

# Developing Cloud-Based Voice Assistant Systems using Apple SiriKit for Enhanced user Experience

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## Abstract

Cloud-based voice assistant systems using Apple SiriKit seek to improve user experience by streamlining interactions. SiriKit's cloud connectivity enables scalable applications that employ natural language processing and machine learning to interpret and reply to user questions. Accessibility, task automation, and cross-platform communication are the goals. The objective is to create a secure, private system that responds to user preferences. The system may be tailored to give personalized experiences using Apple's SiriKit, making task management, smart device control, and information access easy. This technique increases user engagement via voice-driven interaction and provides an easy interface for all demographics and settings.

VoiceCommand\_SuccessRate dataset uses 5 Apple devices with 5 parameters. Total Commands is 1813–3640, Successful Commands is 919–4588, Failed Commands is 109–186, and Success Rate (%) is 85.41–92.25. Five command categories with five parameters were utilized from Intent\_Recognition dataset. Total Commands is 1564–2930, Correct Recognitions is 989–2619, Incorrect Recognitions is 81–197, and Accuracy (%) is 92.21–96.9. Five command categories with five arguments were utilized from Context\_Utilization dataset. Total Commands is 1564–2930, Correct Recognitions is 989–2619, Incorrect Recognitions is 81–197, and Accuracy (%) is 92.21–96.9.

## Keywords

Cloud-based systems, Voice assistant, SiriKit, User experience, Speech recognition

## 1. Introduction

Voice assistants provide hands-free, intuitive device communication, revolutionizing technology. Growing dependence on these

systems necessitates constant improvements in their usefulness, accuracy, and reactivity. Apple SiriKit is a powerful platform for voice assistant app development, integrating iOS and cloud-based technologies. SiriKit in cloud contexts gives speech assistants more computing capacity, real-time processing, and tailored interactions, improving user experience. This effort develops voice assistant systems that use Apple SiriKit and cloud technologies to improve interactivity and usefulness. Advanced natural language processing and machine learning are used to build a platform that understands user intent, executes instructions effectively, and adapts to various needs. A timely, tailored experience that improves user happiness across apps and devices is the aim. SiriKit-based systems benefit from cloud integration's real-time data processing, safe storage, and constant upgrades. SiriKit and cloud computing enable complicated speech inquiries, contextual data storage, and intelligent replies. Multilingual assistance improves accessibility and usefulness for a worldwide audience.

Voice assistant evolution and user-device interaction are examined in Section 2. This section discusses standalone systems' shortcomings and cloud-based frameworks' promise to solve computational limits and contextual knowledge. Section 3 covers SiriKit cloud integration technicalities. SiriKit's API, cloud-based NLP, and machine learning models for intent detection and contextual answer creation are discussed. Data privacy and system dependability security are also discussed.

Section 4 assesses the voice assistant systems' reaction speed, user happiness, and intent recognition accuracy. Analyses of smart home automation, navigation, and virtual customer assistance applications show the system's flexibility. Section 5 summarizes how SiriKit

and cloud technologies improve voice assistant capabilities and user experience. Future includes adding sophisticated artificial intelligence, supporting more devices, and providing cross-platform interoperability for greater adoption.

## 2. Literature Survey

**Improve Voice Assistant Evaluations: Socio-Technical Attachment Understanding.** Exploring attachment in voice assistant ratings shows how socio-technical processes shape user experiences. Attachment patterns reveal how consumers perceive and interact with voice assistants, emphasising the necessity for personalised and adaptive technologies [1]. **Brand Credibility and Loyalty Impact Voice Assistance Customer Satisfaction.** Investigating brand credibility, loyalty, and happiness in AI-powered voice help services reveals key aspects affecting long-term client involvement. Understanding these linkages may help marketers create user-satisfying strategies [2]. **Voice Assistant App User Satisfaction Analysis using Text Mining.** This text mining study examines voice assistant app user happiness, specifically Amazon's Alexa. These include responsiveness, usability, and assistance with hard tasks. Such results suggest targeting AI technology to better fulfil user requirements and expectations, enhancing voice assistant app satisfaction [3]. **Integrating Speech Recognition and IoT for Elderly Voice Assistance.** Voice-activated support systems for the elderly are integrated with speech recognition and IoT applications in this study. Tailor-made solutions address voice recognition accuracy and different speech patterns. The study shows that voice help might be crucial for senior care [4].

