"chainge" – Future Search Engine

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BIOTS 2018

FuturICT2.0 Challenge: Token Obtainer

Project Report

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« The attempt to break the monopoly »

Table of Contents

Index of Illustrations

Abstract

During the BIOTS 2018 Hackathon the concept of a community driven search engine named "chainge" was created. The project name "chainge" was a deliberate play on the words "chain" and "change", as this alternative search engine uses the potential of the blockchain and thus tokens to initiate a change in how humanity will receive answers to its search requests.

Due to the limited amount of time (2 days) the project team focused on making a case for the necessity of such an engine and how its imperative cornerstones could be built in a self-regulating cycle. "chainge" shows the key considerations concerning users and websites, especially how to obtain momentum and alternative ranking information. The result is a 2-token-evaluation-recognition system without any involvement of fiat money built on the GenesisApp.

1 Introduction

BIOTS 2018 challenged the participants to find ways how blockchain, the Internet of Things and Smart Devices can be used to obtain the United Nations objectives[1] of a sustainable world or other hot topics in the industry.

Our team decided to participate in the challenge "FuturICT 2.0", which showed how the usage of tokens could be of value for a more sustainable ecosystem. We were inspired from the introductory note by Professor Helbing. He pointed out that diversity is a key factor of sustainability. Biodiversity guarantees the sustainability of a biosphere. Knowledge diversity is a guarantee of important innovations and findings. It is self-explanatory that for the challenges we are facing in the next 20 years, human mind diversity and thus information diversity will be key to guarantee the sustainability of mankind.

The access to diverse information seems to be fulfilled with the existence of the worldwide web. However, the existence of vast resources of information and free search engines is by itself not sufficient to achieve diversity. A key requirement is that the access to information is unbiased and unrestricted, that information is freely available and that the user is the one who determines what he needs and wants to find.
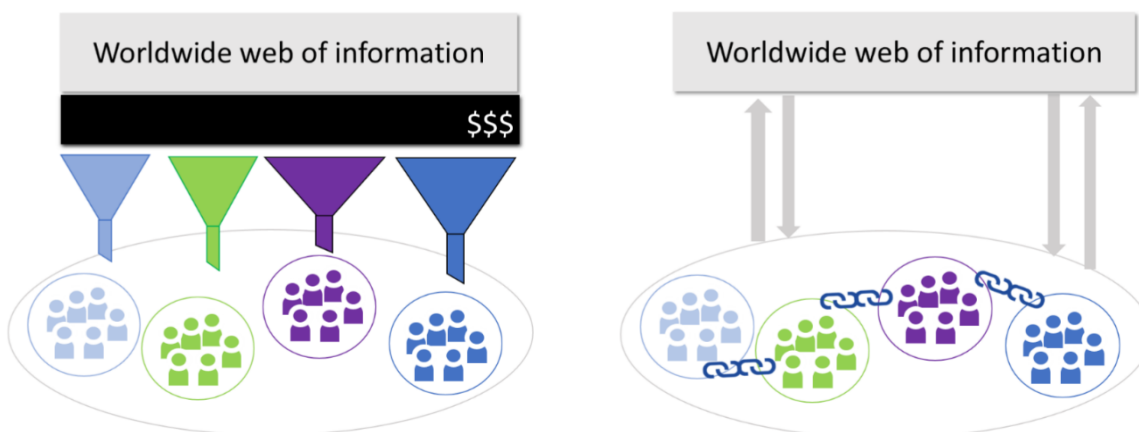
Illustration 1: Funneled information vs. community ranked information

The current reality is that our Internet activities are (miss-) used to narrow the information we get. The ranking mechanisms for search results have been continuously sharpened to allow efficient loading for effective advertising revenue generation. Artificial Intelligence is used to generate user models and thus predictive page loading.[2] Websites are hyped with tags and plug-ins to harvest most interesting users and redirect

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[1] *www.un.org/sustainabledevelopment/sustainable-development-goals/* (19.2.2018)

[2] *https://www.google.com/analytics/analytics/features* (18.2.2018)

them to their sites.[1] Instead of widening the users' scope of view, today's mechanisms lead to a funneling of 'appropriately ranked' information. Instead of making communities more diverse, it leads to clusters of like-minded and, as a consequence, increasingly 'narrow minded' user groups.

