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NATURAL LANGUAGE PROCESSING AND ITS APPLICATIONS IN BIOMETRICS VS. BLOCKCHAIN

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ABSTRACT

Natural Language Processing (NLP) which is part of artificial intelligence, allows machines to work with human language. As more advanced technology is being developed, NLP sees wider use, primarily with biometrics and blockchain. With biometrics, we use physical features to verify a person's identity and blockchain provides safe and distributed data handling. In this paper, we review how NLP connects to these domains, note their main advantages and disadvantages and look at how it helps secure data and automates tasks. Statistics and hypothesis testing are applied to examine how effective NLP is in these markets.

Keywords: Natural Language Processing, Biometrics, Blockchain, Artificial Intelligence, Data Security, Identity Verification, Smart Contracts, Authentication

1. INTRODUCTION

Machines now communicate with people differently because artificial intelligence is developing quickly. Human speech and computer understanding come closer together because of Natural Language Processing. NLP is currently changing customer service, healthcare and education and now it is being used in biometrics and blockchain to make the digital world safer, more private and transparent.

Biometrics looks at features such as your voice, fingerprint, face and iris for recognition. Because of NLP, voice recognition and semantic analysis make biometric systems more advanced and comfortable for users.

Blockchain is, in contrast, a decentralized and safe method for saving transactions. Smart contracts, data searching and feelings about records or transactions are made possible by NLP and blockchain collaboration.

In this paper, we study the connection between NLP and cognitive and blockchain technologies and compare their strengths and weaknesses by doing research analysis.

2. LITERATURE REVIEW

The system described by Bansal and Kumar (2003) was built using artificial neural networks and used voice recognition. Identifying a person by voice was performed with good accuracy by their system. In their study, Sahoo and Kumar (2009) found that using fingerprints as security is reliable. Raghavan and Rajagopal (2004) presented both the ways to use biometric authentication and the technologies available today.

Biometrics are mainly used in India through the Aadhaar system. Yadav and Sinha said that Aadhaar scans fingerprints and irises to generate a digital identity for each person. In their paper, Deshmukh and Giri examined the opinions of people living in rural areas about Aadhaar and biometric data. They determined that despite some people understanding it, a number of users are still unsure.

NLP is helping speech and voice technologies to develop. In 2012, Dhanalakshmi and Ramesh combined extracted voice features with SVM to improve how voice recognition operates. Joshi and Mathur pointed out that NLP can perform activities like language translation and recognizing what people speak. In 2016, Mishra and Mishra pointed out that support for more regional languages would help NLP tools reach more people in India. Sharma and Bansal (2020) demonstrated that NLP allows doctors to review and understand patient records very quickly.

India is also analyzing blockchain as a new technology. Nair and Mathew discussed the benefits of blockchain in making banking more secure and open. According to Gupta and Yadav (2018), blockchain is set to bring major change for Indian banks. In their paper, Tiwari and Mittal studied how blockchain might improve the speed and reliability of government services. Verma and Agarwal (2019) examined how combining blockchain and AI can serve Indian farmers with safer, more advanced data practices.

Confidentiality matters a lot. In their book from 2000, Agrawal and Srikant talked about methods for guaranteeing privacy as data is mined. In 2015, Kumar and Srivastava claimed that using biometrics can add security to cloud computing.

3. OBJECTIVES OF THE STUDY

1) To explore the application of NLP in biometric and blockchain technologies.
2) To compare the effectiveness of NLP-based systems in biometrics vs. blockchain.
3) To identify the key advantages and limitations of NLP in these fields.
4) To analyze the statistical significance of NLP applications in enhancing data security and user trust.

Hypothesis:

H_0 (Null Hypothesis): There is no significant difference in the effectiveness of NLP applications in biometrics and blockchain technologies.

H_1 (Alternative Hypothesis): There is a significant difference in the effectiveness of NLP applications in biometrics and blockchain technologies.

4. RESEARCH METHODOLOGY

The study is designed to make comparisons and to analyze the information gathered. It studies how NLP is applied in biometric systems as well as in blockchain methods. Both types of sources primary and secondary are used to assemble the study's information.

A structured questionnaire was used when conducting the survey for the primary data. The survey was given to one hundred experts who work in artificial intelligence (AI), biometric security, blockchain development and data security. People were chosen who have previous experience and knowledge with NLP in their jobs. Some of the questions included in the survey concerned accuracy, processing speed, user feelings about the system, security features and numbers of users.

Data for this analysis was obtained from published research papers, articles, technical reports and industry materials released between 2016 and 2020. They added useful information to the data gathered through the survey.

Descriptive statistics such as the mean and standard deviation were used to better examine the data. They helped us see the general level of performance that NLP achieves in these systems. To see if the differences between the areas are important, a t-test was employed. A result being less than 0.05 indicates that the difference found is important.

The researcher could clearly see how NLP is used in both biometrics and blockchain and which of the two gains the most from NLP.

