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Original Article

A Blockchain-Based System for Translating Oral Contracts into Written Contracts

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Abstract - *A contract is a formal agreement that may be either written or verbal. While generally less formal, agreements can evolve into contracts once all essential legal elements are present, making agreements a precursor to formal contracts. One of the key components of a legally binding contract is consideration. In India, the statutory provisions outlined in the Indian Contract Act provide the legal framework for contract formation. This paper, however, deals with oral agreements. An oral agreement is legally binding, but in the event of a disagreement, its enforceability is called into doubt and frequently resu lts in a "he said, she said" scenario. To address this issue and enhance the admissibility of oral agreements in the Indian judiciary, an automated system is proposed that converts oral agreements into written contracts using speaker recognition, speech-to-text conversion, and blockchain technology. The system identifies the speaker from the audio recording through speaker recognition algorithms. OpenAI's Whisper module is employed for speech-to-text conversion, enabling the transcription of the oral agreement into written form. A digital signature is then generated using the SHA-256 hashing algorithm, where the hash of the agreement is encrypted with the speaker's private key to ensure authenticity and integrity. Finally, the use of blockchain technology ensures that the written agreement is secure, tamper-proof, and immutable.*

Keywords - *Blockchain technology, Digital signature, Speech recognition, Speech to text conversion, Verbal agreement.*

1. Introduction

The Oral and written agreements are two types of agreements people are aware of. An agreement that is in the form of text and follows a particular format is referred to as a written agreement. Given that they are simpler to read and comprehend, they have a higher evidential value in a court of law. On the other hand, in oral agreement, one party convey a promise to another through spoken words, gestures and symbols. Upon the other party's acceptance, the oral agreement is deemed to have been made and is legally binding. However, a verbal agreement is just as enforceable as one that is in writing. If an oral contract satisfies the conditions outlined in Section 10 of the Indian Contract Act of 1872, its legality cannot be contested. This paper aims to implement a system that automatically analyzes an audio recording of any verbal agreement, creates a legally binding contract, is digitally signed by all parties involved, and is stored on IPFS (Inter Planetary File System), which could solve many existing problems pertaining to verbal contracts. However, in case of dispute, it is challenging to prove the existence of an agreement.

Both oral and written agreements are recognized as legitimate in India and are covered by the Indian Contracts Act. The Delhi High Court's 1991 decision in the case of Nanak Builders and Investors Pvt. Ltd vs. Vinod Kumar Alag (AIR 1991 Delhi 315) serves as confirmation of this [1]. In Alka Bose v. Parmatma Devi & Ors. (Civil Appeal Nos. 6197 of 2000), The Supreme Court also recognized the legality of oral agreements. An oral agreement is legally binding, but in the event of a disagreement, its enforceability is called into doubt and frequently results in a he said/she said scenario. Therefore, one is strongly advised to convert their agreements to a collection of texts. Courts might still want more proof and eyewitnesses to support oral agreements. This offers those with bad intentions a lot of power to deceive the public. Examples of such actions include swindling sales representatives who might charge customers for services that were promised over an audio conversation but were never provided, Lawyers and Journalists who promise anonymity during an audio or video interview but do not hold this promise in publications, and Translators who can incorrectly translate conversations to defraud others. Since all interactions

in such cases are verbal and only protected by the law if it can be proved with sufficient evidence in the Court of Law, it is necessary to design and develop a system that can efficiently and accurately create legally binding contracts from verbal agreements that are duly signed by all the parties involved [2].

1.1. Research Gap

Although existing literature and legal precedents recognize the validity of oral agreements, a noticeable lack of automated systems can transform verbal agreements into legally binding documents in real-time. Existing studies have largely focused on written digital contracts and blockchain-based document verification but have not explored the application of speech recognition, digital signatures, and decentralized storage (e.g., IPFS) in the context of oral agreements. Current research work does not sufficiently cover the integration of speech recognition, digital signatures, and decentralized storage solutions to produce verifiable, enforceable contracts from spoken statements. This lack of intermediary between oral arrangements and formalized written contracts opens the door for disputes and misuse, emphasizing the need for innovative frameworks that close the gap between natural language and written contracts. This article attempts to fill that gap by proposing a complete system that records an audio input, transforms the audio input into a structured legal document, digitally signs the document, and stores the document in a secure location, thereby bridging the gap between verbal communication and formal contractual obligations.