Our team believes that the current situation has to change rapidly before it becomes irreversible. We want to provide a solution that differs from other search engines by having the users searching the internet evaluate the relevance of a website and thus reduce the power of money driven rankings. We therefore imagine a search engine that gives the power to the users with the ultimate goal to assure alternative rankings from a diverse community.

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[1] *https://www.google.com/search/howsearchworks/responses/#?modal_active=none (especially of interest: Google/predictive analysis, Google user analysis) (28.2.2018)*

2 Challenge and Solutions

2.1 Challenge the Status Quo of Searching

The chosen challenge describes the concept of a search engine that allows users to retrieve appropriate websites without being locked into the profit enhancing interests of search engines' paying clients. How could that work?

To achieve that, we believe that the internet community has to pull together. They have to provide un-manipulated ratings of the appropriateness of websites and thus help influence the ranking of websites, rather than just being recipients. Hence, we designed the solution "chainge", a community consensus search engine. The vision of "chainge" is to

- ➢ Provide access to a vast variety of information
- ➢ Provide an alternative to money driven search engines
- ➢ Offer a clear and comprehensive evaluation and ranking process of websites
- ➢ Build a community to increase reliability and quality of information

2.2 The Cornerstones of "chainge"

With those goals specific requirements come along:

1. Make the variety of opinions transparent and valuable
2. Provide a process that transfers opinions into viable weights
3. Provide a search engine that evaluates these opinions to improve search results
4. Prohibit misuse and at the same time reward participation, use and support
5. Generate trust with transparency and reliability

As the size of the community and the traffic on the search engine is key to grow and to have reliable quality of data, the most important element is to reach a critical mass of people, which are on boarded on "chainge" and so are able to make a difference.

But how can we get a significant community and more importantly, their opinions involved into such a project?

We don't want to reimburse for participation and ratings for two reasons:

1. Firstly, we don't want to attract the "wrong" kind of people, those who are in for the easy money. With our solution we want to attract the people who are looking for an alternative and who have a heart-felt opinion about what they looked at and a philanthropic behavior.
2. Secondly, by incentivizing with money we would get ourselves into a pickle – where to get the money from? From websites? And then we would be caught in the money-generating mechanism and as a consequence would torpedo our vision of an un-manipulated system.

Instead we believe that we need to target the inherent good of people and the growing unease with the current situation. Therefore, we looked into examples where a status quo had been changed without money changing hands. The approaches of the likes as Wikipedia combined with an incentive system for viable participation seemed the best solution.

3 Solution Design

The following section explains how the defined cornerstones of "chainge" can be built on the collaboration of a community. We need to create a means for those searching for information to express their feedback concerning the quality of a website and thus influence future website ranking. Thus the idea of evaluation tokens (EVAL Token) was created.

However, our users should feel good about doing it, just like people providing their expertise to Wikipedia or liking YouTube videos. We imagined people sharing their experience by evaluating websites while using them and as a "reward" gaining momentum in the community, if their ranking was valuable. That is why our system includes a second token category, the TRUST Token.

