Embedding a Blockchain Technology Pattern Into the QR Code for an Authentication Certificate

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Article Info	ABSTRACT
	In the disruptive 4.0 era that emphasizes technological sophistication, blockchain is present as a technology that increasingly influences human life, helping humans in all aspects, including education. The role of blockchain technology in the world of education is to test the validity of diplomas, the increasing number of fake diplomas for an interest, both for work and continuing education to a higher level. The purpose of this research with the implementation of blockchain is expected to make it easier for users to verify the authenticity of a diploma. This study uses the SWOT analysis method to identify all possibilities that exist in blockchain technology. The final result of this research, the system will print a physical certificate in the form of paper in general, then the certificate will be printed a QR code. To verify numeric code on QR Code via scanning on smartphone or QR Reader. It is hoped that the blockchain technology applied to digital assets can reduce cases of forgery of diplomas and other important documents.

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1. INTRODUCTION

Learning methods currently running in several universities in Indonesia still use conventional methods rather than digital [1]. In this 5.0 revolution, there have been many studies that discuss cloud storage having efficient, reliable, and user-friendly functions [2]. Despite the presence of various technologies, there are still many uses of fake diplomas that are used by unscrupulous persons. This diploma is used for various purposes, both for applying for jobs, applying for CPNS, even as a condition for continuing education to a higher level [3]. Many of these diplomas are difficult to ascertain because they cannot be traced quickly and precisely. So, a system is needed that can quickly and accurately read the authenticity or validity of the digitally uploaded certificate, so that not many parties will be harmed by the forgery of certificates by various individuals. For this reason, blockchain technology is here as a solution to this problem.

Blockchain is the core technology used to create cryptocurrencies, such as Bitcoin [4]. Blockchain is in the form of a record (database) that continues to grow, called a block, which is connected and secured using cryptographic techniques [5]. In essence, when a file is recorded on a blockchain system, the authenticity of the information is guaranteed by the many nodes that support the network. In other words, the "number of claims" from multiple users supports the validity of all recorded data [6].

In such a scenario, network nodes can be controlled by regulatory authorities or government agencies, which are responsible for verifying and validating digital records [7]. Basically, each node can "choose" the authenticity of the data so that the file can be used as an official document, but with a higher level of security [8]. The concept of this system will continue to print physical certificates on paper, on paper with a DCN

(Digital Certificate Number) or Digital Certificate Number [9]. The company or university concerned only needs to check the number on the blockchain explorer which can be accessed online. Then, you can also easily access it using the QR Code with your cellphone. With the application of blockchain technology to the diploma, illegal manipulation can be identified quickly and accurately [10]. With this system, it is hoped that it will make it easier to reduce the falsification of important data, certificates, and certificates as well as in verifying important data without the need for many files so that falsification of certificates that harm various parties can be reduced and even eliminated if you apply blockchain technology which will certainly be more efficient.

2.   METHOD

This research method uses SWOT analysis of strengths, weaknesses, opportunities and threats [11] which will be implemented in this study.

Figure 1 SWOT Analysis

Strengths: Decentralized Networks: The most important aspect of the Blockchain [12] that makes it a solution in security the transaction process is a decentralized and transparent network between all parties involved [13]. To validate changes in each block, all systems on the network (at least 50%) need to verify every data. Robust Blockchain Ecosystem [14]:Because every technology that works in a decentralized network, it is difficult to find room for any single point of failure. Database Distribution: There will be no lack of databases in the Blockchain model for distributing transaction data[15].

Weaknesses (weaknesses): Disagreements in the public blockchain community often cause divisions that can permanently break the blockchain into two or more[16]. All related parties must be responsible for integrating the data. Some parties can be very closed about information sharing but integration is very important and useful. Because Blockchain makes centralized data accessible to related parties, interoperability is needed between personal and public needs, so we need a rule that governs it. In addition, Blockchain technology does not discuss the reliability of its records. Often people who act as trusted third parties record information on the Blockchain. In the case of tracking or other unethical business practices, an individual can easily enter the Blockchain system that the business is legitimate and upstream actors can be deceived[17].