1.2. Problem Statement

While oral agreements are legally recognized under the Indian Contract Act of 1872, their enforceability remains problematic due to the lack of tangible evidence in the event of disputes. The absence of a reliable system to document, verify, and authenticate verbal agreements leads to challenges in proving their existence and terms in courts. This often results in situations where individuals may exploit the limitations of oral contracts for fraudulent purposes, such as making false promises or altering agreements without mutual consent. Such vulnerability is often abused in industries like sales, law, journalism, and translation, in which verbal promises can easily be denied or twisted. The current legal framework, while acknowledging oral agreements, offers limited practical mechanisms to safeguard against such misuse. There is a critical need for a technological solution that can transform verbal discussions into a legally binding digital contract, whose authenticity is verifiable by all involved and tamper-evident.

Numerous cases involving contract modifications are being investigated in India, in addition to cases involving contract breaches. To prevent terms of an agreement between two parties from being changed, revoked, or altered after it has been signed without both parties' approval, a foolproof method is required.

Significant features of this research paper are as follows:

- A written contract is created out of a voice recording using a speech-to-text machine learning model.
- Verify the voice recording using a speech recognition algorithm, thus verifying the speaker.
- Blockchain and digital signatures ensure the authenticity of documents and prevent forgery.
- A complete user-friendly frontend web application has been designed and implemented, and can be used by professionals in various fields like sales, lawyers, journalists, translators, etc.

2. Literature Survey

This chapter presents an in-depth review of existing research relevant to the conversion of oral contracts into written agreements using emerging technologies such as blockchain, speech-to-text conversion, and speaker recognition methods based on Mel-Frequency Cepstral Coefficients (MFCC). The review aims to identify key theories, findings, and gaps related to the topic to establish a foundation for the present study. One of the Author describes the concept of speech recognition and its importance in various applications. The authors highlight the challenges involved in accurately recognizing Speech and emphasize the need for effective techniques to address these challenges. Speech recognition using Mel Frequency Cepstral Coefficients (MFCC) is explored in this paper. It covers the process of MFCC extraction and how it can be used to represent speech signals for recognition purposes. The paper also explains the process of MFCC extraction, which involves transforming the frequency domain of speech signals into the Mel frequency domain, followed by a Discrete Cosine Transform (DCT) to produce a set of cepstral coefficients. These coefficients are then used to represent the Speech signal in a compact and effective way for recognition purposes.

The authors evaluate the effectiveness of MFCC-based speech recognition using a dataset of spoken digits and compare the performance of MFCC-based recognition with other feature extraction methods. The results show that MFCC-based recognition outperforms other methods in terms of accuracy, demonstrating its effectiveness for speech recognition. The findings suggest that MFCC is a promising technique for improving the accuracy of speech recognition systems. The paper explores Maximum Likelihood and Support Vector Machines to perform classification on 2-dimensional MFCC data. However, these classifiers do not give satisfactory results. The paper also does not explore techniques such as Gaussian Mixture models that give a higher accuracy while classifying the data. This study only discusses the application of Mel-Scale Frequency Cepstral Coefficients for speaker identification; its use in formalizing agreements between speakers is not covered. R. Kaur and A. Kaur [3] describe "digital signatures" as a mathematical formula that ensures the confidentiality of communications, verifies data integrity, confirms the identity of the originator, and provides

non-repudiation of the sender. Problems caused by security concerns with digital documents, such as unauthorized access and data theft, can be solved by using digital signatures. Digital signatures are used in a wide range of industries, including governance, banking, financial services, and healthcare, to protect data privacy and hinder unauthorized access. Privacy, authentication, integrity, and non-repudiation are the four fundamental pillars of information security. Privacy, also known as confidentiality, ensures that information is shielded from unauthorized parties. Data is transformed into an unintelligible form known as a ciphertext through the process of encryption. Decryption is the process of converting encrypted data back into its unencrypted state in a readable form.

The same key is used for both encrypting and decrypting data in the symmetric encryption method. Two different keys, a public key and a private key, are used in the asymmetric encryption method of the cryptosystem. For authenticating a digital signature, a special code that serves as a signature is included in the message of the sender. Typically, the signature is created by encrypting the message's hash with the sender's private key. This way, the message's origin and integrity are ensured by the signature. The Secure Hash Algorithm is employed by the NIST standard for digital signatures. However, this paper focuses only on digital signatures and the steps involved during their application to digital systems. The paper is based only on the application of digital systems using symmetric and asymmetric encryption, but does not discuss how to generate user-specific keys for encryption. The paper is focused on digital signatures used only to verify users, not the content inside a digital document. This paper also does not emphasize the role of digital signatures in transcribed verbal contracts, which is an important application of the technology [4].

