

BLOCKCHAIN IN EDUCATION: HOW TO MANAGE STUDENT CREDITS OF HIGHER EDUCATION THROUGH THE BLOCKCHAIN?

Kumalakov B.A.¹, Shakan Y.²

¹*University of International Business, Almaty, Kazakhstan*
²*Al-Farabi Kazakh National University, Almaty, Kazakhstan*

Abstract

Currently, technologies are developing very quickly and the need for information security is constantly increasing. In this connection, Blockchain technology is becoming in demand, which allows us to keep information safety and integrity. In addition, the technology enables the creation of a decentralized environment where transactions and data are take place without any third party organization. We proposed a decentralized web resource based on the Ethereum platform for managing student credits. The decentralized application (Dapp), will process, manage and control tokens, which represent credits that students gain for completed certain courses. The credit system is a first step towards a more transparent and technologically advanced form which could be used by universities and students to manage credits. The novelty of this scientific research is the creation of a web-based information resource based on Blockchain technology. Thanks to this resource, it becomes possible to track students' grades and receive reliable information about higher education. This completely eliminates the possibility of making changes to existing records.

Keywords: blockchain, higher education, credits, tokens, application, tracking.

Аңдатпа

Б.А. Құмалақов¹, Я. Шақан²

¹*Халықаралық бизнес университеті, Алматы қ., Қазақстан*
²*Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы қ., Қазақстан*

БЛОКЧЕЙН БІЛІМ САЛАСЫНДА: ЖОҒАРЫ ОҚУ ОРЫНДАРЫНДА СТУДЕНТТЕРДІҢ БАҒАСЫН БЛОКЧЕЙН АРҚЫЛЫ ҚАЛАЙ БАСҚАРУҒА БОЛАДЫ?

Қазіргі уақытта технологиялар өте тез дамып келеді және ақпараттық қауіпсіздікке деген қажеттілік үнемі артып келеді. Осыған байланысты, Blockchain технологиясы сұранысқа ие болуда, бұл бізге ақпараттық қауіпсіздік пен тұтастықты сақтауға мүмкіндік береді. Сонымен қатар, технология орталықтандырылмаған ортаны құруға мүмкіндік береді, онда транзакциялар мен мәліметтер үшінші тарап ұйымысыз жүзеге асырылады.

Біз студенттердің нәтижелерін басқару үшін Ethereum платформасына негізделген орталықтандырылмаған веб-ресурстарды ұсындық. Орталықтандырылмаған бағдарлама (Dapp) студенттерге белгілі бір курстардан алған нәтижелерін білдіретін жетондарды өңдейді, басқарады және басқарады. Несиелік жүйе - бұл университеттер мен студенттер несиелерді басқаруда қолдана алатын ашық және технологиялық тұрғыдан жетілдірілген формаға алғашқы қадам. Бұл ғылыми зерттеудің жаңалығы - Блокчейн технологиясына негізделген веб-ақпараттық ресурстарды құру. Осы ресурстың арқасында студенттердің бағаларын бақылауға және жоғары білім туралы сенімді ақпарат алуға мүмкіндік туады. Бұл қолданыстағы жазбаларға өзгерістер енгізу мүмкіндігін толығымен жояды.

Түйін сөздер: блокчейн, жоғары білім, несиелер, жетондар, қосымша, бақылау.

Аннотация

Б.А. Кумалаков¹, Я. Шақан²

¹*Университет международного бизнеса, г.Алматы, Казахстан*
²*Казахский национальный университет им. аль-Фараби, г.Алматы, Казахстан*

БЛОКЧЕЙН В ОБРАЗОВАНИИ: КАК УПРАВЛЯТЬ СТУДЕНЧЕСКИМИ КРЕДИТАМИ ВЫСШЕГО ОБРАЗОВАНИЯ ЧЕРЕЗ БЛОКЧЕЙН?

В настоящее время технологии развиваются очень быстро и потребность в информационной безопасности постоянно растет. В связи с этим технология Blockchain становится востребованной, что позволяет нам сохранять безопасность и целостность информации. Кроме того, технология позволяет создавать децентрализованную среду, в которой транзакции и данные осуществляются без какой-либо сторонней организации.