The following illustration shows an overview of the "chainge" cycle. In a nutshell: "chainge" users evaluate with EVAL Tokens the websites they visit. These evaluations lead to new website rankings and determine the TRUST Token balance of each user. The TRUST Token balance determines EVALs in the next cycle.
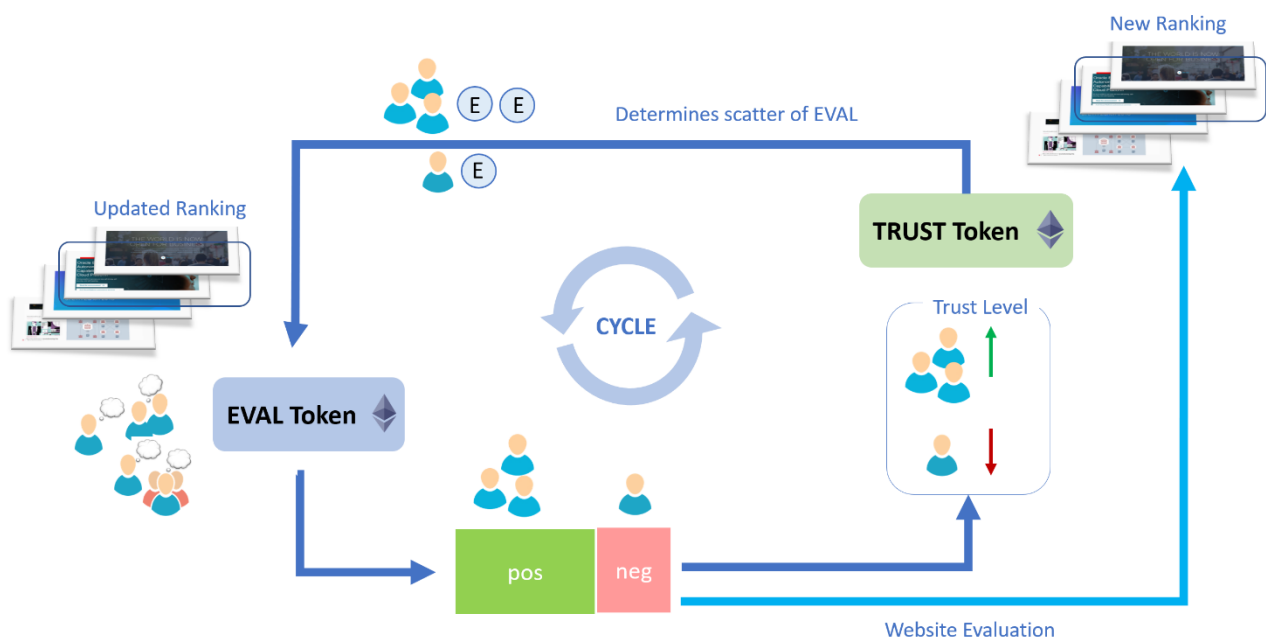
Illustration 2: The "chainge" cycle

3.1 Model in Detail

Like Google's PageRank [1] our search engine - algorithm will create a ranking amongst all websites that are known to the engine. The key difference of our's to Google's approach is the reliance on a token economy consisting of two different kinds of tokens and three distinct agents.

How will it start? When a user decides to use our search engine, he has the possibility to register himself at our platform. If he/she opts for the registration, then our search engine will assign to him/her a wallet that is only used by the engine itself. In a second step a browser extension will be installed that allows the user to

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[1] https://en.wikipedia.org/wiki/PageRank *(as seen 6.3.2018)*

up- or down vote any site he/she visits. In the end the functionality of our search engine on the user side does not differ much from the competition, the only difference is the browser extension that allows the user to rate websites.

Focusing on the technical aspects of the search engine, our search engine consists of three main components:

- ➢ Web crawler
- ➢ Search interface
- ➢ Database
- ➢ Ranking creation

The web crawler searches the internet for keywords/meta-info and new urls/web content etc. and updates the database with information about the newly found websites.

The search interface is responsible for the translation of a user search request into an actual result. It does that by accessing the database and figuring out the relevant results for a user. It gets all results with matching keywords from the crawler's dataset as well as the weights for sorting from the blockchain (EVAL Token balance).

The database contains a ranking of all websites known to our search engine. It is stored on a public blockchain as a smart contract.

The **ranking creation** is the key differentiator of our project. For that, let us have a closer look at the two tokens, the three involved parties and the ranking mechanism as such:

3.1.1 Evaluation and TRUST Token

The Evaluation token is used to reward the relevance of a website. It has the following properties:

- ➢ EVAL are distributed to registered "chainge" users based on their trust rating
- ➢ Users hand out EVAL to websites they consider favourable and thus increase a websites EVAL balance
- ➢ There is a minimum start amount per registered "chainge" user each "chainge"-cycle
- ➢ EVALs cannot be accumulated by users – they are reallocated at each cycle
- ➢ The EVAL statistics of websites are used to assess the TRUST Tokens for each "chainge" user

The TRUST Token is used to incentivize users by rewarding them with trust. The TRUST Token has the following properties:

- ➢ Fixed minimum and maximum amount of tokens for each user
- ➢ Trust status changes according to trust level statistic
- ➢ The more trust a user has, the more evaluation tokens he gets distributed in the next evaluation round

Neither the evaluation nor the TRUST Token can be bought or can be exchanged into real money!!