According to D. A. Reynolds [5], a listener receives multiple levels of information from spoken signals. Speech, at its most basic level, uses words to transmit information. However, Speech also conveys information about the spoken language and the speaker's emotion, gender, and overall identity. There are two fundamental tasks that fall under the umbrella of speaker recognition. The process of identifying the speaker from a group of recognized speakers is known as speaker identification. Verifying a speaker's identity entails deciding whether or not the individual is who they say they are. Speaker recognition technology offers numerous use cases, and this list is constantly expanding. Access control, transaction authorization, law enforcement, speech data management, and personalization are a few examples of some general applications where speaker recognition technology has been or is now used. Most speaker identification systems use a probability ratio test to differentiate between two possible outcomes: the test speech originates from the purported speaker or a forger. The claimed speaker's features are taken from the speech signal during frontend processing and compared to some model(s) representing potential imposter speakers to create a likelihood ratio statistic that is then compared to a threshold to determine whether to accept or reject the speaker. Speech is a behavioral signal that may vary and cannot always be reproduced consistently by the same speaker and is affected by uncontrolled and harsh acoustic environments, so while Speaker Recognition technology relies on natural and unobtrusive signal which can be easily captured from almost anywhere using the familiar telephone network, it is not completely robust. This study only discusses the current methods for speaker identification; its use in formalizing agreements between speakers is not covered. The article does not mention the more effective noise reduction and speech framing techniques used today to improve speaker recognition. The subject of spoofing and speakers emulating the speech qualities of other speakers is not addressed in the research.

The paper by Dongfeng Wang et al. [6] suggests a blockchain-based method for contract signing. The approach suggested ensures multi-party privacy protection, but it does not delve into aspects of real-time processing of the system under heavy transaction loads. The method proposed focuses on basic contract signing but does not take into account dynamic amendments and agreements. Yang et al. [7] explores blockchain technology in speech recognition. Sensitive data, such as voice recordings and speech patterns, is stored securely using blockchain technology. In this method, blockchain serves as a security layer and for speech recognition, deep learning techniques are used. Amir Salar et.al. [11] present a blockchain-based system outlined to automate the creation and management of meeting minutes, which ensures transparency and immutability in recording meeting discussions. The method also incorporates a summarization module that extracts important key points from the meeting transcripts. Performance metrics like ROUGE scores are used to evaluate summarization effectiveness, indicating promising results but highlighting areas for improvement. One of the author studied the research articles published in the period from 2012 to 2022. This paper's key findings include a major challenge due to legal ambiguity with respect to smart contracts.

3. Proposed Methodology

The system comprises a user-friendly web application that allows users to register by recording their biometric voice signature and personal details (Email ID, password, Aadhar number, etc.), thus adding two layers of security. Users can upload an audio file of any verbal agreement, and a transcribed document contract is created automatically. The document is created using a speech-to-text machine learning algorithm. The audio file of the voice agreement is then compared to the voice signature of users for accurate speaker recognition and identification. A pool of miners, such as lawyers, judges, or experts in the field of contract generation, can verify the structure of the file and vote for its validity. Once a consensus

of more than 50% is reached, the document is shared with the speaker. A private-public user key pair allows secure validation and signing of the contract between the involved parties. The document is stored securely on a blockchain network, thus not allowing any unwarranted modifications to the contract.

3.1. System Architecture

The research work focuses on the development of a Web Application whose workflows are described in Figure 1. With this application, a written contract is created out of a voice recording.

3.2. Module Description

3.2.1. Registration and Login

The user registers himself/herself on the system using the national unique identifier, i.e. Aadhaar number, and other user-related data along with a 30-second voice recording that will be used to identify the speaker later. A written document is created from a voice recording using a speech-to-text algorithm. The agreement is shared with miners who are experts in their respective professional fields. Once a 51% verification vote from miners and an approval vote from the speaker of the recording is received, the document is saved on IPFS signed with the private key of the speaker. Later, this signed agreement can be verified using the speaker's public key.

