Blockchain Based Professional Networking and Recruiting Platform

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GitHub: `https://github.com/EchoLinkTech/Echo`

Abstract

We introduce a blockchain based system of verified education, skill, and career information for individuals. The system, Echo, stores professional and related information in an unalterable format on blockchains. The Echo system supports and provides access to multiple public, alliance, and private blockchains. All the information are provided by trusted information authorities. The system saves businesses and other entities time and financial resources in recruiting, admission, vetting efforts while providing easy access to a pool of vetted candidates. Echo can be further extended to provide verified information in addition situations and industries, such as banking, finance, and insurance.

Figure 1: ECHO = Education + Career skills + Human capital + Opportunity

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1   Introduction

In information society, education, skills, and work experience amount to better career opportunities for individuals. Businesses increasingly seek out candidates with the right level of education and real world job skills. The need for high quality employees create tremendous opportunities for people with the right education, skills, and job experiences.

1.1   Global Education in the Age of Internet

The education industry is being disrupted by the Internet. The global e-education market has been growing at a CAGR of around 7.2% over the next decade to reach approximately $325 billion by 2025. [1] U.S. e-Learning market size was over USD 27 billion by 2016, owing to rising significance of these services across the region. [1]There are numerous other encouraging facts about the continuing growth and adoption in this sector.

Easy accessibility along with improvised effectiveness due to animated learning is likely to positively impact e-learning market size. In addition, increasing number of internet users coupled with escalating number of internet enabled mobile phones are anticipated to propel industry demand over the several upcoming years.

On top of academic education, the online corporate training market is expected to grow by 13% per year, with 77% of U.S. companies offering online training to improve the development of their employees.[1] The era of e-education is truly upon us. In addition to academic training, skill training related to specific job requirements are also in demand.

1.2   Demand For Talent

The economy of today is based on knowledge. As such, employers look for job candidates with an increasing level of skill requirements. Be it, language skills, IT skills, financial skills, or other service skills, people with skills are highly sought after by employers.

Employers pay high amounts of referral bonus or head hunting fees to acquire candidates with good skills. The recruiting industry generated 428 billion USD in revenue worldwide in 2016 (EUR 386 billion), with the US, Japan and the UK making up a majority of the revenue.[2] Online job sites, such as TaskRabbit, that cater to employers seeking certain skill sets for specific jobs are experiencing explosive growth. Employers are increasingly looking for and pay for specific skill sets.

In today's competitive global market, employers are willing to spend a high percentage of revenues to find the right employee with good skill sets.

In the case of LinkedIn: Q3 2016 revenue is $960 million with 17% generated ($162 million) generated from premium account subscriptions; 18%($175 million) from marketing solutions, and staggering 65% ($623 million) from talent solutions.[3] According to LinkedIn, it's talent solutions help corporate recruiters share, find, and engage the best talent. Corporate Recruiter service at LinkedIn costs $9,000 per year per seat (user login).

2   Current Issues

As demand for education and training become global, academic and training institutions are still very fragmented and silo-ed. Academic record verification and skill verification is a cumbersome process. In the US and many other countries, there is no nationwide academic record system.

When it comes to job skill, such as IT skill certification, the process is even more fragmented. While we trust the integrity of students and academic institutions, degree and grade reports could be altered or non-verifiable in many situations. Employer spend a huge amount of resources looking for candidates with the right skill set and even more resources to check references and verify academic record and skill certifications.

All of these problems can be solved with an immutable and verifiable blockchain based system.

In particular, the following areas are most affected by inaccuracies in education, skill, and employment history:

1. Degree Inflation

   List education and degree information that's not accurate on resumes in order to gain employment or achieve a high position in industry. In a very high profile case in 2012, Yahoo CEO Scott Thompson is out after it was found he padded his resume with an embellished college degree, ending his term at the company after just four months.

2. Skill Inflation

   In certain industries, businesses high value candidates with the right skill set. It is not uncommon for job candidates to claim to have certain skill certification on resumes. It is entirely up to the employer to verify such claims. As certain Information Technology skills become increasingly in demand, claims of possessing certain IT certification, such as Big Data or Artificial Intelligence, are more common. Such certification is usually done by private organizations, and can be difficult to verify.