3.1.2 The Three Involved Parties

Users: They are given the opportunity to rate websites that they visit. Websites can receive a positive, negative or no rating at all. Registered users have a "chainge" wallet containing their EVAL Tokens and their TRUST Token balance.

Websites: They can receive ratings from users. Each website has one evaluation balance only.

Token Distributor (a single instance): He is like the central bank of "chainge": The token distributor

- Is responsible for setting up the initial balances for new users and websites.
- Manages and stores the evaluation of websites
- Stores the TRUST Token balances from the users.
- Has its own evaluation token balance.
- Determines the cycle length between website ranking and trust evaluation updates

3.1.3 The Workings of the Ranking Mechanism

The mode of operation of our ranking algorithm can be partitioned into four different stages:

a. Website evaluation
b. User evaluation / reputation
c. Evaluation token collection and redistribution
d. Plus a fourth stage, the initiation stage for new users and new websites

a. Website evaluation: If a user decides to rate a website, he/she can choose between a positive or negative rating. If the rating is positive, our search engine will transfer a certain amount of evaluation tokens from the user to the website. On the other hand, if the rating is negative, the user and the website will transfer the same amount of tokens to the token distributor, one as payment for his vote, the other to show the loss in appreciation.

In both cases a vote reduces the evaluation token balance in a users wallet. That restricts the number of votes he/she can give. This restriction is needed to minimize the risk of abusive ratings. As the user-rating is the only thing that can affect the evaluation token balance of a website. It is possible to use this balance as a tool to create our ranking - websites with higher evaluation token balances have a higher relevance.

b. User evaluation is the stage where the TRUST Token balance of a user is updated. For every website "chainge" knows the amount of evaluation token received and lost. With this information the ratio of positive to negative ratings can be determined. According to that ratio and the vote a user has given, we want to award or penalize him/her. If the user is part of the majority his trust status and TRUST Token balance will be augmented, otherwise reduced. The effect is the shift of TRUST Tokens to those people that better reflect the majority of the community.

c. Evaluation token collection: After all the TRUST Token balances have been updated, the token distributor resets the evaluation token balance in the user wallets according to their trust level. More trust leads to more EVAL Tokens. This stage is needed to give users more reputation, more influence within the voting system because we want our ranking to reflect the opinion of the majority of the community.

d. Adding new users and websites to our search engine. "chainge" initializes their balances which results in the creation of new EVAL and TRUST Tokens respectively. This is initiated via a smart contract stored on the blockchain.

3.2 Proof of Concept

Because of time constraints during the hackathon, we decided to build a demonstration using an existing app called GenesisApp provided by FuturICT2.0 and to use SQLite as a database.

3.2.1 Evaluation Token (EVAL Token)

The EVAL Token is implemented in the GenesisApp. The Rest API calls the function rateWebsite(userIndex, websiteIndex, rating). This function checks if the user has enough EVAL Token to rate the website. If so, it updates the ranking of the website as requested by the user and removes the needed EVAL Token from the user. Our implemented function looks like this:

```
public static void rateWebsite (int userIndex, int websiteIndex, int rating){
    long userBalance = repo.readUserEval(userIndex);
    long userTrust = repo.readUserTrust(userIndex);
    long websiteBalance = repo.readWebsiteEval(websiteIndex);

    //Determining the amount of EVAL a user should give a website, amount depends on trust level
    long wantedTransactionSize = userTrust*7; //implement naive version by giving each vote the same weight

    //A user can only give evaluation tokens to a website if he owns some
    if (userBalance > 0){
        long transactionSize = (wantedTransactionSize < userBalance) ? wantedTransactionSize :
            userBalance;
        if(rating == 1) {
            positiveTransfer(userIndex, websiteIndex, transactionSize);
        } else {
            negativeTransfer(userIndex,websiteIndex, transactionSize);
        }
    }
}
```

