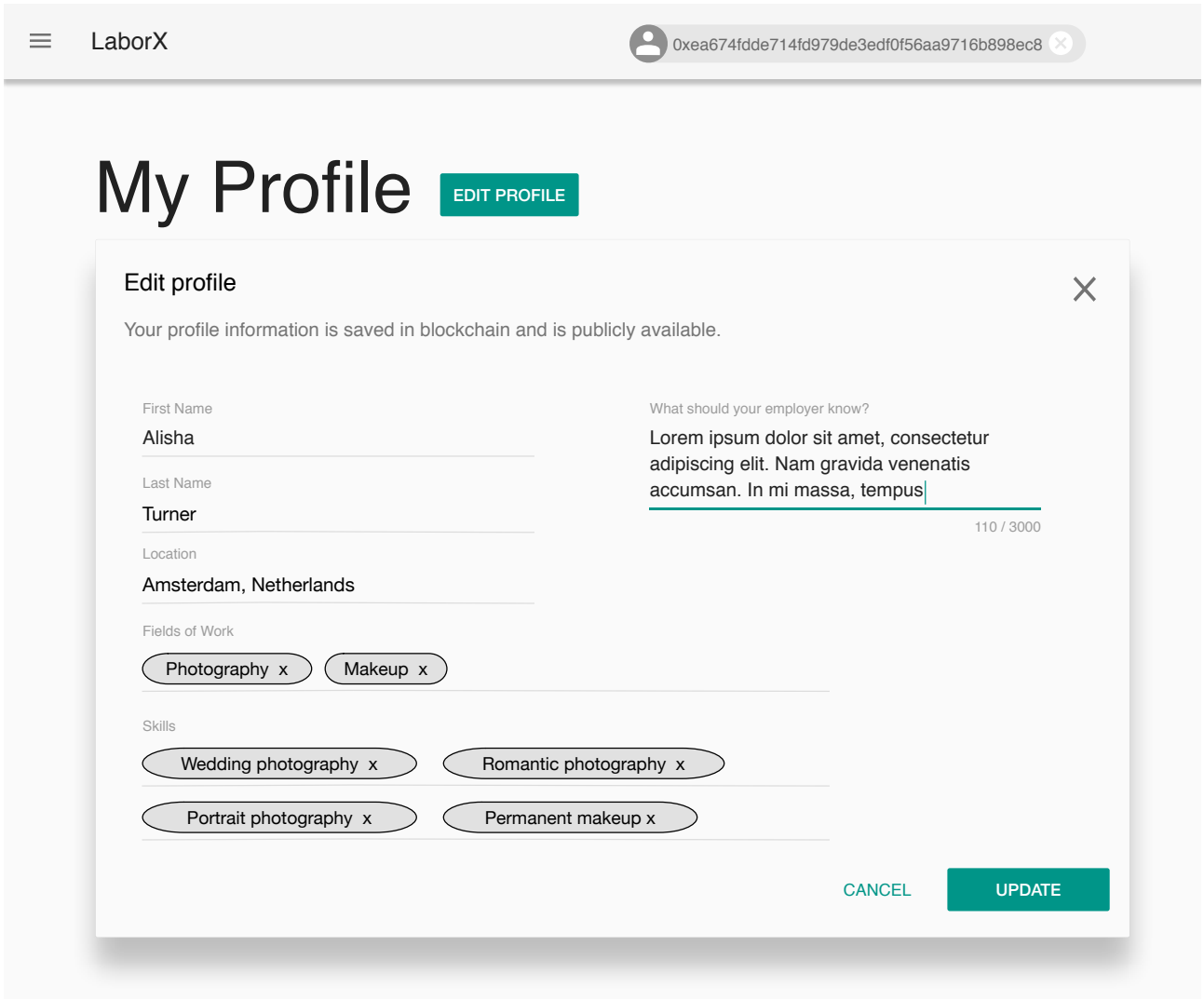

FIGURE 6. Worker's profile editing