3. Job Experience Inflation

   Inaccuracies in job resumes are not limited to certain sectors, but instead are pervasive across industries. The following is some of the most notorious cases that took place in recent years. [7]

   - Celebrity chef Robert Irvine lied about designing Price Charles and Princess Diana's wedding cake.[8]
   - An MIT dean never received any college degrees despite claiming to have a bachelor's and a master's degrees
   - Jeffrey Papows, president of IBM's software maker Lotus Development, fibbed about his academic and military background.
   - Top Wall Street analyst lied about studying at MIT when he actually attended Boston University. At one time, Salomon Smith Barney's Jack Grubman was Wall Street's highest-paid analyst with a salary of $20 million per year.
   - Former Notre Dame Head Coach lied about a master's degree and being a football legend in college when he never even played a game.

- Top Norwegian bureaucrat lied about being a registered nurse and having two degrees. She was sentenced to 14 months in prison.

- Bausch Lomb CEO lied about his MBA degree. Ronald Zarrella had to give up his $1 million bonus when it was revealed that he never received his MBA from NYU like he claimed he did. He actually started the program, but never finished it.

- Former Harvard student, Adam Wheeler, fabricated SAT scores, letters of recommendations and transcripts to gain admissions and received $40,000 in grants.

  His background was revealed when Wheeler attempted to apply for the Rhodes and Fulbright scholarships in his senior year.

4. Cross Border Verification

The global number of students who study abroad continues to rise with an annual increase of 10%. There were almost 5 million international students in 2014. The Organization for Economic Co-operation and Development (OECD) has projected that, with demographic changes, the international student population is likely to reach 8 million by 2025.[9]

It is often difficult to ascertain information regarding degree or skill level certification across borders. It is also difficult to judge the quality of education for degree holders from abroad, with the exception of well known universities.

5. HR Verification Omission

According to a 2016 CareerBuilder survey, 75 percent of employers said they have hired the wrong person for a position, and of those who had a bad hire affect their business in the last year, one bad hire costs them nearly $17,000 on average.[4]

Steven D. Levitt, the co-author of Freakonomics, and an economics professor at the University of Chicago cites research suggesting that more than 50% of job applicants lie on their resumes. Cover letters are notorious for embellishment and exaggeration.[5]

Though many employers are performing background checks, 75 percent said they have hired the wrong person for the job. These employers say a bad hire has resulted in:

Less productivity: 36 percent
Compromised quality of work: 33 percent
Lower employee morale: 31 percent
Lost time to recruit and train another worker: 30 percent
Cost to recruit and train another worker: 30 percent
Employee's managers or coworkers had to spend excessive time assisting bad hire: 29 percent[5]

Most importantly, the majority of employment related verification are done after the initial resume screening process or in-person interviews. Most pre-employment verification process costs between $5-65 per item.[6] Considerable time and efforts are invested in the initial resume screening and interview processes, and would be wasted should the verification process discover any negative indicators. A resume screening system that offers verified education, skill, and job history would be invaluable to recruiters and save businesses time and financial resources. It would allow recruiters to precisely find candidates with the desired education, skill, and job history before spending valuable time and efforts to fully engage the candidates.

3   Our Solution - Echo

Echo is a blockchain network that connects students, education and training institutions and industry participants. Echo is a blockchain based system of verified education, skill, and career information for individuals. The system, Echo, stores professional career related information in a hashed and unalterable format on public blockchains. All the information are provided by trusted information authorities.

For students   Echo stores student grades, degrees, and certificates in a protected and verifiable blockchain system. It provides student records to potential employers and higher learning institutions in a trusted manner.

For academic and training institutions   Echo relieves them of the resources required to handle degree and certificate verification. Gives academic institutions the ability to both provide and receive trusted academic records.

For businesses   Echo provides a trusted source of candidate information that is not alterable. Academic records, skill certificates are associated with job candidate in a trusted way, all supplied by the academic and training institutions directly, and immutable.

