Voice Biometric for Banking Management using Python

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Abstract: This Paper introduces a Speech-to-Visualization with Face Recognition system that combines speech and facial recognition for secure, intuitive, and efficient user interaction. Banking Users can query databases using spoken natural language, generating visualizations. Facial recognition serves as a secure authentication mechanism, ensuring only authorized access. The paper also reviews banking applications for various devices, focusing on features, usability, security, and user experience.It evaluates the app's ability to handle tasks like account management and fund transfers, along side its design, navigation, and robust security features to protect sensitive data.

Key Words: Speech recognition, natural language processing (NLP), facial recognition, machine learning, TalkSQL, feature extraction, structured queries, database interaction, Python, sqlite3, automated data analysis.

1. Introduction

Artificial Intelligence (AI) is a rapidly advancing field with the potential to transform how we live and work. At its core, AI aims to create intelligent machines capable of performing tasks that would typically require human intelligence, such as visual perception, speech recognition, decision-making, and language translation. One of the most exciting areas within AI research is deep learning, which uses neural networks to model complex patterns in data. Deep learning has led to breakthroughs in fields like computer vision, natural language processing, and game playing, enabling applications such as image recognition, speech synthesis, and automated language translation. AI encompasses several subfields, each with specific goals and applications. Machine learning focuses on developing algorithms that allow systems to learn from data and improve performance over time, with applications ranging from image recognition to fraud detection. Natural language processing (NLP) involves designing algorithms that can understand and generate human language, powering technologies like voice assistants and chatbots. Computer vision focuses on creating algorithms that analyze and interpret visual data, which has applications in areas like autonomous vehicles and medical imaging. Robotics is concerned with designing intelligent machines that can interact with the physical world, with uses in manufacturing, healthcare, and logistics. Expert systems aim to replicate human decision-making abilities within a specific domain, commonly used in medical diagnosis and financial planning. Cognitive computing focuses on simulating human cognitive processes like reasoning and decision-making, with applications in fraud detection and personalized marketing. Reinforcement learning enables systems to learn through trial and error, adjusting their actions based on rewards or penalties. Despite its many benefits, AI also raises significant challenges, particularly regarding privacy, security, and bias. As AI systems become more advanced, there is a risk they could perpetuate social inequalities or infringe on individual rights and freedoms. The report is organized as follows: Section 2 will discuss related work in AI, while Section 3 will present the conclusion and outline future work in the field.

2. Related Work

This paper surveys the advancements in Natural Language to SQL (NL2SQL) query generation, exploring key methods such as rule-based systems, sequence-to-sequence models, and pre-trained language models. It highlights challenges like query complexity, schema understanding, and ambiguity while suggesting future research directions for improved scalability and generalization. Integrating face recognition for security in Natural Language Query Generation systems enhances authentication by verifying users through their unique facial features. Once scanned, the system matches the face to stored data, granting access if they align. This prevents unauthorized access and ensures only verified users can query the database. Face recognition also eliminates the need for passwords or PINs, offering a fast and seamless authentication process. Combined with NLP, it provides secure, efficient, and user-friendly access to database information, ensuring both security and ease of use.

Voice-based SQL Query Generation systems enable secure access to information using voice commands. The system integrates voice-based authentication and a natural language processing (NLP) system. It uses machine learning techniques to generate SQL queries based on user voice input. The process begins with capturing speech, which is then converted into text. In the next step, the text is analyzed using Python scripts to identify the appropriate response. Finally, the system generates SQL queries based on the processed information, facilitating dynamic and secure database interactions through voice commands.Voice and Text-Based Natural Language Query Processing systems are designed to assist users who are not familiar with database query languages. The system accepts input in natural language, either as text or voice, and processes it to extract the necessary information for generating a query. The primary goal is to facilitate communication between the database and users without requiring them to learn complex query syntax. By allowing speech input, the system becomes more user-friendly, making database interactions accessible to a broader range of users.

TalkSQL is a voice-based query system that converts spoken input into SQL queries, using regular expressions to identify CRUD operations (Create, Read, Update, Delete) and generate feedback with pre-defined templates. A survey of 53 participants showed that 91.2% understood the CRUD commands. Designed as a C# Windows Forms Application (WPF) on the .NET framework, TalkSQL translates verbal input into executable SQL queries and displays the results.The paper addresses the challenges posed by SQL's complexity, particularly for banking users without prior experience. Researchers explored Natural Language Processing (NLP) models to convert a user's native language query into an SQL query. This approach allows novice users to interact with databases and retrieve data without the need to understand or generate complex SQL queries.

The proposed system allows novice users to retrieve data from a database using natural language queries in English. It follows a four-step process to convert these queries into accurate SQL queries. First, it extracts keywords using word grouping and morphological analysis. Then, a pattern matching formula is applied to categorize these keywords, simplifying the mapping of natural language to SQL syntax. The system addresses challenges in keyword mapping and join path inference by employing techniques from natural language processing, database implementation, and compiler design methodologies.

The proposed system enables novice users to retrieve and modify data using natural language queries, either through text or speech. It converts these queries into accurate SQL queries in four steps and supports English. The system allows users to interact with databases in English, eliminating the need to understand complex query languages like SQL. Implemented using Java Database Connectivity and servlets, it improves the performance of existing Natural Language Interfaces (NLIs) by leveraging information from the SQL query log. Despite challenges in communication with databases using natural language, the system is designed to cater to users like Talent and Performance managers, simplifying data retrieval without SQL knowledge.The authors discuss a model designed to enhance user-database interactions by allowing users, regardless of their knowledge of SQL, to communicate in natural language (English). The system interprets and responds to queries in natural language. It incorporates three linguistic phases: Morphological analysis, Syntactic analysis, and Semantic analysis, to process and accurately interpret the user's request. This model aims to bridge the gap between non-technical users and database systems.