Opportunities: Blockchain can be designed to encrypt private data with an encryption key that can be forgotten or to store personal data outside the chain in a database that allows deletion by only linking to the data stored on the network [18].

Threats: Taxation Problems: Although there are many benefits to the Blockchain, it will not be easy and fast to fully implement technology. For example, there are legal issues that need to be taken care of before cross-border technology applications.

3.   RESULT AND DISCUSSION

The application of blockchain in the world of education has not been realized, this is because blockchain technology is still relatively new, and the first time the application of blockchain was used for digital financial innovation in the economy and business[19]. The discussion this time will review the application of blockchain technology that does not concentrate on the field of cryptocurrency.

This paper refers to the application of the blockchain in the field of education that refers to socio-technological indicators [20]. This study uses input material in the form of a diploma of students who have graduated to take data in the form of Diploma Number, Name, NIM, Place and Date of Birth of the Faculty, Study Program, Level, Year of Entry, Year of Graduation, Name of Dean, Rector Name as shown in the table the following.

Table 1. Analysis of Input Needs

Name	Certificate Data
Description	University of Raharja Alumni Certificate
Data Structure	Certificate Serial Number + Name + NIM + Place of Birth + Date of Birth + Faculty + Study Program + Level + Year of Entry + Year of Graduation + Name of Dean + Name of Rector
Certificate Serial Number	Numeric
Name	Alphanumeric
NIM	Numeric
Place of birth	Alphanumeric
Date of birth	Alphanumeric
Faculty	Alphanumeric
Study program	Alphanumeric
Level	Alphanumeric
Year of Entry	Numeric
Graduation year	Numeric
Name of Dean	Alphanumeric
Name of Rector	Alphanumeric

3.1 Software and Hardware Used

In designing the application equipment used QR Generator that uses PHP language and QR Reader application installed on the smartphone.

3.2 Logarithmic Flow

The flow of algorithm design used in making this application is to use the system prototype. This prototype serves to explain the flow of the program that will be developed using the QR Code generate by utilizing the QR Reader on the mobile phone application. Following is the barcode scan flow on the diploma which will be tested for validity using the QR Reader and integrated with the blockchain.
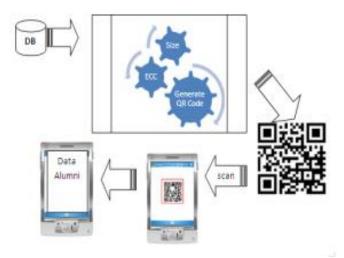

Figure 2. Certificate Verification Flow Using Scan Barcodes

3.3 Design of developing QR Code

Development of QR Code that is used based on alumni data stored in a database. Then this data is integrated to make a QR Code listed on a physical or paper diploma. Next is the flowchart display of diploma verification development using barcode scanning.
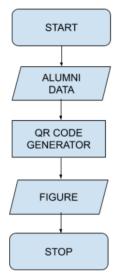
Figure 3. QR Code Generator Flowchart Diagram

As noted in the flowchart diagram above, to develop this innovation product requires several stages. Among them:

1. Alumni Data Input

Table 2. List alumni data

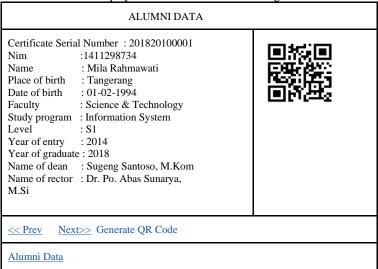| No	Name	Matrix ID	Place of Birth	Date of Birth	Faculty	Study Program	Level	Year of Entry	Year of Graduate	Name of Dean	Name of Rector	QR Code
1.	Mila Rahma wati	141129 8734	Tanger ang	01-02-1994	Science of Technol ogy	Informati on System	S1	2014	2018	Sugeng Santoso, M.Kom	Dr. Po Abas Sunar ya, M.Si	
2.	Anisa Wulan dari	142234 23	Bogor	03-04-1994	Science of Technol ogy	Informati on System	S1	2014	2018	Sugeng Santoso, M.Kom	Dr. Po Abas Sunar ya, M.Si	
3.	Waahy u Irawan	132276 54	Lampu ng	02-08-1993	Science of Technol ogy	Informati on System	S1	2013	2017	Sugeng Santoso, M.Kom	Dr. Po Abas Sunar ya, M.Si	
4.	Dirham Dirgant ara	131145 67	Jakarta	02-12-1993	Science of Technol ogy	Informati on System	S1	2013	2017	Sugeng Santoso, M.Kom	Dr. Po Abas Sunar ya, M.Si	
5	Anasta sya Fina	141134 56	Palemb ang	01-10-1994	Science of Technol ogy	Informati on System	S1	2014	2018	Sugeng Santoso, M.Kom	Dr. Po Abas Sunar ya, M.Si	

2. The QR Code Generate Process

Input data in the form of alumni data is then processed to become output results in the form of QR Code stored in a database. In generating QR Code using the PHP programming language. This PHP programming is used as a help library to generate QR Code images with a combination of alumni data which is then stored in file.png.

3. Results

QR Code alumni data processing will be stored in a folder with a primary key or a unique name to distinguish between data from one another. It also functions to call according to the order of the alumni.

Table 3. Display Alumni Data After Generating

ALUMNI DATA	
Certificate Serial Number : 201820100001 Nim :1411298734 Name : Mila Rahmawati Place of birth : Tangerang Date of birth : 01-02-1994 Faculty : Science & Technology Study program : Information System Level : S1 Year of entry : 2014 Year of graduate : 2018 Name of dean : Sugeng Santoso, M.Kom Name of rector : Dr. Po. Abas Sunarya, M.Si	
<< Prev Next>> Generate QR Code	
Alumni Data	

As seen in table 3, QR Code images that have information relevant to alumni data are taken from a special directory resulting from storing QR Code image files that have been generated in the previous QR Generate process.

4. CONCLUSION

Based on the analysis of the paper above, it can be concluded that the use of the matrix code in the QR Code is to store big data, such as student alumni data. The mechanism is, the QR code printed on physical paper can later be read by the QR Code reader. Blockchain facilitates the certificate verification process in that data, which helps government or private companies know when employees are using fake diplomas. For further research, it is hoped that this system will not only identify with QR-Code but also add Hash codes so that future verification will be even stronger.

5. ACKNOWLEDGEMENT

6. REFERENCES

[1] Q. Aini, U. Rahardja, and A. Khoirunisa, "Blockchain Technology into Gamification on Education," *IJCCS (Indonesian J. Comput. Cybern. Syst.*, vol. 14, no. 2, pp. 1–10, 2020, doi: 10.22146/ijccs.53221.

[2] U. Rahardja, S. Sudaryono, N. P. L. Santoso, A. Faturahman, and Q. Aini, "Covid-19: Digital Signature Impact on Higher Education Motivation Performance," *Int. J. Artif. Intell. Res.*, vol. 4, no. 1, May 2020, doi: 10.29099/ijair.v4i1.171.

[3] J.-C. Cheng, N.-Y. Lee, C. Chi, and Y.-H. Chen, "Blockchain and smart contract for digital certificate," in *2018 IEEE international conference on applied system invention (ICASI)*, 2018, pp. 1046–1051.

[4] Q. Aini, N. Lutfiani, F. Hanafi, and U. Rahardja, "Application of Blockchain Technology for iLearning Student Assessment," *IJCCS (Indonesian J. Comput. Cybern. Syst.*, vol. 14, no. 2, 2020, doi: 10.22146/ijccs.53109.

[5] F. Agustin, S. Syafnidawati, N. P. Lestari Santoso, and O. G. Amrikhasanah, "Blockchain-based Decentralized Distribution Management in E-Journals," *Aptisi Trans. Manag.*, vol. 4, no. 2, pp. 107–113, 2020.