3.2.2 TRUST Token

The TRUST Token is implemented in the GenesisApp as well. It reflects the trust a user has, except for the token distributor who has constant trust level 1. Across every visited website we accumulate the difference between received EVAL Tokens and lost ones. If the difference between received and lost EVAL Tokens is too high, the user's trust level is updated. It is increased if his voting is part of majority, else he will lose trust. This function has not been implemented yet.

3.2.3 SQLite

Among other things, we have implemented the following functions in the SQLite database.

a. addUser(user_id, init_eval, init_trust)

The parameter «user_id» is of the type long and auto increment. This is needed so that there is never the same id for different users. The other parameters («init_eval» and «init_trust») are used to set the start value of the tokens.

b. readUserEval(user)

This function returns the value of the EVAL Token of the given user id.

c. writeUserEval(user_id, newBalance)

This function updates the EVAL Token of the given user id with the new balance.

3.2.4 Extension, JavaScript

For each website we need a way that the user can score it. Therefore, we have two options.
The first one is to create an extension for each browser. The major point in favor of this is that we could rate each website whether it wants it or not. If the user has installed the extension on his browser it is not possible to disable the rating for a website. On the other hand, it requires that the users would install the extension. If they don't, they could not rate the website. Another point is that there exist different browsers for which we need to create an extension.

The other way would be that we write a JavaScript file (JS) which the owner of the website could include. The advantage of the JS is, that the user would have nothing to install or care about. Furthermore, if there is a bug we could update the JS on our server and it would be published for all websites immediately if they use a link and they do not need to download a script. But, with this approach ratings are only possible if the website would have this JS included:

```
<!—PLUGIN CHAINGE START -->
<script type="text/javascript" src="https://ajax.googleapis.com/ajax/libs/jquery/3.3.1/jquery.min.js" async defer></script>
<script type="text/javascript" src="chainge.js" async defer></script>
<!—PLUGIN CHAINGE END -->
```

Our conclusion is that we would use both options. If the website has the JS, the user has not to use the extension and if not, he would. So, we have eliminated all the negative points for each option.

The JS file already exists but not the extension.

3.2.5 Rest API

To Update the EVAL Token and the TRUST Token» we would use a Rest API. The JavaScript-File or the extension of the browser would call an URI asynchronous which the following parameters.

- User Index
- Website Index
- Rating

The Rest API would than update all the values and send a response if it was successful or not.
The Rest API has not been implemented yet because of the time constrains, but we simulated its working with code for the GenesisApp.

3.2.6 GenesisApp

In the GenesisApp we can display the «Trust-Balance», the «Evaluation-Balance» of a user and the «Evaluation-Balance» of the website on the «User-Info» tab.
On the «Browser» tab it is possible to open the browser to rate a website. Now the URL of the website is static for the demonstration. After rating the website we can go back to the «User-Info» tab and see the new balance for user and website.

Rate Website   *Website rated*

Illustration 3: "chainge" ratings in progress

3.3 Gaining Momentum

3.3.1 Participants - Chaingers and Supporters

Since a few years there is an ever-growing group of people all around the globe that is concerned about the current dominating position of a few minimal-regulated search engines and their never satiable hunger for personal data and influence.

We believe that this people would welcome the service "chainge". We also believe they would shoulder the burden to register and vote for sites they know well for the greater good. The example of Wikipedia shows that people are eager to share their knowledge and be part of a community that makes the world a better place.