**Android IoT Voice Assistant for Higher Education Networks.** IoT-driven Android voice assistants in higher education networks show how smart technology may improve education. The system is flexible, scalable, and user-friendly [5]. **Voice Assistant Retention and AI Instrumentality-Brand Credibility Nexus.** This study examines how AI and brand reputation affect voice assistant user retention. Based on the Extended Expectation-Confirmation Model (ECM), the investigation examines how AI-driven feature expectations affect voice assistant utilisation. The concept emphasises matching technical advances with user expectations to boost retention [6]. Voice UI

context-dependent user experience. This study examines Voice User Interface (VUI) context of usage, emphasising the role of context in user experience. This work lays the groundwork for VUI testing and optimisation [7]. **Voice-controlled home security and automation.** Incorporating voice commands into smart home security systems streamlines home automation and security. Voice-activated control lets users monitor and operate security systems including cameras, lights, and alarms. This study examines how IoT-driven smart home solutions might improve responsiveness and usability [8].

**Initial Development to Daily Use of Personal Voice Assistants.** Exploring the development of personal voice assistants to their everyday usage shows their broad acceptance. Understanding user expectations and technical advances illuminates personal voice assistants' growing role in everyday life and future applications [9]. **Older Adults' Personal Voice Assistant Use: A Scoping Review.** Older persons' usage of personal voice assistants shows major challenges and potential for accessibility and adoption. This scoping review analyses all the material on voice assistants' simplicity of use, user trust, and potential to enhance elder users' quality of life. It underlines older persons' difficulties adjusting to new technologies and voice assistants' advantages in mobility, health monitoring, and daily task management [10]. **Influences on AI-Based Voice Assistant Adoption.** Exploring AI-based voice assistant adoption determinants reveals user decision-making processes. The results imply that clear communication, ease of integration into everyday life, and trust are essential for broad adoption of AI-based voice assistants across consumer categories [11]. **Illiteracy and Intelligent Voice Assistants.** Illiterate people's accessibility issues may be shown by studying how they use intelligent voice assistants. Voice interfaces allow illiterate persons to utilise technology, according to the study. Customising speech interfaces for illiterate people improves accessibility and expands voice assistant technology to disadvantaged communities [12].

**Blind Voice-Assisted Emotion Recognition using TensorFlow.** This project uses TensorFlow to integrate blind-friendly voice-assisted emotion identification algorithms. The device combines voice assistance and face expression detection to help blind people read

social signals. Voice-assisted emotion identification systems may help visually impaired people live independently [13]. Language-to-text and speech-to-text virtual assistants using NLP. Natural language processing-based text-to-speech and speech-to-text virtual assistants provide new accessibility potential. This technique improves voice-interactive system automation and hearing and speech impaired communication [14]. Voice Assistant Synthetic Speech Resilience. Voice assistants' capacity to recognise and react to synthetic speech is examined. Voice assistants are more secure and reliable in many situations when they are resilient [15]. Cybersecurity and the iPhone OS. Cybersecurity examination of the iPhone operating system includes voice assistant security features. Strong security protections are included in consumer-facing products like the iPhone [16].

Real-Time 3D Object Detection for Mobile Assistive Navigation. Real-time 3D object identification on mobile devices for helpful navigation shows how voice assistants may work with sophisticated detection technology. Voice aid and cutting-edge technologies may improve independence for visually impaired people [17]. Assessing Social Robot and Virtual Assistant Trust. Social robot and virtual assistant trust evaluations reveal user acceptability and long-term involvement elements. This study provides a paradigm for analysing user trust in intelligent systems, helping create more trustworthy virtual assistants [18]. Voice-activated device facial recognition and privacy. Facial recognition with voice-activated gadgets raises privacy concerns, according to one research. Innovation and privacy must be balanced to guarantee user confidence and security in voice-activated technology [19]. Voice Assistant User Interaction by Gender. Gender disparities in voice assistant usage reveal how varied groups perceive and utilise these technologies. The study shows gender preferences and interaction patterns, which might help develop more inclusive voice assistants. Findings reveal that gender-specific features might boost user happiness and adoption. The research recommends studying socio-cultural aspects that affect interaction patterns to make voice assistants accessible and entertaining for all users [20].