Мы предложили децентрализованный веб-ресурс на основе платформы Ethereum для управления кредитами студентов. Децентрализованное приложение (Dapp) будет обрабатывать, управлять и контролировать токены, которые представляют собой кредиты, которые студенты получают за прохождение определенных курсов. Кредитная система является первым шагом к более прозрачной и технологически продвинутой форме, которая может использоваться университетами и студентами для управления кредитами.

Новизной данного научного исследования заключается в создании информационного веб-ресурса на базе технологии Блокчейн. Благодаря этому ресурсу, появляется возможность сделать отслеживание оценок студентов и получать достоверную информацию о высшем образовании. При этом полностью исключается возможность вносить изменения в существующие записи.

Ключевые слова: блокчейн, высшее образование, кредиты, токены, приложение, отслеживание.

1 Introduction

Blockchain technology is becoming popular not just a financial sphere, but also are entering into more and more new spheres such as medicine, Internet of things, education, voting etc. This technology has not been ignored in the field of education. Currently, there is already a number of works interested in various aspects of the application of blockchain technologies in education, for example, and others. However, these works are mainly focused on theoretical nature, considering the prospects of applying blockchain technologies to various issues of digitalization of education.

One of the relevant issues of education system is to create a web-based information resource based on Blockchain technology. Thanks to this resource, it becomes possible to keep records and receive reliable information about the student achievements. This completely eliminates the possibility of making changes to existing records.

This paper aims to show some practical implementation to solve this kind of problems via using blockchain. The paper considers technical details of building the appropriate decentralized application (Dapp), which could be used by universities and students to manage credits. That means, after each successful completion of a semester an employee (teacher) of the university with certain access rights could issue credits to students as tokens, when fully getting the needed number of credits/tokens, students could see their achievements, as well as could show to their potential employers or to another university.

Remainder of the paper is organised as follows. Section 2 defines the problem. Section 3 provides related works. Section 4 provides implementations. Section 5 concludes this paper.

2 Problem definition

Today, most higher education institutions keep their students' records including credits in various applications. However, these databases are designed on a centralized approach that leads to numerous drawbacks, such as mutability, privacy and reliability of records. To overcome the issue of centralized approach of storing credits, we have proposed a decentralized web resource based on the Ethereum platform for managing student credits.

Blockchain is one of the new technologies with special features like security, immutability, transparency and so on. For instance, academic credit is an important piece of learning achievements of students which confirm that student has achieved certain learning outcomes before graduating certain degrees. This information will now be decentralized and available to public so that anyone can validate this information through web application interacting with blockchain.

3 Methodology

To understand the practical implementation of the blockchain technology in education we researched and analyzed a number of materials which related to this problem, the aim was to improve practical skills in this area. Allocated more time for interacting user interface with smart contract, for this was built process model of blockchain app, as well as examined several problems associated with the practical implementation of this issue.

Related works

After the appearance of Bitcoin [1, p.5] in 2009, Blockchain technology has been applied to many fields, including medicine [2,3], economics [4, p.6], Internet of things [5,p.10], education [6,7], voting [8,p.4] and so on. Its underlying technique has shown promising applications prospects and attracted lots of attentions from academia and industry.

Besides cryptocurrency one of the relevant areas is blockchain in education, however, the studies on the blockchain technology are still very new, reflections on the education are still at the beginning stage. Therefore, some of these few studies of the filed are briefly summarized.

One of the studies addresses the value decentralized ledgers, in particular those based on blockchain, may bring to stakeholders within the educational sector, with a particular focus on its potential for digital accreditation of personal and academic learning. As well as focuses on the feasibility, challenges, benefits and risks of the Blockchain as applied to formal and non-formal education credentials [9, p.6].

This postgraduate dissertation study addresses some problems that centralized e-learning platforms may encounter and emphasizes the importance of decentralized access control in solving these problems. In this study, a model proposal for decentralized access systems is presented.

In the realization of this model, blockchain structure was utilized. Thus, it is argued that the integrity, correctness, deniability, and traceability of e-learning sources can be achieved. The mean response time was used as a metric when evaluating the proposed model. The two different network environments (such as the Local Area Network (LAN) and the Cloud Web Service (i.e. Amazon Web Service)) are compared. It is stated that LAN environment represents the most appropriate condition and the cloud environment represents the real situation in the real world.

The average response time in the LAN environment is faster (about 1.5 times) than in the cloud environment, but when the number of customers is large, the difference in average response time between these two environments becomes insignificant [10, p.7].