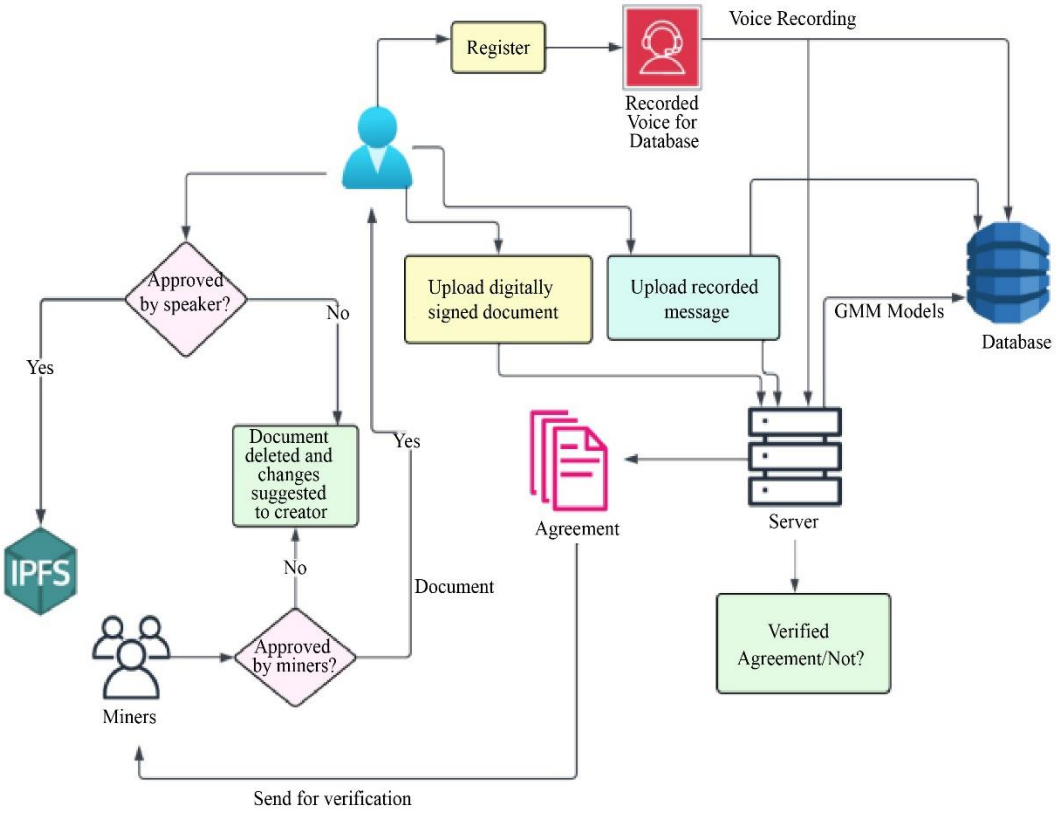

Fig. 1 The proposed system architecture

Here, a user-friendly and highly functional one-stop application for users is developed without compromising the security of user information or illegitimate users. Each new user is required to create an account to use the application. User details are stored on the Ethereum blockchain network and a MongoDB database, and each user is verified using the mobile number linked to their Aadhar Card. The user registers using their name, email address, phone number, and a 30-second voice sample. The user is also required to create an 8-character-long password that should include an uppercase alphabet, a lowercase alphabet, a special character, and a digit. Once registered, a public and private key are generated and the private key is stored on the blockchain network along with the Aadhaar number. All other user-related data is stored in the database. This is done so as to minimize the number of transactions and the time required to verify the transactions.

To log into the system, users can use their Aadhar number and the password created during the registration process. The workflow of the authentication module is shown in Figure 2.