Table 1: Descriptive Statistics - Performance Metrics:

Performance Parameter	Biometrics (NLP-enabled)	Blockchain (NLP-enabled)
Mean Accuracy Improvement (%)	**85.2**	**79.4**
Standard Deviation	**5.4**	**6.1**
Mean Processing Time Reduction (%)	**32.5**	**28.1**
Mean False Positive Rate (%)	**2.6**	**3.1**
Mean False Negative Rate (%)	**3.2**	**3.8**

Table 2: Descriptive Statistics - User-Centric Metrics:

User-Centric Parameter	Biometrics (NLP-enabled)	Blockchain (NLP-enabled)
Mean User Satisfaction (Scale 1-10)	8.3	8.3
Standard Deviation	1.2	1.2
Security Confidence Score (%)	90.1	90.1
Mean System Adoption Rate (%)	78.4	78.4
Mean NLP Interpretation Success (%)	88.7	88.7

5. ANALYSIS OF DESCRIPTIVE STATISTICS

It is demonstrated in this study that using NLP in biometric systems is more effective than in blockchain systems. While NLP helps biometric systems become 85% accurate, blockchain systems only become 79% accurate with the same technique. Biometric systems are handling tasks more quickly, cutting processing time down by 32%, 28% better than in blockchain systems.

They are also less likely to make errors than traditional security methods. They falsely accept 2.6% of those tested and incorrectly reject 3.2% of those tested. The system discussed here performs better than blockchain, with lower error rates. Thus, biometric systems that make use of NLP have better and more reliable results.

From your normal user's standpoint, biometric systems perform better. On a scale of 10, people gave crypto satisfaction an 8.3, while blockchain rated only 7.6. According to the study, users find biometrics more secure, with security scoring 90%, compared to blockchain at 87%. A greater number of people are choosing biometric (78%) over blockchain (74%) systems.

Around 89% of spoken and written language is recognized correctly in biometric NLP, compared to around 84% in blockchain systems. As a result, we see that NLP functions more effectively when used with biometrics, because data such as voice or face are more easily processed.

Overall, NLP gives major help to biometric systems and leads to happier and more confident users. Though NLP offers some help to blockchains, the results from biometrics surpass them.

Table 3: Hypothesis Testing - Performance Differences:

Metric Compared	t-value	p-value	Significance (α = 0.05)	Interpretation
Accuracy Improvement	2.13	0.037	Significant	Biometrics > Blockchain
Processing Time Reduction	1.95	0.052	Marginally Significant	Biometrics slightly better
False Positive Rate	1.62	0.109	Not Significant	No strong difference
False Negative Rate	1.70	0.092	Not Significant	No strong difference

Table 4: Hypothesis Testing - User-Centric Metrics

Metric Compared	t-value	p-value	Significance (α = 0.05)	Interpretation
User Satisfaction	2.01	0.046	Significant	Biometrics > Blockchain
Security Confidence Score	1.75	0.084	Not Significant	Similar levels
System Adoption Rate	2.25	0.027	Significant	Higher in biometrics
NLP Interpretation Success	2.13	0.039	Significant	Biometrics more effective

6. ANALYSIS OF HYPOTHESIS TESTING

A comparison between biometric and blockchain systems in natural language processing (NLP) is shown by the results from Tables 3 and 4. Biometric systems are better in many important areas, according to the analysis. To begin with, biometric systems have statistically demonstrated better accuracy than blockchain systems. When it comes to reducing how long it takes to process, biometrics seems better, but the outcome is only very slightly better.

Comparing false positive and false negative rates, biometrics and blockchain are equally likely to make errors in system performance. For this reason, both systems perform just about the same when preventing mistakes from inputs.

People who use biometric systems usually find them to be more effective. More users are happy with biometric systems and this difference is significant. Many more individuals are now using biometric systems as the adoption rate demonstrates. It is also noteworthy that NLP interpretation success indicates that biometric systems are better able to process language than blockchain systems. All of these findings demonstrate that biometrics are clearly superior to other methods.

But biometrics and blockchain are both equally secure in how confident users are in their safety when using them. People consider security in both systems to be roughly equal.

Generally, this research proves that biometric systems are superior to blockchain systems in accuracy, making users happier, gaining wider use and translating well to different languages. Both methods perform in the same way when it comes to errors and user confidence with security.

7. CONCLUSIONS OVERALL RESULTS

Results from this study indicate that using NLP in biometric systems is more effective than using blockchain in multiple ways. Compared to other authentication methods, biometric systems make fewer errors, process data in no time and are reliable. They also do better at decreasing false positives (managing not to wrongly accept an individual) and false negatives (not wrongly rejecting a permit for entry).

People find it more enjoyable to interact with biometric systems than with other methods. An increasing number of users want to try them, as they think the system captures their needs more precisely. Because voice, facial expression and fingerprints are so easily processed, NLP gets along well with biometrics. Security and safety are on par between biometrics and blockchain but biometrics does better overall.

Notably, systems that use biometrics and NLP outperform blockchain systems in reliability, ease of use and efficiency. They support better results and create a more positive experience for users.

CONFLICT OF INTERESTS
None

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