Another study describes a decentralized learning system CHiLO which utilizes e-books. In this study provided a basic demonstration of the first stage “content exchange” and demonstrated the making of e-books while protecting copyright by using the blockchain [11].

A study in which using blockchain as a tool for tracking and verification of official degrees is addressed the main concepts of blockchain and the particular implementation of Blockcerts as an opensource solution devoted to the certification and verification of documents.

As well as briefly introduce the Higher Education market in Europe to determine the volume, geography and trend of the economic sector to address the developed solution [12, p.10]. In this research blockchain in education address the fundamentals and developments of blockchain technology and suggests a reflection and a debate which should address in the near future the impact, or not, of blockchain in education [13, p.9].

4 Implementaions

Development of a web resource on the basis of the ethereum platform for managing student credits of higher education

At the moment, the product has been developed in the development environment configured locally. The following is a list of tools used to perform this test (figure 1).

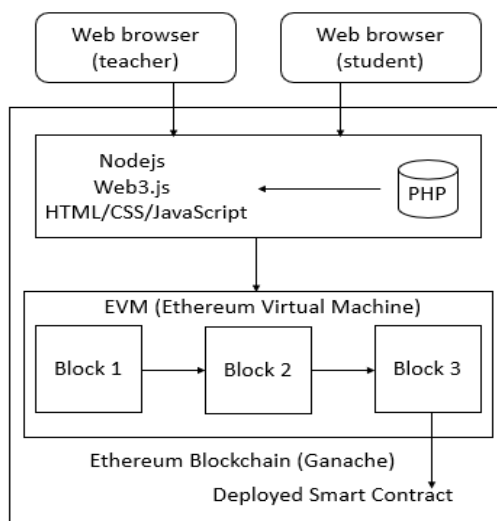


Figure 1. System flow

- Required for the operation of a web resource:
Apache web server, database (MySQL), PHP language, JavaScript/CSS;
- Required for the interactions with applications over the network:
NodesJS, Web3;
- Required Ganache blockchain server to deploy a private blockchain on the Ethereum platform;
- Required for compiling Smart Contract:
Program language Soidity (Remix IDE).

4.1 Description of the credit process model

For clarity, we considered the following situation: student to complete studies at the university they must get needed number of credits, after the semester of study, an employee (teacher) of the university with

certain access rights update the students profile, upon successful accumulation of all credits/tokens. Ganache (blockchain server) will register a block for this student and stores the credit details in the block. As well as student, can see their achievements respectively from website. The webpage interact with the Ganache to fetch the details about the student credit.

The admin / professor of the student will be able to update all the information for each students (figure 2).

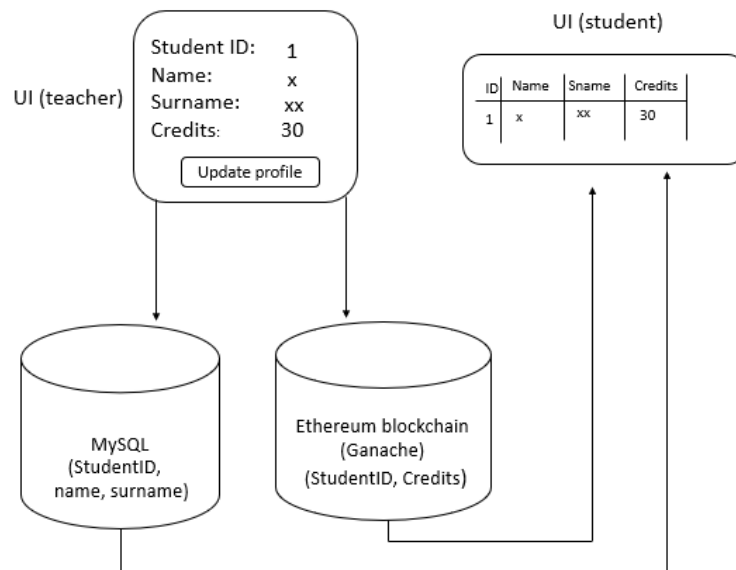


Figure 2. Student credit process model

4.2 Creating a web interface and connection with a blockchain server

When creating the web interface, we used the HTML hypertext markup language, as well as certain Javascript libraries, such as jQuery. Created special form for filling the student detail, The record consists of the following fields:

- Student ID
- First Name
- Last Name
- Credits

After clicking the button (update) located at the bottom of the form, the corresponding summary record will be store in the Blockchai as a hexadecimal format. As a result of processing the record, a web page opens with the following information: student id, first name, last name, block number and credits. Thus, a student can quickly obtain information about their achievements.