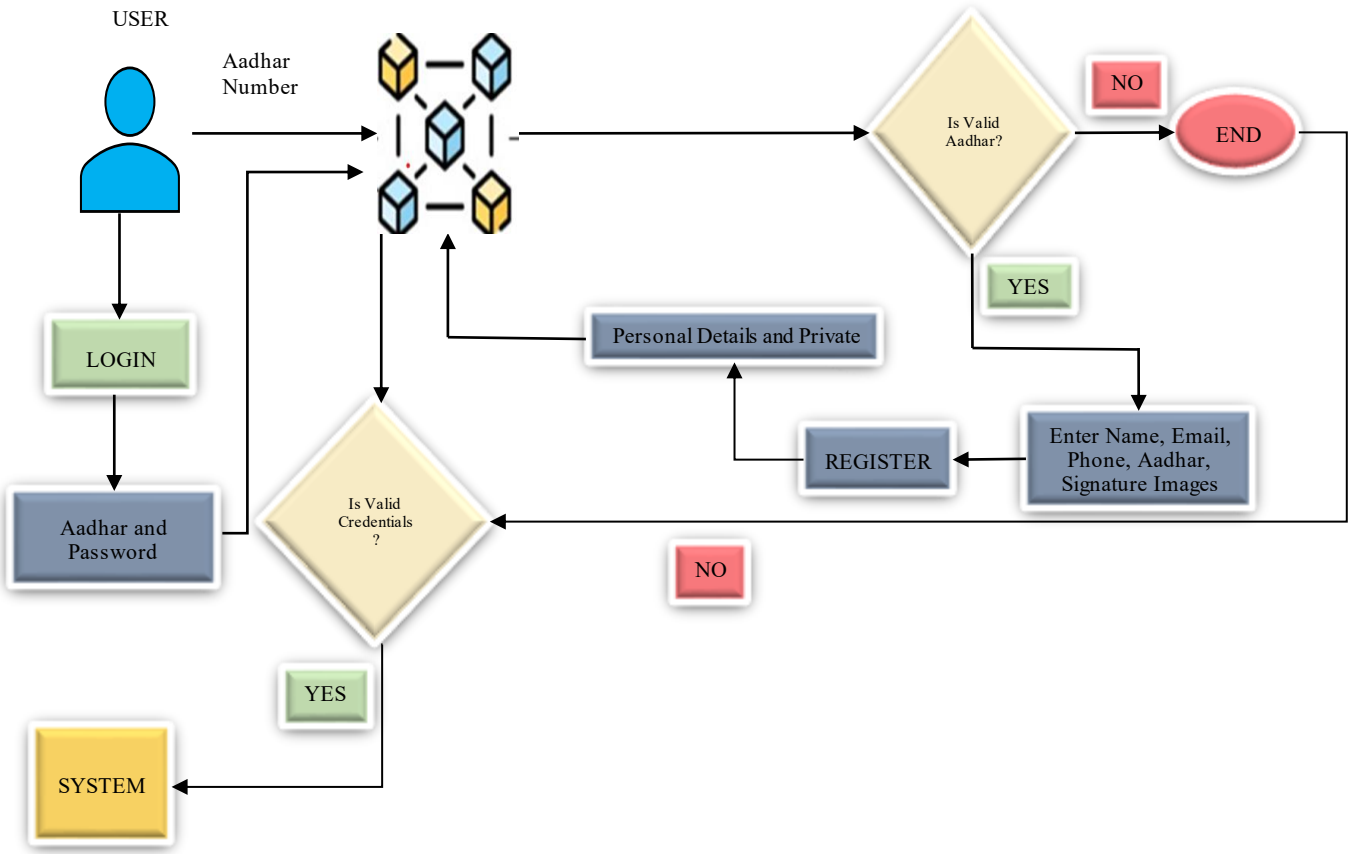

Fig. 2 Authentication workflow

3.2.2. Speaker Recognition

Upon registration, every user is required to submit an audio recording of their voice. These recordings are stored in an S3 bucket. The audio recording is processed to eliminate long pauses such that only voiced segments of the audio are stored. The audio is also passed through a noise reduction filter that smooths the audio file by removing unwanted noise. The processed audio is then split into multiple segments, each of about 300 milliseconds. These segments are then used as training data for the speaker recognition model. Sixteen Mel-frequency Cepstral Coefficients are extracted from the user audio that contain important and unique features from the audio segments generated from the user audio recording. These features are used to build a Gaussian Mixture Model (GMM) unique to each user. A '.gmm' file is created for every user and contains a model trained to the user's voice. These files are also stored in an S3 bucket and later used for comparison with an unknown user's audio to match the input voice recording, which is used to perform user recognition and verification. When a new, unknown audio is passed to the system, the system extracts MFCCs in a similar manner for the new audio and compares it to the GMM models of each user. The model that most closely resembles the unknown audio is identified as the speaker. This is how the system performs speaker recognition.

3.2.3. Speech-to-Text Open AI Whisper Module

OpenAI's Whisper module is used to convert a speech or voice recording into textual data. Whisper is a versatile model used for speech recognition. It is trained on a vast and varied audio dataset. This multi-task model has the capability of recognizing multilingual Speech, translating Speech, and identifying language. The whisper module is useful for generating textual data from the voice recording uploaded to the system. The output text data is then used to create an agreement for further use. When the speaker of the audio recording approves of the document, the text created from the speech recognition module and the eventual agreement in the form of a PDF is digitally signed using the private key of the speaker [1]. The SHA-256 hashing algorithm is used for the generation of digital signatures. The hash of the agreement generated is then encrypted using the speaker's private key, and the document is signed. The encrypted hash of the agreement is stored in the MongoDB database for verification later. During the verification of the agreement, the public key is used by other users of the application. The encrypted hash is decrypted using the public key, and the hash is regenerated and compared with the SHA-256 hashing algorithm. If the hashes match, the document is verified, and a relevant message is displayed to the user.

3.2.4. Storing and Verifying Agreements using Blockchain

Every block on a blockchain network is tamper-resistant; this is done by hashing the previous block's hash into the current block's hash, ultimately linking the two blocks.