3.1   Advantages of Blockchain

Traditionally, any kind of credential verification has depended on the issuing institution or other trusted authority to confirm the authenticity of a credential. This is a time consuming and costly process. In case of the issuing organization ceasing to exist, records are lost and unverifiable. The blockchain provides a more robust solution in the form of a distributed network of recorded ledger. Blockchain cannot be easily altered or taken down. Blockchain removes single points of failure and ensures that records can be verified without any organizational dependencies.

The blockchain logs transactions between parties, and can be used to verify:

- existence of a record

- record has not been altered since issuance

- identity of the issuing institution

- ownership of the record

- record has not expired or been revoked

This is all done on a distributed and public system. All amendments and alterations of the record are also recorded in the distributed ledger, which provides a chain of evidence on the record as well.

Once a record, in the form of a smart contract on the blockchain, has been cryptographically created and recorded on the blockchain, it cannot be altered or spoofed. Anyone attempting to impersonate an issuing institution will not be able to execute the smart contract. Decentralized key registries help map keys and institutions across different industries.

3.2   Economic Incentives

The Echo system operates on public blockchains, which greatly reduces the cost of operating a similar system in a traditional web environment.

In the case of Ethereum, with a properly written smart contract, the cost of execution is fixed at 21,000 gas. Given that the speed of transaction confirmation is not the most critical factor in our use case, the smart contract can be confirmed at a slower pace. When confirmation of transaction is done at around 60 seconds, the cost is at around $0.003 per record creation. For a sizable university, such as University of California, Berkeley, with a graduating class of around 10,000 students, the cost of creating digital proof of graduation for the whole class year is at around $30 per year.

In the case of AntShares public blockchain, with an allocation of 10 free gas per smart contract, the Echo system runs essentially free of charge in most situations.

This greatly reduces the cost of maintaining the system. The economic benefits are shared with all the participants of the system.

For businesses   in particular, our system reduces the cost of verification, which directly translates reduction in cost of hiring.

For academic and training institutions   , our system removes the burden of maintaining a verification system, which in most cases requires personnel and I.T. equipment. This amounts to savings to operational costs. In addition, our system passes a portion of the fees paid by businesses to issuing organizations. This creates a positive economic incentive for issuing organizations.

For students   , our system puts credibility into their credentials. Potential employers put greater trusted in verified education, skill, and work experience. Our system injects a higher degree of seriousness in employer queries, and provides students greater exposure in the job market.

4   Technical Implementation

Overview   The Echo system consists of four major components, and offers heterogeneous and multiple blockchain support:

1. Digital Identity and Mapping System - translates digital identity to real world names and well known institutions

2. On-chain Credential Creation System - supports batch creation and storage of credentials

3. Off-chain Data I/O System - external data input and output from web, database, feeds, etc.

4. Multi-chain Data Browser for End User - intuitive interface to credential created and stored on a number of heterogeneous blockchains, such as Ethereum, AntShares, Metaverse, etc.

Identities of students and organizations in the Echo system are in the form of public encryption keys. Certificate/degree info are created and stored onto the blockchain by issuing organizations directly. Certificate/degree info include the digital identity of the corresponding student.

All the information are stored on blockchain in an encrypted format. Through the Echo browser, users may find candidates matching certain attributes in certificate/degree info. Query results will be resolved by the naming service into human readable format. Results are presented to the end user by the Echo browser.
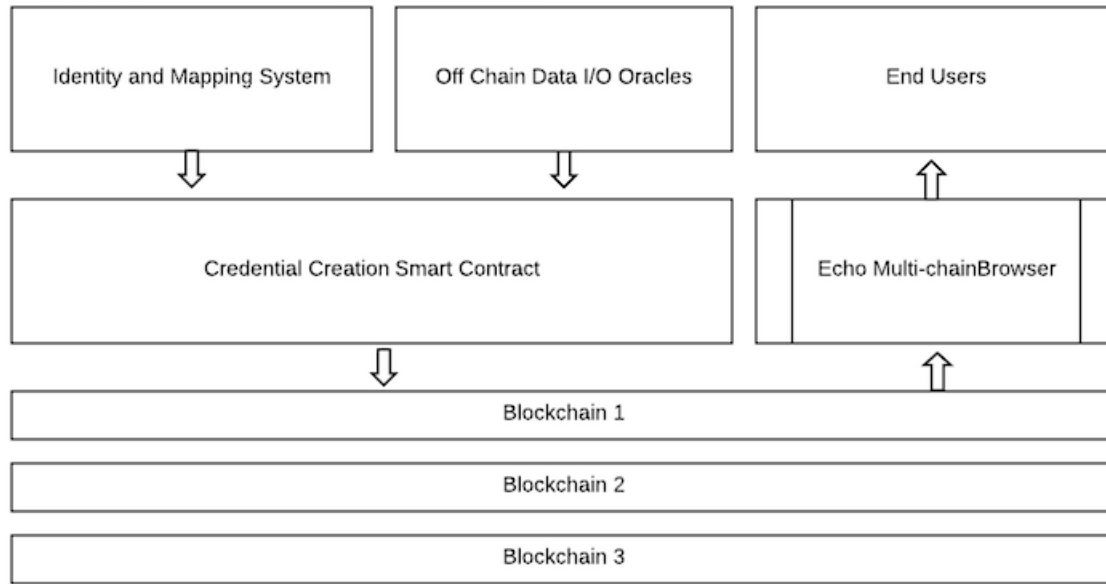
Figure 2: Echo System Overview