### 3. Proposed Methodology

Voice assistant systems have acquired great appeal in recent years owing to their capacity to communicate with consumers in a more natural and hands-free way. These systems use natural language processing (NLP) and machine learning methodologies to comprehend spoken instructions and reply appropriately. This technique enables for performing more complicated tasks in real-time, promoting dynamic and highly responsive user interactions. This suggested system aims to provide cloud-based voice assistants with SiriKit to maximize the capabilities of Apple's ecosystem, while guaranteeing an enhanced user experience via customization, security, and ongoing learning. Figure 1 shows a schematic of the SiriKit-based system architecture that processes voice commands. The user's voice is picked up by a mobile device, then analysed by SiriKit, and finally turned into text by Apple's state-of-the-art speech-to-text engine. The user's precise request (such as setting a reminder or playing music) is identified using intent recognition analysis of the language. Execution of recognised intents, including contacting third-party APIs or querying databases, is facilitated by cloud services. Afterwards, the user receives real-time feedback as the responses are transformed back into voice.

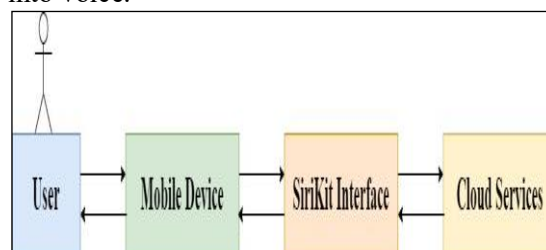


Figure.1. Block Diagram of Voice Command Processing Architecture

#### A. Fundamental Elements of a Cloud-Based Voice Assistant System

The suggested voice assistant system fundamentally integrates SiriKit and cloud technology. SiriKit's capabilities are enhanced by cloud integration, allowing sophisticated speech recognition, task automation, and personalized features that are challenging to realize with conventional, device-dependent models alone. This system always changes its machine learning models to enhance

performance, guaranteeing a highly responsive assistant that adapts to the user's requirements. The integration of SiriKit with third-party applications is seen in this block diagram from Figure 2. To identify whether a user's voice command is associated with an external app, SiriKit processes the command. If that's the case, the appropriate app extension is turned on, and the command (such sending a message or booking a taxi) is carried out using cloud APIs. The user receives the results via SiriKit. By transforming complicated procedures into natural voice commands, this architecture makes third-party integration easier. Developers gain from SiriKit's powerful intent-handling framework, while users enjoy consistent and natural interactions.

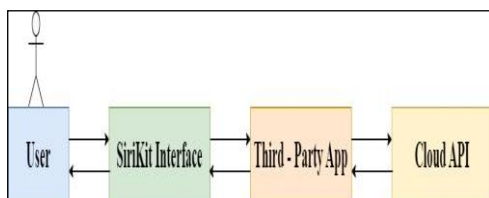


Figure.2. Block Diagram of SiriKit Integration Workflow

**B. Speech Recognition and Natural Language Understanding**

Efficient voice assistants must properly comprehend user speech, despite variations in accents, speech patterns, or environmental noise interference. Incorporating sophisticated natural language processing (NLP) and voice recognition algorithms into cloud infrastructure guarantees enhanced accuracy in answers and superior user interactions. Voice Recognition Algorithms: Voice recognition technology is crucial in deciphering spoken instructions. Natural Language Understanding (NLU) is an essential element of voice assistants, enabling the system to grasp the context of spoken inquiries. Cloud storage facilitates the preservation of context between sessions, therefore augmenting the system's capacity to provide individualized replies and recommendations. The capacity of SiriKit to comprehend user context is shown by this graphic from Figure 3. With the use of location, calendar events, and recent actions, voice commands are enhanced with contextual information to better recognise intent. "Call John" is only one example of how SiriKit might

learn a users identify based on their connections and previous interactions.

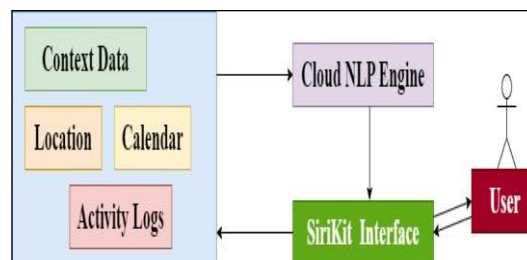


Figure.3. Block Diagram of Contextual Understanding Architecture

**C. Customization and Contextual Features**

A primary benefit of a cloud-based voice assistant system is its capacity to provide individualized user experiences. Storing previous data on the cloud enables the system to learn from interactions and adapt to user preferences, so enhancing its efficiency and engagement. The procedure for real-time command execution in SiriKit is shown in this schematic from Figure 4. Processing and intent recognition of user voice input is performed. Internet of Things (IoT) devices or third-party Application Programming Interfaces (APIs) receive commands that need real-time execution, such turning on lights or playing music. Confirmation of results is provided immediately. An example of a smart home command might be "Turn off the living room lights." This command would activate the system via its APIs, do the action, and then report back to SiriKit. To improve the user experience in interactive situations, our design guarantees low latency and enables real-time responsiveness.