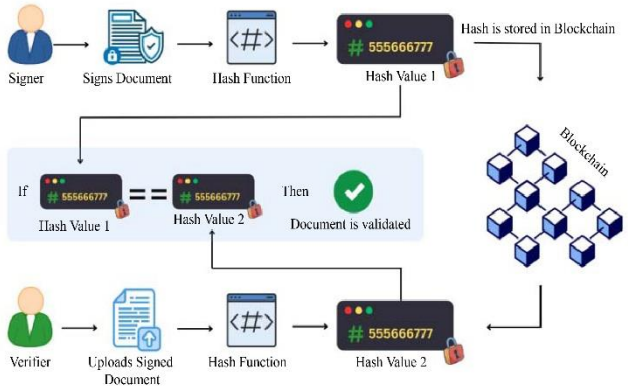

Fig. 3 Document verification through blockchain

Although storing the whole document on the blockchain would be expensive, storing just the hash of the document, which is much smaller in size, would be cost-effective. Apart from digital signatures, the hash stored on the blockchain can be used to compare and validate the agreement in a way similar to digital signatures. Figure 3 demonstrates how document verification is done through blockchain technology.

3.2.5. Digital Signature

Once a user registers, a private and public key are generated. The private key is saved on the blockchain, whereas the public key is not, because the public key can be generated using the private key.

3.2.6. Confidence Ratio

The concept of confidence ratio is introduced to signify the validity of a transcribed document. The confidence ratio is the ratio of the number of approved votes to the total number of miners who have approved or rejected the document. The confidence parameter is an important metric for concerned parties, i.e., the speaker of a recording, to verify the document. Once a confidence ratio of 51% is reached, the document is visible to the speaker and would be deleted if not.

$$Confidence\ Ratio = \frac{Number\ of\ approved\ votes}{Total\ number\ of\ votes\ received}$$

4. Results and Discussion

4.1. Experimental Set-Up

The proposed system was developed using Angular for the frontend, Flask for the backend, MongoDB for database management, and IPFS for decentralized storage. The experimental set-up consisted of a Windows 10 machine equipped with an Intel Core i5 processor and 16 GB of RAM. The OpenAI Whisper model was used for speech recognition, while speaker identification was performed using Gaussian Mixture Models (GMMs) trained on MFCC features extracted from audio samples. A 30-second audio sample was recorded using a standard noise-cancelling microphone. The RSA algorithm was employed to generate digital signatures, with the private key stored securely on a blockchain and the public key used for verification. Testing of the system included speaker recognition using known and unknown audio inputs, speech-to-text accuracy using Word Error Rate (WER), agreement verification through hash matching, and validation by simulated miner nodes. A confidence ratio above the 51% threshold was required for agreement approval and IPFS upload. APIs and system functionality were tested using Postman and Jasmine/Karma for frontend components to ensure accuracy, integrity, and reproducibility across modules.

A voice recording consisting of both parties, recognising the speakers involved, transcribing the words spoken, and finally embedding the information in a PDF file is implemented in this research work. The PDF is then stored on a peer-to-peer network called Inter Planetary File System (IPFS). This happens efficiently without any problems, hence allowing users to have voice contracts and make business dealings more feasible without being present in person. That way, one can make a contract by living in different geographical places, hence allowing them to create a contract without physical presence. The PDF created, which represents the document, cannot be tampered with as it is stored safely. Background noise and voice frequency do not affect the speech-to-text algorithm or the speaker recognition algorithm. Accent also does not affect the conversion of Speech to text. The speaker recognition has an accuracy of 100% on the dataset generated.

This research work consists of a backend developed using the Flask Framework of Python. Flask provides sensible default configurations to initialize the project, which can then be customized and extended to add the appropriate functionality. The framework is compatible with SQLite3 to initialize a working database to create storage for necessary models like User Information. The JSON Web Tokens, an open, industry standard, RFC 7519, are used here as a method of authentication between parties. User tokens are generated from login/ signing credentials, which are then encoded using the SHA256 cryptographic hashing algorithm. SHA256 generates a unique 256-bit hash for a payload consisting of user details like email, phone, Aadhaar number, name, gender, etc. This hash is used as a unique signature to send validation information over the internet without risk of interception or leaking. Whisper is an open-source and trained neural network for speech recognition that aims to reach human-level robustness and accuracy. It has been trained extensively on multilingual and multi-task supervised datasets collected from the internet. The new user has to register on the web application. All necessary fields, such as personnel details and contact details, are to be submitted by the user. The

registration page for a new user is shown in Figure 4. To maintain user privacy, sensitive information such as passwords is stored in hashed form, so user data is not at risk even in the case of a leak. Figures 5 and 6 demonstrate the personal and contact details required, such as Aadhar number, name, date of Birth, gender, Email and mobile number.