Since all the certificate/degree information are entered into the system by the issuing organizations. The credibility of the issuing organization constitute the integrity of the certificate/degree information.

Note: Reference implementation on Ethereum. The Echo system supports AntShares, Metaverse, Qtum, and other blockchains.

4.1   Digital Identity and Credential Creation

Echo uses public key (e.g. Ethereum addresses) to identify entities in the system. Each student would have a public key in the system. Each issuing organization would also have a public key (i.e. account) in the system.

Credential creation involves the issuing organization executing a smart contract that binds the issuer (e.g. school) to the recipient (e.g. student) along with pertinent credential information. The smart contract acts as a proof of existence of the credential on blockchain. Since the smart contract is executed by the issuer, we can be certain of the authority of such a credential.

4.1.1   Digital Identity

Digital identities of the participants of the system are stored in the blockchain in the form of public keys. Students and known issuers will have a set of public keys that are recognized by the community. The public keys are used in the creation of credentials in the Echo system.

The Echo system provides a convenient way of mapping public keys to students, known issuers and their accreditation. Business organizations pay a fee in the form of Echo coins to access the mapping information of real world identities and public keys in the system.

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4.1.2   Credential Creation

Issuing entities create credentials by executing smart contracts that set the status of state of the smart contract. In the case of Ethereum, smart contract with state information are time-stamped and stored in the blockchain. This mechanism creates an immutable proof of existence.

Issuing entities may include the recipient's public key address, degree info, or even hashed value of photographs and paper degree files into the blockchain. Even though the blockchain can be downloaded into a node and scanned. The information contained in the Echo system smart contract are only utilizable after resolution from Echo's identity mapping service. The state info (i.e. credential details) are presented in human-readable format through blockchain browser.

P2P encrypted document storage   is utilized to store image and binary information associated with a certain credential. Once called upon, images and other binary files can be accessed by the Echo browser, thus providing the end user a rich media experience accustomed to business users.
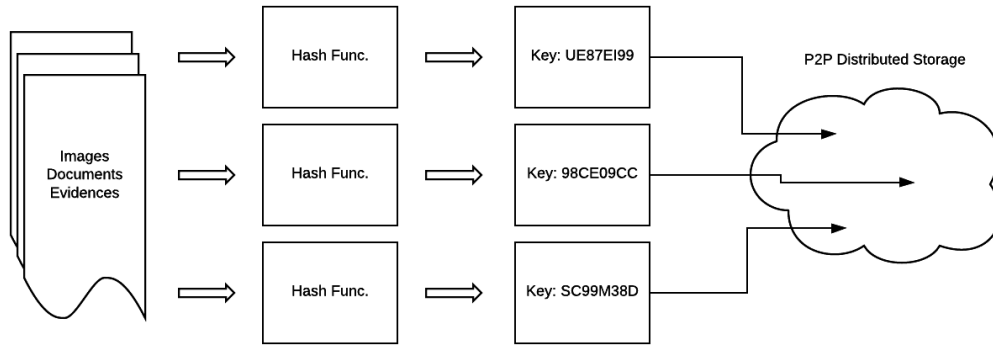

Figure 3: P2P Encrypted Document Storage

One method of implementing such off chain data feed is through IPFS. Images or pdf files associated with the recipient are stored on IPFS. Hashed addresses of such documents are used in the smart contract that generates the credentials, thus linking additional documents to the credential.