We therefore defined 3 groups of participants:

    a.   hero / influencer

    b.   favorer

    c.   supporters

a. Hero/Influencer

A hero or influencer on our platform would be an individual with lots of trust. Trust can be gained by being a registered user of "chainge", who evaluates websites and whose ratings reflect the majority of opinions held in a defined time segment. The trust evaluation of a user is a key mechanism of "chainge" to both incentivize registered users to evaluate to the best of their abilities and to reward them with a status reflecting their importance for the community. The "chainge" system will reward the user by attributing TRUST Tokens accordingly to gained trust. Public registered users have an address in the blockchain together with at least some linked data to their profile (e.g. verified email address or passport number). Of course, there is the risk that companies pay money to gain votes and thus a real challenge to our goal to avoid buy-your-page-rank. But actually, it is not. Influencers have to be careful to choose their sponsors to recommend websites that are really of interest to the community, because otherwise they would lose TRUST Tokens very fast and thus lose their state as an influencer.

b. Favorer

We are aware that not all people who like to do good are at ease with being known. Therefore, "chainge" also offers to be "anonymously" registered. Anonym registered users have an address in the blockchain and can participate in the voting system, but they don't need to link any personal data (e.g. name, email, ..) with this account.

The anonymously registration process enables us to bind silent contributors, who are verified people but who act anonymously when evaluating.

c. Supporters

To make a difference, we need people to use our search engine. Non-registered users are not participating in the voting process but can still use the search engine to find their favorite websites. They can support "chainge" by growing the "chainge" user community and hopefully by donating money.

As "chainge" is for the participants, we wanted to make sure that registered participants don't suffer from their openness. Public users have their verified personal information (e.g. email-address) publicly saved on the blockchain but encrypted using an asymmetric one-way-hash of the real info to avoid public disclosure for spam bots. Nevertheless, it is still possible for an individual to proof that he or she is the account holder by providing the email address such that the other party can verify the authenticity by calling the proposed smart contract below.

```
SmartContract for chainge: VerificationOfInfluence
Prove_my_identity(address account, string email){
        return account.hashed(email) == hash(email);
}
```

3.3.2 Gaining Critical Mass for Meaningful Search Results

The principle of a community-based search engine fortunately scales quite well - already in a very early stage of votes and sites added to the blockchain. Suppose a group of ETH students found their way to this project. Lots of them share the same interests or need to find good explanations to some mathematical problems. They can easily enhance the quality of the search results in their very specific field within a single cycle of the voting process. Many such groups of interest can grow up to a large system where almost all subjects are getting covered.

Another approach is to start with search results from a competitor and switch over after a certain start-up phase of voting to our own best results.

3.3.3 Fraud Prevention

Web presence is one of the key aspects of many of today's companies. We have to ensure that the misuse of the system is very limited. To a major level, this can be ensured by the mechanism of the TRUST Token as explained when describing the influencer/hero.

Nevertheless, there are always clever people that try to exploit the system in order to make money and/or create damage.

One such possibility could be that someone registers hundreds of thousands of users in order to outvote the real users. In order to prevent that we propose two strategies:

- Limitation of #registrations per entity (e.g. IP-Address)
- Use of artificial intelligence to analyze new users and find patterns of automatically created users, which we could invalidate or deny access.

When starting serious work on "chainge", the real danger of entities seeking to hinder "chainge"'s success has to be dealt with in much more detail and needs to encompass every angle of vulnerability. At the moment, this is beyond this paper's purpose.

3.3.4 Financing Transaction Costs

Besides the creation and daily running and improvement of "chainge", costs are mainly incurred due to transactions such as:

- Updating the trust balances
- Initialization of new "chaingers" and thus creation of their wallets
- Reallocating the evaluation tokens

We want to tackle the financing with donations, similar to Wikipedia. "chainge" would accept donations in fiat and crypto currencies as well as donations of computation power (similar to the approach used by coinhive).[1]

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[1] https://coinhive.com (28.2.2018)

4 Evaluation

4.1 Possible Barriers

One of the key problems today's blockchain technology is confronted with is scalability. The amount of transactions per second is usually limited to a constant amount. Fortunately, our project is not dependent on how fast each transaction (e.g. votes, and cycle trigger) finds its way into the blockchain, but nevertheless, the amount of transactions scales with the number of active participants, which could end in a bottleneck.

A possible proposal to solve this issue is to adapt the time to trigger a new cycle and thus the reallocation of evaluation tokens.