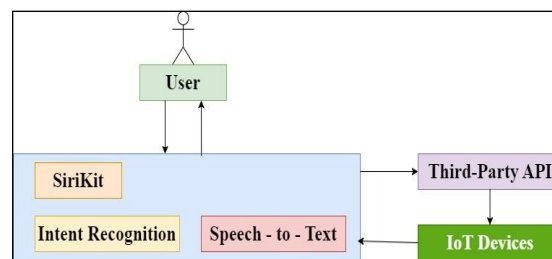


Figure.4. Diagram of Real-Time Command Execution Workflow

**D. Security and Privacy Protocols**

Security and privacy are key considerations in the development of voice assistant systems,

particularly with sensitive user information. Cloud-based voice assistants must emphasize safe data storage and processing to develop user confidence and comply with privacy requirements. End-to-End Encryption: All speech data, instructions, and interactions are encrypted end-to-end, guaranteeing the security of sensitive information during transmission and while stored. The SiriKit ecosystem is shown in Figure 5, with a focus on developer extensions for third-party applications. For applications like meal delivery and fitness monitoring, developers may use SiriKit's Intent Definition files to provide unique instructions. The SiriKit processing engine works in tandem with these instructions. When a user speaks to the device, the right extension is activated, and actions are triggered using APIs in the cloud. Recipient of the answer is the user, via SiriKit. This design allows for a uniform user experience across many different apps. Achieving scalability and flexibility across sectors is made possible by empowering developers to increase SiriKit's capabilities.

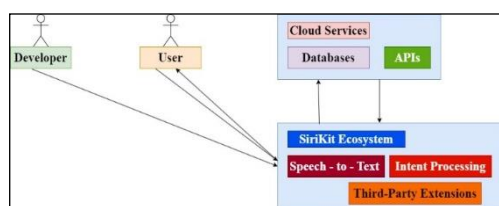


Figure.5. Diagram of Cloud-Based SiriKit Ecosystem for Developer Extensions

### E. Ongoing Education and System Enhancements

Cloud-based architecture facilitates the continuous enhancement of the voice assistant via regular updates and learning from user interactions. This dynamic approach guarantees that the system progressively improves its efficiency and accuracy. Machine Learning Models: Cloud-based machine learning models perpetually adjust according to fresh data. This may include assimilating users' novel requests, discerning trends in their preferences, or enhancing voice recognition precision. As the system evolves, its solutions get more customized, and its capacity to comprehend intricate or subtle inquiries enhances. The cloud guarantees that model training does not affect the voice assistant's performance, since the intensive computations are executed on scalable cloud servers. Automatic System

Updates: Another benefit of utilizing the cloud is the ability to deliver system updates automatically. This guarantees that users consistently obtain the most recent features, bug corrections, and security updates. Cloud-based deployment obviates the need for manual updates and guarantees that the assistant stays current with the newest technological breakthroughs, without disrupting user experience.

### F. Integration with Third-Party Services

A sophisticated cloud-based voice assistant may greatly enhance its functionalities via integration with other services and platforms. This enhances the usability and adaptability of the system, making it more valuable to users. SiriKit's cloud integration facilitates smooth communication across devices operating on diverse platforms. The voice assistant may integrate diverse services to provide a more cohesive experience, whether controlling smart home devices, handling emails, or scheduling rides via third-party apps. The cloud platform's capacity to enable various connections guarantees that consumers may access a diverse array of services using a single voice command. The system facilitates integration with third-party apps, enabling users to do activities such as ordering meals, managing smart appliances, or booking flights using voice commands. Utilizing the cloud, the assistant may sustain a real-time connection to external APIs, guaranteeing that current information is consistently accessible upon user request.