4.1.3   Digital Identity Mapping System

As stated previously, digital identities of the participants of the system are stored in the blockchain in the form of public keys. Since Echo is system that provides trustworthiness of credentials, anonymity is not a requirement for Echo users. On the contrary, participants of the Echo system would like to make their identities known to system queries.

The Echo system provides a mapping service to map public keys to identities of students and organizations. This mapping service is related to the Echo Browser to the end users, and is transparent to the end user. Only during the presentation of query results submitted by the end user, would the mapping service resolve the identities of the public keys and present human-readable information to the end user.
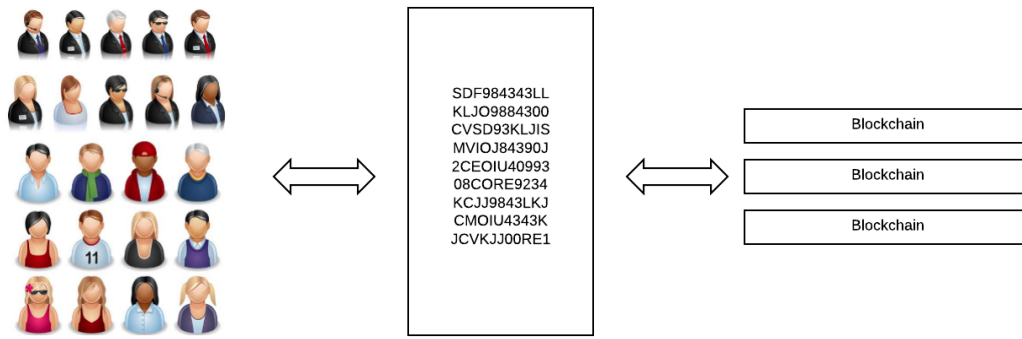
Figure 4: Digital Identity Mapping

4.2   Off Chain Data Sources

In the Echo system, only digital identities of the issuing entity and the recipient are technically necessary to constitute a verified credential on blockchain. In reality, more information may be useful for the user to gain more insight.

Besides digital identities, there are other important information regarding a person's credentials, such as grades, course work transcript, detailed degree information, skill certification information. These information will be accessible to queries through oracles i.e. off chain data sources.
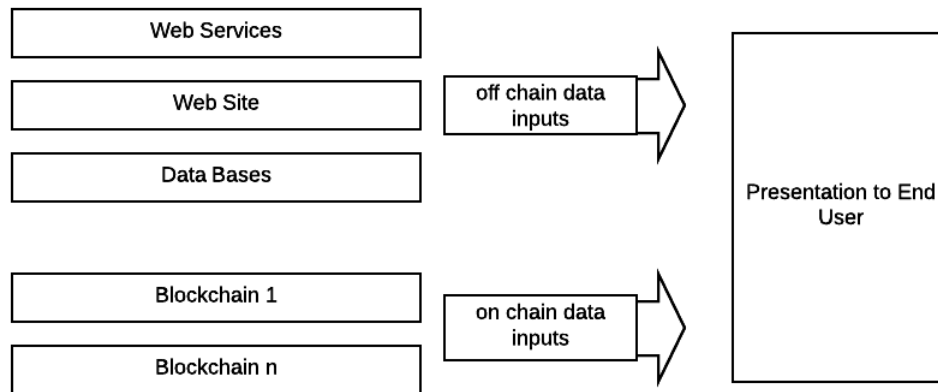

Figure 5: Off Chain Data Inputs Present More Information to End Users

Furthermore, through dedicated oracle services, more information sources, such as web services, can be linked into the smart contract.