A positive side effect is that this issue does not affect the actual functionality of the search engine, because it only reads the current evaluation token balances of the websites.

4.2 Non-Proprietary Analytics

The property of the blockchain as a public database offers everybody the same possibility of analyzing the voting behavior and extract trends or other important data without disclosure of anybody's identity (except if some email addresses of public registered users are publicly available, but that is ok). It would be possible to see exactly the different ratings and thereby making the rating system transparent.

The decentralized search engine network can handle lots of request quite fast because of the many blockchain nodes available all over the world for reading the evaluation balances (low latency because of the spatial locality, lots of capacity available because of the 1000+ nodes). So, we believe our "chainge" solution can provide "chainge-ratings" per webpage quite fast.

4.3 Similar Concepts

While working on the "chainge" concept we looked into steemit [1] as well as the presentation of AKASHA [2] at the event and their website. Both steemit and AKASHA want users to share information and to participate in evaluation of content. Steemit launched their platform incentivizing authors and curators through a three-tiered token system. Steemit rewards posts and comments as follows: the reward is divided between the author (75%) and the curators (they obtain 25% of the total). Half of the reward is paid in STEEM Power and the other half in Steem Dollar/STEEM. It is possible to receive the reward in STEEM Power only or to reject it completely. Steem Dollars can be converted into fiat money.

AKASHA's approach is working on an idea with 4 tokens, but details are not public yet. AKASHA's vision is to achieve privacy and freedom of expression. Neither AKAHSA nor steemit is a search engine – but well, who can tell now whether knowledge can't be shared even better via these platforms in the future?

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[1] *www.steemit.com* (25.2.2018)

[2] *www.akasha.world* (25.2.2018)

In the weeks that followed our hackathon we became aware of presearch. They position themselves as "open, decentralized search engine that rewards community members with Presearch Tokens for their usage, contribution to, and promotion of the platform." [1] However, their white-paper lacks a concept of how they would ever achieve their declared vision. Their beta version has the feel and looks of a GUI strapped onto the search-engine of your choice, with presearch tokens going in user's wallet just for looking at a webpage!

So, the concept of "chainge" is quite unique - but, well, it is only a concept so far.

4.4 Future - Technology Roadmap

Our key concern is financing the token generation, attribution and redistribution. If there were to be a less gas intensive way to publicly verify voting and account balances, this would promote a fast market entry of "chainge".

Moreover, our idea is at the very beginning. There is lots of room for improvement by proactively defining algorithms and website plug-in to optimize token-calculation and distribution, but also more sophisticated ranking mechanisms that guarantee quality finds and allow user privacy. On a future "chainge" roadmap there need to be:

- AI to detect bots and/or fraud
- Different cycles for EVAL token redistribution and TRUST Token balance reevaluation
- More sophisticated ratings such as relevance, quality and correctness of information
- Maybe more trust levels, even for certain areas of knowledge ("experts")
- Rethink the idea of "chainge" tokens in a world of their own and maybe introduce an exchangeable coin to interact with other altruistic platforms such as AKASHA

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[1] *https://www.presearch.io/* *(28.2.2018)*

5   Conclusion and Outlook

The solution "chainge" responds to the need for change in our current monopolistic search engine market place. Start-ups like steemit, Prospect, DuckDuckGo and others try to address this necessity on a global scale. While working on the project we became more and more aware that we are just skirting the outlines of what would really upheaval the dominance of Google LLC. Probably "chainge" would have to start as a community pet project that gains momentum after a certain time and others flock to it. Starting it within a limited user base would allow honing the necessary backbone requirements and achieving a proof-of-concept. A suitable group to start with are in our opinion students that value privacy of search engines and the need reliable sources e.g. for reports at universities.

We are aware that because our concept doesn't allow fiat money, we will not be able to tap into the pool of blockchain venture capital money and that that might be a hindrance to finance the progress of such a project. However, it is time that politicians become aware that to keep their constituents save, fed and free it is not sufficient to maintain traditional societies' systems. They will have to address the real danger posed by information monopolies in a decisive way.