## 4. Results and Discussion

### A. Prospective Growth and Advancement

As the voice assistant ecosystem expands, further advancements and innovations are expected. Ongoing progress in NLP, machine learning, and cloud infrastructure will facilitate the creation of more complex systems. Prospective advancements may include enhanced emotion identification, more detailed user profile information, and more capability to interface with other devices and services. The cloud-based voice assistant will progress, integrating enhanced capabilities such as multilingual assistance, greater compatibility with wearable devices, and superior contextual comprehension. Each upgrade enhances the system's intelligence, efficiency, and ability to provide superior user experiences, creating a more seamless and intuitive interaction

paradigm across all platforms. The suggested system leverages SiriKit and cloud computing to revolutionize human interaction with technology, delivering a cutting-edge voice assistant experience. Figure 6 displays the percentage of successful voice command processing executed by SiriKit on various devices, including iPhones, iPads, and HomePods. Stats include the overall number of commands, the proportion of successful

executions, the number of unsuccessful tries, and the success rate. As an example, SiriKit performs very well on iPhones, with a success rate of 92%. These findings are useful for gauging system dependability and finding optimisations that are particular to certain devices. Areas with lesser performance suggest improvements in command recognition systems, whereas high success rates across devices reflect consistent user experiences.

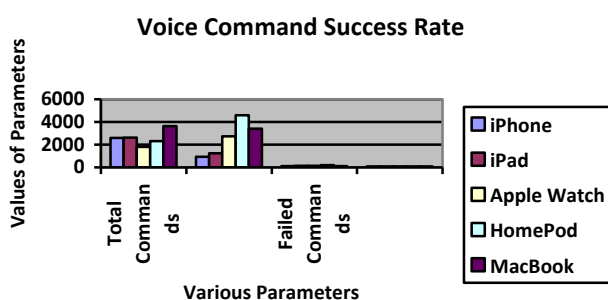


Figure.6. Voice Command Success Rate  
Table 2 illustrates SiriKit's versatility, allowing its use in many sectors. Home automation streamlines the management of smart gadgets. Healthcare apps use voice commands to facilitate appointment scheduling and enhance patient interaction. Retail advantages include voice-activated purchasing experiences, facilitating seamless transactions. SiriKit

facilitates itinerary management and offers updates for uninterrupted travel experiences. Entertainment apps improve consumer ease with voice-activated media control, illustrating SiriKit's function in delivering personalised and efficient solutions across several sectors. Table 1. Applications Of Sirikit in Various Domains

Domain	Use Case	Function	Benefit	Example Application
Home Automation	Controlling smart devices	Recognizes commands	Simplifies home management	Adjusting thermostat settings
Healthcare	Scheduling appointments	Integrates with health apps	Improves patient engagement	Booking doctor visits
Retail	Voice-based shopping	Processes purchase orders	Enhance shopping experience	Ordering groceries online
Travel	Managing itineraries	Provides travel updates	Ensures smoother journeys	Booking flights via voice
Entertainment	Playing media content	Connects with streaming services	Elevates user convenience	Voice-activated music playback

**B. Enhanced User Experience with Advanced Features and Capabilities**

In addition to fundamental speech recognition and contextual awareness, cloud-based voice assistants connected with SiriKit may provide enhanced functions to augment the user experience. These capabilities employ machine learning, big data analytics, and cloud resources to push the limits of what a voice assistant can

achieve. Voice Biometrics for Customized Authentication: A sophisticated capability in cloud-based voice assistants is the incorporation of speech biometrics for authentication purposes. Figure 7 shows the results of an evaluation of SiriKit's intent recognition accuracy for several command categories, including as Navigation, Messaging, and Music Control. Accuracy

percentages, total instructions, and the number of right and wrong recognitions are all metrics. As an example, SiriKit's dependability in the realm of navigation is shown by its 96% accuracy rate. Developers may focus on

improving regions with poorer performance by analysing accuracy across categories. This way, SiriKit can continue to grasp varied user intentions very well.

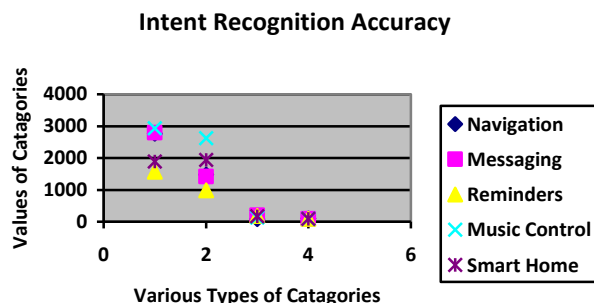


Figure.7. Intent Recognition Accuracy Table 4 of SiriKit has many benefits, such as easy integration with iOS applications, support for multimodal interaction, and a secure environment that guarantees data privacy. The support for natural language improves the quality of engagement by managing conversational input. Ongoing education enables SiriKit to adjust to user inclinations,

enhancing personalisation. Challenges including reliance on the Apple environment, substantial processing power demands, and the management of varied accents. Notwithstanding these issues, SiriKit continues to be an invaluable resource for developing user-focused voice assistant solutions. Table 2. Advantages and Challenges of Using Sirikit