4.3   Dynamic Blockchain Browser

The primary end user of the Echo system is business organizations and recruiters in particular. A user friendly blockchain browser would be essential to business users.
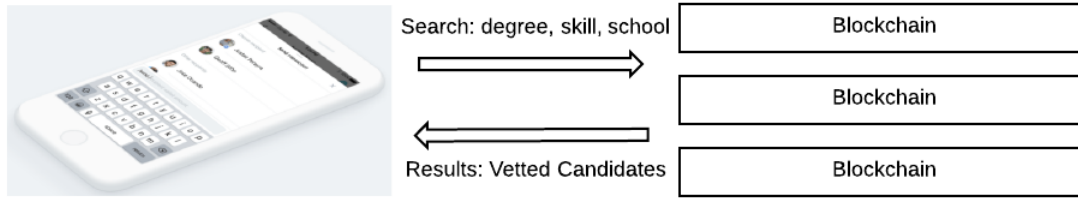
Figure 6: Echo Browser: Search and Get Vetted Candidates

Ideally, the Echo Browser would combine functionality of both a blockchain explorer and an Echo wallet. Business users search candidates through the blockchain functionality and pay fees through the wallet functionality, all in the same browser application.

4.4   Multi-Blockchain Support

Echo users span the globe. Echo serves students from various countries studying abroad. Businesses recruiting internally use our system to find the best talent worldwide. Echo needs to provide support for data stored on different blockchains operating on different technology platform and countries.

Echo operates through smart contracts for credential creation on various blockchains. Blockchain platforms that offer support for smart contracts with Turin-complete virtual machines can be used as the underlying blockchain layer for Echo. (e.g. Ethererum, EOS, and AntShares) Although not necessary, blockchains that offer oracle access to off chain data would be more compatible with Echo premium features, such as graphical credential certificates.

The mechanism to establish multi-blockchain support is through the Echo Browser. It is the end user interface for smart contracts to multiple back-end blockchains. The nature of the supported blockchain can be public ledger, alliance ledger, or even private ledgers. The Echo Browser provides a human readable and user friendly interface to multiple blockchains.

5   Economic Model

As indicated earlier in the paper, large amounts of financial resources and personnel are spent on acquiring talent by businesses around the world. On average, each user of LinkedIn's Corporate Recruiter service pays $9,000 per year. LinkedIn generated an staggering $623 million from such solutions in Q3 of 2016 alone. The need to find the right job candidate is the fundamental economic driver of the Echo system.

The fees paid by business users contribute to the health of the Echo system. A portion of the fees are distributed to education and training organizations as incentives to provide verified information. A portion of the fees also contribute to the actual upkeep of the Echo network.

5.1   Token on Echo System - EchoCoin

The Echo system provides an exchange medium to pay fees between users and other participants of the system in the form of the EchoCoin (symbol: ECH). With support for heterogeneous back-end blockchain data sources in the Echo system, a common exchange medium is needed. Echo smart contract and multi-blockchain browser have built-in support for EchoCoin across different blockchain systems. Therefore, data providers from public blockchains, alliance blockchains, and even private blockchain would be easily rewarded with EchoCoins.

An even more important use of EchoCoin is to establish an international education reputation and skill level market place. With EchoCoin as the common method of value exchange in the Echo system, quality of education in different countries, institutions, and disciplines can be measured by a common and consistent token.

6   Conclusion

Echo is a user focused blockchain application system, and is designed with a user perspective. Echo supports multiple blockchain platforms across countries. It addresses an acute business need, namely identifying great talent with verified credentials at a reduced cost. Echo is driven by real-world economic needs and is built on top of a sound economic model.

Furthermore, Echo breaks down barriers between education systems, credential verification systems, and value systems to bring out a truly trusted and worldwide talent market.

6.1   Future Work

We plan to further strengthen the Echo system by focusing on the following areas:

- Next generation of end user access and interaction: both mobile and desktop

- More industries support in addition to talent and education

- Education credential valuation market based on Echo user voting

In addition to improvements to the Echo system, the same design principle can be utilized to create blockchain based notary, transaction, and proof of existence system for other industries.

6.2   Acknowledgements

We would like to acknowledge several industry veterans for advising our project.

6.3   Whitepaper Versions

- Echo v. 1.0 – April 2017, initial release

- Echo v. 1.1 – July 2017, first update

6.4   Code Base

Codebase: `https://github.com/EchoLinkTech/Echo`

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