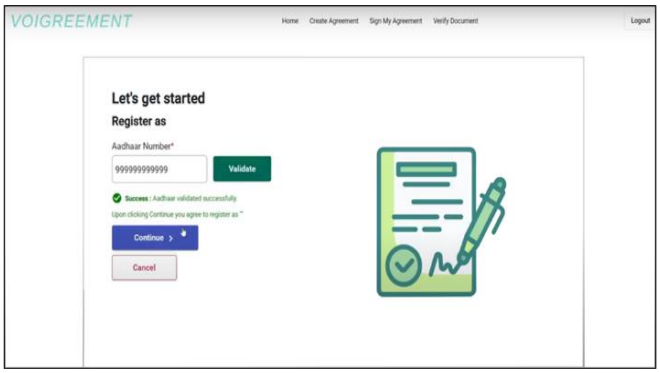

Fig. 4 New user registration page. Users have to register by entering and validating their Aadhar number

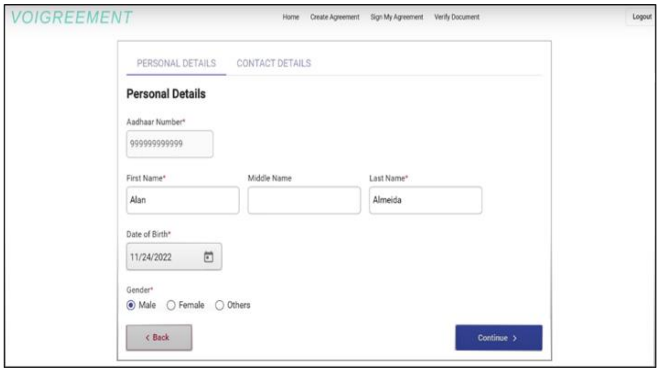

Fig. 5 New user registration requires personal details such as Aadhar number, name, date of birth, and gender

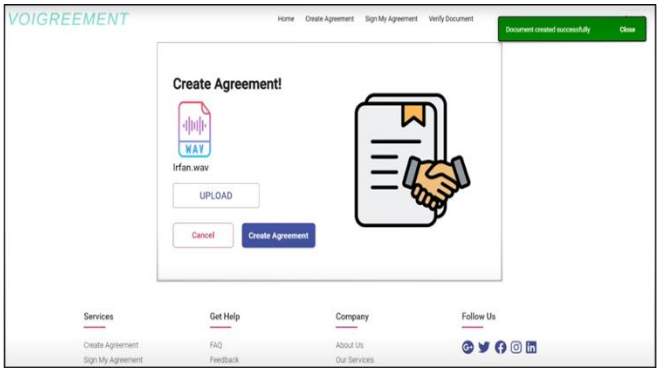

Fig. 6 Agreement document creation from an audio file

Once user registration is done successfully, every user is required to submit an audio recording of their voice. The pre-recorded audio system can be in the form of a .wav or an MP4 file. This file is used to create a document. The creation of an oral agreement document from an audio file can be seen in Figure 6. OpenAI's Whisper module is used to convert a speech or voice recording into textual data. The output text data is then used to create an agreement for further use. A text file is generated in the form of a PDF. The PDF is digitally signed using the speaker's private key. This way, an agreement document is signed digitally successfully, and the same is shown in Figure 7.