[6] P. A. Sunarya, U. Rahardja, L. Sunarya, and M. Hardini, "The Role Of Blockchain As A Security Support For Student Profiles In Technology Education Systems," *InfoTekJar J. Nas. Inform. dan Teknol. Jar.*, vol. 4, no. 2, pp. 13–17, 2020.

[7]   H. Bhanushali, A. Arthena, S. Bhadra, and J. Talukdar, "Digital Certificates Using Blockchain: An Overview," in *2nd International Conference on Advances in Science & Technology (ICAST)*, 2019.

[8]   Q. Aini, U. Rahardja, and D. L. Nurani, "Penerapan Mata Uang Armo (AirzonE-Mall Money) Pada Marketplace AirzonE-Mall Sebagai Inovasi Pembelajaran Internet dan E-commerce," *Technomedia J.*, vol. 1, no. 1, pp. 114–125, 2016.

[9]   J. Umeh, "Blockchain double bubble or double trouble?," *Itnow*, vol. 58, no. 1, pp. 58–61, 2016.

[10]   G. Chen, B. Xu, M. Lu, and N.-S. Chen, "Exploring blockchain technology and its potential applications for education," *Smart Learn. Environ.*, vol. 5, no. 1, p. 1, 2018.

[11]   G. Di Battista, V. Di Donato, M. Patrignani, M. Pizzonia, V. Roselli, and R. Tamassia, "Bitconeview: visualization of flows in the bitcoin transaction graph," in *2015 IEEE Symposium on Visualization for Cyber Security (VizSec)*, 2015, pp. 1–8.

[12]   G. D. Putra, S. Sumaryono, and W. Widyawan, "Rancang Bangun Identity and Access Management IoT Berbasis KSI dan Permissioned Blockchain," *J. Nas. Tek. Elektro dan Teknol. Inf.*, vol. 7, no. 4, pp. 384–390, 2018.

[13]   D. Yulianto and H. Yuliansyah, "Rancang Bangun Aplikasi Traffic Counter RFID," *J. Nas. Tek. Elektro dan Teknol. Inf.*, vol. 4, no. 1, pp. 32–38, 2015.

[14]   C. D. Munthe and M. P. S. Hutagalung, "PEMBANGUNAN SISTEM E-VOTING MENGGUNAKAN TEKNOLOGI BLOCKCHAIN (STUDI KASUS: IT DEL)." PROGRAM STUDI DIII TEKNIK INFORMATIKA, 2019.

[15]   R. Sriwiji, "Studi Empiris Pada Pemodelan Dan Prediksi Harga Bitcoin berdasarkan Informasi Blockchain Menggunakan Bayesian Regularization Neural Network," 2019.

[16]   I. B. P. Bhiantara, "Teknologi Blockchain Cryptocurrency Di Era Revolusi Digital," in *Seminar Nasional Pendidikan Teknik Informatika (SENAPATI)*, 2018, vol. 9, pp. 173–177.

[17]   R. C. Noorsanti, H. Yulianton, and K. Hadiono, "Blockchain-Teknologi Mata Uang Kripto (Crypto Currency)," 2018.

[18]   E. Ardhianto and N. Wakhidah, "Pengembangan Metode Otentikasi Keaslian Ijasah dengan Memanfaatkan Gambar QR Code," *J. Transform.*, vol. 13, no. 2, pp. 35–41, 2016.

[19]   A. C. Nugraha, "Penerapan Teknologi Blockchain dalam Lingkungan Pendidikan," *Produktif J. Ilm. Pendidik. Teknol. Inf.*, vol. 4, no. 1, pp. 15–20, 2020.

[20]   M. N. Ubaka-Okoye, A. A. Azeta, A. A. Oni, H. I. Okagbue, O. S. Nicholas-Omoregbe, and F. Chidozie, "Blockchain Framework for Securing E-Learning System," *Institutions*, vol. 27, p. 28.

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