The authors propose a system for voice-based natural language query processing that converts speech to text using speech recognition. The system tokenizes the query, identifies necessary table attributes, and performs natural join operations by selecting appropriate tables. It then forms the SQL query and displays the result on the GUI. The model offers easy accessibility, error prompting, auto-correction, and handles complex queries, facilitating user-database interaction using natural language.The authors propose a system that converts natural language input into SQL queries, handling both simple and complex queries, including aggregate functions and advanced clauses like ORDER BY, GROUP BY, and `HAVING. Additionally, the system converts DML natural language statements into SQL. The system uses NLP techniques such as tokenization, lemmatization, POS tagging, parsing, and mapping to process and convert the user's input into SQL. It employs an intelligent layer to extract keywords and eliminate redundant data, ensuring accurate query generation.

The model features a user-friendly GUI that allows users to input English language queries, which are processed by a query generator. The system identifies constraints and predicates to formulate the desired SQL query using NLP methods like chunking and entity recognition. The query generator utilizes a set of rules to identify predicates, with a prediction model added for cases where translation is insufficient. The database component includes a response generator that converts DBMS outputs back into English, providing users with understandable feedback.

2.1 Methodology

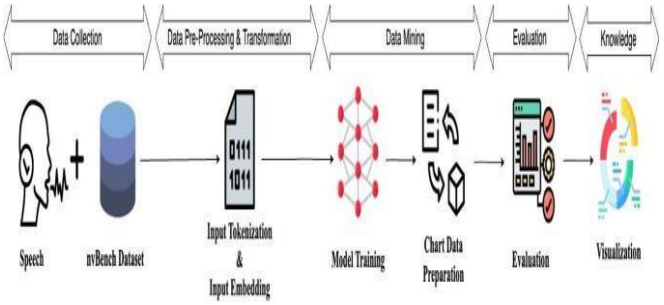

Figure 1. Process Flow of Methodology

The steps of process flow are as follows:

- **Data Collection**

  The process begins with gathering relevant data, as shown in the first step of Figure 1. This involves collecting speech data, possibly using a dataset like nvBench. This raw data serves as the foundation for the subsequent steps in the pipeline.

- **Data Pre-processing & Transformation**

  The raw speech data is not directly usable by machine learning models. It undergoes pre-processing and transformation. This involves tokenizing the text,

breaking it down into smaller units, and embedding these tokens into numerical representations. This transformed data is suitable for machine learning algorithms.

- **Data Mining**

  The pre-processed data is fed into a machine learning model for training. The model learns to identify patterns and relationships within the data. This training process enables the model to make predictions or classifications on new, unseen data.

- **Evaluation**

  The evaluation stage, represented in Figure 1, is crucial to assess the performance of the trained model. A separate dataset is used for testing, and metrics like accuracy, precision, and recall are calculated. The evaluation results are visualized using charts and graphs, aiding in comprehending the model's effectiveness.

- **Knowledge**

  The final stage involves interpreting the model's predictions and understanding its decision-making process. Visualizing the model's outputs, such as feature importance or decision boundaries, can help uncover insights and gain knowledge from the data. This step is crucial for building trust in the model and ensuring its ethical and responsible use.

2.2 System Design

The process, as illustrated in Figure 2 System Architecture, begins with the user interacting with the system through a user interface, providing voice input that is captured and converted into text via voice recognition. This text is then refined by removing stop words, simplifying the query. Tokenization breaks the text into individual words, which are analyzed by a part-of-speech tagger to determine their grammatical roles.

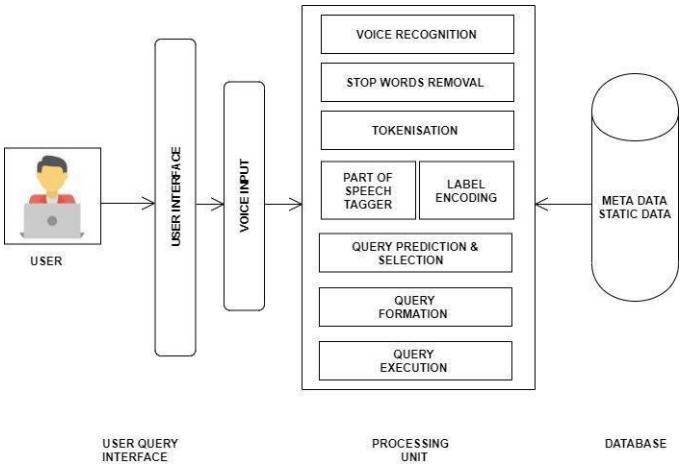

Figure 2: System Architecture

The system then uses label encoding to convert these tokens into numerical representations for easier processing. The metadata static data provides reference information to enhance query prediction and selection. The system predicts the most likely query, forms the corresponding SQL query, and executes it against the database, presenting the results to the user through the interface.

3. Conclusion

In conclusion, bank application is a powerful tool for financial institutions to improve their customer service and engagement. By providing customers with quick and easy access to banking services through a conversational interface, banking chatbots can help reduce wait times, improve response times, and provide personalized recommendations and advice. It is also important for financial institutions to ensure that our chatbot complies with relevant banking regulations and data privacy laws, and to provide clear and transparent information about how customer data is being used and protected. Overall, a well-designed and well-implemented Voice Biometric for Banking management app can help financial institutions improve their customer service, reduce costs, and stay ahead of the competition in an increasingly digital world.

Acknowledgement

We would like to thank our institution JNNCE, Computer science and Engineering department for giving us this opportunity to put for our ideas. Also, we would like to extend our heartfelt gratitude towards the faculty who supported us throughout our journey and our parents who were the backbones and helped us complete this project in success.

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