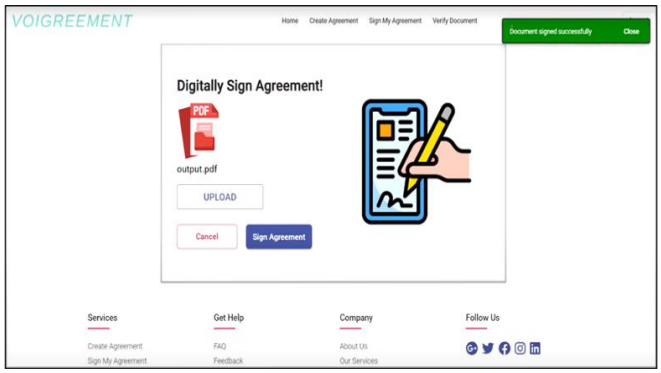

Fig. 7 Digital Signature creation on the agreement document

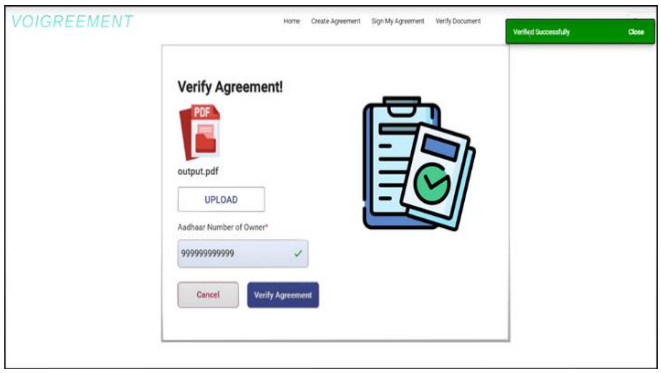

Fig. 8 Verbal agreement verification

5. Conclusion

This paper proposes a secure and verifiable agreement from an audio recording using voice recognition, speaker recognition, and blockchain technology. Together, these technologies ensure that the agreement is authentic, secure, and easily accessible to all parties involved. The audio recording of the speaker is first recognized with the help of speaker recognition technology using MFCC. Speech recognition technology to transcribe the audio recording into text is implemented using the Whisper model. The resulting text is then used to create a written agreement that accurately reflects the terms discussed in the audio recording. The blockchain technology is employed here to store and secure the agreement after the audio recording has been transcribed and generated. This is accomplished by building a smart contract on Ethereum, a blockchain platform. When specific criteria are met, such as when all parties have consented to the agreement's terms, the smart contract is designed to run automatically. The resulting agreement is a useful tool for corporations, legal experts, and individuals alike because it is simple for all parties to access and verify. Furthermore, with the incorporation of multilingual support not only on the

website but also in the contracts, which are voice recordings in any language, the system must be able to establish the contract in any language. Creating different legal contracts and agreements like rent agreements, transfer of property or any other asset, etc., all of which require a different template onto which the text can be stored, can be developed as the scope of the project advances.

Author Contribution Statement

SP and SD conceived and designed the research. SP and AL wrote the manuscript. SP and SD built a web app and conducted experiments. TS and AS analyzed the result and conducted verification. All authors read and approved the manuscript.

References

[1] Arunkumar, Nanak Builders Andinvestors Pvt. Ltd. vs Vinod Kumar Alag on 24 October, 1990, Delhi High Court, 1990. [Online]. Available: https://indiankanoon.org/doc/1775134/#:~:text=As%20per%20the%20provisions%20of,contract%20must%20be%20in%20writing

[2] J. Chandrashekhara et al., "A Comprehensive Study on Digital Signature," *International Journal of Innovative Research in Computer Science & Technology (IJIRCST)*, vol. 9, no. 3, pp. 2347-5552, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[3] Ravneet Kaur, and Amandeep Kaur, "Digital Signature," *International Conference on Computing Sciences*, Phagwara, India, pp. 295-301, 2012. [CrossRef] [Google Scholar] [Publisher Link]

[4] Alec Radford et al., "Robust Speech Recognition Via Large-Scale Weak Supervision," *arXiv Preprint*, 2022. [CrossRef] [Google Scholor] [Publisher Link]

[5] Douglas A. Reynolds, "An Overview of Automatic Speaker Recognition Technology," *2002 IEEE International Conference on Acoustics, Speech, and Signal Processing*, vol. 4, pp. IV-4072 - IV-4075, Orlando, FL, USA, 2002. [CrossRef] [Google Scholar] [Publisher Link]

[6] Dongfeng Wang et al., "Privacy-Awareness Fair Contract Signing Protocol Based on Blockchain," *International Symposium on Cyberspace Safety and Security*, Haikou, China, pp. 274-278, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[7] Xuemei Yang, and Heming Huang, "Exploring Blockchain in Speech Recognition," *International conference on Data Science, Medicine and Bioinformatics*, Singapore, pp. 211-220, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[8] Kai-Jie Yong et al., "Application of Blockchain Smart Contracts in Smart Tenancies: A Malaysian Perspective," *Cogent Social Sciences*, vol. 8, no. 1, pp. 1-20, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[9] Shivam Shukla, Speaker Identification and Verification using ML Techniques and Hindi Speech Dataset, Medium, 2020. [Online]. Available: https://medium.com/@shivam_shukla/speaker-identification-and-verification-using-ml-techniques-and-hindi-speech-dataset-2f2ad8f2aef6

[10] Hamed Taherdoost, "Smart Contracts in Blockchain Technology: A Critical Review," *Information*, vol. 14, no. 2, pp. 1-19, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[11] Amir Salar Hajy Sheikhi et al., "Smart Minutes - A Blockchain-Based Framework for Automated, Reliable, and Transparent Meeting Minutes Management," *Big Data and Cognitive Computing*, vol. 6, no. 4, pp. 1-19, 2022. [CrossRef] [Google Scholar] [Publisher Link]