The interaction of the smart contract with the web interface is carried out thanks to the JavaScript library Web3.js. The Web3.js and Node.js library are collection of modules that contain specific functions for the Ethereum platform, which makes it easier to interact with the Ethereum Blockchain, its smart contracts and related functions.

In order to make it clear the data flow diagram (DFD) is shown below (figure 3).

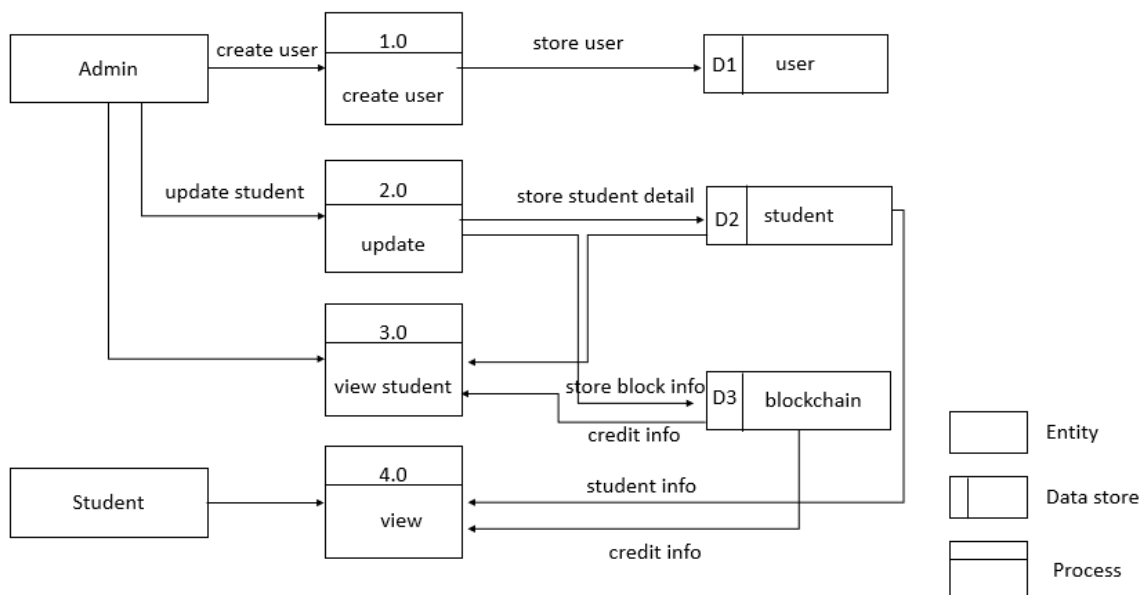


Figure 3. Data flow diagram (DFD)

5 Conclusion and future research

In this paper we explored how to use the blockchain technology in education, more precisely, proposed tracking students' grading system. Our result show that this technology can be used in other industries and spheres. During the study, we were able to learn the principles of the Blockchain technology, explore the scope of application of the Blockchain technology, develop an information web resource for managing student credits in higher education based on the Ethereum Blockchain. Firstly, the transparency and integrity of the system, this means any student in the educational process that has its own id, via this can confirm the "truth" of the their credits at any time. At the same time, the blockchain block cannot be changed or deleted from the network. Secondly, the general reduction of paper documents for proving their achievements. Of course in parallel with this there were certain problems (technical) that successfully resolved.

As a result of all this, the following practical and theoretical significance of this scientific research can be noted:

- Blockchain technology is becoming popular not just a financial sphere, but also are entering into more and more new spheres such as medicine, education, etc.
- The practical implementation of the blockchain technology in education showed that using this technology for track student's grading system in higher education is quite possible. Proof of this: system flow between web browser and Ethereum Blockchain, credit process model, web interface and connection with a blockchain server.

In our future research we intend to explore the possible solution to the problem of issuing digital certificates and related problems using blockchain, as well as we plan to extent and adapt proposed credit system to any existing grading system and thus incorporate other aspects of educational digitalization.

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