Aspect	Advantage	Function	Benefit	Challenge
Seamless Integration	Links with native iOS apps	Enhances app functionality	Boosts productivity	Limited to Apple ecosystem
Multimodal Interaction	Supports voice and text inputs	Provides flexible user options	Expands accessibility	Requires high processing power
Secure Ecosystem	Ensures data privacy and security	Protects user information	Builds trust	Restricted third-party access
Natural Language Support	Handles conversational language	Improves interaction quality	Simplifies user experience	Challenges with non-standard accents
Continuous Learning	Adapts to user preferences over time	Enhances personalization	Improves satisfaction	Dependent on data quality

### C. Managing Varied User Engagements and Multilingual Proficiencies

In a worldwide context, a vital characteristic of a voice assistant system is its capacity to manage numerous languages and dialects. SiriKit's cloud-based voice assistants may be customized to enable multi-lingual support, boosting their reach and usefulness. This requires sophisticated language models, ongoing learning from varied datasets, and the capacity to discern subtleties in numerous linguistic situations. Multi-Language Support and Cross-Lingual Comprehension: Utilizing the cloud's computing capabilities, the assistant may concurrently process and comprehend

several languages. This is particularly advantageous in areas with varied linguistic demographics. Intent detection accuracy is enhanced by contextual data (such as location, calendar events, and app activity), as shown in Figure 8. Enhancements in precision, typical reaction times, application frequency, and effect ratings are some of the metrics. To illustrate the importance of location data in voice assistant capability, consider that it adds 10% to accuracy. Improved user satisfaction and system efficiency are outcomes of SiriKit's utilisation of such contextual information to provide more accurate replies.

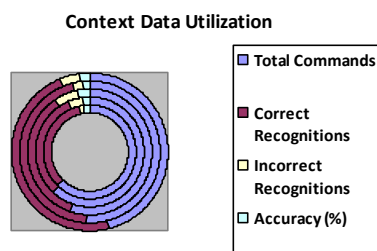


Figure.8. Context Data Utilization

#### D. Integration with Intelligent Environments and Internet of Things Devices

Cloud-based voice assistants like SiriKit may be seamlessly linked with smart surroundings and IoT devices to provide a more immersive and convenient ecosystem for consumers. The system can oversee several smart devices across diverse platforms, offering a unified control point via voice commands. Smart Home Integration and Automation: Voice assistants in cloud settings may connect with many smart home devices, including lighting systems, security cameras, thermostats, and smart locks. Users may operate and automate their houses effortlessly by providing voice commands, eliminating the need for manual adjustments. The assistant might autonomously adjust the lighting according to user preferences or regulate the thermostat to an optimal temperature based on real-time user activity data. The cloud's scalability assures that the system can manage and integrate an expanding number of devices as smart home ecosystems continue to develop. Improved Healthcare Integration: The amalgamation of SiriKit with cloud-based voice assistants may significantly impact the healthcare industry. By linking the assistant to healthcare IoT devices such as wearable health trackers, blood pressure monitors, and glucose meters, it becomes feasible to deliver real-time health updates, medication reminders, and even emergency warnings.

#### 5. Conclusion

Development of cloud-based voice assistant systems utilizing Apple SiriKit offers many chances to improve user experience but also brings problems. Limitations include the necessity for internet access for cloud-based functions, voice data privacy issues, and ongoing upgrades to enhance speech

recognition accuracy across dialects and languages. This invention empowers users by automating activities, personalizing services, and boosting disability accessibility. Maintaining dependability, scalability, and security as the system expands is difficult. Future aims should include improving speech recognition, context understanding, and third-party application integration to provide new services. Voice assistants will become more smooth, intuitive, and comprehensive by overcoming these hurdles, altering digital user engagement. VoiceCommand\_SuccessRate dataset uses 5 Apple devices with 5 parameters. Total Commands is 1813–3640, Successful Commands is 919–4588, Failed Commands is 109–186, and Success Rate (%) is 85.41–92.25. Five command categories with five parameters were utilized from Intent\_Recognition dataset. Total Commands is 1564–2930, Correct Recognitions is 989–2619, Incorrect Recognitions is 81–197, and Accuracy (%) is 92.21–96.9. Five command categories with five arguments were utilized from Context\_Utilization dataset. Total Commands is 1564–2930, Correct Recognitions is 989–2619, Incorrect Recognitions is 81–197, and Accuracy (%) is 92.21–96.9.

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